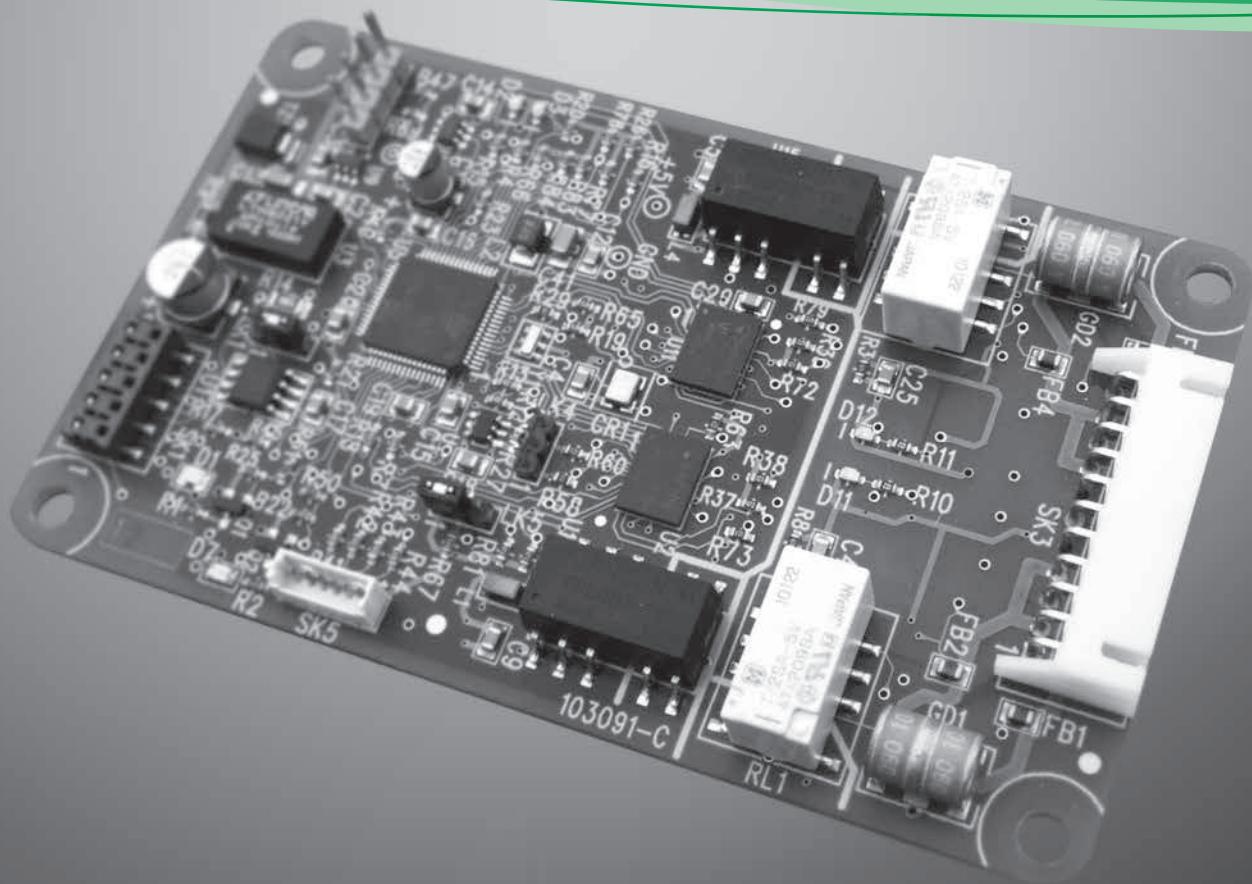# centork®

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CK range

Profibus Actuator Control
Profibus DP Option Card Installation Manual

PROFI BUS®

Modular Design Electric Valve Actuators

Profibus® DP Option Card Installation Manual

Note 1:

Throughout this manual the Profibus® DP Module may simply be referred to as the module or the Profibus module.

Note 2:

The information in this manual relates to the following firmware releases:

Profibus Network Interface Card V101.

Centork Main Board software version V013.

The manual can be used with other versions, but be aware that there may be differences.

Note 3:

The Profibus DP Module described in this manual is suitable for inclusion in the following Centork Centronik Actuators: CK$_C$ (Isolating Duty) and CK$_{RC}$ (Modulating Duty) Actuators.

Note 4:

This manual is to be used in conjunction with, and makes reference to, the CK technical manual (PUB111-005/6) and assumes a pre-existing level of knowledge of using the CK range of actuators.

It is advised that the CK technical manual is read before attempting to set-up Profibus with the actuator.

Contents

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Contents

Glossary

Glossary of Terms:

Address	The unique address for a node on the fieldbus, range 0-126.
Fieldbus	The digital, two-way, multi-drop Profibus DP communication link.
Field Unit	The Profibus option card fitted to the actuator.
Interoperability	The capability for a device from one manufacturer to interact with that of another manufacturer, on a fieldbus network, without loss of functionality.
Master/Slave	The method of communication used by the Profibus DP Module. The fieldbus requires a Profibus master to control the data exchange on the highway.
Profibus DP	The communication protocol used on the highway.
Profibus DP-V0 and DP-V1	The cyclic (V0) and acyclic (V1) versions of the protocol supported by the Centork module.
PNO	Profibus Nutzerorganisation – Profibus User Group, Germany.
RedCom	Dual redundant system as defined in PNO 2.212.
Node	A single device on the fieldbus.
RS485	The electrical properties of the data highway as defined by the IEC 61158 standard, copper conductors, 2-wire twisted pair.
Segment	A section of an RS485 fieldbus that is correctly terminated in its characteristic impedance. Each Segment can include up to 32 devices.

Abbreviations:

Comms	Communications	PFU	Profibus Field Unit
DTM	Device Type Manager	RAM	Random Access Memory
EDD	Electronic Device Description	ROM	Read Only Memory
FDT	Field Device Tool	RTU	Remote Terminal Unit
GSD	Generic Station Description	SW	Software
PDM	Process Device Manager		

References:

Profibus Guideline 2.112 Installation Guideline for Profibus DP/FMS

Profibus Guideline 2.212 Specification Slave Redundancy

Profibus Guideline 2.152 Specification for Profibus Device Description and Device Integration – EDD

Profibus Guideline 2.162 Specification for Profibus Device Description and Device Integration – FDT

Notes for Centork:

There are two models of the Centork that can use the Profibus Network; The CK$_C$ standard duty actuator and the CK$_{RC}$ modulating duty actuator. These two models are interchangeable when talking about Profibus: this manual refers to both. Centronik is the term applied to a Centork actuator that has an optional electronic control system in it. This is required for Profibus use.

The Centork/Centronik 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.

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1	INTRODUCTION

The Centork Profibus DP Actuator Control option card (PFU) conforms to the PNO as compliant with specifications IEC61158 and EN50170. The card supports both Profibus DP-V0 cyclic and Profibus DP-V1 acyclic messages. Three versions are available - single channel, simple dual channel and RedCom dual channel. The simple dual channel card does not include the Redstate diagnostics whilst the RedCom dual channel card fully supports RedCom (Redundant Communication) extensions to the V1 protocol as specified by PNO for systems using either FR (Flying redundancy) or SR (System redundancy) configurations. The inclusion of acyclic message capability (V1) allows for system maintenance and asset management tools to be used. Electronic data sheets are available in GSD, EDD and DTM formats.

- Profibus DP-V0 and DP-V1 compliant

- RedCom redundancy included, both FR and SR modes

- GSD, EDD, DTM device description files available

- Address changes by master class 2, IR/*Bluetooth®*, FDT or PDM

- Zero internal stub length

- Mounted within an IP68 enclosure, 8 meters for 96 hours.

- All card settings are non-intrusive and can be made over the data highway or with *Bluetooth* or the setting tool.

The Profibus DP Module circuits do not impinge on the actuator control electronics; the actuator itself remains fully self-protecting. The module performs the tasks of network interface, actuator data collection and the issuing of actuator commands to open, stop, close, perform an ESD operation or move to a set position.

Fig. 1: The Centronik.

General

1.1 General

The Profibus DP Module has three versions:

- Single Channel Profibus DP

- Simple Dual Channel, independent isolated Profibus DP highways for redundant systems that do not support full RedCom

- RedCom Dual Channel, independent isolated Profibus DP highways for RedCom compliant systems

The two dual channel versions have the same physical assembly, but are configurable to include the necessary extra messages for RedCom systems. PLCs that cannot accept the extended diagnostic messages from RedCom slaves should use the Simple Dual channel card. The reporting of RedCom extended diagnostics can be selected from the GSD file.

**Profibus DP
Highway 1**

Single Profibus DP Highway
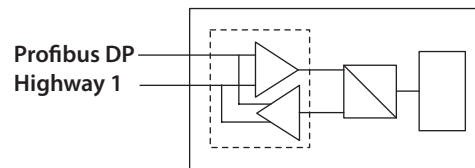
**Profibus DP
Highway 1**

**Profibus DP
Highway 2**
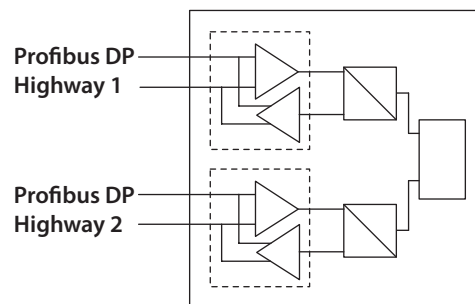
Simple Dual Profibus DP Highway Connections

**Profibus DP
Highway 1**

**Profibus DP
Highway 2**
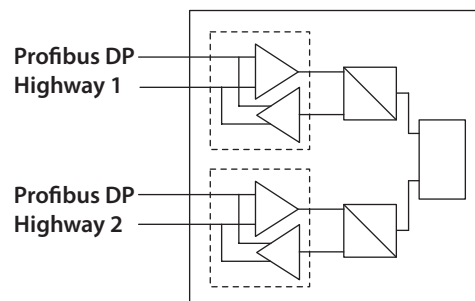
RedCom Dual Profibus DP Highway Connections

Fig 2: The Types of Profibus DP Module Option Card

Communication Media	RS485 2-wire highway (single or dual), half duplex
Protocol	Profibus DP-V0 and DP-V1
Mode	Master/Slave, module is a slave, cyclic and acyclic messaging

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Profibus DP option card properties

2	PROFIBUS DP OPTION CARD PROPERTIES

2.1	Mechanical Properties

The PFU module consists of a network interface card, which fits directly to the main actuator printed circuit board.

All the connectors are polarised to prevent incorrect insertion.

- **Network Interface Card (NIC)**

This small printed circuit board carries the Profibus DP, RS485 highway connections and protection circuits.

There are two versions of the Network Interface Card, one for a single highway and a second for two highways, Simple or RedCom Dual (RedCom has two highway configurations, two highways for SR mode or one highway with two network interface connections for FR use).
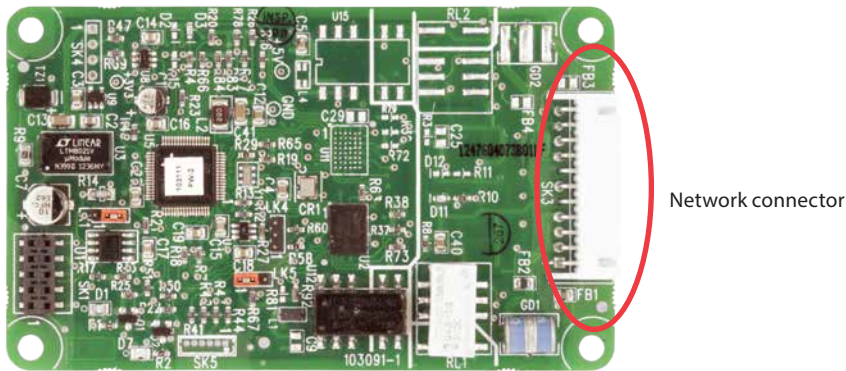
Network connector

Fig 3 : The Profibus single channel NIC, showing the network connector

2.2	Electrical Properties

The PFU does not sit in the main control path for the actuator and does not affect the actuator control integrity.

The Profibus DP fieldbus data highway connections are fully isolated from the actuator electronics.

2.3	Operation and Storage

The PFU is designed to be stored in the actuator and operated within the same environment as the actuator.

The constraints are:

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

Refer to actuator manuals for environmental range applicable for the particular actuator type.

Fitting the Profibus card

| 3 | FITTING THE PROFIBUS DP OPTION CARD |

| 3.1 | Inside a CKc or CKRC Actuator |

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

The Interface card must be correctly profiled and loaded with the appropriate connectors to match the actuator. The illustration below shows the location of the cards in the Centronik unit.
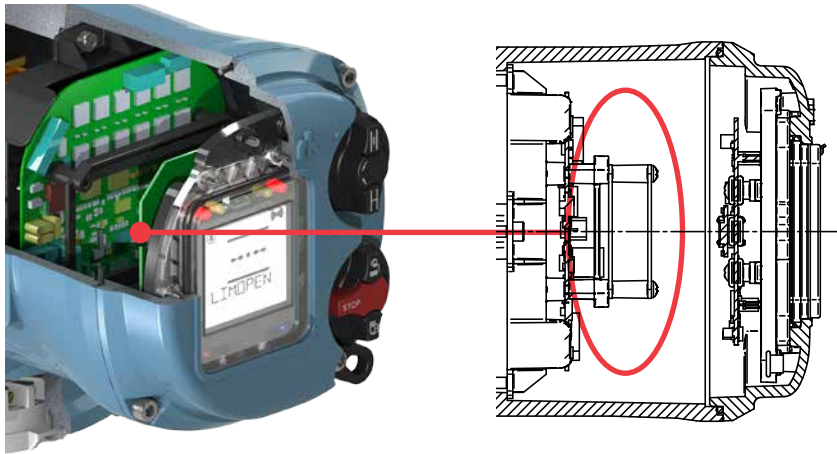
Fig 4: The Profibus option card located in a Centronik unit.

Within the actuator the remote inputs are always present and are conditioned by the auxiliary mask setting and there is an option to include Digital Outputs from relay contacts. If the PFU is required to operate the 4 digital outputs that can be controlled from the card, then the Extra Relay Indication card associated with these outputs must be fitted into the actuator. The following table describes the wiring harnesses and their function in the Centork actuator.

PFU Socket	Socket Function
SK1	Power and CANbus to option 2 card.
SK2	Power and CANbus from actuator.
SK3	Profibus Fieldbus connection.

For layout please see Fig. 16 in section 6.3.

Fitting the Profibus card

The PFU should be replaced or fitted only in a suitable environment. The actuator must be made electrically safe before opening any covers.

WARNING: REMOVAL OF CERTAIN COVERS WILL VOID WARRANTY, IT IS ADVISED THAT A CENTORK APPROVED ENGINEER PERFORM THIS FUNCTION.

Suitable anti-static precautions should be taken, as the actuator circuitry contains static-sensitive components.

The electrical housing cover should be removed and the existing PFU carefully unplugged from its main connector. The Interface card will be attached to the Main PCB mounting ring by four screws, which are T20 (or T15 if two cards are present). Once removed from the main connector the wiring loom connectors should be removed. The replacement board is fitted in the reverse order to removal. The wiring harnesses are polarised so that only the correct one will fit its mating part on the circuit board.

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

Once the module is fitted the actuator should be re-assembled and the battery reconnected (if applicable). If an option card is fitted into a Centork after it has left the factory then the actuator needs to be set-up to use this card in the software, the card will not do anything until this has been done. This can be done using the HMI or Accent but needs to be done by a Centork service engineer. This is not necessary if a card is being replaced with the same type of card, e.g. replacing Profibus with Profibus.

It is advisable to check the software version numbers are the same between the new and old card to ensure consistence operation. For more information please contact Centork.

