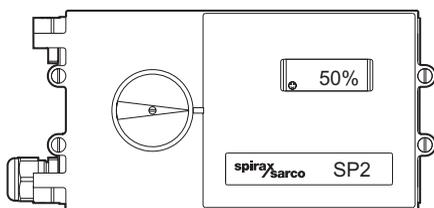


SP2

**Electropneumatic Smart Positioner  
Installation and Maintenance Instructions**

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# 1. Index

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## 2. Safety information

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Your attention is drawn to Safety Information Leaflet IM-GCM-10, as well as to any National or Regional regulations.

### 2.1 General requirements

The flawless and safe operation of the SP2 positioners is reliant on proper transportation, storage, installation and commissioning by qualified personnel, proper use and careful maintenance.

Prior to installing, using or maintaining the positioner, consideration should be given to:

- The working environment.
- Safe access.
- Lighting.
- Pipeline fluid hazards.
- Temperature.
- System isolation.
- Location.

The SP2 positioner should be mounted with sufficient space to allow opening of the hinged cover and to provide access for electrical and air connections. When fitting to an actuator, ensure that the positioner will not be exposed to an ambient temperature outside the range of -10°C to +80°C. The positioner enclosure is rated to IP65 (see BS EN 60534-1 1998).

### 2.2 Electrical safety requirements

The SP2 is a class III product which must only be powered from Safe Extra Low Voltage (SELV) sources whether by virtue of a 4 - 20 mA control signal or from a separate power supply. Similarly all signal circuits connected to an options board must operate within the confines of SELV systems. All associated wiring must be separated from other wiring containing hazardous voltages.

### 2.3 Electromagnetic compatibility

The product complies with the Electromagnetic Compatibility Directive 89/336 EEC by meeting standards EN 5008-1 (Emissions) and EN 50082-2 (Industrial Immunity). This product may be affected by interference above the limits within EN 50082-2 if:

- The product or its wiring is located near a radio transmitter. The actual separation necessary will vary according to the power of the transmitter.
- Cellular telephones or mobile radios are used within approximately one metre of the product or its wiring.
- The wiring is routed alongside power cables subject to high voltage transients or current surges.

# 3. Technical information

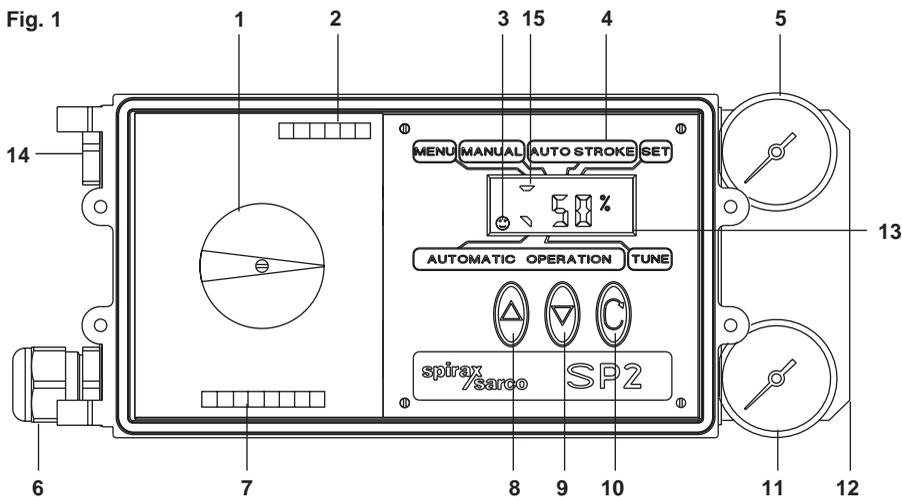
## 3.1 Description

The SP2 smart valve positioner can be loop powered from a 4 - 20 mA input signal or independently powered to provide accurate adaptive positional control of pneumatic linear actuated valves.

Precise control is maintained through valve position feedback that automatically varies the pneumatic output pressure to overcome the effects of stem friction and flow forces to maintain desired valve position. Indication of valve position is provided through a rotating travel indicator plus continuous digital display of % travel.

The SP2 includes many smart functions that can be fully programmed through menu driven software using an integral keypad and LCD alphanumeric data. Valve commissioning is simplified through an autostroke routine and display of programming status, software travel switch status, mA input signal and valve diagnostics data. The SP2 is supplied with a NAMUR standard mounting kit for attachment to yoke or pillar mounted actuators.

Fig. 1



No.	Part
1.	Travel indicator
2.	Terminal block for options board
3.	☺ indicating all OK. (! indicates an error)
4.	Main menu functions with LCD flag indication
5.	Signal pressure to actuator
6.	Gland connection for wiring Pg 13.5
7.	Terminal block for input signal and independant power supply
8.	Increase value or toggle value key
9.	Decrease value or toggle value key
10.	Enter key
11.	Supply pressure to positioner
12.	Optional pressure gauge block with gauges
13.	Display of programming data, mA input signal and % travel
14.	Spare Pg 13.5 gland connection for wiring options
15.	Status of software configured travel switches.

## 3.2 Technical data

<b>Input signal range</b>	4 - 20 mA nominal
<b>Minimum input signal (loop powered)</b>	3.6 mA
<b>Minimum air supply pressure</b>	1.0 bar g above maximum spring range pressure (Note: For the PN5120 actuator, the supply air pressure should be set at 1.5 bar g)
<b>Maximum air supply pressure</b>	6.0 bar g
<b>Air quality</b>	Air supply must be dry, oil and dust free to ISO 8573-1 class 2:3:1
<b>Output pressure</b>	0 to 100% supply pressure
<b>Stroke range</b>	10 mm to 100 mm
<b>Action</b>	Single action (spring return actuators) / fail vent
<b>Operating temperature</b>	-10°C to +80°C
<b>Maximum air flow</b>	4.5 normal m <sup>3</sup> /h at 1.4 bar g <b>or</b> 11 normal m <sup>3</sup> /h at 6 bar g
<b>Steady state air consumption</b>	Less than 0.035 normal m <sup>3</sup> /h
<b>Air connections</b>	Screwed ¼" NPT
<b>Cable gland</b>	Pg 13.5
<b>Electrical connections</b>	Spring clamp terminals for 0.2 to 1.5 mm <sup>2</sup> wire
<b>Enclosure rating</b>	IP65
<b>Characteristic</b>	Linear, Equal % (ratio 1:50) <b>or</b> Fast opening (ratio 50:1)
<b>Resolution (maximum)</b>	8000 steps
<b>Scan time</b>	10 ms
<b>Option boards</b>	Individually electrically isolated and externally powered
<b>Front cover</b>	Hinged with security tag facility
<b>Shipping weight</b>	3.2 kg

## 3.3 Materials

<b>Part</b>	<b>Material</b>	<b>Finish</b>
<b>Case and cover</b>	Die cast Aluminium	Anti-corrosive paint to RAL5010
<b>Linkage kit</b>	Stainless steel / plated steel	

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### 3.4 Programmable functions

<b>Autostroke</b>	Automatic commissioning routine
<b>Valve type</b>	2-port or 3-port
<b>% travel</b>	Selectable 0 to 100% or 100% to 0% depending on valve / actuator configuration
<b>Control action</b>	Direct or reverse action (4 - 20 or 20 - 4 mA)
<b>Travel limits</b>	Setting of minimum and maximum travel limits (valve open and valve close % travel)
<b>Displayed travel %</b>	0 - 100% displayed over mechanical travel limits or MIN-T/MAX-T adjusted settings
<b>Signal span</b>	4 - 20 mA or split ranged (minimum span 4 mA)
<b>Dead-band</b>	Positional accuracy (minimum 0.2% to max. 10% of valve travel)
<b>Tight shut-off</b>	Fully vent or inflate at preset input signals
<b>Characteristic</b>	Linear, = % or fast opening input signal to valve travel relationship
<b>Travel time</b>	Slows down valve opening or closing
<b>Travel switches</b>	Software travel switch setting (range 0 - 100%)
<b>Reset</b>	Resets all programmed values to default settings
<b>Calibrate</b>	Centering of feedback potentiometer span
<b>Input signal</b>	Visualisation of input mA signal
<b>Auto operation/vent</b>	Option of automatic operation or vent (actuator) whilst reprogramming
<b>Data logging</b>	Diagnostic record of total number of valve strokes and completed hours run time

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# 4. Options

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## 4.1 Available options

### 4.1.1 Software travel switches

Two software configured travel switches supplied on a standard options PCB.  
The travel switch 1 (TS1) is normally open and the travel switch 2 (TS2) is normally closed.

### 4.1.2 Pepperl and Fuchs mechanical travel switches

Two mechanical proximity travel switches plus standard options PCB board.

### 4.1.3 4 - 20 mA retransmit

4 - 20 mA retransmission of actual valve position (as measured in autostroke - **AUTOS**) plus standard options board having two software configured travel switches or connections for Pepperl and Fuchs mechanical proximity travel switches.

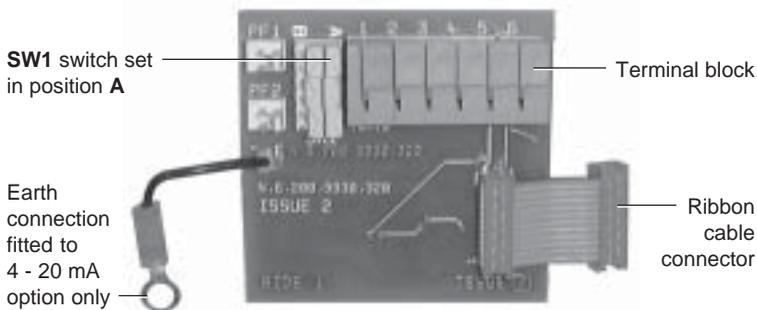
### 4.1.4 Gauge block

Manifold block complete with two pressure gauges indicating air supply and output pressure.  
Available ranges: 2 x 0 to 2 bar, 2 x 0 to 4 bar or 2 x 0 to 7 bar.

## 4.2 Fitting the options board

**4.2.1** Firstly set the yellow slide switch as follows (refer to Figure 2):

If the options PCB is used for software configured travel switches, set all elements of the yellow slide switch **SW1** to position 'A'. Prepare the ribbon cable by ensuring that the connector is at right angles to the options PCB, ready for insertion into the main PCB socket (refer to Figure 2).

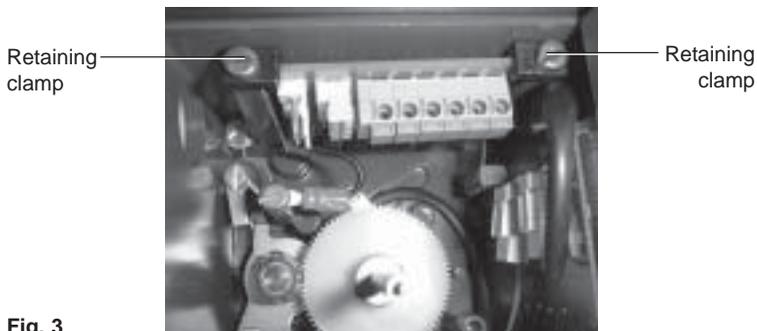


**Fig. 2 Options PCB**

**4.2.2** To gain easy access for fitting the options board remove the indicator disc domed nut, washer and travel indicator disc.

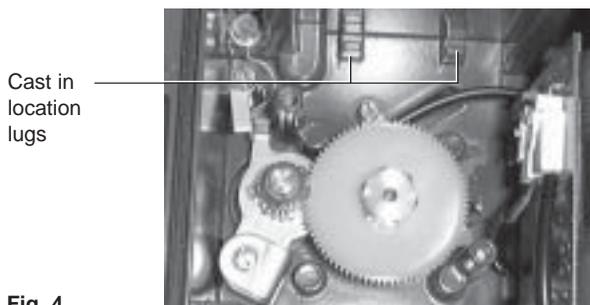
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**4.2.3** Loosen the two plastic retaining clamps within the SP2 housing (refer to Figure 3).



**Fig. 3**

**4.2.4** Locate the edge of the options PCB in the two cast-in location lugs at the base of the SP2 case (refer to Figure 4).

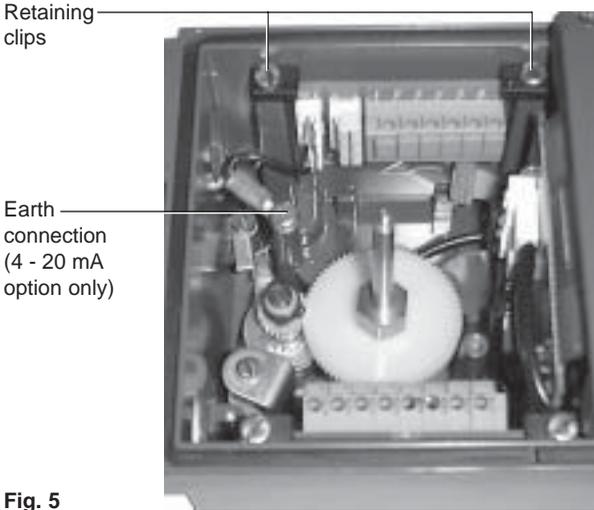


**Fig. 4**

**4.2.5** Push the connector on the ribbon cable into the socket on the main PCB.

**Note:** this should be done with light finger pressure only, **do not apply force.**

**4.2.6** Secure the options PCB in place by locating the two retaining clips and tighten the fixing screws. **Note:** with the retaining clips secured, there will be some float of the PCB (refer to Figure 5).



**Fig. 5**

**4.2.7** Options boards having 4 - 20 mA retransmit are provided with an earth connection. Using the M4 screw, secure the earth wire to adjacent pillar removing any excess paint that may be present. The same pillar should be used for both the 4 20 mA PCB and Pepperl and Fuchs switch earth connections if necessary.

**4.2.8** Make electrical connections to terminals as required. Refer to Section 6 'Electrical connection' for details of wiring connections.

**4.2.9** Refit the travel indicator disc, washer and domed nut.

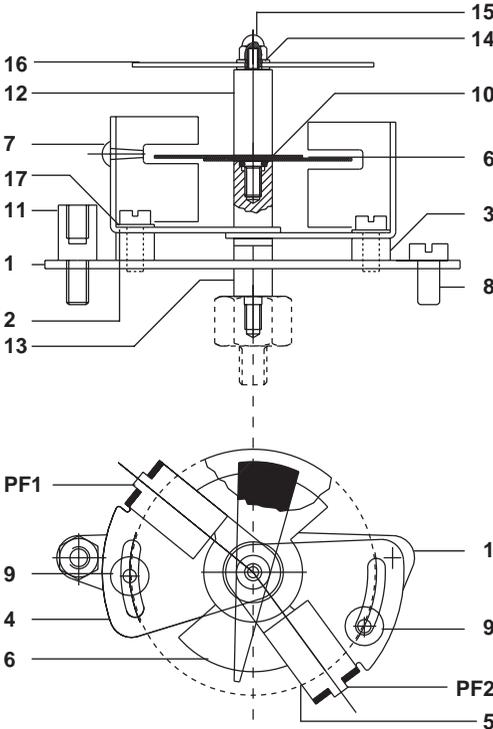
### 4.3 Fitting Pepperl and Fuchs mechanical proximity switches

4.3.1 Fitting of Pepperl and Fuchs switch assembly. Refer to Figure 6 for components and Figure 7 for general assembly.



Fig. 6 Pepperl and Fuchs switch assembly kit components

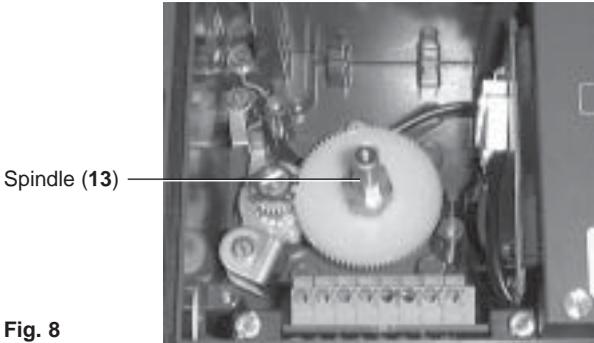
4.3.2 Prepare the assembly kit by unscrewing the extension spindle (12) and remove the two switch vanes (6). Remove the spindle (13) ensuring that the 'O' ring (10) remains in place.



