

# rotork



## ROMpak Pakscan Field Unit Technical Manual

As we are continually developing our products their design is subject to change without notice.

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The information in this manual relates to ROMpak Pakscan field control unit software version 1.0

**Contents:**

|                                                                             |           |
|-----------------------------------------------------------------------------|-----------|
| <b>INTRODUCTION .....</b>                                                   | <b>5</b>  |
| <b>1. FIELD UNIT PROPERTIES .....</b>                                       | <b>6</b>  |
| 1.1 Mechanical Properties .....                                             | 6         |
| 1.2 Electrical Properties.....                                              | 6         |
| 1.3 On- Board Indication LEDs.....                                          | 7         |
| 1.3.1 Green LED .....                                                       | 7         |
| 1.3.2 Red LED .....                                                         | 8         |
| 1.3 Operation and Storage.....                                              | 8         |
| <b>2. COMPATIBILITY .....</b>                                               | <b>9</b>  |
| 2.1 Pakscan 3 and P3F Master Station.....                                   | 9         |
| 2.2 Pakscan IIE Master Station.....                                         | 9         |
| 2.3 Pakscan IIS Master Station.....                                         | 9         |
| 2.3 Paktester and other Tools.....                                          | 9         |
| 2.4 2-Wire Loop .....                                                       | 9         |
| <b>3. FITTING THE FIELD UNIT .....</b>                                      | <b>10</b> |
| 3.1 Replacing a Field Unit.....                                             | 10        |
| <b>4. 2-WIRE LOOP CONNECTIONS .....</b>                                     | <b>11</b> |
| <b>5. 2-WIRE LOOP INTERFACE .....</b>                                       | <b>12</b> |
| 5.1 Loopback Feature .....                                                  | 12        |
| 5.2 Loop Bypass Circuit .....                                               | 12        |
| <b>6. INPUT AND OUTPUT SIGNALS .....</b>                                    | <b>13</b> |
| 6.1 Summary of Digital and Analogue Feedback Data .....                     | 13        |
| 6.2 Digital Status Data Bits.....                                           | 15        |
| 6.2.1 Actuator Position Limit Switch Data - 'CAS' & 'OAS'.....              | 15        |
| 6.2.2 Stop Indication Data - 'STOP' .....                                   | 15        |
| 6.2.3 Move Indication Data - 'MRUN' .....                                   | 15        |
| 6.2.4 Motor Running Data - 'MRO' & 'MRC' .....                              | 15        |
| 6.2.5 Remote Auxiliary Input Signals - 'AUX1', 'AUX2', 'AUX3', 'AUX4' ..... | 16        |
| 6.2.6 Loopback On - 'LBON' .....                                            | 16        |
| 6.2.7 New Alarm Indication - 'NALRM' .....                                  | 16        |
| 6.2.10 Alarm Indication - 'ALARM' .....                                     | 16        |
| 6.3 Alarm Status Data Bits.....                                             | 17        |
| 6.3.1 Memory Fault - 'MEMF' .....                                           | 17        |
| 6.3.2 Communication Failure - 'COMMS' .....                                 | 17        |
| 6.3.3 Power on Reset - 'POWR' .....                                         | 17        |
| 6.3.4 Watchdog - 'WDOG' .....                                               | 17        |
| 6.3.5 Control Not Available - 'CNA' .....                                   | 17        |

|            |                                                                       |           |
|------------|-----------------------------------------------------------------------|-----------|
| 6.3.6      | Local Stop - 'LSTOP' .....                                            | 18        |
| 6.3.7      | Monitor Relay - 'MREL' .....                                          | 18        |
| 6.3.8      | Start/Stop Failure - 'SFAIL' .....                                    | 18        |
| 6.3.9      | Obstructed Valve, Torque Trip - 'VOBS' .....                          | 18        |
| 6.3.10     | Jammed Valve, Torque Trip - 'VJAM' .....                              | 19        |
| 6.3.11     | Manual Valve Movement - 'MOP', 'MCL', 'MOPG', 'MCLG' .....            | 19        |
| 6.3.12     | Motor Continues Running at End of Travel Limit Position - 'EOT' ..... | 19        |
| <b>6.4</b> | <b>Additional Feedback Data</b> .....                                 | <b>19</b> |
| 6.4.1      | Valve Position Feedback - Continuous Position Data 'MV' .....         | 19        |
| <b>6.5</b> | <b>Command Outputs</b> .....                                          | <b>20</b> |
| 6.5.1      | Local Controls (Open, Stop, Close) .....                              | 20        |
| 6.5.2      | Pakscan Controls (Full Travel Open, Stop, Close) .....                | 20        |
| 6.5.3      | Pakscan Position Control - (Set DV) .....                             | 21        |
| 6.5.4      | Actuator protection in position control mode .....                    | 22        |
| 6.5.5      | Remote Auxiliary Control Inputs .....                                 | 23        |
| 6.5.6      | Emergency Shut Down - 'ESD' .....                                     | 23        |
| <b>7.</b>  | <b>ALARM HANDLING</b> .....                                           | <b>24</b> |
| <b>8.</b>  | <b>SETTING UP A FIELD UNIT</b> .....                                  | <b>25</b> |
| <b>8.1</b> | <b>Pakscan Parameters</b> .....                                       | <b>26</b> |
| 8.1.1      | Communication Baud Rate .....                                         | 26        |
| 8.1.2      | Field Unit Address .....                                              | 26        |
| 8.1.3      | Analogue Update Time .....                                            | 26        |
| 8.1.4      | Analogue Deviation Threshold .....                                    | 26        |
| 8.1.5      | Motion Inhibit Timer .....                                            | 27        |
| 8.1.6      | Deadband .....                                                        | 27        |
| 8.1.7      | Hysteresis .....                                                      | 27        |
| <b>8.2</b> | <b>Using a Paktester</b> .....                                        | <b>28</b> |
| <b>8.3</b> | <b>Using the Pakscan 3 Master Station Screens</b> .....               | <b>28</b> |
| <b>8.4</b> | <b>Using the Pakscan 3 Web Pages</b> .....                            | <b>28</b> |
| <b>8.5</b> | <b>Replacing the FCU Software</b> .....                               | <b>28</b> |
| <b>9.</b>  | <b>MAINTENANCE AND REPAIR</b> .....                                   | <b>29</b> |
| <b>10.</b> | <b>RECORDS</b> .....                                                  | <b>30</b> |
| <b>11.</b> | <b>WIRING DIAGRAM EXAMPLE</b> .....                                   | <b>31</b> |

## INTRODUCTION

The Pakscan Field Unit fitted to the ROM actuator in the ROMpak version is fully compatible with the Pakscan 3, 2-wire control systems. The field unit forms an integral part of the ROMpak and is housed within the control electronics housing of the actuator. A Paktester connected to the 2-wire cable terminals inside the electrical housing should be used to initially set the field unit parameters. Once the parameters are set, any future alterations (except the address) can be made remotely using the 2-wire interface and special loop communications. The Pakscan P3 master station can be used to reconfigure a number of the settings should they require alteration after initial commissioning.

The field unit circuits do not impinge on the actuator control electronics, the actuator itself remains fully self protecting. The field unit performs the tasks of 2-wire interface communication, actuator data collection and the issuing of actuator commands.



*Fig 1: The ROMpak Actuator*

In most cases the ROM actuator will be fitted with a potentiometer to allow position feedback data to be reported together with a full compliment of discrete information. However, if the potentiometer components are not fitted, some data will not be available. In addition, the smallest size, ROM 1, of this actuator does not include torque trip switches and is unable to report data relating to torque alarms. The information included in this manual assumes that all the components are fitted and the actuator includes torque switches.

## 1. FIELD UNIT PROPERTIES

### 1.1 Mechanical Properties

The field unit comprises a single printed circuit board that fits inside the ROMpak electrical housing. It connects to the main control board by a multi-pin connector and due to the physical layout of the field unit and the actuator main board, the field unit may only be fitted one way round. The actuator internal wiring harness has connections to the field unit for the 2-wire loop connection (via the actuator terminals), the isolated supply voltages for the field unit and the remote auxiliary inputs. These connectors are polarised to prevent incorrect connection.