Single and Dual Data Highway Configurations

4	SINGLE AND DUAL DATA HIGHWAY CONFIGURATIONS

4.1	Profibus Data Highway

The rules governing the installation and connection of a Profibus DP highway should be observed at all times to produce a successful installation. The highway does not allow power to be transferred and the Profibus module is powered from the actuator itself. The module can only report data when the actuator is powered up.
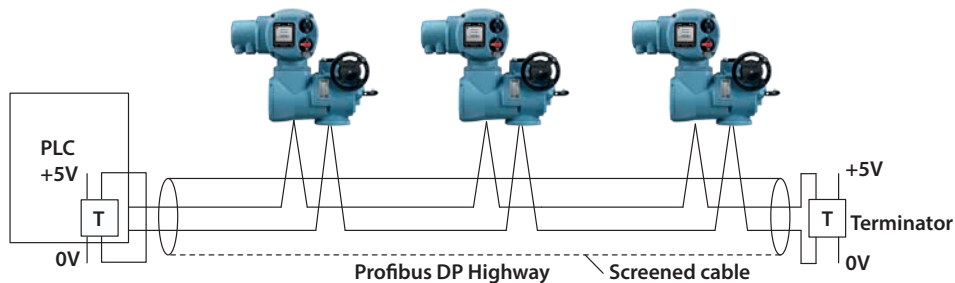
Fig 5: Typical Profibus DP Data Highway

The data highway must be terminated with a proper active termination network at each end of a segment. To ensure successful operation the highway itself should not use tapped spur or stub connections. The connection should be made in and out of each actuator in a daisy chain arrangement on separate terminals to eliminate any internal cabling stubs inside the actuator. The length of the highway and number of devices connected will vary from project to project. The standard permits up to 32 devices to be connected on a section, though one of these will be the PLC. If more devices are needed (up to the maximum addressable of 126) then repeaters may be added as required. Up to 9 repeaters can be used on a single highway provided no more than 4 are between any two devices.

Data Rate (Baud)	9600	19200	45.45k	93.75k	187.5k	500k	1.5M
Maximum Segment Length	1.2 km	1.2 km	1.2 km	1.2 km	1000m	400m	200m
Maximum Highway Length	10 km	10 km	10 km	10 km	10 km	4 km	2 km
Max number of actuators/segment	31[1]	31[1]	31[1]	31[1]	31[1]	31[1]	31[1]

Note [1] – The PLC or Repeater module will be one device. Max 32 devices/segment

Since the data passes over a single 2-wire cable there are periods between messages when no devices are actively driving the lines. In order to ensure that data continues to flow correctly after these periods it is advisable to ensure the lines are biased to suitable voltage levels during the time the line is idle. The PFU contains active termination circuits that ensure suitable levels are maintained on the line even with no device transmitting.

Single and Dual Data Highway Configurations
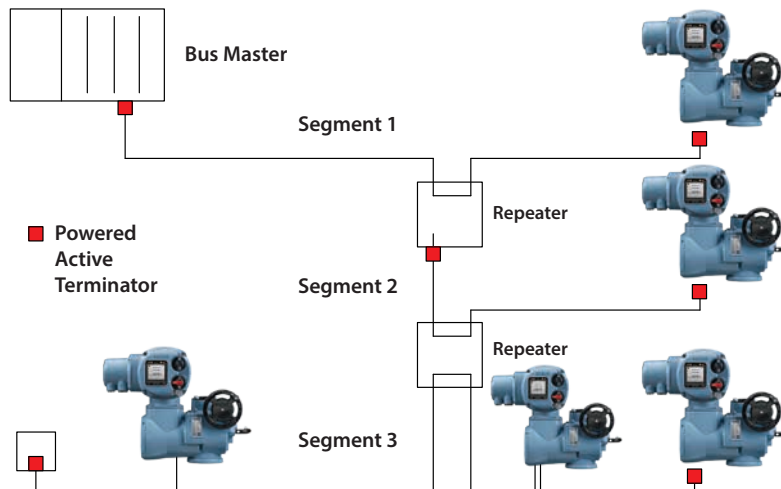
Fig 6: Profibus Single Channel Data Highway Topology

The data highway may be connected as several segments coupled by repeaters. The repeaters or actuator slaves will require termination components if they are on the end of the segment. Alternatively, separately powered active termination devices can be used so that when the actuator is switched off the bus performance is not affected.

Maximum number of devices participating in the exchange of data	127 (addresses from 0 to 126, 0 is usually the PLC)
Maximum number of devices per segment including repeaters	32
Maximum number of segments in series	EN50170 specifies a maximum of 4 repeaters between any two devices. Some manufacturers of repeaters allow more than this number.

Single and Dual Data Highway Configurations

4.3	Redundant Systems – Simple Redundancy

The Simple Dual Channel Profibus DP Option Card version has two redundant communications channels. Like the RedCom version, this card supports two types of redundant operation.

· **SR** – System Redundancy (One common slave address)

· **FR** – Flying Redundancy (Two slave addresses offset by 64)

> **The Simple Dual Channel card is suitable for all PLCs where redundant highways are being used.**
> **This option does not report the extended diagnostic bytes relating to the card's redundant status.**

These two connection options allow for redundancy protection against either a failure of the highway (SR mode) or failure of the card interface channel (FR mode). Most dual channel systems use two highways and one connection to each, so the most common use for this card is in SR mode. The functionality and provisions of the card are identical to the RedCom version except in the way the card reports its status on the highway.

There are a number of PLC systems, including older PLCs, that do not have the ability to use the RedCom system and as a consequence they are likely to report errors when connect to a RedCom compliant card. If the PLC does not support the RedCom standard then the Simple Redundant card must be used.
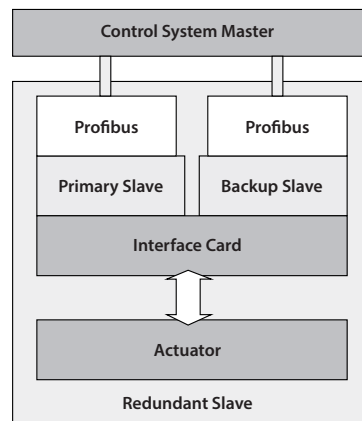
Fig 7: Profibus DP Simple Dual Redundant Option Block Diagram

The Profibus DP Simple Dual Channel card includes:

· Two Profibus Connections, Channel 1 and Channel 2

· Selectable FR/SR mode

· No Extended Diagnostics

A Simple Dual Channel card can be altered to a RedCom Dual Channel card, or vice versa, by entering the appropriate value in parameter 15 in the GSD file.

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Single and Dual Data Highway Configurations
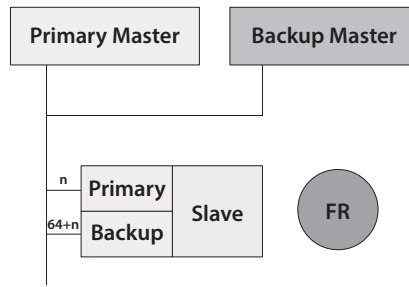
Fig 8: Profibus DP Flying Redundancy Connection

With FR (Flying Redundancy) the aim is to protect against a failure of the Profibus Interface. The data highway is considered to be more reliable than the connection interface. There is a single data highway and both the Profibus card inputs are connected to it. The card must be set to FR mode and it then adopts a fixed offset of 64 between the set address (used for primary communication) and the backup communication address.

When the card is powered 'on', Channel 1 will be the Primary channel. If the card does not enter Configuration Mode within 1 second (because there is no Master present) then Channel 2 will take over as Primary. Once again, if there is no communication within 2 seconds, then it will revert to Channel 1 and now it will wait 4 seconds before Channel 2 assumes Primary status. The switch over time will increase by a factor of 2 each time until it reaches its maximum of 32 seconds. It will continue to switch channels using a 32 second switch over time until one channel receives PLC messages.

In the event of a failure of the Primary channel, the Backup automatically changes to use the Primary address. Hence for all control purposes the Master only uses the Primary address. The Backup address can be used for exchanging data but any commands to move the actuator directed to the backup address will be ignored. If a configuration message is sent to the Backup address that is different to the one sent to the Primary address it will be accepted, but not actioned. The data exchanged between the Master and the Primary includes information on the status of the device and hence the availability of a Backup should the Primary fail.

- Single Data Highway, two communication ports

- Channel 1 is Primary on power up

- Default method is SR mode; to achieve FR parameter 15 must be altered

- Fixed offset of 64 between Primary and Backup addresses

- Backup automatically adopts Primary address if Primary fails

- V0 cyclic Commands to Backup ignored

- Reports the status of Primary and Backup to the Master

- Configuration and Parameterisation changes only over the Primary address

Single and Dual Data Highway Configurations
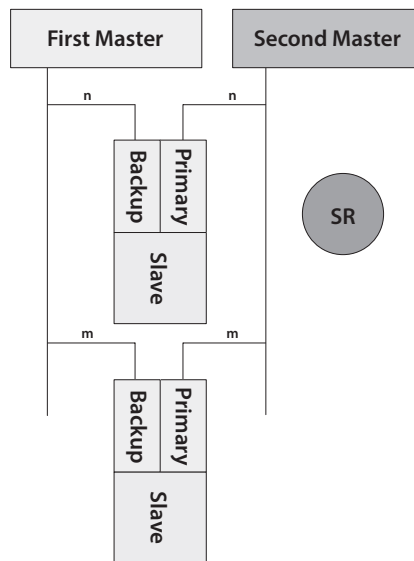
Fig 9: Profibus DP System Redundancy Connection

With SR (System Redundancy) there are two data highways and the aim of the redundancy is to secure communication with the actuator even if one of the highways fails. Although two masters are shown they will normally be a Primary and Backup pair and communication will occur directly between them. SR mode is the default for all dual Profibus cards.

The Profibus card has two communication channels and both have the same slave address. As with the FR mode, when the card is powered 'on', Channel 1 will be the Primary channel. If the card does not enter Configuration Mode within 1 second (because there is no Master present) then Channel 2 will take over as Primary. Once again, if there is no communication within 2 seconds, then it will revert to Channel 1 and now it will wait 4 seconds before Channel 2 assumes Primary status. The switch over time will increase by a factor of 2 each time until it reaches its maximum of 32 seconds. It will continue to switch channels using a 32 second switch over time until one channel receives PLC messages.

In the event of a failure of the Primary channel the Backup automatically changes to become Primary and communication will be established with the Second master on the second highway. The Backup channel can be used for exchanging data but any commands to move the actuator directed to the backup channel will be ignored. If a configuration message is sent to the Backup channel that is different to the one sent to the Primary it will be ignored. The data exchanged between the Master and the Primary includes information on the status of the device and hence the availability of a Backup should the Primary fail.

- Two Data Highways, two communication ports

- Channel 1 is Primary on power up

- Default communication method is SR mode

- Both channels have the same address

- V0 cyclic Commands to Backup channel are ignored

- Reports the status of Primary and Backup to the Master

- Configuration and Parameterisation changes only over the Primary channel

Single and Dual Data Highway Configurations

4.4	Redundant Systems – RedCom Redundancy

The RedCom Dual Channel Profibus DP Option Card version has two redundant communications channels. Like the Simple card, the RedCom card supports two types of redundant operation and the details are as described in Profibus Guideline 2.212 'Specification Slave redundancy'. The two modes are:

- **SR** – System Redundancy (One common slave address)

- **FR** – Flying Redundancy (Two slave addresses offset by 64)

> **The Centork Profibus DP RedCom Dual Channel Option Card obeys the Profibus REDCOM Specification for Redundant Communications. This includes 3 bytes of Extended Diagnostics for RedState. Not all PLC systems can accept these diagnostic messages.**

As with the Simple Redundant card, there are two basic considerations when looking at redundant systems; protection against the failure of the connecting cable and protection against failure of the device. Most systems consider cable protection to be the most important and this is termed 'SR' or System Redundancy. The alternative setup, using only a single cable, but with two Profibus connections is termed 'FR' or Flying Redundancy. With FR systems there are two Profibus interfaces on the slave, but only one slave, so protection against failure of the Profibus interface is included. SR and FR are described in more detail in the previous section.
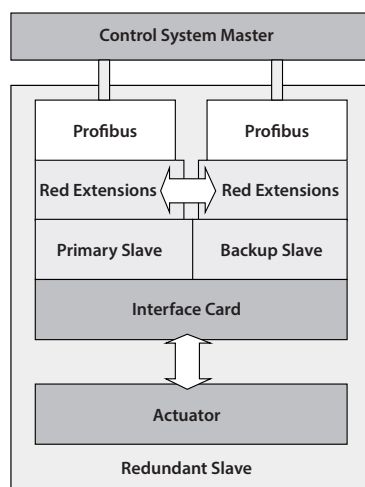
Fig. 10: Profibus DP RedCom Dual Redundant Option Block Diagram

The Profibus DP RedCom Dual Channel card includes:

- Two Profibus Connections, Channel 1 and Channel 2

- RedCom link between the two connections

- Redundancy extensions to the V1 protocol

- No loss of data during switching

- Selectable FR/SR mode

- Status reported in Extended Diagnostics data

Single and Dual Data Highway Configurations

4.4.1 Extended Diagnostic Messages for RedCom

The Redundancy Extensions to the standard V1 protocol allow the two channels to communicate between themselves to establish correct operation of the highway if there is a failure, both the Simple and RedCom versions of the card do this. In addition to these, there are extra Extended Diagnostic messages that are reported to the PLC as part of the RedCom system that the Dual RedCom card reports. Not all PLCs are RedCom compliant, so some are unable to understand these messages and, as a consequence, will mark the device as having an error. If this is the case, either reconfigure the Profibus card to be 'Simple' or disable the PLC's diagnostics package that is looking at the extended diagnostics.

A RedCom Dual Channel card can be altered to a Simple Dual Channel card, or vice versa, by entering the appropriate value in parameter 15 in the GSD file.

The extended diagnostics is contained in 3 bytes in the diagnostic message and is reported by the Primary slave only:

Description	Comment
Headerbyte	= 8 hex
Status_Type	= 9Fhex
Slot_Number	= 0 hex
Specifier	
Function	
Red_State_1	State of Primary slave
Red_State_2	State of Back Up slave
Red_State_3	Not used

The information in the Red_State bytes is as below:

Bit No: 7 6 5 4 3 2 1 0   **Description if set**

- This slave is the Backup
- This slave is the Primary
- There is a Hardware Defect
- This slave is in Data Exchange Mode
- Master State Clear
- Baud rate not found
- Toh started (hold timer active - set if a change of channel is imminent
- Reserved
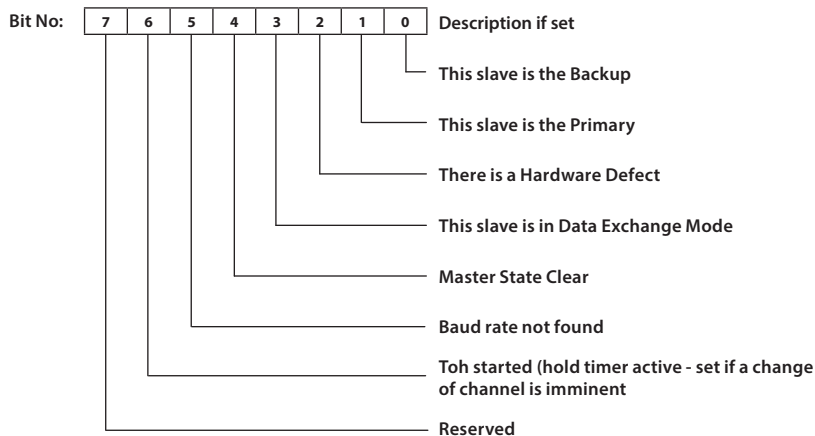
Single and Dual Data Highway Configurations

4.5	Cable Types

The network must be connected using a suitable cable for Profibus DP applications. Two conductors plus a shield are required and there is a Profibus specification for the cable.

Amongst the cable manufacturers Belden have PVC jacketed single pair 2 core cable, which meets the minimum requirement. Information on Belden cable may be found on the Belden website (www.belden.com).

