

D3

Digital Positioner



Manual



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1. Introduction

The PMV D3 is a digital positioner designed primarily for controlling adjustable valves.

The positioner can be used with single or double action actuators with either rotary or linear movement.

The D3 can be equipped with modules for feedback, limit switches, and a pressure gauge block.

The modules can be factory assembled before delivery or fitted later.

The modules for feedback and limit switches can contain the following:

Feedback 4-20 mA and one of the following functions:

- Two mechanical contacts
- Two reed switches
- Two inductive sensors, DIN 19234



Safety instruction

Read the safety instructions in this manual carefully before using the product. The installation, operation, and maintenance of the product must be done by staff with the necessary training and experience. If any questions arise during installation, contact the supplier/sales office before continuing work.

Warning

- The valve package moves when in operation and can cause personal injury or damage if handled incorrectly.
- If the input signal fails or is switched off, the valve moves quickly to its end position.
- If the compressed air supply fails or is turned off, fast movements can occur.
- The valve is not controlled by the input signals when in the Out of service mode. It will open/close in the event of a leak.
- If a high value is set for Cut off, fast movements can occur.
- When the valve is controlled in the Manual mode, the valve can move quickly.
- Incorrect settings can cause self-oscillation, which can lead to damage.

Important

- Always turn off the compressed air supply before removing or disconnecting the air supply connection or the integral filter. Remove or disconnect with care because C- is still under pressure even after the air supply is turned off.
- Always work in an ESD protected area when servicing the PCB's. Make sure the input signal is switched off.
- The air supply must be free from moisture, water, oil and particles.



2. Storage

General

The PMV positioner is a precision instrument. Therefore it is essential that it is handled and stored in the right way. Always follow the instructions below!

N.B. As soon as the positioner is connected and started, internal air leakage will provide protection against corrosion and prevent the ingress of moisture. For this reason, the air supply pressure should always be kept on.

Storage indoors

Store the positioner in its original packaging. The storage environment must be clean, dry, and cool (15 to 26°C, 59 to 79°F..

Storage outdoors or for a longer period

If the positioner must be stored

outdoors, it is important that all the cover screws are tightened and that all connections are properly sealed. The unit should be packed with a desiccant (silica gel) in a plastic bag or similar, covered with plastic, and not exposed to sunlight, rain, or snow.

This is also applicable for long-term storage (more than 1 month) and for long transport by sea.

Storage in a warm place

When the positioner is stored in a warm place with a high relative humidity and is subjected to daily temperature variations, the air inside the unit will expand and contract.

This means that air from outside the unit may be drawn into the positioner. Depending on the temperature variations, relative humidity, and other factors, condensation and corrosion can occur inside the unit, which in turn can give rise to functional disorders or a failure.

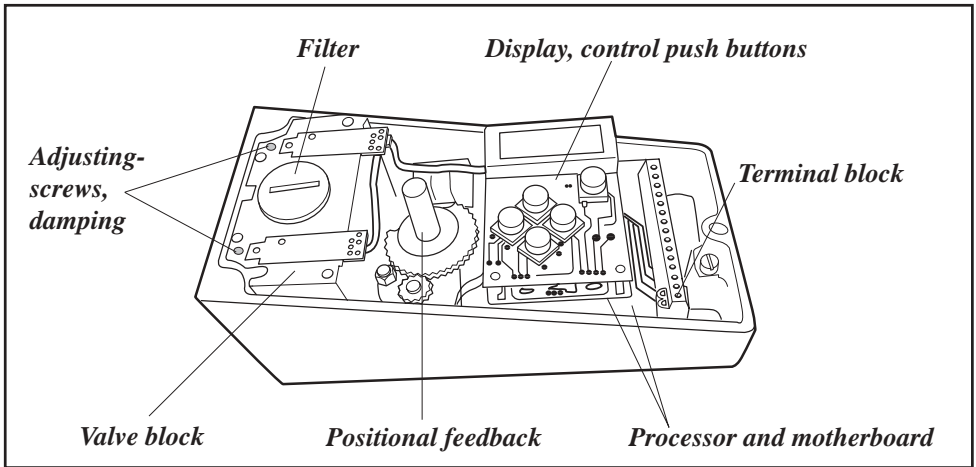
3. Design

The D3 positioner contains:

- Electronic board with microprocessor, HART modem, display, etc.
- Valve block
- Positional feedback with potentiometer
- Sealed compartment for electrical connections

The push buttons and display are accessible underneath the aluminium cover, which is sealed with an O-ring.

The figure shows the D3 with the cover removed.



4. Variants

D3 270° deg.

D3 up to 270° deg for extended travel range is available. It features all benefits and options similar to the standard D3. Communication with HART or Profibus is possible.



D3 Explosion proof

The digital positioner D3 is available in explosion proof enclosure. It features the same easy to use user interface for local configuration as D3. Communication with Hart or Profibus is possible.

Further features are gauge ports and local graphic LCD display.



D3 Intrinsically safe

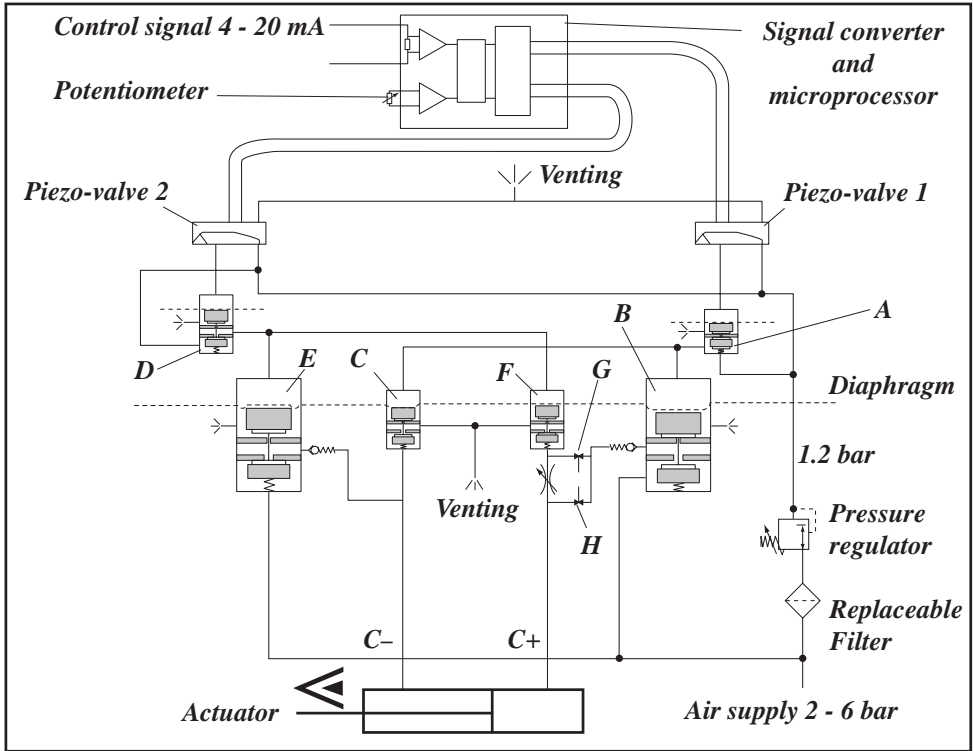
The digital positioner D3 is available in intrinsically safe version for installation in hazardous areas. It features the same easy to use user interface for local configuration as D3. Communication with HART or Profibus is possible. It features all benefits and options similar to the Standard D3 positioner, gauge block, local graphic LCD display and feedback option etc.

D3 remote mounted

The D3 with remote mount is now available on the market for order. This version is suitable for installations in severe applications e.g. vibrations, high or low temperature corrosive environment, high mountings or difficult of access, etc. A flat or dome style indicator can be fitted on the feedback box installed on the actuator. Max recommended distance between D3 and remote unit is 5 m.



5. Function



Double action function

The control signal and the feedback potentiometer position are converted to digital signals that are processed with a PID algorithm in the microprocessor. This provides control signals to the two piezo-valves.

The two piezo-valves are closed in the schematic diagram above and have no effect on the valves A and D. Air from the pressure regulator is lead through the open valve A to the valve B, which opens. The supply pressure can now pass through valve B to the actuator via H. The actuator then moves in the direction of the arrow. At the same

time, air from valve A keeps valve C open and allows venting of the actuator.

When both the piezo-valves open, valve A closes but valve D opens and controls valves E and F to that the actuator moves in a direction opposite to the arrow. When only piezo-valve 1 is open, the actuator is stationary.

Single action function

Valve B is used for the supply air and valve F for venting.

6. Installation

Tubing

Use tubes with an inner diameter of minimum 6 mm (1/4").

Air supply requirements

Max. air supply pressure, see the section Technical Data, Section 10.

The air supply must be free from moisture, water, oil, and particles.

The air must come from a refrigeration dried supply or be treated in such a way that its dew point is at least 10°C (18°F) below the lowest expected ambient temperature.

To ensure a stable and problem-free air supply, we recommend the installation of a filter/pressure regulator 40μ as close to the positioner as possible.

Before the air supply is connected to the positioner, we recommend the hose is opened freely for 2 to 3 minutes to allow any contamination to be blown out. Direct the air jet into a large paper bag to trap any water, oil, or other foreign materials. If this indicates that the air system is contaminated, it should be properly cleaned.



WARNING! Do not direct the open air jet towards people or objects because it may cause personal injury or damage.

Poor air supplies are the main source of problems in pneumatic systems.

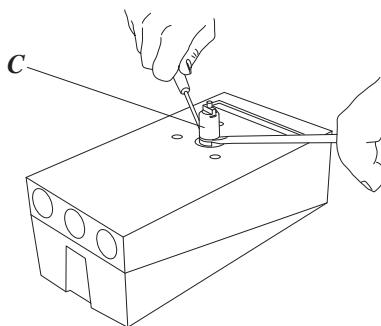
Mounting

N.B. If the positioner is installed in a hazardous environment, it must be of a type approved for this purpose.

The D3 positioner has an ISO F05 footprint, A. The holes are used to attach it to the mounting bracket B, which is suitable for most types of linear actuator.

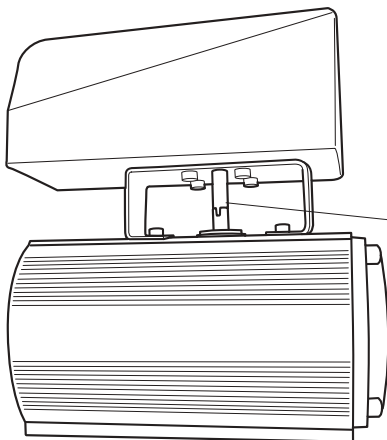
The spindle adapter C can be changed to suit the actuator in question.

Remove the existing adapter using two screwdrivers. Check that the spring ring on the positioner spindle is undamaged and fit the new adapter.

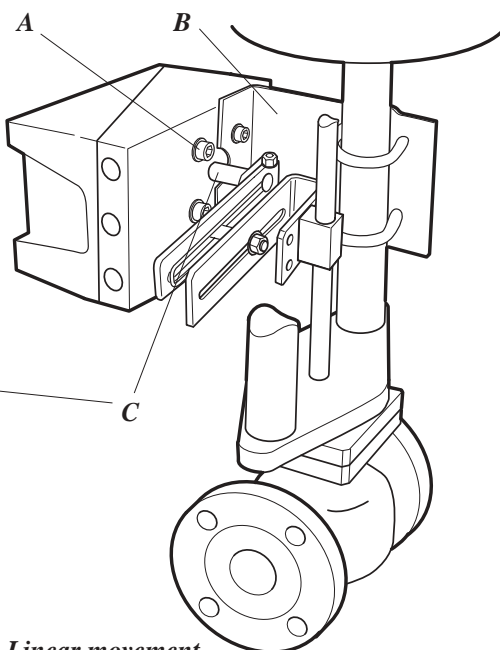


It is important that the positioner's spindle and the arms, that transfer the actuator movements, are correctly mounted. Any tension between these parts can cause incorrect operation and abnormal wear.

Assembly examples



Rotary movement

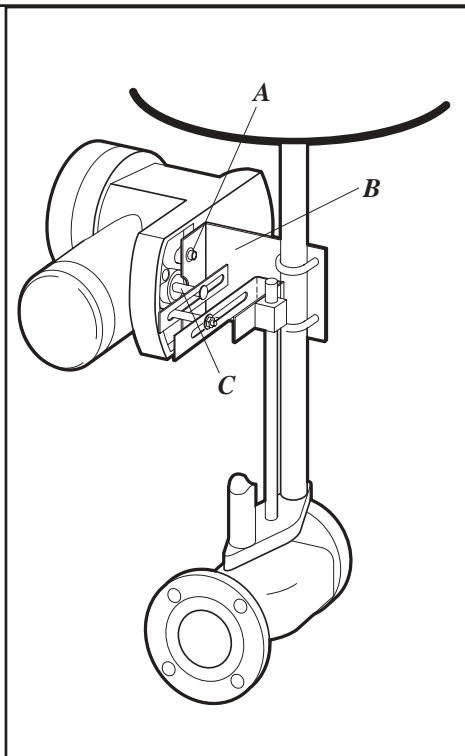


Linear movement



The D3 Ex positioner has an ISO F05 footprint, A. The holes are used to attach it to the mounting bracket B, which is suitable for most types of linear actuators.

The spindle adapter C can be changed to suit the actuator in question, see previous page.



Connections

Air:

- Port S Supply air, 2-7 bar
- Port C+ Connection to actuator
- Port C- Connection to actuator
(only for double action)

Electrical connection

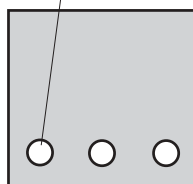
See page 12, 13.

Dimensions

- Air connections:
1/4" NPT alt. G 1/4"
- Electrical connection:
M20 x 1.5 alt. NPT 1/2"

Loctite 577 or equivalent is recommended as a sealant.

Must be plugged when converting to single action function.



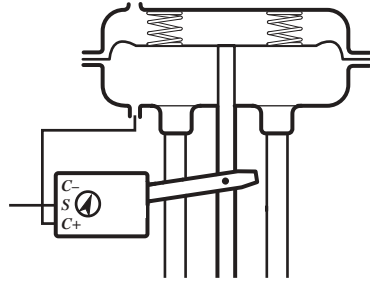
C- S C+

For data for air and electrical connections, see section Technical Data on page 48.

Single action positioner (Direct function)

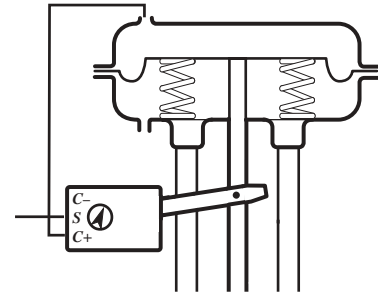
Actuator with closing spring

When the control signal increases, the pressure C+ to the actuator is increased. The valve spindle moves upward and rotates the positioner spindle counter-clockwise. When the control signal drops to zero, C+ is vented and the valve closes.