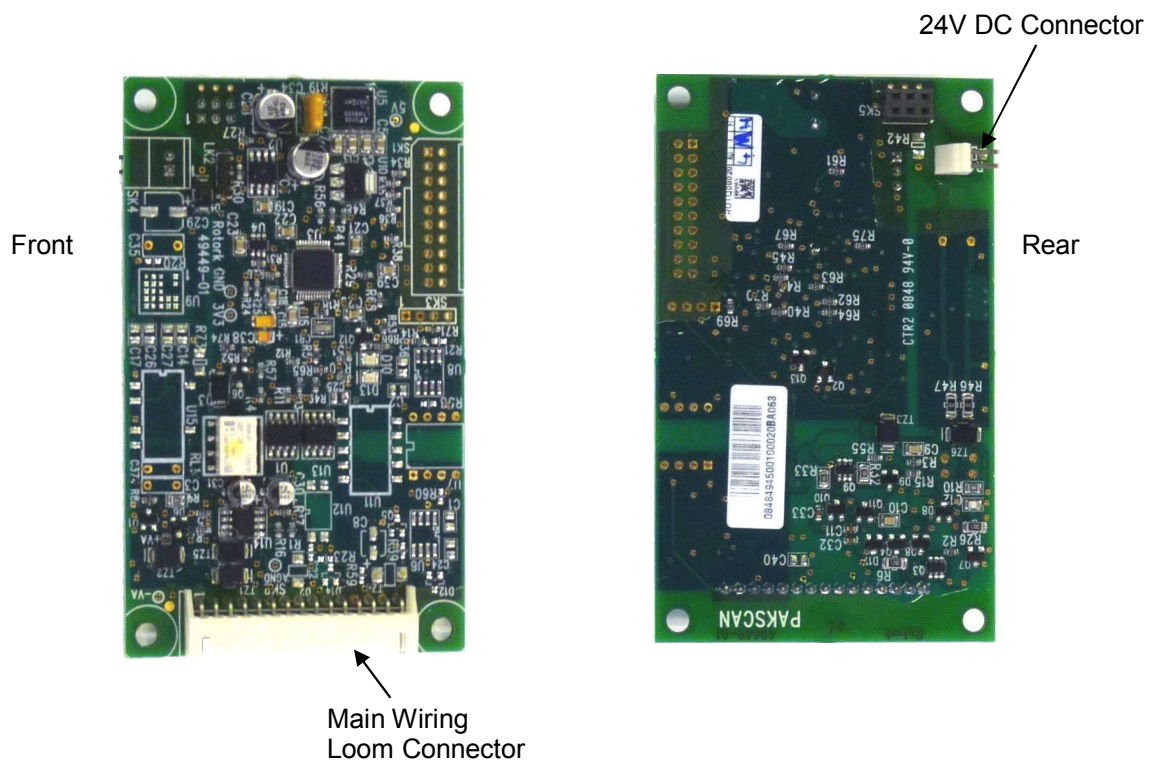


Fig 2: The Pakscan ROMpak Field Unit

### 1.2 Electrical Properties

The field unit connects to the actuator main processor circuits using an internal 2-wire bus within the actuator. The field unit does not sit in the main control path for the actuator and does not affect the actuator control integrity. The field unit processor is controlled by a programme stored in non-volatile memory located on the field unit board. The factory loaded software version is indicated on the label fitted to the field unit; however this can be upgraded and the actual version will be displayed on the Pakscan 3 master station web pages. The non-volatile memory is also used to store parameter settings that contain information about the field unit settings.

The 2-wire loop interface electronics is also on the field unit board. The interface circuits are fully opto-isolated from the field unit processor and actuator electronics. The loop interface includes the loopback circuits used to maintain communication integrity if there is a loop cable fault. It also includes the loop bypass circuits that ensure loop continuity if the actuator loses power.

### 1.3 On- Board Indication LEDs

The field unit includes LED indicators to show the communication status between the field unit and the actuator main board and between the master station and the field unit over the Pakscan loop. In addition, the loop status indicator also shows the condition of the loopback circuits.

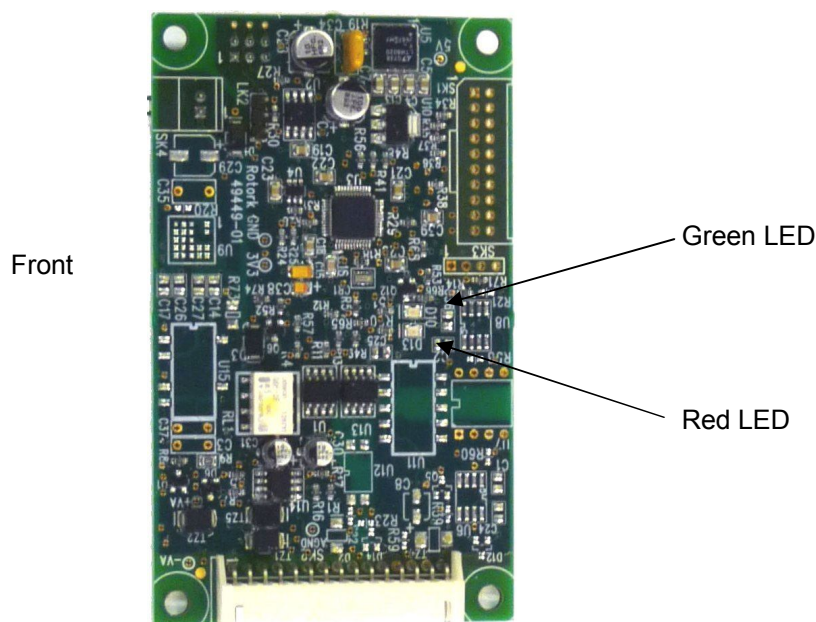


Fig 3: Field Unit Indication LEDs

#### 1.3.1 Green LED

The green LED flashes whenever there is a successful message transaction between the field unit and the main actuator control board. The communication is initiated either by the FCU requesting data or issuing a command to the main board, or by the main board broadcasting information. In either case the LED will flash once for each message. If the LED is not flashing, there is a fault on either the actuator or field unit.

### 1.3.2 Red LED

The red LED flashes when there is a communication message from the Pakscan master station over the 2-wire loop. When the field unit is in loopback mode the LED flashes once per second.

On applying power to the field unit, the red LED flashes according to the baud rate set for the 2-wire loop communication speed.

|           |              |
|-----------|--------------|
| 1 flash   | = 110 baud   |
| 2 flashes | = 300 baud   |
| 3 flashes | = 600 baud   |
| 4 flashes | = 1200 baud  |
| 5 flashes | = 2400 baud. |

The 'power on' flashes may be affected by the establishment of communication with the master station. If a valid message is received before the sequence of flashes is completed, the incoming/outgoing message takes priority.

## 1.3 Operation and Storage

The field unit is designed to be stored in the actuator and operated within the same environment as the actuator. The constraints are:

|                        |                 |
|------------------------|-----------------|
| Operating temperature: | -5° C to +60° C |
| Storage temperature:   | 0° C to +60° C  |

Refer to the actuator documentation for more details.

## **2. COMPATIBILITY**

The ROMpak field unit is compatible with Pakscan IIE current loop systems and the associated Pakscan 3, P3F, IIE and IIS master station. The master station must be fitted with a compatible level of software. Where necessary the software in the master station and associated tools may be upgraded.

### **2.1 Pakscan 3 and P3F Master Station**

All versions of the Pakscan 3 master station Current Loop option module support the ROMpak field unit. Pakscan 3 Software versions 1.02.02 (CPU)/1.0.6 (Pakscan Loop) and earlier show the ROMpak as a Q range actuator.

### **2.2 Pakscan IIE Master Station**

Those systems fitted with V25 card software 5206-014 higher than version 3.0 and/or Loop Driver card software 5206-034 higher than version 3.0 are compatible with ROMpak field units. Master stations with earlier software can be upgraded to a suitable version. The ROMpak is identified as an Integral field unit.

### **2.3 Pakscan IIS Master Station**

All Pakscan IIS systems are compatible with the ROMpak field unit, which is identified as an Integral field unit.

### **2.3 Paktester and other Tools**

In order to be able to use a Paktester to set up and commission the ROMpak actuator, a Paktester fitted with software 5161-013 with a version higher than V4.0 must be used. Note that the ROMpak is not uniquely identified, although set-up screens are available. Currently, the Paktester is the only tool that can set the address of the ROMpak field unit. It is also the most convenient tool for setting the baud rate. The remaining parameters must be set using the Pakscan master station block and parameter write facility.

