

EX210

Compact Electronic Actuator Positioner –
for use in EX2010 B System



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Features

- Large backlit liquid crystal display
- Communication via IR900 infra red keypad for adjustments within Hazardous Areas
- Simple two-step calibration
- Calibration trim for fine adjustment
- 4-20mA current command signals and current or potentiometer feedback signal.
- Actual position 4-20ma calibrated output
- Three way isolation for command and actual position signals
- MANUAL mode
- Stepping mode with adjustable ON and OFF times
- Selectable solenoid drive sense for failsafe operation
- Selectable default operation on command signal/feedback signal break
- ESD solenoid output on fault - 24Vdc open drain
- Fault output - 24Vdc open drain
- Hydraulic pump drive controlled by demand or external pressure sensors
- External fault contact monitoring
- Selectable interlock between ESD and fault outputs
- Local adjustment inhibit by remote contact closure
- Fault and status logging
- Low power - normal operation less than 3W
- Direct mounting within Compact Ex d Enclosure System EX2010 B

The EX210 can be used in any positioning system relying on the on-off control of the position driver including electro-hydraulic actuators and reversing ac motors (with the addition of suitable relays or contactors). The EX210 can accept positional feedback from a three-wire potentiometer or a position transducer with a current output. The EX200 is mounted to a special chassis plate and fitted within an Ex d enclosure - EX2010 B. All field and customer wiring is taken through a close-coupled Ex e enclosure. Comprehensive power supply and signal isolation allows connection to any user DCS system without the need for further signal isolation.

This handbook describes the configuration and operation of the basic EX210. Other hardware and firmware options will be described in additional sections published separately.

Contents

What the EX210 does.....4
 What the EX210 looks like..... 4

How to connect the EX210.....4
 Switching on the EX210 for the first time.....4
 Normal operation display.....4
 How to ‘tune’ the actuator system.....4

How can I get into the EX210 Manual and Configuration Modes?..... 6

How do I get into Manual Mode and operate the actuator with the IR900.. 6
 How can I adjust the stepping mode timers interactively?.....7
 How do I leave Manual Mode?.....7

What other displays might I see in Automatic mode?..... 8
 What do the LEDs above the display mean?.....6

How do I get into Configuration and Calibration modes?..... 6
 How do I calibrate the EX210?..... 6
 How do I ‘trim’ the zero end of the calibration?.....10

How do I set up the EX210 basic operating parameters?11
 How do I set the EX210 solenoid sense?.....11
 How do I set the EX210 Fail Mode?.....11
 Fail to Position..... 12
 Slow/Fat fail operation..... 12
 How so I set Self Contained pump control?..... 12
 On demand run-on time.....13
 Pressure transmitter set points.....13
 How do I calibrate the Pressure TX for pump control?13
 How do I set Stepping mode?.....14
 How do I set Dead zone and band edge hysteresis?.....14
 How do I set the EX210 Input and output sense?.....15
 How do I set the EX210 action on faults?..... 15

Utilities Menu – Page 1..... 16
 Date and Time..... 16
 Miscellaneous Timers..... 16
 Manual Pass Code.....17
 Configuration Mode Pass Code..... 17
 Force retransmitted signal output..... 17

Utilities Menu – Page 2.....18
 View Fault and Status Log.....18
 Reset Fault Log Index.....19
 Load/Save Instrument Configuration..... 19

Utilities Menu – Page 3.....19
 Display Instrument Details.....19

Why doesn’t the EX210 work?.....20

EX210 physical appearance – drawing..... 21
 EX210 Specification.....22
 Connections description.....23

What the EX210 does

The instrument compares two analogue signals, one representing the desired position (**demand or command signal**) and the other representing the actual position (**feedback signal**) from a position transducer mounted on the actuator.

A difference between these two signals will cause one of the EX210 outputs to operate electro-hydraulic solenoids, driving the actuator to the desired position.

A positional **dead-zone or dead-band** may be adjusted to overcome “hunting” problems associated with mechanical overrun of the actuator.

The speed of transit of the actuator can be reduced by selecting the **stepping mode** that provides independently adjustable on and off times for the open and close solenoid operation.

The instrument outputs a galvanically isolated 4-20mA signal (**retransmitted output**), proportional to the calibrated stroke of the actuator.

Please read this handbook carefully before operating the EX210. The instrument will have been set up during factory trials so please avoid changing any parameters until you have gained some familiarity with the operation of the positioner.

What the EX210 looks like

The EX210 is mounted on a chassis plate and housed within an Ex d enclosure. It has an 8 line x 20 character display and 8 LEDs above the display. The circuit boards are coated with a resist layer that protects the track from moderate condensation and mould growth problems. Connections within the Ex d enclosures are by factory assembled 0.1” connectors and must not be disturbed or re-wired. The only internal hardware configuration adjustment is the jumper link selection of either sinking or sourcing excitation of the retransmitted actual position signal and is usually set to customer requirements on order.

The EX210 requires the Intrinsically Safe (Ex’ia’) IR900 keypad for calibration, configuration and manual operation.

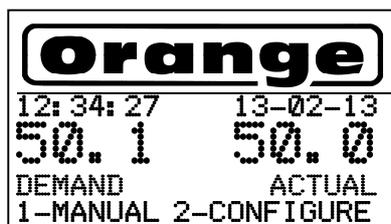
How to connect the EX210

Not all installations will have the same wiring arrangement. Only use the hook-up drawing provided for the specific installation. Wiring to the Ex e enclosure terminals should be completed by suitably trained personnel taking into account the following notes:

- To ensure RFI compliance the analogue signals should be routed in copper braided screened cables with a fill factor density of at least 0.7.
- The screens should be terminated to the metal of the actuator housing, ideally at a suitable metal cable gland.
- Signal cables should be routed separately from power and switching conductors.

Switching on the EX210 for the first time

When the EX210 is first switched on the display it should show the normal running status:



Normal Display

A Company Logo is displayed over the first three lines. The first text line shows the time as hrs:mins:secs (24 hour clock) followed by the date as dd:mm:yy. The main display shows the current demand signal as a percentage of the full range, normally 4-20mA followed by the actuator stroke as a percentage of the full stroke.

The actuator should not be moving and the Actual display should reflect its physical position. Similarly, the Demand display should reflect the applied demand signal. There should be a retransmitted signal proportional to the current position of the actuator.

If the Company Logo does not show and/or either the Demand or Actual display shows -99.9, then there is a problem with the external components of the system e.g. the wiring, demand signal, hydraulic supply or electrical supply. Please see the section **Why doesn't the EX210 work?**

If the actuator has been fitted to a valve and passed through factory commissioning, then all that is necessary will be ‘tuning’ the actuator to the site conditions i.e. the valve operating under process conditions with the local hydraulic supply. If there is any doubts as to the calibration of the unit then proceed first to **How do I calibrate the EX210?**

How to ‘tune’ the actuator system

Ideally, the EX210 will position the actuator exactly to the position directed by the Demand signal without any overshoot or instability.

Why do we need to ‘tune’ the actuator system?

