



# **Pakscan Field Unit Technical Manual**

(IQ / IQT 3<sup>rd</sup> generation, CVA, CMA, ROMpak, CK, SI3)

**The Pakscan card described in this manual contains static-sensitive devices. Suitable precautions, such as wearing an earthed anti-static wrist strap, should be taken before handling the card. It should be kept in an anti-static bag or box while it is not fitted within an actuator.**

Note 1:

The Pakscan cards described in this manual are suitable for inclusion in Rotork IQ / IQT / SI 3<sup>rd</sup> generation, CVA, CMA, ROMpak and CK actuators.

Note 2:

The information in this manual supersedes manual PUB008-003 for the ROMpak.

Note 3:

The information in this manual relates to the Pakscan module firmware release V208 (for ROMpak V101).

Note 4:

For simplicity, the IQ / IQT (3rd generation) products are referenced within this document as IQ.

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

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**Contents:**

Glossary of Terms: .....	5
Abbreviations:.....	5
<b>INTRODUCTION.....</b>	<b>7</b>
<b>1. FIELD UNIT PROPERTIES.....</b>	<b>9</b>
1.1 Mechanical Properties.....	9
1.2 Electrical Properties .....	10
1.3 On-Board Indication LEDs .....	10
1.3.1 Green LED.....	10
1.3.2 Red LED .....	11
1.4 Operation and Storage.....	11
<b>2. COMPATIBILITY .....</b>	<b>13</b>
2.1 Pakscan 3 and P3F Master Station.....	13
2.2 Pakscan IIE Master Station .....	13
2.3 Pakscan IIS Master Station .....	13
2.4 Paktester and other Tools.....	13
2.5 2-Wire Loop.....	13
<b>3. FITTING THE FIELD UNIT.....</b>	<b>15</b>
3.1 Inside an IQ and SI3 actuator .....	15
3.2 Inside a CVA actuator.....	16
3.3 Inside ROMpak actuator.....	17
3.4 Inside CMA actuator .....	18
3.5 Inside CK actuator .....	19
3.6 Replacing or Fitting a Field Unit.....	20
<b>4. 2-WIRE LOOP CONNECTIONS .....</b>	<b>21</b>
<b>5. 2-WIRE LOOP INTERFACE .....</b>	<b>22</b>
5.1 Loopback Feature.....	22
5.2 Loop Bypass Circuit.....	23
<b>6. INPUT AND OUTPUT SIGNALS .....</b>	<b>25</b>
6.1 Input Data summary .....	26
6.2 Digital Status Data Bits .....	28
6.2.1 Actuator Position Limit Switch Data - 'CAS' & 'OAS' .....	28
6.2.2 Stop Indication Data - 'STOP'.....	28
6.2.3 Move Indication Data - 'MOVE'.....	28
6.2.4 Motor Running Data - 'MRC', 'MRC' .....	28
6.2.5 Travelling Data - 'Travelling', 'TRC', 'TRC' .....	28
6.2.6 Remote Auxiliary Input Signals - 'AUX1', 'AUX2', 'AUX3', 'AUX4' .....	29
6.2.7 Remote Auxiliary Input Signal - 'EXT' .....	29
6.2.8 Battery Status - 'batt', 'bakbatt', 'bakpwr' .....	29
6.2.9 Loopback On - 'lbon' .....	29
6.2.10 New Alarm Indication - 'nalarm' .....	30
6.2.11 Remote - 'remote' .....	30

6.2.12	Alarm Indication - 'alarm' .....	30
6.3	Alarm Status Data Bits .....	31
6.3.1	Memory Fault - 'memf' .....	31
6.3.2	Communication Failure - 'comms' .....	31
6.3.3	Power on Reset - 'powr' .....	31
6.3.4	Watchdog - 'wdog' .....	31
6.3.5	Local - 'local' .....	31
6.3.6	Local Stop - 'lstop' .....	32
6.3.7	Thermostat Trip - 'therm' .....	32
6.3.8	Monitor Relay - 'mrel' .....	32
6.3.9	Start/Stop Failure - 'sfail' .....	32
6.3.10	Obstructed Valve, Torque Trip - 'vobs' .....	33
6.3.11	Jammed Valve, Torque Trip - 'vjam' .....	33
6.3.12	Auxiliary Override Input Detected - 'auxor' .....	33
6.3.13	Valve Travel Time - 'vtt' .....	33
6.3.14	Manual Valve Movement - 'mmove' .....	33
6.3.15	Motor Continues Running at End of Travel Limit Position - 'eot' .....	34
6.3.16	Manual Open, Manual Close, Manual Opening, Manual Closing - 'MOP', 'MCL', 'MOPG', 'MCLG' .....	34
6.3.17	Fault relay - 'FAULT' .....	34
6.4	Additional Feedback Data – Analogue .....	35
6.4.1	Valve Position Feedback - Continuous Position Data .....	35
6.4.2	Limited range position reporting .....	35
6.4.3	Actuator Torque Feedback (IQ, CK and CVA only – Pressure for SI3) .....	36
6.4.4	Analogue feedback .....	36
6.5	Command Outputs .....	37
6.5.1	Local Controls (Open, Stop, Close) .....	37
6.5.2	Pakscan Controls (Open, Stop, Close and Set dv) .....	37
6.5.3	Position Control (set dv) .....	37
6.5.4	Remote Auxiliary Control Inputs (IQ, CK and SI3 only) .....	39
6.5.5	EMERGENCY SHUT DOWN .....	40
6.5.6	PARTIAL STROKE (IQ, CK and SI3 only) .....	40
7.	ALARM HANDLING .....	41
8.	SETTING UP A FIELD UNIT .....	43
8.1	Using a Paktester .....	48
8.2	Using a Setting Tool (IQ only) .....	48
8.3	Using Insight2 (IQ and CVA only) .....	48
8.4	Using Enlight (CVA only) .....	48
8.5	Using the CMA menu (CMA only) .....	48
8.6	Using Accent (CK only) .....	48
9.	RECORDS .....	49
	APPENDIX 1. PARAMETER ACCESS TABLE .....	50

## FIGURES

Figure 1:	The Pakscan Option Card's Actuator Compatibility .....	7
Figure 2:	The IQ Pakscan Field Unit .....	9
Figure 3:	Field Unit Indication LEDs .....	10
Figure 4:	The IQ FCU and its location behind the control module .....	15
Figure 5:	The FCU located on the underside of the control PCB in a CVA actuator .....	16
Figure 6:	The FCU located on the Main PCB in a ROMpak actuator .....	17
Figure 7:	The FCU located in a CMA actuator .....	18
Figure 8:	The FCU located in a CK actuator .....	19
Figure 9:	The Pakscan 2-wire loop connections for an IQ actuator .....	21
Figure 10:	Loopback feature .....	22
Figure 11:	Loop Bypass relay .....	23
Figure 12:	Input and Output Data Directions .....	25
Figure 13:	Limited range Position Reporting .....	35
Figure 14:	Torque Log Reporting - Limited range position .....	36
Figure 15:	Deadband and Hysteresis Settings .....	39
Figure 16:	Alarm Handling Sequences .....	41
Figure 17:	Deadband and Hysteresis .....	46

## Glossary of Terms:

Enlight	A graphical user interface for Bluetooth communication with CVA actuators. This is downloadable from the Rotork web site, <a href="http://www.rotork.com">www.rotork.com</a>
FCU	The Pakscan Field Control Unit.
Insight2	A graphical user interface for communication with IQ, SI3 and CVA actuators. This is downloadable from the Rotork web site, <a href="http://www.rotork.com">www.rotork.com</a>
Accent	A graphical user interface for communication with CK actuators.

## Abbreviations:

CMA	Compact Modulating Actuator
Comms	Communications
CVA	Control Valve Actuator
CVL	Linear version of CVA
CVQ	Quarter-turn version of CVA
DIO	Digital Input / Output Board
DV	Desired Value
ESD	Emergency Shut Down
MV	Measured Value
PCB	Printed Circuit Board

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## INTRODUCTION

The Pakscan Field Control Unit (FCU) described in this manual is fully compatible with the Pakscan 2-wire current loop control systems. The field unit forms an integral part of the actuator and is housed within the main electrical housing. For the IQ, SI3 and CVA products, the electrical housing is double sealed and need never be opened (under normal circumstances) once the actuator leaves the assembly plant. The ROMpak and CMA range of actuators do not have double sealing and the electrical cover is required to be opened for making field connections. The CK has plug and socket electrical connection separate from the main electrical housing.

Adjustments to the settings for the field unit may be made via the 2-wire interface using a Paktester for all Pakscan field units, or via the Infra-red or the Bluetooth tools for those products that support those interfaces.

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.



Figure 1: The Pakscan Option Card's Actuator Compatibility

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# 1. FIELD UNIT PROPERTIES

## 1.1 Mechanical Properties

The FCU comprises a single printed circuit board that fits inside the actuator electrical housing. It connects to the main board of the actuator by a multi-pin connector. The actuator internal wiring harness has connections to the field unit for the 2-wire loop connection, via the actuator terminals, and the isolated supply voltages for the field unit communications components (IQ, SI3 and ROMpak only). These connectors are polarised to prevent incorrect connection.