The Pakscan IIE (if separate Ethernet bridge fitted) and P3 master station web pages can also be used to set up most of the ROMpak field unit parameters, though with Pakscan 3 software V1.02.02 it is shown as a Q actuator.

### **2.4 2-Wire Loop**

The ROMpak is compatible with all other Pakscan current loop field units. Different types of actuator or field unit may be connected to the same 2-wire loop, provided they all operate at the same baud rate and each has a unique address.

### 3. FITTING THE FIELD UNIT

The field unit is factory fitted inside the ROMpak housing on the side of the actuator. It is located as shown in figure 3.

The field unit has two cable loom connectors as well as plugging directly into the main board connector. These connectors are for the 24V power supply and the input and output signals from the main board.

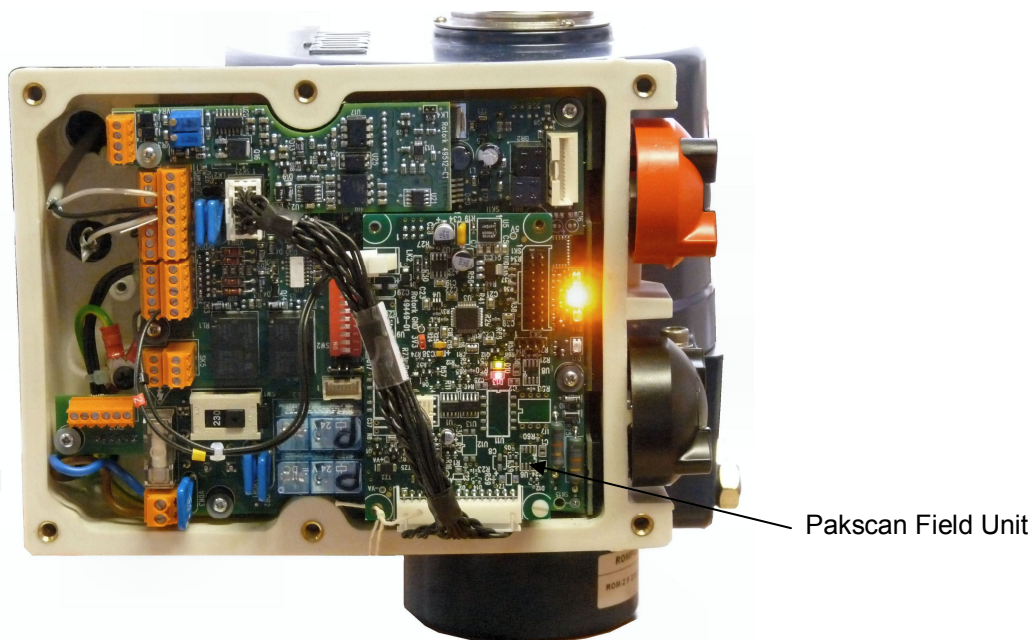


*Fig 4: Electrical Enclosure - Cover Removed*

Please contact Rotork for advice and assistance if a field upgrade is required, the actuator may require several additional mechanical and electrical components as well as the Pakscan FCU.

#### 3.1 Replacing a Field Unit

The field unit should only be replaced or fitted in a suitable environment, using anti-static precautions. The actuator must be made electrically safe before opening any covers. The electrical housing cover should be removed and the existing field unit wiring looms carefully unplugged from their connectors. Once these are removed, the retaining screws should be undone and the board carefully lifted from its main connector. The replacement board is fitted in the reverse order to removal.

Once the field unit is fitted, the actuator should be re-assembled and the field unit parameters set.

## 4. 2-WIRE LOOP CONNECTIONS

The actuator should be wired in the communication loop as indicated in figure 5.

It is important to connect the current loop input terminal (31) to the previous actuator current loop output terminal and the current loop output terminal (33) to the next actuator current loop input terminal. The current flow around the loop must always pass in the same direction through all the actuators. The common wire is connected to terminal (32).

The screen of the 2-wire loop cable must be isolated from ground at all the actuators (to prevent the possibility of earth current loops). A specific terminal (36) is allocated in the actuator for the screen to connect to. The screen should be continuous for the whole 2-wire cable.

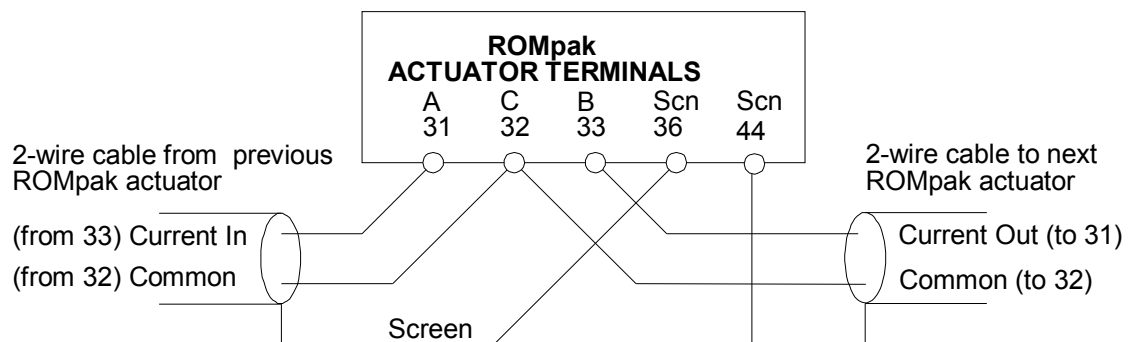


Fig 5: The Pakscan 2-wire loop connections

## 5. 2-WIRE LOOP INTERFACE

The field unit interfaces directly with the 2-wire loop. The circuits for the interface are isolated electrically from the actuator processors and field unit processor by opto-isolators. The interface includes protection devices to suppress the effects of lightning strikes or other high induced voltages. These surge suppressors are rated at 1.5kV for 1 mSec.

### 5.1 Loopback Feature

The interface includes circuits that permit the field unit to 'loopback' the current on the 2-wire loop if the cable is broken. As the system operates on 20 mA current, there has to be a current path at all times if communication is to be possible. If the cable is unable to pass this current, then the field unit will, after a short time, turn on its loopback devices so that the current may return to the master station along the common wire. This feature ensures that communication can be maintained with the actuator even though the cable is faulty. The loopback circuit will be in use if the cable is short-circuit or open-circuit.

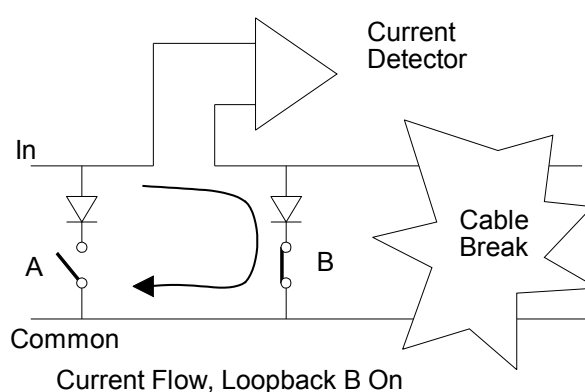


Fig 6: Loopback feature

To programme the major field unit parameters the field unit must be in loopback.

### 5.2 Loop Bypass Circuit

If the actuator is powered off then the field unit detector circuits will not function. The system includes a bypass relay contact that will still permit the loop current to flow through the actuator.

If the actuator is wired in circuit with incorrect polarity, the current detector circuits will not function correctly and the field unit will go into loopback mode. Note that an incorrectly connected actuator will prevent the system from operating that actuator.

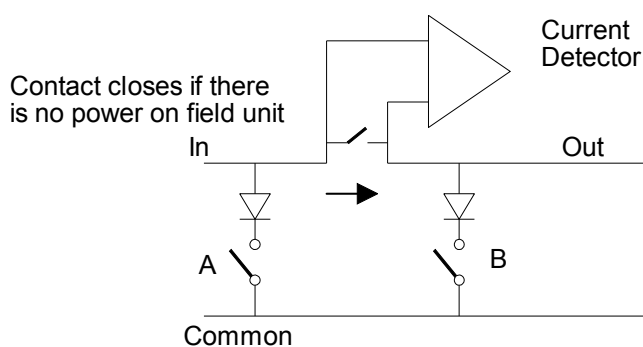


Fig 7: Loop Bypass relay

## 6. INPUT AND OUTPUT SIGNALS

The following section describes the inputs and outputs of the field unit, plus the possible uses of the remote actuator inputs. In all cases feedback data is considered to flow from the actuator (or field) to the master station and command data in the reverse direction. Thus Inputs are feedback signals and Outputs are commands.

