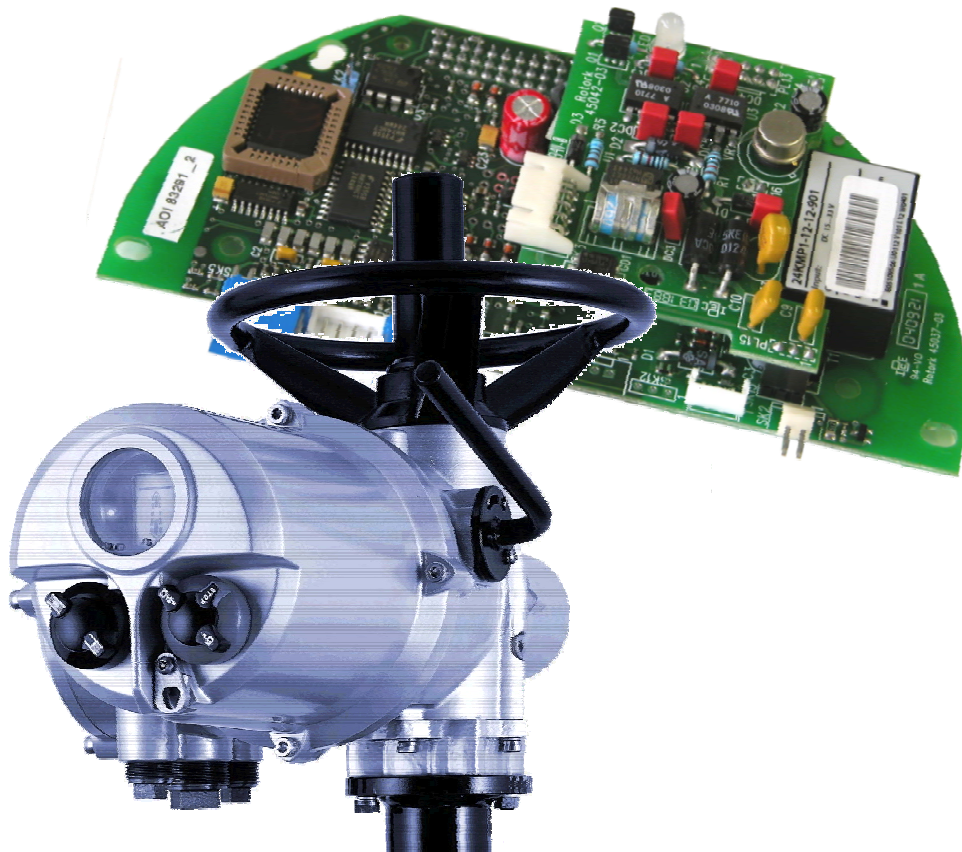


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DeviceNet



DeviceNet Actuator Control DFU Option Card Installation Manual

Publication S180E V1.2

Issue 04/04

Note 1:

Throughout this manual the DeviceNet DFU may simply be referred to as the module.

Note 2:

The information in this manual relates to the following firmware release
EDS file version V1.05
EPROM version K109

Note 3:

The DeviceNet DFU module described in this manual is suitable for inclusion in Rotork IQ Mk2, IQT and Q range actuators.

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

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Glossary of Terms:

Controller Area Network	Generic name for DeviceNet, CAN forms the basis for DeviceNet communications
Electronic Data Sheet (EDS)	A file that provides information to a DeviceNet configuration tool to allow the variable parameters in the DFU to be set up and specifies the number of data bits exchanged between the DFU and the master
Fieldbus	The digital, two-way, multi-drop communication links.
Field Unit	The DeviceNet DFU 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
MAC ID	The unique address for a node on the fieldbus, range 0-63.
Master/Slave	The method of communication used by the DFU. The fieldbus requires a master scanner to control the data exchange on the highway.
Node	A single device on the fieldbus
Scanner	A DeviceNet component that controls the movement of messages on the fieldbus.
Segment	A section of a DeviceNet fieldbus that is terminated in its characteristic impedance. Each Segment can include up to 64 devices.