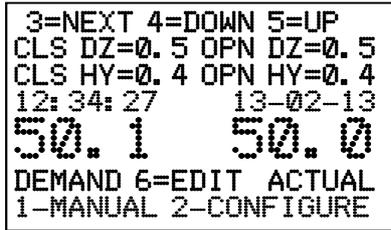
As the speed of the actuator increases, by increasing the flow rate of the hydraulic system, the stability decreases as more unwanted fluid is passed during the electro-mechanical operation of the solenoids valves. This unwanted fluid causes the actuator to overshoot the desired position.

If we can cause the solenoid to switch a little earlier when approaching the desired position then the overshoot is turned into a ‘coast’ to this position. This offset is the **dead-zone or dead-band** and can be set independently for each direction of travel. The dead-zone can be adjusted in increments of 0.1% of the total stroke of the actuator.

In addition to the dead-zone, an additional parameter is available for each direction of travel, **open hysteresis and close hysteresis**. This is an additional offset that is added to the dead-zone as the actuator commanded to move away from its stable position and ensures that no instability at the edge of the dead-zone due to small analog to digital conversion variations in processing on the incoming signals.

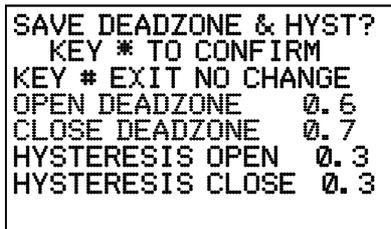
How to adjust the dead-zone or dead-band interactively

- 1) Before attempting ‘tuning’ make sure that the hydraulic flow rate is set to give a stroking speed that is acceptable for the process being controlled. Where possible, make this speed *as low as possible* to give the best potential performance of the system. The hydraulic flow rate should be set according to the actuator Manufacturer’s Instructions and is best performed with the EX210 in **manual mode** see How to operate the EX210 in Manual Mode.
- 2) Provide a local demand signal, preferably with a process calibrator with a ‘stepped’ output over the 4-20mA range. Monitor the retransmitted actual position signal locally with a DVM or process calibrator.
- 3) In the **Normal Display** press Key 9 in the IR900
- 4) The display will be modified:



Tuning Display

- 5) The first of the four parameters, **CLS DZ** (close dead-zone) will be shown in reverse, indicating that this parameter can be edited. Pressing Key 3 on the IR900 will cycle the highlight round the other three positions.
- 6) Set the demand signal at 75%, and allow the actuator to position. It may be unstable.
- 7) Switch the demand signal to 50% and note if there is any overshoot. If there is then, with CLS DZ highlighted, press Key 6 on the IR900. The display will show a highlighted **‘EDITING’** label. The actuator solenoids will relax to their stop position.
- 8) Use Key 5 (up) to increase the close dead-zone, perhaps by 5 (0.5%). Press Key 6 again.
- 9) Repeat steps 6) and 7) until the overshoot disappears in the close direction. Confirm the best adjustment by reducing the close dead-zone (Key 5) and finding the transition between stability and instability.
- 10) Repeat the process for an increasing demand signal (25% to 50%) and editing the **OPM DZ** (open dead-zone) to give the best stability.
- 11) If any ‘flickering’ of the EX210 solenoid indicator LEDs occurs, then the **CLS HY** (close hysteresis) and **OPN HY** (open hysteresis) parameters can be adjusted in the same fashion as the dead-zones to reduce this band-edge instability.
- 12) When all adjustments have been completed satisfactorily, press Key 9. The display will change:



Tuning ‘accept’ Display

- 13) Press Key * to accept the changes or Key # to return to the Normal Display.

How can I get into the EX210 Manual and Configuration Modes?

The EX210 has some protection against unauthorised entry into these modes. If the instrument is left in either Manual or Configuration then it will not spontaneously return to automatic mode and the remote operator will lose control of the process.

Hardware access enable

Access can be controlled by an external volt free contact or +24V level between Terminal 30 and the +24Vdc, Terminal 19.

The sense of the contact can be selected – see **How do I configure the digital I/O.**

If unrestricted access to the EX210 is desired then select NORmal for choice 4 ENABLE, to enable access without any external connections.

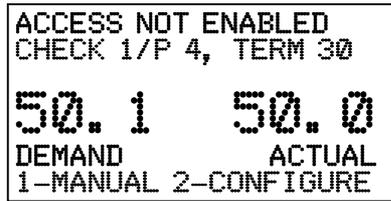
When enabled, LED 6 is lit and an external output on Terminal 26 changes state to give a remote alert that instrument access is enabled.

Communications (HART or FF) access enable

For HART or FF enabled EX210 positioners, there is a further software enable. Please see the appropriate HART or FF Supplement.

How do I know if access is enabled or not?

If you press Keys 1 or 2 from the Normal Display and you see this display, then EX210 access is NOT enabled.



Access 'Not enabled' Display

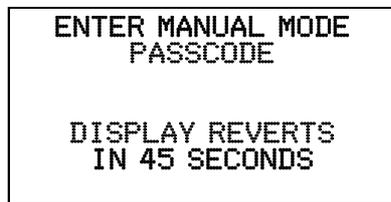
This display will show for several seconds during which time the positioner will continue to operate in automatic mode.

Passcode protection for Manual and Configuration modes

In addition to the hardware enable described above, both Manual and Configuration Modes are protected by different four digit passcodes. These passcodes are only effective if a demand signal of 4mA or greater is present.

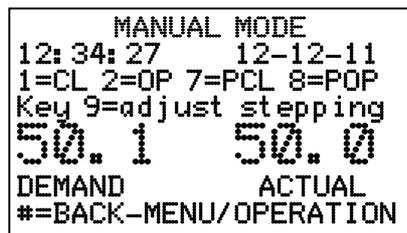
How do I get into Manual Mode and operate the actuator with the IR900?

- 1) Press Key 1. If hardware access is enabled then the following display shows:



Manual passcode entry display

- 1) The counter drops in one second increments, giving time to enter the required four digits.
- 2) If the incorrect code is entered or the counter goes to zero then the display reverts to normal.
- 3) If the correct code is entered, the following display is seen:



Manual mode main display

- 4) The DEMAND signal is displayed but ignored for automatic positioning and the ACTUAL signal reflects the position of the actuator. The actuator solenoids are in their 'stop' position.
- 5) Key 1 to close the actuator, **1=CL** will be highlighted. The actuator will continue to close until Key 1 is pressed again. The same applies to Key 2, **2=OP**, to open the actuator.
- 6) Key 7, **7=PCL** applies a chain of brief pulses to close the actuator, similarly Key 8, **8=POP** pulses the actuator open. The action is stopped by pressing the key again.
- 7) If any Key 1,2,7 or 8 is 'active' then no other key will have any effect.
- 8) The actuator can be operated, under the control of the IR900, to adjust open and close speed via the hydraulic flow controls or to position the actuator in the absence of a demand signal.

How can I adjust the stepping mode timers interactively?

As well as providing a continuous on-off drive to the solenoids, the EX210 can pulse them with an adjustable mark-space ratio. Normally the ON time is adjusted to the shortest pulse that will reliably cause a movement of the actuator and the OFF time can be set to give the required stroking time. This is particularly useful if the desired stroke time is too slow to allow adjustment via the hydraulic flowrate.