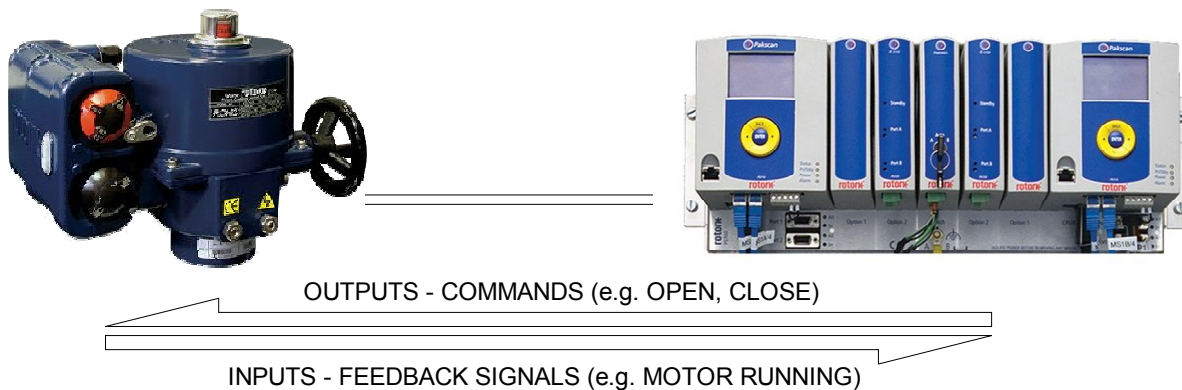


Fig 8: Input and Output Data Directions

### 6.1 Summary of Digital and Analogue Feedback Data

#### Digital Status Data Bits Actuator Data

|       |                                                                              |
|-------|------------------------------------------------------------------------------|
| AUX 1 | - The status of the remote input connected to input Aux 1 (Open).            |
| AUX2  | - The status of the remote input connected to input Aux 2 (Close).           |
| OAS   | - The actuator has reached the fully open position limit switch.             |
| CAS   | - The actuator has reached the fully closed position limit switch.           |
| STOP  | - The actuator is stationary and in mid travel.                              |
| MRUN  | - The actuator is moving, either open or closed direction.                   |
| MRO   | - The actuator is running open.                                              |
| MRC   | - The actuator is running closed.                                            |
| AUX3  | - The status of the remote input connected to input Aux 3 (Stop / Maintain). |
| AUX4  | - The status of the remote input connected to input Aux 4 (ESD).             |

#### Digital Status Data Bits Field Unit Status and Alarm Indicators

|       |                                     |
|-------|-------------------------------------|
| LBON  | - The actuator is in Loopback mode. |
| NALRM | - There is a New Alarm to report.   |
| ALARM | - There is an Alarm to report.      |

**Alarm Status Data Bits**  
**Field Unit Alarms**

- MEMF - A failure of the memory test.
- COMMS - Communication failure.
- POWR - Power on reset.
- WDOG - Field unit watchdog alarm.

**Alarm Status Data Bits**  
**Actuator Alarms**

- CNA - Actuator Local Control Selected.
- MREL - Actuator monitor relay.
- LSTOP - Actuator Local Stop selected.

**Alarm Status Data Bits**  
**Actuator Derived Alarms**

- SFAIL - Motor start or stop failure.
- VOBS - Valve obstruction detected, Torque trip.
- VJAM - Valve stuck detected, Torque trip.
- MOP - Actuator was manually opened.
- MCL - Actuator was manually closed.
- MOPG - Actuator being opened manually by the handwheel.
- MCLG - Actuator being closed manually by the handwheel.
- EOT - Actuator motor continues to run past End of Travel position.

**Analogue Feedback Data**  
**Actuator Analogue Data**

- Position - Valve current position.

## 6.2 Digital Status Data Bits

### 6.2.1 Actuator Position Limit Switch Data - 'CAS' & 'OAS'

There are two data bits relating to the actuator set positions for open and close positions. OAS is used to indicate that the ROM open limit switch (LS1) has been reached and CAS is used to indicate that the ROM closed limit switch (LS2) has been reached (when the actuator is set to close in the clockwise direction).

With all ROMpak actuators, except for size 1 (which has no torque switches), the limit positions (LS1 and LS2) should be set within the actual valve stroke when the actuator is set to stop on torque. The position limit switch must be set slightly before the actuator mechanical stop bolt position so as to ensure that the position is correctly reported. The actuator will continue to move in the chosen direction of travel for only 5 seconds after the limit switch position is reached, so the stop bolt position must be quite close to the limit switch position.

The data relating to position is maintained even though the position itself has been passed through.

### 6.2.2 Stop Indication Data - 'STOP'

Whenever the actuator output shaft stops moving and it has not traversed or reached the end of travel limit switches it is stationary in mid travel. This situation is indicated by the STOP data bit. If the actuator is subsequently moved by either a 2-wire control input command, a local control command, a remote input command or by manually moving the valve the STOP signal will be removed for the duration of the movement of the output drive.

### 6.2.3 Move Indication Data - 'MRUN'

The actuator senses any movement of its output drive shaft whether this is generated by a manual (hand) operation or by the action of the motor. Whenever the output shaft is in motion the MRUN data bit is present. The movement is detected by the position feedback potentiometer.

### 6.2.4 Motor Running Data - 'MRO' & 'MRC'

There are two data bits relating to the motor running and the direction of travel. Whenever one of the internal contactors is energised and the actuator begins to move the valve, either a MRO or MRC signal will be generated. If the contactor to run the actuator in the open direction is energised then MRO (Motor Running Open) is reported. If the contactor to run the actuator closed is energised then MRC (Motor Running Closed) is reported.

These signals will be reported if the actuator is commanded over the 2-wire loop to move or if it is commanded from the remote pushbuttons that can be fitted.

### 6.2.5 Remote Auxiliary Input Signals - 'AUX1', 'AUX2', 'AUX3', 'AUX4'

The field unit is able to report the status of hard-wired local control inputs wired to the remote input terminals.

These signals are designated AUX 1 - AUX 4, where:

- AUX 1 = Remote Open
- AUX 2 = Remote Close
- AUX 3 = Remote Stop/Maintain
- AUX 4 = Remote ESD

Whenever the input contact is closed, the Pakscan system reports the state as 'true' (1).

### 6.2.6 Loopback On - 'LBON'

The field unit will assert its loopback circuit when instructed to do so by the master station, or if the field unit receives no messages within a specified time. A field unit's normal condition is to go into loopback a short time after it is powered on and remain in that state until told to remove its loopback by the master station.

The condition of the loopback circuit is reported in the LBON data bit. Loopback is automatically asserted if there are no messages to the field unit. The time the field unit waits to be sure there are no messages is dependant on the loop baud rate set for the field unit. The periods are:

|           |            |
|-----------|------------|
| 2400 baud | 8 seconds  |
| 1200 baud | 12 seconds |
| 600 baud  | 24 seconds |
| 300 baud  | 44 seconds |
| 110 baud  | 90 seconds |

When interrogating a field unit with a Paktester, the field unit will be in loopback. When programming the major parameters (address & Baud rate) in a field unit, the field unit must be in loopback.

### 6.2.7 New Alarm Indication - 'NALRM'

This data signal is generated within the master station. The data bit NALRM is set whenever there is a new alarm in the field unit. Each time the alarms are read and accepted the New Alarm bit will be cleared, irrespective of the alarm status. This bit is used as a flag to indicate that there is an alarm in the field unit that has not yet been examined by the master station.

### 6.2.10 Alarm Indication - 'ALARM'

The ALARM data bit is used to show that an alarm condition has been detected by the field unit. This single bit is an OR function of all the possible alarm conditions that the field unit detects. The bit will be present if there is an alarm currently active on the field unit, or if there is a transient alarm that has not yet been read by the master station and accepted by the master station. All initiating alarms are latched. The latch will clear only if two conditions are met in the correct order- the initiating alarm must first be read and then accepted. This alarm handling is automatically handled by the master station.