Actuator with opening spring

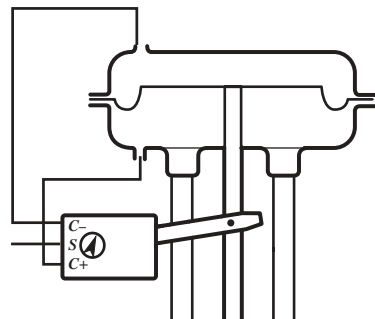
When the control signal increases, the pressure C+ to the actuator is reduced. The springs press the valve spindle upward and the positioner spindle rotates counter-clockwise. When the control signal drops to zero, C+ is vented and the valve opens.



Double action positioner (Direct function)

Double action actuator

When the control signal increases, the pressure C+ to the actuator is increased. The valve spindle is pressed upward and rotates the positioner spindle counter-clockwise. When the control signal is reduced, the pressure C- to the actuator increases and the valve spindle is pressed downward. If the control signal disappears, the pressure goes to C-, C+ vents, and the valve closes.





Electrical connections

The diagrams show the terminal blocks in D3 and D3 Ex.

Remote unit

The remote unit shall be connected between terminals 3, 4 and 5 in the D3 and 3, 4 and 5 in the remote unit. Use a shielded cable and ground it in the D3 only. Max recommended distance between D3 and remote unit: 5 m.

Note! When converting D3/D3 Ex for use with remote unit, some changes have to be done inside the positioner, see Section 8.

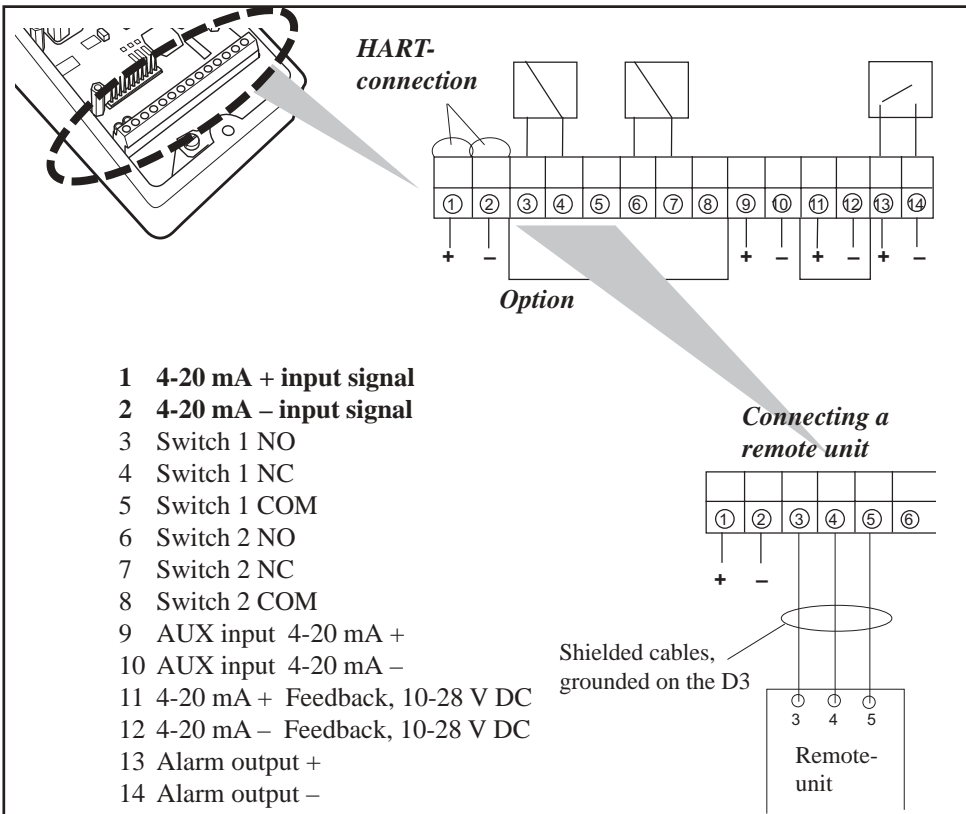


Warning! In a hazardous environment where there is a risk of explosion, electrical connections must comply with the relevant regulations.

D3

The terminal block (below) for the positioner is accessible when the aluminium cover and inner cover is removed, see Section 8.

When installing D3 Intrinsically safe unit, always consider cdwg D3-70.

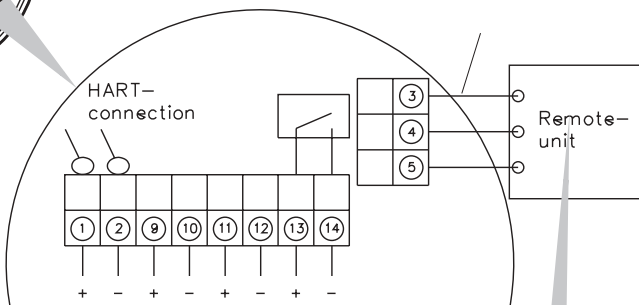
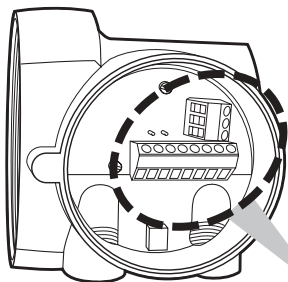


D3 Ex

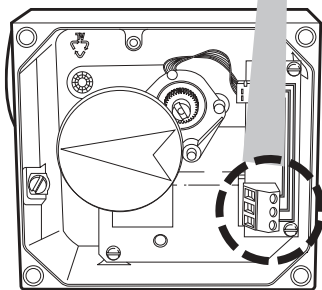
The terminal block (below) for the positioner is accessible when the terminal cover is removed, see Section 8.



Warning! In a hazardous environment where there is a risk of explosion, electrical connections must comply with the relevant regulations.



- | | |
|---|-----------------|
| <ul style="list-style-type: none"> 1 4-20 mA + input signal 2 4-20 mA - input signal 3 (Remote unit) 4 (Remote unit) 5 (Remote unit) 9 AUX input 4-20 mA + 10 AUX input 4-20 mA - 11 4-20 mA + Feedback, 10-28 V DC 12 4-20 mA - Feedback, 10-28 V DC 13 Alarm output +, 8-28 V DC 14 Alarm output -, 8-28 V DC | <p>Optional</p> |
|---|-----------------|




7. Control

Menus and pushbuttons

The positioner is controlled using the five pushbuttons and the display, which are accessible when the aluminium cover is removed.

For normal functioning, the display shows the current value. Press the ESC button for two seconds to display the main menu.

Use the  pushbuttons to browse through the main menu and the sub-menus.

The main menu is divided up into a basic menu and a full menu, see page 16.

Other functions

ESC

Exit the menu without making any changes (as long as any changes have not been confirmed with OK).

FUNC

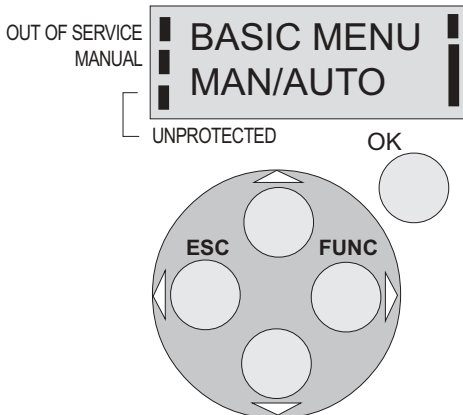
To select function and change parameters.

OK

To confirm selection or change of parameters.

MENU INDICATOR

Displays the position of the current menu row in the menu.



IN SERVICE

The positioner is following the input signal. This is the normal status when the positioner is working.

OUT OF SERVICE

The positioner is not following the input signal. Critical parameters can be changed.

MANUAL

The positioner can be adjusted manually using the pushbuttons. See section "Man/Auto", page 21".

UNPROTECTED

Most of the parameters can be changed when the positioner is in the "Unprotected" position. However, critical parameters are locked when the positioner is in the "In service" position.

Menu indicator

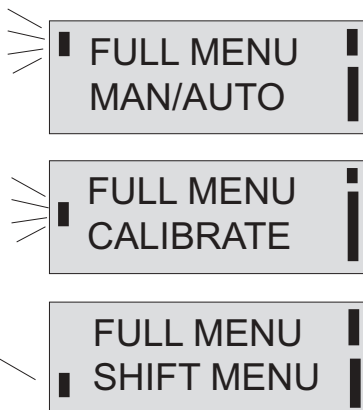
There are indicators at both sides of the display window and they indicate as follows:

Flashing in position **Out of service**

Flashing in position **Manual**

Displayed in position **Unprotected**

The indicators on the right-hand side show the position in the current menu.



Menus

To display the menus you can select:

- **Basic menu**, which means you can browse through four different steps


- **Full menu**, which comprises ten steps. Use the Shift Menu to browse through the steps

Full Menu can be locked out using a passcode.

The main menus are shown on the next page and the sub-menus on the subsequent pages.

Changing parameter values

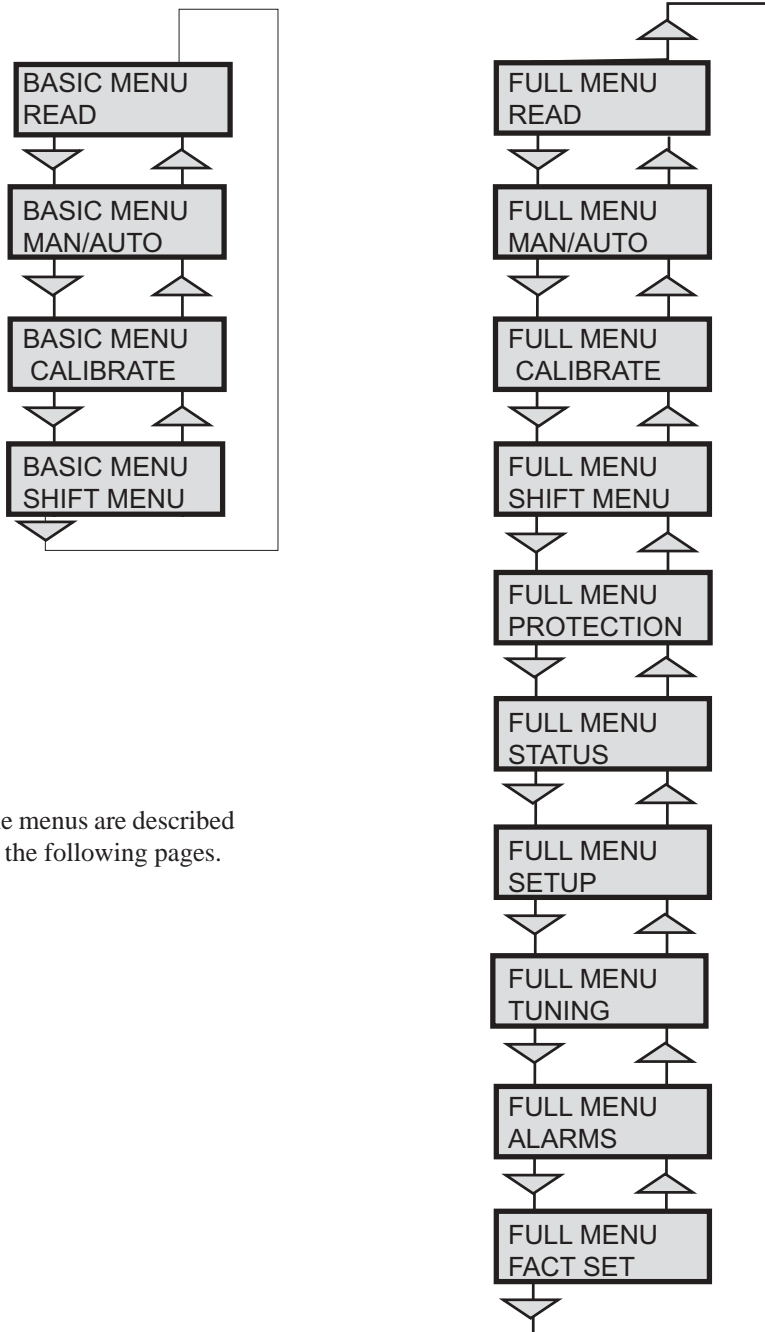
Change by pressing  until the desired figure is flashing.

Press  to step to the desired figure. Confirm by pressing OK.

A change can be undone by pressing the **ESC** button, which returns you to the previous menu.



Menu system



The menus are described on the following pages.

BASIC MENU CALIBRATE



First start

Calibrate in the basic menu is displayed automatically the first time the positioner is connected up, and can be selected from the basic/main menu at any later time.

A complete calibration takes about 3 minutes and includes end limit calibration, auto-tuning, leak test, and a check on the speed of movement. Start the automatic calibration by selecting **Auto-Cal** and then answer the questions on the display by pressing **OK** or the respective arrow. The menu is described on the next page.

Calibration error messages

If a fault occurs during calibration, one of the following error messages can be displayed:

Invalid movement/press ESC to abort

No movement because the air is incorrectly connected, for example. After the fault is corrected, the calibration sequence must be restarted.

Pot unaligned/press ESC to abort

The potentiometer has been set to an illegal value. The potentiometer is aligned using the Calibrate - Expert cal - pot Menu. The calibration sequence must be restarted after the fault is corrected.

Air leak detected/ESC = abort

OK = go on

An air leak has been detected. The calibration sequence should be restarted after the fault is corrected.

Increase C- damper/ESC = abort

OK to retry

Increase C+ damper/ESC = abort

OK to retry

Speed of movement is too fast. Adjust with the damper screws (see page 5). Press OK. Repeat the adjustment and press OK until the speed is correct. If there is an abort, the calibration sequence must be restarted.

First start, Profibus

Connect the input signal at pos 1 and 2 on the terminal block. See Electrical connections in the manual.

In the SETUP/Devicedata/Profibus: change the address from 126 to any number between 1-125.

Do never use the same number to more than one unit. Install values in failsafe mode, for communication when loss of signal.

Calibrate the unit.

GSD files are available at our homepage www.pmv.nu



C+

(C-)

Clockwise

CCW

3 revsCCW

= Increased damping/Less flow

= Decreased damping/More flow

= Max flow

***Note!** To much increased damping (low flow) might cause irregular actuator function.*




The contents of the menu are shown on the next page. The various menu texts are described below.

Auto-Cal

Start tune

Auto-tuning and calibration of end positions

Starts the tuning. Questions/commands are displayed during calibration. Select the type of movement, function, etc. with  and confirm with **OK** as shown in the chart on the next page.

Lose prev value? OK?

A warning that the value set previously will be lost (not during the first auto-tuning).

Actuator? rotating

Select for rotating actuator.

Actuator? linear

Select for linear actuator.

Actuator single act

Select for single act.

Actuator double act

Select for double act.

Direction? direct

Select for direct function.

Direction? reverse

Select for reverse function.

In service? Press OK

Calibration finished. Press OK to start positioner functioning. (If ESC is pressed, the positioner assumes the "Out of service" position but the calibration is retained).

TravelCal

Start cal

Calibration of end positions

Start end position calibration.

Lose prev value? OK?

A warning that the previously set value will be lost. Confirm with OK.

The calibration sequence starts.

In service? Press OK

Calibration finished. Press OK to start positioner functioning. (If ESC is pressed, the positioner assumes the "Out of service" position but the calibration is retained).

Perform

Normal

Setting gain

100% gain

Perform 50%, 25%,

12%, L, M, S

Possibility to select a lower gain in steps.