PVC sheath, usually coloured purple   Tinned copper screen   Signal wires
Red is positive, 'B'
Green is negative, 'A'

Typical Profibus DP Cable Specification	
Impedance	135 up to 165 ohm at a frequency of 3 to 20 MHz
Cable capacitance	<30 pF per metre
Core diameter	>0.34 mm^2 (corresponds to AWG 22)
Cable type	Twisted pair cable, 1x2 or 2x2 or 1x4 lines
Resistance	<110 ohm per km
Signal attenuation	Max 9 dB over total length of line section
Shielding	Copper shielding braid or shielding braid and shielding foil

Fig. 11: Typical Profibus DP cable specifications

The terminals to which the wires connect in each actuator type will be different and the actuator wiring diagrams must be consulted to establish the connections.

4.6	Termination Network

In order to operate correctly all Profibus segments must be terminated at each end in an active network termination circuit.

The Profibus DP card includes the necessary components to allow an active termination to be connected. The termination can be set using the HMI or Accent software. It is advised that internal termination is only used during the testing/commissioning phase, because upon removal of power to the unit or removal of the unit itself, the termination will be lost, affecting communications of the entire network.

It is therefore advised that external termination is used during full operation.
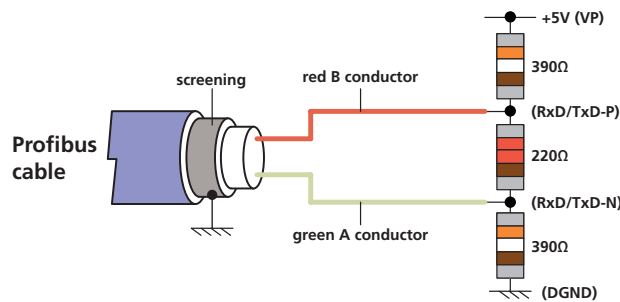
Active termination resistors are included on the Profibus card. These can be switch on or off using the menu. Please see the CK manual for details.

Single and Dual Data Highway Configurations

The Centork Profibus variants allow for different highway connections. The 'single channel' can be used for simple highways. The 'dual channel' (both Simple and RedCom compliant) is used for redundant highway applications where the highway integrity (SR mode) or the physical connection is important (FR mode).

4.7.1   **Single Channel Highway**
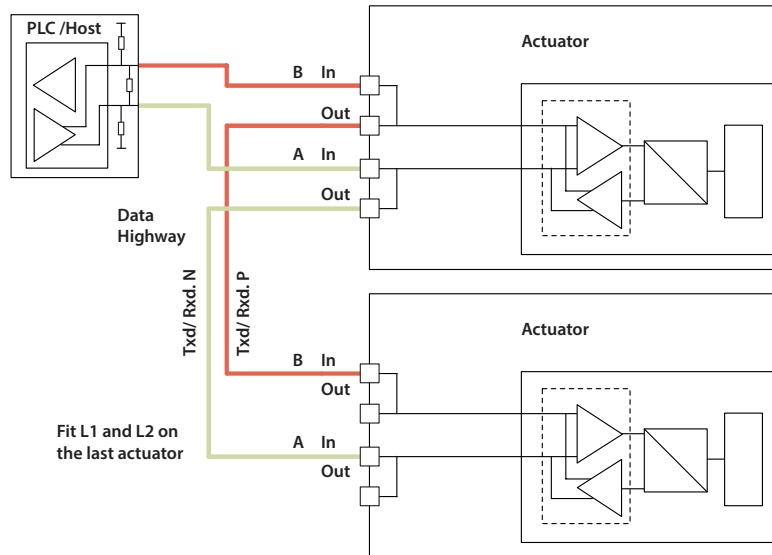
Fig. 12: Single Highway

With the single channel option the actuator is connected to only one highway. The connection of the actuator to the highway uses terminals A and B (in and out terminals) and are indicated on the actuator wiring diagram. The highway should be arranged so as to eliminate any stub connections. Take care to ensure that the correct polarity is observed on the data highway connection, all the A terminals must be used on one data line and all the B terminals on the other.

•   Data line B is positive with respect to data line A when the PFU is transmitting a '1'.

•   Data line A is also called TxD/RxD-N

•   Data line B is also called TxD/RxD-P

Single and Dual Data Highway Configurations

The most common application of the Dual channel card is for Dual Highways in SR (System Redundancy) applications. If FR (Flying Redundancy) is being used then a similar connection at the actuator applies, but only one channel will require termination at the end of the highway. The choice between Simple and RedCom compliant redundancy does not affect the connection options.
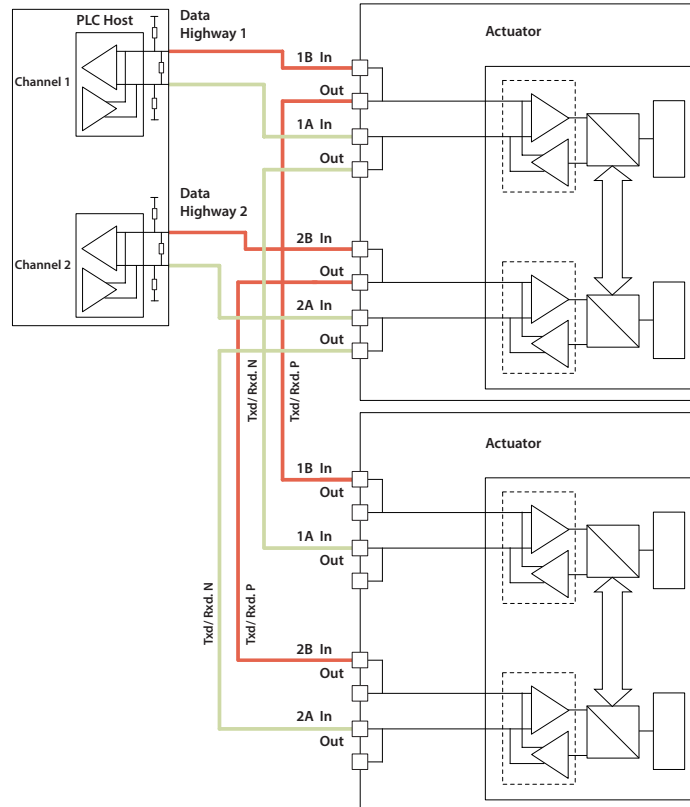
Fig. 13: Dual Highway SR Mode Connections

The connection of the actuator to the highway uses terminals 1A /1B (in and out terminals) on highway 1 and 2A / 2B (in and out terminals) on highway 2, the terminal numbers depend on the actuator type and are indicated on the actuator wiring diagram. The highways should be arranged so as to eliminate any stub connections. Take care to ensure that the correct polarity is observed on the data highway connection.

- Data line B is positive with respect to data line A when the PFU is transmitting a '1'.

- Data line A is also called TxD/RxD-N

- Data line B is also called TxD/RxD-P

Both the Dual card options default to System Redundancy; this allows two separate highways to be used. When the RedCom compliant version is used the card uses RedCom extensions to the standard DP V1 protocol to permit redundancy to be used in a controlled manner. The host system should be able to support V1 messages and RedCom, if it cannot then the Simple redundant option should be used.

The Actuator Cyclic Data Signals

5	THE ACTUATOR CYCLIC DATA SIGNALS

The Profibus DP Module allows the actuator to be controlled by, and to report data to, a suitable host device using Profibus DP protocol. This section explains the data signals that are presented during cyclic V0 data exchange and their meaning in relation to the actuator functionality. The register locations used for the data exchange are given later in this manual.

This section also gives information on the other control inputs available for moving the actuator.
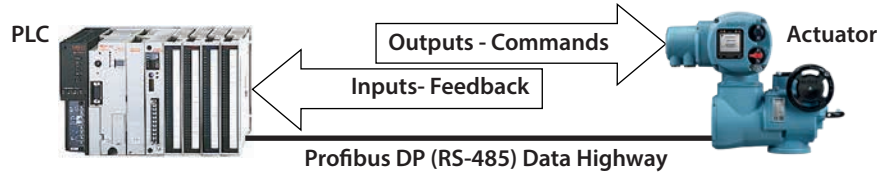
Fig. 14: Input and Output Data Direction

- **Outputs** are defined as signals originating at the PLC and operating the actuator controls.

- **Inputs** are defined as signals originating at the actuator and fed back to the PLC over the Profibus network.

Cyclic Data Exchange			
	Output Registers		**Input Registers**
1	ACTCON	1	IDATA2 / IDATA1
2	POS_DV	2	IDATA4 / IDATA3
3	O_STAT	3	TORQUE[1]
4	RESERVED	4	POSITN[1]
		5	TEMPER
		6	RESERVED
		7	RESERVED

Note[1] : – Requires a DSM or an MSM with optional potentiometer.

> The actual registers exchanged during normal cyclic data exchange will depend on the Configuration set for the card. Section 5.4 contains information on the Configuration options available.

The Actuator Cyclic Data Signals

5.1	Control Outputs

The Profibus DP Module can be used to control the actuator and position the valve. The valve may be moved fully closed, fully open or to an intermediate position (requires DSM or MSM with optional potentiometer). Additionally, the actuator can make the valve adopt an Emergency Shut Down (ESD) position. The actuator may also be operated from its local controls or by hard-wired direct contact inputs (The Auxiliary Input Mask must be correctly set, refer to CK manual).

As well as controlling the actuator the PFU can also be used to operate 4 discrete output relays when fitted to an actuator with the extra relay indication board fitted. Example diagram: P01A.0000.

The control commands have three potential sources:

- Profibus DP network generated commands

- Actuator Local Controls

- Direct Hard-wired digital input controls

The full list of commands is shown in the table.

Command	CK_C & CK_{RC}
Profibus over the network	
Open	✓
Close	✓
Stop	✓
Emergency Shut Down	✓
Analogue Position Demand	✓[2]
Partial Stroke	✓[2]
Relay output DO-1	✓[1]
Relay output DO-2	✓[1]
Relay output DO-3	✓[1]
Relay output DO-4	✓[1]
Local Actuator Controls	
Open	✓
Close	✓
Stop	✓
Direct Hard-Wired Inputs	
Open	✓
Close	✓
Stop/Maintain	✓
Emergency Shut Down (Network Disable)	✓
Open Interlock (active prevents opening)	✓
Close Interlock (active prevents closing)	✓

Note[1] : – Requires Extra Relay Indication board to be fitted
Note[2] : – Requires a DSM or MSM with the optional potentiometer.

The Actuator Cyclic Data Signals

The Profibus DP network commands will operate the actuator provided –

- Local/Stop/Remote selector is in 'Remote'
- Profibus commands are not inhibited by the 'Inhibit/DI-4' input parameter setting and DI-4 condition
- No interlock is active
- There is no standing hard-wired control input active
- No alarm condition prevents it from moving

Open
A digital command to cause the actuator to open to the fully open position as indicated by the Open limit switch. Under correct operation the actuator stops either when the open limit switch is reached, when the torque exceeds the value set and the open limit switch has been reached, or a new command is sent over the network.

Close
A digital command to cause the actuator to close to the fully closed position as indicated by the Close limit switch. Under correct operation the actuator stops either when the close limit switch is reached, when the torque exceeds the value set and the close limit switch has been reached, or a new command is sent over the network.

> Most Centork multi-turn actuators are set to open until the open limit switch is reached and close until the closing on torque switch trips, but it is dependent on the type of valve. This setting can be changed to close of torque using the HMI or Accent.
>
> The control room indication is always taken from the end of travel limit switch settings.

Stop
With no other command present this digital command causes an actuator motor that is running to stop.

Emergency Shut Down
A digital command that causes the actuator to drive to its Emergency position. There are settings within the actuator to determine if this is a closed, open or stay put action.

Analogue Position Demand
This function is only available over the Profibus DP network. To initiate Analogue Position Control the ACTCON register Position Enable bit must be set to 1 and all other bits to 0, enabling Position mode and a value must be written to the Position DV register (range 0-100.0%, resolution 0.1%), the valve will open to the appropriate amount and stop in that position (within the deadband setting). If a subsequent digital command to open or close the valve is issued, from any source, this will take priority over the analogue position command. Once the set point is reached the positioning controller is switched off, but whilst the Profibus outputs are being written the positioner is continuously being updated. A new value in the Position DV register will cause a new position to be adopted and a new bit set in the ACTCON register will cancel positioning mode. Provided limited range positioning is not invoked, the values 0% and 100% written to the Position DV register produce a special case output where the command is revised so as to fully close the valve to its tight shut off position (0%) and fully open the valve (100%). (This feature requires the actuator to be fitted with a DSM or MSM with optional potentiometer). Provided limited range positioning is not invoked, the values 0% and 100% written to the Position DV register produce a special case output where the command is revised so as to fully close the valve to its tight shut off position (0%) and fully open the valve (100%). (This features requires the actuators to be fitted with a DMS or MSM with optional potentiometer).

Partial Stroke
The actuator will move the valve to an intermediate position and back to the start position provided it is at the correct end of travel position when the command is issued. The end to start from and the amount of travel are selected during parameterisation. (This feature requires the actuator to be fitted with a DSM or MSM with optional potentiometer).

Relay Output DO-1 to DO-4
These 4 commands are used to energise and de-energise the internal relays on the extra relay indication board (if fitted), (these outputs are referred to as S5-S8 in the standard actuator documentation when there is no Profibus DP Module in the actuator). The resulting outputs can be used for operating other equipment such as a pump or indication light. The actuator is not able to control these relays directly from the main board when the PFU is fitted. They will maintain their last state if power is removed from the actuator. On restoration of power the relays will be reset to their de-energised condition and the coils will report '0'.

Developing the Future

The Actuator Cyclic Data Signals

Hard-Wired Open and Close	These commands operate the actuator in the same way as the open and close commands sent over the Profibus highway.
Hard-Wired Stop	The hard-wired stop input acts as a change of state input. If the actuator is moving, opening the Stop input will stop the actuator. If the Stop input is already open and a Profibus command is sent to the actuator, the Profibus command will be initiated. To stop the actuator the hard-wired input must be closed and opened again.
Hard-Wired ESD (Network Disable)	The hard-wired ESD may be set to cause the actuator to drive to its Emergency position. Alternatively, the input can be used to disable Profibus network control. The function of the input is determined by the parameterisation set into the PFU.

5.1.1   Controls Priority

Since there are three potential sources for control inputs the actuator and Profibus DP Module assign a priority for those occasions when two or more commands are applied simultaneously.

For the Centork actuator, the remote control hard wired inputs can be used as discrete input signals, to report the status of other devices or as control inputs. The associated Auxiliary Input Mask parameter must be set for the required function, see section 7.1.10. In the case of the hard wired input for ESD this can be configured either as an ESD/DI-4 signal or as a 'Net Command Inhibit' to prevent Profibus network control signals from moving the actuator.

Centronik controls priority

The following statements are useful when considering control priority relating to the network commands and the hardwired inputs:

1. Profibus commands and commands using the hardwired inputs, with the exception of ESD, will not operate the actuator unless it is in the remote mode.

2. All Profibus commands have the same priority, multiple Profibus commands sent at the same time will cause control contention, at which point it will continue to perform the last good command. New Profibus commands clear previous commands.

3. An ESD command sent over the Profibus network or using the hardwired inputs (when enabled with the Auxiliary mask) will have priority over all other commands (bear in mind point 2). The ESD will operate the actuator in local and remote.

4. Any ESD (network or hardwired) can also be set to override local stop (refer to the installation manual).

5. A standing hardwired command (when enabled using the auxiliary mask) will override any Profibus network command, except network ESD.

6. A maintained hardwired command (when enabled using the auxiliary mask) can be overridden by a Profibus network command.

7. An ESD over the Profibus network is maintained until a new command is received, this includes a new Profibus network command received in local i.e. a Profibus network STOP will remove a DeviceNet network ESD whilst in local.

8. An ESD over the hardwired is ONLY Push-to-Run, i.e. it is not maintained.

The Actuator Cyclic Data Signals

Profibus Control using the ACTCON Register

A single register is provided to allow the digital control of the actuator. Writing to the individual bits in the register causes the actuator to open, close, stop, ESD, adopt Positioning mode or perform a Partial Stroke and at the same time cancels any other command set. The bit written changes any output states already set to the new value. Only one bit may be written in a command. If more than one bit is set then the whole register is ignored.