In most cases, the field unit connects directly to the main actuator control PCB (Printed Circuit Board). In an IQ and SI3, it can be fitted directly to the control Module PCB using either one of the 2 slots available, or can be fitted on top of another option module that may already be fitted in one of these slots. There are 4 available slots for option cards to be mounted either directly or indirectly behind the control module PCB. For the CMA and CK there are 2 option slots available and for the CVA and ROMpak there is one slot available.

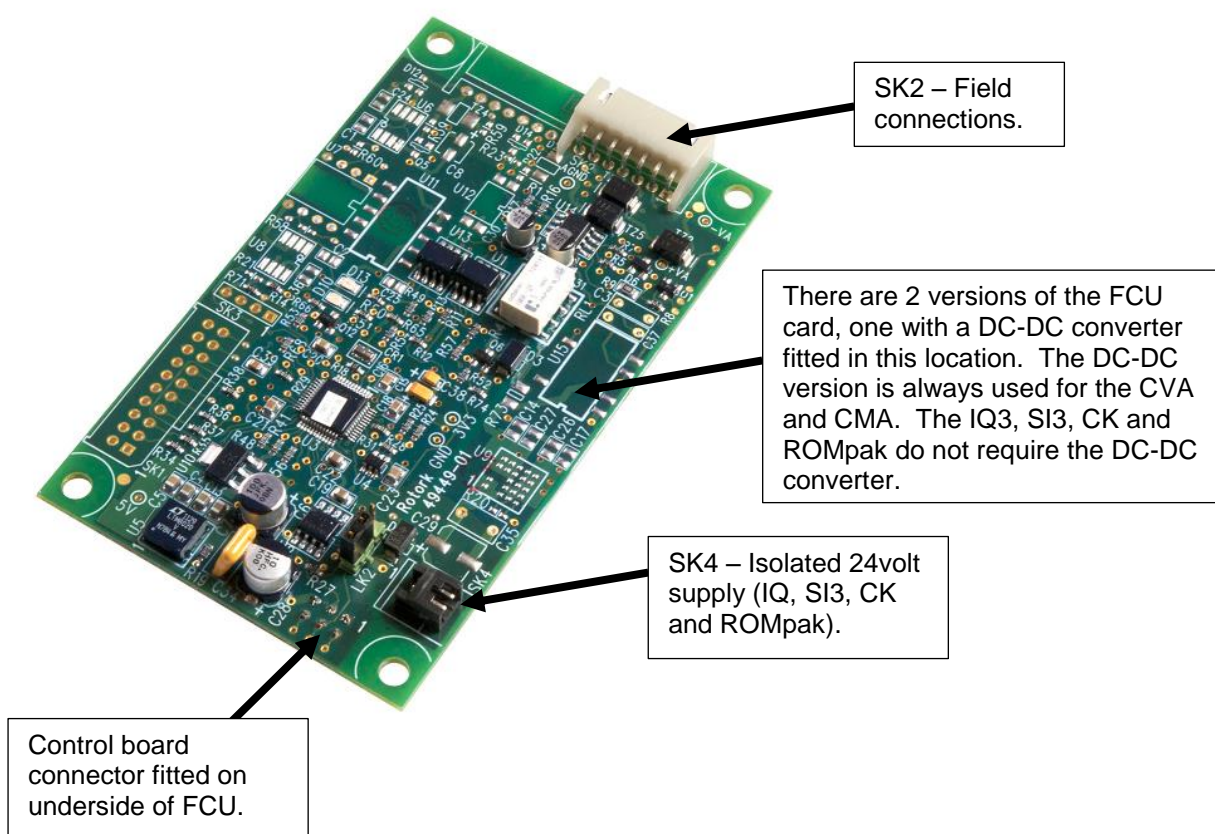


Figure 2: The IQ Pakscan Field Unit

## 1.2 Electrical Properties

The FCU processor circuits communicate to other modules in the actuator via an internal communications bus. 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 contains the firmware for the unit. The firmware version is indicated on the label fitted to the processor. Additionally, the circuit includes non-volatile memory that is used to store specific field unit settings, e.g. communications parameters.

The digital 2-wire loop interface electronics are 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 and also 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.

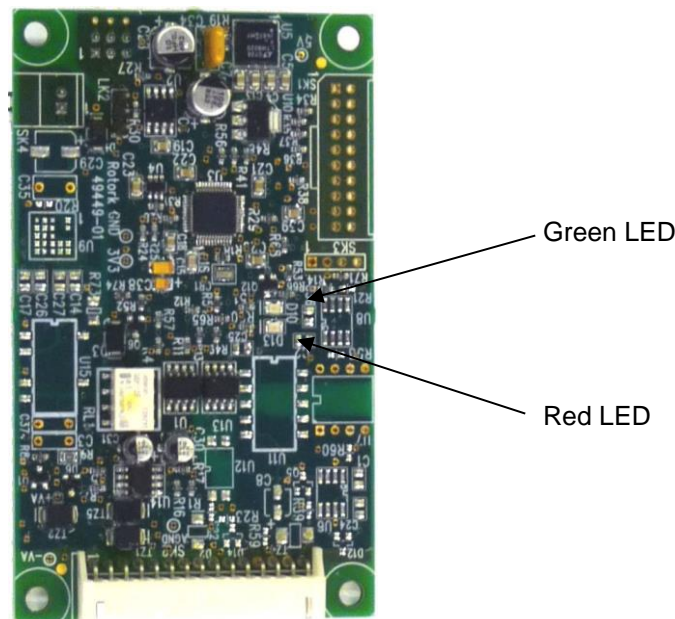


Figure 3: Field Unit Indication LEDs

### 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. Communication between the FCU and the actuator main PCB will be continuous, therefore 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.

## 1.4 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:	-40degC to +70degC
Storage temperature:	-50degC to +85degC
Relative Humidity:	5% to 95% (<50degC) non-condensing

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## **2. COMPATIBILITY**

The FCU is compatible with Pakscan current loop systems and the associated Pakscan 3, P3F, IIE and IIS master stations. 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 field unit. Earlier versions of the software will report the actuators covered in this manual as an integral. Versions of software from CPU code 2.01.18 and current loop 1.1.7 will correctly identify all these products.

### **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 3.0 are compatible with the field unit. Master stations with earlier software can be upgraded to a suitable version. The actuators covered in this manual will be reported as an integral devices; this does not affect the ability to access data through the Modbus database.

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

All Pakscan IIS systems are compatible with the field unit. The actuators covered in this manual will be reported as an integral devices; this does not affect the ability to access data through the Modbus database.

### **2.4 Paktester and other Tools**

In order to be able to use a Paktester to set up and commission Pakscan field units a Paktester fitted with software 5161-013 with a version higher than V4.0 can be used.

The Rotork Setting Tool supplied with the actuator (IQ, SI3 and CK) and the on board menu in the CMA can also be used to set up certain field unit parameters – See appendix 1 for details of which parameters can be accessed.

### **2.5 2-Wire Loop**

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

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### 3. FITTING THE FIELD UNIT

#### 3.1 Inside an IQ and SI3 actuator

The FCU is suitable for fitting into IQ actuators with wiring diagrams containing a 'K' as the 4<sup>th</sup> character, for example 100K2000 for IQ and 300K2000 for IQT. For the SI3 refer to the wiring diagram issued with the Actuator.

The FCU can be located in one of 4 option 'slots' located on the back of the control module PCB, housed in the electrical cover. There are 2 slots for directly connecting the option module to the Control module and where those slots are already filled, the option card can be fitted on top of an existing option module with the appropriate fixings. The modules can be stacked 2 high.

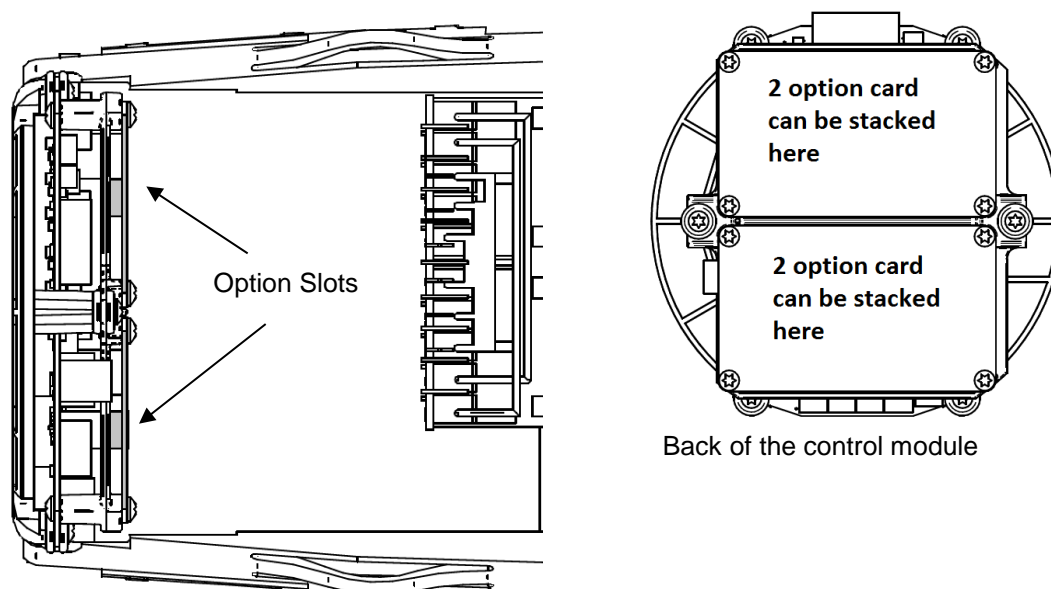


Figure 4: The IQ FCU and its location behind the control module

On the IQ and SI3 actuators the remote inputs are always present (they are conditioned by the control board) and there are 4 standard Digital Outputs from relay contacts. If the FCU is required to operate digital outputs, then an Extra Relay Indication card or DIO card must be fitted into the actuator; providing relay contacts S5 to S8.