No.	Description	Quantity
1	Support plate	1
2	Spacer	1
3	Spacer	1
4	Adjustment plate	2
5	Switch sensor	2
6	Switch vane	2
7	Fixings	2
8	Screws (M4 x 8)	1
9	Adjustment screw	2
10	'O' ring	1
11	Earth adaptor screw	1
12	Extension spindle	1
13	Spindle	1
14	Washer	2
15	Domed nut	1
16	Indicator disc	1
17	Washer	2

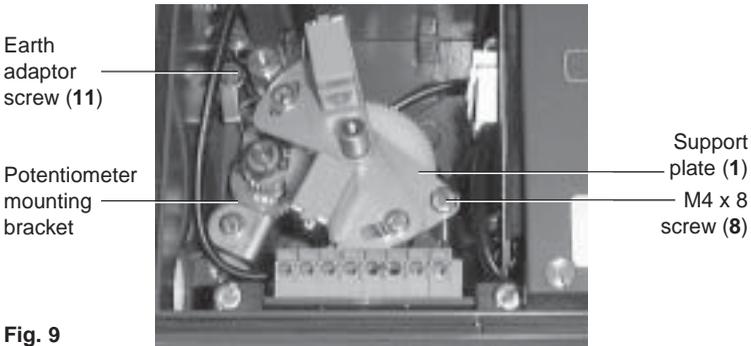
Fig. 7 General assembly

- 4.3.3 Ensure that the electrical and pneumatic supplies to the positioners are isolated. To fit the Pepperl and Fuchs switches it is recommended that the SP2 positioner is removed from the valve / actuator assembly and fitting is carried out on a clean flat surface.
- 4.3.4 Prepare the SP2 by removing the indicator disc domed nut, washers, indicator disc and spindle. Remove existing M4 x 8 screw from the SP2 earth pillar.
- 4.3.5 Screw new spindle (13) onto existing central pin (refer to Figure 8) using a 7 mm spanner.



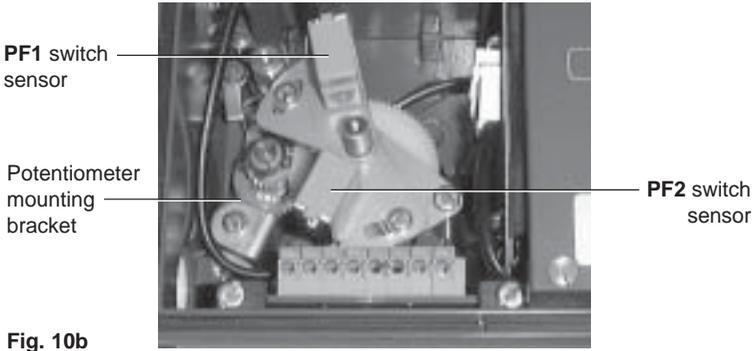
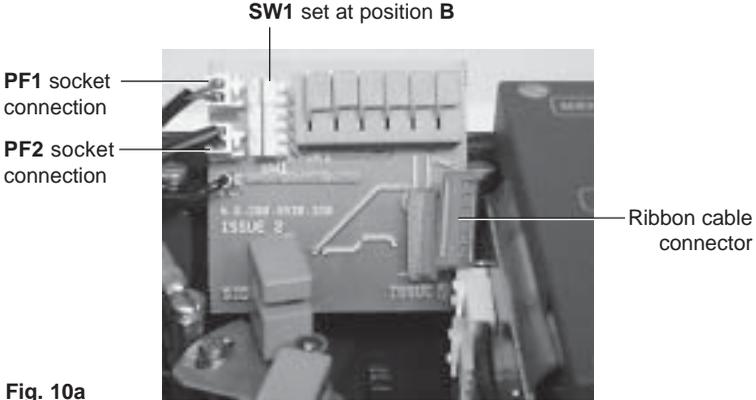
**Fig. 8**

- 4.3.6 Fit the Pepperl and Fuchs support plate (1) aligning central holes to pass over spindle (13). **Note:** the support plate will only locate in one orientation.
- 4.3.7 Use earth adaptor screw (11) and M4 x 8 screw (8) and tighten to locate the support plate (1) (refer to Figure 9).



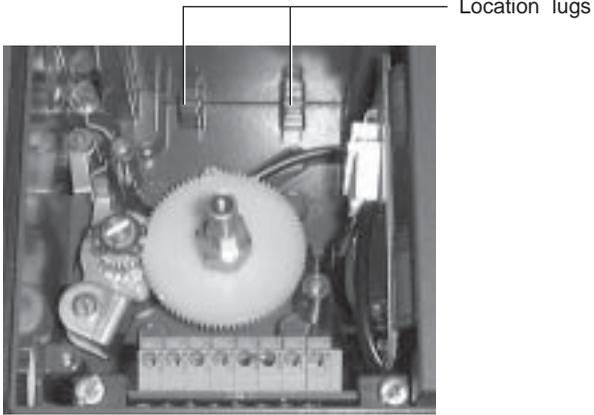
**Fig. 9**

**4.3.8** It is now necessary to fit the options board. Firstly ensure all elements of the yellow changeover switch **SW1** are set at position 'B'. Prepare the ribbon cable by ensuring that the connector is at right angles to the options PCB, ready for insertion into the main PCB socket, (only required with 4 - 20 mA retransmit option). Plug the Pepperl and Fuchs switch sockets onto the options board connectors. The **PF1** socket should be engaged in the **PF1** connector. The **PF2** socket should be connected to the **PF2** connector (refer to Figure 10a).



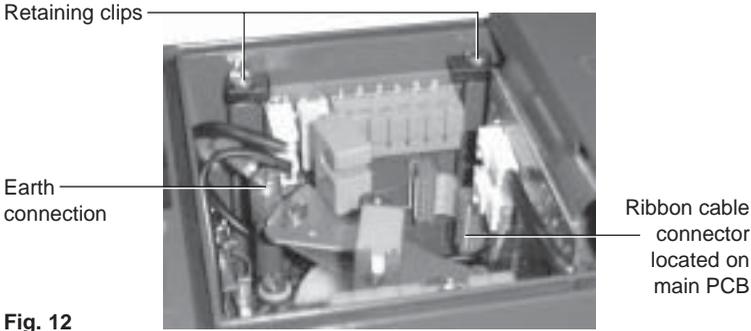
**4.3.9** Secure the **PF2** switch connector wire behind the potentiometer mounting bracket (refer to Figure 10b).

**4.3.10** Loosen the option board plastic retaining clamps. Now locate the options board within the SP2 enclosure ensuring it is correctly located within the lugs at the bottom of the housing (refer to Figure 11). **Note:** the options board should be located with terminal connectors at the top.



**Fig. 11**

**4.3.11** The earth cable should now be reconnected to the earth adaptor (11) and secured using the original M4 x 8 screw (refer to Figure 12). When correctly located, the plastic retaining clips can be tightened to secure the options board in place. **Note:** With the retaining clips secured there will be some float of the PCB.

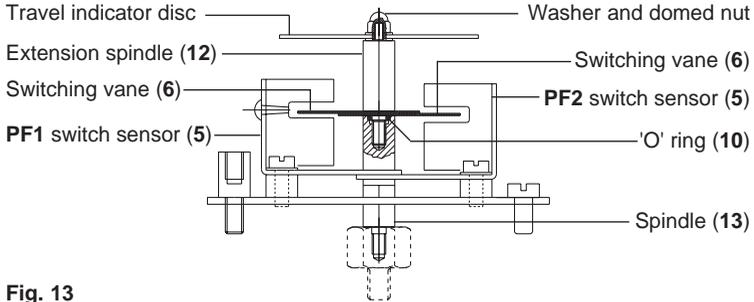


**Fig. 12**

**4.3.12** Prepare the ribbon cable by ensuring it is at right angles to the options PCB. Engage the ribbon connector onto the main PCB socket permanently pushing in place to locate. This should be done with light finger pressure only (refer to Figure 12) do not apply force, (only required with 4 - 20 mA retransmit and software switch options).

**4.3.13** Fit switching vanes (6) to the spindle (13) and ensure 'O' ring (10) is correctly located within the end of the spindle. Now fit the extension spindle (12) and finger tighten to secure in position.

It is essential that the switching vanes are correctly located within the slots of the **PF1** and **PF2** switches. The top vane should be positioned within **PF1** switch sensor (5) and the bottom vane positioned within the **PF2** switch sensor (5) to ensure they are positioned evenly within the slots (refer to Figure 13).



**Fig. 13**

**4.3.14** It is now necessary to set the switching action. Note, adjustment of the switch vanes provides coarse setting whilst movement of the adjustment plates (4) provides fine setting.

**For setting the Pepperl and Fuchs switches you must now mount the SP2 positioner onto the valve / actuator assembly and recommission the SP2 positioner as described in Section 5, 'Installation'.**

**Please note: if the SP2 positioners are supplied with Pepperl and Fuchs switches already fitted, they will be supplied unset.**

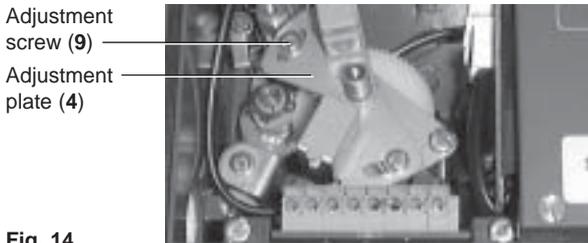
## 4.4 Setting Pepperl and Fuchs switches

**Note:** The **PF1** or **PF2** switch will open when the switching vane is 50% or more within the switch sensor.

### 4.4.1 Coarse setting of the PF1 switch

Locate the adjustment plate (4) at its mid position and tighten the adjustment screws (9) (refer to Figure 14).

Position the valve at the desired switching position for **PF1** switch. The valve can be positioned using manual control (M-CTL) in conjunction with the digital display of percentage travel, or alternatively using the valve travel indicators located on the actuator pillar / yoke. Coarsely set the switching vane within the **PF1** switch sensor (5) at the desired switching position. Fine adjustment will be made later.



**Fig. 14**

#### 4.4.2 Coarse setting of the PF2 switch

Position the valve at the desired switching position for **PF2**. Coarsely set the second switching vane within **PF2** switch sensor (5) as previously described whilst maintaining the previous setting of the **PF1** switching vane. Tighten the extension spindle (12).

#### 4.4.3 Fine adjustment of the PF1 and PF2 switch

To achieve fine adjustment it is necessary to have some form of switching indicator device across terminals 1 and 2 for **PF1** and terminals 3 and 4 for **PF2**. Adjust the valve travel position of **PF1** switch sensor (5). If fine adjustment is required it can be achieved by loosening the adjustment screw (9) and sliding the adjustment plate (4) in either direction to achieve the desired switching position. Tighten the adjustment screw (9) to secure the setting. This exercise should be repeated for the **PF2** switch whilst maintaining the previous setting position of switch **PF1** (refer to Figure 7).

4.4.4 On completion of setting **PF1** and **PF2** switches refit the travel indicator disc, washer and domed nut (refer to Figure 15).

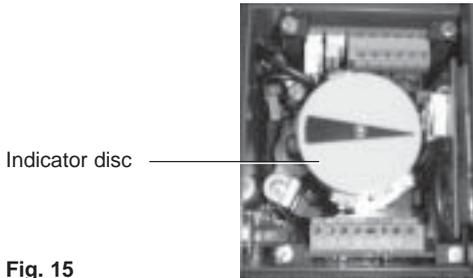


Fig. 15

### 4.5 Pressure gauge block

An optional pressure gauge block (Figure 16) can be fitted onto the SP2 positioner which includes two pressure gauges indicating air supply pressure and output air signal pressure to the actuator. The pressure gauge block can be retrospectively fitted using 2 off M5 Allen screws. Ensure that the gauge block air connection 'O' rings are correctly located before tightening.

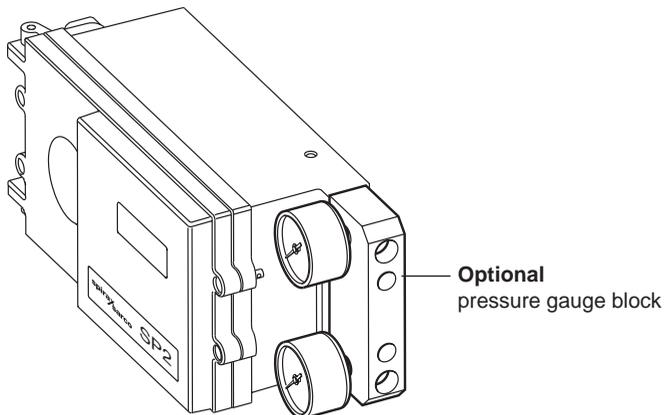


Fig. 16

# 5. Installation

## 5.1 Mounting the SP2 positioner

**Preliminary check of valve and actuator assembly** - A preliminary check should be carried out on the valve and actuator assembly prior to mounting and commissioning the SP2 positioner to confirm smooth movement of the stem. This can be performed by providing an air supply directly from a filter/regulator to the actuator. The air supply pressure should be gradually increased to progressively move the stem through its full travel. Any stiction or jerky movement of the stem should be investigated prior to commissioning the SP2.

**5.1.1** The SP2 positioner is supplied with a fixing kit for mounting to valve / actuators conforming to NAMUR standards. To conform to safety directives the fixing kit includes a finger guard protection plate which must be fitted prior to putting the valve into automatic operation. All parts supplied in the fixing kit are shown in Fig. 25. The general assembly of the fixing kit is shown in Fig. 25.

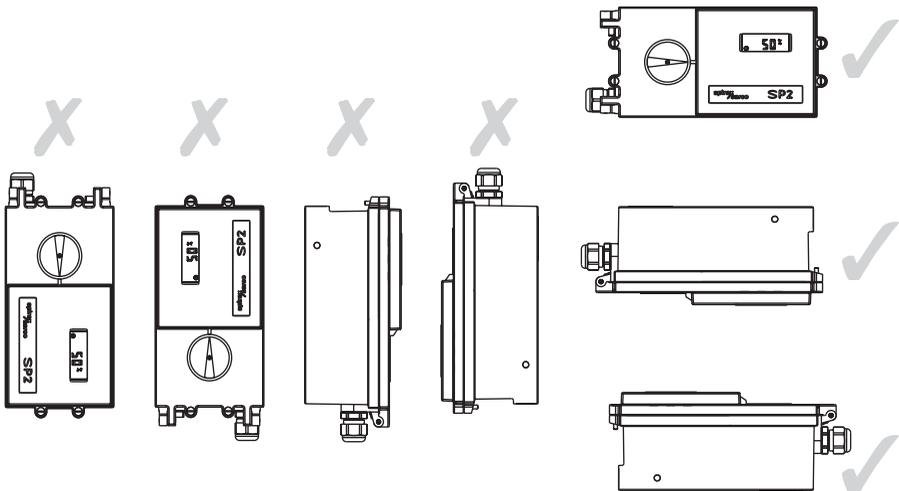
**5.1.2** The SP2 should be mounted on a valve installed vertically above or below a horizontal pipeline. If the valve is installed hanging below the pipeline the SP2 should be mounted so that the LCD displayed data is in the correct orientation to be read easily.

**Note:** Control Action (CTRL) will be reversed (see Section 9.5.2 for further details).

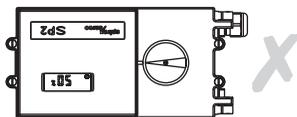
The SP2 can also be mounted face up or down. This facilitates mounting on a valve installed in a vertical pipeline providing the actuator yoke/pillars are attached to the valve in a horizontal plane.

**The SP2 will not work if mounted on its side.**

The following illustrations provide further guidance on SP2 mounting.



The SP2 should be installed in such a way to allow good visibility of the rotating travel indicator and LCD displayed data. Sufficient space should be available to allow the hinged cover to be fully opened to provide access to the operating keys and electrical connections.