ACTCON Register						
Bit 6 - 15	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	Partial Stroke	Position Enable	ESD	Open	Close	Stop

5.1.3 **Profibus Control using the POS_DV register**

To position the actuator requires a Centronik unit with a DSM or MSM with optional potentiometer.

The analogue position control function requires two registers to be set.

- A desired position value to move the valve to should be placed in the POS_DV register

- The ACTCON register must be set to Position mode (0010 hex)

POS_DV Register
Register value: 0 to 1000 (0 to 3E8)
Position demand: 0.0% to 100.0% of valve travel

When the ACTCON register with Position mode set is sent, the actuator will position to the value set in the POS_DV register and any other commands that are currently being carried out will be cancelled.

If the POS_DV register is set to 0% and limited range positioning is not being used the actuator will operate as though a 'close' command had been sent. Similarly if the POS_DV register is set to 100% under these conditions the actuator will interpret the instruction as an 'open' command.

Note that when limited range positioning is used and the actuator is in the fully closed position a POS_DV value of 0%, or when the actuator is in the fully open position a POS_DV value of 100%, are not acted upon.

The Actuator Cyclic Data Signals

5.1.4 The Centronik 'S' contacts (Profibus DOs) controlled by the O_STAT register

The actuator has four 'S' contact outputs that may be configured to report the status of the actuator with signals such as Open Limit, Closed Limit etc. These are identified as S1 to S4. In addition, an optional extra relay indication board can be fitted with four more relays. The status of these relays is then adjusted by Profibus commands on outputs DO-1 to DO-4 in the O_STAT register. Writing a '1' in the appropriate location energises the relay and '0' de-energises the relay. Note that these relays are latching and, if energised, will not change state when the actuator power is removed. On restoration of power the relays will be reset to their de-energised condition.

Actuator with Additional Relay Output Board fitted

| Actuator Main Board | → | S1-S4 |

| PFU | → | DO-1 to DO-4 Output Board |
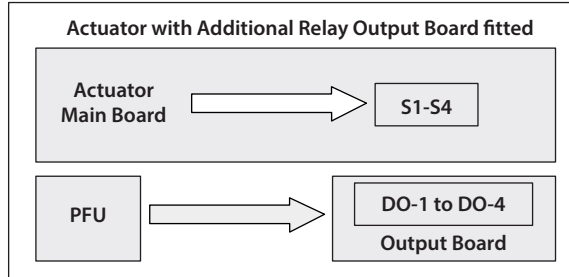
O_STAT Register				
Bit 4 - 15	Bit 3	Bit 2	Bit 1	Bit 0
Reserved	DO-4	DO-3	DO-2	DO-1

Fig. 18: Centronik relay outputs DO-1 to DO-4

5.1.5 Profibus Network Control Disable feature

It is possible to set the ESD/DI-4 input so that the actuator ignores open, stop, close, ESD and position control signals sent over the Profibus network. If the ESD DI-4 / Net Disable parameter is set to Active, then when the ESD input is made (i.e. 24 volts applied to ESD), Profibus control is not allowed. This feature is independent of the Auxiliary mask setting. When the ESD DI-4 / Net Disable parameter is set to active, no ESD will be available.

The Actuator Cyclic Data Signals

5.2	Digital Input Status Feedback

The Profibus DP Module cyclically reports over the network a comprehensive data set relating to the status of the valve, actuator and card settings as indicated in the table below.

NOTE: Data is reported in the order: IDATA2 / IDATA1 and IDATA4 / IDATA3.

Register Name		Status Feedback
IDATA1/0	Register 0 Bit 0	Actuator Moving
IDATA1/1	Register 0 Bit 1	Close Limit
IDATA1/2	Register 0 Bit 2	Open Limit
IDATA1/3	Register 0 Bit 3	Running Closed
IDATA1/4	Register 0 Bit 4	Running Open
IDATA1/5	Register 0 Bit 5	Remote selected
IDATA1/6	Register 0 Bit 6	Local Stop selected
IDATA1/7	Register 0 Bit 7	Local selected
IDATA2/0	Register 0 Bit 8	Thermostat Tripped
IDATA2/1	Register 0 Bit 9	Monitor Relay
IDATA2/2	Register 0 Bit 10	Valve Obstructed
IDATA2/3	Register 0 Bit 11	Valve Jammed
IDATA2/4	Register 0 Bit 12	Valve Moving by Hand
IDATA2/5	Register 0 Bit 13	Moving Inhibited
IDATA2/6	Register 0 Bit 14	Position Control Enabled
IDATA2/7	Register 0 Bit 15	Watchdog Recovery
IDATA3/0	Register 1 Bit 0	Reserved
IDATA3/1	Register 1 Bit 1	Open Interlock input
IDATA3/2	Register 1 Bit 2	Close Interlock input
IDATA3/3	Register 1 Bit 3	DI −1
IDATA3/4	Register 1 Bit 4	DI −2
IDATA3/5	Register 1 Bit 5	DI −3
IDATA3/6	Register 1 Bit 6	DI −4
IDATA3/7	Register 1 Bit 7	Reserved
IDATA4/0	Register 1 Bit 8	GSD Configuration Permitted
IDATA4/1	Register 1 Bit 9	Reserved
IDATA4/2	Register 1 Bit 10	Control Contention
IDATA4/3	Register 1 Bit 11	Partial Stroke in Progress
IDATA4/4	Register 1 Bit 12	Partial Stroke Error
IDATA4/5	Register 1 Bit 13	Primary (0) or Back up (1)
IDATA4/6	Register 1 Bit 14	1 or 2 Channels Available
IDATA4/7	Register 1 Bit 15	SR (0) or FR (1) mode

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The Actuator Cyclic Data Signals

5.2.1	Digital Inputs

Actuator Moving — Whenever the actuator position is changing due to the motor running or if the output drive is moving, this bit will be set true (1).

Close Limit — This data bit indicates that the actuator has reached the closed position. The limit switch should be set slightly within the actual valve stroke to allow for torque seating or overshoot on closing without damaging the valve. The data bit will remain true (1) even if the position is passed through or exceeded.

Open Limit — This data bit indicates that the actuator has reached the open position. The limit switch should be set slightly within the actual valve stroke to allow for torque seating or overshoot on opening without damaging the valve. The data bit will remain true (1) even if the position is passed through or exceeded.

Running Closed — Whenever the actuator motor contactor used to drive the actuator in the closing direction is energised this bit will be true (1).

Running Open — Whenever the actuator motor contactor used to drive the actuator in the opening direction is energised this bit will be true (1).

Remote Selected — This bit is true (1) when the actuator three position remote/local stop/local selector is in the Remote position. The selector must be in this position for Profibus control to be permitted.

Local Stop — The actuator three position selector passes from Local to Remote or Remote to Local through the Local Stop position. The switch can also be placed in Local Stop. When the switch is in the Local Stop position this bit will be true (1). Remote control of the actuator is not possible when the selector is in this position.

Local Selected — This bit is true (1) when the actuator three position remote/local stop/local selector is in the Local position. Remote control of the actuator is not possible when the selector is in this position.

Thermostat — If the temperature of the motor windings rises above the thermostat trip value, the thermostat contact will open and this signal will be present (1). 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 and the thermostat has reset itself can a new Remote, Network Host or Local command to move the actuator be carried out. A setting on the actuator main board allows the ESD command to override the thermostat. The bit will remain set at logic 1 until the motor cools down and the thermostat resets itself.

Monitor Relay — This signal is true (1) when actuator remote control is not available. The actuator Monitor Relay status is a composite signal for several alarms. This signal will be set true if the actuator selector is in Local or Local Stop (not in Remote) or if the thermostat trips. The mains supply is also monitored and if one of the three phases is lost this bit is set. If the actuator is operated from a single phase supply and this is lost then communications with the actuator will also be lost. Where a 3 phase supply is used, if the phase associated with the control circuits is lost then communications with the actuator will be lost.

Valve Obstructed — This bit will be true (1) if the actuator stops in mid travel when not expected to do so after receiving a command to move. If the actuator torque exceeds the trip value set during commissioning then the motor will stop and motion will cease. The reason for the actuator stopping will be the high torque due to an obstruction and not a 'Stop' signal or reaching the desired set-point position.

The bit will remain true (1) until the actuator position changes by 2% or more.

> **Attempting to restart the actuator to move towards the obstruction (even if the obstruction no longer exists) is not possible, the actuator will not restart. The actuator must be electrically reversed away from the obstruction before attempting to continue in the original direction.**

Valve Jammed — This bit will be true (1) if the actuator is stationary at the end of travel and fails to move away from the seat of the valve when a network command requests it to do so. The actuator will trip on excessive torque due to the valve being jammed in the seat. The PFU fails to see movement and reports this status after the time set in the associated parameter during the PFU set up.

The bit will remain true (1) until the actuator position changes by 2% or more.

> **Attempting to restart the actuator to move out of the seated position is not possible. The actuator must be reversed before it will run in the same direction again. The jammed seat must first be released manually before electrical control is attempted. The problem may be overcome by adjusting the actuator torque setting which is designed to provide extra power on leaving the seated position.**

The Actuator Cyclic Data Signals

Valve Moving by Hand   The manual movement of the valve is reported as true (1) if the actuator is moved by the handwheel away from the last position. The percentage of travel required to trip the indication is set in the associated parameter during PFU set up.

The bit will remain true (1) until the actuator is moved electrically by either the local controls or a network command.

Moving Inhibited   This bit will be true (1) when the Motion Inhibit Timer is active or the Interrupter Timer is active, or both are active.

The Motion Inhibit Timer is used in position control to prevent the actuator from exceeding its prescribed number of starts per hour, or to reduce the effects of hunting during closed loop control.

The Interrupter Timer can be used over part or the entire actuator stroke to slow down the effective speed of valve travel.

When under network control, the control signal does not need to be re-applied when this bit is true, as the control action will continue once the time has elapsed.

Position Control Enabled   This bit will be true (1) when a Position command is being actioned. This data can be used to indicate that positioning mode has control of the actuator.

Watchdog Recovery   The PFU watchdog automatically resets the processor if it is tripped. This bit will be true (1) following a watchdog trip for the time period set in the associated watchdog timeout parameter.

Open Interlock   The input contact to the Open Interlock is monitored by the PFU. Whenever the input contact is closed this bit will be true (1). If the actuator is not using the interlock function then this input can be used as a digital status feedback for a plant signal not associated with the actuator. If the interlock circuit is being used then permission must be granted before the actuator can be opened and the presence of this bit will indicate that opening is permitted and permission is granted.

Close Interlock   The input contact to the Close Interlock is monitored by the PFU. Whenever the input contact is closed this bit will be true (1). If the actuator is not using the interlock function then this input can be used as a digital status feedback for a plant signal not associated with the actuator. If the interlock circuit is being used then permission must be granted before the actuator can be closed and the presence of this bit will indicate that closing is permitted and permission is granted.

Digital Input DI-1   This bit reports the status of the contact connected to the actuator hard-wired **Open** terminals. The input can be used to control the actuator or simply to report the status of a plant feedback signal. The function is set in the Auxiliary Input Mask parameter which determines whether the bit is reported as true (1) for a closed contact or an open contact and whether the input controls the actuator or not. Note that the input is always reported even when it is also controlling the actuator.

Digital Input DI-2   This bit reports the status of the contact connected to the actuator hard-wired **Close** terminals. The input can be used to control the actuator or simply to report the status of a plant feedback signal. The function is set in the Auxiliary Input Mask parameter which determines whether the bit is reported as true (1) for a closed contact or an open contact and whether the input controls the actuator or not. Note that the input is always reported even when it is also controlling the actuator.

Digital Input DI-3   This bit reports the status of the contact connected to the actuator hard-wired **Stop/Maintain** terminals. The input can be used to control the actuator or simply to report the status of a plant feedback signal. The function is set in the Auxiliary Input Mask parameter which determines whether the bit is reported as true (1) for a closed contact or an open contact and whether the input controls the actuator or not. Note that the input is always reported even when it is also controlling the actuator.

Digital Input DI-4   This bit reports the status of the contact connected to the actuator hard-wired **ESD** terminals. The input can be used to control the actuator or simply to report the status of a plant feedback signal. The function is set in the Auxiliary Input Mask parameter which determines whether the bit is reported as true (1) for a closed contact or an open contact and whether the input controls the actuator or not. Note that the input is always reported even when it is also controlling the actuator.

A configuration feature also allows DI-4 to be set to act as a 'Disable Network Control' input. In this mode when the input is made (irrespective of the Auxiliary Mask setting) the actuator cannot be controlled over the network. This can be useful during plant commissioning to prevent unwanted valve movement.

Developing the Future

The Actuator Cyclic Data Signals

GSD Parameterisation Permitted   If the actuator and card is being parameterised using either the FDT, PDM programmes and the associated device description files, or using the Setting Tool, then the ability to alter the card parameters by the GSD may need to be removed. The status of this bit shows if, during parameterisation after connection or power up, the settings in the GSD file will be used or the existing settings will be retained. When the bit is true (1), GSD parameterisation is permitted.

> On start-up of the card following connection to the bus the PLC will conduct a sequence of events including setting the Configuration of the card and then adjusting the card Parameters. The configuration will be the one selected for this particular card when it was commissioned onto the Profibus highway (see section 5.4). The parameterisation will be in accordance with the values in the GSD file associated with the specific actuator. It is possible to set the card so that GSD parameterisation is ignored; this then allows the actuator to be powered off and on again without resetting any parameter values.

Control Contention   If an incorrect value is transmitted in the ACTCON register then there will be no control action and this bit will be true (1) until a valid ACTCON value is received. Only one bit may be set in the ACTCON register at a time.

Partial Stroke in Progress   When the actuator is performing a partial stroke this bit is true (1). Once the action is complete the bit is reset (0). If the partial stroke is interrupted by a new command then the bit will be reset

Part Stroke Error In order to perform a partial stroke of the valve, the starting position is specified as either the open limit or the close limit. If the actuator is commanded to perform a partial stroke when it is not in the correct starting position or when it is in a mid-position this error is generated and the bit will be set (1).

There is a timer associated with Partial Stroke that is set during parameterisation to a value long enough to cover a successful partial stroke operation from end to mid position and back to the end. If the actuator fails to complete the partial stroke within the time set then this bit will be true (1).

Once set, the Part Stroke Error bit will be reset to 0 when the actuator next moves at least 2% by either a manual or automatic operation.

Backup or Primary Channel   This bit is used to indicate if the Profibus communication is to a channel on the card that is able to move the valve (Primary) or to a channel that is prevented from operating the valve (Backup).

When the communication is to the Primary Profibus DP channel the bit will be off (0).

> With a single channel card this bit will always indicate 'Primary' and be (0).
> With a dual card set to FR mode there is only one highway and the card uses two addresses, one per channel. If the communication is directed to the address for the backup channel this bit will be set to 1; if it is to the address for the primary channel it will be set to 0.
> With a dual card set to SR mode only one address is used, but there are two highways. If the communication is direct on the highway connected to the backup channel of the card then the bit will be set to 1; if the highway is connected to the primary channel the bit will be set to 0.
> Valve control can only be achieved if this bit reports as a (0).

1 or 2 Channels Available   This bit indicates the condition of the second channel on a dual channel card. It will be true (1) if both channels are available and working on the card. It does not indicate the status of the connection or highway to the second channel.

On a single channel card it will always report (0).

If there is a fault on the second channel of a dual channel card it will report (0), indicating that the second channel is not working correctly.

SR or FR Mode   This bit indicates the addressing mode chosen for the card. When reporting as (0) the bit indicates that one address is being used. On a single channel card only one address is permitted.

On a dual channel card a single address is used when two Profibus DP highways are used and the System Redundancy is employed.

If the bit reports as (1) then the card must be dual channel and the redundancy is using two addresses for Flying Redundancy configuration.

5.3   Actuator Analogue Input Feedback

In conjunction with the Profibus DP Module an optional analogue monitoring card can be added (taking up the second option card space).

This card can be used, to report over the Profibus network, an analogue variable. It can be connected to another piece of equipment near the actuator from which feedback is required, such as level sensors, pressures sensors or flow rate sensors, etc.