Abbreviations:

CAN	Controller Area Network, a type of bus system
Comms	Communications
DFU	DeviceNet Field Unit
MAC ID	Media Access Controller Identifier
ODVA	Open DeviceNet Vendor Association
RAM	Random Access Memory
ROM	Read Only Memory
SW	Software



Open *DeviceNet*. Vendor Association, Inc.

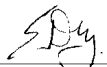
Declaration of DeviceNet Conformance

The following product has passed the ODVA DeviceNet Conformance test at the DeviceNet Europe Technical Support Centre test laboratory and is declared to be conformant to the composite test revision indicated. Family approval may be granted in accordance with the ODVA Conformance Policy. If family approval is requested, tested family members are listed on the first page with qualifying untested products listed on the attachment.

Test Date: 20/11/01 Composite Test Revision: A16

Vendor ID: 659
 Vendor Name: Rotork Controls Ltd
 Vendor Address: Brassmill Lane
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UK

Product Name(s) (Device actually tested)	Electric Actuator
Product Code(s)	208
Product Revision	1
Device Type Code	00
Device Profile Name	Generic
Electronic Data Sheet Revision	1.02

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1 INTRODUCTION

The Rotork DeviceNet Actuator Control option card (DFU) conforms to the ODVA standard, release 2.0, 30th June 1998. It is suitable for use on a DeviceNet fieldbus and uses the standard 5 connections to the fieldbus, two wires for connection to the data highway and two wires for connection to the DC power lines of the highway, plus a screen connection. It is necessary to have a suitable power supply and termination on the highway for the DFU to function correctly, though the DFU card draws very little DC power from the power bus.

The current version of the DFU assembly may be fitted into the IQ, IQT or Q range of actuators, including modulating versions. The DFU is an integral part of the actuator in which it is housed. The module is fitted within the main double sealed electrical housing. This electrical housing need never be opened once the actuator leaves the assembly plant. All adjustments to the settings for the DFU may be made via the DeviceNet data highway using a suitable network configuration tool. The IQ and IQT actuator also allows the primary settings to be adjusted via the infra-red programming link.

The DFU 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.

The DFU may command the actuator into which it is fitted to open, stop, close, perform an ESD operation or move to a set position. Commands to the module come from the network and will be generated in a master controller. The DFU operates in two communication modes, Polling and Master/Slave.