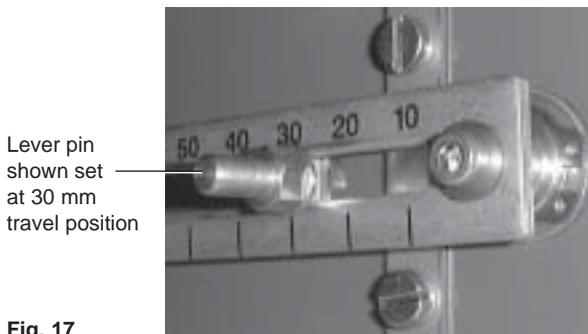
**5.1.3** The SP2 should be installed in a location that will not exceed its ambient temperature limits of -10°C minimum and +80°C maximum and enclosure rating of IP65

**5.1.4** Before fitting and commissioning the SP2 positioner ensure that the valve and actuator are correctly assembled. Refer to the valve and actuator Installation and Maintenance Instructions for details. To correctly assemble the positioner you will need to know the valve travel. This information is given on the valve name-plate.

**5.1.5** The positioner feedback arm is graduated in mm valve travel. Locate and fix the lever pin (6, 7 and 8) on the feedback arm at the equivalent valve travel position (refer to Figs. 17 and 18).

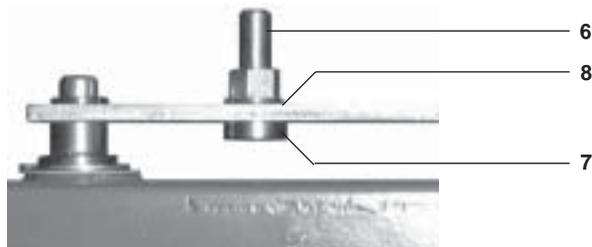
**Caution:** Incorrect setting of the lever pin may cause excessive rotation of the feedback arm with the possibility of mechanical damage being caused. It is therefore important that the lever pin is not set 'less than' the valve travel stated on the valve nameplate.

To help prevent excessive rotation of the feedback arm, a travel limiter is fitted to the SP2.

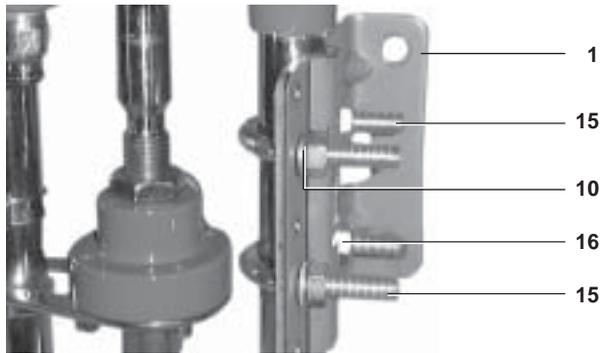


**Fig. 17**

**5.1.6** Ensure that the square face of the lever pin nut (7) is correctly located in the feedback arm slot. Attach the connection lever pin (6) and M5 washer (8) and tighten to 3.5 - 4.0 N m (refer to Figure 18).

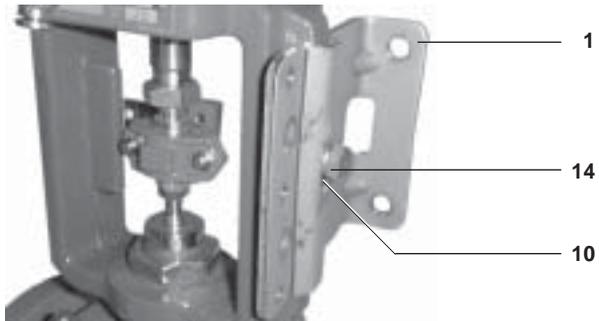


**Fig. 18**



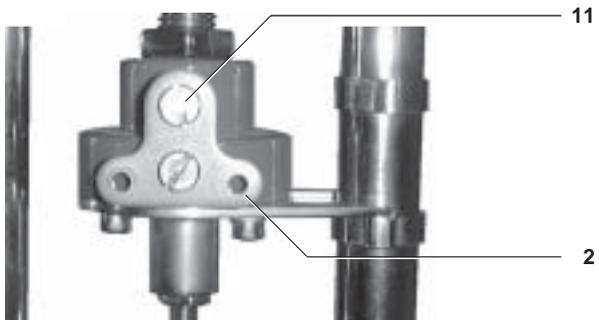
**Fig. 19**

- 5.1.7** Loosely attach the mounting plate (1) to the actuator using the 2 off 'U' bolts (15) and M8 nuts (16) and spring washers (10) for pillar mounted actuators (refer to Figure 19) or; 1 off M8 hexagon headed screw (14) and M8 spring washer (10) for yoke mounted actuators (refer to Figure 20).



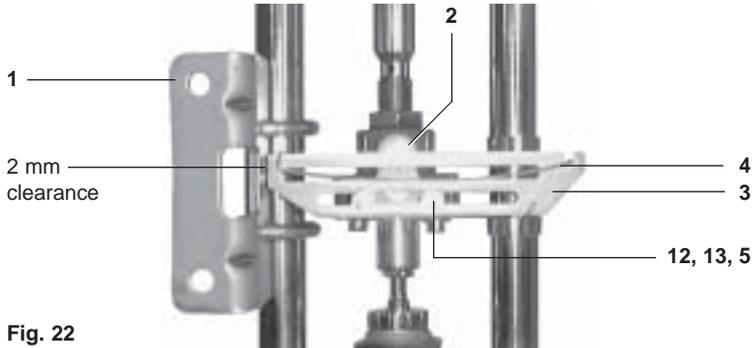
**Fig. 20**

- 5.1.8** Attach the valve stem bracket (2) to the valve / actuator connector using 2 off M6 slotted headed screws (11) (refer to Figure 21). Tighten to 4 - 5 N m. To help prevent the feedback arm going beyond its rotational travel limits it is important that the feedback arm is positioned horizontally when the valve is at mid travel position. This would also help to ensure that the feedback potentiometer is at its mid span position when the valve is at 50% travel. To help achieve this the valve stem bracket (2) can be mounted vertically up or down to suit the valve / actuator combination.



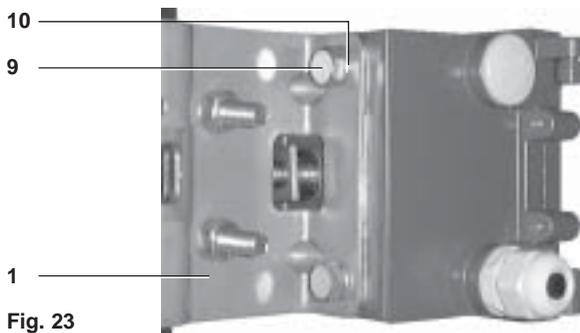
**Fig. 21**

**5.1.9** Loosely fix the connection arm (3) to the valve stem bracket (2) using the 2 off M5 slotted screws (12) and M5 washers (13) and stem spacers (5). Refer to Figure 25 for correct assembly sequence. For correct performance ensure that there is approximately 2 mm clearance between the connection arm (3) and the positioner mounting plate (1) and that the connection arm (3) is located square to the actuator pillars or yoke (refer to Figure 22). Tighten to 3.5 - 4.5 N m.



**Fig. 22**

**5.1.10** Present the positioner to the mounting plate (1) engaging the connecting lever pin (6) into the top slot of the connection arm (3), ensuring that pressure from the lever spring (4) is acting down onto the connection lever pin (6). Attach positioner mounting plate (1) to the positioner casing using the 2 off M8 hexagon headed screws (9) and spring washers (10) and tighten to 18 - 20 N m (refer to Fig. 23). Care should be taken not to over tighten.

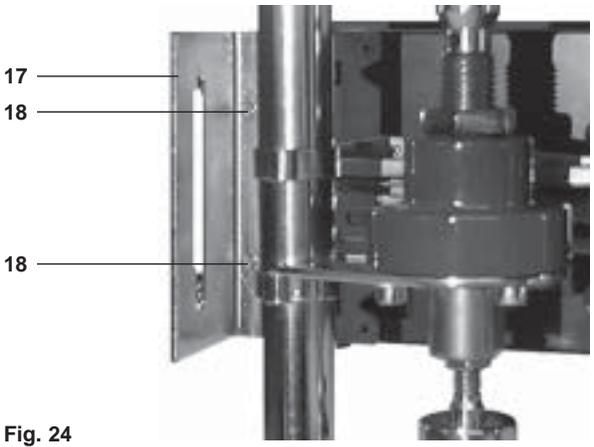


**Fig. 23**

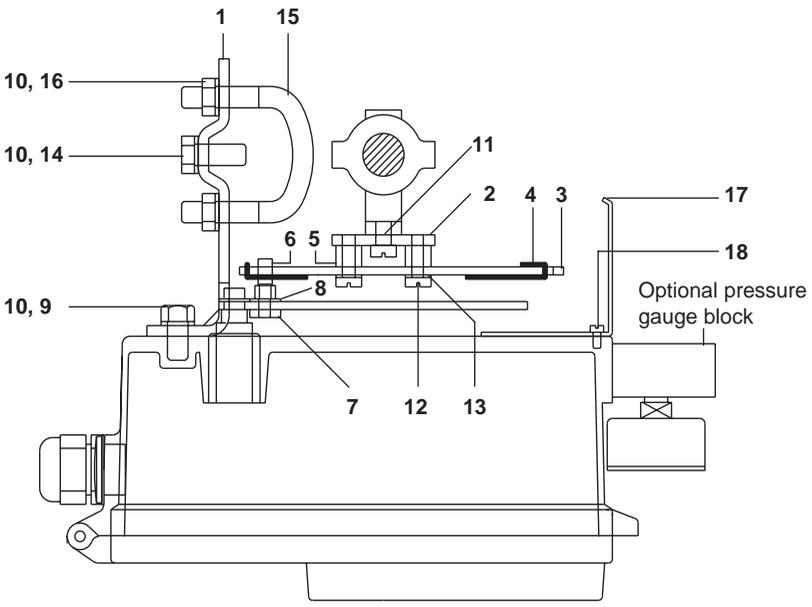
**5.1.11** As previously stated it is important that the feedback potentiometer is at mid span position by ensuring the feedback arm is positioned horizontally when the valve is at 50% travel. The desired setting can be achieved as follows. Refer to the actuator name-plate for spring signal range. Apply sufficient air pressure to the actuator to position the valve at its 50% travel position. Adjust the vertical position of the SP2 positioner and mounting plate assembly by sliding up or down on the pillars / yoke to ensure the feedback arm is horizontal. This can be achieved manually or more accurately using the digital display within the **CALIB** programming procedure. Refer to Section 9 'Programming and commissioning' for details of this procedure. **Note:** A minimum input signal of 3.6 mA is required for this procedure.

**5.1.12** When correctly positioned tighten 'U' bolt nuts (15) to 10 - 12 N m for pillar mounted actuators. For yoke mounted actuators, tighten the hexagon headed screw (14) to 10 - 12 N m ensuring that the connection lever pin (6) remains correctly located within the slot of the connection arm (3).

**5.1.13** Locate the protection plate (17) onto the back of the SP2 positioner housing and fix in place using 2 off M3 slotted screws (18) (refer to Figure 24).



**Fig. 24**



**Fig. 25 General assembly**

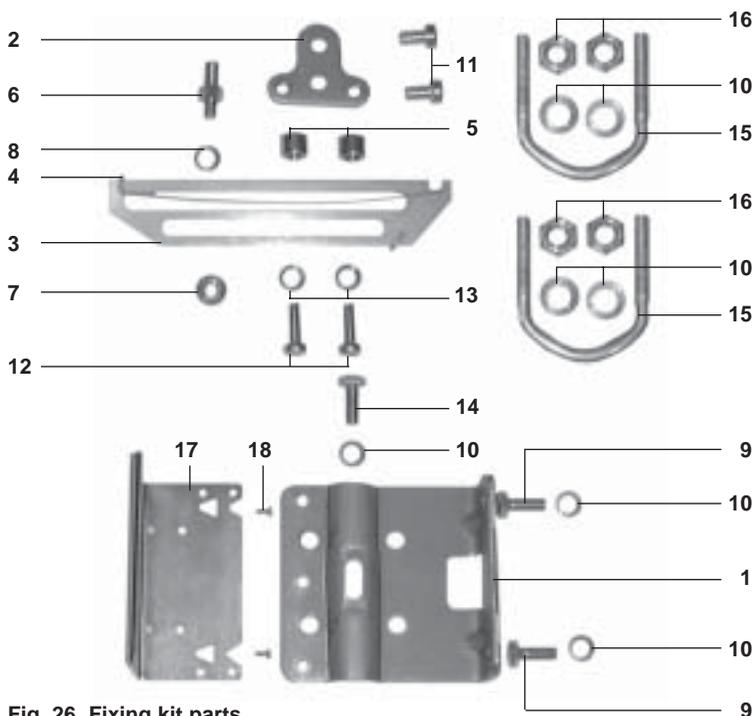


Fig. 26 Fixing kit parts

## 5.2. Air supply and connections

Air connections should be 1/4" NPT for air supply (supply) and output signal to actuator (output 1) as shown in Figure 27. The supply air should be between 1.4 bar g minimum and 6 bar g maximum and be oil and dust free to IEC 60770. Mains air supply may sometimes contain traces of dirt, rust, water, oil and other deposits with the potential for contaminating the internals of the positioner. It is therefore essential that a filter / regulator is fitted in the mains air supply to the positioner. The filter / regulator should have a coalescing filter such as a Spirax Sarco type MPC2, or equivalent. It is recommended that a minimum 6 mm diameter x 1/4" NPT fittings and suitable compressed air pipework is used.

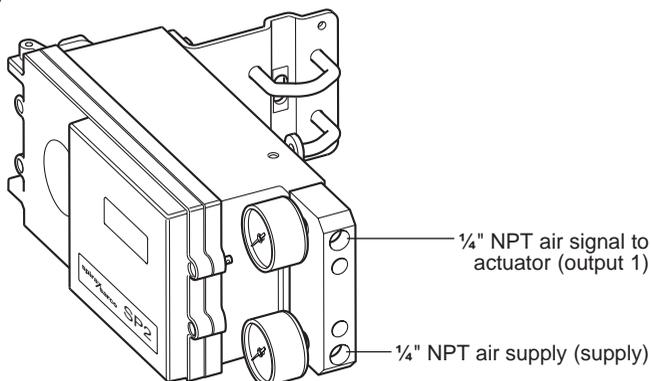


Fig. 27

# 6. Electrical connections

## 6.1 Guidance notes on wiring installation

For heavy industrial applications it is recommended to use screened cables or signal cables run in metal conduit. Failure to do so could result in positional errors of up to  $\pm 5\%$  in an RF field excess of 10 V/m. If screened cables are used, ensure that the screen is connected to the local earth at one end with a connection resistance of less than 1 ohm.

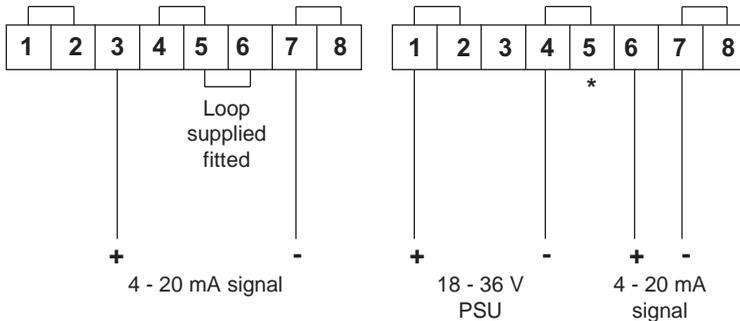
For light industrial applications where RF fields do not exceed 3 V/m unshielded cables may be used.

Cabling should be installed in accordance with BS 6739 - Instrumentation in Process Control Systems: Installation design and practice or local equivalent.