## **6.3 Alarm Status Data Bits**

### **6.3.1 Memory Fault - 'MEMF'**

The field unit performs tests on the memory devices under its control. If a fault is detected during this test, then the MEMF alarm is raised. This alarm is indicative of a device failure or possible data corruption. The field unit should be switched off and on again to see if the fault persists. If the fault does not clear, then the field unit can be considered as faulty. This is a fleeting alarm and will clear once accepted.

### **6.3.2 Communication Failure - 'COMMS'**

The field unit itself cannot report a communication failure. This data has to be determined by an interrogation device such as the master station or Paktester. If a field unit fails to respond to messages, including retries, then the master station or Paktester will report that the field unit is in Communication Failure by asserting the COMMS data bit. This is an alarm and also sets the Alarm and New alarm bits.

### **6.3.3 Power on Reset - 'POWR'**

When powered 'on', the field unit resets the processor and checks its memory. When this occurs the alarm data bit, POWR, is set to indicate that the field unit has just been powered on. As the field unit obtains its power from the actuator, it is also an indication that the actuator has just been powered on. It is a fleeting alarm and it will go away once accepted.

### **6.3.4 Watchdog - 'WDOG'**

There is a watchdog timer circuit in the field unit, the purpose of which is to monitor the field unit processor. If the WDOG alarm is present, it is indicative of a potential failure in the field unit or a power brown-out. Note that when the alarm is active, the system is operating correctly; if it were not, then a communication error would result. However, the reason for the alarm should be determined. Accepting the alarm will cause it to go away (it is a fleeting alarm and a power brown out could be assumed), but if it returns, then it should be assumed that the field unit is about to fail completely.

### **6.3.5 Control Not Available - 'CNA'**

The actuator has a 3-position switch for selecting Remote, Local Stop or Local control. The switch passes from Remote to Local, or Local to Remote, through the Local Stop position. When the actuator local control switch is fully in the Local position then the CNA alarm bit is generated. This data bit is not present when the actuator control switch is in the Local Stop or Remote positions. The alarm is present as long as the switch is in the Local position; it will clear only when accepted and the switch is returned to the Remote or Local Stop position. If the switch is returned to the Remote or Local Stop position before the alarm is accepted, then on acceptance the alarm bit will clear.

### 6.3.6 Local Stop - 'LSTOP'

When the actuator local control switch passes through, or is set in, the Local Stop position, then the alarm bit LSTOP is set. The actuator may be placed in Local Stop as a unique function to prevent operation of the valve by any remote means. Note that LSTOP will be generated when moving the selector switch from Remote to Local and when moving the switch from Local to Remote.

If the selector switch simply traverses the Local Stop position, then the alarm generated will be fleeting and will clear itself on the next 'read and accept' cycle.

### 6.3.7 Monitor Relay - 'MREL'

The actuator includes a composite signal using several alarms referred to as the Monitor relay. The MREL alarm bit will be set if the actuator selector is in Local or Local Stop (not in Remote) or there is a Memory Fault detected. The MREL alarm bit remains set until read and accepted, and the condition returns to normal.

### 6.3.8 Start/Stop Failure - 'SFAIL'

The actuator must be set in Remote for this alarm to be valid. If the actuator motor fails to respond to a valid Pakscan or Remote Auxiliary Input start or stop signal, then the field unit will raise the SFAIL alarm bit. The SFAIL bit is not raised if the alarm is detected as an obstructed or jammed valve. The alarm is fleeting and only generated at the time the failure occurs. The alarm bit will clear once it has been read and accepted.

### 6.3.9 Obstructed Valve, Torque Trip - 'VOBS'

If the actuator is required to generate more torque than the actuator maximum torque setting, the motor will stop. The field unit detects this internal condition and also detects the fact that the actuator is not currently in its end of travel position. The reason for the stopped condition must, therefore, be an excessive stiffness in the valve or an obstruction in the pipe preventing the valve from moving any further in the selected direction. The alarm reported is VOBS.

If the valve movement stops in mid travel due to the drive becoming disconnected, for example by being placed in hand operation, then the actuator detects the loss of motion of the centre column and VOBS is reported. The VOBS alarm bit is fleeting and will clear once read and accepted.

Note: If the valve is obstructed and the actuator stops, attempting to restart the actuator to move towards the obstruction (even if the obstruction is no longer present) will generate an SFAIL alarm. The actuator must be reversed away from the obstruction before attempting to continue in the original direction.

This alarm requires the actuator to be fitted with Torque switches. These are not fitted to size 1, where there is physically not enough space for fitment. All other ROM sizes can be fitted with Torque switches.

#### **6.3.10 Jammed Valve, Torque Trip - 'VJAM'**

This signal is similar to the SFAIL Start/Stop failure alarm. In the case of the VJAM alarm, the actuator stall condition will be detected whilst the actuator is stationary at an end of travel position. The torque trip will have been generated because the valve is stuck in the seat. If the actuator is set to stop on torque, to guarantee a fully shut or open valve irrespective of the position limit switch setting, then the VJAM alarm is not generated at the end of travel position. The alarm is only generated when the actuator attempts to leave the valve seated condition. The VJAM alarm bit is fleeting and will clear once read and accepted.

This alarm requires the actuator to be fitted with Torque switches.

#### **6.3.11 Manual Valve Movement - 'MOP', 'MCL', 'MOPG', 'MCLG'**

The actuator must be set in Remote for these alarms to be valid. If the valve is placed in hand operation and moved by the handwheel, the actuator will detect the motion of the centre column if it reaches or leaves the end of travel limit switches. If the actuator reaches the end of travel switch either the MOP, (manual open), or MCL, (manual close), alarm will be generated. If the actuator leaves the end of travel switch, either the MOPG, (manual opening), or MCLG, (manual closing), alarms will be generated. These alarms are fleeting and will clear once accepted.

#### **6.3.12 Motor Continues Running at End of Travel Limit Position - 'EOT'**

The actuator must be set in Remote for this alarm to be valid. If the actuator motor continues to run for more than 5 seconds after the valve reaches the set end of travel limit switch position, then the EOT alarm bit is set. The EOT alarm bit is fleeting and will clear once read and accepted.

### **6.4 Additional Feedback Data**

#### **6.4.1 Valve Position Feedback - Continuous Position Data 'MV'**

The ROMpak actuator always includes an internal continuous valve position monitor (potentiometer) when fitted with a Pakscan field unit. The data about the valve's position is fed to the field unit for onward transmission as a Valve position feedback signal (0-100%) with a resolution of 0.5%. There are no ranging adjustments required for the signal as it is pre-calibrated by the limit switch settings of the actuator itself.

The 0% value will correspond to the Close limit switch setting and 100% to the Open limit switch setting.

If the valve is torque-seating, then the torque-off point position should be set very close to the limit switch setting, so as to minimise the actual position error. It is necessary to set the Deviation Threshold and Update Timeout for position reporting.

## 6.5 Command Outputs

The actuator is able to be commanded either from the local controls, the Pakscan field unit, or the Remote Auxiliary Inputs. When the actuator is in local, only ESD and the local commands can control the actuator. When Remote is selected, control priorities are as indicated in figure 9. The actuator will always respond to the last Open/Stop/Close input or DV command.

If the command is an ESD, then it will generally override any other command. It is possible for Local Stop to override ESD by setting the actuator for this priority.

| High Priority →→→→→→ →→→→→→ →→→→→→ Low Priority |                 |                      |
|-------------------------------------------------|-----------------|----------------------|
| Aux Input ESD                                   | Aux Input Stop  | Master Station Stop  |
| Master Station ESD                              | Aux Input Close | Master Station Close |
|                                                 | Aux Input Open  | Master Station Open  |
|                                                 |                 | Set DV               |

Fig 9: Command Priorities in Remote control

### 6.5.1 Local Controls (Open, Stop, Close)

The selector switch must be in Local for the Local Open or Local Close controls to be actioned. When commanded, the actuator will move in the desired direction. The actuator is able to accept instantaneous reversal of direction of travel without the need for a Stop signal. Local Stop is a unique position for the selector switch and causes the actuator to stop.

Whenever the actuator is in Local or Local Stop, no other input from Pakscan or the Remote Auxiliary Inputs will cause actuator motion (except ESD). In Local control mode no derived alarms are generated by the Pakscan system.