- 1) In Manual Mode, press Key 9. The normal Manual display changes to:

```

MANUAL MODE
12: 34: 27      12-12-11
1=CL 2=OP 7=PCL 8=POP
CL0.5 010  OP0.3 015
50.1  50.0
DEMAND 6=EDIT ACTUAL
#=BACK-MENU/OPERATION
    
```

Stepping mode adjust display

- 2) Normal operation with Keys 1 and 2 continues but not the solenoids are pulsed according to the displayed times:
CL0.5 010 – indicates the CLOSE solenoid will pulse with an ON time of 0.5s and an OFF time of 10s
OP0.3 015 – indicates the OPEN solenoid will pulse with an ON time of 0.3s and an OFF time of 15s
- 3) Pressing Key 3 cycles an editing highlight over each of the four parameters
- 4) If Key 6 is pressed the highlighted parameter can be edited using Keys 4 to reduce and 5 to increase the value. Pressing Key 6 again ends the edit and the new value can be seen operating if Keys 1 or 2 are pressed.
- 5) Press Key 9 to leave the stepping adjustment routine back to Manual mode

How do I leave Manual Mode?

- 1) Press Key # to leave Manual mode.
- 2) If any of the timers have been changed during the Manual session then the following display is shown:

```

SAVE STEP TIMES?
KEY * TO CONFIRM
KEY # EXIT NO CHANGE
CURRENT OPEN TIMES
ON 0.5s  OFF 010s
CURRENT CLOSE TIMES
ON 0.3s  OFF 015s
    
```

Stepping change save display

- 3) Press Key * to accept the changes or Key # to return to the Normal Display.
- 4) If, on exit from Manual operation, the actuator position differs from the demanded position by more than 5% then the following screen warns of the potential of and unwanted step change in valve position when automatic operation resumes.

```

WARNING
DEMAND AND ACTUAL ARE
NOT EQUAL
KEY 1=BACK TO MANUAL
#=BACK-MENU/OPERATION
    
```

Manual exit warning display

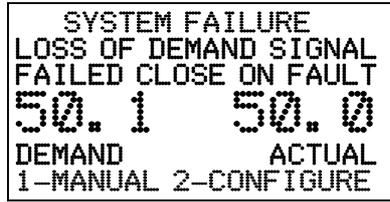
- 5) Key 1 will return to manual mode and Key # will resume automatic mode with the Normal display.
- 6) If the EX210 is left in Manual mode then it will remain there indefinitely, however, if the Hardware Enable state is changed – see **How can I get into the EX210 Manual and Configuration Modes?** – then the operation will revert to automatic operation without any local operator intervention.

What other displays might I see in Automatic mode?

Status displays

Changes to the external conditions of the EX210 can be displayed as they occur. These are normally fault conditions selected for display – see **What faults can the EX210 detect?** and **What does the EX210 do when a fault occurs?**

If a fault condition is selected for display then the normal display will change:



System fault and action display

Descriptions of faults can include the following:

LOSS OF DEMAND SIGNAL
 LOSS OF F/B SIGNAL
 FAILURE TO POSITION
 EXTERNAL FAULT INPUT

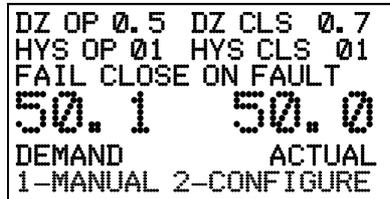
Positioner actions on fault can include the following:

FAILED CLOSE ON FAULT
 FAILED OPEN ON FAULT
 FAILED STAY PUT
 GO TO POSN. ON FAULT
 AT REST PUMP OFF

The failed system information will be reset to a normal display when the fault condition has been resolved, or, in the case of a failure to position, Key 0 is pressed to de-latch the fault and restart the failure to position timer.

Tuning parameter detail display

Pressing key 3 on the IR900 keypad toggles an alternative display. The Company Logo is overwritten by the current dead zone, band edge hysteresis data and the current fail-mode setting:



Tuning parameter display

Line 1 – OPEN dead-zone, CLOSE dead-zone

Line 2 – OPEN hysteresis, CLOSE hysteresis

Line 3 – Current fail mode

Pressing Key 3 again restores the Normal display.

What do the LEDs above the display mean?

There are 8 LED indicators above the main display and they have the functions, running clockwise from top right:

- | | |
|-----------|------------|
| CLOSE [8] | [1] OPEN |
| FAULT [7] | [2] MANUAL |
| ENBL [6] | [3] STEP |
| [5] PUMP | ESD [4] |

1. OPEN – lit when the open solenoid is energised
2. MANUAL – lit when the EX210 is in manual mode
3. STEP – lit when stepping mode has been selected
4. ESD – lit when the ESD output is energised – this may be ‘fail-safe i.e. energised healthy
5. PUMP – lit when the hydraulic pump is ON if pump control is selected
6. ENABLED – lit when the enable contact has been made, enabling access to manual and configuration
7. FAULT – lit when there is a fault within the EX210 system– this may be ‘fail-safe i.e. energised healthy
8. CLOSE – lit when the close solenoid is energised

How do I get into Configuration and Calibration modes?

You should only need to configure or calibrate the EX210 one time during its site life. Note down any changes made to the parameters for future reference.

- 1) Press Key 2. The Configuration Passcode Display will show if entry is enabled – see **How can I get into the EX210 Manual and Configuration Modes?**

```
ENTER CONFIG. MODES
PASSCODE

DISPLAY REVERTS
IN 45 SECONDS
```

Configuration mode entry display

- 2) If enabled and the correct passcode is entered (note that the demand signal should be 4mA or greater), automatic positioning is suspended; the actuator is left in its stay put position and the pump is stopped.

```
CONFIGURATION MENU
1 - CALIBRATION
2 - CALIBRATION TRIM
3 - INST. SET UP MENU
4 - UTILITIES MENU

#=BACK-MENU/OPERATION
```

Configuration mode Menu

- 3) Key 1 to 4 selects one of the options shown and key # returns the display and operation to automatic mode. If the Enable Input is changed whilst the unit is in this Main Configuration Menu then operation is immediately transferred back to normal, automatic operation. However, there is no automatic exit from Configuration from within any of the four choices displayed in this menu.

How do I calibrate the EX210?

Calibration ONLY sets the relationship between the Demand Signal, the Actual Position of the actuator, the Retransmitted Position Signal and, as a consequence, the displayed values of Demand and Actual. Recalibration will NOT solve problems associated with positional accuracy and response. These need to be addressed via the hydraulic fluid flow rate and the Tuning Parameters – see **How to ‘tune’ the actuator system.**

Calibration is a two-stage procedure requiring control of the demand signal to the EX210, a view of the physical position of the actuator and a means of measuring the retransmitted signal from the unit. The actuator and valve may need to be isolated from the process as full stroke operation of the actuator is required. It is usually best if the demand signal injection (Process Calibrator) and the actual retransmitted position signal monitoring (DVM or Process Calibrator) is done locally to the EX210 and actuator.