The range of inputs available are;

• 0-5 mA

• 0-10 mA

• 0-20 mA

• 0-5 V

• 0-10 V

• 0-20 V

The analogue monitoring card is powered from the actuators internal power supply and can provide a current source for the feedback. The feedback values will be in the range 0x0000=0% - 0x03E8=100% (0-1,000).

The card will need to be calibrated to the device during set-up of the unit. To do this, apply a 100% signal and write any non-zero number to parameter 35. For more information please consult the Centork technical manual.

5.4   Configuring the Registers to be Exchanged in Cyclic Communication

In the start-up routine for Profibus communication the card firstly enters parameterisation mode and adjusts the card parameters according to the GSD file settings. Next the card enters configuration mode where the configuration settings in the GSD file are used to determine the registers to be exchanged with the PLC during the normal cyclic messaging.

The configuration stage allows for the tailoring of the registers to be exchanged to allow the system to be tuned to improve data throughput. If certain information or controls are not required by the PLC then they may be left out of data exchange by choosing the appropriate configuration.

Both the PLC and the card must be aware of the configuration chosen for successful data exchange.

The Profibus DP Module has 10 possible configurations as indicated in the table. The default value is Configuration 1. The PLC must send a Check Configuration message during start up to confirm the Configuration to be used.

Configuration		1	2	3	4	5	6	7	8	9	10
OUTPUTS (16 Bits each)	ACTCON	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
	POS-DV	✓	✗	✓	✗	✓	✗	✗	✓	✗	✗
	O-STAT	✓	✗	✗	✗	✗	✓	✓	✓	✓	✗
INPUTS (16 Bits each)	IDATA1 & IDATA2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	IDATA3 & IDATA4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	TORQUE	✓	✗	✓	✗	✓	✓	✗	✓	✗	✓
	POISTN	✓	✗	✓	✗	✓	✓	✗	✓	✗	✓
	TEMPER	✓	✗	✗	✓	✓	✗	✓	✗	✗	✓
	ANALOG	✓	✗	✗	✓	✓	✗	✓	✗	✗	✓

Developing the Future

6	PROFIBUS DP COMMUNICATION

6.1	Electrical Specification

Line Electrical Specification: RS485, two wire, half duplex

6.2	Protocol

Profibus DP   Cyclic (V0) and Acyclic (V1) communication

Supported Baud Rates   9k6, 19k2, 45k45, 93k75, 187k5, 500k, 1M5

Data Speed (Baud)	9k6	19k2	45k45	93k75	187k5	500k	1M5
Maximum Slave Response Delay Time (mS)	15	15	15	15	15	15	50

6.3	Single Highway, Single Channel

When using a single channel version the following must be set up:

Address   The address can be set using the Accent software directly with the actuator (free from www.Centork.com) or using the setting tool. The address can also be set over the highway using a Class 2 master.

Baud Rate   This is selected by the PLC.

Slave Configuration   One of the 10 configurations for the slave must be chosen.

Basic Parameterisation   The basic parameters such as deadband and motion inhibit time can be set using either the GSD file or a suitable PDM or FDT utility. The default settings will be suitable for most systems.

Communication will be established automatically between the PLC and the card once the correct GSD has been identified. If the actuator cover is opened there are several LEDs on the circuit board that are used to indicate communication activity. These indicate both the communication between the Profibus highway and the card and the communication within the cards two main processors.
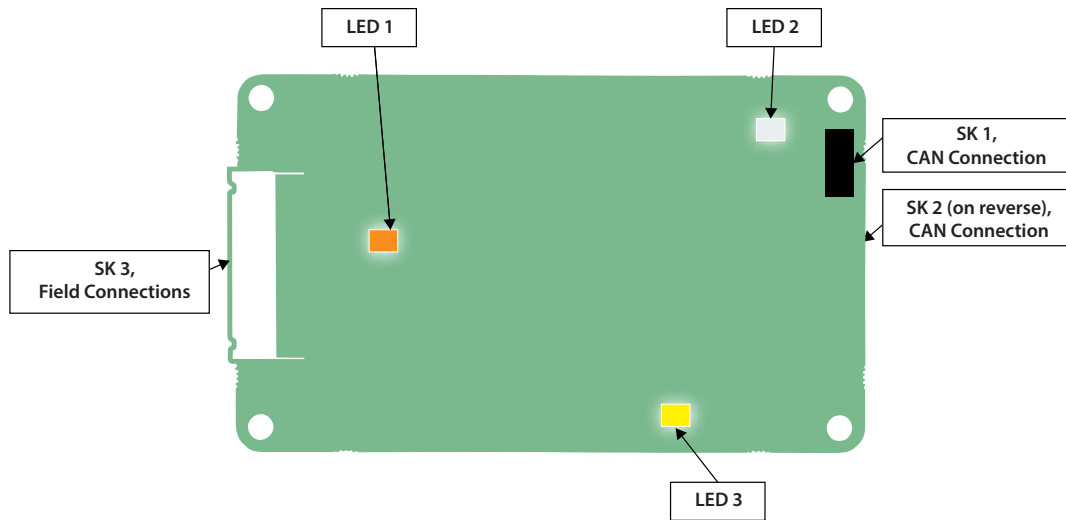
Fig. 16: Single Channel Profibus card LED positions

LED	Description	State	Indication
1	Orange LED	Flash (variable speed)	Flash's when receiving Profibus messages. This LED flashes at the rate of the incoming messages, so faster baud rates will cause a faster flash (will appear dimmer at faster speeds).
2	Green LED	Slow flash	Indicates communication and power between the Profibus card and the actuator main board.
3	Yellow LED	Solid on	Indicates Profibus cyclic DPV0 communications.

For SK functions please see the table in section 3.1.

Profibus DP Communication

6.4	Dual Highway, Dual Channel – SR Mode

When using the Simple or RedCom Dual Channel card the mode for communication has to be selected between SR (System Redundancy) and FR (Flying Redundancy). This is chosen during parameterisation by the GSD file values or by using a parameterisation utility such as FDT or PDM.

Redundancy   The default setting for redundancy is SR mode

In SR mode there are two highways and a redundantly configured PLC. The two channels on the card both use the same address. One channel is in Primary mode whilst the other is in Backup mode. The card is waiting for a communication message on the channel that is in Primary mode and the two channels will switch their mode whilst searching for comms. There is no discrimination between Channel 1 and Channel 2 to determine which is in Primary mode. The two channels will both try to adopt Primary mode.

When using either the Simple or the RedCom dual channel card in SR mode the following must be set up:

Address   The two channels share the same common address. The address can be set using the Accent software directly with the actuator (free from www.Centork.com) or using the setting tool. The address can also be set over the highway using a Class 2 master.

Baud Rate   This is selected by the PLC, both channels adopt the same baud rate.

Slave Configuration   One of the 10 configurations for the slave must be chosen. Both channels will use the same configuration setting. Configuration can only be carried out on the Primary channel.

Basic Parameterisation   The basic parameters such as deadband and motion inhibit time can be set using either the GSD file or a suitable PDM or FDT utility. The default settings will be suitable for most systems. Both channels will adopt the same settings.

Parameterisation can only be carried out on the Primary channel.

IDATA4 Bit 5 indicates the channel status and will show if the channel in communication is the Primary or Backup.

Fig. 17: System Redundancy – Two highway redundancy

SR Mode -
- **Both channels have the same slave address.**
- **When the card is powered 'on' Channel 1 will be the Primary channel. After power up the card will seek a master to communicate with by alternating the channel 1 and 2 between Primary and Secondary mode. The switch over time increases with each change to a maximum of 32 seconds. The card will continue to switch channels using a 32 second switch over time until one channel receives PLC messages.**
- **It may be necessary for the PLC to wait until the correct channel is in Primary mode before communication is started.**
- **If the Primary channel fails, the Backup will automatically adopt Primary status and wait for messages from the second master.**
- **The Backup channel can be used for exchanging data but any commands to move the actuator directed to the backup channel will be ignored.**
- **If a configuration message is sent to the Backup channel that is different to the one sent to the Primary it will be accepted, but not carried out.**

Developing the Future

Profibus DP Communication

6.5	Single Highway Dual Channel – FR Mode

On either the Simple or RedCom dual channel card the mode for communications may be set to FR (Flying Redundancy) in some cases. This will require the card's GSD file to be changed or the parameter value altered by a PDM or FDT utility.

Redundancy   SR is the default mode; it must be altered for FR mode.

In FR mode there is one highway and a single PLC can be used. The two channels on the card each have an address offset by 64. One channel is in Primary mode and uses the base address whilst the other is in Backup mode using the base address plus 64. As with SR mode, the card is waiting for a communication message on the channel that is in Primary mode and the two channels will switch their mode whilst searching for comms. There is no discrimination between Channel 1 and Channel 2 to determine which is in Primary mode. The two channels will both try to adopt Primary mode. The difference here is that the PLC can communicate with the backup using a different address.

When using either type of dual channel card in FR mode the following must be set up:

Address   The two channels have address offset by 64. The address can be set using the Accent software directly with the actuator (free from www.Centork.com) or using the setting tool. The address can also be set over the highway using a Class 2 master.

Baud Rate   This is selected by the PLC, both channels adopt the same baud rate.

Slave Configuration   One of the 10 configurations for the slave must be chosen. Both channels will use the same configuration setting.

Configuration can only be carried out on the Primary channel.

Basic Parameterisation   The basic parameters such as deadband and motion inhibit time can be set using either the GSD file or a suitable PDM or FDT utility. The default settings will be suitable for most systems. Both channels will adopt the same settings.

Parameterisation can only be carried out on the Primary channel.

IDATA4 Bit 5 indicates the channel status and will show if the channel in communication is the Primary or Backup.
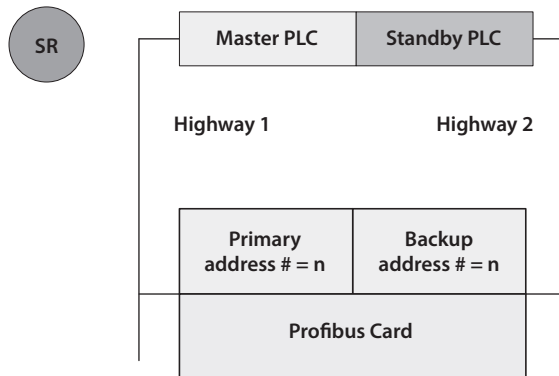

Fig. 18: Flying Redundancy – One highway redundancy

FR Mode -
- **Primary is offset from Backup address by 64.**
- **When the card is powered 'on' Channel 1 will be the Primary channel. After power up the card will seek a master to communicate with by alternating the channel 1 and 2 between Primary and Secondary mode. The switch over time increases with each change to a maximum of 32 seconds. The card will continue to switch channels using a 32 second switch over time until one channel receives PLC messages. The channel addresses alternate at this point.**
- **The PLC need not wait for a particular channel to be in Primary mode before starting communications.**
- **If the Primary channel fails the Backup will automatically adopt Primary address and wait for messages from the master.**
- **The Backup channel address can be used for exchanging data but any commands to move the actuator directed to the backup address will be ignored.**
- **If a configuration message is sent to the Backup address that is different to the one sent to the Primary it will be accepted, but not carried out.**

Profibus DP Communication

If the actuator cover is opened there are several LEDs on the circuit board that are used to indicate communication activity. These indicate both the communication between the Profibus highway and the card and the communication within the card's two main processors.
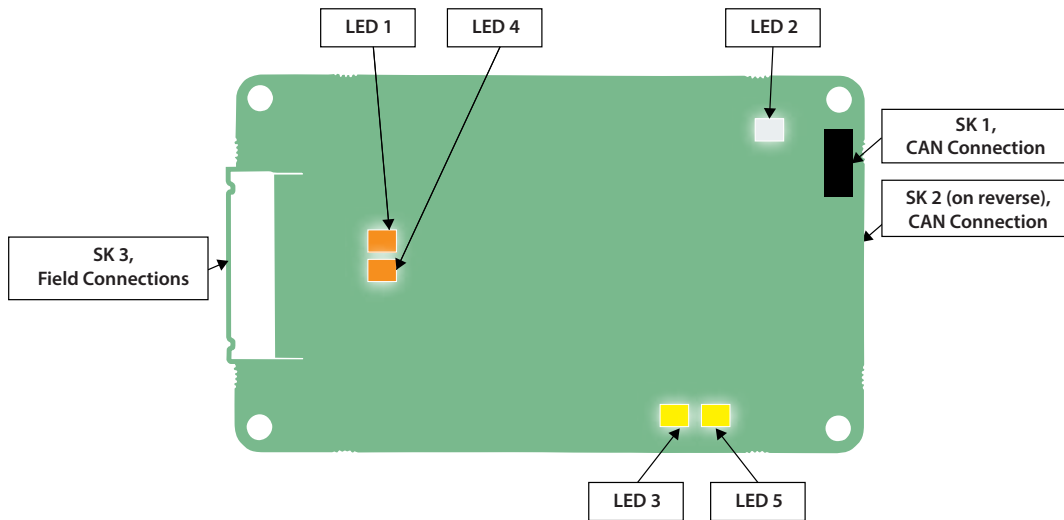
Fig. 19: Dual Channel Profibus card LED positions

LED	Description	State	Function
1	Orange LED (Channel 1)	Flash (variable speed)	Flash's when receiving Profibus messages on channel one. This LED flashes at the rate of the incoming messages, so faster baud rates will cause a faster flash (will appear dimmer at faster speeds).
2	Green LED	Slow flash	Indicates communication and power between the Profibus card and the actuator main board.
3	Yellow LED (Channel 1)	Solid on	Indicates Profibus cyclic DPV0 communications on channel 1.
4	Orange LED (Channel 2)	Flash (variable speed)	Flash's when receiving Profibus messages on channel two. This LED flashes at the rate of the incoming messages, so faster baud rates will cause a faster flash (will appear dimmer at faster speeds).
5	Yellow LED (Channel 2)	Solid on	Indicates Profibus cyclic DPV0 communications on channel 2.

For SK functions please see the table in section 3.1.

Profibus DP Communication

6.7   Basic Operation on Start up

Whenever a field device is powered up and it is found by the PLC it will go through the standard Profibus procedure of Parameterisation and Configuration before commencing Data Exchange. This exchange can include altering the address if the device has an address of 126 and the master supports address changes – master class 2.

1) The first message – master sends a **DIAG_req** telegram.

2) The response should be a **DIAG_res** with diagnostic data attached.

3) If this is correct a **Set_Parameter** telegram is sent with the parameterisation data attached.

4) The response should be a **Short Ack** message.

5) If a correct response is received a **Check_Config** telegram is sent

6) The response should be a **Short Ack** message.

7) If this is correct a **DIAG_req** telegram is sent.

8) The response should be a **DIAG_res** with diagnostic data attached.

9) If DIAG is not reporting an error data exchange commences.

The Parameterisation data is extracted from the GSD file for the particular address of the slave device. The association between the GSD to be used and the address is made in the master during the configuration of the network on the master (a table is created). The association can also be defined in a Master 2 and sent to a Master 1 by the master to master comms. Most master 1 devices permit the same device type (as described in the GSD) to have different GSD files, so allowing the GSD to be edited.

Editing the GSD file guarantees that a device coming on line after having been switched off will have the correct settings. If FDT or PDM changes the same parameters as those installed by a GSD then the GSD values will replace those set by the FDT or PDM when the device is switched off and on again, or the PLC is powered off and back on, unless GSD parameterisation is not permitted.