The FCU is connected to the control module by a header, which contains most of the interconnections. SK4 is used to supply 24volts to the card for the isolated network communications. The wiring harness from the actuator terminal bung connects the 2-wire field connections to SK2. See section 1.1 for details of the location of the connectors on the card.

### 3.2 Inside a CVA actuator

The FCU is suitable for fitting into CVA actuators, wiring diagrams CXX-20 (where X can be any value). The FCU module is fitted in the only option board slot available inside the CVA electrical housing – on the underside of the Main PCB assembly.

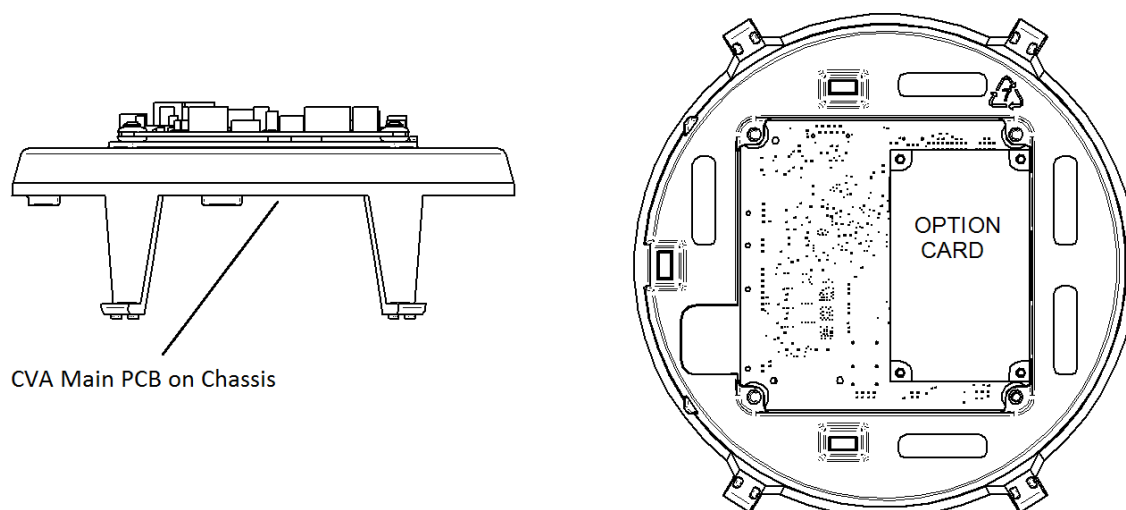


Figure 5: The FCU located on the underside of the control PCB in a CVA actuator

SK2 is the connection to the Pakscan Data Highway.

The FCU must be enabled in the CVA. This would usually be done during factory test, but may be required to be completed on site when converting to Pakscan. To enable the FCU, the Rotork PDA software Enlight (downloadable from the Rotork web site) is required, to change parameter 34. It must be first read, then 2048decimal added to it. This procedure is best performed by a Rotork Engineer.

The FCU is connected to the control module by a header, which contains most of the interconnections. The wiring harness from the actuator terminal bung connects the 2-wire field connections to SK2.



### 3.3 Inside ROMpak actuator

The FCU is suitable for fitting into ROMpak actuators, wiring diagrams RX0X-2X0 (where X can be any value). The FCU module is fitted in the only option board slot available inside the ROMpak electrical housing.

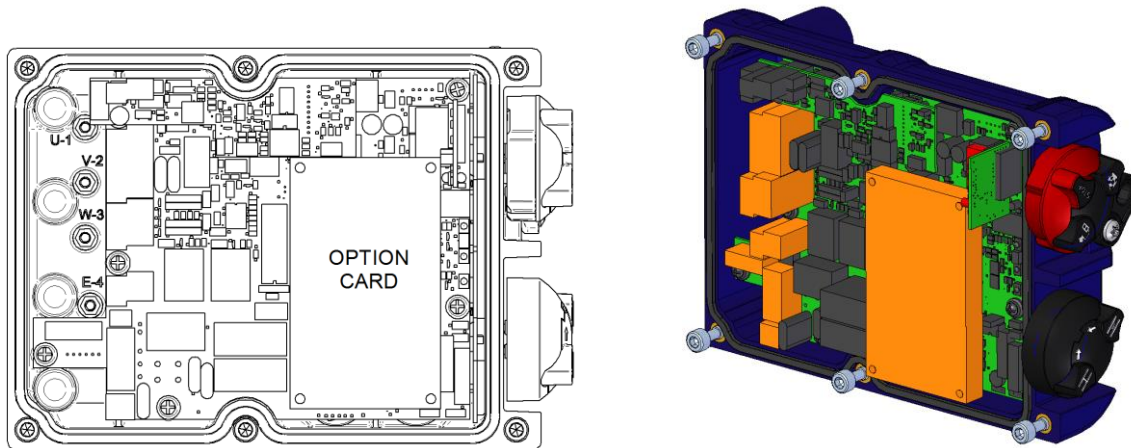


Figure 6: The FCU located on the Main PCB in a ROMpak actuator

The FCU is connected to the control module by a header, which contains most of the interconnections. SK4 is used to supply 24volts to the card for the isolated network communications; this is connected to SK8 on the main PCB assembly via an internal loom. SK2 is the connection to the Pakscan Data Highway; this is connected to SK23 on the main PCB assembly via an internal loom. The user wires the Pakscan connections to the main PCB assembly at the terminal block SK18 as per the wiring diagram.

### 3.4 Inside CMA actuator

The FCU is suitable for fitting into CMA actuators, wiring diagrams MX0-K0 (where X can be any value). The FCU module is fitted onto the only option slot available inside the CMA electrical housing.

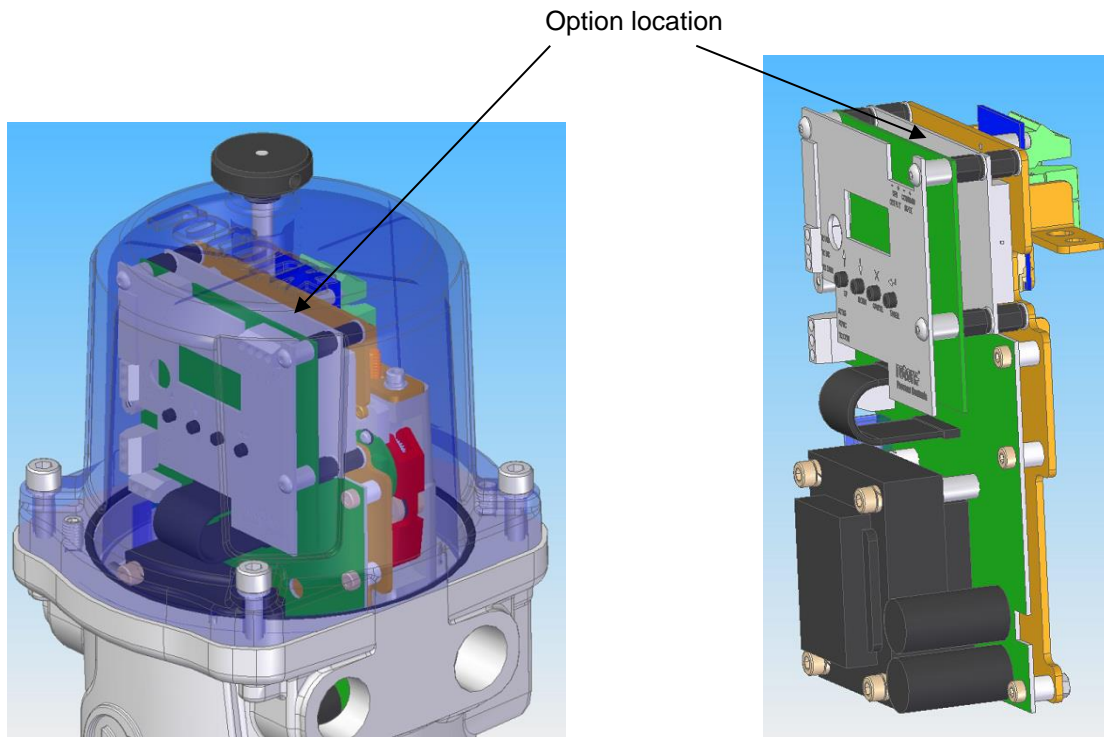


Figure 7: The FCU located in a CMA actuator

SK2 is the connection to the Pakscan Data Highway and the interconnect board. The user wires the Pakscan connections to the interconnect board assembly at the terminal block SK1-SK4 as per the wiring diagram.