## 6.2 Main board wiring diagrams

### 6.2.1 Single loop applications

(see page 22 for Multi-loop applications)



\*

**Note:** Remove external link between Terminals 5 and 6.

**Fig. 28 Loop powered mode**

Minimum current	= 3.6 mA
Maximum current	= 30 mA
Voltage drop	= 8-10 volts

**Note:** A link is supplied fitted between Terminals 5 and 6

**Fig. 29 Separate power mode**

Maximum supply voltage	= 36 V @ 9.6 mA
Minimum supply voltage	= 18 V @ 3.6 mA
Maximum loop current	= 30 mA @ 3.0 volts
Minimum loop current	= 0 mA
Loop series resistance	= 100 ohms
Supply to signal isolation	= 50 Vac

The SP2 can be loop powered using the 4 - 20 mA input signal source providing a minimum signal of 3.6 mA can be maintained. If required, the SP2 can be separately powered. This is particularly useful if the input signal is likely to fall below 3.6 mA minimum or for any application that has limited voltage drop available.

## 6.2.2 Multi-loop applications

### Loop powered multi-positioner connections

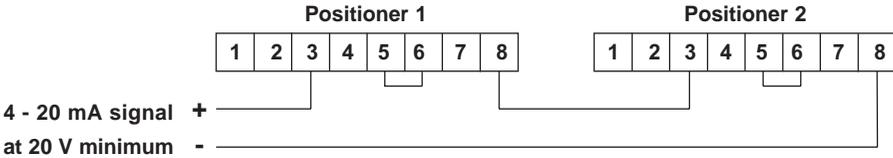


Fig. 30

In a loop powered application, the 4 - 20 mA signal must be capable of supplying a minimum of 10 V per positioner at 20 mA. In a split range application the signal source loop must be capable of supplying sufficient voltage, i.e. a multiple of 10 V, to satisfy each positioner within the loop (e.g. 20 V for two positioners).

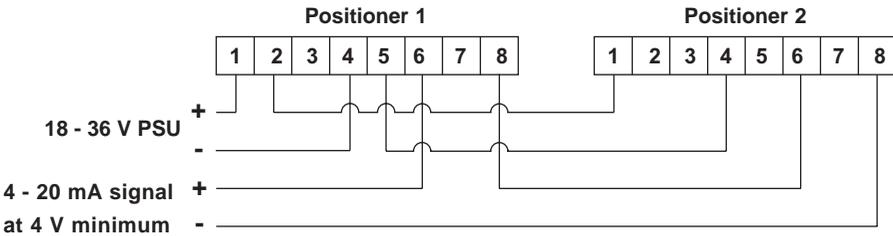


Fig. 31

If necessary, a separate power supply can be used. This separate supply can power all the positioners with a parallel connection and yet still allow a series connection of the signal loop to the signal input connections. The voltage required for signal input for externally powered positioners is 2 V per positioner.

Cable connection blanking plug

(Note: a spare Pg 13.5 cable gland is supplied with each options board kit)

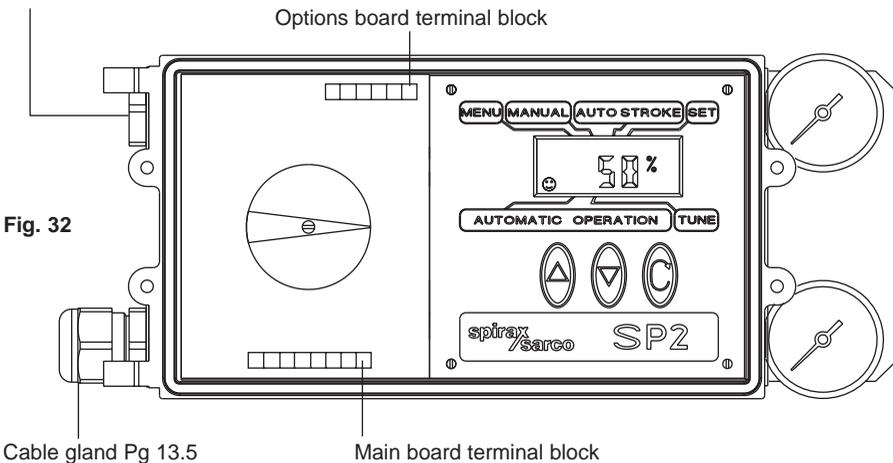
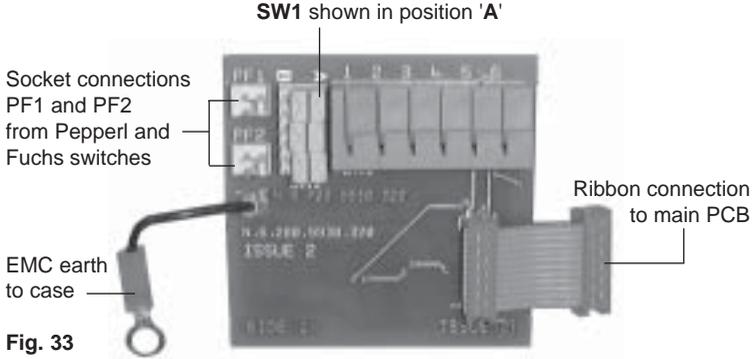


Fig. 32

### 6.3 Options board wiring diagrams



#### 6.3.1 Options wiring diagrams

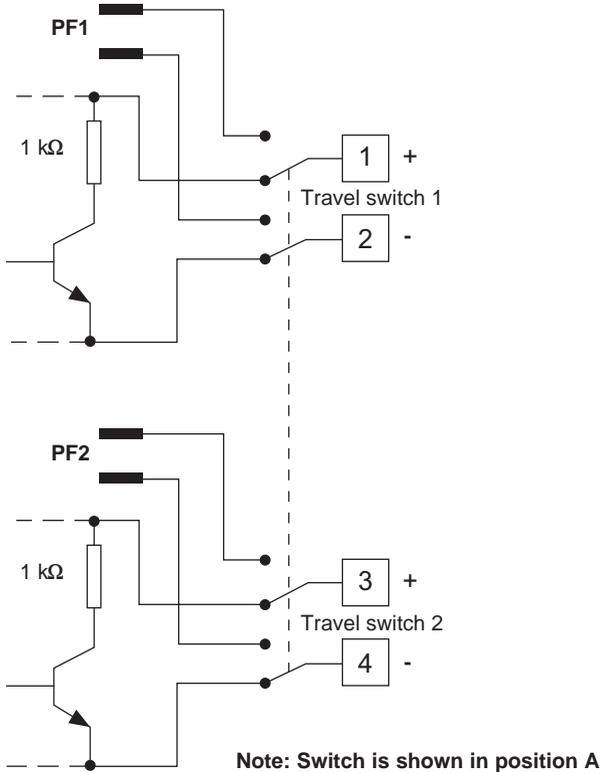


Fig. 34 Software switches

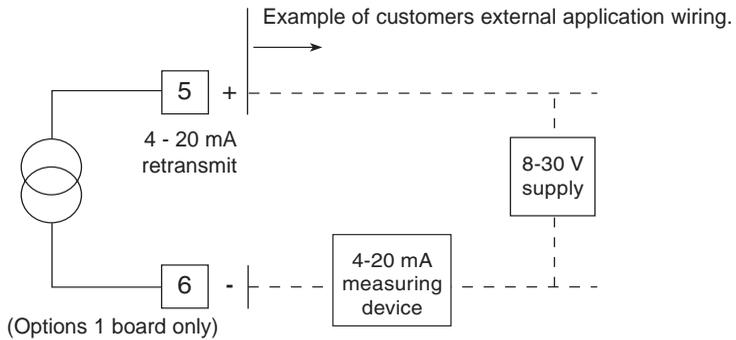


Fig. 35 4 - 20 mA retransmit

Table 1

Changeover switch SW1	Terminals 1 and 2	Terminals 3 and 4
A	TS1	TS2 (Software travel switches)
B	PF1	PF2 (Pepperl and Fuchs mechanical travel switches)

Table 2

Ratings	Supply	Impedance	On current	Off current
TS1 travel switch	18 - 30 Vdc	1 k $\Omega$	10 mA	< 53 $\mu$ A @ 24 V
TS2 travel switch	18 - 30 Vdc	1 k $\Omega$	10 mA	< 53 $\mu$ A @ 24 V
4 - 20 mA	8 - 30 Vdc	-	-	-

Isolation between each option and between option boards to main circuit = 50 Vac

### 6.3.2 Pepperl and Fuchs switch ratings

Switch type	Pepperl and Fuchs SJ3, 5-N
Switch characteristic	NAMUR constant current
Voltage range	5 - 25 Vdc
Nominal voltage	8 Vdc
Current (sensing face covered)	< 1 mA
Current (sensing face free)	> 3 mA

---

# 7. Quick start procedure

---

## 7.1 2-port valves

The following applies to positioners fitted to 2-port valves having plug above the seat and fitted to pneumatic actuators having a direct acting (DIR) 4 - 20 mA input signal and excludes the setting of any additional program functions (i.e. default value only).

**7.1.1** The positioner should be correctly assembled as described in Section 5 and Section 6 and supplied with mains air and signal pipework as described in Section 5.2.

**7.1.2** Provide a minimum input signal of 3.6 mA to the positioner.  
**SET-UP NOW** should be displayed.

**7.1.3** Ensure that upstream isolation valves are closed.  
Press and hold **C** key for 3 seconds to advance to **SP2 MENU**.  
The display will count down the 3 seconds.

**7.1.4** Press **▼** to advance to **MANOP**.

**7.1.5** Press and hold **C** key for 3 seconds to enter manual control mode **MCTL**.

**7.1.6** In manual control press and hold **▲** or **▼** keys to drive the valve stem up or down.  
Check for any obstructions of valve movement.  
The display will indicate **FILL** or **VENT** as appropriate.  
Any obstruction should be investigated before proceeding to 7.1.7.

**7.1.7** Press **C** key to return to **MANOP** in main menu.

**7.1.8** Press **▼** key to advance to **AUTOS** autostroke mode.

**7.1.9** Press and hold **C** key for 3 seconds to start the autostroke routine.  
This will take approximately 2 minutes to complete.

**!** displayed indicates an incomplete or unsuccessful autostroke.

The routine can be aborted at any time by pressing **C** key once.  
If autostroke is aborted during operation **ABORT** will be displayed and **!** to indicate incomplete autostroke.

On completion the program will automatically return to **AUTOS** in main menu.

A **☺** will be displayed if successful autostroke has been completed. It is now possible to advance to **RUN** in main menu.

**7.1.10** Press **▼** key three times to advance to **RUN** in main menu.

**7.1.11** Press and hold **C** key for 3 seconds to commence automatic operation.  
The valve will move to a control position related to the input control signal.  
The percentage valve travel will be displayed **%**.  
The positioner cover can now be closed and cover screws tightened.

---

## 7.2 3-port valves (with travel setting (TRAVL) 0 - 100%, see page 34)

Proceed as above up to paragraph 7.1.9.

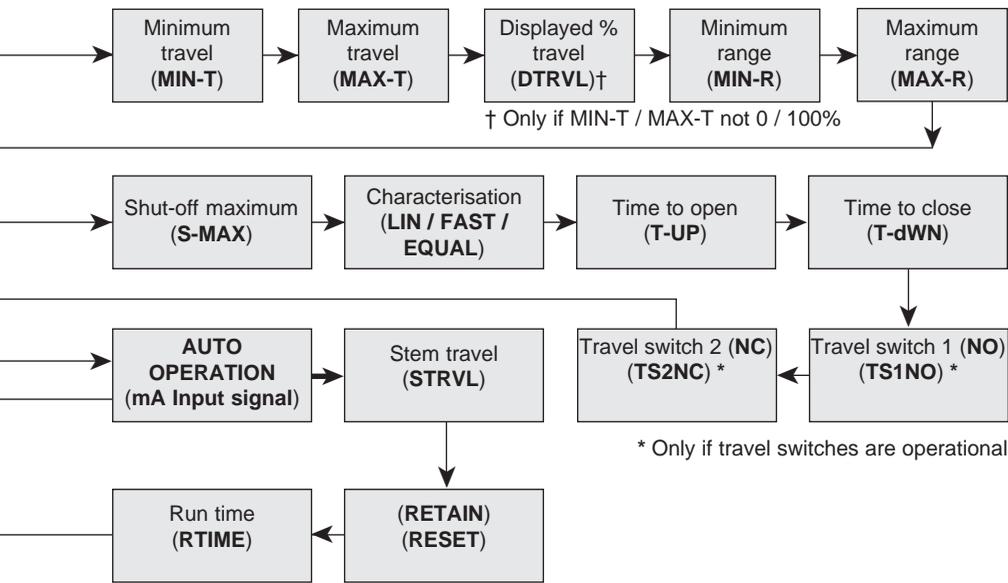
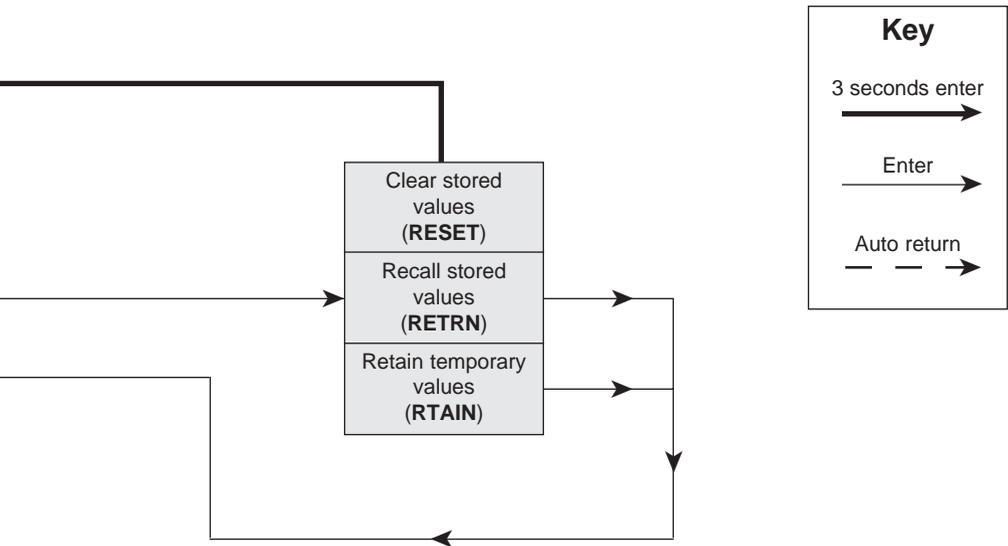
**7.2.1** On completion of a successful autostroke press the ▼ key once to advance to **SET** in main menu.

**7.2.2** Press ⏪ key once to advance to **VALVE TYPE**.  
Press ▲ key to indicate **VALVE 3-PORT**.

**7.2.3** Press ⏪ key to select **VALVE 3-PORT**. Continue to press ⏪ key to return to **SET** in main menu.

**7.2.4** Press ▼ key twice to advance to **RUN** in main menu. Proceed as described in 7.1.11.





# – 9. Programming and commissioning –

## 9.1 SET-UP NOW

### Programming notes

The positioner fitted to this control valve requires programming. A minimum input signal of 3.6 mA is required to power the positioner. To program the positioner it is necessary to enter **SP2 MENU** and carry out an autostroke commissioning routine (**AUTOS**) prior to putting the control valve into automatic operation.

A flow chart is included in Section 8 to guide you through the procedure. The display provides a flag indication of the active main menu function.

To enter **SP2 MENU** press and hold **C** key for 3 seconds. The display will count down the 3 seconds.

### Commissioning notes

#### Main menu functions include:

<b>SP2 MENU</b>	View software version, check potentiometer calibration, reset default values.
<b>MANOP</b>	Manual control of valve movement (Actuator inflation / deflation).
<b>AUTOS</b>	Automatic valve commissioning. Provides selection of % travel display.
<b>SET</b>	Setting of valve type, control action, travel limits and input signal span.
<b>TUNE</b>	Setting of deadband, tight shut-off, lift characterisation, travel time and software switches (optional).
<b>RUN</b>	Activates automatic operation plus input signal, total valve strokes and total run time. Also provides route for returning to <b>SP2 MENU</b> .

**Note:** **SET**, **TUNE** and **RUN** functions are restricted and can only be accessed on completion of a successful autostroke routine (**AUTOS**).