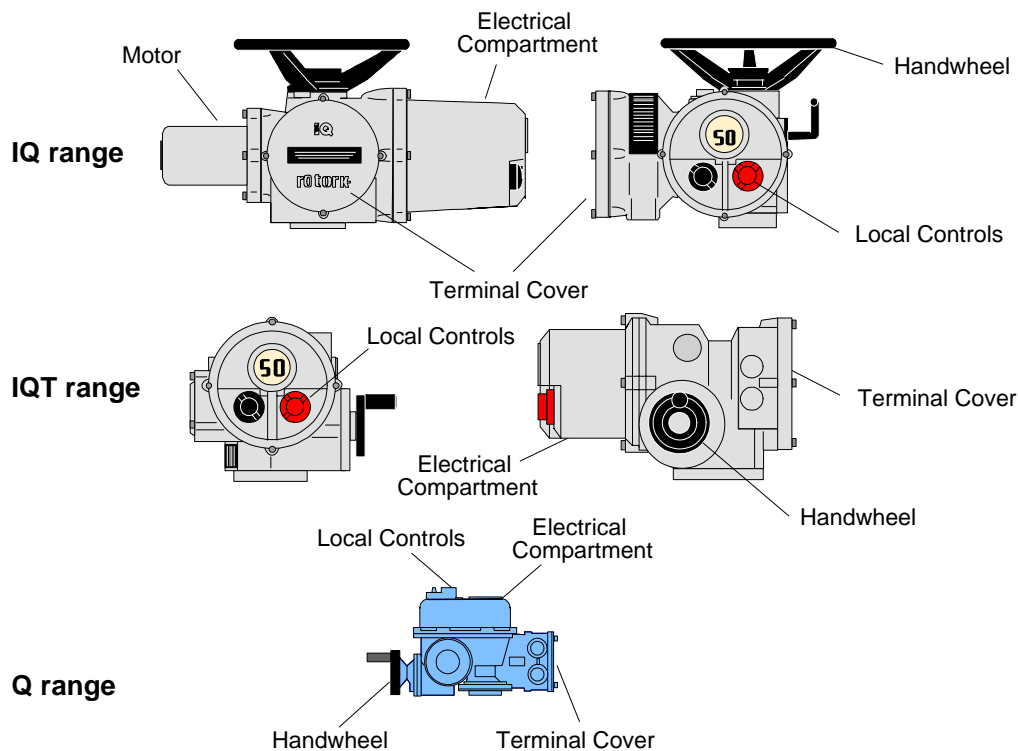


Fig 1: The DeviceNet Option Card Actuator Compatibility

Supporting Documents from the ODVA, Boca Raton, Florida, USA:

- ❑ Cable Installation Guide

1.1 General

The DFU has the following characteristics –

Device Type	Generic
Group	Group 2 only slave device
Communication	Explicit and Polled I/O messaging of the predefined master/slave connection
Speed	500k, 250k, 125k baud (default 125kbaud)
MAC ID (address)	0-63, default 63
Output (to actuator)	4 bytes
Inputs (from actuator)	8 bytes

Bus Connection	Function
+V (Red)*	24V DC power supply
CAN_H (White)	Data High
Screen	Shield
CAN_L (Blue)	Data Low
-V (Black)*	0V DC power supply

**Note: The DFU is not operated from the bus power supply. The unit draws only 5 mA of current from the bus DC supply. The connection must be made for correct operation.*

2 DEVICENET OPTION CARD PROPERTIES

2.1 Mechanical properties

The DFU comprises two printed circuit boards connected together and the assembly is fitted inside the actuator electrical housing.