### 3.5 Inside CK actuator

The FCU is suitable for fitting into CK actuators with P000.000 and K000.0000 series wiring diagrams and CK<sub>RC</sub> with P000.1000 and K000.1000 series wiring diagrams. The connections and fitting in a CK<sub>RC</sub> are the same as the CK<sub>C</sub> so the following information effectively relates to both actuator types. The FCU is normally located in the first option board slot inside the electrical housing, using Main PCB connection SK2.

The Interface card must be correctly located and attached to the appropriate connectors to match the actuator. The illustration below shows the location of the cards in the CK.

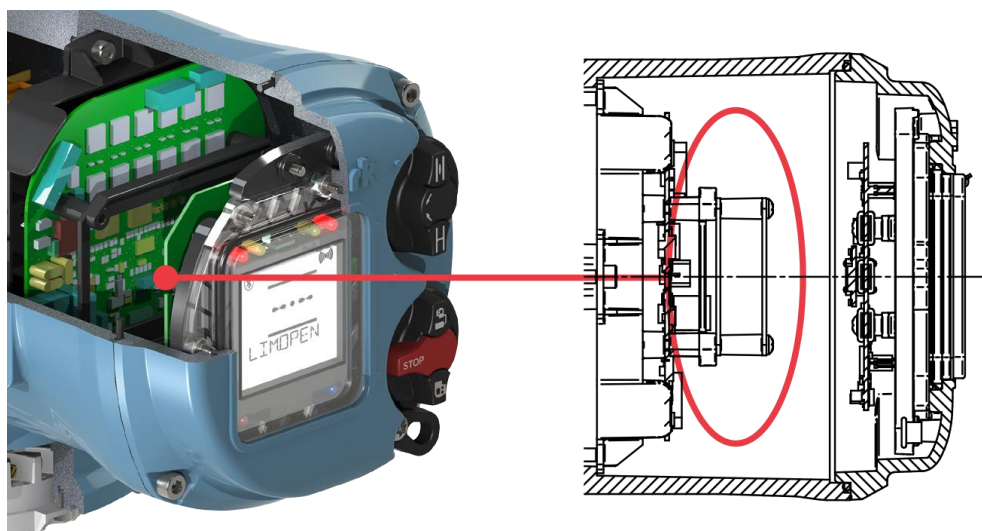


Figure 8: The FCU located in a CK actuator

With the CK actuator, the remote inputs are always present (they are conditioned by the FCU) and there is an option to include Digital Outputs from relay contacts. If the FCU is required to operate the 4 digital outputs that can be controlled from the card, then an Extra Relay Indication card associated with these outputs must be fitted into the option slot above the FCU card in the actuator.

The FCU is connected to the control module by a 10 way header (SK2). SK4 is used to supply 24volts to the card for the isolated network communications. The wiring harness from the actuator terminal bung connects the field connections to SK3.

### 3.6 Replacing or Fitting a Field Unit

The field unit should be replaced or fitted only in a suitable environment. The appropriate actuator manual should be reviewed before proceeding. The actuator must be made electrically safe before opening any covers and in the case of an IQ it is advisable to disconnect the internal battery. In the case of a CVA and a CMA which contain a back-up power pack, it is advisable to make sure the back-up power has dissipated before opening the electrical cover.

The electrical housing cover should be removed and the existing field unit carefully unplugged from its connector. Once removed from the connector the wiring loom connectors should be removed. The replacement board is fitted in the reverse order to removal.

If the operation is to fit a field unit for the first time then the necessary wiring looms must be added to the internal wiring harness. The actuator wiring diagram shows the connectors and harnesses used. The wiring harnesses should be fitted inside the actuator before fitting the field unit. Once the looms are in place connect them to the field unit, then fit the field unit to the actuator main board connector.

Once the field unit is fitted the actuator should be re-assembled and, in the case of the IQ, the battery connection replaced.

Once power is applied the field unit parameters should be checked and corrected where necessary.

**The Pakscan card described in this manual contains static-sensitive devices. Suitable precautions, such as wearing an earthed anti-static wrist strap, should be taken before handling the card. It should be kept in an anti-static bag or box while it is not fitted within an actuator.**

## 4. 2-WIRE LOOP CONNECTIONS

The actuator should be wired in the communication loop as indicated in figure 8.

It is important to connect the current loop input terminal (for example: terminal 26 on an IQ actuator) to the previous actuator current loop output terminal and the current loop output terminal (for example: terminal 27 on an IQ actuator) 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 28 on an IQ actuator.

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 (for example: terminal 29 on an IQ actuator) is allocated in the actuator for the screen to connect to. The screen should be continuous for the whole 2-wire cable.

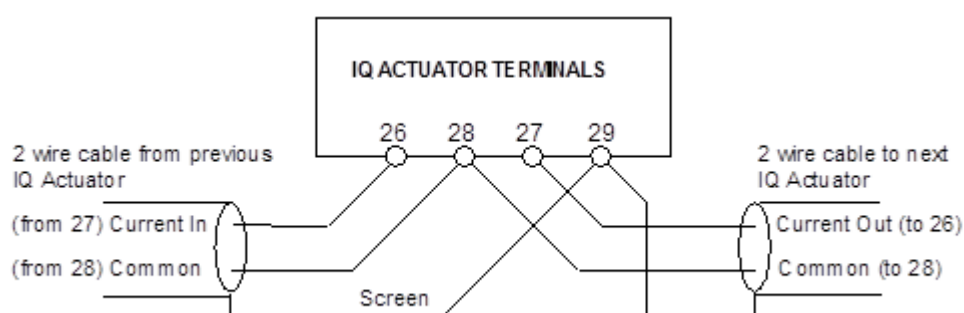


Figure 9: The Pakscan 2-wire loop connections for an IQ actuator

The wiring diagram for the actuator should be checked before connecting up; the terminal numbers listed above are for a standard 100K2000 wiring diagram (IQ). For some wiring diagrams the terminal numbers may be different due to the requirements of other options fitted.

### Earthing NOTE

**The standard FCU card for the IQ, SI3, CK and ROMpak actuators utilises the customer 24 volt supply available at the actuator terminal bung for the isolated network communications. Because of this, care should be taken to ensure that the Customer Supply (on terminals 4 and 5 for an IQ for example) is not directly or indirectly connected to earth, otherwise this can stop network current loop communications.**

**If it is required that the customer supply is connected to earth, it should be made known at the time of order such that an FCU card with a DC-DC converter can be fitted, to maintain isolation.**

**The CVA and CMA utilise the isolated DC-DC converter version of the card as standard.**

## 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, refer to Rotork publication PUB059-028.

### 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.

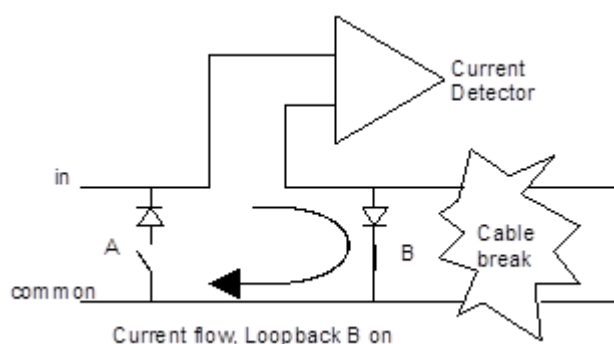


Figure 10: Loopback feature

## 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 in the 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.

For a CVA with a back-up power pack fitted, the pakscan unit will continue to communicate whilst mains power is removed and the backup power is still available.

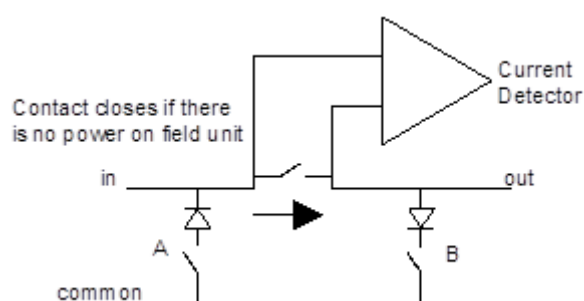


Figure 11: Loop Bypass relay

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## 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.