## 9.2 SP2 MENU

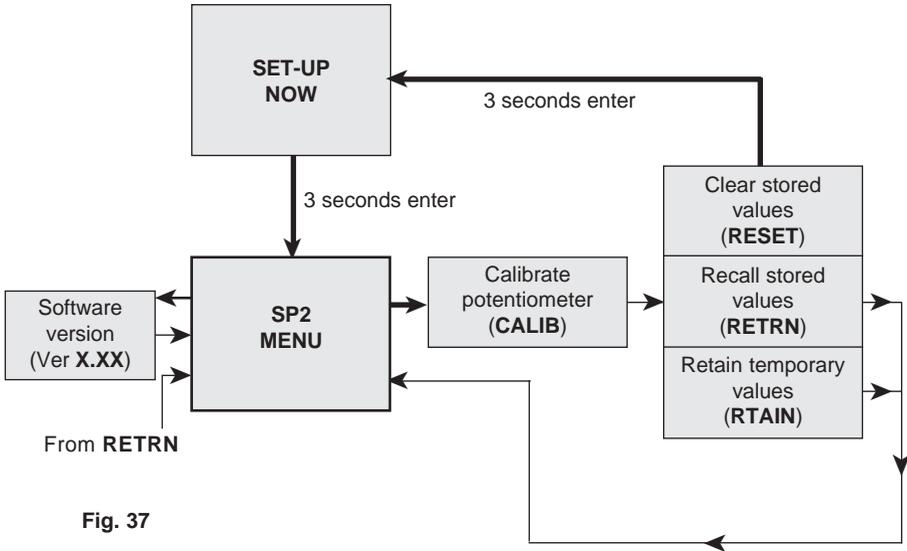


Fig. 37

### Programming notes

You are now in **SP2 MENU**.

#### SP2 functions include:

1. Visualisation of the embedded software version (**VER--**).
2. Positional setting of the feedback potentiometer (**CALIB**).
3. Resetting of programmed values to default settings (**RESET**).
4. To retain settings in the temporary memory (**RTAIN**).
5. Returning to previously stored settings (**RETRN**).

To check the setting or to re-center the feedback potentiometer (**CALIB**) press and hold **C** key for 3 seconds. The display will count down the 3 seconds. **CALIB** also provides access to **RESET / RTAIN / RETRN** functions.

To view the embedded version of software (**VER--**) press **C** key. To advance to manual operation (**MANOP**) press **▼** key.

### Commissioning notes

The positioner is supplied with the feedback potentiometer pre-calibrated therefore there is normally no need to check the setting on start-up. To speed up the commissioning time proceed directly to **MANOP** in the main menu.

### 9.2.1 VER -- software version

#### Programming notes

To view the version of the embedded software (**VER--**) press **C** key.

Press **C** key to return to **SP2 MENU**. The display will automatically return to **SP2 MENU** after 10 seconds.

## 9.2.2 CALIB - calibrate potentiometer

### Programming notes

To check the setting or to re-center the feedback potentiometer (**CALIB**) press and hold **C** key for 3 seconds. The display will count down the 3 seconds. You are now in calibrate potentiometer mode. In this mode it is possible to check and re-centre the potentiometer relative to the feedback arm. Desired setting is 50% with the feedback arm positioned horizontally. The **▲** and **▼** keys can be used to manipulate the actuator inflation. Press **C** key to save displayed value and advance to **RESET / RTAIN / RETRN**.

### Commissioning notes

The SP2 is supplied with the potentiometer calibrated at 50%  $\pm$  1% with the feedback arm positioned horizontally. This ensures there is sufficient span of the potentiometer available to cover the maximum valve lift and full rotational movement of the feedback arm.

Check for free and full movement.

Reading at minimum travel < 35%.

Reading with arm horizontal 50%.

Reading at maximum travel > 65%.

#### Causes for non-compliance:

1. Positioner not in correct position.
2. Feedback pin in wrong position.
3. Obstruction to full movement.
4. Potentiometer not calibrated at 50% with feedback arm horizontal (see procedure below).

### Procedure to re-centre the potentiometer

If required, the potentiometer can be re-centred by moving the SP2 positioner so that the feedback arm is horizontal with the valve at 50% lift position. The **▲** and **▼** keys can be used to inflate or deflate the actuator to help position the valve at its 50% lift position. Move the position so that the feedback arm is horizontal. The LCD should indicate 50%. If necessary the potentiometer can be re-centered by adjusting the clutch (refer to Figure 38).

Rotate clockwise to increase the displayed value and anticlockwise to reduce the displayed value.

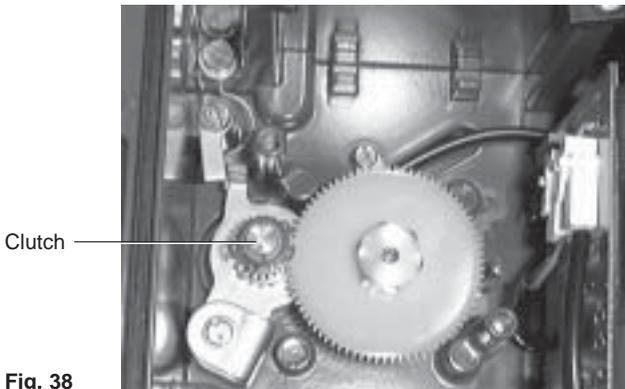


Fig. 38

---

### 9.2.3 RETRN - RTAIN - RESET

#### Programming notes

Provides the facility to restore previous permanently stored values (**RETRN**), to retain values stored in the temporary memory (**RTAIN**) or to reset all values to factory default settings (**RESET**). Press ▲ and ▼ keys to select **RETRN**, **RTAIN** or **RESET**. To advance proceed as follows:

#### RETRN

To cancel any temporary changes to programmed values select **RETRN** and press C key to return to **SP2 MENU**.

#### RTAIN

To retain temporary changes to programmed values select **RTAIN** and press C key to return to **SP2 MENU**.

#### RESET

Provides the facility to reset all values to factory default settings and return to **SET UP NOW**. Press and hold C key for 3 seconds. The display will count down the 3 seconds.

#### Commissioning notes

##### RETRN

If changes have been made to program values they will be held in the temporary memory. To retain changes in the permanent memory it is necessary to advance to **RUN** in the main menu and press and hold C key for 3 seconds. The display will count down the 3 seconds. **If you do not wish to retain temporary changes** select **RETRN** and press C key to return to **SP2 MENU**.

##### RTAIN

If changes have been made to programmed values they will be held in the temporary memory. If you wish to retain these changes select **RTAIN** and press C key to return to **SP2 MENU**. **To retain temporary changes in the permanent memory** advance to **RUN** in the main menu and press and hold C key for 3 seconds. The display will count down the 3 seconds.

##### RESET

Resetting to default values (refer to Section 9 for default values) should be used if it is intended to use the positioner on a different control valve. If the SP2 positioner has been moved on its mounting or is to be fitted on a different control valve it will be necessary to undertake a new autostroke (**AUTOS**).

**RESET** to factory default settings can also be used if it is required to recommission the valve.

**To reset to factory default values** select **RESET** and press and hold C key for 3 seconds. The display will count down the 3 seconds.

## 9.3 MANOP

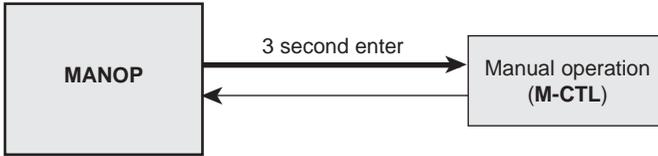


Fig. 39

### Programming notes

Press and hold **C** key for 3 seconds to enter manual control mode (**MCTL**). The display will count down the 3 seconds. Press **C** key to return to **MANOP**.

In **MANOP** press **▼** key to advance to autostroke (**AUTOS**).

### Commissioning notes

Before initiating an autostroke commissioning (**AUTOS**) use manual control (**MCTL**) to manually fully inflate and deflate the actuator to ensure there are no obstructions to the full valve travel movement.

Manual control is also useful during normal operation to manually control the valve position as a commissioning aid or in the event of input signal failure.

### 9.3.1 MCTL - manual control

#### Programming notes

Manual control enables the actuator to be manually inflated or deflated. Press **▲** key to inflate actuator and **▼** key to deflate the actuator. Press and hold **▲** or **▼** key to accelerate action.

Prior to undertaking an **AUTOS** the display will indicate **FILL** or **VENT**.

On completion of **AUTOS** the display will indicate **%** valve travel.

#### Manual control (MCTRL) - Tight shut-off function

Press and hold the **▼** key to drive the valve to its closed position. At 0% travel the **!** will flash to indicate limit of travel. To initiate tight shut-off release the **▼** key and press **▼** again. The actuator will be vented of air to provide dead tight shut-off. This also applies to the 100% valve position by pressing and releasing the **▲** key and pressing **▲** again to inflate the actuator to provide dead tight shut-off.

#### Manual control (MCTRL) - Travel limits

When operating in manual control any travel limit settings will be overridden therefore it is possible to manual position the valve through its full 0 to 100% travel as measured in autostroke (**AUTOS**).

Press **C** key to return to **MANOP** in the main menu.

### Commissioning notes

Before initiating an autostroke commissioning routine (**AUTOS**) the actuator should be manually fully inflated and deflated to ensure there are no obstructions to the full valve travel movement.

Manual control is also useful during normal operation to manually control the valve position as a commissioning aid or in the event of input signal failure.

## 9.4 AUTOS - automatic autostroke commissioning

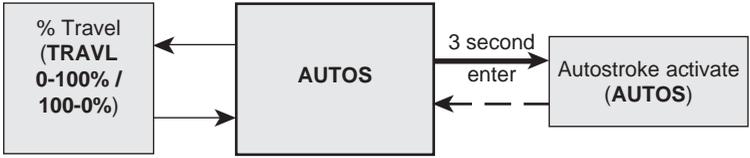


Fig. 40

### Programming notes

**AUTOS** provides access to:

1. Autostroke commissioning (**AUTOS**).
2. % travel display (**TRAVL**).

### **AUTOS**

Autostroke provides an automatic commissioning routine which will take approximately 1 to 3 minutes to complete.

Press and hold **C** key for 3 seconds to start autostroke. The display will count down the 3 seconds. When autostroke is active a flashing **AUTOS** message will be displayed.

On completion of a successful autostroke the programme will automatically return to **AUTOS** in the main menu and a ☺ will be displayed. In the event of an unsuccessful autostroke routine a flashing **!** will be displayed.

If during **AUTOS** inconsistent data is obtained due to mechanical problems, the autostroke procedure will be terminated and **ABORT** will be displayed.

It is also possible to immediately abort during an autostroke routine by pressing the **C** key. **ABORT** will be displayed together with a flashing **!**.

#### **Error messages:**

**ERROR 1** Indicates that the potentiometer setting is out of range. Minimum range setting is 30% or more. Maximum setting is 60% or less. Return to **CALIB** and re-centre the potentiometer to read 50% when the valve is at mid travel position.

**ERROR 2** Indicates that there is insufficient air pressure to achieve valve movement. Check that the air supply is adequate to overcome the actuator spring force. Fitting of a gauge block will aid the commissioning procedure.

**ERROR 3** Indicates that the actuator will not deflate. Check that there is no obstruction preventing the stem travel or air venting from the actuator.

**ABORT** indicates mechanical problems have occurred during the Autostroke procedure or the **C** key has been pressed during Autostroke to abort the procedure.

On completion of a successful autostroke it will be possible to advance to **SET**, **TUNE** and **RUN** functions in the main menu. Press the **▼** key to advance to these functions.

### **Commissioning notes**

Prior to undertaking an autostroke routine, manual operation should be used to fully inflate and deflate the actuator to ensure there are no obstructions to the full valve movement. Autostroke is an automatic commissioning routine that checks for maximum valve travel, signal response, valve characteristics, inflation / deflation times etc. Data gathered will be automatically download into the embedded software to ensure optimum performance of the valve / actuator combination.

Autostroke commissioning will take approximately 1 to 3 minutes to complete depending on air pressure and actuator size etc.

Autostroke commissioning must be carried out on start-up or at any other time if the valve performance is not satisfactory.

### 9.4.1 TRAVL - % travel display

#### Programming notes

Press **C** key to access **TRAVL**.

Provides selection of % valve travel display with option of 0 - 100% or 100 - 0%.

Default is 0 - 100%.

Use **▲** and **▼** keys to toggle selection.

Press **C** key to return to **AUTOS**.

#### Commissioning notes

The selection of % valve travel display depends on the valve and actuator configuration. Figures 41 to 44 (pages 34 and 35), and Figs. 45 and 46 (page 36) provide guidance on selection. After completion of **AUTOS** if a change is made to **TRAVL** it will be necessary to initiate an **AUTOS** routine once again.

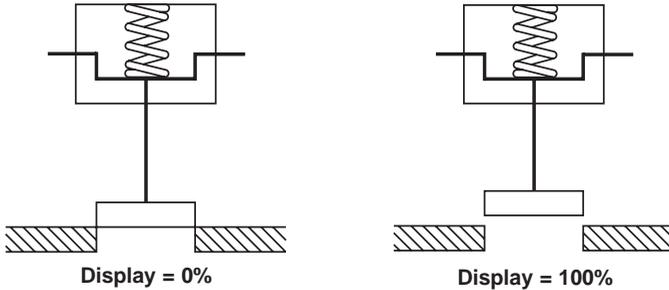


Fig. 41 2-port valve normally closed - TRAVL setting = 0 to 100%

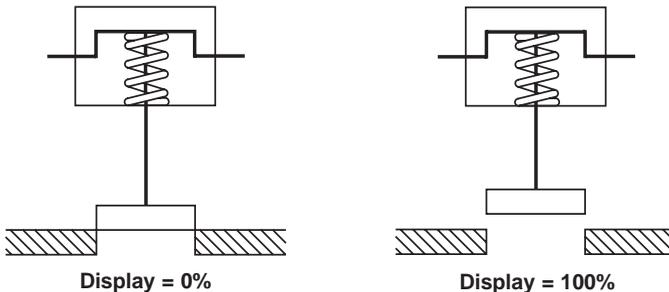


Fig. 42 2-port valve normally open - TRAVL setting = 0 to 100%

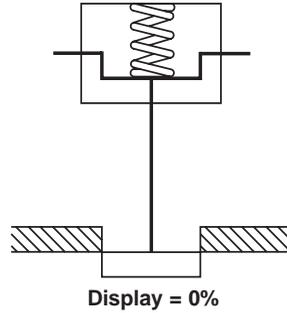
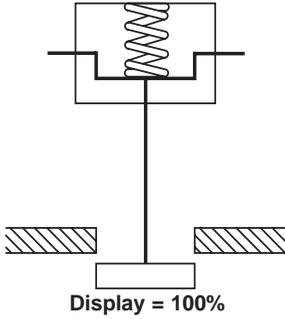


Fig. 43 2-port valve normally open - TRAVL setting = 100% to 0%

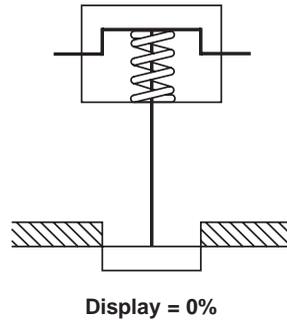
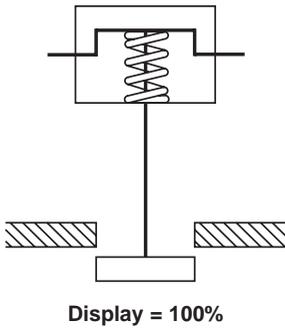