(See section 5.4 for information on the Configurations allowed).
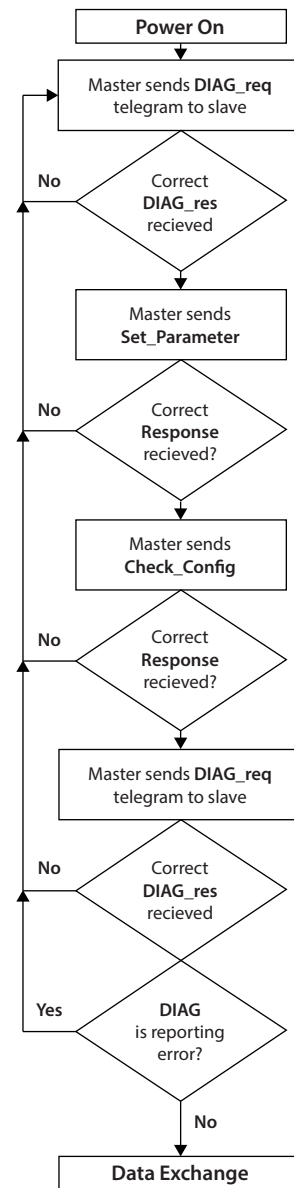
Fig 20: Profibus Start Up Sequence

Profibus DP Communication

7	PARAMETERS

7.1	Parameters set by GSD and DP-V1 Communication

Profibus defines a power on reset sequence for all devices as:

Diagnostic Request

Set Parameterisation

Check Configuration / Set Configuration

Diagnostic Request

Data Exchange

After a successful Diagnostic Request the Set Parameterisation Telegram is sent from the PLC. The Set Parameter message contains the user defined Parameter Data Unit (DU) of a minimum of 7 bytes, max 244 bytes. The first 7 bytes are mandatory and fixed. The following bytes contain the parameter values to be set and these are derived from the GSD file and the values in it. The response is a short acknowledgement (E5) with no data field if the Parameterisation is accepted.

The Profibus DP Module (Mk2) GSD contains 19 configurable parameter registers sent in a 23 byte string. The first 3 bytes are Profibus Specific, the next 19 relate to the configurable parameters and the 23rd is reserved for future use. Some of the parameters can be altered by using the Accent software and the setting tool. All of them can be altered by the values in the GSD file or by a V1 communication tool such as PDM or FDT when the appropriate files are provided. It is possible to lock out parameterisation by GSD in the more sophisticated uses of this card. This facility is there to ensure that V1, FDT or PDM parameterisation is not lost on a power cycle.

Care must be exercised with access to these parameter registers as they can alter the complete performance of the actuator. This section of the manual describes each variable parameter and should be used for reference when using the parameterisation tools.

Parameters

The parameters that may be set by the GSD exchange or V1 comms (Where V1 read and write slot number is 0 for all parameters and the index number is the parameter number shown in the table) are:

Param. No.	Description	Value/Range	Default Value
1	Limited Range Position Minimum	0-100% 0000 – 0064 hex	0% 0000 hex
2	Limited Range Position Maximum	0-100% 0000 – 0064 hex	100% 0064 hex
3	Deadband[1]	0.0– 25.5% 0000 – 00FF hex	5.0% 0032 hex
4	Hysteresis[1]	0.0– 25.5% 0000 – 00FF hex	2.0% 0014 hex
5	Reserved	N/A	N/A
6	Motion Inhibit Time	0 – 255 sec 0000 – 00FF hex	5 sec 0005 hex
7	Manual Movement Travel	0 – 100% 0000 – 0064 hex	10% 000A hex
8	Valve Jammed Time	0 – 255 sec 0000 – 00FF hex	5 sec 0005 hex
9	Watchdog Timeout	0 – 255 sec 0000 – 00FF hex	10 sec 000A hex
10	Action on Loss of Comms	0 = Nothing (No Action) 1 = Open 3 = Close 5 = Stop 7 = Position Any other value = Off	0 = Nothing (0000 hex)
11	Comms Lost Position	0 – 100% 0000 – 0064 hex	0% 0000 hex
12	Comms Fault Timer	0 – 255 sec 0000 – 00FF hex	255 sec 00FF
13	Aux Input Mask	0 – 255 0000 – 00FF hex	15 00FF hex
14	ESD DI4/Net Disable and Data logger disable	DI-4 is ESD = 0 or 2 DI-4 is Net Disable = 1 or 3 Data Logger is enabled = 0 or 1 Data Logger is disabled = 2 or 4 (Bit 0 = EDS/Net disable Bit 1 = data logger en/disable)	ESD and Data Logger enabled 0 0000 hex
15	Redundancy FR/SR mode and Simple/RedCom mode	Bit 0 : SR mode = 0, FR mode = 1 Bit 1 : Simple = 0, RedCom = 1	0[2] 0000 hex
16	Part Stroke position	1 – 99% 0001 – 0063 hex	90 005A
17	Part Stroke Limit and timeout	Bit 15 is 0 for close limit and 1 for open limit. Bits 0-14 are time values in seconds for timeout	Open and 300 secs 812C hex
18	Actuator Type	0 – Unknown (default), 23 – Centork	0
19	Reserved	N/A	N/A

Note - On Redcom Dual Channel cards the default is 2 (0002 hex)

These parameters set up the response the actuator will make to various control and network actions. There are three GSD files, one for a single channel card, one for a simple dual channel and one for a RedCom dual channel card. They all contain the same number of parameter settings.

- **Single Channel Card**   **GSD file   RTRK0845**

- **Simple Dual Channel Card**   **GSD file   RTRC0845**

- **RedCom Dual Channel Card**   **GSD file   RTRR0845**

Parameters

These parameter registers are used to define the positions in the range of valve travel that will be reported as 0 to 100% if the whole travel from the closed position to the open position is not used. In addition the position demand set-point output value will also be modified to follow this limited range.

It is possible to make the position data reported and the position controller relate to a reduced span of actual valve travel. In this mode the position data relates to the 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 the fully closed position (or fully open position). These parameters define the actual limited range of valve travel that will be used for the position reporting and control by the positioner.
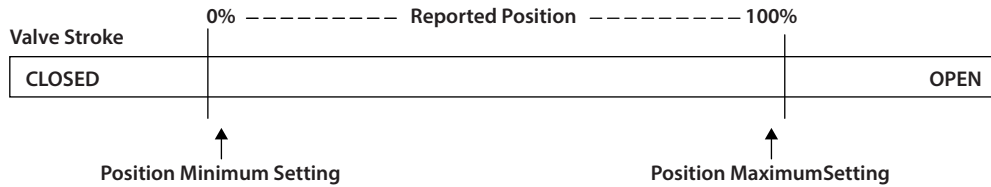

Fig 21: Limited Range Position Control and Reporting

Note that the digital open and close commands will still make the valve travel over its full stroke. The special case analogue commands of 0% and 100% that would otherwise cause the actuator to travel to the limit switch or torque off positions are inhibited if values other than 0 and 100 are set in these parameters (limited range position parameters).

The values inserted relate to the maximum total valve travel between closed and open and represent the point in the full stroke which will now be used for the limited stroke 0 and 100 values.

7.1.2   Deadband and Hysteresis (Parameter 3 and 4)

When using position control by sending a value to the Actuator Position DV set-point there are a number of parameter registers used to tune the position controller and reduce the possibility of damage to the actuator. These two registers are set to prevent hunting around the set-point due to high inertia of the valve. They will require adjustment for each specific application. In addition the Motion Inhibit Timer is used to ensure the actuator does not carry out an excessive number of starts in a given period.

Deadband   The control used for the positioner is proportional only. The PFU will run the actuator to the desired position and then it stops. As the actuator and valve combination have some inertia there is a possibility that the desired position may be overrun and the positioner will then reverse the direction of travel to make the valve adopt the desired position. This overshoot and return may continue for a number of cycles and is known as hunting. The valve and actuator combination will hunt around the set-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 position nearer the desired position.

The deadband is the allowable error around the set point.

Hysteresis   In addition to the deadband a second setting, hysteresis, further refines the performance of the position controller. The positioner will run the actuator towards the setpoint DV until the actual position is within the deadband minus the hysteresis setting. This has the effect of instructing the actuator to stop when it is nearer the DV. The actuator will not restart unless it overshoots and runs outside the deadband or a new command places the new desired position outside the deadband.

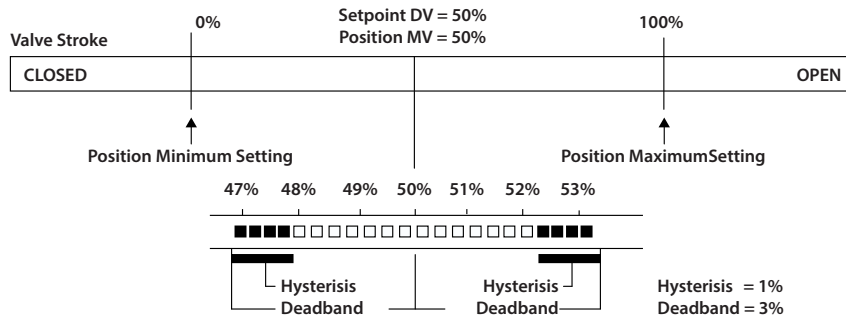The Hysteresis is the amount of movement inside the deadband permitted before the motor stops.

Fig 22: Deadband and Hysteresis settings

Parameters

7.1.3   Motion Inhibit Timer (Parameter 6)

The Motion Inhibit Timer setting is the period that must elapse between consecutive starts of the actuator motor when in positioning mode. The idle period will prevent the actuator motor from exceeding its rated number of starts per hour.

In addition, when tuning the valve positioner the setting can be used to allow the plant dynamics to stabilise between valve movements.

7.1.4   Manual Movement Travel (Parameter 7)

Manual Movement Travel sets the amount of valve travel not under motor action that is permitted before being considered 'Manual Movement'. The setting must be sufficiently large to cover overrun of position control due to valve inertia. Too small a setting will result in Manual Movement alarms each time the valve is positioned, particularly if the deadband is small.

7.1.5   Valve Jammed Time (Parameter 8)

Parameter 8 sets the time delay that must elapse without any actuator movement before deciding the Valve Jammed status bit must be set. Valve Jammed is only announced if the actuator is asked to move and fails to respond when it should. The time must be long enough to ensure that the valve is not moving at all.

7.1.6   Watchdog Timeout (Parameter 9)

If the watchdog trips to reset the processor the Watchdog Recovery data bit is set. The data bit will automatically reset to '0' after the time period set in this parameter register.

7.1.7   Action on Loss of Comms (Parameter 10)

This parameter is used in conjunction with Parameter 11 (Comms Lost Position) and 12 (Comms Fault Timer).

The Action on Loss of Comms parameter defines the actuator action that will result after the time set for the Comms Fault Timer (parameter 12) if there is no network communication activity detected by the PFU.

The action may be

- **Nothing** (0)   No action, actuator will complete any command in process (the default setting)
- **Open** (1)   The actuator will open the valve
- **Close** (3)   The actuator will close the valve
- **Stop** (5)   The actuator stops
- **Position** (7)   The actuator will adjust the valve position to the setting given in the Comms Lost Position (parameter 11).

7.1.8   Comms Lost Position (Parameter 11)

The setting in this parameter determines the position in the range 0 to 100% that the actuator will move to if the Profibus network communications stops being received, provided the Action on Loss of Comms (parameter 10) is set to 'Position'. No action will be taken unless the communication stops for a period equal or greater than the setting in the Comms Fault Timer (parameter 12).

7.1.9   Comms Fault Timer (Parameter 12)

Parameter 12, the Comms Fault Timer setting, determines the number of seconds that network communication must be absent before the setting for the Fault Mode will be carried out.

Parameters

This parameter relates to the auxiliary inputs (open, stop, close, ESD) to be set to control the actuator or simply report their status. In addition it allows the sense of the input (open or closed contact) that is reported as true (1) to be set. Actuator control always requires a true (1) input signal. The status of the inputs is always reported over the network and they can be used to report associated plant inputs instead of controlling the actuator.

The register should be considered in its binary format using the low order byte. The number has the binary form $x^7x^6x^5x^4, y^3y^2y^1y^0$, requiring 8 bits. Each bit in the high order nibble, $x^7x^6x^5x^4$, either enables or disables the associated input for control of the actuator. The bits in the low order nibble, $y^3y^2y^1y^0$, determines if the input reports a closed contact as a '1' or an open contact as a '1'. Only when the input is a '1', as set by the mask, and the contact state will the actuator respond to the input if it is also set to control the actuator.

To allow an input to act as a control signal its associated bit in the high order nibble must be set to a '1' in the mask. To allow a closed contact to be reported as a '1' then its associated bit in the low order nibble must be set to '1' in the mask.

Bit	Position	Value	Function
7	X^7	0	Disable ESD input as command
		1	Enable ESD input as command
6	X^6	0	Disable Stop/Maintain input as command
		1	Enable Stop/Maintain input as command
5	X^5	0	Disable Close input as command
		1	Enable Close input as command
4	X^4	0	Disable Open input as command
		1	Enable Open input as command
3	Y^3	0	Report closed contact on ESD input as '0'
		1	Report closed contact on ESD input as '1'
2	Y^2	0	Report closed contact on Stop/Maintain input as '0'
		1	Report closed contact on Stop/Maintain input as '1'
1	Y^1	0	Report closed contact on Close input as'0'
		1	Report closed contact on Close input as '1'
0	Y^0	0	Report closed contact on Open input as '0'
		1	Report closed contact on Open input as '1'

The following examples show how the Auxiliary Input Mask settings can be applied.

Most Significant Bit							Least Significant Bit
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X^7	X^6	X^5	X^4	Y^3	Y^2	Y^1	Y^0
Enable DI-4 ESD	Enable DI-3 Stop	Enable DI-2 Close	Enable DI-1 Open	Invert DI-4	Invert DI-3	Invert DI-2	Invert DI-1
Example 1 0	0	0	0	1	1	1	1
Example 2 1	1	1	1	1	1	1	1
Example 3 0	0	0	0	0	0	0	0

- **Example 1**   The default value of '15' (0000,1111 binary or 0F hex) makes all 4 inputs report closed contacts as true (1) and none of the inputs will operate the actuator.
- **Example 2**   The value 255 (1111,1111 binary or FF hex) makes all 4 inputs report closed contacts as true (1) and all the inputs control the actuator in their predefined way.
- **Example 3**   The value 0 (0000,0000 binary or 00 hex) makes all 4 inputs report open contacts as true (1) and none of the inputs will operate the actuator.

Developing the Future

Parameters

7.1.11 ESD DI-4/Net Disable (Parameter 14)

This input determines the mode of operation for the ESD/DI-4 remote input. The input can be used either to disable control of the actuator from the network, or to act as an ESD/digital input. When this setting is made 'Active' the input will disable network control of the actuator when the contact input is closed irrespective of the Aux Mask setting.

Please consult the Centork manual for more information.

7.1.12 Redundancy FR/SR Mode and Simple/RedCom Mode (Parameter 15)

When using either type of dual channel card there are two methods for redundancy that can be used, Flying Redundancy, where the two channels have addresses 64 apart, and System Redundancy, where they have the same address. The first bit of this parameter selects the type of redundancy to be used. The way that data is reported can be altered and the second bit selects either Simple redundancy where there is no extended diagnostics message, or fully RedCom compliant redundancy that includes the RedCom extended diagnostics messages.

Function	Value
SR and Simple, two highways and no extended diagnostics	0 0000 bin
FR and Simple, one highway and no extended diagnostics	1 0001 bin
SR and RedCom, two highways plus extended diagnostics	2 0010 bin
FR and RedCom, one highway plus extended diagnostics	3 0011 bin

7.1.13 Partial Stroke Position (Parameter 16)

This parameter sets the position to travel to when a Partial Stroke command is carried out. The partial stroke can be initiated from either the open or the closed position of the valve. The target position can be any value in the range 1-99% where 1 % is near the closed position. Note that the desired value to which the actuator is required to move must be outside the deadband setting.

7.1.14 Partial Stroke Limit and Timeout (Parameter 17)

This parameter is used to set two values. The most significant bit in the register is used to determine the starting position, which can be either the open position (1) or closed position (0) for the valve. The remaining 7 bits are used to set the time limit before which the required position (set by parameter 16) must be achieved if the test is successful.

Bit	Value	Function
15	0	Start test from closed position
	1	Start test from open position
0-14	0-7FFFxhex	Time to complete, 0 – 32676 seconds

7.1.15 Actuator type (Parameter 18)

This parameter allows the identification of the type of actuator in which the PFU is fitted. This can be useful on some systems to allow the correct display and controls to be enabled.