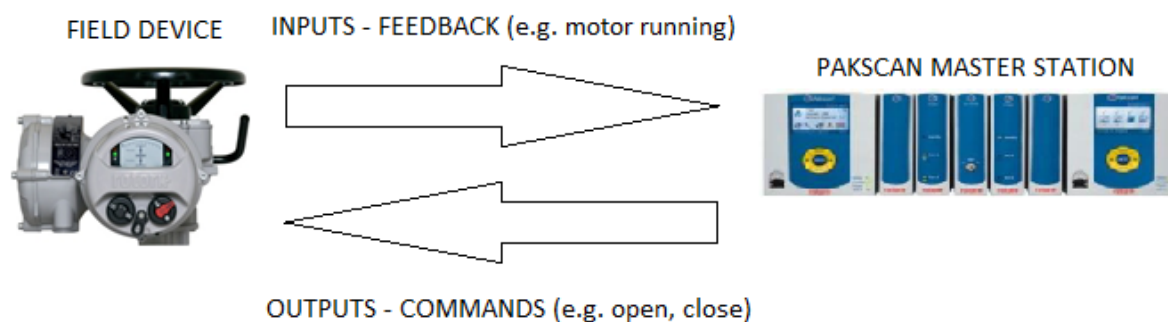


Figure 12: Input and Output Data Directions

## 6.1 Input Data summary

Not all of the discrete data bits are available for each actuator; see the tables below for which bits are supported by which actuator type. The following sections first shows a brief description of the data and finally detailed descriptions of the data.

### Digital Inputs:

IQ	SI3	CK	ROMpak	CVA	CMA
AUX 1	AUX 1	AUX 1			
AUX 2	AUX 2	AUX 2		BAKPWR	
OAS	OAS	OAS	OAS	OAS	OAS
CAS	CAS	CAS	CAS	CAS	CAS
STOP	STOP	STOP	STOP	STOP	
MOVE	Travelling	MOVE	MRUN	MOVE	MOVE
MRO	TRO	MRO	MRO	TRO	MRO
MRC	TRC	MRC	MRC	TRC	MRC
AUX 3	AUX 3	AUX 3	EXT		
AUX 4	AUX 4	AUX 4			
LBON	LBON	LBON	LBON	LBON	LBON
NALRM	NALRM	NALRM	NALRM	NALRM	NALRM
ALRM	ALRM	ALRM	ALRM	ALRM	ALRM
BATT				BAKBATT	
Remote	Remote	Remote			

### Digital Status Data Bits, Actuator Data

AUX1	-	The remote input connected to input Aux 1
AUX2	-	The remote input connected to input Aux 2
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
MOVE	-	The actuator output drive is moving
Travelling	-	The actuator is moving
MRO	-	The actuator is running open (electrically)
MRC	-	The actuator is running closed (electrically).
TRO	-	The actuator is travelling open
TRC	-	The actuator is travelling closed
AUX3/EXT	-	The remote input connected to input Aux 3 or EXT
AUX4	-	The remote input connected to input Aux 4
(BAK)BATT	-	The status of the actuator internal battery or backup power pack for CVA
BAKPWR	-	The CVA is running using the (optional) back-up power pack
Remote	-	The actuator is in remote

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

LBON	-	The actuator is in Loopback mode
NALARM	-	There is a New Alarm to report
ALARM	-	There is an Alarm to report Alarm Status Data Bits

## Alarms:

IQ	SI3	CK	ROMpak	CVA	CMA
MEMF	MEMF	MEMF	MEMF	MEMF	
COMMS	COMMS	COMMS	COMMS	COMMS	COMMS
LOCAL	LOCAL	LOCAL	CNA	LOCAL	LOCAL
POWR	POWR	POWR	POWR	POWR	POWR
WDOG	WDOG	WDOG	WDOG	WDOG	WDOG
MREL	MREL	MREL	MREL	MREL	MREL
THERM	FAULT	THERM	THERM	THERM	THERM
LSTOP	LSTOP	LSTOP	LSTOP	LSTOP	LSTOP
SFAIL	SFAIL	SFAIL	SFAIL	SFAIL	SFAIL
VOBS	VOBS	VOBS	VOBS	VOBS	VOBS
VJAM	VJAM	VJAM	VJAM	VJAM	
AUXOR	AUXOR	AUXOR	MOP		
VTT	VTT	VTT	MCL		
			MOPG		
MMOVE	MMOVE	MMOVE	MCLG	MMOVE	
EOT	EOT	EOT	EOT	EOT	

## Field Unit Alarms

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

## Actuator Alarm Status Data Bits

LOCAL	-	Actuator Local Control Selected
MREL	-	Actuator monitor relay
THERM	-	Actuator motor thermostat
LSTOP	-	Actuator Local Stop
SFAIL	-	Motor start or stop failure
VOBS	-	Valve obstruction detected, Torque trip
VJAM	-	Valve stuck detected, Torque trip
AUXOR	-	Actuator auxiliary remote controls activated
VTT	-	Specified valve travel time exceeded
MMOVE	-	Actuator being moved manually by the handwheel
EOT	-	Actuator motor continues to run past End of Travel position
FAULT	-	Fault relay set for any fault present

## Additional Feedback Data - Analogue

Valve position (8 bits for ROMpak, 16 bits for CVA, CMA and IQ)  
 Current Torque (8 bits)  
 Historical Torque Opening and Closing Directions

## 6.2 Digital Status Data Bits

Refer to the tables in section 6.1 for details of the data that is supported by each actuator type.

### 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 for open limit indication, CAS is used for close limit indication. These limit positions may be set within the actual valve stroke, as with a torque seating valve the actuator will stop when seated fully closed and the rated torque has been delivered to seat the valve. The position limit switch must be set slightly before the torque off position so as to ensure that the position is correctly reported.

### 6.2.2 Stop Indication Data - 'STOP'

Whenever the actuator output drive 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 - 'MOVE'

The actuator senses any movement of its output drive, whether this is generated by a manual (hand) operation or by the action of the motor. Whenever the output drive is in motion the MOVE data bit is present.

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

There are two data bits relating to the motor running and the direction of travel. Whenever the actuator begins to move the valve electrically, either an MRO or MRC signal will be generated. If the actuator is run in the open direction, then MRO (Motor Running Open) is reported. If the actuator is run in the closed direction 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 Travelling Data – 'Travelling', 'TRO', 'TRC'

These mean Travelling, Travelling Open and Travelling Closed respectively. They are different from MRO and MRC as the SI3 actuator can be moving by use of the spring return rather than the Motor. TRO and TRC will either meaning travelling under motor control or travelling under spring control in the respective directions.

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

The IQ, CK and SI3 actuators are fitted with Remote Inputs; the field unit is able to collect and use the information from the 4 remote input signals designated AUX1 - 4. These signals are reported to the master station over the 2-wire loop for all conditions set in the actuator. The data may relate to the use of some or all of these inputs as remote actuator controls, as remote input signals (for example from tank level switches) or a mixture of the two. Depending on the status of the auxiliary input mask, these inputs can control the actuator.

#### 6.2.7 Remote Auxiliary Input Signal - 'EXT'

The ROMpak is fitted with Remote inputs; the field unit is able to collect and use the data from the digital input designated for the Stop / Maintain function. The ROMpak digital inputs are always enabled and therefore care should be taken to avoid control contention when controlling with the digital inputs at the same time as the pakscan network. Note that operating the Stop / Maintain digital input has no effect on Pakscan commands.

#### 6.2.8 Battery Status - 'batt', 'bakbatt', 'bakpwr'

The IQ actuators are fitted with a battery that is used to power the circuits used to enable the display to be shown and some actuator settings to be made when the mains power is removed. The condition of the battery is monitored at all times and a signal is generated if the battery power is low.

The field unit reports the condition of the battery in a data bit BATT. Remember that the field unit can only report information if the actuator is powered on.

For the CVA BAKBATT indicates a failure in the backup power pack, if fitted. BAKPWR also indicates that the CVA is being powered by the back-up power supply rather than the mains power supply.

#### 6.2.9 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 taken to be sure there are no messages is dependent 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.

#### 6.2.10 New Alarm Indication - 'nalarm'

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.

#### 6.2.11 Remote - 'remote'

The IQ, SI3 and CK actuators have 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 Remote position then the REMOTE digital bit is generated. This data bit is not present when the actuator control switch is in the Local Stop or Local positions.

#### 6.2.12 Alarm Indication - 'alarm'

This data signal is generated within the master station. 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 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 the watchdog timer is to monitor the field unit processor. Every so often the processor examines the watchdog circuit hardware. If the processor does not restart the watchdog timer then, on timing out, the watchdog timer resets the processor and the alarm data bit WDOG is set. If this alarm is present it is indicative of a potential failure in the field unit. When announced 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 as it is a fleeting alarm, but if it returns then it should be assumed that the field unit is about to fail completely.

### 6.3.5 Local - 'local'

The IQ, SI3, CK and ROMpak actuators have 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 LOCAL 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.

For a CVA this will report that the actuator is being controlled by a local source for example using the Enlight software. For a CMA this will report if the actuator is in local or local stop.

#### 6.3.6 Local Stop - 'lstop'

For the IQ, SI3, CK and ROMpak, 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.

The CVA has a 3 position switch for selecting Run, Test and Stop. The run mode is the normal mode for a CVA and in this mode network control will be allowed. When the switch is in the Stop position the pakscan FCU will report LSTOP.

#### 6.3.7 Thermostat Trip - 'therm'

The actuator motor is protected by a thermostat; if the temperature of the motor windings rises above the thermostat trip value then the THERM alarm bit is set. There are no adjustments for the temperature at which the thermostat trip operates. The motor will be stopped if the thermostat trips. Only once the motor has cooled down can a new Remote, Pakscan or Local command to move the actuator Open or Closed be actioned. The ESD command may be set to override the thermostat. The THERM alarm bit will remain set until the motor cools down and until read and accepted.