### 6.5.2 Pakscan Controls (Full Travel Open, Stop, Close)

The actuator selector switch must be in Remote for Pakscan control to be enabled. The field unit is able to command the actuator to move full travel or to a particular position.

The field unit outputs Open, Stop and Close commands that are actioned by the actuator. When the field unit issues a command, the actuator actions it until another command is issued or the instruction has been completed. For example, the field unit will issue a command to 'open' the valve. The actuator will then action this command until the valve is fully open or until a Close or Stop command is issued from the field unit, whichever is the sooner.

The command to the field unit from the 2-wire loop is a momentary 'write' of data. Once initiated, the field unit does not require the command to be cancelled before another is issued. Since the command to the actuator itself is a fleeting signal, it is not possible to 'read back' the status of command data.

If multiple commands are sent to the same field unit, the command received last will be obeyed. Note that as commands are processed by the master station, it is possible for a multiple coil or register write that the order could be reversed. If single coil write commands are used on the host data link this possibility is eliminated.

It is acceptable to reverse the actuator in mid-travel without issuing a stop command.

It is not possible to induce a 'push to run' action with a Pakscan system. The actuator will run in the chosen direction to the end of travel unless stopped by another command.

### **6.5.3 Pakscan Position Control - (Set DV)**

The field unit is able to accept a 'Desired Value' signal to cause the actuator to move to a particular position in the valve stroke. The action of sending a DV signal to the field unit places it in 'positioning mode'. The positioning signal must be in the range 0-100%, where 0% is towards the close position of the valve. Once a desired value has been sent to the actuator, the field unit will maintain control of the actuator and position it such that the measured value position signal equals the desired value sent. This control will be continued until it is replaced with a new command. If at any time an alarm occurs the control action will be cancelled. If the actuator is placed into Local or Local Stop the command will be cancelled.

The command to the field unit from the 2-wire loop is a momentary 'write' of data for the Desired Value. Once initiated, the field unit does not require the command to be cancelled before another is issued. Since the command to the field unit is then interpreted as instructions to the actuator itself, it is not possible to 'read back' the Desired Value.

It is acceptable to send a new Desired Value at any time. There is no need to issue a Stop command or cancel the existing value. If a full travel command (such as Open, Stop or Close) is sent to the field unit, this will cause the Desired Value command to be removed and replaced with the most recent command.

In situations where multiple register writes to the master station are sent to the same field unit, then the last Desired Value command received by the field unit will be the command actioned.

When any alarm is detected by the field unit, then the position control action is cancelled and the actuator will not attempt to continue controlling the valve position. This means that, for example, if the valve is obstructed during a positioning action, the actuator will stop and not continue to try to achieve the desired position. The alarm reason should be investigated and corrected before any further attempt is made to position the actuator. A Remote Auxiliary Control input becoming active will also cancel the position control action.

If an alarm is already present on the actuator and a DV command is sent to the field unit, then the command will not be actioned and it will be discarded. For example, if the actuator selector is in Local Stop and a DV position command is sent to the field unit, when the selector is moved to Remote the actuator will NOT run to obey the DV command.

#### 6.5.4 Actuator protection in position control mode

The actuator includes several settings designed to prevent damage to the actuator when a DV signal is being actioned.

##### a) Motion Inhibit Timer

The setting of the Motion Inhibit Timer is the period that must elapse between the actuator stopping and then restarting when operating in positioning mode. This idle period will prevent the actuator motor exceeding its rated starts per hour.

##### b) Deadband Setting

The control algorithm used for the Pakscan field unit positioner is proportional only. The field unit runs the actuator to the desired position and then stops it. As the actuator and valve combination will have some inertia, it is possible that the desired position may be 'overrun' and the positioner will then reverse the actuator direction of travel in order to make the valve adopt the desired position. This phenomenon is termed 'hunting'. The actuator/valve combination may hunt around the control point if the inertia is high compared to the deadband. To prevent this from happening, there is a deadband setting whereby once the actuator enters the deadband the motor will be stopped. For example a 5% deadband will cause the motor to be stopped once the actual position is within 5% of the desired position. The inertia will then bring the actual position nearer to the desired position.

It is important to set the deadband such that the actuator does not hunt around the control point.

##### c) Hysteresis

In addition to the deadband setting, there is also a fixed Hysteresis value. The field unit positioner will run the actuator until the actual position is within the deadband setting minus the hysteresis. This has the effect of instructing the actuator to stop when the position is nearer to the desired position. The actuator will not start again unless the deadband is exceeded.

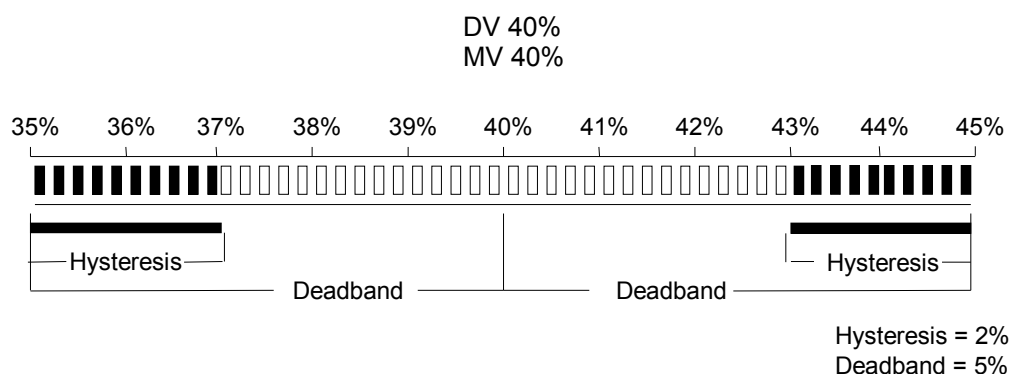


Fig 10: Deadband and Hysteresis Settings

### 6.5.5 Remote Auxiliary Control Inputs

The four auxiliary contact input signals may be used as remote control inputs to operate the actuator. For any of these inputs to be actioned, the actuator selector switch must be set in Remote.

The functions of the four inputs are predefined; they may only be used for actuator control. The actuator operation may be set to either 'Maintained' or 'Push-to-Run'. In Maintained mode the actuator will run full travel for a momentary contact input change. In Push-to-Run mode the actuator motion is only present whilst the input initiation contact is present. AUX 3 determines the type of control.

- AUX 1 = Remote Open
- AUX 2 = Remote Close
- AUX 3 = Remote Stop/Maintain
- AUX 4 = Remote Emergency Shut Down

### 6.5.6 Emergency Shut Down - 'ESD'

The action as a result of an ESD command is programmed into the actuator itself and may cause the valve to Close, Open or No Action (Stayput).

The actuator may receive an ESD command from either the Auxiliary Input ESD Command (AUX 4) or from the Pakscan loop. The ESD command has the highest priority. All existing control commands are cancelled and replaced by the ESD action.

When the ESD input is from a contact connected to AUX 4, the resulting action may be either Maintained mode, where the actuator moves the valve full travel, or Push to Run mode where the actuator moves the valve only whilst the input is present, depending whether AUX 3 is applied (AUX 3 is the Remote Stop/Maintain input). If AUX 3 is not applied then the action is Maintained mode.

When the ESD signal is initiated from the Pakscan system, the action is latched into the field unit and it is not possible to move the actuator by the Local controls until the ESD action is unlatched. The latch may only be released by a new Pakscan generated remote control signal. The actuator movement is always as Maintained mode (irrespective of the AUX 3 input) and the actuator will run to an end position. An ESD from the Pakscan system cannot be unlatched by a Remote Auxiliary Input command. It can only be unlatched by a Pakscan command, such as Stop, Open or Close.

7. ALARM HANDLING

Alarm handling is automatically controlled by the master station and each alarm is latched and reported by the field unit as it occurs. All alarms identified by the field unit are reported to the master station.

The way these alarms are handled at the master station and on the master station to host computer communication link requires special attention. If they are not handled correctly, then there is a possibility of confusion at the host system display.

If an alarm is reported by the field unit it is automatically accepted by the master station. The alarm is then free to clear once the actuator returns to normal.