Fig. 44 2-port valve normally closed - TRAVL setting = 100% to 0%

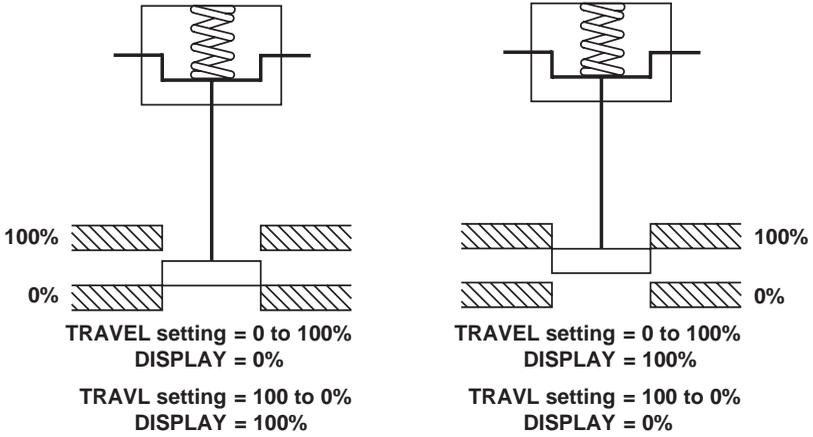


Fig. 45 3-port valve and spring extend actuator

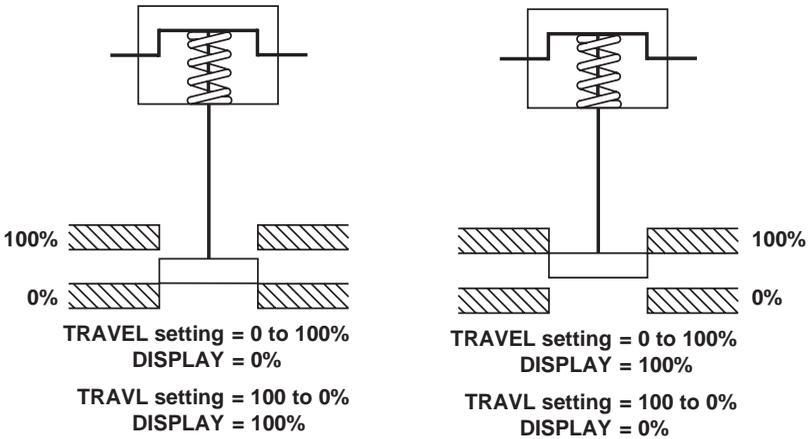


Fig. 46 3-port valve and spring retract actuator

## 9.5 SET - setting of valve functions

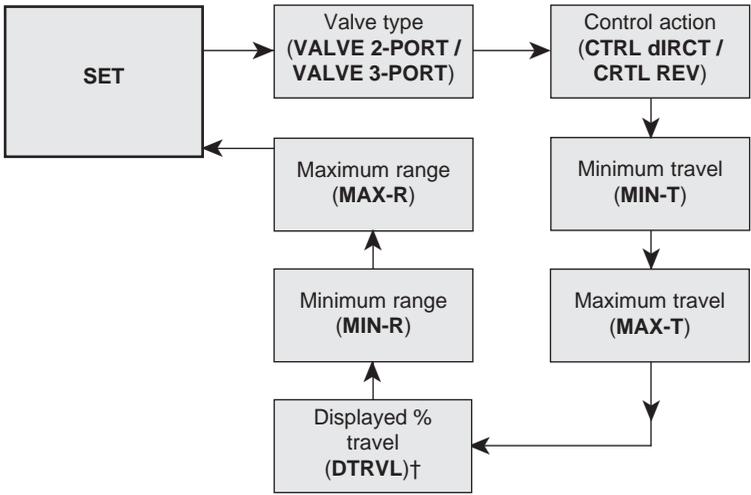


Fig. 47

† Only if MIN-T / MAX-T not 0 / 100%

### Programming notes

Provides access to basic valve set up functions. Press **C** key to scroll round all **SET** functions.

#### Functions include:

- Valve type (2-port or 3-port) (VALVE)
- Control action (direct or reverse) (CTRLA)
- Minimum travel setting (0 to 66.66%) (MIN-T)
- Maximum travel setting (33.3 to 100%) (MAX-T)
- Displayed % travel (on/off) (DTRVL)
- Minimum span range (input mA signal) (MIN-R)
- Maximum span range (input mA signal) (MAX-R)

Press **C** key to advance to valve type (VALVE). Repeat pressing of **C** key will scroll round all **SET** functions.

Press **▼** key to advance to **TUNE** in the main menu.

### Commissioning notes

Each **SET** function has a default value as listed in the Installation and Maintenance Instructions. Default values are based on a 2-port normally closed valve having maximum 95% lift and an input signal span range 4 - 20 mA.

**SET** values should be adjusted to suit the valve type (2-port or 3-port) and application. Functions include the facility to change the control action, limit the full travel of the valve plug (minimum and maximum) and to split range the input signal.

More detailed information is provided for each **SET** function.

---

## 9.5.1 VALVE - valve type

### Programming notes

Provides selection between 2-port and 3-port valves. Default is 2-port valve. Default values for travel limit settings (**MIN-T** and **MAX-T**) and early vent / inflate settings (**S-MIN** and **S-MAX**) will depend on the valve type (2-port or 3-port) and control action (direct or reverse) as follows:

### 2-port

Display	Direct	Reverse
MIN-T	0%	0%
MAX-T	95%	95%
S-MIN	0.1%	OFF
S-MAX	OFF	0.1%

### 3-port

Display	Direct	Reverse
MIN-T	0%	0%
MAX-T	100%	100%
S-MIN	0.1%	0.1%
S-MAX	0.1%	0.1%

Use ▲ and ▼ keys to select type. Press C key to accept displayed type and advance to control action (CTRLA).

### Commissioning notes

Selection of 2-port or 3-port valves will automatically alter the maximum travel default value (**MAX-T**) to 95% for 2-port and 100% for 3-port valves. Advance to **MAX-T** to change these values if required.

## 9.5.2 CTRLA - direct or reverse control action

### Programming notes

Provides selection of direct (**DIRCT**) (4 - 20 mA) or reversed (**REV**) (20 - 4 mA) valve positioning control action. Press ▲ and ▼ keys to select desired action. Default action is **DIRCT**.

Default values for travel limit settings (**MIN-T** and **MAX-T**) and early shut-off vent / inflate settings (**S-MIN** and **S-MAX**) will depend on the valve type (2-port or 3-port) and control action (direct or reverse) as follows:

### DIR - direct action

Display	2-port	3-port
<b>MIN-T</b>	0%	0%
<b>MAX-T</b>	95%	100%
<b>S-MIN</b>	0.1%	0.1%
<b>S-MAX</b>	OFF	0.1%

### REV - reverse action

Display	2-port	3-port
<b>MIN-T</b>	0%	0%
<b>MAX-T</b>	95%	100%
<b>S-MIN</b>	OFF	0.1%
<b>S-MAX</b>	0.1%	0.1%

Press **C** key to accept the displayed action and advance to minimum travel setting (**MIN-T**).

### Commissioning notes

Selection of direct or reverse action changes the direct of valve plug movement relative to the input signal. Refer to Figures 48 and 49 below, and the table shown on page 42 for further guidance.

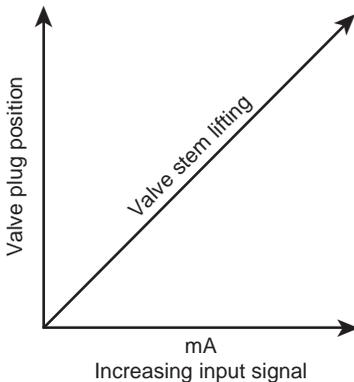


Fig. 48 Direct action (DIR)

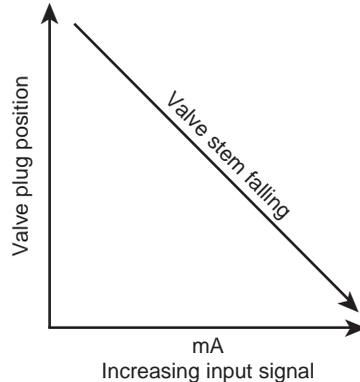
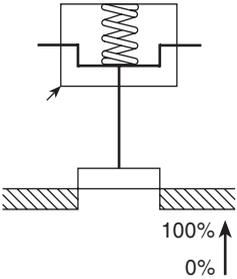
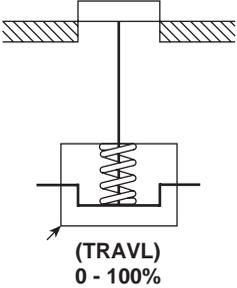
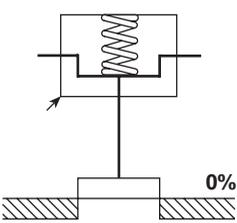
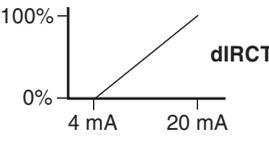
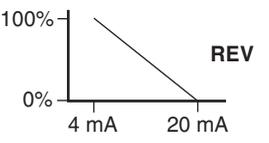
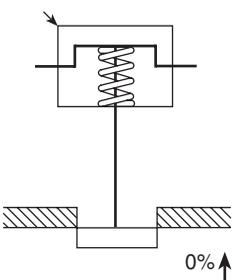
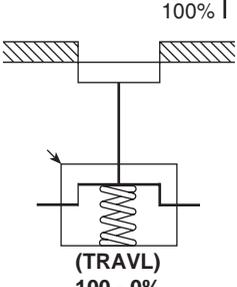
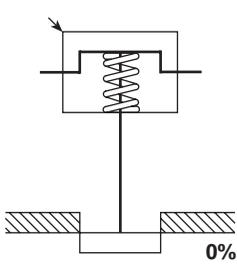
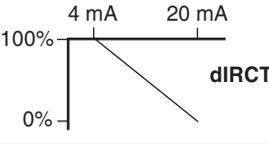
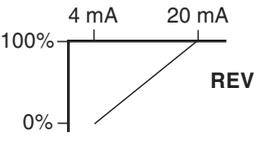


Fig. 49 Reverse action (REV)

**Fig. 50 CTRL Control Action dIRECT or REV setting guidance**

Installed orientation	At-rest position	Control action
  <p>(TRAVL) 0 - 100%</p>		 <p>dIRECT</p>  <p>REV</p>
  <p>(TRAVL) 100 - 0%</p>		 <p>dIRECT</p>  <p>REV</p>
<p>Manual Selection of required % travel (TRAVL)</p>	<p>Automatic determination Spring action only affects the rest or fail-safe position</p>	<p>Manual Selection of required Control Action (CTRL)</p>

---

### 9.5.3 MIN-T - minimum travel setting

#### Programming notes

Enables the minimum valve travel to be set as a percentage of the maximum travel obtained during autostroke. Maximum setting is **MAX-T** less 33.3%.

Default value is 0%.

Use ▲ and ▼ keys to alter the displayed value. Press C key to accept the displayed value and advance to the maximum travel setting (**MAX-T**).

#### Commissioning notes

Minimum travel should be used where a minimum flowrate is required to be maintained through the valve, (i.e. a cooling water application). Setting a minimum travel % value will prevent the valve fully closing.

The input signal span range set (**MIN-R**) and (**MAX-R**) will operate over the travel limits set. If a value for **MIN-T** is set it will exclude the setting of shut-off minimum (**S-MIN**) for control action direct (**DIR**) and shut-off maximum (**S-MAX**) for control action reverse (**REV**).

### 9.5.4 MAX-T - maximum travel setting

#### Programming notes

Enables the maximum valve travel to be set as a percentage of the maximum travel measured during autostroke. Minimum setting is **MIN-T** plus 33.3%.

Default values will depend on the selection of valve type (2-port or 3-port) and control action (direct or reverse) as follows:

Valve type	Direct	Reverse
2-port	95%	95%
3-port	100%	100%

Use ▲ and ▼ keys to adjust the displayed value. Press C key to accept displayed value and advance to the minimum span range (**MIN-R**).

#### Commissioning notes

The maximum valve travel percentage should be used to prevent a control valve fully opening. This is useful for applications where the valve is oversized or to restrict the maximum flowrate through the valve.

On 2-port valves the default value is 95% to prevent the back of the plug hitting the bonnet. On 3-port valves to ensure shut-off on both seats a 100% setting is required.

The input signal span range set (**MIN-R**) and (**MAX-R**) will operate over the travel limits set. If a value for **MAX-T** is set it will exclude the setting of shut-off maximum (**S-MAX**) for direct action (**DIR**) and shut-off minimum control action (**S-MIN**) for reverse action (**REV**).

## 9.5.5 DTRVL - displayed travel percentage

### Programming notes

The full mechanical limits of valve travel (0 to 100%) are measured during autostroke (**AUTOS**).

It is possible to limit the minimum and maximum valve travel by programming **MIN-T** and **MAX-T** values, i.e. **MAX-T** maximum travel limit of 95% (Autostroke default value for 2-port valves).

**DTRVL** (0 to 100% displayed travel value) can be displayed over the actual mechanical travel limits (as measured during Autostroke), or adjusted **MIN-T** and **MAX-T** travel settings.

### DTRVL programming options

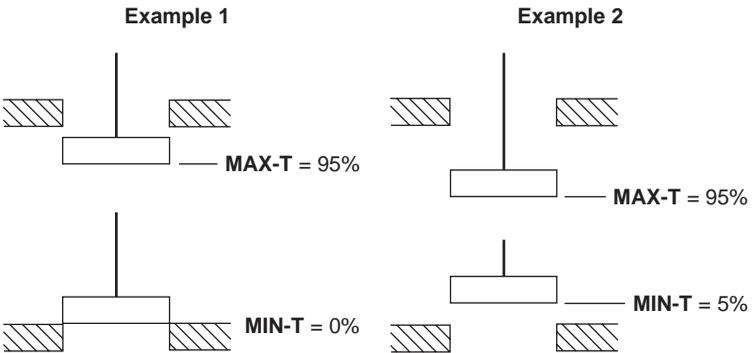
**DTRVL - ON** will display 0 to 100% over the **MIN-T** and **MAX-T** travel settings, or,

**DTRVL - OFF** will display 0 to 100% over the actual mechanical limits of travel.

Default value is **DTRVL - ON**. Use ▲ and ▼ keys to toggle selection.

Press C key to accept displayed 'ON' or 'OFF' option and advance to minimum range setting (**MIN-R**).

### Examples



Display values	
DTRVL - ON	DTRVL - OFF
100%	95%
0%	0%

Display values	
DTRVL - ON	DTRVL - OFF
100%	95%
0%	5%

### Commissioning notes

**DTRVL** provides the choice of travel display. For 2-port valves you can adjust the **MAX-T** setting to achieve the actual desired valve lift (i.e. 20 mm or 30 mm, etc). Using **DTRVL** you can then choose to display the **MAX-T** valve travel you have set as 100%.

---

## 9.5.6 MIN-R - minimum signal span range

### Programming notes

Enables the minimum mA input signal span range to be set. The value set will correspond to the minimum travel setting. Default value is 4 mA.

Use ▲ and ▼ keys to alter the displayed value. Minimum difference between **MIN-R** and **MAX-R** is 4 mA.

Press C key to accept the displayed value and advance to the maximum mA input span range (**MAX-R**).

### Commissioning notes

This function can be used to set split range applications i.e. 4 - 12 mA or 12 - 20 mA. To ensure tight shut-off refer to Section 9.6.2 **S-MIN**, page 43.

## 9.5.7 MAX-R - maximum signal span range

### Programming notes

Enables the maximum mA input signal span range to be set. The value set will correspond to the maximum travel setting. Default value is 20 mA.

Use ▲ and ▼ keys to alter the displayed value. Minimum difference between **MIN-R** and **MAX-R** is 4 mA.

Press C key to accept the displayed value and return to **SET** in the main menu.

### Commissioning notes

This function can be used to easily set split range applications i.e. 4 - 12 mA or 12 - 20 mA. To ensure tight shut-off refer to Section 9.6.3 **S-MAX**, page 44.