#### 6.3.8 Monitor Relay - 'mrel'

The actuator includes a composite signal for some alarms referred to as the Monitor relay. The basic functionality of this bit is to indicate whether the actuator is available for remote control. To that effect, the alarm bit will be set if the actuator selector is not in Remote (or Run for a CVA); i.e. if the IQ, SI3, CK or ROMpak are in Local or Local Stop, the CVA is in Test or Stop, the CMA is in Local or Local Stop. Other actuator faults will also trigger the MREL bit, for example thermostat tripped. The actuator also monitors the 3 phase supply (if appropriate), if the phase not associated with the control circuits is lost, the monitor relay will operate and the MREL data bit is raised. The remaining two phases are used by the control circuits and if either of these is lost at any time then the actuator switches off. Communication with the field unit will then be lost. The MREL alarm bit remains set until read and accepted, and the condition returns to normal.

#### 6.3.9 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. This alarm will detect a stall condition, if the actuator has stalled it will not allow control again in the direction that it stalled in without a stop command being sent first or the direction of travel reversed.



#### 6.3.10 Obstructed Valve, Torque Trip - 'vobs'

If the actuator is required to generate more torque than the actuator maximum torque setting the motor will stop; if the actuator is not currently in its end of travel position this bit will be set. 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. For the CMA, 'vjam' and 'vobs' are reported in the 'vobs' bit.

The VOBS alarm bit is fleeting and will clear once read and accepted.

#### 6.3.11 Jammed Valve, Torque Trip - 'vjam'

If the actuator is required to generate more torque than the actuator maximum torque setting the motor will stop; if the actuator is currently in its end of travel position and it is attempting to leave the limit, this bit will be set. 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. For the CMA, 'vjam' and 'vobs' are reported in the 'vobs' bit.

The VJAM alarm bit is fleeting and will clear once read and accepted.

#### 6.3.12 Auxiliary Override Input Detected - 'auxor'

The actuator must be set in Remote for this alarm to be valid. The actuator is capable of being operated by Remote Auxiliary Input signals for Open, Stop, Close and ESD. If one of these inputs is generated then the AUXOR alarm bit is set. The function is to announce that the actuator has been asked to move from this signal source. The AUXOR alarm bit is fleeting and will clear once read and accepted.

#### 6.3.13 Valve Travel Time - 'vtt'

If the field unit detects that the actuator is in motion for a time greater than the setting of the travel time trip then the VTT alarm bit is set. The alarm will not cause the actuator to stop. The VTT alarm bit is fleeting and will clear once read and accepted. This alarm is detected in both local and remote modes.

#### 6.3.14 Manual Valve Movement - 'mmove'

If the valve is placed in hand operation and moved by the handwheel the actuator detects the motion of the output drive. This motion will set the MMOVE alarm bit. The MMOVE alarm bit is fleeting and will clear once read and accepted. This alarm is detected in both local and remote modes.

#### 6.3.15 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. This alarm is detected in both local and remote modes.

#### 6.3.16 Manual Open, Manual Close, Manual Opening, Manual Closing – 'MOP', 'MCL', 'MOPG', 'MCLG'

If the actuator is placed in hand operation and moved by the handwheel the actuator detects the motion of the output drive. This motion will set the appropriate alarm bit depending on the direction of travel. 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. This alarm is detected in both local and remote modes and is fleeting, so will clear once accepted

#### 6.3.17 Fault relay - 'FAULT'

General Fault on the actuator.

## 6.4 Additional Feedback Data – Analogue

General notes on the CK. The CK can be fitted with either a DSM (Digital Switching Mechanism) or a MSM (Mechanical Switching Mechanism). The DSM can report analogue torque values (0-120%) and position (0-100%). The MSM will only report torque as minimum (0%) or maximum (tripped), it does not report any intermediate values. It also only reports position as fully closed, fully open or intermediate (mid-travel). Therefore any functions that require use of analogue position or torque will not function and as such should not be used for units fitted with a MSM.

There is an optional potentiometer that can be fitted to the MSM which allows it to report position (0-100%), which means that the position features can be used, however, this does not include the torque. If there is any uncertainty about what the model is, please consult the wiring diagram which will show which option is fitted.

### 6.4.1 Valve Position Feedback - Continuous Position Data

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% for ROMpak, a resolution of 0.01% for the IQ, CK, SI and the CVA. For a linear CMA the resolution is 0.2% of full scale and 2 degrees for rotary. The resolution of the position value as reported over the network is dependent on the database chosen – refer to the master station Modbus technical manual for more details.

Note that this is the resolution of the position reporting and not the accuracy of the positioning, which is related to the positioning parameters (i.e. deadband and hysteresis), the capabilities of the actuator (i.e. speed and number of turns) and other factors outside of the control of the actuator (i.e. inertia, gearing, gearing and backlash).

There are no ranging adjustments required for the signal as it is pre-calibrated by the limit switch settings of the actuator itself.

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 the data reporting.

### 6.4.2 Limited range position reporting

It is possible to make the position data reported relate to a reduced span of actual valve travel. In this mode the position data relates to a reduced portion of the valve stroke. This is sometimes used where the valve is required to have a 0% position (or 100% position) that is not the same as fully closed and fully open. To make the actuator take note of limited range position reporting it is necessary to set the Position-Minimum and Position-Maximum range using a Paktester or Communicator. The default is always 100% reporting of position from fully open to fully closed limit switch positions.

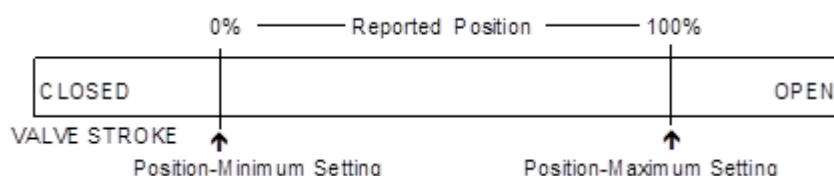


Figure 13: Limited range Position Reporting

### 6.4.3 Actuator Torque Feedback (IQ, CK and CVA only – Pressure for SI3)

This section only relates to the IQ and CVA actuators. The field unit performs several functions in relation to torque data collection and transmission.

For the SI3, the torque location reports pressure.

#### Continuous Torque Transmission

Data relating to the current value of torque being developed by the actuator is available from the field unit. Whilst the actuator motor is stationary this signal will remain as the last value measured. Whilst the motor is running the signal will vary in the range 0-120%, with a 1% resolution. There are no ranging adjustments required for the signal as it is pre-calibrated by the actuator settings; the signal is a percentage of rated actuator torque. It is necessary to set the Deviation Threshold and Update Timeout for the data reporting.

#### Historical Torque Transmission

The field unit collects torque values as the valve traverses from open to closed. These signals are then available from the field unit for reading at the master station. The values are ranged 0-120% of rated torque with a 1% resolution. Eight readings are recorded in each direction of travel, there are 16 readings in total. Readings are not taken at the fully open (100%) position or the fully closed (0%) position as the torque generated in these positions will be that set for the actuator if the valve is torque seating. The torque records are related to valve positions 6%, 19%, 31%, 44%, 56%, 69%, 81% and 94% open. If the valve does not travel for its full stroke only the entries relating to the proportion of the span being used will be updated. If a reduced range of operation has been selected by setting the position minimum and maximum parameters the torque records will correspond to the reduced range of position data.

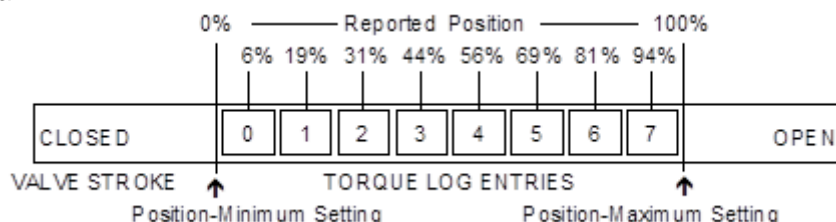


Figure 14: Torque Log Reporting - Limited range position

The 'filter' parameter is used enable or disable auto reporting of the torque historical logs. When set to 0 or Auto, the FCU will automatically report the 6 historical torque logs once the actuator has stopped at a limit. The historical log will contain the instantaneous value of torque for each log. When set to 1 or Man, the historical torque logs are not automatically updated, they will need to be read to update them. In this mode, the historical logs will contain the averaged (or filtered) torque logs i.e. the logs from the actuator datalogger average torque logs.

### 6.4.4 Analogue feedback

With the addition of one or two analogue input cards to the actuator, it is possible to feedback information from 2 analogue output devices, to the master station (and the host). Requires extra analogue input card(s) to be fitted, refer to actuator publication for availability.

## 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. Local controls will always preclude remote controls when actuator is in local. When Remote is selected the actuator will always respond to the last Open/Stop/Close input or DV command. If the command is an ESD then it will override any other command. A standing digital input will override a command received over the network.

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

For local control operation of the actuator refer to the appropriate actuator manual.