Parameters

Parameters viewed and set by DP-V1 Communication

The Profibus DP Module supports V1 acyclic communication as well as V0 cyclic messages. These parameters can be accessed in a number of ways including using standard Profibus tools and the specialist device description files associated with them.

- **FDT** Field Device Tool, this utility requires a DTM (Device Type Manager) file.
- **PDM** Process Device Manager, this tool requires an EDD (Electronic Device Description) file

The Profibus DP Module supports both these utilities. The list of parameters that can be accessed by these tools is as below. These tools will allow the actuator to be controlled and monitored by the tools as they support the display of the registers containing feedback status and output commands. The size of the parameter is listed together with the ability to Read (R) or Write (W) to the parameter using one of these utilities.

For V1 read and writes the slot number is 0 for all parameters and the index number is the parameter number shown in the table.

Parameter No.	Data	Read / Write	Value / Range	Default Value
20	Actuator Tag data	R/W	12 byte	0
21	Actuator software version	R	12 byte	e.g. V013
22	Profibus interface software version	R	12 byte	e.g. V101
23	Reserved			
24	Field Interface type	R	00 to FF	02
25	Permit GSD Parameterisation	R/W	1 = Permit GSD 0 = Lock out GSD	1
26	Actuator digital control	R/W	0000 to FFFF	0
27	Actuator position control	R/W	0000 to FFFF	0
28	Reserved			
29	Additional Control Flags	R/W	0000 to FFFF	0
30	Input data IDATA1/2	R	0000 to FFFF	0000
31	Input data IDATA3/4	R	0000 to FFFF	0000
32	Torque feedback[2]	R	0-120%, 0000 to 0078 hex	0
33	Position feedback[3]	R	0-100.0%, 0000 to 03E8 hex	0
34	Temperature	R	-32767 to +32767 °C 0000 to FFFF	0
35	Analogue Input Calibration[4]	R/W	1 = Calibrate High Signal 2 = Calibrate Low Signal	0
36	Analogue Input[4]	R	0 - 100.0%, 0000 to 03E8	0
37	Reserved			
38	Reserved			
39	Reserved			
40[1]	Configure Data Exchange Data	R	1-10, 1 to 000A hex	0
41-67	Reserved			
68	Parameterisation Date (8 ASCII character string dd/mm/yy)	R/W	DD/MM/YY, 8 byte	0
69	Reserved			
70-77	Reserved			

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Developing the Future

Parameters

Parameter No.	Data	Read / Write	Value / Range	Default Value
78	Function for Indication contact S1	R/W	Bit 0: 0-Normally Open, 1 – Normally Closed. Bits 1 to 15: See separate table 'S contact functions'.	0000
79	Function for Indication contact S2	R/W		0001
80	Function for Indication contact S3	R/W		0002
81	Function for Indication contact S4	R/W		0003
82	Position trip when function set to 'PO' contact S1[3]	R/W	0-100%, 0 to 0064 h	0001
83	Position trip when function set to 'PO' contact S2[3]	R/W	0-100%, 0 to 0064 h	0001
84	Position trip when function set to 'PO' contact S3[3]	R/W	0-100%, 0 to 0064 h	0001
85	Position trip when function set to 'PO' contact S4[3]	R/W	0-100%, 0 to 0064 h	0001
86	Function for Indication contact S5[4]	R/W	Bit 0: 0-Normally Open, 1 – normally closed. Bits 1 to 15: See separate table 'S contact functions'.	0001
87	Function for Indication contact S6[4]	R/W		0003
88	Function for Indication contact S7[4]	R/W		000D
89	Function for Indication contact S8[4]	R/W		002B
90	Position trip when function set to 'PO' contact S5[3]	R/W	0-100%, 0 to 0064 h	0001
91	Position trip when function set to 'PO' contact S6[3]	R/W	0-100%, 0 to 0064 h	0001
92	Position trip when function set to 'PO' contact S7[3]	R/W	0-100%, 0 to 0064 h	0001
93	Position trip when function set to 'PO' contact S8[3]	R/W	0-100%, 0 to 0064 h	0001
94 - 96	Reserved			
97	ESD direction	R/W	00: Close, 01: Open, 10: Stationary 11: Ignore ESD	0000
98	ESD contact	R/W	0: ESD break contact 1: ESD make contact	0000
99	ESD bypasses the actuator interlocks	R/W	0: bypass disabled 1: bypass enabled	0000
100	ESD bypasses the Thermostat trip	R/W	0: bypass disabled 1: bypass enabled	0000
101	ESD bypasses Local stop	R/W	0: bypass disabled 1: bypass enabled	0000
102	Bits 0 to 5 - reserved Bit 6 – Interlocks enable / disable Bits 7 to 15 - reserved	R	0: Interlocks Enabled 1: Interlocks Disabled	0001
103	Open limit position	R	-	001A0000
104	Interrupter timer start limit	R/W	0: Around close limit 1: Around open limit	0000
105	Interrupter timer off time	R/W	1-99 secs, 0 to 0063 h	0002
106	Interrupter timer on time	R/W	1-99 secs, 0 to 0063 h	0003
107	Interrupter timer activated when opening if below xx%	R/W	0-100%, 0 to 0064 h	0028
108	Interrupter timer activated when closing if below xx%	R/W	0-100%, 0 to 0064 h	002D
109	Bits 0 to 4 - reserved Bit 5 – Language Bits 6 to 15 - reserved	R	0: English 1: Alternative language	0000
110	Reserved			
111	ID Main	R	16 bytes ASCII	-
112	ID Locals	R	16 bytes ASCII	-
113	ID DSM	R	16 bytes ASCII	-
114	ID Power	R	16 bytes ASCII	-
115	ID Option1	R	16 bytes ASCII	-

Parameters

Parameter No.	Data	Read / Write	Value / Range	Default Value
116	ID Option 2	R	16 bytes ASCII	-
117	Reserved			-
118	Reserved			-
119	Manufacture notes	R	48 bytes ASCII	-
120	General Notes	R/W	67 bytes ASCII	-

Note ¹ - Only readable by V1 comms on Simple Dual and RedCom Dual modules.
Note ² - Only on units with a DSM.
Note ³ - Only available on unites with a DSM or MSM with optional potentiometer.
Note ⁴ - Requires extra option card.

7.2.1   Actuator Tag Data (Parameter 20)

This parameter allows the Profibus card to hold a tag name for the actuator, up to 12 characters long.

7.2.2   Software Versions (Parameter 21 and 22)

Parameter 21 holds the Interface card software version in the form VXXX and parameter 22 holds the Profibus network interface card software version in the form VXXX.

7.2.3   Field Interface Type (Parameter 24)

This parameter reports the type of network interface card fitted. It will read 02 for a Profibus card.

7.2.4   Permit GSD Parameterisation (Parameter 25)

If the Profibus card has been set up using FDT or PDM it may be desirable to prevent any of parameters 1 to 19 from being altered by the GSD file during normal start up or on a power cycle. If the actuator is switched off, then back on, the standard Profibus start up routine will impose the parameter values set in the GSD file for the device.

This parameter allows the card to be set to ignore the GSD parameterisation routine. If it is set to '1' then the GSD Parameterisation is permitted. The default value is 1.

7.2.5   Control Outputs (Parameter 26 to 29)

Parameter 26 allows the actuator to be controlled using the same values as in the ACTCON register described in section 5.1.2. Parameter 27 (in conjunction with Parameter 26) allows the actuator to be positioned using the same values as in the POS_DV register, refer to section 5.1.3.

Parameter 29 allows the relay outputs to be controlled as described in section 5.1.4

Parameter 29					
Bit	4 - 15	3	2	1	0
Function	Reserved	DO-4 control	DO-3 control	DO-2 control	DO-1 control

7.2.6   Configure Data Exchange (Parameter 40)

The data to be exchanged during normal cyclic data exchange is determined by the Configuration set during start-up of communication between the PLC and the Profibus card. In setting up the card from the PLC one of the 10 possible Configuration will have been chosen – refer to section 5.4.

Parameter 40 shows which of the 10 possible configurations has been chosen and allows the choice to be verified. It cannot be changed except by the choice entered during the configuration stage.

7.2.7   Parameterisation Date (Parameter 68)

This parameter can be set to contain information showing the date when the card was set up. The format for the entry should be DD/MM/YY. This parameter does not automatically update and must be set manually.

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Parameters

7.2.8   Function for indication Contacts S1 – S8 (Parameters 78-81 and 86-89)

These parameters enable the indication contacts S1 to S8 to be set to trip to any one of the following functions. The contact can be set to Normally Open or Normally Closed using bit 0.

Note: The relays can be set to extra functions that are not listed below, using the HMI or Accent (these extra functions will appear as disabled (1C hex) over Profibus. Please consult the CK technical manual for more detail on these functions.

Relay		
Name	**Hex (bits 1-15)**	**Function**
Disabled	1C	Relay turned off
Close Limit	00	Activates at close limit
Open Limit	01	Activates at open limit
Position % Open	02	Activates when past a set function
Motor Running	18	Activates when motor is running
Closing	07	Activates when the centre column is moving close
Opening	08	Activates when the centre column is moving open
Moving	09	Activates when the centre column is moving
Hand Op	0C	Activates when the centre column is moved manually
Move Blink	0D	Relay alternates when centre column is moving
Valve Alarm	19	Indicates a valve alarm is present
Torque Close	03	Activates when the unit reaches the set torque in the close direction
Torque open	04	Activates when the unit reaches the set torque in the open direction
Torque trip	05	Activates when the unit reaches the set torque in any direction
Torque Mid	06	Activates when the unit reaches the set torque in mid-travel
Motor Stall	0A	Indicates the motor has stalled
Stop Selected	0E	Indicates that stop is selected
Local Selected	14	Indicates that local is selected
Remote Selected	15	Indicates that remote is selected
Control Alarm	1B	Indicates that there is a control alarm
ESD Active	12	Indicates that an ESD signal is present
Open Interlock	0F	Indicates that the open interlock is present
Close Interlock	10	Indicates that the close interlock is present
Interlock	11	Indicates that an interlock is present
Thermal Trip	1A	Indicates that the units thermal trip in the motor has activated
Loss Phase	13	Indicates that a phase has been lost (only on three phase units)
24 V Fail	17	Indicates that the 24 V customer supply has failed

Parameters

7.2.9 Position Trip for indication Contacts S1 – S8 (Parameters 82-85 and 90-93)

These parameters select the position for the contact to trip at if the Intermediate position contact function has been selected (if available).

7.2.10 ESD Parameters (Parameter 97 - 101)

The ESD signal is used to operate actuators to a pre-determined state, under shutdown conditions. There are a number of settings that can be made for this operation.

- **ESD direction (Parameter 97)** — This parameter sets the direction of operation in the event of an ESD signal being applied to the actuator.

- **Parameter ESD Contact (Parameter 98)** — This parameter sets the polarity of the ESD contact, either Normally Open or Normally Closed.

- **ESD Bypasses the actuator interlocks (Parameter 99)** — This parameter selects whether an ESD will override the interlock setting on the actuator.

- **ESD Bypasses the Thermostat trip (Parameter 100)** — This parameter selects whether an ESD will continue to operate in the event of a Thermostat trip.

- **ESD Bypasses Local Stop (Parameter 101)** — This parameter selects whether an active ESD will still operate the actuator even if it is in Local Stop.

7.2.11 Interlock enable (Parameter 102)

This parameter indicates if the interlocks are enabled or disabled on the actuator.

7.2.12 Open Limit position (Parameter 103)

The DTM decodes this parameter to show the number of turns that the actuator has been set to.

7.2.13 Interrupter Timer parameters (104 – 108)

The interrupter timer enables pulsed 'start / stop' operation as a response to local or remote control commands. This can be used to extend the valve stroke time. There are a number of parameters that can be set up for this.

- **Interrupter Timer start limit (Parameter 104)** — This parameter sets up the limit around which the interrupter timer will operate, whether the open or the closed limit.

- **Interrupter Timer off time (Parameter 105)** — This parameter sets up the time that the interrupter timer will stop the actuator for.

- **Interrupter Timer on time (Parameter 106)** — This parameter sets up the time that the interrupter timer will start and run the actuator.

- **Interrupter Timer activated when opening if below xx% (Parameter 107)** — This parameter sets the position that the interrupter timer start to be active when the actuator is travelling in the open direction.

- **Interrupter Timer activated when closing if above xx% (Parameter 108)** — This parameter sets the position that the interrupter timer start to be active when the actuator is travelling in the close direction.

7.2.14 Language used (Parameter 109)

This parameter indicates if the language used in the local actuator display is the Standard English language or an alternative one.

7.2.15 IDs and notes (Parameters 111 - 120)

The 'ID' parameters contain information about the serial numbers of the Printed circuits boards inside the actuator. The Manufacturing notes section contains details of the manufacture of the actuator i.e. wiring diagram.

The final section 'General notes' is available to be written to for any notes required.

8	SETTING UP AND MAINTAINING THE PROFIBUS MODULE

In most applications the majority of the default settings in the Profibus DP Module will be suitable for the operation of the valve and need not be altered. However, in every case it will be necessary to alter the address, since the default should never be used within a live system (the default value is 126).

8.1	Using a Network Configuration Tool

The Profibus DP Module caters for two configuration tools, FDT and PDM. Files for both tools are available for download from the Centork website.

8.1.1	FDT (Field Device Tool)

This utility uses DTM device description files and a suitable FDT container. A typical configuration screen is illustrated below.
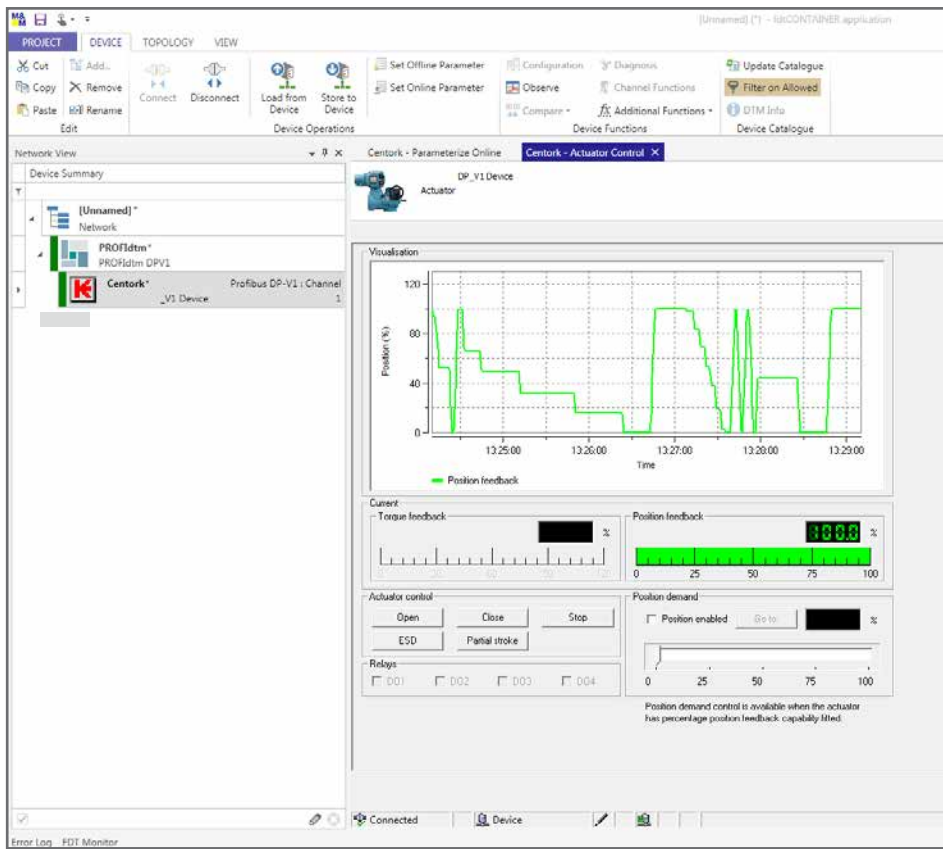

Fig 23: Centork DTM running in the M&M FDT container

The settings for the parameters and the control and review of actuator information can all be carried out in the FDT container using the DTM. The screens displayed will be dependent on the software version of the Profibus card and the actuator type.