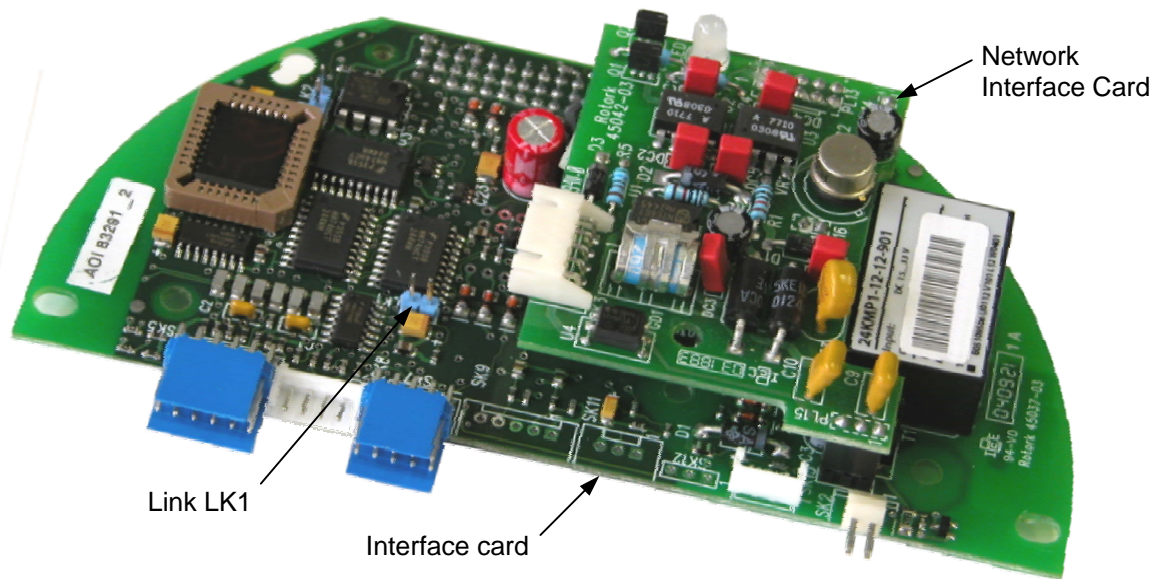


Fig 2: The DFU module showing the NIC and Interface card (IQ/IQT actuator)

- ❑ Network Interface Card - The small printed circuit board carries the DeviceNet highway connections and protection circuits.
- ❑ Interface Card The larger motherboard is profiled to suit the actuator into which it fits. The IQ actuator assembly is shown. It carries the processor, memory components and power supplies for the module.

The primary connection to the actuator circuits is by a multi-pin connector on the Main Card that, due to its physical shape, may only be fitted in the correct polarisation. Internal wiring harnesses connect to the Main Card for other signals and options within the actuator. The Network Interface Card carries the fieldbus connector, this couples to the wiring harness routed to the terminal compartment of the actuator. Power for the Network Interface Card is taken from the Interface Card and the whole assembly is powered from the actuator.

All the connectors are polarised to prevent incorrect insertion.

2.2 Electrical Properties

The DFU connects directly to the main board of the actuator. The DFU does not sit in the main control path for the actuator and does not affect the actuator control integrity.

An EPROM stored program controls the processor on the module, the software can be updated by replacing this chip.

The DeviceNet fieldbus data highway connection and power lines are fully isolated from the actuator electronics.

The DeviceNet fieldbus power supply must be connected to the actuator to maintain the data highway noise integrity and common mode voltage rejection capability.

2.3 Operation and Storage

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

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

3 FITTING THE DFU OPTION CARD

3.1 Inside an IQ and IQT actuator

The DFU is suitable for fitting into IQ Mk2 actuators with 3000 series wiring diagrams or IQT actuator with 6000 wiring diagrams. The DFU is normally located in the first option board slot inside the IQ/IQT electrical housing using connection SK1. The DFU does not have an assembly with a two sided connector and a second option board is not included in standard assemblies.

The Interface card must be correctly profiled and loaded with the appropriate connectors to match the IQ/IQT actuator. The illustration (Fig 3) shows the IQ/IQT version of the DFU.

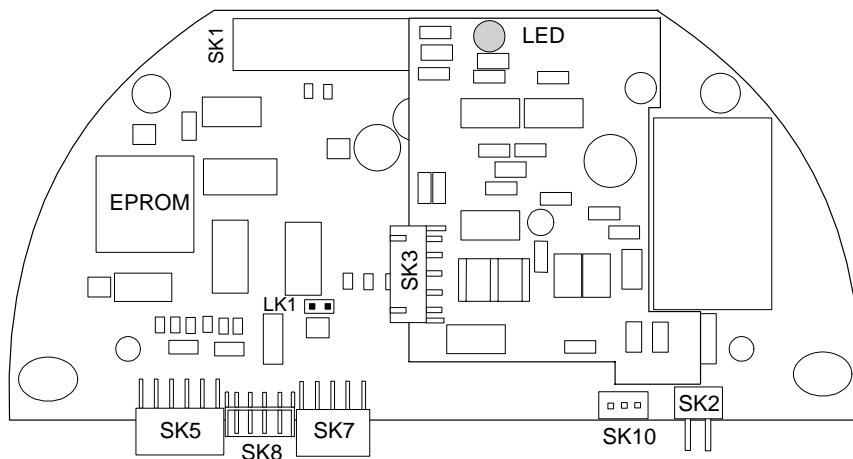


Fig 3: The DFU profiled for the IQ or IQT actuator

With the IQ/IQT actuator the remote inputs are always present (they are conditioned by the DFU) and there is an option to include Digital Outputs from relay contacts. If the DFU 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 IQ Mk2 and IQT actuator.