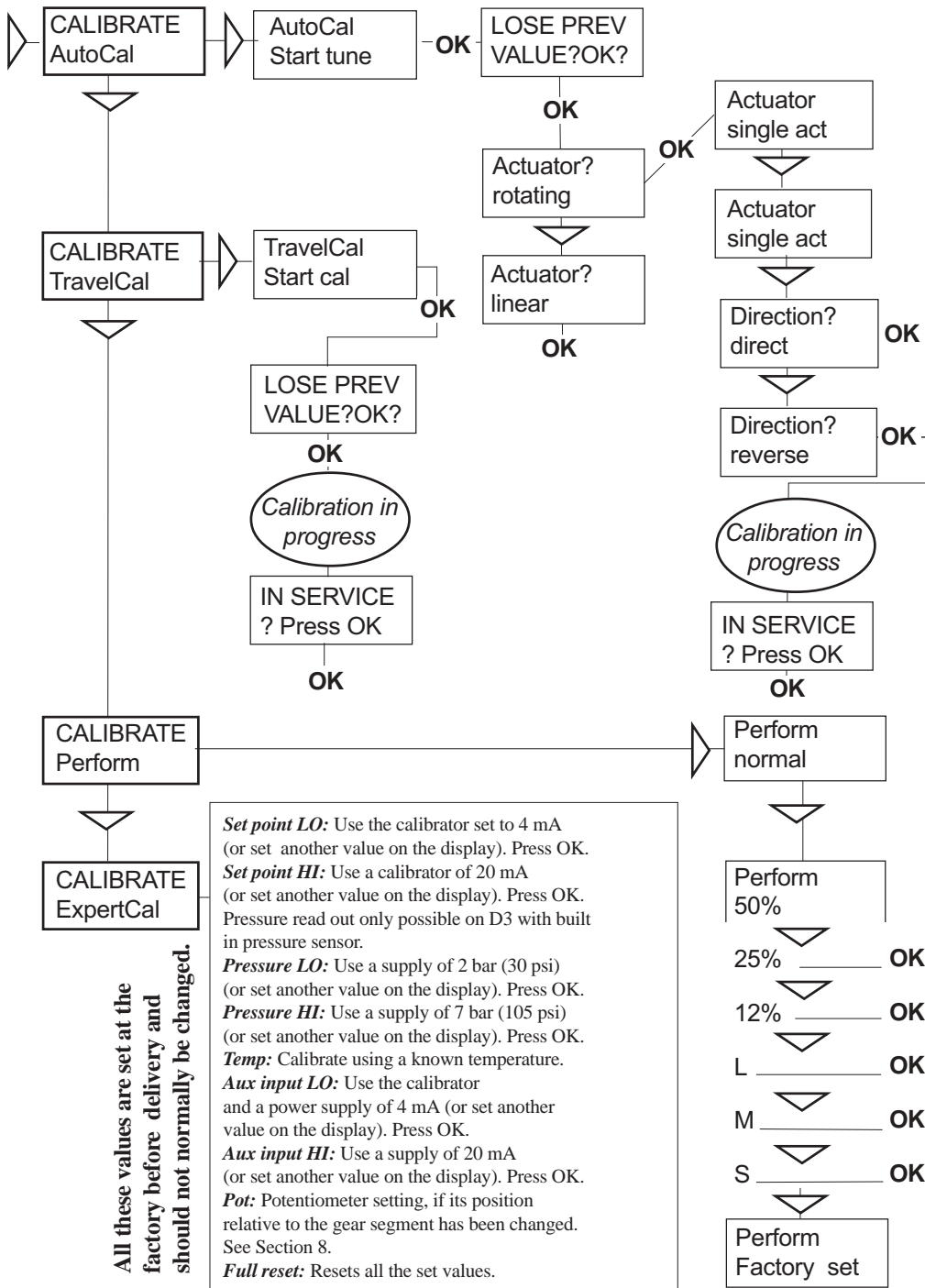
L, M, S

Preset values for L, M, S actuators

Factory set

Resets all set values and enters Factory Mode. **Should only be used by authorized staff.**

Note. Original P. I. D. will always be shown in display



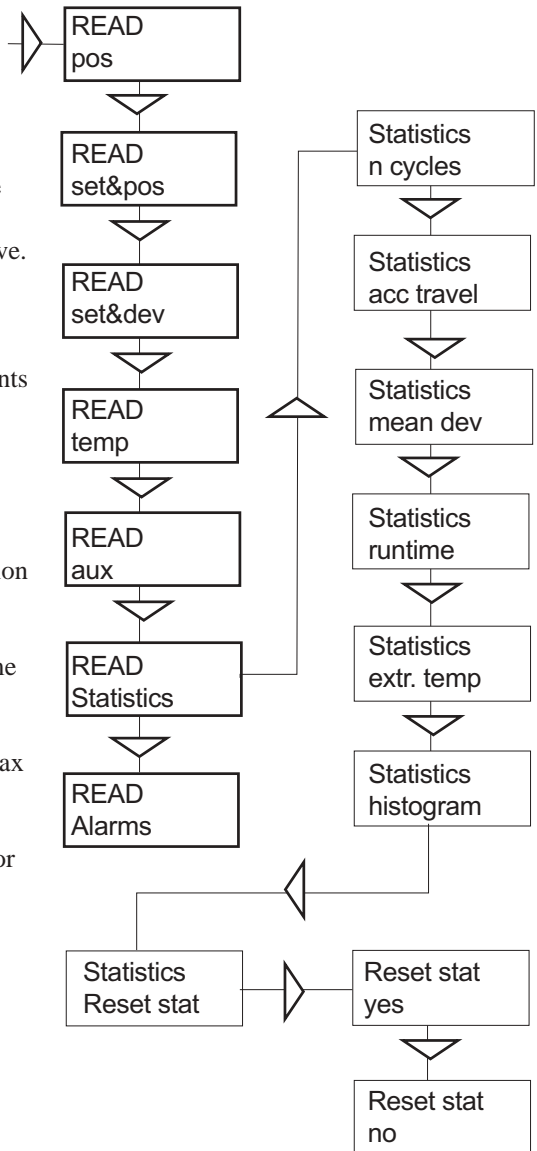


The menu contents are shown in the figures on the right and the texts are described below:



Current values can be read using the Read Menu and some values can be reset.

<u>Pos</u>	Shows current position
<u>Set&pos</u>	Set point and position
<u>Set&dev</u>	Set point and deviation
<u>Temp</u>	Shows current temperature
<u>Aux</u>	Shows auxinput signal valve. External pot or similar
<u>Statistics</u>	
n cycles	Shows number of movements (turns)
Acc travel	Shows accumulated movement
mean dev	Shows accumulated deviation in %
runtime	Shows accumulated runtime since last reset
Extr temp	Shows extreme min and max temperature
Histogram	Shows position and time for PV
<u>Alarms</u>	Displays tripped alarms





The Man/Auto menu is used to change between manual and automatic modes.

The menu contents are shown in the figures on the right and the various texts are described below:





AUT, OK = MAN

Positioner in automatic mode

MAN, OK = AUT


Positioner in manual mode



When changing between **MAN** and **AUT** mode, the **OK** button must be depressed for 3 seconds.

In the **MAN** mode, the value of POS can be changed using  . The push-buttons increase/decrease the value in steps. The value can also be changed in the same way as for the other parameter values, as described on page 15.

Other functions

C+ can be fully opened by pressing  and then immediately OK simultaneously.

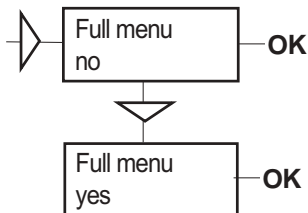
C- can be fully opened by pressing  and OK simultaneously.

C+ and C- can be fully opened for blowing clean by pressing   and OK simultaneously.



The Shift Menu is used to choose between the basic menu and the full menu.

The menu contents are shown in the figures on the right and the various texts are described below:



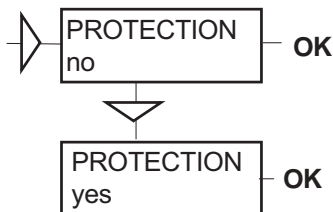
- No** Full menu selected.
- Yes** Basic menu selected.

Full Menu can be locked with a passcode, see Setup menu.



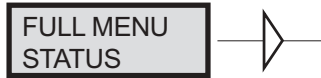
The Write Protect menu is used to protect all essential settings.

The menu contents are shown in the figures on the right and the various texts are described below:



- No** Entered values are not write protected. "Unprotected" is displayed in the lower left-hand corner.
- Yes** Entered values are write protected. Passcod needed for change to **No** (Applicable when a passcode has been set up in SETUP menu).

When changing between **Yes** and **No** mode, the **OK** button must be depressed for 3 seconds.

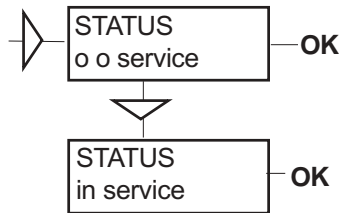


The Status Menu is used to select whether or not the positioner is in service.

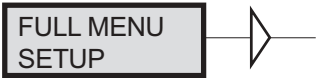
The menu contents are shown in the figures on the right and the various texts are described below:

o o service Not in service. Flashing indicator in upper left-hand corner of display.

in service Positioner in service. Critical parameters cannot be changed.



When changing between **In service** and **Out of service**, the **OK** button must be depressed for 3 seconds.



The Setup Menu is used for various settings.

The menu contents are shown in the chart on the next page and the various texts are described below:

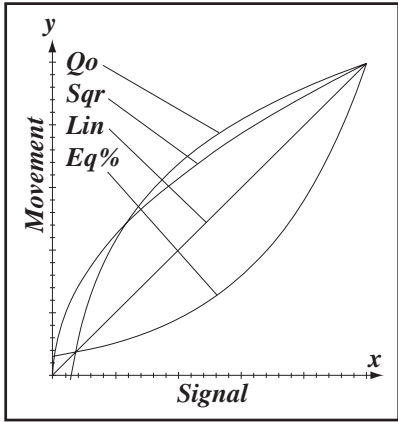
Actuator	<u>Type of actuator</u>	<u>Size of actuator</u>	<u>Time out</u>
Rotating	Rotating actuator.	Small	10 s
Linear	Linear actuator.	Medium	25 s
		Large	60 s
		Texas	180 s

- Lever** Only for linear actuator.
- Lever stroke** Stroke length to achieve correct display.
- Level cal** Calibration of positions to achieve correct display.

- Direction**
- Direct** Direct function (signal increase opens). Indicator/spindle rotates counter-clockwise.
 - Reverse** Reverse function.

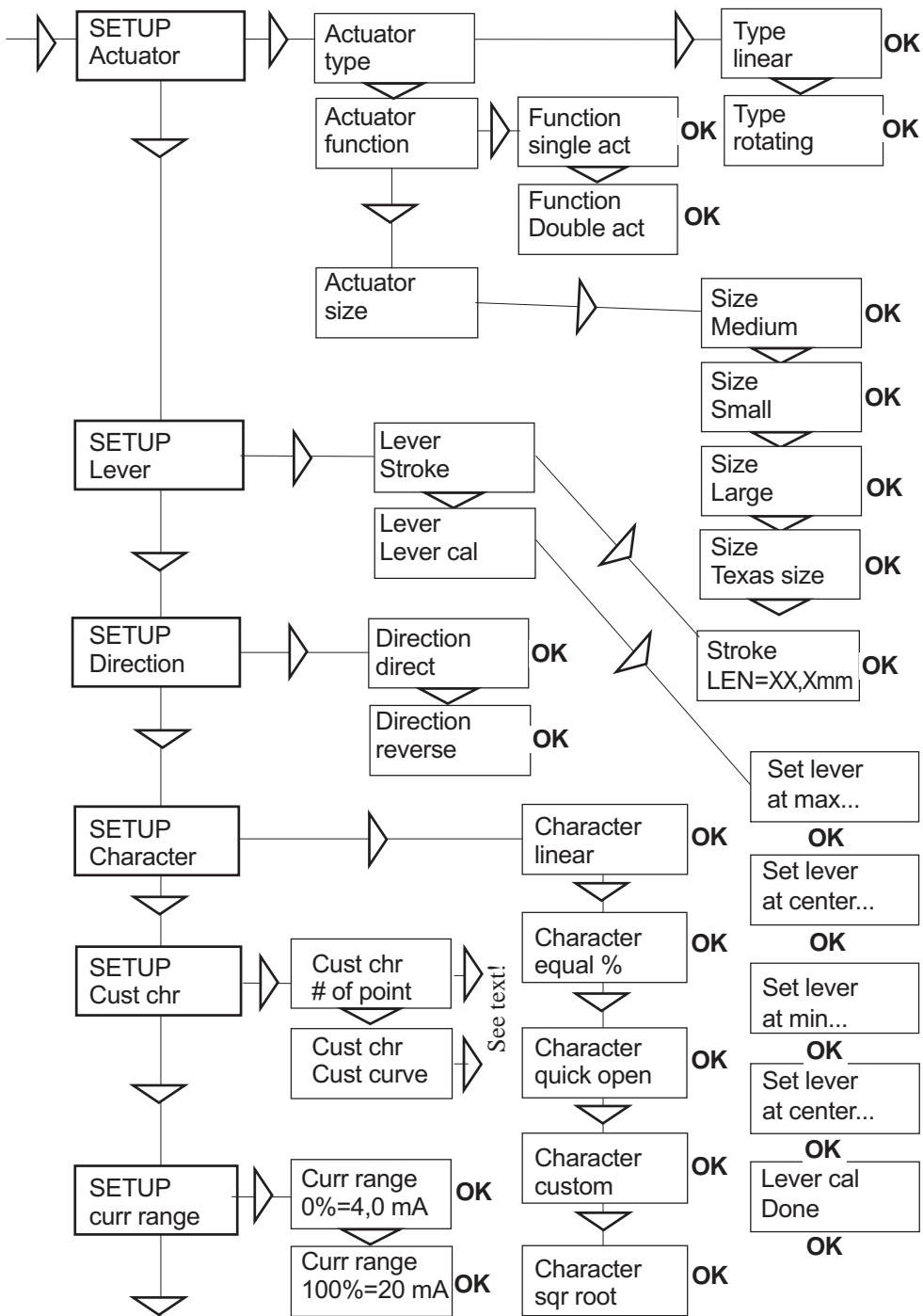
Character Curves that show position as a function of input signal.

- Linear**
- Equal %** | See diagram.
- Quick open**
- Sqr root**
- Custom** Create own curve.



- Cust chr**
- # of point** Specify number of points (3, 5, 9, 17, or 33)
 - Cust curve** Enter values on X and Y axes.

- Curr range**
- 0%=4.0 mA**
 - 100%=20.0 mA** Possibility of selecting which input signal values will correspond to 0% and 100% movement respectively. Examples of settings: 4 mA = 0%, 12 mA = 100%, 12 mA = 0%, 20 mA = 100%.





TRVL range

0%=0.0%

Setting end positions

Select Out of Service.
Set percentage value for desired end position (e.g. 3%).

Set 0%

Select In Service.
Connect calibrator.
Move forward to desired end position (0%) and press OK.

100%=100.0%

Select Out of Service.
Set percentage value for desired end position (e.g. 97%).

Set 100%

Select In Service.
Connect calibrator. Move forward to desired end position (100%) and press OK.