8.1.2   PDM (Process Device Manager)

This utility uses EDD device description files and the PDM programme from Siemens. A typical configuration screen is illustrated below.

As with FDT, the parameters and the control and review of actuator information can all be carried out in PDM using the EDD device description file.
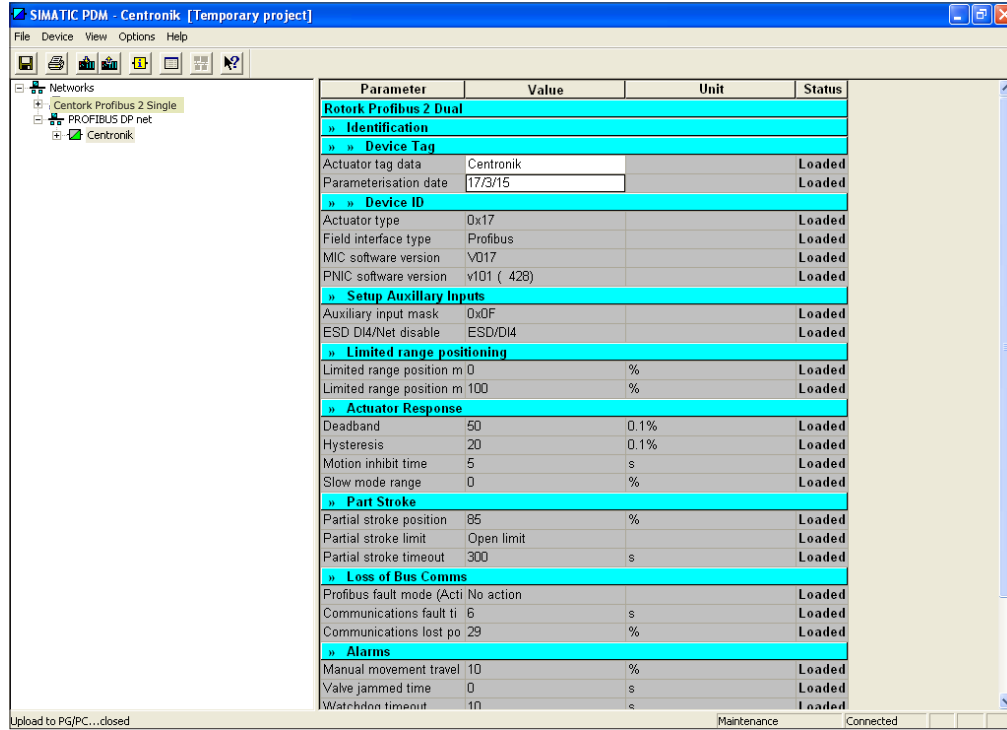

Fig 24: Centork EDD running in the Siemens PDM application.

Setting Up and Maintaining the Profibus® Module

8.2 Accent - Actuator Configuration Tool

This software can be used to configure and view the settings and configuration of the Centronik. It can be freely downloaded from the Centork website. It designed to be run from a Windows computer and connects to the actuator using *Bluetooth*. Please see the Centork technical manual for more details.
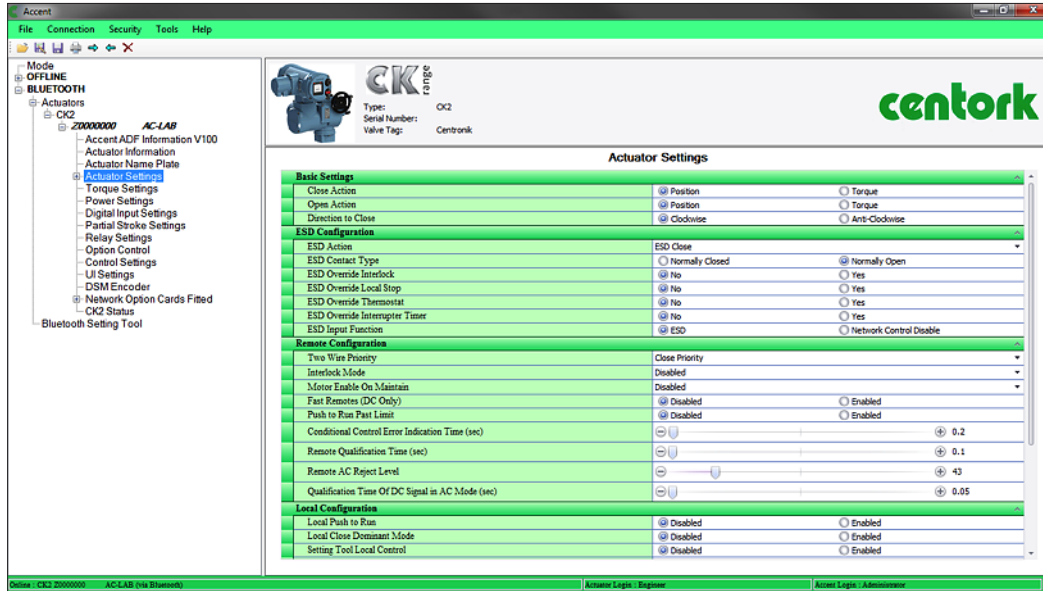

Fig 25: Accent Software; connected to a CK actuator using Bluetooth, viewing the actuators settings.

8.3 Setting up the network address in the PFU

The actuator includes an infra-red (and optional *Bluetooth*) communication port for setting the network address for the actuator using the supplied setting tool. The software Accent can also be used (requires *Bluetooth*). It can be set-up up over the Profibus network using a Class 2 master.

8.4 Setting up a Centronik with the Setting Tool

The actuator includes an infra-red (and optional *Bluetooth*) communication port for setting the actuator performance, limit switches and so on. This communication link can be used to set some, but not all, of the PFU parameters.

> **Unless parameter 25 (Permit GSD parameterisation) is set to '0', any modification from the GSD setting to the parameters listed in this section will be lost in the event of a power cycle or bus reset (if the actuator is connected to a master on the Profibus highway).**
>
> **This is because the master will write to the Profibus card with the settings that it has for that device in its configuration file, created from the GSD.**

Parameter updates should either be completed with an update to the GSD file OR if using the setting tool, parameter 25 must be set to '0'.

> **Parameters may only be altered by the IR/*Bluetooth* link if the actuator control knob is set to the Local or Local Stop position.**

Setting Up and Maintaining the Profibus® Module

The diagram illustrates the access route through the actuator menu screens to reach the settings that affect the PFU for the Centork unit.
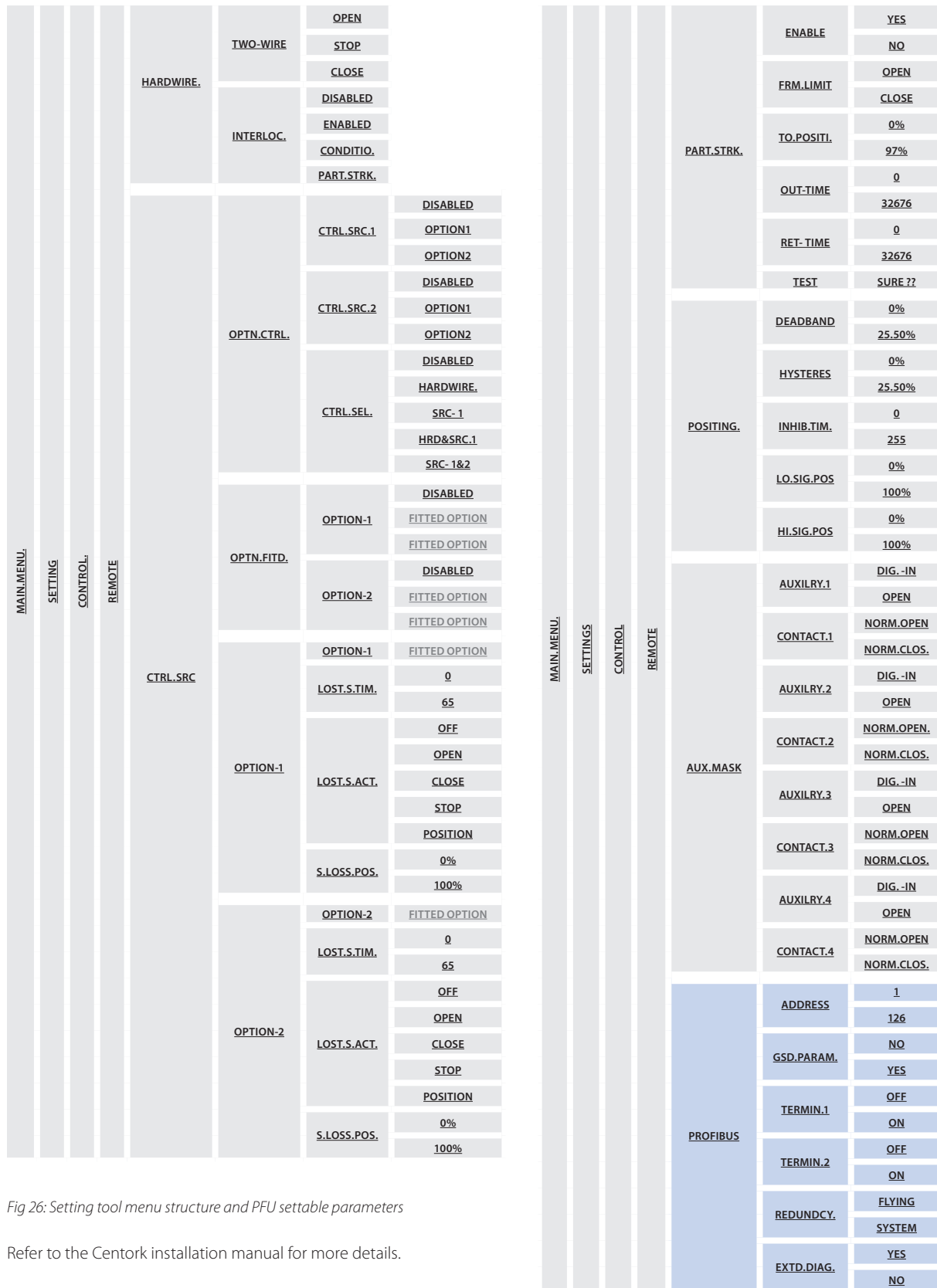

MAIN.MENU > SETTING > CONTROL > REMOTE

- **HARDWIRE.**
  - **TWO-WIRE:** OPEN, STOP, CLOSE
  - **INTERLOC.:** DISABLED, ENABLED, CONDITIO., PART.STRK.
- **CTRL.SRC**
  - **OPTN.CTRL.**
    - **CTRL.SRC.1:** DISABLED, OPTION1, OPTION2
    - **CTRL.SRC.2:** DISABLED, OPTION1, OPTION2
    - **CTRL.SEL.:** DISABLED, HARDWIRE., SRC- 1, HRD&SRC.1, SRC- 1&2
  - **OPTN.FITD.**
    - **OPTION-1:** DISABLED, FITTED OPTION, FITTED OPTION
    - **OPTION-2:** DISABLED, FITTED OPTION, FITTED OPTION
  - **OPTION-1**
    - **OPTION-1:** FITTED OPTION
    - **LOST.S.TIM.:** 0, 65
    - **LOST.S.ACT.:** OFF, OPEN, CLOSE, STOP, POSITION
    - **S.LOSS.POS.:** 0%, 100%
  - **OPTION-2**
    - **OPTION-2:** FITTED OPTION
    - **LOST.S.TIM.:** 0, 65
    - **LOST.S.ACT.:** OFF, OPEN, CLOSE, STOP, POSITION
    - **S.LOSS.POS.:** 0%, 100%

MAIN.MENU > SETTINGS > CONTROL > REMOTE

- **PART.STRK.**
  - **ENABLE:** YES, NO
  - **FRM.LIMIT:** OPEN, CLOSE
  - **TO.POSITI.:** 0%, 97%
  - **OUT-TIME:** 0, 32676
  - **RET- TIME:** 0, 32676
  - **TEST:** SURE ??
- **POSITING.**
  - **DEADBAND:** 0%, 25.50%
  - **HYSTERES:** 0%, 25.50%
  - **INHIB.TIM.:** 0, 255
  - **LO.SIG.POS:** 0%, 100%
  - **HI.SIG.POS:** 0%, 100%
- **AUX.MASK**
  - **AUXILRY.1:** DIG. -IN, OPEN
  - **CONTACT.1:** NORM.OPEN, NORM.CLOS.
  - **AUXILRY.2:** DIG. -IN, OPEN
  - **CONTACT.2:** NORM.OPEN., NORM.CLOS.
  - **AUXILRY.3:** DIG. -IN, OPEN
  - **CONTACT.3:** NORM.OPEN, NORM.CLOS.
  - **AUXILRY.4:** DIG. -IN, OPEN
  - **CONTACT.4:** NORM.OPEN, NORM.CLOS.
- **PROFIBUS**
  - **ADDRESS:** 1, 126
  - **GSD.PARAM.:** NO, YES
  - **TERMIN.1:** OFF, ON
  - **TERMIN.2:** OFF, ON
  - **REDUNDCY.:** FLYING, SYSTEM
  - **EXTD.DIAG.:** YES, NO

Fig 26: Setting tool menu structure and PFU settable parameters

Refer to the Centork installation manual for more details.

Setting Up and Maintaining the Profibus® Module

The actuator requires the remote source to be set up into the correct state otherwise the network will be unable to control the actuator, example below:
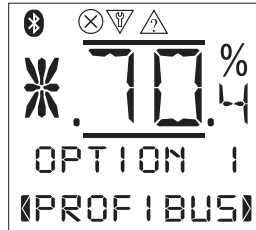
Refer to the installation manual of the actuator for more details and the table on the previous page for information on the menu layout.

8.6   Maintenance and Repair

There is no periodic service requirement for the PFU.

Repairs should not be attempted on the module. Replacing the PFU with a new replacement device should rectify any failure. Static sensitive devices are used in the PFU, it is therefore mandatory to observe anti-static precautions when handling or working on the unit.

8.7	Records

In order that a replacement can be easily introduced in the event of a device failure it is very important to record and keep safe all the settings made for the variable registers. The table lists all the registers that must be checked and set up for each Profibus Module on a network. The data should be recorded for each module.

> Make a note of all changes to register settings to ensure that, in the case of a failure, the replacement device can be swiftly set to the correct values.
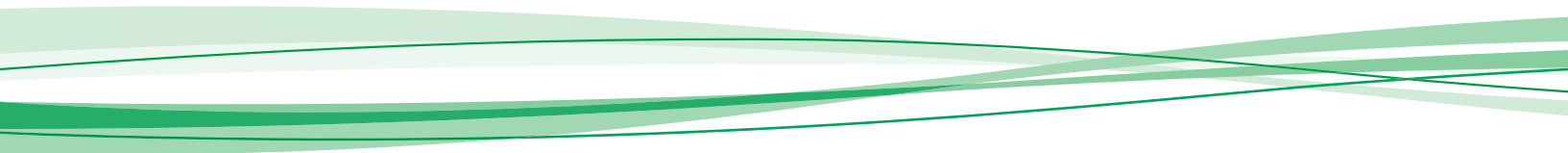
- **GSD accessed Parameters**

Device Address:			
Parameter No.	**Description**	**Setting**	**Notes**
1	Limited Range Position Minimum		
2	Limited Range Position Maximum		
3	Deadband		
4	Hysteresis		
6	Motion Inhibit Time		
7	Manual Movement Travel		
8	Valve Jammed Time		
9	Watchdog Timeout		
10	Action on Loss of Comms		
11	Comms Lost Position		
12	Comms Fault Timer		
13	Aux Input Mask		
14	ESD DI-4/Net Disable		
15	FR/SR mode and Simple/RedCom redundancy		
16	Part Stroke position		
17	Part Stroke Limit and timeout		
18	Actuator Type		

- **Acyclic Communications accessed Parameters**

Parameter No.	**Description**	**Setting**	**Notes**
20	Actuator Tag data		
25	Permit GSD Parameterisation		

Notes

Notes

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