- 1) Select Calibration from the Configuration Menu by pressing key 1

```
MANUAL CALIBRATION
1=CL 2=OP 7=PCL 8=POP
RETRANS ADJ 4=DW 5=UP
ZERO-Press * for span
C=0176 F=0178 R=0651

Press key # to abort
```

Zero calibration display

- 2) Set the Demand signal to 4mA.
- 3) Set the actuator position to the required ZERO position, operating the solenoids as described in - **How do I get into Manual Mode and operate the actuator with the IR900?**
- 4) Use Keys 4(down) and 5(up) to adjust the Retransmitted Signal, as seen on the DVM to the desired output, normally 4mA. The action of these keys is ‘toggled’ i.e. press once to start decreasing or increasing the retransmitted signal output and press again to stop the action. The action is shown by highlights on the display.
- 5) Press Key * to proceed to the SPAN position calibration or Key # to abort the procedure and return to the Configuration Menu.

6) The display changes for the SPAN calibration:

```
MANUAL CALIBRATION
1=CL 2=OP 7=PCL 8=POP
RETRANS ADJ 4=DW 5=UP
ZERO-Press * for span
C=0176 F=0178 R=0651
SPAN-Press * for end
C=0877 F=0875 R=3270
Press key # to abort
```

Span calibration display

- 7) Set the Demand signal to 20mA. Set the position of the actuator using manual operation of the solenoids as in 3) above and modify the retransmitted signal as described in 4) above.
- 8) Press Key * to continue or Key # to abort the calibration and return to the Configuration Menu.
- 9) At the end of the calibration, the following screen is shown:

```
MANUAL CALIBRATION

KEY * TO CONFIRM
CALIBRATION

KEY # -LEAVE WITHOUT
SAVING CALIBRATION
```

Calibration accept display

10) Press Key * to accept and store the calibration parameters or Key # to leave without saving the calibration.

How can I 'trim' the zero end of the calibration?

You can 'trim' the ZERO end of the calibration, maybe to set the seating of a valve.

1) Press Key 2 in the main Configuration Menu. The following display will show:

```
CALIBRATION TRIM
DEMAND at close value
Adj. ACTUATOR to suit
1=CL 2=OP 7=PCL 8=POP
C=0176 F=0178 R=0651

Press * for end
Press key # to abort
```

Trim calibration display

- 2) Set the Demand signal to the required ZERO value, usually 4mA.
- 3) Set the actuator position to the required ZERO position, operating the solenoids as described in - **How do I get into Manual Mode and operate the actuator with the IR900?**
- 4) Use Keys 4(down) and 5(up) to adjust the Retransmitted Signal, as seen on the DVM to the desired output, normally 4mA.
- 5) Press Key * to proceed to the SPAN position calibration or Key # to abort the procedure and return to the Configuration Menu.
- 6) An accept display is shown:

```
CALIBRATION TRIM

KEY * TO CONFIRM

KEY # EXIT NO CHANGE
```

Trim calibration accept display

7) Press Key * to accept and store the trim calibration parameters or Key # to leave without saving the calibration.

How do I set up the EX210 basic operating parameters?

You should NOT need to change any of these parameters as they will have been set and checked during tests at the actuator manufacture’s facility, when the valve was fitted to the actuator and during final FATs. Please discuss any proposed changes with your suppliers before adjustment.

These sub-menus allow the setup of the positioner to suit the hydraulic hardware, the control signals and the process control required.

```
INSTRUMENT SETUP MENU
1 - SOLENOID SENSE
2 - INST. FAIL MODE
3 - PUMP CONTROL
4 - SET STEPPING MODE
5 - SET DEADZONE, HYST
6 - MORE CHOICES
#=#BACK-MENU/OPERATION
```

Setup Menu - 1

- 1) Press Key 1-6 to select the required action.
- 2) If Key 6 is pressed, Page 2 is displayed.

```
SETUP MENU – PAGE 2
1 - SET I/P, O/P SENSE
2 - SET FAULT MATRIX

#=#BACK-MENU/OPERATION
```

Setup Menu - 2

- 3) Press Key # when in Page 1 to return to normal positioning.

How do I set the EX210 Solenoid Sense?

This allows the matching of the solenoid control with the particular hydraulic circuit used and is normally a one-off adjustment completed during factory tests. The open and closed solenoids can be assigned to cause flow either when energised or when de-energised. This allows the three common hydraulic configurations, stay put, fail close or fail open, under fault conditions. The following screen is displayed:

```
SET SOLENOID SENSE
CURRENT CHOICE IS 1
1 - STAY PUT
2 - FAIL CLOSE
3 - FAIL OPEN
#=#BACK-MENU/OPERATION
```

Set solenoid sense display

- 1) Press Key 1-3 to select the desired solenoid configuration.
- 2) Press Key # to save changes and return to the Configuration Menu

How do I set the EX210 Fail Mode?

The EX210 can detect failures in the systems connected. The demand or actual position feedback signals are monitored and an alarm is set if they stray outside the normal 4-20mA range – the detection points are less than 1mA or greater than 21mA. The time taken to position is monitored and an alarm set if position has not been attained. An external contact input, possibly monitoring hydraulic pressure unit operation is also monitored. Any or all of these points can cause the positioner to fail to a predetermined position – see **How do I select positioner action on a fault?** Normally the fault mode will reflect the solenoid sense setting described above.

```
ACTION ON FAULT
CURRENT CHOICE IS 1
1 - STAY PUT
2 - FAIL CLOSE
3 - FAIL OPEN
4 - FAIL TO POSN 50.0
5 - FAST/SLOW SLOW
#=#BACK-MENU/OPERATION
```

Fail mode display

- 1) Press Key 1-5 to select the required choice. Pressing Key # will return to the main Set up Menu and save any changes.

- 2) The key choices are:
 1. **Stay put** – normal for a double acting system where both solenoids are de-energised when the actuator is at the required position.
 2. **Fail close** – normal for an actuator with a mechanical spring or hydraulic accumulator to close with the solenoids de-energised.
 3. **Fail open** – normal for an actuator with a mechanical spring or hydraulic accumulator to open with the solenoids de-energised.
 4. **Fail to position** would normally be used on a double acting system where the process required a particular fail position.
 5. **Fail fast or slow** – if the actuator is set to Stepping Mode – see **How do I set Stepping Mode?** then the chosen fail mode can operate with either continuous (Fast) or stepped (slow) solenoid operation.

Choice 4 - Fail To Position

This choice requires the setting of the stroke position that the actuator would drive to on fault.

```

FAIL TO POSITION
ANY KEY TO CONTINUE
ENTER POSITION

50.0 percent

#=#BACK-MENU/OPERATION
    
```

Set fail position display

The current fail position is displayed. Pressing any key will place a flashing cursor on the value, waiting for a position to be entered in the range 00.0 to 99.9%. The operation can be finished and the current valued saved by either modifying the value or pressing Key #

Choice 5 – Fast / Slow fail operation

Pressing Key 5 toggles the choice of fast (continuous) or slow (pulsed) solenoid operation during fault-induced positioning.

How do I set Self Contained pump control?