Trvl ctrl

Set low

Behaviour at set end position

Choose between Free (go to mechanical stop), Limit (stop at set end position), and Cut off (go directly to mechanical stop at set end position).

Set high Values

Similar to Set low.
Select position for Cut off and Limit at the respective end positions.

Passcodes

Full menu

Setting passcodes for various functions

Passcode for access to full menu.

Write prot

Passcode for removing write protect.

Expert

Passcode for access to Expert menu (TUNING).

Fact set

Passcode to return to default values applicable when positioner was delivered.

Numbers between 0000 and 9999 can be used as passcodes. 0 = no passcode required.

Appearance

Language

On display

Select menu language.

Units

Select units.

Def. Display

Select value(s) to be displayed during service.

The display reverts to this value 10 minutes after any change is made.

Start menu

Start in Basic menu or Full menu.

Contrast

Adjust display contrast.

Orient

Orientation of text on display.

Par mode

Display of control parameters such as P, I, D or K, Ti, Td.

Devicedata

HW rew

SW rew

Capability

HART

General parameters.

Menu with HART parameters. Only amendable with HART communicator. It is possible to read from display.

Profibus

Status

Indicates present status

Device ID

Serial number

Address

1-126

Tag

Allotted ID

Descriptor

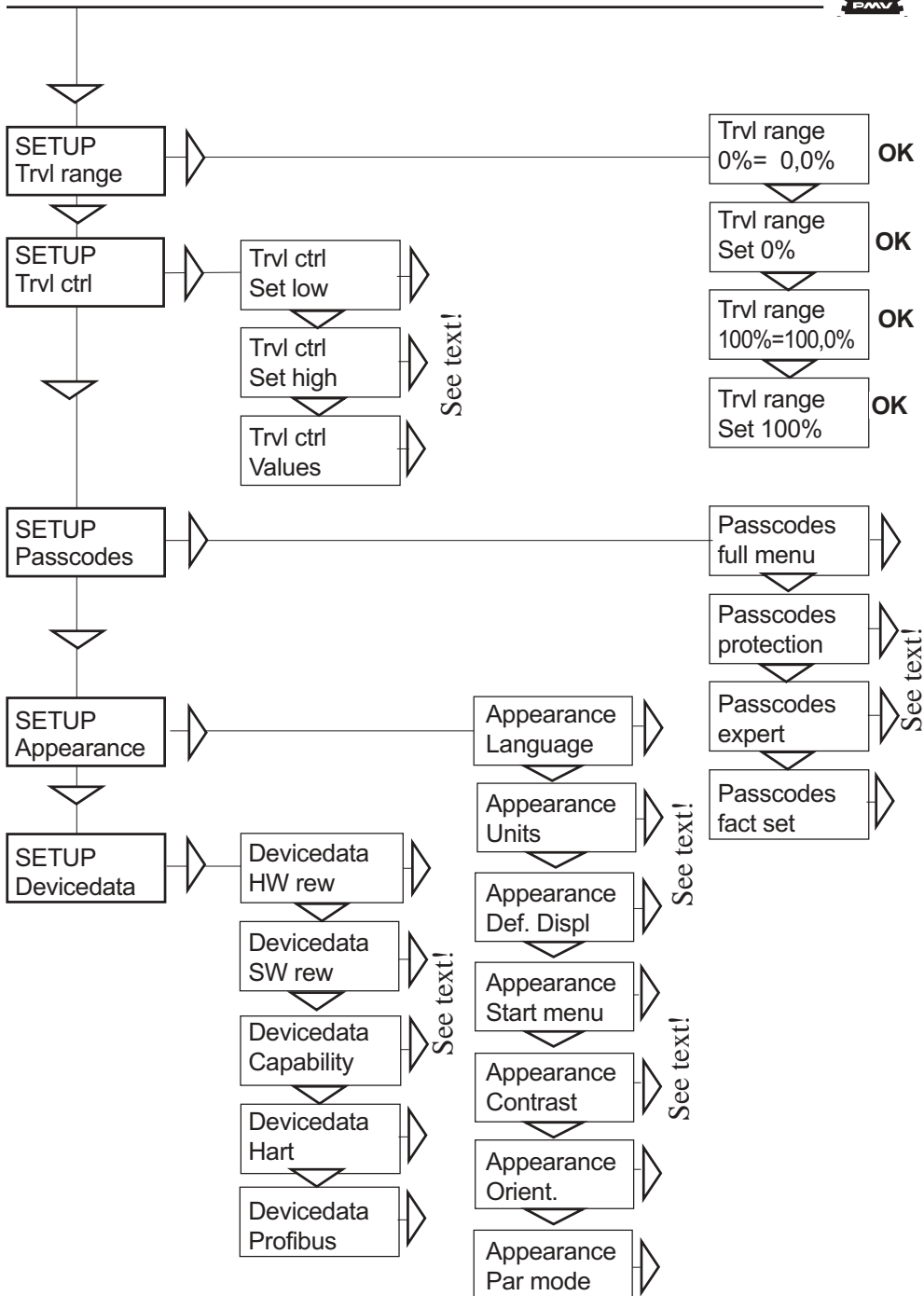
ID description

Date

N/A

Failsafe

Value = preset pos
Time = Set time + 10sec = time before movement
Valve act = failsafe (preset pos) or lastvalue (present pos)
Alarm out = On/Off

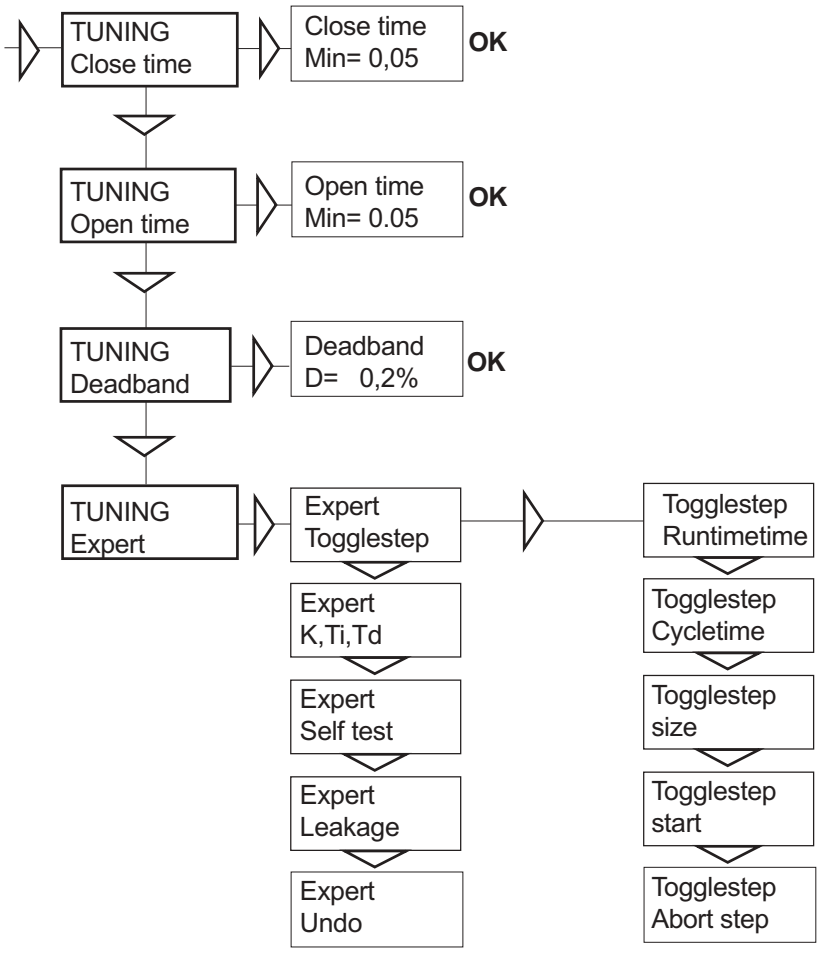




FULL MENU TUNING

The menu contents are shown in the chart on the next page and the various texts are described below:

<u>Close time</u>	<u>Minimum time from fully open to closed.</u>
<u>Open time</u>	<u>Minimum time from closed to fully open.</u>
<u>Deadband</u>	<u>Setting deadband. Min. 0.2%.</u>
<u>Expert</u>	<u>Advanced settings.</u>
Togglestep	Test tool for checking functions. Overlays a square wave on the set value.
K, Ti, Td	Setting K, Ti, and Td parameters.
Self test	Test of processor, potentiometer, etc.
Leakage	Air leakage detected can be either connections, positioner tubing or actuator.
Undo	You can read last 20 changes.





FULL MENU ALARMS



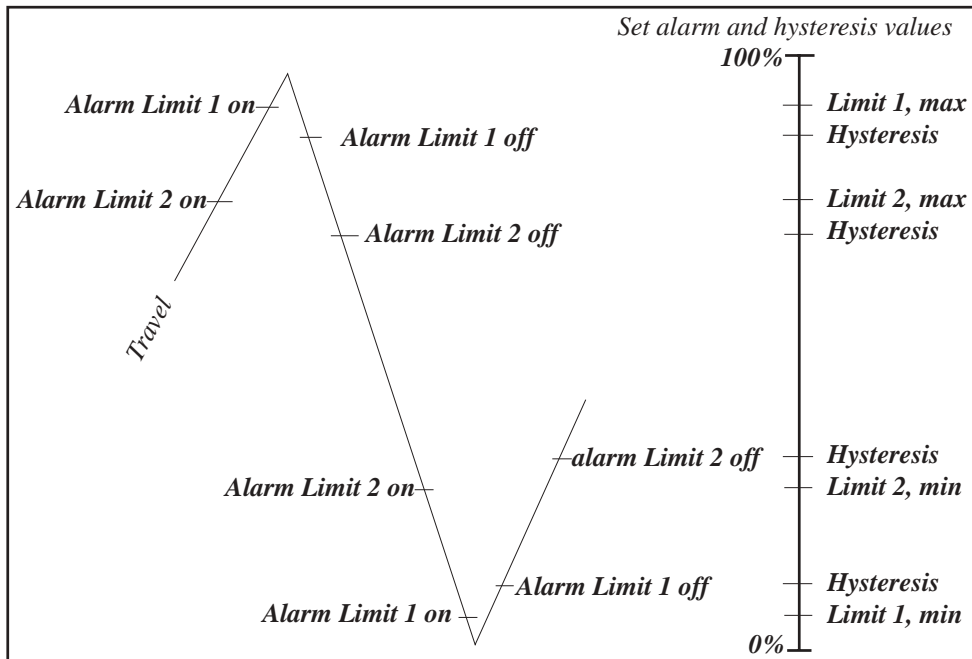
The menu contents are shown in the chart on the next page and the various texts are described below:

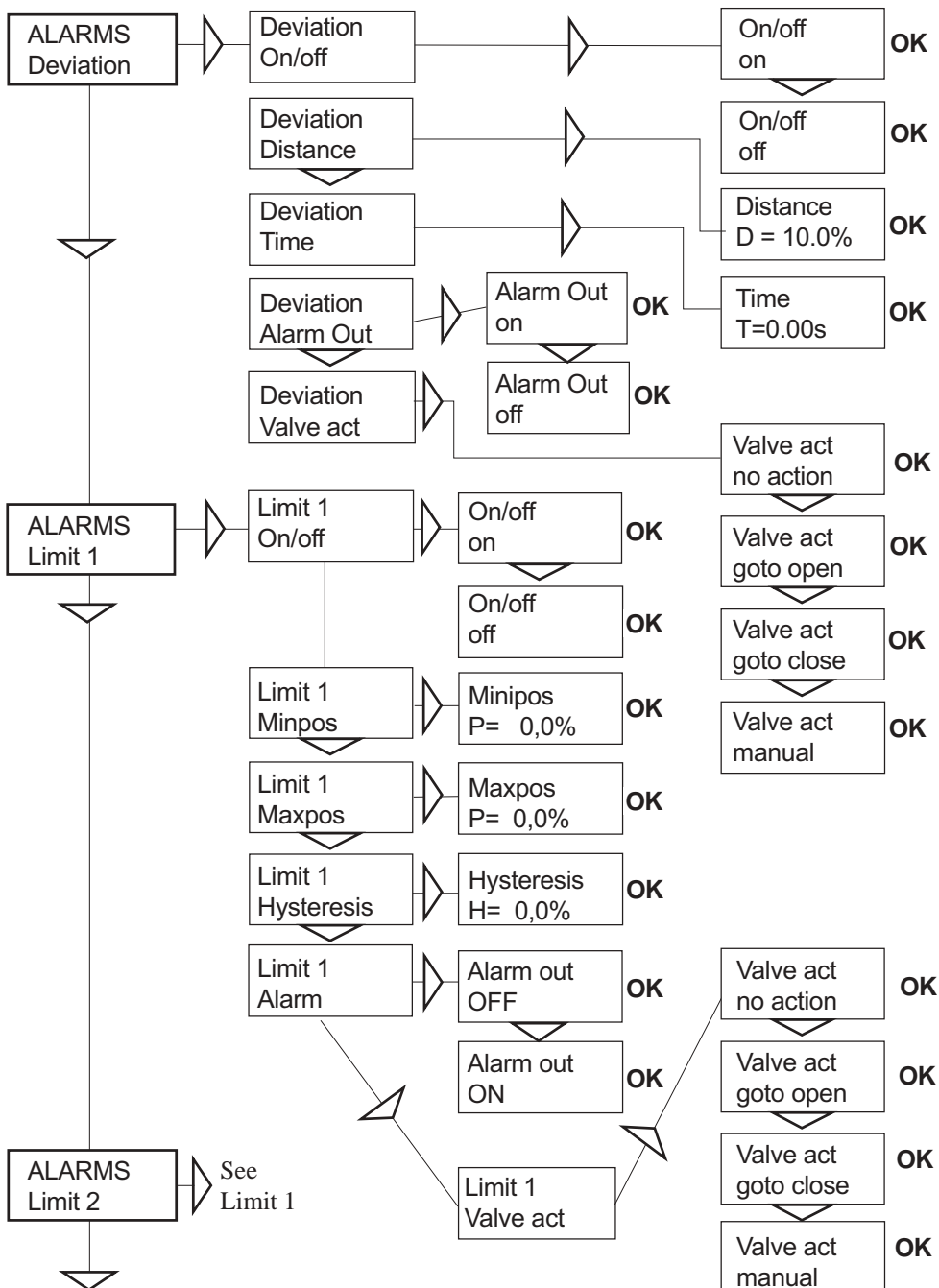
- Deviation** Alarm generated when deviation occurs
- On/Off** Alarm on/off.
- Distance** Allowed distance before alarm is generated.
- Time** Total deviation time before alarm is generated.
- Alarm out** Select ON/OFF offers output on terminals 13 and 14.

- Valve act** Behaviour of valve when alarm is generated.

- Limit 1** Alarm above/below a certain level.
- On/Off** Alarm on/off.
- Minipos** Setting of desired min. position. |
- Maxpos** Setting of desired max. position. | — See diagram below!
- Hysteresis** Desired hysteresis. |
- Alarm on** Select ON/OFF offers output on terminals 13 and 14.
- Valve act** Behaviour of valve when alarm is generated.