### 6.5.2 Pakscan Controls (Open, Stop, Close and Set dv)

The actuator must be in the Remote mode (or run for the CVA) for Pakscan control to be enabled. The field unit is able to command the actuator to move full travel or to a particular position.

#### Full Travel Control

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 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 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.

When the actuator has been set for limited range position reporting it will take the 0-100% position range over a portion of the total valve stroke. If a Desired Value position is sent to the actuator it will use the same limited range for positioning the actuator as it uses for reporting the actual position. A full travel command will move the actuator over the full range to the appropriate limit switch position.

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 an instruction 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 and 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 (IQ only) 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.

### **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. This idle period will prevent the actuator motor exceeding its rated starts per hour. This feature is not present in CVA and CMA.

#### **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. 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 stopping 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 setting for Hysteresis. The field unit positioner will run the actuator until the actual position is within the deadband setting minus the hysteresis setting. 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.

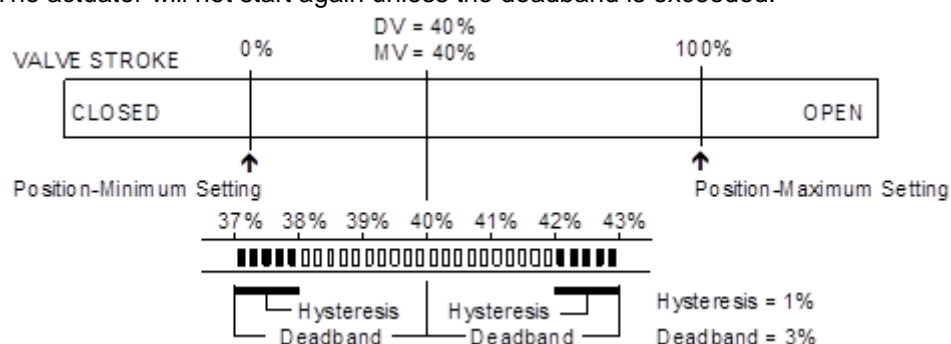


Figure 15: Deadband and Hysteresis Settings

For the CVA and CMA there is no customer programmable hysteresis value.

#### 6.5.4 Remote Auxiliary Control Inputs (IQ, CK and SI3 only)

Some or all of 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.

#### Configuring the Remote Control Auxiliary Inputs

The function of the four inputs are predefined when they are used as control inputs. Note that a mixture of control inputs and data reporting inputs is acceptable. The actuator open and close (not ESD) 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	-	EMERGENCY SHUT DOWN

The Auxiliary Input Configuration Mask must be enabled for the desired function to be set into the actuator. When this is suitably set, the Remote Auxiliary Inputs will be Remote Auxiliary Control inputs.

If any one or more Remote Auxiliary Inputs is operated, the AUXOR alarm signal is generated. These controls override any existing Pakscan command or Position control action.

If AUX 3 (Remote Stop/Maintain) is not enabled then the actuator will adopt a Maintained operation mode where a momentary input will cause full travel of the valve.

AUX4 (ESD) is always push to run.

#### 6.5.5 EMERGENCY SHUT DOWN

The action on receipt of an ESD command is programmed into the actuator itself and may cause the valve to Close, Open or No Action. The ESD action may also override the actuator thermostat.

The actuator may receive an ESD command from either the Auxiliary Input ESD (AUX 4) Command (IQ only) 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 will be Push to Run mode where the actuator moves the valve only whilst the input is present. AUX 3 (maintain) has no effect on the ESD signal.

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, a new Auxiliary Input command on an IQ or toggling stop / maintain auxiliary input on the IQ. The actuator movement, in this case, is always as Maintained mode (irrespective of the AUX 3 input).

#### 6.5.6 PARTIAL STROKE (IQ, CK and SI3 only)

The action of the partial stroke is programmed into the actuator itself and will cause the actuator to move a set amount from a pre-determined limit, then return to the limit. This feature is used in the process of proving that the unit will operate when required, it can be a safety related function. If a network command to perform a partial stroke test is sent to an actuator, it will carry out the test sequence provided the actuator has been set up to perform partial stroke testing. The actuator must be set to Remote and be at the correct end limit set for partial stroking. There is no specific feedback bit to confirm that the partial stroke has occurred successfully, the user should confirm the process by checking first for movement (MOVE, MRO, MRC etc) and then the return to the correct limit (OAS, CAS).

FCU card software version V209 and newer only.



## 7. ALARM HANDLING

Alarm handling is automatically controlled by the master station. The user need not consider how alarms are latched and reported by the field unit. Any alarm revealed by the field unit will be reported to the master station.

The user should be aware of how to handle the alarms at the master station and on the master station to host computer communication link.

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 three logically separate areas, the data base for comms port 1, the data base for comms port 2 and the database for the Ethernet ports. In all cases the alarm must be read by requesting the data before the alarm can be removed from the system. 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.

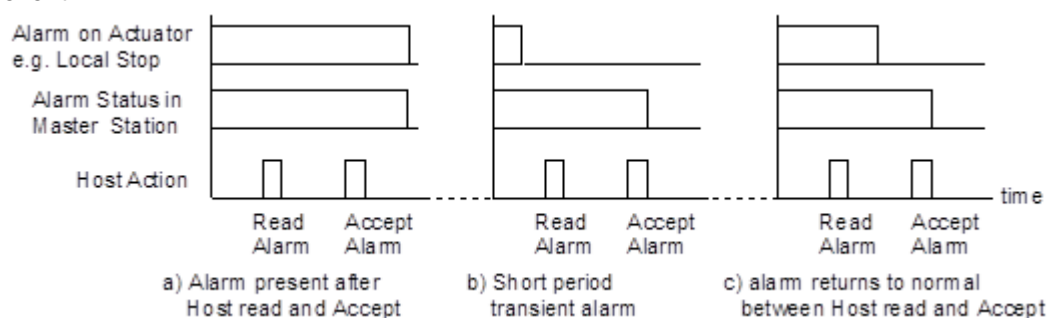


Figure 16: Alarm Handling Sequences

The alarms are automatically accepted on the Web pages and the master station HMI.

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## 8. SETTING UP A FIELD UNIT

The parameters that determine the actions and settings of the field unit may be programmed by a variety of tools. 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 ARE 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
- IQ, CK, SI3 - Setting Tool Infra-red or Blue tooth as appropriate
- IQ, CVA, SI3 - Insight version 2
- CK - Accent
- CMA – actuator menu

In all cases the data variables are stored in in non-volatile memory on the FCU. Table 1 shows the identity of each variable parameter and its default setting. Appendix 1 shows the field unit parameters and which tools can alter them.

Parameter Identity	Permitted Values	Default
Comms Baud Rate	110, 300, 600, 1200, 2400 Baud	1200
FCU Address	1 -240	1
Auxiliary mask	XXXX YYYY	0000 0000 (disabled)
Analogue Update Timeout	2 - 255 seconds	30 (1 sec resolution)
Analogue Deviation Threshold	2 - 99%	20% (1% resolution)
Position Minimum	0% - 100%	0% (1% resolution)
Position Maximum	0% - 100%	100% (1% resolution)
Motion Inhibit Timer	2 - 99 seconds	2 sec. (1 s. resolution)
Deadband	0% - 9.9%	5% (0.1% resolution)
Torque Update Timeout	0, 5 - 255 minutes	0 (off)
Torque Deviation Threshold	0, 5 - 99%	0 (off)
Torque Filter	0 - 1	0 (automatic logging)
Valve Travel Time	0 - 65535 seconds	1000 s (1 s. resolution)

Table 1 – Parameters and Defaults

### 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.

## 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.

## Remote Auxiliary Input Mask (IQ, CK and SI3 only)

Must be set for the desired function of the Remote Inputs, if no action is required then the default setting may be left in place. It is possible to set this over the network as indicated below, but it is more user friendly to modify using the actuator menu in conjunction with the setting tool. See the relevant Configuration manual for more information (IQ PUB002-040, CK PUB111-005, SI3 PUB021-059).

The 8 data bits in the mask relate to the function and contact sense of the inputs.

The 4 most significant bits (4 to 7) relate to the use of the inputs for actuator control, if a '1' is put in the mask in the appropriate position then that input is enabled as an actuator control input, if a '0' is placed in the mask then the input becomes a reported signal only.

The 4 least significant bits (0 to 3) relate to the sense of the input. A '1' placed in the appropriate bit makes a contact closure achieve the action or be reported as a '1' on the data communications. A '0' placed in the bit inverts the signal and makes a contact opening achieve the action or be reported as a '1'.