## 9.6 TUNE - setting of valve tune functions

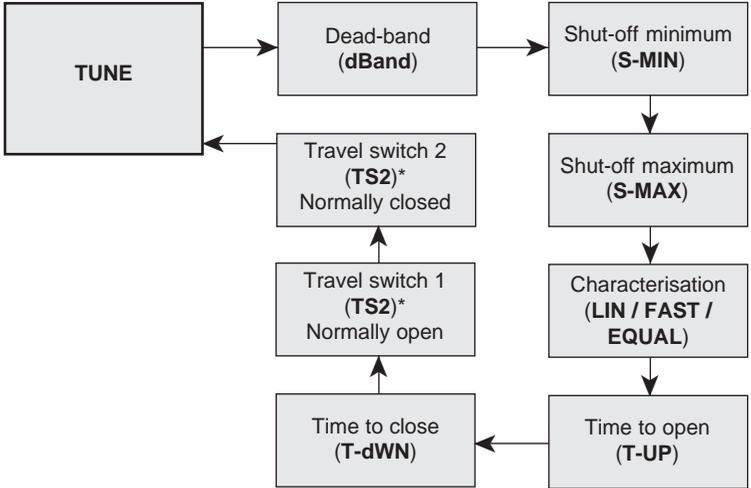


Fig. 50

\* Travel switch options board optional

### Provides access to more advanced valve tuning functions including:

- Dead-band (valve positioning sensitivity) **(dBAND)**
- Shut-off minimum (ensures tight closure) **(S-MIN)**
- Shut-off maximum (ensures tight closure) **(S-MAX)**
- Characterisation (signal / lift relationship) **(CHAR)**
- Time open (slows down valve opening) **(T-UP)**
- Time close (slows down valve closure) **(T-dWN)**
- Travel switch 1 normally open (sets software travel switch) **(TS1)** - optional
- Travel switch 2 normally closed (sets software travel switch) **(TS2)** - optional

### Programming notes

Press **C** key to advance to deadband **(dBAND)**. Repeated pressing of **C** key will scroll round all TUNE functions. **If you do not wish to alter TUNE default values** press **▼** key to advance to **RUN** in the main menu.

### Commissioning notes

Each **TUNE** function has a default value as listed in the Installation and Maintenance Instructions. Default values are based on a 2-port normally closed valve having maximum 95% lift and an input signal span range 4 - 20 mA.

**TUNE** values should be adjusted to suit the valve type and application. Functions include:

1. The facility to alter deadband positioning sensitivity (to dampen out signal fluctuations).
2. Setting input signal to achieve tight shut-off (inflation and deflation of actuator).
3. Relationship between valve lift to input signal.
4. Slowing down the valve open or closing time duration.
5. Setting the switching position for the software travel switches.

More detailed information is provided for each **TUNE** function .

### 9.6.1 dbANd - deadband setting (positional sensitivity)

#### Programming notes

Dead-band provides adjustment of the valve positioning sensitivity relative to the input signal and is expressed as a % of the input signal span.

Default value based on a 4 - 20 mA input signal span is 0.5% with a minimum setting of 0.2%.

These values may change if the input signal span is reduced i.e. for a 4 mA input signal span the default and minimum setting is 0.8%.

The maximum setting is 10% of the input signal span.

To alter the displayed value press ▲ and ▼ keys. Press C key to accept the displayed value and advance to the shut-off minimum (S-MIN).

#### Commissioning notes

Setting a narrow deadband may induce oscillations of valve movement caused by fluctuations in the input signal, high stem friction or operating at low ambient temperatures below 0°C. Setting a wider deadband will dampen out oscillations but may cause an inaccuracy in actual valve position. This effect will increase if valve travel is limited. It is normally recommended that the default value is used. If necessary gradually increase the % value to dampen out any oscillations in valve movement. This may be necessary for valves having graphite packed stem seals or smaller size actuators where typically a deadband of 4% may be required.

### 9.6.2 S-MIN - valve shut-off - minimum travel

#### Programming notes

Provides the facility to fully vent the actuator at a predetermined input signal. The value set is a percentage of the input signal span range, i.e. setting a value of 10% with an input span range of 4 - 20 mA (span 16 mA), will cause the valve to close with an input signal of 5.6 mA i.e. 4 mA + 1.6 mA (10% of 16 mA). Maximum setting is 20%.

Default values will depend on the selection of valve type (2-port or 3-port) and control action (direct or reverse) as follows:

Valve type	Direct	Reverse
2-port	0.1%	Off%
3-port	0.1%	0.1%

For direct control action (**DIRCT**) can only be set if **MIN-T = 0%** (will vent the actuator at set value). For reverse action (**REV**) can only be set if **MAX-T = 100%** (will inflate the actuator at set value).

Press ▲ and ▼ keys to alter the displayed value. Press C key to accept the displayed value and advance to shut-off maximum (S-MAX).

#### Commissioning notes

With an actual input signal equivalent to minimum input signal span range (**MIN-R**) it may cause the valve plug to hover over the seat preventing tight closure with the possibility of erosion damage to the plug and seat faces. Setting a shut-off value can help prevent this by providing early closure of the valve.

### 9.6.3 S-MAX - valve shut-off maximum

#### Programming notes

Provides the facility to fully inflate the actuator at a pre-determined input signal. The value set is a percentage of the input signal span range, i.e. setting a value of 10% with an input span range of 4 - 20 mA (16 mA), will cause the valve to close with an input signal of 18.4 mA i.e. 20 mA - 1.6 mA (10% of 16 mA). Maximum setting is 20%.

Default values will depend on the selection of valve type (2-port or 3-port) and control action (direct or reverse) as follows:

Valve type	Direct	Reverse
2-port	Off	0.1%
3-port	0.1%	0.1%

For direct action (**dIRECT**) can only be set if **MAX-T = 100%** (will inflate the actuator at set value). For reverse action (**REV**) can only be set if **MIN-T = 0%** (will vent the actuator at set value).

Press ▲ and ▼ keys to alter displayed value. Press C key to accept the displayed value and advance to the characterisation (**CHAR**).

#### Commissioning notes

With an actual input signal of 20 mA and a maximum span range setting (**MAX-R**) of 20 mA may cause the valve plug to hover over the seat preventing tight closure with the possibility of erosion damage to the plug and seat. Setting a shut-off value can help prevent this by providing early closure of the valve.

### 9.6.4 CHAR - valve characterisation

#### Programming notes

Provides selection of linear (**LIN**), equal percentage (**EQUAL**) or fast opening (**FAST**) characterisation. Characterisation is the relationship between input signal and valve lift. Default value is Linear (**LIN**).

Use ▲ and ▼ keys to select the desired action. Press C key to accept the displayed characterisation and advance to time open (**T-UP**).

#### Commissioning notes

The standard characterisation for 2-port and 3-port valves is linear (**LIN**). For special applications using 2-port valves an equal percentage (**EQUAL**) or fast opening (**FAST**) characteristic can be selected. With equal percentage the valve will start to open slowly and gradually accelerate opening related to input signal. With fast opening characteristic the valve will commence to open quickly and gradually slow down opening related to the input signal. This action is in addition to the valve trim flow characterisation (refer to Figure 51 for guidance).

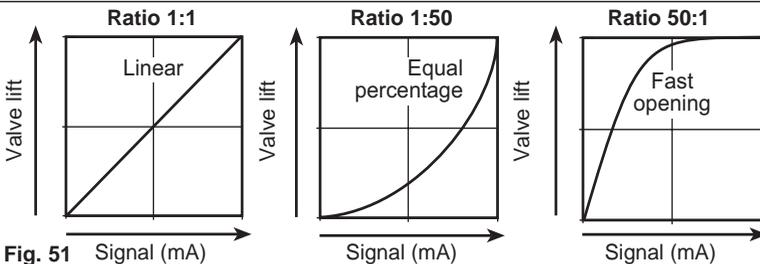


Fig. 51

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## 9.6.5 T-UP - valve slow opening action

### Programming notes

This function slows down the time taken for the valve to travel from 0 to 100% lift. The time displayed is the fastest travel time measured during autostroke (**AUTOS**). The maximum value that can be set is 180 seconds.

Default value is the fastest time measured during autostroke.

Press ▲ and ▼ keys to alter the displayed value. Press C key to accept the displayed value and advance to time down (**T-dWN**).

### Commissioning notes

The time displayed on start-up is the fastest time measured during autostroke commissioning (**AUTOS**). A time cannot be set less than the minimum recorded during autostroke. The value set will be the time taken for the valve to travel from 0 to 100% lift. The time set will apply at all times and not just at start-up. This function is useful to prevent the effects of system waterhammer, thermal shocks or slow down over-reactive systems or the effects of oversized valves.

Default is the fastest time measured during autostroke. Maximum setting is 180 seconds.

## 9.6.6 T-dWN - valve slow closing action

### Programming notes

This function slows down the time taken for the valve to travel from 100 to 0% lift. The time displayed on start-up is the fastest travel time measured during autostroke (**AUTOS**). The maximum value that can be set is 180 seconds. Default value is the fastest time measured during autostroke.

Press ▲ and ▼ keys to alter the displayed value. Press C key to accept the displayed value and advance to **TUNE** in the main menu (or travel switch 1 normally open (**TS1NO**) if optionally fitted).

### Commissioning notes

During autostroke routine the quickest time taken for the valve to fully close will be measured and displayed. A time cannot be set less than the minimum recorded during autostroke. The value set will be the time taken for the valve to travel from 100 to 0% lift. This action will apply at all times and not just at start-up. This function is useful to prevent the effects of system waterhammer, or to slow down over-reactive systems or the effects of oversized valves. Default is the minimum time measured during autostroke. Maximum setting is 180 seconds.

### 9.6.7 TS1 and TS2 software travel switches - (optional)

Software configured travel switches are optional and provided on a separate plug in PCB board. They will only appear in the programming menu if the options PCB is fitted, and switch **SW1** set to position **A**.

Two switches are available **TS1** and **TS2**.

**TS1 is normally open** and **TS2 is normally closed**. Switching action is set as a % of valve travel (refer to Figs. 52 and 53).

#### TS1 - software configured travel switch 1 (normally open)

##### Programming notes

Software configured travel switches are optional with the SP2 positioner. The switching point can be set as a percentage of the valve travel between 0 to 100%. A value can be set outside the limits of the travel settings (**MIN-T**) and (**MAX-T**). Initially **OFF** will be displayed indicating that the switch is not set. To set a switching point press **▲** and **▼** keys to alter the displayed value. Press **C** key to accept the displayed value and advance to travel switch 2 normally closed (**TS2**).

##### Commissioning notes

Travel switch 1 (**TS1**) is normally open. External wiring should be made between terminals 1 (+) and 2 (-). The value set is a % of valve travel. At the set value the switch will close. If the options PCB is fitted and the slide switch **SW1** set to position 'A' the status of the switch will be shown on the LCD (refer to Figure 52).

Software configured travel switches can be used to remotely indicate valve position or to operate warning devices, fans, stirrers, motors or other process equipment via a secondary switching device.

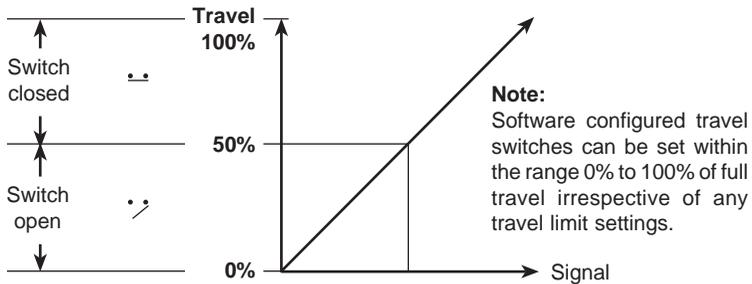


Fig. 52 TS1 Travel switch 1 (normally open)

## TS2 - software configured travel switch 2 (normally closed)

### Programming notes

Software configured travel switches are optional with the SP2 positioner. The switching point can be set as a percentage of the valve travel between 0 to 100%. A value can be set outside the limits of the travel settings (**MIN-T**) and (**MAX-T**). Initially **OFF** will be displayed indicating that the switch is not set. To set a switching point press ▲ and ▼ keys to alter the displayed value. Press C key to accept the displayed value and return to **TUNE** in the main menu.

### Commissioning notes

Travel switch 2 (**TS2**) is normally closed. External wiring should be made between terminals 3 (+) and 4 (-). The value set is a % of valve travel. At the set value the switch will open. If the options PCB is fitted and the slide switch **SW1** set to position 'A' the status of the switch will be shown on the LCD (refer to Figure 53).

Software configured travel switches can be used to remotely indicate valve position or to operate warning devices, fans, stirrers, motors or other process equipment via a secondary switching device.

**Note:** If the switch is in its 'off' status it will be an open circuit.

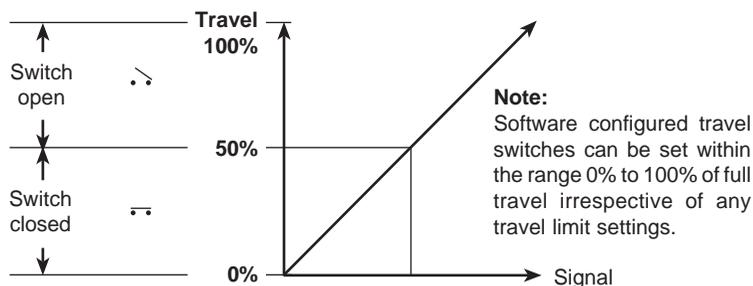


Fig. 53 TS2 Travel switch 2 (normally closed)

## 9.7 RUN - automatic operation

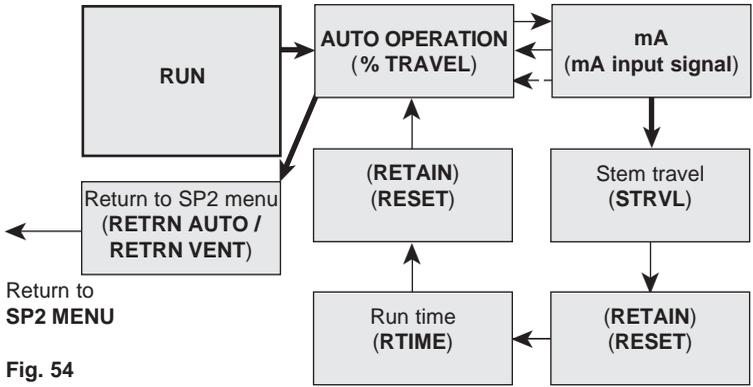


Fig. 54

### Programming notes

Provides the facility to put the valve into automatic operation. Press and hold **C** key for 3 seconds to start automatic operation. The display will count down the 3 seconds.

The valve will move to a position in response to the input control signal. All values stored in the temporary memory will be transferred to the permanent memory.

### Commissioning notes

By pressing and holding the **C** key for 3 seconds all values previously set will be entered into the permanent memory. The valve will move to a position as dictated by the input control signal.

To alter or check **SET** or **TUNE** values it is necessary to return to **SP2 MENU**. Press and hold **C** key for 3 seconds to return to **SP2 MENU**. The display will count down the 3 seconds.

There are two options for returning to **SP2 MENU**.

**Option 1** is to stay in automatic control (**AUTO**) where the valve will continue to position itself relative to the input control signal.

**Option 2** is to vent the actuator (**VENT**) where the valve will travel to its fail-safe position.

### 9.7.1 Automatic operation - % travel

#### Programming notes

During normal automatic operation the % valve travel will be continuously displayed together with the switch status of the software travel switches (if fitted). Additionally, a ☺ will be displayed indicating that the valve is operating satisfactorily. At any time during automatic operation the mA input signal can be displayed by pressing **C** key.

To return to **SP2 MENU** press and hold **C** key for 3 seconds. The display will count down the 3 seconds. You will advance to **RETRN** with the option of **AUTO** (automatic operation) or **VENT** (venting air from actuator). Use **▲** and **▼** keys to select the desired option. Press **C** key to accept the displayed option and return to **SP2 MENU**.

### Commissioning notes

During normal operation the % valve travel will be continually displayed. A ☺ indicates that the valve is performing satisfactorily. Causes of fluctuations in valve movement can be related to input signal. Press **C** key to view actual mA input signal.

---

## 9.7.2 Input signal - mA signal display

### Programming notes

The mA input signal will be displayed. Press **C** key to return to displaying % travel. The programme will automatically return to displaying % travel after 5 minutes. It is possible to advance to view valve diagnostics data **STRVL** (total valve strokes) and **RTIME** (total run time).

To advance to **STRVL** press and hold **C** key for 3 seconds. The display will count the 3 seconds.