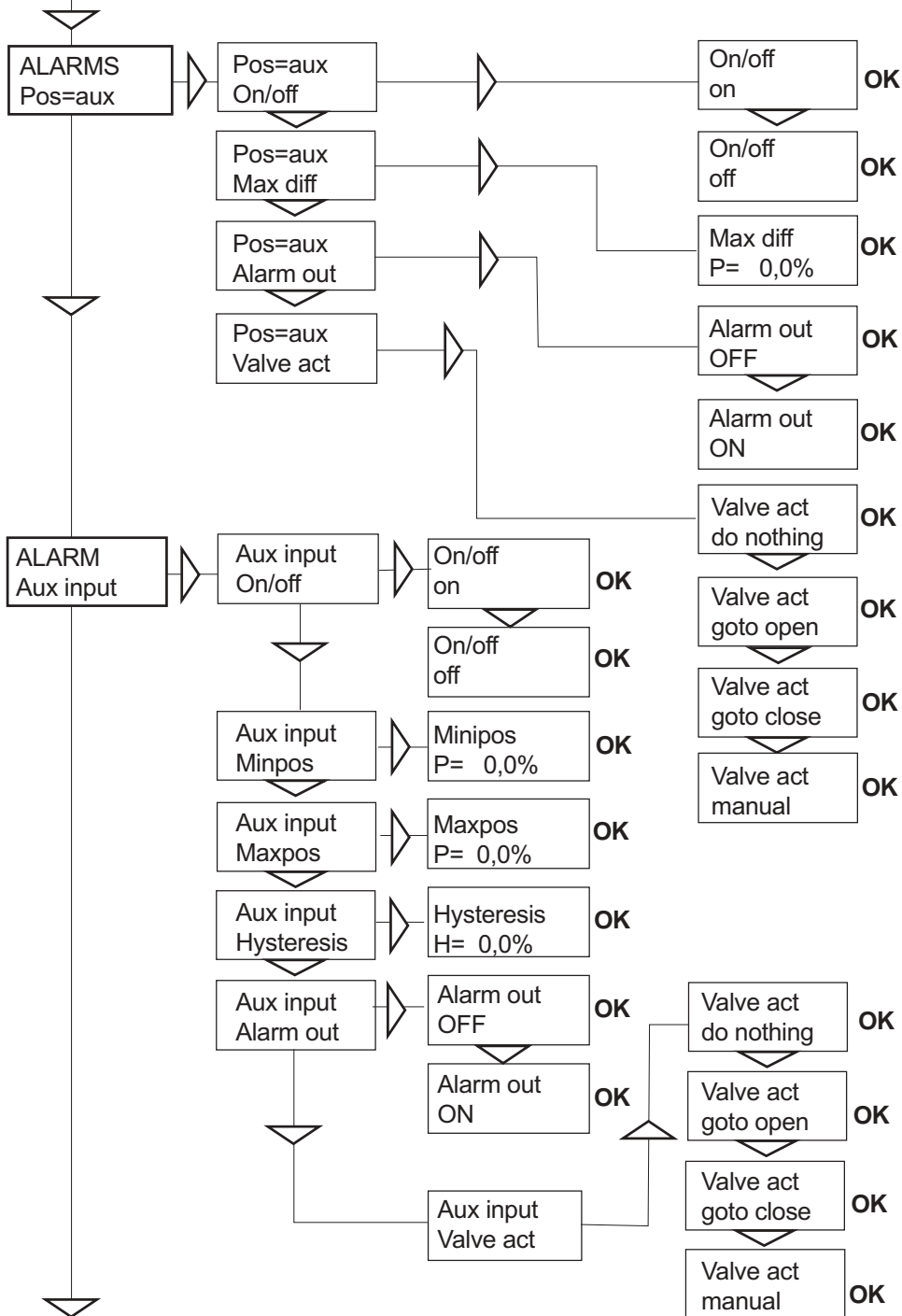
Limit 2 See Limit 1.







<u>Pos=aux</u>	<u>External potentiometer</u>	
On/Off	Function on/off.	
Max diff	Max. allowed deviation between internal and external potentiometer.	
Alarm out	Select ON/OFF offers output on terminals 13 and 14.	
Valve act	Behaviour of valve when alarm is generated.	
<u>Aux input</u>	<u>External input signal 4-20 mA.</u>	
On/Off	Alarm on/off.	
Minipos	Setting of desired min. position.	Function similar to Limit 1 and 2. See chart on previous page.
Maxpos	Setting of desired max. position.	
Hysteresis	Desired hysteresis.	
Valve act	Behaviour of valve when alarm is generated.	





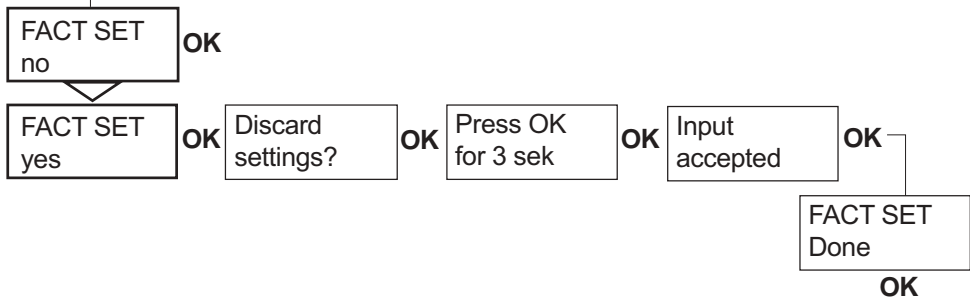
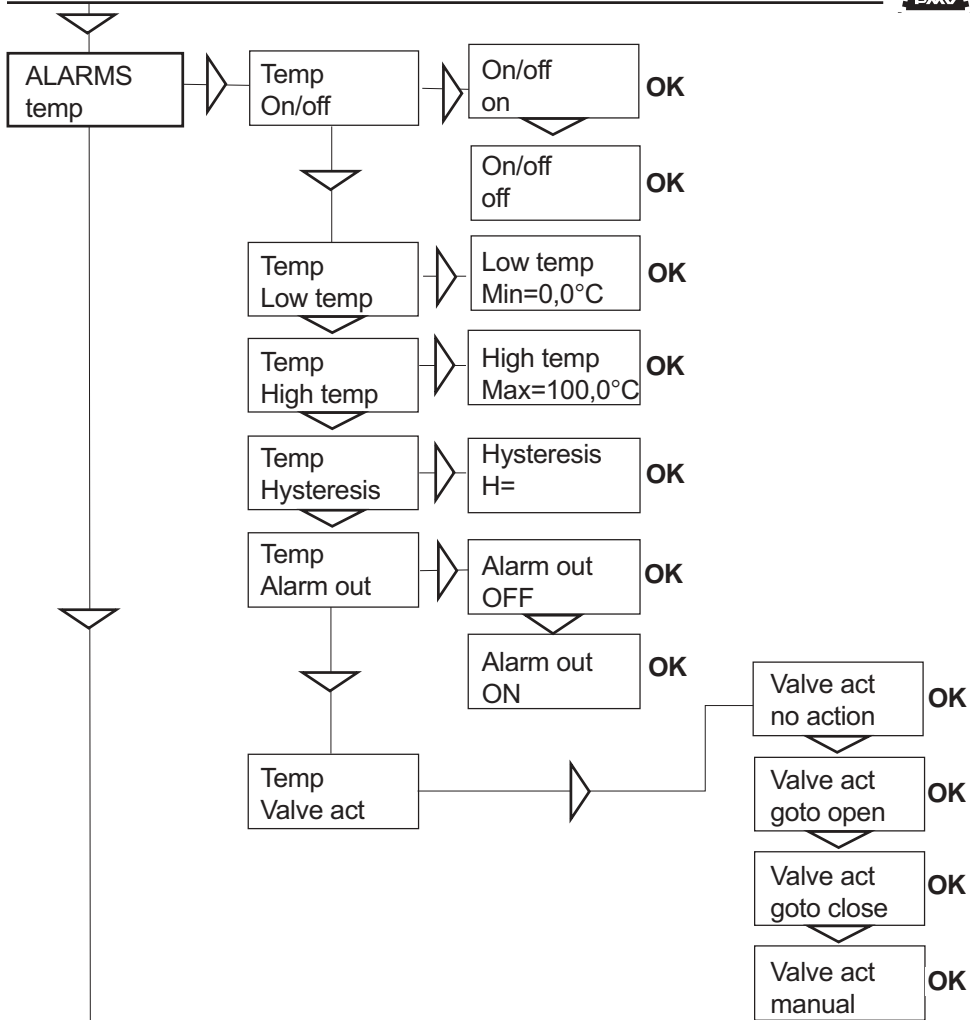
<u>Temp</u>	<u>Alarm based on temperature</u>
On/Off	Temperature alarm on/off.
Low temp	Temperature setting.
High temp	Temperature setting.
Hysteresis	Allowed hysteresis.
Alarm out	Select ON/OFF offers output on terminals 13 and 14.
Valve act	Behaviour of valve when alarm is generated.

<u>Valve act</u>	
No action	Alarm generated only. Operations not affected.
Goto open	C+ gives full pressure and valve moves to fully open position. Positioner changes to position Manual.
Goto close	C- gives full pressure and valve moves to fully closed position. Positioner changes to position Manual.
Manual	Valve stays in unchanged position. Positioner moves to position Manual.



The menu contents are shown in the chart on the next page and the various texts are described below:

The default values that were set on delivery can be reset using the Fact Set menu. Values from calibration and from other settings will then be lost.





READ			pos	set&pos	✦		
MAN/AUTO	AUT.OK=MAN	MAN.OK=AUT	normal	temp		n cycles	
CALIBRATE	AutoCal		50%	aux		acc travel	
	TravelCal		25%	statistics		mean dev	
	Perform		12%	alarms		runtime	
	ExpertCal	Set point**	L			extr temp	
		Pressure	M			histogram	
		Temp	S			Reset stat	
		Aux input	Factoryset				
		Transm.					
		Pot					
SHIFT MENU	Basic menu	Full reset					
	Full menu						
PROTECTION	no	✦					
	yes	Enter code					
STATUS	o	o service					
	in service						
SETUP	Actuator	type	Rotating	✦	single act	small	
		function	Linear		double act	medium	
		size				large	
						Texas-size	
	Lever (*)		Stroke				
			Lever cal	direct	✦		
	Direction			reverse			
	Character					linear	✦
	Cust chr		# of points	Xo=		0%=	equal %
			Cust curve	Yo=		Set 0%	quick open
	Curr range**	0%=4mA				100%= 100%	custom
		100%=20mA				Set 100%	sqrr root
	Trvl range						
	Trvl ctrl	Set low	free	Cutoff Low 0,1			full menu 0
		Set high	cutoff	Cutoff Hi 99.9			protection 0
Values		limited	Limit Low			expert 0	
			Limit Hi			fact set 0	
Passcodes							
Appearance	Language	English	✦	percent	✦		
		Svenska		mA**			
		Deutsch		mm	percent	✦	
		Francais		cm			
	Units	Setpoint	degrees	inch	cm		
		Position		inch	degrees		bar
		Pressure					psi
		Temp					KPa
	Aux	percent	✦			degrees C	position
		mA				degrees F	set&pos
					Kelvin	set&dev	
						menu	
Def. Displ					last value	✦	
Start menu					basic		
Contrast					full		
Orient.		normal	✦	P,I,D			
		flipped		K,Ti,Td	✦	Message	
Par mode						Tag	
Devicedata			HW rev			Descriptor	
			SW rev			Date	
			Capability			Device ID	
			Hart**			Poll adr	
TUNING	Close time 0	Togglestep	runtime	PROFI**	Status	Assemblyno	
	Open time 0	Pid params	cycle time		Device ID	univ cmd	
	Deadband 0,5	Leakage	size		Address	spec cmd	
	Expert	Self test	start		Tag		
	Undo	Abort step			Descriptor		
ALARMS	Deviation	On/off	off		Value		
		Distance	10		Time		
		Time	10		Valve act		
	Limit 1	Alarmout	on		Fail safe	Alarm out	no action
		Valve act	→				goto open
	Limit 2**	On/off	off	On/off	off	Lo	manual
		Minpos	0	Lo	Lo	Lo	
	Pos=Aux	Maxpos	100	Hi	Hi	Hi	
		Hysteresis	2	Hi	Hi	Hi	
		Alarmout	off				
Aux input	Valve act	→					
Temp							
FACT SET	no	✦					
	yes						

Set figures are
 ✦ Factory set
 Read, only for info
 Devicedata only readable with Hart device

(*) appear if Linear set
 ** Not available with Profibus
 ***Only Profibus

8. Maintenance/service

When carrying out service, replacing a circuit board, etc., it may be necessary to remove and refit various parts of the positioner. This is described on the following pages.

Read the Safety Instructions on page 3 before starting work on the positioner.

Cleanliness is essential when working with the positioner. Contamination in the air ducts will infallible lead to operational disturbances. Do not disassemble the unit more than that described here.

Do not take the valve block apart because its function will be impaired.

When working with the D3 positioner, the work place must be equipped with

ESD protection before the work is started.

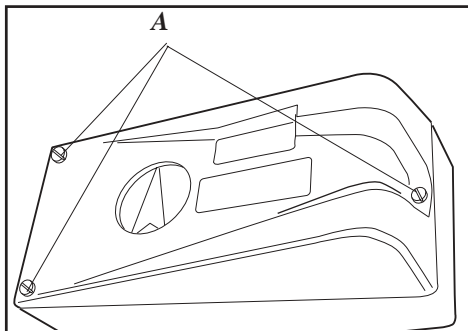


Always turn off the air and electrical supplies before starting any work.

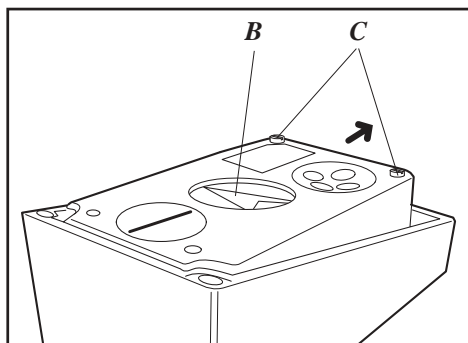
Disassembling PMVD3

Removing cover and inner cover

- Unscrew the screws A and remove the cover.



- Pull off the arrow pointer, B.
- Unscrew the screws C, pull the inner cover slightly in the direction of the arrow, and remove the cover.

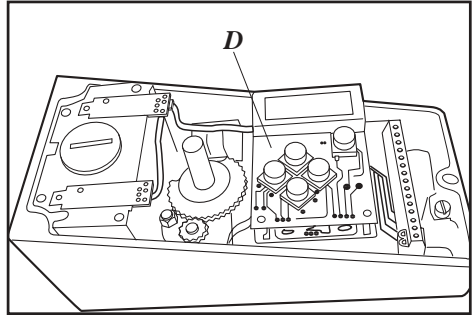


Circuit boards (pcb)

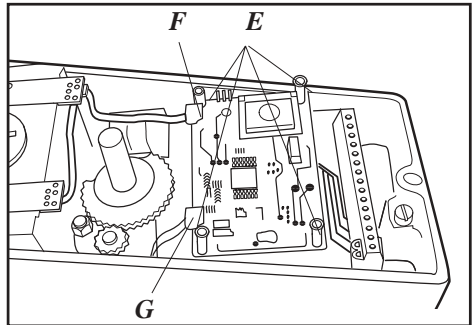


Disconnect or switch off the electric power supply before starting any work.