The EX210 can oversee the control of the hydraulic power unit pump supplying the hydraulic fluid to the actuator system. This menu lists the choices available for that control and the associated settings.

```

PUMP CONTROL MODES
CURRENT CHOICE IS 1

1-NO PUMP CONTROL
2-ON DEMAND R/O 005s
3-PRESSURE SWITCHES
4-PRESSURE TX
#=#BACK-MENU/OPERATION
    
```

Pump control display

- 1) Press Key 1-4 to select the required choice. Pressing Key # will return to the main Set up Menu and save any changes.
- 2) The choices are:
 1. **No pump control** – this is selected for systems with a ring-main type hydraulic supply.
 2. **On demand** – this would be selected for systems with some local hydraulic accumulation and a low to moderate duty cycle. The pump would start to operate when the actuator was caused to move either by a change in demand signal or in manual operation. The control is sensitive to the particular solenoid sense set for the system thus the pump would not run for actuator closing if *fail close* was selected or fail open if *fail open* was selected. Similarly, the pump would not run if the system had detected a system fault as described above. The overrun time, which can be set for the recharge of any hydraulic accumulators, is displayed.
 3. **Pressure switches** – external contact inputs 1 and 2 can be used as low pressure and high pressure controls respectively. These switches, fitted within the hydraulic system, will stop the pump at high pressure and start it again at low pressure. The sense of the inputs can be set in **How do I set the EX210 digital Input and Output sense?**
 4. **Pressure transmitter** – the pressure switches mentioned above can be replaced with a pressure transmitter to monitor the HPU pressure.

Choice 2 – Set pump on demand run on time

```
ON DEMAND PUMP
RUN-ON TIME
ANY KEY TO CONTINUE
RUN-ON TIME 010 SECS
#=#BACK-MENU/OPERATION
```

Set run-on timer display

The current run on time is displayed. Press any key to start and enter the required time in the range 0 to 999 seconds. The operation can be finished either by entering a value or pressing Key #.

Choice 4 – Pump control Pressure Transmitter set points

```
PTX PUMP CONTROL
3=NEXT 6=EDIT
CURRENT PTX VAL. 100
Set LOW Press 050bar
Set HIGH Press 120bar
Calibrate PTX
#=#BACK-MENU/OPERATION
```

Set pressure TX control

The scaled current pressure and the set points are displayed.

1. Press Key 3 to cycle around the low and high pressure and the Calibrate PTX option
2. Press Key 6 to edit the current selection.
3. Press Key # to exit back to the Pump Control Menu and save any new values.

How do I calibrate the Pressure Transmitter used for pump control?

Selecting the 'Calibrate PTX' option in Choice 4 above gives the following display:

```
PTX CALIBRATION
* for ptx zero units
PTX read zero 176
PTX ZERO units 000
#=#BACK-MENU/OPERATION
```

Calibrate Press Transmitter – 1

The display shows current PTX raw digital conversion and the ZERO end engineering units (bar) value.

1. Set the system at a PTX low pressure value – any known value will do.
2. Press * Key and enter the value in bar (whole numbers)

The display will change to:

```
PTX CALIBRATION
* for ptx zero units
PTX read zero 176
PTX ZERO units 000
* for ptx span units
PTX read span 875
PTX SPAN units 200
#=#BACK-MENU/OPERATION
```

Calibrate Press Transmitter – 2

3. Set the system at a PTX high pressure value
4. Press * Key and enter the value in bar (whole numbers)
5. The display will return to the Set pressure TX screen above. Pressing Key # at any time, apart from data entry, will also return to the Set pressure TX screen above.

How do I set Stepping Mode?

These parameters can be adjusted whilst in Manual Mode – see [How can I adjust the stepping mode timers interactively?](#)

The EX210 can operate its control solenoids intermittently in order to slow down the actuator speed in situations where the process cannot tolerate sudden changes in flow. This stepping mode applies preset on and off times to both the close and open solenoids, giving the option for different speed operation for opening and closing.

- 1) Press Key 1 and to select the required option. Pressing the # Key saves the selection and returns the display to the main Set up Menu.

```
CURRENT STEP MODE OFF
1-STEPPING OFF
2-STEPPING ON AND SET
  STEPPING TIMES
#=BACK-MENU/OPERATION
```

Stepping mode menu

- 2) Selecting Option 2 opens a new menu:

```
SOLENOID STEP TIMES
  3=NEXT 6=EDIT

CURRENT OPEN TIMES
ON 0.5s OFF 001s
CURRENT CLOSE TIMES
ON 0.5s OFF 001s
#=BACK-MENU/OPERATION
```

Set stepping timers display

- 3) On entry OPEN TIME – ON is highlighted, pressing Key 3 selects the next parameter to change.
- 4) Pressing Key 6 allows the edit of the highlighted time – ON times 0.1 to 9.9s and OFF times 1 to 999s.
- 5) Pressing the # key will return to the Set up Menu, saving any changes.

How do I set the EX210 ‘tuning parameters’ – Dead zone and Band edge Hysteresis?

These parameters can be modified interactively during normal operation of the EX210 – see [How to ‘tune’ the actuator system](#)

The dead zone allows an area of control of the actuator position where no movement takes place. Such a zone is required in systems that have on-off control of the hydraulic control elements due to magnetic and mechanical delays inevitable with such components. Control is enhanced by having two settings, one for the open direction and one for the close direction solenoid operations. The hysteresis value provides an additional suppressed band, active only on entry into the deadzone to reduce instability due to conversion and arithmetical errors in the positioner. The dead zone is expressed in percent of full stroke of the actuator whilst the hysteresis is a notional value.

```
SET DEADZONE AND HYST
  3=NEXT 6=EDIT

OPEN DEADZONE      0.5
CLOSE DEADZONE     0.5
HYSTERESIS OPEN    0.3
HYSTERESIS CLOSE   0.3
#=BACK-MENU/OPERATION
```

Deadzone and hysteresis display

- 1) On entry OPEN DEADZONE is highlighted, pressing Key 3 selects the next parameter to change.
- 2) Pressing Key 6 allows editing of the highlighted time – DEADZONE and HYSTERESIS - 0.1 to 9.9%.
- 3) Pressing the # key will return to the Set up Menu, saving any changes.

How do I set the EX210 digital Input and Output sense?

The EX210 has four digital inputs that are operated by pulling high to the 24V instrument supply and four open drain outputs acting as low-side switches using the 24V instrument supply. This setpoint allows the inactive state to be set for both inputs and outputs. The first four values are the INPUTS and the last four are OUTPUTS.

```

SET I/P AND O/P SENSE
1=NORM 2=REV 3=NEXT
PRES L NOR PRES H NOR
EXT FL NOR ENABLE NOR
ESD OP NOR FLT OP NOR
PUMP NOR STATUS NOR
#=BACK-MENU/OPERATION
    
```

Digital input and output sense

- 1) On entry, the Pressure Low Input (Input 0) is highlighted. Pressing Key 1 sets a normal state, inputs active low, outputs not energised, and Key 2 set the reverse condition for this input.
- 2) Key 3 moves to the next choice.
- 3) Key # is pressed the display will return to the second page of the Set up Menu and save any changes

How do I set the EX210 action on faults?