In the master station the alarm is posted to several logically separate areas: the modbus data bases for the serial comms and Ethernet ports, and the HMI / web pages. In all cases the alarm must be read either by viewing the screen or by requesting the data before the alarm can be removed from the particular data base. (It is possible to link some of the data bases so as to make them appear as a single set of data - refer to the appropriate master station manual.) Once it has been read, then the alarm will only clear on two further conditions: it must be accepted and the fault must clear. Until all three conditions are met, the alarm will remain locked in the system. If an alarm has not been cleared and subsequently repeats itself, then the more recent event overwrites the earlier event. In the case of the internal data logger in a Pakscan 3 master station, both the events will be logged.

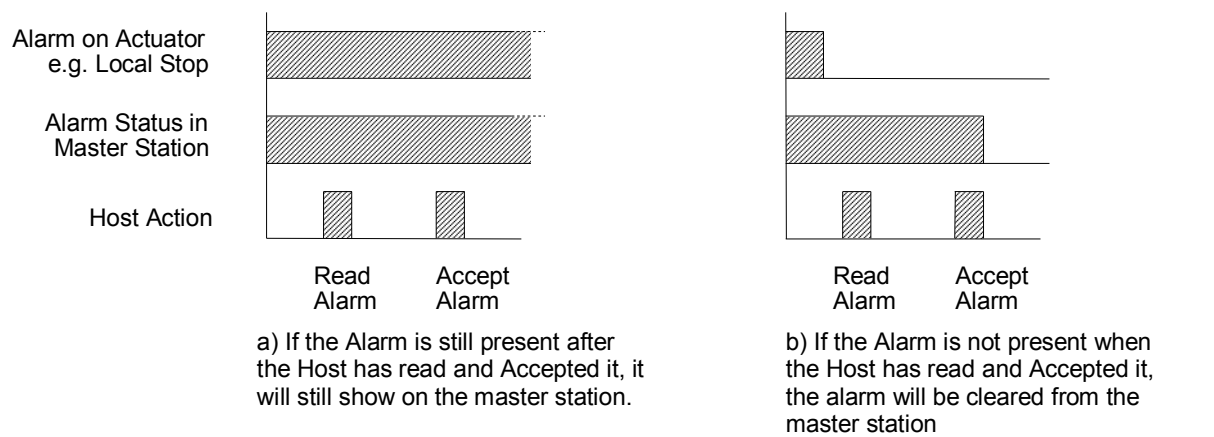


Fig 11: Alarm Handling Sequences

## 8. SETTING UP A FIELD UNIT

The parameters that determine the actions and settings of the field unit may be programmed by a Pakscan 3 master station. A Paktester must be used to set the field unit address and baud rate initially. Then the master station screens or web pages can be used to alter the default values to those required for correct operation. All field unit variable parameters have default settings that will be present on a new field unit. These will generally require some alterations, so as to match the field unit to the actuator and to the system.

**BEFORE SETTING ANY VARIABLES, ENSURE THAT THE ACTUATOR AND PLANT IS IN A SAFE CONDITION. SETTING SHOULD ONLY BE CARRIED OUT BY A COMPETENT ENGINEER.**

The tools that may be used to set the parameters are:

- Paktester version higher than 4.0
- Pakscan 3 Master Station Web Pages
- Pakscan 3 Master Station screens for FCU parameters

In all cases the data variables are stored in non-volatile memory. As a protection on the system, when the address or baud rate is to be changed by using the Paktester, the field unit must be in loopback. The following section shows the identity of each variable parameter and its default setting, together with the tool that can be used to vary the setting.

The ROMpak also includes a DIP switch on its main board and some of these switches can affect the operation of the field unit. In particular, switch 11 must be set 'On' to permit the FCU to control the actuator. The default position for all other switches is 'Off'.

### ROMpak DIP Switch Functions

| Switch | Title  | Function                                                                                                                      |
|--------|--------|-------------------------------------------------------------------------------------------------------------------------------|
| 1      | LED    | Off = Green LED for closed, On = Red LED for closed.                                                                          |
| 2      | 3PH    | Allows Synchrophase detector to operate, set On when 3 phase supply in use.                                                   |
| 3      | ESD    | On ESD contact Normally Open, Off ESD contact Normally Closed.<br>(Exception: Part number 48187 On = ESD On , Off = ESD off). |
| 4      | ESDDIR | On = open, Off = close on ESD.                                                                                                |
| 5      | P1     | ) Both 5 & 6 On = open priority, Both 5 & 6 Off = close priority,<br>) Both 5 & 6 different = stop priority.                  |
| 6      | P2     |                                                                                                                               |
| 7      | CA     | Off = clockwise to close.                                                                                                     |
| 8      | PTR    | On = maintained action, Off = push-to-run action for local controls.                                                          |
| 9      | TLO    | On = open until open torque limit reached, Off = open until open position limit.                                              |
| 10     | TLC    | On = close until close torque limit reached, Off = close until close position limit.                                          |
| 11     | RSC    | On = permit Pakscan control (and remote control), Off = local control only.                                                   |
| 12     | Folo   | On = set-up mode, Off = normal mode.                                                                                          |

Details for the setting of the DIP switch are also included in the actuator manual.

## 8.1 Pakscan Parameters

### Field Unit Parameters

| Parameter Identity           | Permitted Values               | Default                  |
|------------------------------|--------------------------------|--------------------------|
| Comms Baud Rate              | 110, 300, 600, 1200, 2400 Baud | 1200                     |
| FCU Address                  | 1 -240                         | 1                        |
| Analogue Update Timeout      | 10 - 255 seconds               | 30 (1 sec resolution)    |
| Analogue Deviation Threshold | 2 - 99%                        | 20% (1% resolution)      |
| Motion Inhibit Timer         | 0 - 65 seconds                 | 2 sec. (1 s. resolution) |
| Deadband                     | 0% - 10%                       | 5% (0.1% resolution)     |

#### 8.1.1 Communication Baud Rate

Must be set to 110, 300, 600, 1200, or 2400 Baud. All the Field Units on the loop must be set to the same base speed baud rate. The baud rate can only be set with a Paktester.

#### 8.1.2 Field Unit Address

Must be set in the range 1-240. On a single 2-wire loop, each Field Unit must have a unique address. The order of the addresses on the loop need not be consecutive. For reasons of speed performance it is best to have no unused addresses on the loop. The address can only be set with a Paktester.

#### 8.1.3 Analogue Update Time

When set, this is the period between updates to the master station of analogue position data. The valve position is reported each time it changes by more than the Analogue Deviation or every 'x' seconds, where 'x' is the Analogue Update Time. As the value updates on deviation whilst the valve is moving, the update time can be set to quite a long period and should be approximately 10 times the loop scan period. If analogue data is not being used at all, then the Update Time should be turned off by setting it to zero (0). The Analogue Update Time can only be set from the master station.

#### 8.1.4 Analogue Deviation Threshold

When set this is the amount of change that has to occur before the analogue position data is reported to the master station. The valve position is reported each time the value changes by the Analogue Deviation setting or every Update Time period. Whilst the valve is in motion, reports about its position will be made each time the position changes by more than the Deviation setting. The recommended value is 5%, where analogue data is required. If analogue data is not being used then the Deviation should be turned off by setting it to zero (0). The Analogue Deviation Threshold can only be set from the master station.

8.1.5 Motion Inhibit Timer

To protect the actuator motor, the setting for the Motion Inhibit Timer is designed to prevent the motor exceeding the rated number of starts per hour. If the motor is rated at 60 starts per hour and the average running period is 30 seconds, the setting should be 30 seconds. The motion Inhibit Timer can only be set from the master station.

8.1.6 Deadband

The Deadband setting will prevent the actuator from hunting. The deadband must be set to a number that provides good close control with the minimum of actuator starts. Ideally, the actuator should never be prevented from starting by the motion inhibit timer. The actual setting for the deadband will depend on the actuator and valve combination. If the control has to be exact then a small (2%) deadband should be set. If a more tolerant control is permitted, then a deadband of 5% is reasonable. The deadband can only be set from the master station.

8.1.7 Hysteresis

This is a fixed value of 2% and cannot be adjusted at this time.

The hysteresis is a setting for 'no action' at the edge of the deadband. It will prevent the actuator from hunting at the transition point from inside to outside the deadband. The actuator will be stopped at a point where the measured value has entered the region of the deadband minus the hysteresis but will not attempt to correct the position unless the error exceeds the deadband. The deadband must be set greater than the hysteresis for the deadband to have any effect.