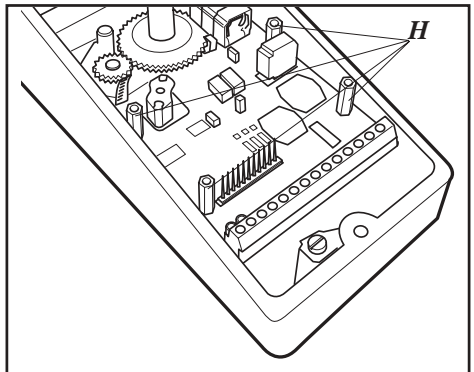
- Lift off the display pcb.




- Unscrew the spacers E, release the cable connections F and G, and lift up the processor pcb.



- Remove the terminal board by unscrewing the spacers H.



Valve block

 Turn off the air and electric power supply before starting any work.

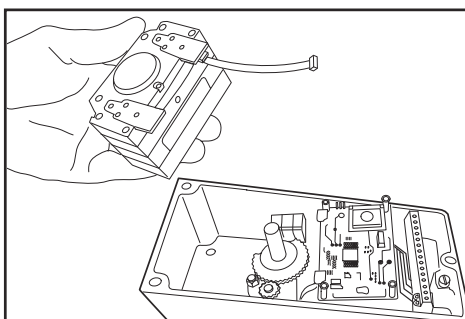
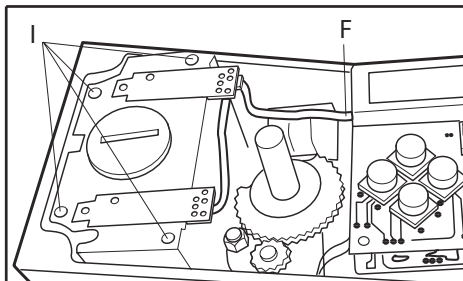
• Release the connector F from the processor pcb.

¥ Remove the four screws I.

¥ Lift out the valve block

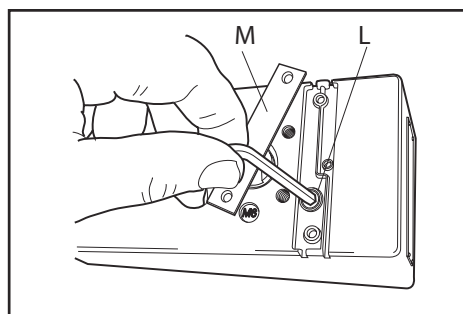
N.B. Do not disassemble the valve block

¥ When installing the valve block Ñ torque the four screws to 1,4 Nm and seal with Loctite 222.



Silencer

A silencer, L (option) can be mounted under the plate M on the D3. Contact PMV .



Spindle adapter

The spindle adapter can be changed to suit the actuator in question, see page 9.

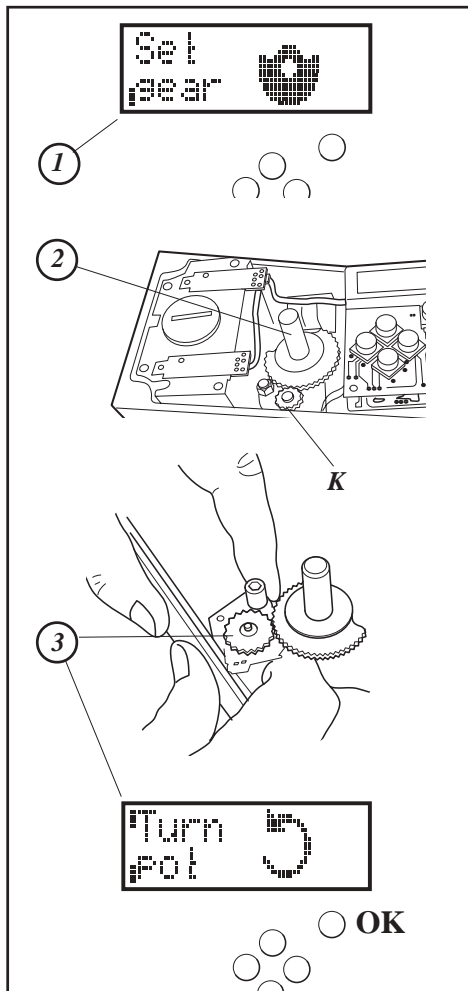
Potentiometer

90° and 270° spring loaded potentiometer

The spring-loaded potentiometer **K** can be removed from the gearwheel for calibration or replacement.

If the potentiometer is replaced or the setting is changed, it must be calibrated.

- Select the menu Calibrate - Expert - Cal pot. The display shows Set gear (1).
- Turn the spindle shaft (2) cw to end position and press OK. Turn ccw to the end and press OK.
- Unmesh the potentiometer (3) and turn it according to display until OK is shown. Press OK.

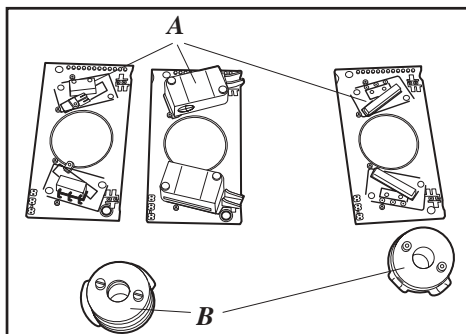


Transmitter boards


The equipment for transmitter feedback consists of a circuit board A, cam assembly B and screws.

The circuit board exists in four:

- with mechanical switches, SPDT
- with namur sensors, DIN 19234
- with proximity switches
- with feedback transmitter only



Transmitter board installation

 **Caution! Turn off the power and air supply starting the installation.**

Important for D3 Intrinsically safe units: Transmitter boards NOT for on site mounting by customer. FM, CSA and ATEX certificate only valid when transmitter board is mounted by manufacturer.

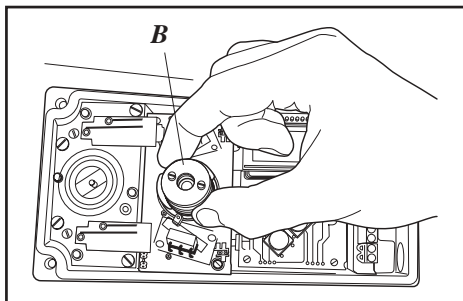
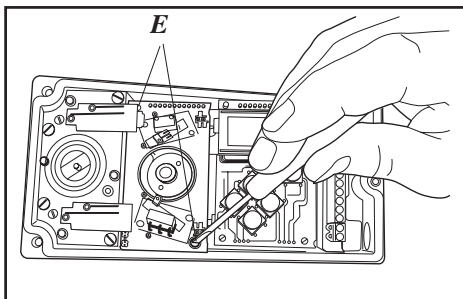
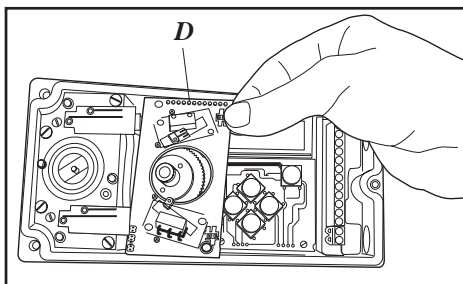
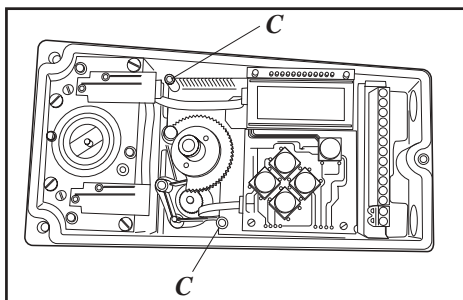
- Remove the cover, indicator and inner cover according to the description on page 37.

- Check that both spacers **C** are installed.

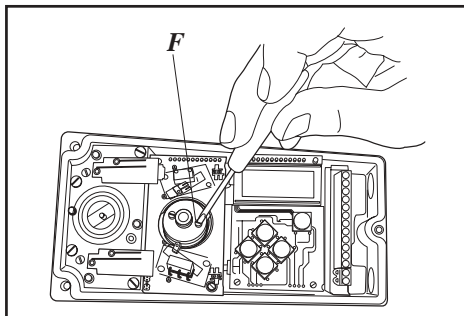
- Carefully mount the circuit board in its position. The pins **D** should fit in the connector and the positioners motherboard. Make sure that the feed back PC board is properly connected.

- Secure the circuit board with the enclosed screws **E**.

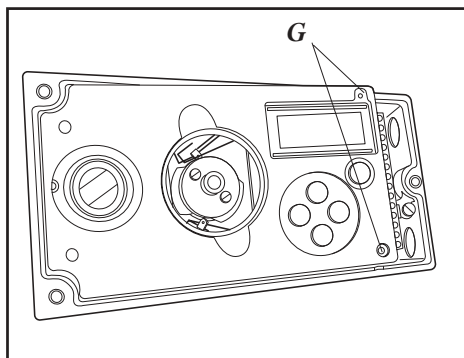
- Install the cam assembly **B** on the shaft and push it down to its position. If the board has microswitches, be careful not to damage the levers.



- Tighten the screws **F**, on the cam assembly. Do not tighten the screws to hard. The cams should be able to move in relation to each other.

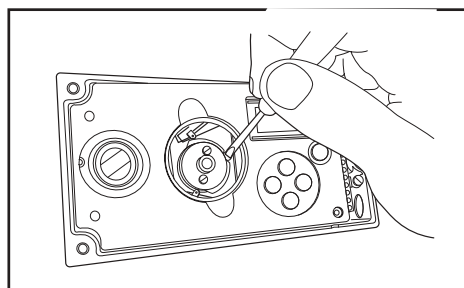


- Install the inner cover with the two screws, **G**.



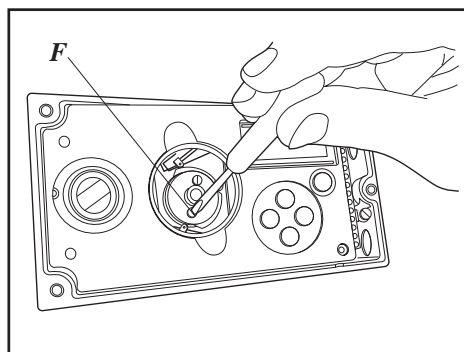
- Connect the wiring for the transmitter feedback on the terminal block, according to the drawing on next page.

- Adjust the position where the switches/sensors should be affected, by turning the cams with a screwdriver.



- Tighten the cam assembly screws **F** when the cams are correctly adjusted.

- Install the indicator and cover. To calibrate the feedback transmitter, see drawing on next page.



Microswitch kit D3-AS38M

Transmitter card

Non-sensorkit D3-AS38N

Transmitter card

Feedback kit D3-AS38D

Transmitter card

Mechanical & Proximity switches

Non-sens sensors

Switch 1

Switch 2

IMPORTANT!

- For D3 IS units (intrinsically Safe):
 - Transmitter card NIT for on site mounting by customer.
 - FM, CSA and ATEX certificates only valid when transmitter card is mounted by manufacturer.

Calibration of the 4-20 mA transmitter

Go to menu shown in diagram, click reading. Adjust output signal using UP or DOWN key until meter I reads 4.00 mA. Repeat the above for EO mA.

Connect a mA meter I to terminal II & I2

MECHANICAL SWITCHES

SPDT	Sub Measure
3A	125V AC / 24V DC *
Rating	
NAMUR SENSORS	Proximity DIN 19234 NAMUR
Load current	≤ 100 mA
Load voltage	24V DC
Hysteresis	±2%
Temperature	-50°C to 65°C (-4°F to 150°F)
PROXIMITY SWITCHES	SPDT
Rating	5V/250mA/24V DC/25V DC *
Denoting the output	24V DC
Denoting the input	24V DC
Contact resistance	0.1 Ohm
Mechanical/Electrical life	1000000/10000000 operations

4-20 mA TRANSMITTER

Supply	9-28V DC
Output	4-20 mA
Resolution	0.1 mA
Linearity	±0.1%
Output current limit	30 mA IEC
Load impedance	600 Ohm @ 24V DC

* Switch rating limited to 100 mA/24V DC/25V AC. For 24 units with connection board D3-AS38D NIT.

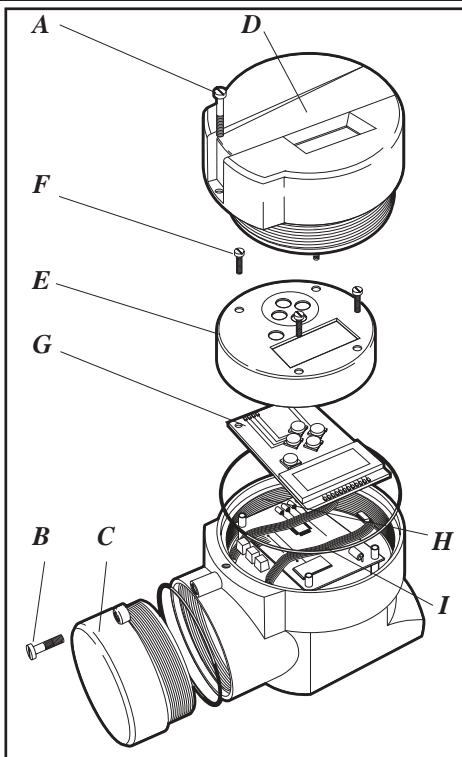
For more information see manual chapter 9, Transmitter boards.

Disassembling PMV D3 Ex

- Loosen the screws **A** and **B** and remove the caps **C** and **D**.

- Remove the inner display cover **E** by loosening the four screws **F**.

- Carefully remove the display board and loosen the connections **H** and **I**.

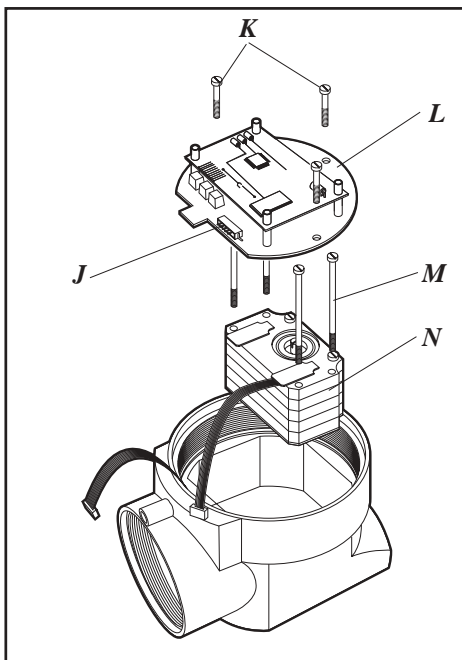


- Release the wide cable from the connector **J** on the terminal board.

- Loosen the three screws **K**.

- Remove the circuit board package **L**, consisting of terminal and processor board.

- Remove the four screws **M** and lift the block **N**.