The EX210 has four main fault conditions, divided between positioning faults and external faults, and four possible reactions to a fault condition:

```

FAULT ACTION MATRIX
1=ACTIVE 2=OFF 3=NEXT
FAULT TYPE-POS N EXTR
POSITION ACTV OFF
ESD O/P OFF OFF
FAULT O/P OFF OFF
DISPLAY ACTV OFF
#=BACK-MENU/OPERATION
    
```

Fault action display

There are four possible fault types

Internally sensed positioning faults

- Demand signal out of range – normally a line break - POS N fault above
- Actual position feedback out of range – normally a line break - POS N fault above
- Failure to position within a pre-set time - POS N fault above

Externally sensed faults

- External fault contact - EXTR fault above

There are four possible actions that can be associated with these faults

Set the actuator to a known position via the fail modes described in

How do I set the EX210 Fail Mode?

- Change state of Emergency Shutdown Output - POSITION – positioner fault action above
- Change state of Fault Output - ESD O/P – operation of ESD output
- Alert operator with a display message and LED changes - FAULT O/P – operation of fault output
- DISPLAY – displaying the fault on the screen

This option can associate any of the four faults types with any of the four actions. You would normally choose to associate positioner faults to positioner action and permit the display of the fault type

- 1) Press Key 1 and to select the required option. Pressing the # Key saves the selection and returns the display to the main Set up Menu.
- 2) The 'positioner fault – position actuator' field will be highlighted. Press Key 1 to make the link active or Key 2 to ignore the link.
- 3) Press Key 3 to advance to the next action associated with a positioner fault – ESD output. Edit as it 1) above or continue pressing Key 3 through the remaining positioner fault and then external fault action links.

Utilities Menu

The final item in the Main Configuration Menu is the Instrument Utilities Settings. Pressing Key 4 from the Configuration Menu enters the Utilities Menu.

```
UTILITIES MAIN MENU
1-SET DATE AND TIME
2-SET MISC TIMERS
3-SET MANUAL PASSCODE
4-SET CONFIG PASSCODE
5-FORCE RETRANS O/P
6-MORE CHOICES
#-BACK-MENU/OPERATION
```

Pressing Keys 1-6 will access the listed choices and Key # will return the display to the Main Configuration Menu.

1.Set Date and Time

The EX210 has a real time clock equipped with a short term back up in the event of power loss.

```
DATE AND TIME
3=NEXT 6=EDIT

TIME 12: 10: 54
DATE 12-02-12

#-BACK-MENU/OPERATION
```

- 1) Pressing Key 3 allows the selection of the individual date and time values.
- 2) Pressing Key 6 allows the highlighted value to be edited.
- 3) Pressing Key # returns to the Utilities Menu

2.Set miscellaneous timers

The EX210 has a number of utility timers that can be reset if desired. These are normally set during factory testing and should only be adjusted after fully understanding the function of the timer and any consequences of the change.

```
SET MISC. TIMERS
3=NEXT 6=EDIT
1. POSN. TIME S 999
2. ENABLE WARN S 010
3. TRIM PULSE S 0.1
4. P-CODE WAIT S 030
5. B'LIGHT TIME S 010
#-BACK-MENU/OPERATION
```

- 1. Pressing Key 3 allows the selection of the individual date and time values.
- 2. Pressing Key 6 allows the highlighted value to be edited.
- 3. Pressing Key # returns to the Utilities Menu

- 1. **Time to position** – this is the time in seconds allowed for the actuator to move to the desired position before a positioning fault is set. This should be set to at least 50% more than the full stroke time of the actuator to avoid spurious alarms. This timer will be suspended if the positioner is in stepping mode due to the very long potential stroking times. This is normally set to the maximum time 999 seconds.
- 2. **Operator entry enable warning time** – this is the time in seconds that a warning will show on the display if an attempt is made to enter Manual or Configuration modes without the external enable contact being made.
- 3. **Trim pulse** – this is the on-time pulse length, in 100mS increments. During the Calibration or Manual operations it may be necessary to finely position the actuator using Keys 7,8. This timer sets a short ON pulse followed by 8 times the pulse time as the OFF pulse. The resulting pulse train can position the actuator more precisely than a continuous pulse.
- 4. **Pass code entry timer** – this is the down count timer in seconds associated with Manual or Configuration pass code entry.
- 5. **Backlight timer** – The display backlight is normally off but will light on any key press from IR900 key pad. The display will stay lit for the duration of this timer.

3.Manual Mode pass code

Manual Mode entry is protected by a four digit pass code.

```
SET MANUAL PASSCODE
ANY KEY TO CONTINUE
CURRENT CODE    1234

#=#BACK-MENU/OPERATION
```

Press Key # to return to the Utilities Menu. Press any other key to start editing the pass code. The display returns to the Utilities Menu automatically after the entry is complete.

4.Configuration Mode pass code

Configuration Mode entry is protected by a four digit pass code.

```
SET CONFIG PASSCODE
ANY KEY TO CONTINUE
CURRENT CODE    5678

#=#BACK-MENU/OPERATION
```

Press Key # to return to the Utilities Menu. Press any other key to start editing the pass code. The display returns to the Utilities Menu automatically after the entry is complete.

5.Force retransmitted signal output

This option is included to acts as a check for the outgoing signal loop from the positioner. This can be useful in checking problems in the signal interface on the process DSC.

```
FORCE RETRANS. OUTPUT
ENTER O/P IN mA

    12.0

#=#BACK-MENU/OPERATION
```

Entering a value in mA will cause that current to be output by the suitably calibrated EX210 . Key # returns the display to the Utilities Menu.

6. Page 2 of Utilities Menu

```

UTILITIES MAIN MENU
PAGE 2
1-VIEW FAULT LOG
2-RESET LOG INDEX
3-LOAD/SAVE STATUS
4-Disabled-NO HART
5-MORE CHOICES
#=BACK-MENU/OPERATION
    
```

Pressing Keys 1-5 will access the listed choices and Key # will return the display to the Main Configuration Menu.

1. View Fault Log

The EX210 can record up to 512 fault and status events into non-volatile memory to enable analysis of the equipment operation

```

LOG NUMBER      0025
12: 34: 27      12: 12: 10
FAULT LOG        NEW
FAILURE TO POSITION

1=BACK          2=FORWARD
#=BACK-MENU/OPERATION
    
```

The log can be navigated by Key 1 (Back) and 2 (Forward) with Key # returning to Page 2 of the Utilities Menu. The two top lines show the log number and date and time of entry. The new two lines indicate the fault that has been logged and whether it is a new fault or an old one getting cleared. Each fault event should have two entries, one for the fault detection and one for the fault being cleared.