Aux 1	Bit 0	0	Report closed contact input as '0', action as control input if enabled
		1	Report closed contact input as '1', action as control input if enabled
Aux 2	Bit 1	0	Report closed contact input as '0', action as control input if enabled
		1	Report closed contact input as '1', action as control input if enabled
Aux 3	Bit 2	0	Report closed contact input as '0', action as control input if enabled
		1	Report closed contact input as '1', action as control input if enabled
Aux 4	Bit 3	0	Report closed contact input as '0', action as control input if enabled
		1	Report closed contact input as '1', action as control input if enabled
Aux 1	Bit 4	0	Disable Aux 1 as 'OPEN' command
		1	Enable Aux 1 as 'OPEN' command
Aux 2	Bit 5	0	Disable Aux 2 as 'CLOSE' command
		1	Enable Aux 2 as 'CLOSE' command
Aux 3	Bit 6	0	Disable Aux 3 as 'STOP/MAINTAIN' input, all remote inputs always maintained mode
		1	Enable Aux 3 as 'STOP/MAINTAIN' input
Aux 4	Bit 7	0	Disable Aux 4 as 'ESD' command
		1	Enable Aux 4 as 'ESD' command

The auxiliary input mask takes the form:

	Most significant bit							Least significant bit
	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Enable Aux 4 (ESD)	Enable Aux 3 (Stop/Maintain)	Enable Aux 2 (Close)	Enable Aux 1 (Open)	Invert Aux 4	Invert Aux 3	Invert Aux 2	Invert Aux 1
Example 1	1	1	0	0	0	1	X	X
Example 2	1	0	1	1	0	X	1	1
Example 3	1	0	1	1	1	1	1	1

Key: Enable = 1 to enable the input as a Remote Control Input  
 Invert = 1 for a normally open input contact to achieve the action

Example 1: Remote auxiliary control ESD input contact, opening to cause ESD, Actuator to be Push to Run [no connection need be made to the Aux 3 (Stop/Maintain input)].

Example 2: Remote auxiliary control ESD input contact, opening to cause ESD, Remote Open and Close inputs where a closing contact causes the actuator motion, all motion to be Maintained mode.

Example 3: Remote auxiliary control ESD input contact, closing to cause ESD, Remote Open and Close inputs where a closing contact causes the actuator motion, all motion in Maintained mode, Aux 3 input utilised for a contact input that reports its state over the Pakscan system, when the Aux 3 contact is closed a '1' is reported.

### Analogue Update Time

Must be set for the period to update the master station with 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).

### Analogue Deviation Threshold

Must be set for 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).

## 0% and 100% Positions - Limited Range Position Reporting

Where the analogue Valve Position data is to be reported over only part of the total valve stroke the settings for minimum and maximum position have to be made. The 0% position is that point in the stroke where the analogue data will report 0%, the 100% position is where it will report 100%. Between these two settings the position reported is a proportion of the travel between these two positions.

Where the position is to be reported over the full valve stroke of a forward acting valve, then these settings should be 0% when the valve is closed and 100% when it is open.

## 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.

This feature is not available on the CVA or CMA.

## 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.

## Hysteresis

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 default is 2%. The deadband must be set greater than the hysteresis for the deadband to have any effect. The recommended setting is the default setting.

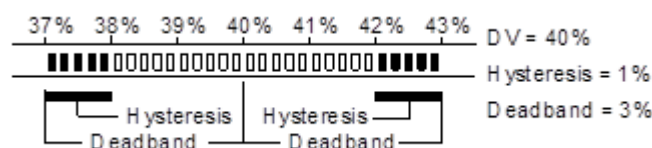


Figure 17: Deadband and Hysteresis

This feature is not available on the CVA or CMA.

**Torque Update Timeout (IQ and CVA only)**

The torque value reported is always the last sampled measurement taken by the actuator. The Torque Update Timeout should be set to approximately 20 times the loop scan time as when the value varies it will be reported by the Deviation Threshold being exceeded. Setting the timer to a long period ensures that the value is occasionally refreshed from a stationary actuator. If torque data is not being used at all then the timer should be set to zero (0) which turns off the reporting.

**Torque Deviation Threshold (IQ and CVA only)**

Must be set for the amount of change that has to occur before the continuous torque data is reported to the master station. The torque is reported each time the value changes by the Torque Deviation setting or every Update Time period. Whilst the valve is in motion reports about the current torque value will be made each time the torque changes by more than the Deviation setting. The recommended value is 5% where continuous torque data is required. If torque data is not being used then the deviation should be set to 0% which turns off the reporting.

**Torque Filter (IQ and CVA only)**

The 'filter' parameter is used enable or disable auto reporting of the torque historical logs.

**Maximum Valve Travel Time**

This should be set to a value 10% greater than the actual valve travel time. Note that the setting is relative to the time the actuator is in motion.

## **8.1 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 manual about that product. The required variable can be programmed using the 'Program' button on the Paktester and by then inserting the new values on the screens as they appear.

## **8.2 Using a Setting Tool (IQ only)**

The Setting Tool accesses the field unit via the infra-red or Bluetooth data link. The Pakscan and related menus within the actuator list the parameters in the field unit that can be changed. Full details are included in the IQ manuals.

## **8.3 Using Insight2 (IQ and CVA only)**

The Insight software accesses the field unit via the Bluetooth data link. Full details of the use of Insight2 for setting the Pakscan variables is included in the Insight2 manual (PUB095-004).

## **8.4 Using Enlight (CVA only)**

Enlight does not support display and change of the pakscan field unit parameters.

## **8.5 Using the CMA menu (CMA only)**

The CMA on board Menu includes settings for the pakscan field unit and is accessed via the HMI (LCD and push buttons), refer to the CMA manual PUB093-009 for details of the menu structure.

## **8.6 Using Accent (CK only)**

The Accent software accesses the field unit via the Bluetooth data link. Full details of the use of Accent for setting the Pakscan variables is included in the Accent manual (PUB111-010).



## 9. RECORDS

The following information should be recorded for each field unit, where applicable (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										
	Hysteresis										
	Auxiliary Mask Setting										
	0% Limited Position setting (%of full stroke)										
	100% Limited Position setting (%of full stroke)										
	Torque Update Time										
	Torque Deviation Threshold										
	Torque Filter										
	Valve travel Time										

## APPENDIX 1. PARAMETER ACCESS TABLE

Refer to information in this manual in previous sections for details of which parameters apply to each type of actuator. (All numbers in Hex unless appended with a 'd')

Parameter Description	Range	Default Setting	Accessed by				
			Setting Tool (IR/Bluetooth)	Paktester	Master station	Insight2 Accent	CMA menu
FCU Type	0-255d	-	-	R	R/W	R	-
Software version	-	-	R	-	R	R	-
Baud Rate	110-2400d	1200d	R/W	R/W	R/W	R/W	R/W
2-Wire Address	00-F0	1	R/W	R/W	R	R/W	R/W
Double Speed	00/FF	0	-	-	R/W	-	-
Comms Errors	00-FF	0	-	-	R	R	-
Digital Inputs	00-FF	-	R	-	R	-	-
Auxiliary Mask	00-FF	0F	R/W	-	R/W	R/W	-
Alarm Status	00-FF	-	-	R	R	-	-
Alarm Accept	00/FF	-	-	W	W	-	-
Valve Travel Time	0-65535d	1000s	R/W	R/W	R/W	-	-
Position feedback	0000 – FF00	-	R	R	R	R	-
Report Deviation	00-FF	14 (20%)	R/W	-	R/W	R/W	-
Report Timeout	00-FF	1E (30s)	R/W	-	R/W	R/W	-
Position Minimum	0-100d	0%	R/W	-	R/W	R/W	R/W
Position Maximum	0-100d	100%	R/W	-	R/W	R/W	R/W

Parameter Description	Range	Default Setting	Accessed by				
			Setting Tool (IR/Bluetooth)	Paktester	Master station	Insight2 Accent	CMA menu
Desired Position	0000-FF00	-	-	R/W	R/W	-	-
Motion Inhibit Time	02-99d	5 (5s)	R/W	-	R/W	R/W	-
Deadband	0-99d	05, (5%)	R/W	-	R/W	R/W	-
Hysteresis	00-FF	2, (2%)	R/W	-	R/W	R/W	-
Opening Torque 6%	00-FF	-	-	-	R	-	-
Opening Torque 19%	00-FF	-	-	-	R	-	-
Opening Torque 31%	00-FF	-	-	-	R	-	-
Opening Torque 44%	00-FF	-	-	-	R	-	-
Opening Torque 56%	00-FF	-	-	-	R	-	-
Opening Torque 69%	00-FF	-	-	-	R	-	-
Opening Torque 81%	00-FF	-	-	-	R	-	-
Opening Torque 94%	00-FF	-	-	-	R	-	-
Closing Torque 6%	00-FF	-	-	-	R	-	-
Closing Torque 19%	00-FF	-	-	-	R	-	-
Closing Torque 31%	00-FF	-	-	-	R	-	-
Closing Torque 44%	00-FF	-	-	-	R	-	-
Closing Torque 56%	00-FF	-	-	-	R	-	-
Closing Torque 69%	00-FF	-	-	-	R	-	-
Closing Torque 81%	00-FF	-	-	-	R	-	-
Closing Torque 94%	00-FF	-	-	-	R	-	-
Current Torque	00-FF	-	R	R	R	R	-
Torque Deviation	00,05-FF	00	R/W	R/W	R/W	R/W	-
Torque Timeout	00,05-FF	00	R/W	R/W	R/W	R/W	-
Torque Filter	0-1	0 (auto report)	R/W	R/W	R/W	R/W	-

Notes:

When using the Paktester the field unit must be in loopback.

R = Read, W = Write,



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