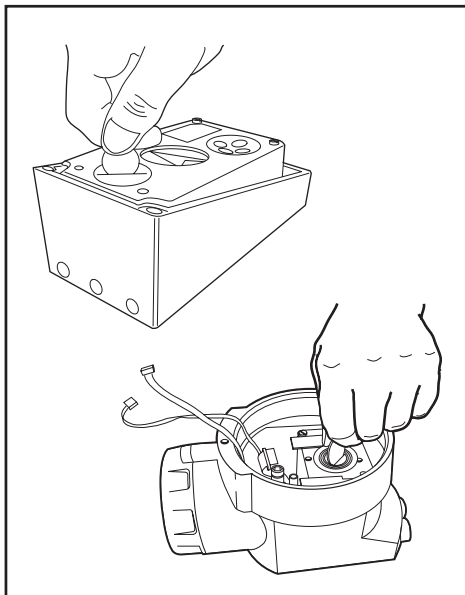
Filter change, D3 and D3 Ex




Turn off the compressed air supply before starting any work. Otherwise the filter can be uncontrollably blown out of the positioner by the air pressure, which can be dangerous.

- Remove the filter cap using a coin of suitable size.

Note! Do not use a screwdriver. The filter cap might crack and cause air leakage.



Converting for remote control

 **Disconnect or switch off the electric power supply before starting any work.**

- Remove cover and inner cover, see page 37.

- Lift off the display pcb, **D**.

- Disconnect and secure the pot cable.

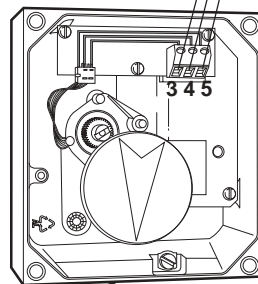
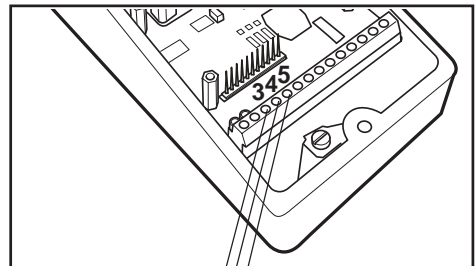
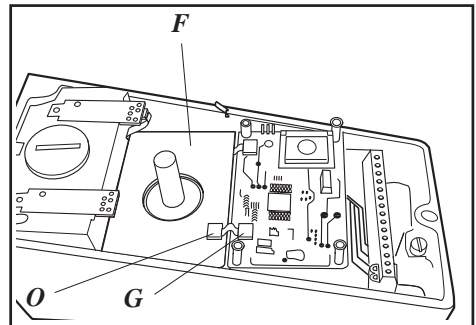
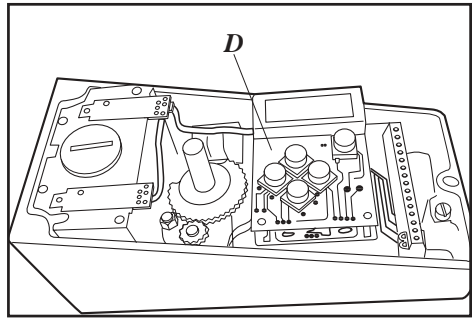
- Install transmitter board D3-AS38T , **F**.

- Install the enclosed wire between **G** and **O** on the transmitter board.

- Connect the wiring between terminals 3, 4, 5 in the D3 unit and 3, 4, 5 in the remote unit.

Use a shielded wire and ground it in the D3 unit only.

Avoid longer distance than 5 m between D3 unit and remote unit.



9. Trouble shooting

Fault symptom	Action
Change in input signal to positioner does not affect actuator position.	<ul style="list-style-type: none">• Check air supply pressure, air cleanliness, and connection between positioner and actuator.• Check input signal to positioner.• Check mounting and connections of positioner and actuator.
Change in input signal to positioner makes actuator move to its end position.	<ul style="list-style-type: none">• Check input signal.• Check mounting and connections of positioner and actuator.
Inaccurate regulation.	<ul style="list-style-type: none">• Implement auto-tuning. Check for any leaks.• Uneven air supply pressure.• Uneven input signal.• Wrong size of actuator being used.• High friction in actuator/valve package.• Excess play in actuator/valve package.• Excess play in mounting of positioner on actuator.• Dirty/humid supply air.
Slow movements, unstable regulation.	<ul style="list-style-type: none">• Implement auto-tuning.• Adjust the pressure adjusting screws.• Increase the deadband (Tuning menu).• Adjust Performance (Calibrate menu).



10. Technical data

Rotation angle	min. 30° max 100°
Stroke	5 - 130 mm (0.2" to 5.1")
Input signal	4 - 20 mA
Air supply	2 - 7 bar (30 - 87 psi) Free from oil, water and moisture. Filtered to min. 30 micron
Air delivery	400 nl/min (13.8 scfm)
Air consumption	<0.3 nl/min (0.01 scfm)
Air connections	1/4" G or NPT
Cable entry	3 x M20 or 1/ 2" NPT
Electrical connections	Screw terminals 2.5 mm ² /AWG14
Linearity	<1%
Repeatability	<0.5%
Hysteresis	<0.4%
Dead band	0.2-10% adjustable
Display	Graphic, view area 15 x 41mm (0.6 x 1.6")
UI	5 push buttons
Processor	16 bit, M 16C
CE directives	93/68EEC, 89/336/EEC, 92 /31/EEC
EMC	EN 50 081-2, EN 50 082-2
Voltage drop	<10.1V
Vibrations	<1% up to 10 g at frequency 10 - 500 Hz
Enclosure	IP66/NEMA 4X
Material	Die-cast aluminium, A2/A4 fasteners
Surface treatment	Powder epoxy
Temperatur range	-30 to +80°C (-22 to 176° F)
Weight	D3X, 1.4 kg (3 lbs). D3E, 3 kg (6.6 lbs)
Alarm output	Transistor Ri 1KΩ
Alarm Supply Voltage	8 - 28 V

Mechanical switches

Type	SPDT
Size	Sub Sub miniature
Rating	3 A/125 V AC 2 A/30 V DC

Namur sensors

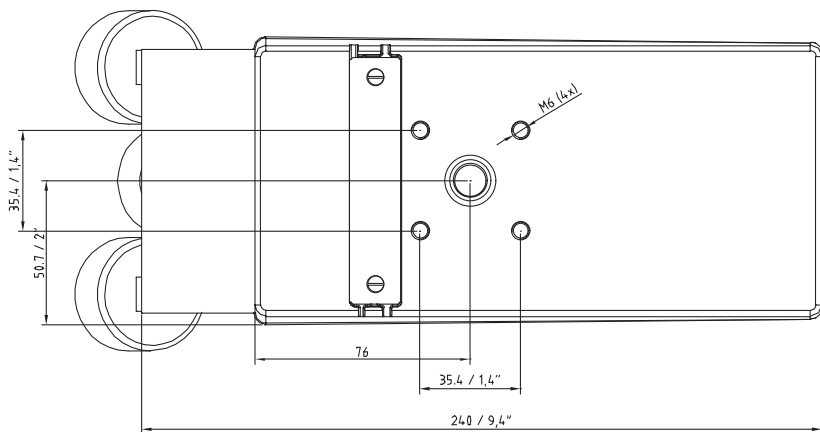
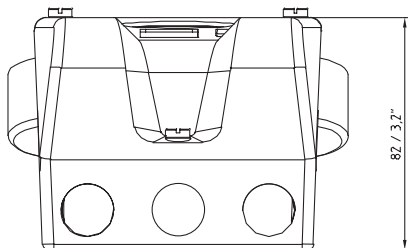
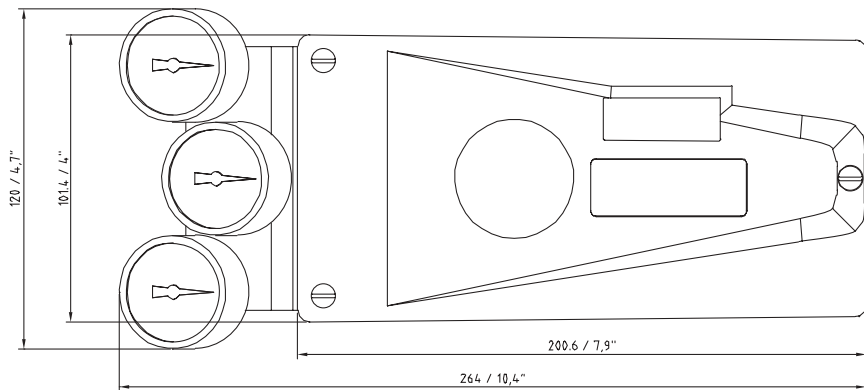
Type	Proximity DIN 19234 NAMUR
Load current	$\leq 1 \text{ mA} \leq 3 \text{ mA}$
Voltage range	5 - 25 VDC
Hysteresis	0.2 %
Temp	-20°C to 85°C (-4°F to 185°F)

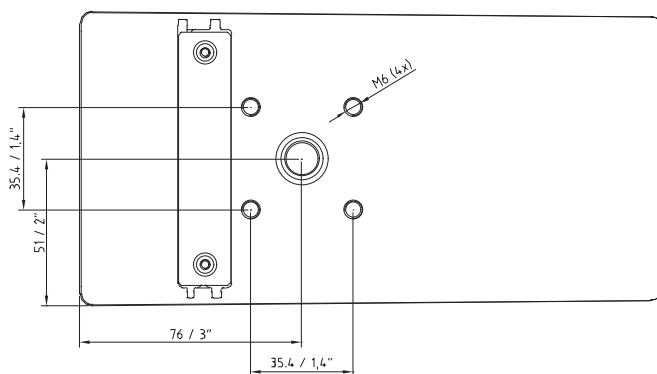
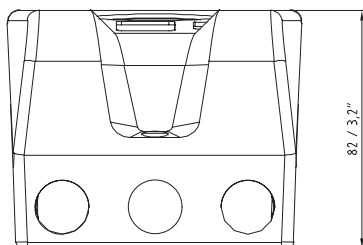
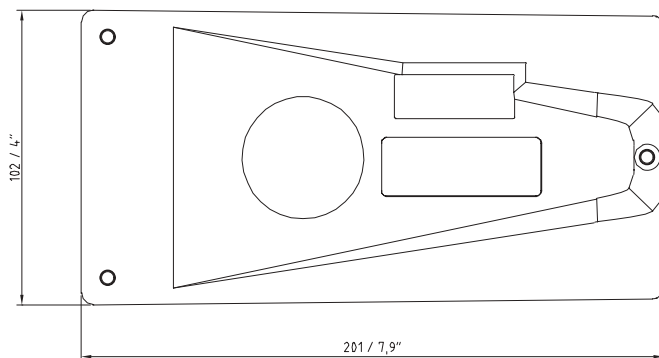
Proximity switches

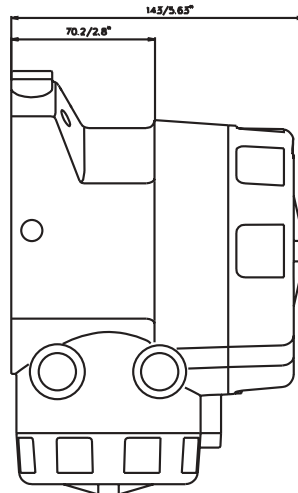
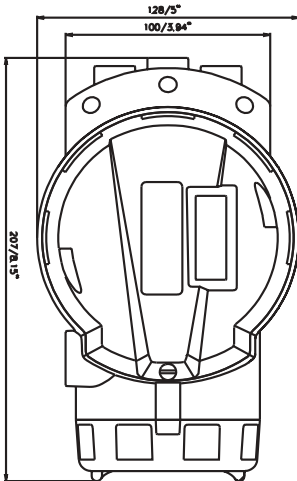
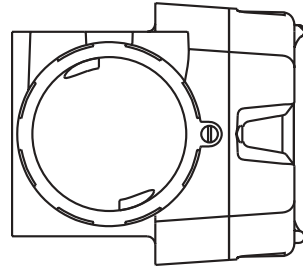
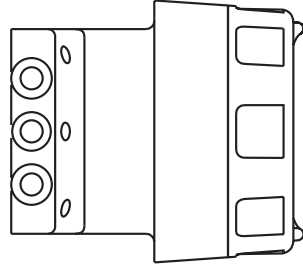
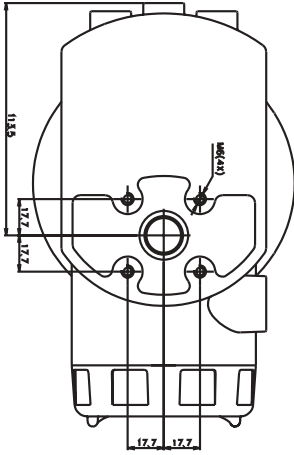
Type	SPDT
Rating	5 W/250 mA/30 V DC/125 V AC
Operating time	0.7 ms
Breakdown voltage	200 VDC
Contact resistance	0.1 Ω
Mechanical/electrical life	$>50 \times 10^6$ operations

4 - 20 mA transmitter

Supply	9 - 28 VDC
Output	4 - 20 mA
Resolution	0.1 %
Linearity full span	$\pm 0.5 \%$
Output current limit	30 mA DC
Load impedance	800 Ω @ 24 VDC







Certificates

FACTORY MUTUAL RESEARCH
Project ID: 3012363

D3E-DIGITAL VALVE POSITIONER

January 24, 2002

from

Palmstermas Instrument AB
Kortia Gatån 9
S-17154 Solna
Sweden

1 INTRODUCTION

1.1 Palmstermas Instrument AB (manufacturer) requested Factory Mutual Approval of their Digital Valve Positioner, Series D3E as explosionproof for Class I, Division 1, Groups B, C & D; T6 Ta = 65°C / T5 Ta = 80°C, dust-ignitionproof for Class II/III, Division 1, Groups E, F & G; T6 Ta = 65°C / T5 Ta = 80°C, indoor and outdoor (Type 4X) hazardous (classified) locations. The D3E Digital Valve Positioner is designed to control modulating valves.

1.2 This Report may be freely reproduced only in its entirety and without modification.

1.3 **Standards:** Approval of the D3E Digital Valve Positioner is based on the applicable requirements of the following standards:

Title	Class Number	Date
Electrical Equipment for Use in Hazardous (Classified) Locations General Requirements.	FM 3600	1998
Explosionproof Electrical Equipment for Hazardous (Classified) Locations	FM 3615	1989
Electrical and Electronic Test, Measuring and Process Control Equipment	3810 Including Supplement #1	March 1989 July 1995
Enclosures for Electrical Equipment.	ANSI/NEMA 250	1991

1.4 As described in this report, the design and construction of the D3E Digital Valve Positioner provides for the required degree of protection against electrical shock, fire, and injury for hazardous (classified) locations.

1.5 **Listing:** The product will appear in the Approval Guide-Electrical Equipment in Chapter 2 as follows:

D3EaU/c23f64Z/XX. Digital Valve Positioner.

XP/UB/DT6 T3 = 65°C/T5 T3 = 80°C; DP/II-III/IEFG/T6 Ta = 65°C/T5 Ta = 80°C; Typ- 4X

a = G or N. Air Pipe connection thread type.

c = S, D, C or R. Function.

fgl) = PVA or PVB. Cover and Indicator.

j) = 4, 3, P or F. Input signal protocol.