Descriptions can include the following:

```

LOSS OF DEMAND SIGNAL
LOSS OF F/B SIGNAL
FAILURE TO POSITION
EXTERNAL FAULT INPUT
    
```

The next two lines record status events in the equipment

```

LOG NUMBER      0025
12: 34: 27      12: 12: 10

STATUS LOG        NEW
INSTRUMENT POWER UP
1=BACK          2=FORWARD
#=BACK-MENU/OPERATION
    
```

Descriptions can include the following:

```

INSTRUMENT POWER UP
CONFIG MODE ENTRY
MANUAL MODE ENTRY
EXTERNAL ENABLE OFF
RE-CALIBRATION
LOAD/SAVE STATUS
RESTORE DEFAULTS
    
```

2.Reset Log Index

The fault and status log is a circular log with 512 possible entries. To allow the log to be used as a diagnostic tool, the index can be reset to any point in this range

```
RESET LOG POINTER  
  
CURRENT LOG No. 0007  
  
#=BACK-MENU/OPERATION
```

The log pointer can be reset to any value, usually zero, by entering the appropriate number. Key # returns to Page 2 of the Utilities Menu.

3. Load / Save Instrument Configuration

The current calibration, set points and utilities configuration of the EX210 can be saved to a special area of non-volatile memory and this can be accessed at a later date if these conditions need to be restored.

```
LOAD/SAVE INST CONFIG  
  
1 SAVE CURRENT CONFIG  
2 LOAD SAVED CONFIG  
  
#=BACK-MENU/OPERATION
```

The current status of the system, i.e. all parameters saved with the non-volatile memory, can be saved, Key 1, or loaded, Key 2, from a previously saved version Key # returns to Page 2 of the Utilities Menu. Pressing Key 1 saves the current status and the following message will appear:

SAVED TO EEPROM

Pressing Key 2 loads a previously saved copy of the instrument status with the message:

LOADED FROM EEPROM

Either action will be logged on the instrument status log.

4. This choice will be disabled for non-HART applications

If there is any other text here please check the HART Communication Option Handbook.

5. More Choices

Press 5 to access Page 3 of the Utilities Menu.

Page 3 of Utilities Menu

```
UTILITIES MAIN MENU  
PAGE 3  
1-INSTRUMENT DETAILS  
  
#=BACK-MENU/OPERATION
```

Pressing Key 1 will access the listed choice and Key # will return the display to the Main Configuration Menu.

1. Display instrument details

This screen records the individual instrument data. It cannot be edited and should be checked and copied in all communications with the Manufacturer.

```
INSTRUMENT DETAILS  
EX210 Positioner  
Logo 01 COMMS NONE  
S/N 12345 22/02/11  
  
J/N 3456 P/O 12345  
S/W 0200 H/W 0200  
#=BACK-MENU/OPERATION
```

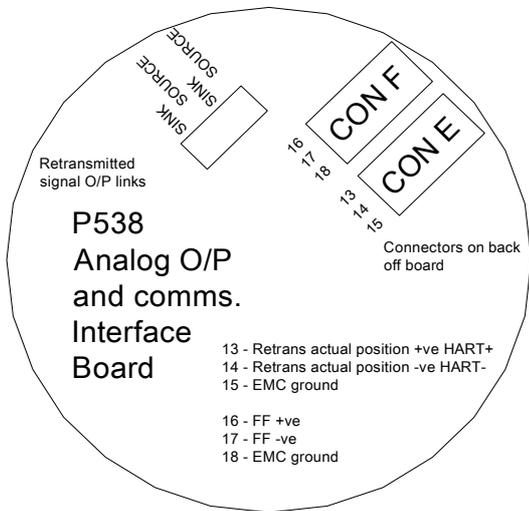
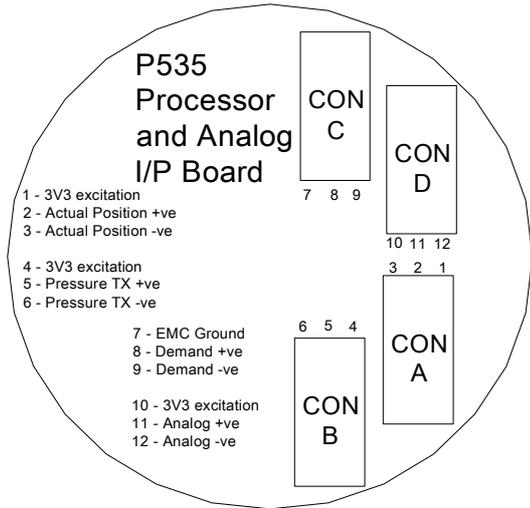
Why doesn't the EX210 work?

1. The vast majority of first time use failures are a result of incorrect electrical connections or compatibility problems in control signals. Remember, the positioner and actuator system will have been tested before shipment, so double-check all electrical connections and signal excitation sense against drawings and descriptions *specific to the particular installation* before any power is applied.
2. In fault-finding the system, always work from the known towards the unknown. Operating the system in Manual Mode confirms a large part of the system as being ok – hydraulics, power to the positioner, general EX210 operation. If the manual mode display shows correct variations of the demand and actual position signals then these signals are also proved, similarly for the retransmitted actual position signal.
3. At the most basic level, disconnect the actuator solenoids – ALWAYS with the EX210 power OFF – and operate the solenoids directly with 24Vdc. This will isolate hydraulic problems from electrical control ones.
4. The current loops in and out of the EX210 are isolated from each other and the instrument supply so there will be no problems with crossed grounds and no need for external isolators.
5. There IS a need to check on the excitation of the retransmitted signal from the EX210. This is the only hardware adjustment on the instrument and comprises of a set of jumper links on the third board down from the display board. The instrument will have to be removed from the EX2010 enclosure:
 - a) Unscrew the two captive fixings at the top and bottom of the instrument.
 - b) Carefully pull out the instrument part-way until the jumper links are visible on the lower edge of the board
 - c) From the left, the link positions are
 - Sourcing, 1 and 3 excitation from the EX210
 - Sinking, 2 and 4 excitation from the external DSC
 - d) Replace the EX210 in the enclosure before re-applying power.
6. Problems in instability and precision of positioning can be address by adjustment of the dead zone and hysteresis bands or, more directly, by adjusting the speed of the actuator via hydraulic flow regulation. Positional overshoot is caused by a failure of the control solenoids to act quickly enough to stop the actuator where required. Slowing down the actuator stroke speed is the ONLY way of improving positional accuracy.
7. Reversed demand signal loops or incorrect connection of external fault devices can cause a failure to operate in automatic mode when there is, apparently, no fault seen in manual mode. Also, check the fault display, input and output sense setting and the fault matrix setting against the required fault environment.
8. In the event of 'losing' the manual and configuration mode pass codes, there is a back door.
 - a) Set the demand signal to 0mA, or temporarily disconnect
 - b) Enter the Configuration Mode and use the pass code 8765
 - c) Go to the Utilities Menu and reset the pass code as required.
 - d) Reconnect and reset the demand signal