### Commissioning notes

This function is of assistance to visualise and check input signal relative to valve position and to investigate causes of fluctuations in valve movement. The mA input signal will be displayed for 5 minutes. Press **C** key to return to displaying % travel. The programme will automatically return to displaying % travel after 5 minutes.

## 9.8 STRVL and RTIME - valve diagnostics

Provides visibility of total number of valve strokes (**STRVL**) and total valve run time in hours (**RTIME**).

### 9.8.1 STRVL - total stem travel

#### Programming notes

The number displayed should be multiplied by a factor of 10 to obtain the total number of complete valve strokes. A complete valve stroke is as measured in autostroke **AUTOS**.

The number displayed can be retained (**RTAIN**) or reset to zero (**RESET**). Press the **C** key to advance to **RTAIN/RESET**. Press **▲** and **▼** keys to toggle selection.

Press **C** key to accept the displayed selection and advance to run time **RTIME**.

### Commissioning notes

Information displayed should be used in conjunction with total runtime **RTIME** to assess the valve usage and evaluate the need for routine maintenance, replacement of stem seals etc. The number displayed should be multiplied by a factor of 10 to obtain the local total number of complete valve strokes. (A complete valve stroke is as measured in autostroke (**AUTOS**)). The maximum possible display value is **99999**. If this value is exceeded, the display will roll over to zero and an **!** will be displayed. To retain the displayed value press the enter key and select **RTAIN**. If the valve is dismantled for maintenance inspection etc. The value can be reset if required by selecting **RESET**.

## 9.8.2 RTIME - total valve run time in hours

### Programming notes

The number displayed is the total valve run time in hours. Run time is defined as the total time the positioner is receiving a control signal.

The number displayed can be retained (**RTAIN**) or reset to zero (**RESET**). Press the **C** key to advance to **RTAIN/RESET**. Press **▲** and **▼** keys to toggle selection.

Press **C** key to accept the displayed selection and return to displaying % travel.

### Commissioning notes

Information displayed should be used in conjunction with total valve strokes (**STRVL**) to assess the valve usage and evaluate the need for routine maintenance, replacement of stem seals etc.

To retain the displayed value press **C** key and select **RTAIN**. If the valve is dismantled for maintenance inspection etc. The value can be reset to zero if required by selecting **RESET**.

## 9.9 RETRN - return to SP2 MENU in main menu



Fig. 55

### Programming notes

Press and hold **C** key for 3 seconds. The display will count down the 3 seconds.

This provides the facility to return to **SP2 MENU** with the option of staying in automatic operation (**AUTO**) or venting the actuator (**VENT**). Use **▲** and **▼** keys to toggle selection. Press **C** key to select and return to **SP2 MENU**.

### Commissioning notes

To alter any **SET** or **TUNE** values, go into manual control (**MCTL**) or to check the calibration of the feedback potentiometer (**CALIB**) it is necessary to return to **SP2 MENU**.

Any values altered will be recorded in the temporary memory and activated immediately. To store in the permanent memory it will be necessary to advance to **RUN** and press and hold **C** key for 3 seconds. The display will count down the 3 seconds.

To return to the main menu but stay in automatic control select **AUTO**. The valve will continue in automatic operation and respond to changes in input control signal. With the exception of **CALIB** and **MCTL** functions, main menu and subroutines will timeout after 5 minutes if no key is pressed and revert to displaying % **TRAVEL** in automatic control mode. Any temporary changes made will not be recorded in the permanent memory.

To return to main menu in a fail-safe position select **VENT**. The actuator will be fully vented of air and the valve will return to its fail-safe position.

To return to manual control (**MCTL**) advance to **MANOP** in the main menu and advance to manual control (**MCTL**). The valve can now be manually controlled using the **▲** and **▼** keys to inflate or deflate the actuator. The desired % **TRAVEL** will be displayed.

To return to automatic control advance to **RUN** and press **C** key for 3 seconds. The display will count down the 3 seconds. The valve will revert to automatic control and position itself relative to the input control signal. Any **SET** or **TUNE** values altered will be recorded in the permanent memory.

## 10.1 Air supply quality

As stated in Section 5.2, it is important for correct operation of the SP2 positioner that good quality air is supplied.

It is therefore recommended that a Spirax Sarco MPC2 filter regulator or equivalent is fitted on the air supply to the positioner. In addition the SP2 positioner has an internal filter. In normal operation it is recommended that this filter is replaced every 6 to 12 months depending on the air quality and valve usage. A spare filter plug kit can be obtained from Spirax Sarco that includes: filter plug, plus 3 off 'O' rings and filter.

## 10.2 Fitting replacement filter plug kit

**To change the filter proceed as follows:**

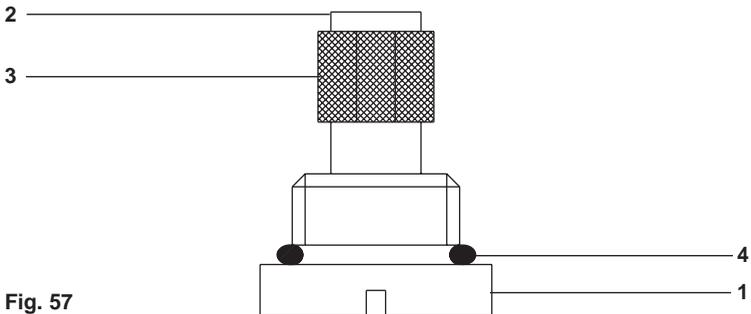
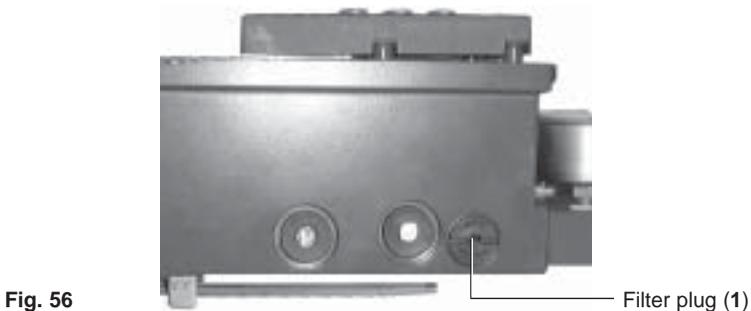
- Ensure that the air supply to the positioner is isolated.
- Unscrew the filter plug (1) from the SP2 housing using a 5 mm allen key (refer to Figure 56).

**The replacement filter plug can now be fitted:**

- Fit the 'O' ring (4) and filter (3) onto the filter plug (1) (refer to Figure 57).
- Finally fit the retaining screw (2).

The filter plug can now be replaced into the SP2 housing, checking that the 'O' ring (4) is correctly located.

The pneumatic air supply can now be restored to the positioner and checks made to ensure that the filter plug 'O' ring has provided the necessary air tight seal.



# 11. Default values and program settings

Main menu	Sub-menu	Setting options	Default value	Programmed value
<b>SET</b>	Valve type ( <b>VALVE</b> )	<b>2-PORT</b> <b>3-PORT</b>	( <b>2-PORT</b> )	
<b>SET</b>	Control action ( <b>CTRLA</b> )	Direct ( <b>dIRECT</b> ) Reverse ( <b>REV</b> )	( <b>dIRECT</b> )	
<b>SET</b>	Minimum travel ( <b>MIN-T</b> )	0 to 66%	0%	
<b>SET</b>	Maximum travel ( <b>MAX-T</b> )	33 to 100%	95% for 2-port 100% for 3-port	
<b>SET</b>	Displayed % travel ( <b>DTRVL</b> )	<b>ON</b> <b>OFF</b>	<b>ON</b>	
<b>SET</b>	Minimum input signal ( <b>MIN-R</b> )	4 to 16 mA	4 mA	
<b>SET</b>	Maximum input signal ( <b>MAX-R</b> )	8 to 20 mA	20 mA	
<b>TUNE</b>	Dead-band ( <b>dBAND</b> )	0.2 to 10% (% of input signal span)	0.5%	
<b>TUNE</b>	Minimum shut-off ( <b>S-MIN</b> )	<b>OFF</b> , 0 to 20%	0.1%	
<b>TUNE</b>	Maximum shut-off ( <b>S-MAX</b> )	<b>OFF</b> , 0 to 20%	<b>OFF</b> for 2-port 0.1% for 3-port	
<b>TUNE</b>	Characteristic ( <b>CHAR</b> )	Linear ( <b>LIN</b> ), Equal ( <b>EQUAL</b> ), Fast ( <b>FAST</b> )	( <b>LIN</b> )	
<b>TUNE</b>	Time-up ( <b>T-UP</b> )	Autostroke time – 180 seconds	Autostroke time (seconds)	
<b>TUNE</b>	Time-down ( <b>T-dWN</b> )	Autostroke time – 180 seconds	Autostroke time (seconds)	
<b>TUNE</b>	Travel switch 1 ( <b>TS1</b> ) - optional	<b>OFF</b> , 0 to 100%	( <b>TS1 OFF</b> )	
<b>TUNE</b>	Travel switch 2 ( <b>TS2</b> ) - optional	<b>OFF</b> , 0 to 100%	( <b>TS2 OFF</b> )	
<b>RUN</b>	Return to menu	Auto ( <b>RETRN AUTO</b> ) Vent ( <b>RETRN VENT</b> )	( <b>RETRN AUTO</b> )	

# 12. Glossary of display data

## 12.1 Main menu display functions

Display	Description
<b>SET UP NOW</b>	Indicates that the SP2 positioner fitted to the valve has not been programmed or commissioned.
<b>SP2 MENU</b>	Indicates that you have now entered the SP2 main menu. <b>Provides access to:</b> <ul style="list-style-type: none"> <li>• View the version of the embedded software.</li> <li>• Adjust the centre position of the feedback potentiometer (<b>CALIB</b>).</li> <li>• Retain temporary changes to menu values (<b>RETRN</b>).</li> <li>• Recall previously stored menu values (<b>RTAIN</b>).</li> <li>• Reset to default values (<b>RESET</b>).</li> </ul>
<b>MAN OP AUTOS</b>	Provides access to manual control ( <b>MCTL</b> ).  <b>Provides access to:</b> <ul style="list-style-type: none"> <li>• Autostroke commissioning routine.</li> </ul> <b>Note: SET, TUNE and RUN functions can only be accessed after a successful AUTOSTROKE routine has been completed.</b> <ul style="list-style-type: none"> <li>• Selection of percentage travel display % (<b>TRAVL</b>).</li> </ul>
<b>SET</b>	<b>Provides access to valve set up functions as follows:</b> <ul style="list-style-type: none"> <li>• Valve type (<b>VALVE</b>).</li> <li>• Control action (<b>CTRLA</b>).</li> <li>• Minimum valve travel (<b>MIN-T</b>).</li> <li>• Maximum valve travel (<b>MAX-T</b>).</li> <li>• Displayed % travel (<b>DTRVL</b>).</li> <li>• Minimum signal range (<b>MIN-R</b>).</li> <li>• Maximum signal range (<b>MAX-R</b>).</li> </ul>
<b>TUNE</b>	<b>Provides access to additional valve characterisation functions as follows:</b> <ul style="list-style-type: none"> <li>• Dead-band sensitivity (<b>dbANd</b>).</li> <li>• Valve shut-off minimum setting (<b>S-MIN</b>).</li> <li>• Valve shut-off maximum setting (<b>S-MAX</b>).</li> <li>• Valve signal – lift characterisation (<b>CHAR</b>).</li> <li>• Valve slow opening time (<b>T-UP</b>).</li> <li>• Valve slow closing time (<b>T-dWN</b>).</li> <li>• Setting software travel switch 1 (normally open) (<b>TS1</b>) – optional.</li> <li>• Setting software travel switch 2 (normally closed) (<b>TS2</b>) – optional</li> </ul>
<b>RUN</b>	<b>Provides access to:</b> <ul style="list-style-type: none"> <li>• Commencing automatic operation.</li> <li>• Displaying percentage valve travel (%).</li> <li>• Visualisation of input mA input signal (<b>mA</b>).</li> <li>• Total stem strokes (<b>STRVL</b>).</li> <li>• Total running time (<b>RTIME</b>).</li> <li>• Return to SP2 menu (<b>RETRN</b>).</li> </ul>

## 12.2 Sub-menu display functions

Display	Description
<b>VER x.xx</b>	Indicates the version of software embedded within the SP2 positioner.
<b>CALIB</b>	Provides facility to re-centre feedback potentiometer.
<b>RETRN</b>	Enables previously stored function values to be recalled.
<b>RTAIN</b>	Enables temporary changes made to function values to be retained.
<b>RESET</b>	Enables all function values to be reset to default settings. Refer to Section 11, page 50 for default settings.
<b>MCTL</b>	Provides manual control of the valve. Use ▲ and ▼ keys (??) to fill or vent the actuator.
<b>TRAVL</b>	Selection of percentage of travel display - 0 to 100% or 100 to 0% depending on valve and actuator configuration.
<b>AUTOS</b>	Initiates the autostroke automatic commissioning routine.
<b>AbORT</b>	Indicates that the <b>AUTOS</b> commissioning routine has been aborted.
<b>VALVE</b>	Selection of 2-port or 3-port valve.
<b>CTRLA</b>	Selection of input signal control action 4 - 20 mA or 20 - 4 mA.
<b>MIN-T</b>	Setting of minimum valve travel % to prevent the valve fully closing.
<b>MAX-T</b>	Selection of maximum valve travel % to prevent the valve fully opening.
<b>DTRVL</b>	Selection of displaying 0 - 100% travel over the mechanical travel limits or adjusted MIN-T / MAX-T settings.
<b>MIN-R</b>	Selection of the input signal related to the minimum valve travel ( <b>MIN-T</b> ).
<b>MAX-R</b>	Selection of the maximum input signal related to maximum valve travel ( <b>MAX-T</b> )
<b>dbANd</b>	Selection of % valve position dead-band sensitivity.
<b>S-MIN</b>	Facility to select pre-determined input signal to fully close the valve at the minimum travel position.
<b>S-MAX</b>	Facility to select a pre-determined input signal to fully close the valve at the maximum travel position.
<b>CHAR</b>	Selection of input signal to valve lift characterisation. <b>Options include:</b> <ul style="list-style-type: none"> <li>• Linear (<b>LIN</b>)</li> <li>• Equal percentage (<b>EQUAL</b>)</li> <li>• Fast opening (<b>FAST</b>)</li> </ul>
<b>LIN</b>	Indicates a linear relationship between the input signal and the valve travel.

Display	Description
<b>EQUAL</b>	Indicates an equal percentage relationship between the input signal and the valve travel.
<b>FAST</b>	Indicates a fast opening relationship between the input signal and the valve travel.
<b>T-UP</b>	Facility to slow down the valve opening movement.
<b>T-dWN</b>	Facility to slow down the valve closing movement.
<b>TS1</b>	Setting of % travel for software travel switch 1 (normally open).
<b>TS2</b>	Setting of % travel for software travel switch 2 (normally closed).
<b>%</b>	Indicates percentage of valve travel in automatic operation or manual control ( <b>MCTL</b> ).
<b>mA</b>	Indicates the input signal in mA.
<b>AUTOC</b>	Return to <b>SP2 MENU</b> remaining in automatic control operation.
<b>FILL</b>	Indicates the actuator is being filled with air (manual control before <b>AUTOS</b> ).
☺	Indicates that there are no problems with the positioner.
<b>!</b>	A warning indication of an error.
<b>ERROR 1 (AUTOS)</b>	Indicates an error with the mechanical set up.
<b>ERROR 2 (AUTOS)</b>	Indicates that there is insufficient air pressure to position the valve.
<b>ERROR 3 (AUTOS)</b>	Indicates that the air cannot be vented from the actuator.
—	Software travel switch ( <b>TS1</b> and <b>TS2</b> ) - closed.
/	Software travel switch ( <b>TS1</b> ) - open.
\	Software travel switch ( <b>TS2</b> ) - open.
<b>STRVL</b>	Indicates the total number of valve strokes (x10). Value can be retained ( <b>RTAIN</b> ) or reset ( <b>RESET</b> ).
<b>RTIME</b>	Indicates the total run time of the SP2 in hours. Value can be retained ( <b>RTAIN</b> ) or reset ( <b>RESET</b> )