Page 1 of 4



Certificate of Compliance

Certificate: 1278854

Master Contract: 176847

Project: 1278854

Date Issued: February 7, 2002

Issued to:

Palmstermas Instrument AB

Kortia Gatån 9

Solna, 171 54

SWEDEN

Attention: Mr. Mats Ragnarsson

The products listed below are eligible to bear the CSA Mark shown



Issued by:

R. Wilksh

Authorized by:

Mark Adams

Operation Manager

PRODUCTS

CLASS 2258 02 -PROCESS CONTROL EQUIPMENT - For Hazardous Locations

Class I, Div. 1, Groups C and D; Class II, Div. 1, Groups E, F and G; Class III, Div. 1; Encl. Type 4X;

Model D3E xUx23PVBZAX Electronic-Pneumatic Valve Positioner; input rated 23 Vdc, 24 mA max; Temp. Code T6 @ Max Ambient 65 Deg C; Temp. Code T5 @ Max Ambient 81 Deg C.

Note: the 'x's in the D3E model code denote minor mechanical and electrical variations.

#	REVISING	DATE	ISSUE	CODE
1	Values and pin numbers adjusted and D3-38 option	020301	DPT	
2	Profibus added	020524	LRN	
3	Modified values \odot and LJ	020620	AE	

Transmitter Board Options

Remove cover and interconnect (see manual), visually verify transmitter board option.

<p>Mechanical or Proximity switches Normally Open Pin 3.5: Switch 1 Pin 6.8: Switch 2</p>	<p>Mechanical or Proximity switches Normally Closed Pin 4.5: Switch 1 Pin 7.8: Switch 2</p>	<p>AUX input 4-20 mA Pin 9,10</p>
<p>Profibus PA input signal Pin 1,2</p>	<p>Mechanical or Proximity switches Normally Closed Pin 4.5: Switch 1 Pin 7.8: Switch 2</p>	<p>4-20 mA Output Pin 11,12</p>
<p>4-20mA input signal Pin 1,2</p>	<p>Mechanical or Proximity switches Normally Closed Pin 4.5: Switch 1 Pin 7.8: Switch 2</p>	<p>Alarm Pin 13,14</p>

DETAIL		DRAWING		MATERIAL		DIMENSION		ANAL.	
NO.	DESCRIPTION	QTY	UNIT	REF.	QTY	UNIT	REF.	QTY	UNIT
1	PMV POSITIONER D3	1	PCB						

	PMV Positioner D3 PALMSTERNAS INSTRUMENT AB KALMAR GATAN 9 SE-171 54 SOLNA - TEL: +46 (0)8 505 106 00 FAX: +46 (0)8 505 106 01	Control Drawing PMV POSITIONER D3 1:0829 D3-70
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Page 1 of 1

Page 1 of 1

CERTIFICATE OF CONFORMITY

Nemko Nr. Ex 01E151

This Certificate is issued for the following electrical equipment, intended for use in potentially explosive atmospheres:

Apparatus or system: **Valve Positioner**

Certified type: **D3/83**

Manufactured by: **Palmsterna Instrument AB**
Korta gatan 9
S-17154 Solna
Sweden

Applicant, on behalf of the manufacturer: **The Manufacturer**

Fax: +47 22 96 05 50

Telephone: +47 22 96 03 50

Office address: Causelidalein, 30

Oslo, 2001-07-17

Roalf Hrolstad
Head of Section for Ex-equipment

Arne Horstman
Certification Engineer

Enterprise number: NO 344352435

1. **CERTIFICATE OF CONFORMITY**
2. **Nemko Certificate reference:**
3. This Certificate is issued for the following electrical equipment, intended for use in potentially explosive atmospheres:
4. Apparatus or system:
5. Certified type:
6. Manufactured by:
7. Applicant, on behalf of the manufacturer:
8. This electrical apparatus or system and any acceptable variations thereto are specified in the Annex and possible Supplement(s) to this Certificate and in the descriptive documents therein referred to.
9. Nemko, being an Approved Certification Body in accordance with Article 14 of the Council Directive of the European Communities of 18 December 1975 (75/101/EEC), confirms that the apparatus has been found to comply with the following harmonized European Standards:
CENELEC EN 50014:1987 +A1, A2: 1989
CENELEC EN 50020: 1984
10. and has successfully met the type verification and test requirements of these standards.
11. A confidential test report has been completed on those verifications and tests.
12. Test Report: **200012233**
13. The code for the electrical apparatus is: **EX ia IIC T4 Ta: 80°C**
14. By marking this electrical apparatus, the manufacturer attests on his own responsibility that this electrical apparatus complies with the descriptive documents referred to in the Annex to this Certificate and has satisfied routine verifications and tests required in the harmonized European Standards referred to in point 6 above.
15. This electrical apparatus may be marked with the distinctive community mark as printed on this certificate, and specified in Annex I of the Council's Directive of 16 January 1984 (84/47/EEC).
16. Total number of pages in the Annex to this Certificate: **3**
17. This Certificate may only be reproduced in its entirety and without changing.


1. CERTIFICATE OF CONFORMITY

2. Nemko Certificate reference: **Nemko Nr. Ex 01E385**
3. This Certificate is issued for the following electrical equipment, intended for use in potentially explosive atmospheres:

Apparatus or system: **Valve Positioner**

Certified type: **D3E**

4. Manufactured by:
- Felinsystems Instrument AB**
 Kungälvsvägen 9
 S-171 54 Solna
 Sweden

Applicant, on behalf of the manufacturer: **The Manufacturer**

5. This electrical apparatus or system and any acceptable variations thereto are specified in the Annex and possible Supplement(s) to this Certificate and in the descriptive documents therein referred to.
6. Nemko, being an Approved Certification Body in accordance with Article 14 of the Council Directive of the European Communities of 18. December 1975(76/117/EEC), confirms that the apparatus has been found to comply with the following harmonized European Standards:
- EN 50418, EN 50411, A2, 1999**
GENELEC EN 50018, 2000

and has successfully met the type verification and test requirements of these standards.

A confidential test report has been completed on these verifications and tests.

Test Report:

200039119

7. The code for the electrical apparatus is: **EEEx d IIB + H₂ T6/T5 Ta: 65°C/80°C**
8. By marking the supplied electrical apparatus, the manufacturer attests on his own responsibility that the electrical apparatus complies with the descriptive documents referred to in the Annex to this Certificate and that the apparatus has passed the verifications and tests required in the harmonized European Standards referred to in point 6 above.
9. This electrical apparatus may be marked with the distinctive community mark as printed on this certificate, and specified in Annex II of the Council's Directive of 16. January 1984, (84/47/EEC).

Total number of pages in the Annex to this Certificate: **2**

This Certificate may only be reproduced in its entirety and without change.

Oslo, 2001-09-26

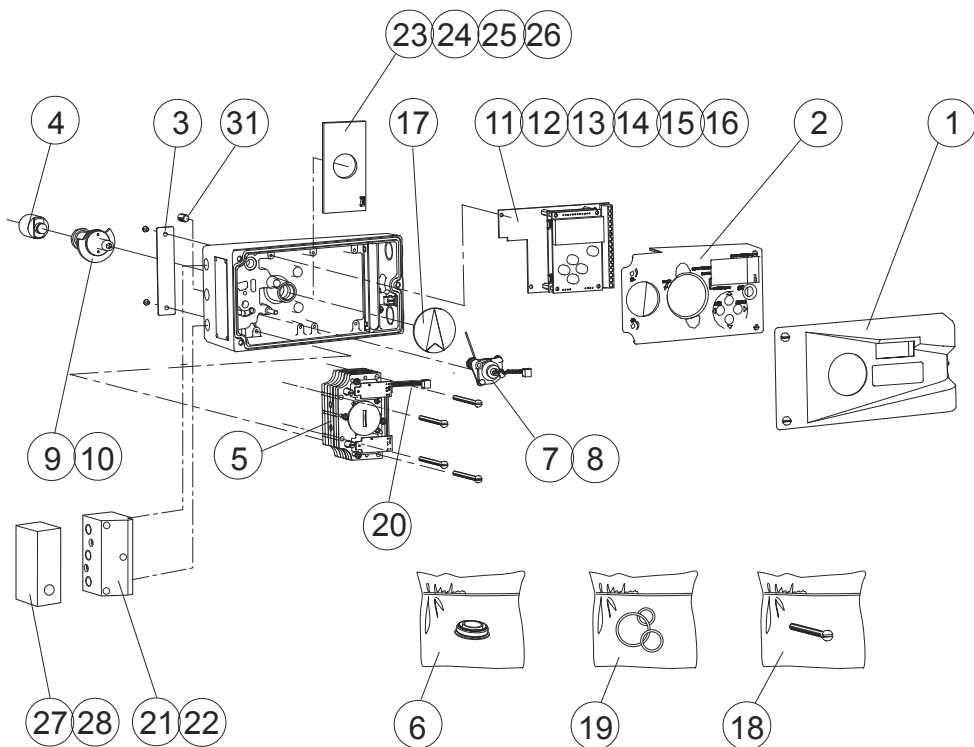
Rolf Heie

Rolf Heie
 Head of Section for Ex-equipment

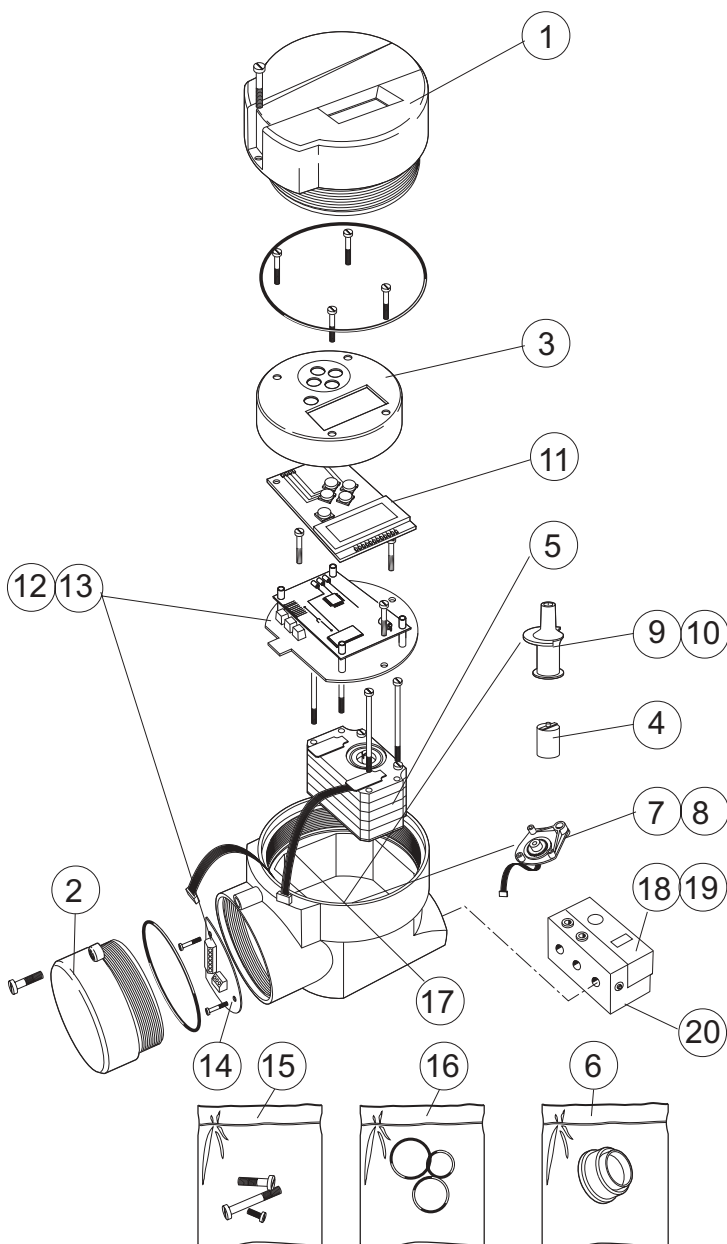
Arvid Holmberg

Arvid Holmberg
 Certification Engineer

Nemko AS, Office address, Telephone, Fax
 P.O. Box 73, Blindern, +47 22 95 03 30, 47 22 95 55 50
 N-0314 Oslo, Norway Enterprise number: NO 944592430



Pos	Part no.	Description
1	D3-SP6	Cover incl.screws
2	D3-SP11	Internal cover incl.screws
3	P3-SP13	Cover plate incl. screws
4	P5-Sxx	Spindle adapter
5	D3-SP1	Block compl incl. cable, rubber seal, filter-plug
6	D3-SP9	Filter-plug incl. O-ring, filter
7	D3-SP8	Potentiometer compl incl. spring, holder, cable
8	D3-SP8-270	Potentiometer compl incl. spring, holder, cable, 270deg
9	D3-SP20	Shaft compl incl. gearwheel, friction clutch
10	D3-SP20-270	Shaft compl.incl. gearwheel, friction clutch, 270deg
11	D3-SP37	Pcb display assy
12	D3-SP35X	PCBs (terminal and processor)
13	D3-SP35H	PCBs (terminal and processor) HART
14	D3-SP35I	PCBs (terminal and processor) intrinsically safe
15	D3-SP35IH	PCBs (terminal and processor)intrinsically safe, HART
16	D3-SP35P	PCBs (terminal and processor) Profibus
17	P48A	Arrow pointer
18	D3-SP/SCREW	Kit, bag with screws
19	D3-SP/SEAL	Kit, bag with O-rings, seals
20	D3-SP42	Cables and PC boards to pneumatic block
21	D3-SP34G	Gaugeblock G, complete
22	D3-SP34N	Gaugeblock N, complete
23	D3-AS38M	Transmitter board, Mechanical switches, assy
24	D3-AS38N	Transmitter board, Namur sensors, assy
25	D3-AS38P	Transmitter board, Proximity switches, assy
26	D3-AS38T	Transmitter board 4-20, assy
27	D3-SP46G	Dumpvalve valve assy ÓGÓ for single acting
28	D3-SP46N	Dumpvalve valve assy ÓNÓ for single acting
30	D3-SP6WC	Cover incl. screws, Worcester
31	D3-67	Silencer



Pos	Part no.	Description
1	D3E-SP2	Front cover incl. screw
2	D3E-SP3	Terminal cover incl. screw
3	D3E-SP4	Internal cover incl. screws
4	P5-Sxx	Spindle adapter
5	D3-SP1	Block compl. incl. cable, rubber seal, filter-plug
6	D3-SP9	Filter plug incl.O-ring, filter
7	D3E-SP8	Potentiometer compl. incl. spring, holder, cable
8	D3E-SP8-270	Potentiometer compl. incl. spring, holder, cable
9	D3E-SP20	Shaft compl. incl. gearwheel, friction clutch
10	D3E-SP20-270	Shaft compl. incl. gearwheel, friction clutch
11	D3-SP37	Display pcb
12	D3E-SP35X	All PCB's, (processor, mother, terminal)
13	D3E-SP35H	All PCB's, HART, (processor, mother, terminal)
14	D3E-SP40	Terminal PCB
15	D3E-SP/Screw	Kit with screws D3E
16	D3E-SP/Seal	Kit with O-rings
17	D3E-SP42	Cable for pneumatic block, incl. 2 x PCB
18	D3E-SP46G	Dump valve G assy for D3E
19	D3E-SP46N	Dump valve NPT assy for D3E
20	D3E-SP18	Adapter complete for dump valv assy



Palmstiernas Instrument AB
Korta Gatan 9 • 171 54 Solna
Tel: +46 (0)8-555106 00 • Fax: +46 (0)8-555106 01
E-mail: info@pmv.nu • www.pmv.nu