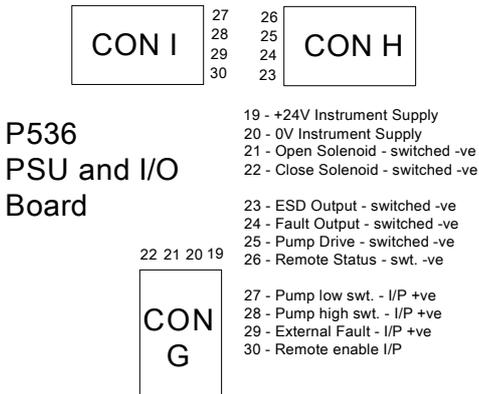
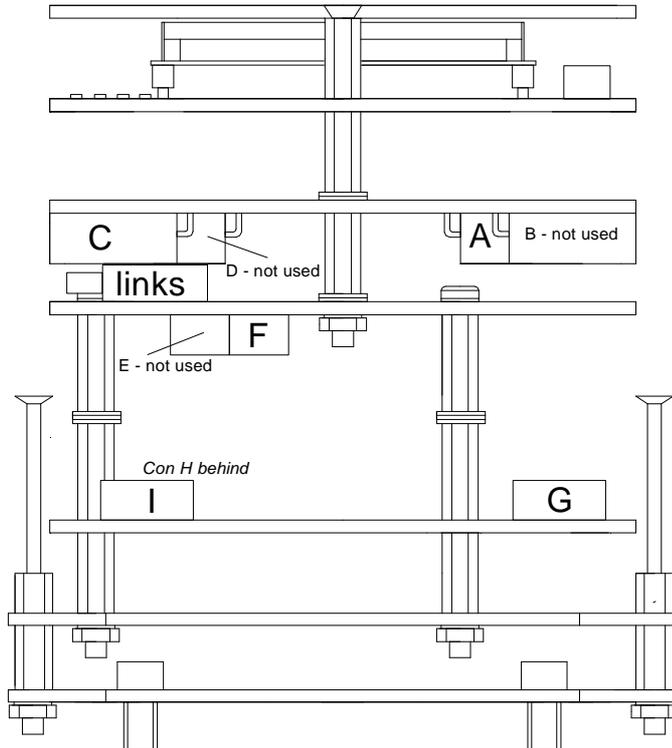
Similarly, Manual Mode can be accessed, when no command signal is available, by pressing Key 1 from the Normal Run Display and then entering the code 4321.

9. The EX210 is not user serviceable. In the event of suspected failure:
 - a) check all the advice above to eliminate external system faults
 - b) record the instrument details as seen on the display on Page 24
 - c) produce a full a failure report as possible, with times, dates, photographs, logs etc – anything to help us to understand the environment surrounding the failure
 - d) carefully remove the EX210 from the EX2010 housing and unplug the free sockets
 - e) package the unit in anti-static bubble wrap and a good solid outer box and return to the supplier

EX200 appearance



Side Elevation of EX210



Note – elevation is rotated by 90°

Physical Description

Size with chassis plate – 80mm wide, 80mm high, 85mm deep

Weight with chassis plate – 0.25kg

Specification

COMMAND SIGNAL INPUT

4-20mA nominal 160R input impedance, fully isolated

ANALOGUE POSITION OUTPUT SIGNAL

0-21mA can be calibrated anywhere in this range, normally 4-20mA, fully isolated

Sourcing – 750R load, Sinking – max excitation 30V

FEEDBACK SIGNAL INPUT

Potentiometer 3-wire, any value greater than 200R

4-20mA nominal 160R input impedance – signal common with instrument supply

SOLENOID OUTPUTS x 2

Maximum 2A for each, low side switched, 24Vdc common with instrument supply

SWITCHED OUTPUTS x 4

Maximum 1A for each output – low side switched 24Vdc common with instrument supply

CONTACT CLOSURE/24V dc INPUTS X 4

Active when pulled high to instrument power supply or +24V dc applied with respect to 0V supply (Terminal 20).

INSTRUMENT AND SOLENOID SUPPLY

24V dc nominal (**18V – 30V** maximum range) – 2.8W excluding solenoids

USER ADJUSTMENTS

All adjustments via IR900 Infra Red Keypad

INTERNAL LINKS

Retransmitted actual position excitation

Link 1 and 3 – sourcing, internal excitation from isolated 24Vdc supply

Link 2 and 4 – sinking external excitation, maximum 30Vdc

ENVIRONMENT

Operating temperature -40°C to +59°C ambient

Storage temperature -40°C to +115°C

PERFORMANCE - the following applies to the EX210 only, characteristics of the feedback element and actuator system response will have additional effects.

Conversion 10 bit max normal conversion range (4-20mA) = 1 in 1000.

Solenoid operation resolution - +/-1 bit theoretically, modified to up to +/-9.9% of span by dead band

Solenoid operation response - 20mS following a step change in demand conditions

EX210 Terminal Descriptions

Note – Always use specific drawings and hook-up diagrams supplied with the job for site wiring. The descriptions below are for information only.

Connections are made via up to nine 3 and 4 way polarised 0.1" free sockets. The free sockets are marked A to I as are the printed circuit board pin headers. Double check all connections when removing or replacing the EX210 from the enclosure.

No.	Conn.	Description	Voltage	Comment
1	A	3V3/24V transducer excitation	24V	Not usually connected
2	A	Actual Position +ve – 4-20mA into 130R	3.2V	Actual Position +ve – common with Instrument Supply
3	A	Actual Position –ve – instrument 0V	0V	Common instrument supply
4	B	3V3/24V transducer excitation	24V	Not usually connected
5	B	Pressure TX +ve – 4-20mA into 130R	3.2V	For pump control
6	B	Pressure TX -ve – instrument 0V	0V	Common instrument supply
7	C	External analog inputs EMC ground	0V	Connect to signal ground
8	C	Demand signal +ve – 4-20mA into 130R	3.2V	Demand +ve – common with Instrument Supply
9	C	Demand signal -ve – instrument 0V	0V	Common instrument supply
10	D	3V3/24V transducer excitation	24V	Not usually connected
11	D	Uncommitted analog input +ve – 130R	3.2V	Not normally connected
12	D	Uncommitted analog –ve – instrument 0V	3.2V	Not normally connected
13	E	Retrans. actual position signal +ve 4-20mA	24V	Sinking or sourcing
14	E	Retrans. actual position signal –ve	3.2V	Isolated output
15	E	Retrans. Signal EMC ground	0V	Connect to signal ground
16	F	Foundation Fieldbus data +ve	3.3V	Not usually connected
17	F	Foundation Fieldbus data -ve	3.3V	Not usually connected
18	F	Fieldbus Signal EMC ground	0V	Connect to signal ground
19	G	Instrument and solenoid supply +ve	24Vdc	
20	G	Instrument and solenoid supply –ve	0V	
21	G	Open Solenoid –ve switched	24Vdc	Solenoid +ve to +24V
22	G	Close solenoid –ve switched	24Vdc	Solenoid +ve to +24V
23	H	ESD solenoid output –ve switched	24Vdc	Output +ve to +24Vdc
24	H	Fault output –ve switched	24Vdc	Output +ve to +24Vdc
25	H	Pump control output –ve switched	24Vdc	Output +ve to +24Vdc
26	H	Remote status output –ve switched	24Vdc	Output +ve to +24Vdc
27	I	Pump control low press switch +ve	24Vdc	Switch to inst. 24V
28	I	Pump control high press switch +ve	24Vdc	Switch to inst. 24V
29	I	External fault input +ve	24Vdc	Switch to inst. 24V
30	I	Operator enable input +ve	24Vdc	Switch to inst. 24V

Bold connections are normally present in all installations.