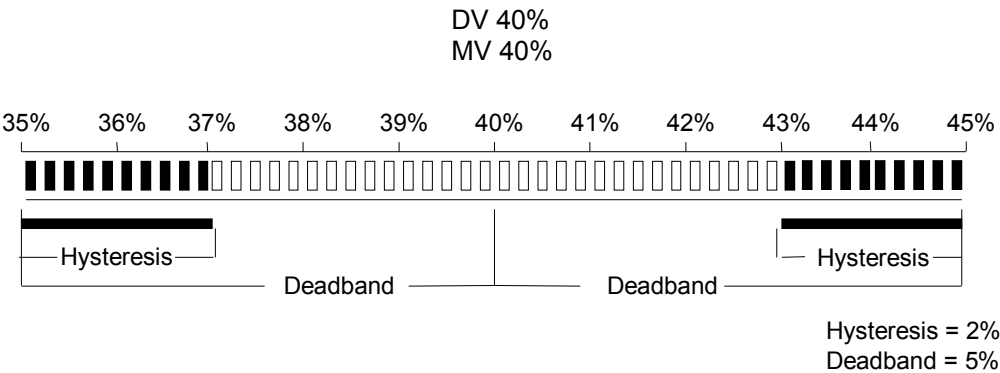


Fig 12: Deadband and Hysteresis

## 8.2 Using a Paktester

The Paktester must be connected to the 2-wire loop terminals of the actuator and the actuator must be powered on. Only one actuator may be connected to the Paktester at a time. Full details of the procedure for using the Paktester are included in the Paktester manual S178E. The required variable can be programmed using the 'Programme' button on the Paktester and by then inserting the new values on the screens as they appear. The type of field unit will not be shown on the Paktester screen and only the speed and address can be altered with this tool.

The actuator must be in loopback for the address to be altered.

## 8.3 Using the Pakscan 3 Master Station Screens

The master station is used to alter the performance parameters of the field unit such as motion inhibit time and deadband. To alter an individual field unit's parameters, follow the screen menus to the FCU screens; then move to the address of the required actuator. Select the FCU screen for setting the actuator and then edit the parameters, as required.

The master station can also be used to change the communication speed of all the field units on the loop at the same time. The Loop Settings maintenance screen allows a new speed to be selected. The speed of all the connected field units will be altered the next time the loop is reconfigured. Take great care when using this facility, since if too high a speed is selected, some field units may be lost from the network. Only one speed step change per programming action is allowed.

It is not possible to change the address of a field unit from these screens.

## 8.4 Using the Pakscan 3 Web Pages

By using a PC and the Pakscan 3 master station internal web pages, it is possible to edit the settings for the individual field units from their respective web pages. Administrator access is required and once the required FCU has been located, simply select 'parameters' and modify the settings, as required. The new value will be sent to the field unit immediately and when the screen is refreshed, the new value will appear.

To alter the loop communication speed also requires Administration access. The speed can be altered in the section on Pakscan 2 Loop Option Card by selecting a new speed. The speed of all the connected field units will be altered the next time the loop is reconfigured. Take great care when using this facility, since if too high a speed is selected, some field units may be lost from the network. Only one speed step change per programming action is allowed.

It is not possible to change the address of a field unit from these screens.

## 8.5 Replacing the FCU Software

The field unit software is held in flash memory. In the event of a field upgrade to the firmware being required it is necessary to make specialist tools available. These tools are only available from Rotork.

It is not possible to upgrade the firmware using the 2-wire loop.

## **9. MAINTENANCE AND REPAIR**

There is no periodic service requirement for the field unit.

Repairs should not be attempted on the field unit. Any failure should be rectified by replacing the field unit with a new compatible device. Static sensitive devices are used in the field unit. It is therefore mandatory to observe anti-static precautions when handling or working on a field unit.

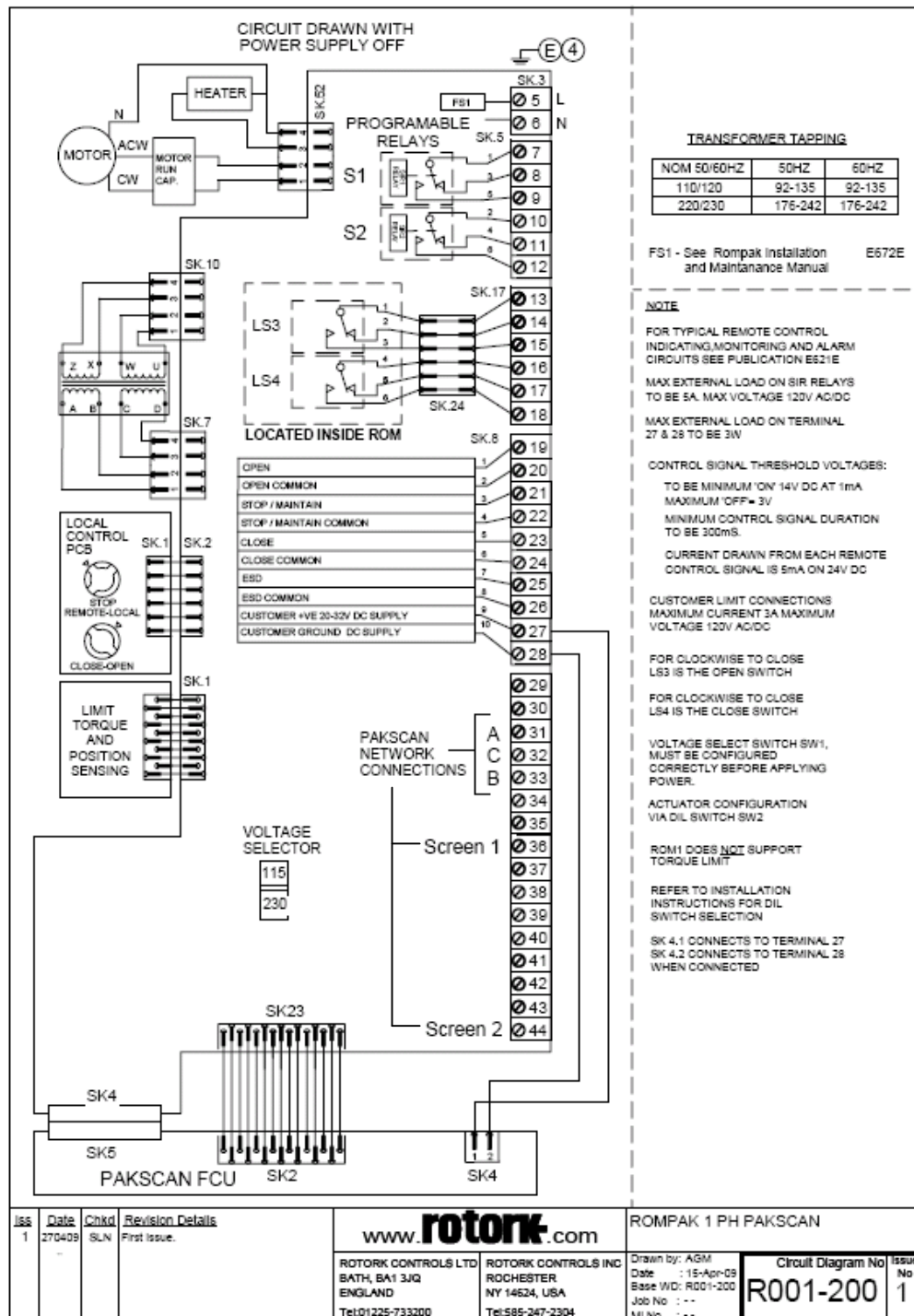
The field unit may be stored for a period of up to 10 years in clean conditions.

## 10. RECORDS

The following information should be recorded for each field unit (M = Major Parameter):

|   |                              |  |
|---|------------------------------|--|
|   | Valve Tag:                   |  |
|   | Actuator Serial Number:      |  |
|   |                              |  |
| M | Field Unit Address:          |  |
| M | Loop Baud Rate               |  |
|   |                              |  |
|   | Analogue Update Time         |  |
|   | Analogue Deviation Threshold |  |
|   | Motion Inhibit Timer         |  |
|   | Deadband                     |  |

## 11. WIRING DIAGRAM EXAMPLE





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