DFU Socket	Wiring Harness
SK2	24V power supply input from actuator
SK3	DeviceNet Fieldbus connection
SK5	Remote Digital Input connections
SK7	Digital Output connections*
SK8	Data Logger information (not used)
SK10	Analogue Input connection

* Note- Requires Extra Relay Indication board to be fitted

To restore the card to its default parameter settings, LK1 should be fitted and the power cycled. In normal operation LK1 should not be fitted.

3.2 Inside a Q actuator

The DFU is fitted in the option board position in this actuator. Only one option board may be fitted at any one time. The necessary internal components must also be present; in this case a potentiometer and auxiliary limit switches at end of travel must be fitted to the actuator.

The illustration (Fig 4) shows the Q version of the circuit board.

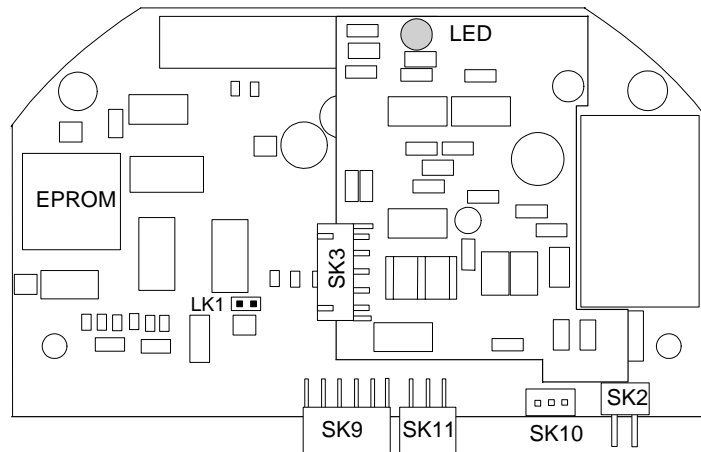


Fig 4: The DFU module profiled for the Q actuator

Digital Outputs from relay contacts are not supported from this actuator, nor is the ability to report the status of the remote control inputs as Digital Inputs. The following table shows the wiring harnesses that must be fitted and the function of each loom for this type of actuator.

DFU Socket	Wiring Harness
SK2	24V power supply input from actuator
SK3	DeviceNet Fieldbus connection
SK9	Limit switches
SK10	Analogue Input connection
SK11	Potentiometer

In addition, in a Q actuator there is a direct connection from PL2 on the DeviceNet module to SK5 of the actuator main board.

To restore the card to its default parameter settings, LK1 should be fitted and the power cycled. In normal operation LK1 should not be fitted.

3.3 Replacing or Fitting a DFU Option Card

The DFU should be replaced or fitted only in a suitable environment. The actuator must be made electrically safe before opening any covers and in the case of an IQ or IQT it is advisable to disconnect the internal battery. The electrical housing cover should be removed and the existing DFU carefully unplugged from its main connector. 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 DFU 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 DFU. Once the looms are in place connect them to the DFU, then fit the DFU to the actuator main board connector.

Once the DFU is fitted the actuator should be re-assembled and, in the case of the IQ or IQT, the battery replaced.

The DFU must not be split between the Network Interface Card and the Interface card. Only complete assemblies should be fitted or exchanged.

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4 DEVICENET DATA HIGHWAY AND CONNECTIONS

4.1 Data Highway

The DeviceNet network is based on the CAN bus system. The network carries the power and signal wires, together with a shield, to each node on the network. In the case of the DFU the device is not powered from the bus and draws minimal power from the network although the connection must be made to ensure the correct reference levels for the data signals. Two wires are used for the data highway (CAN_H and CAN_L) and two wires carry the 24V dc power. The DFU is powered from the actuator itself and the assembly can only report data when the actuator is powered up.

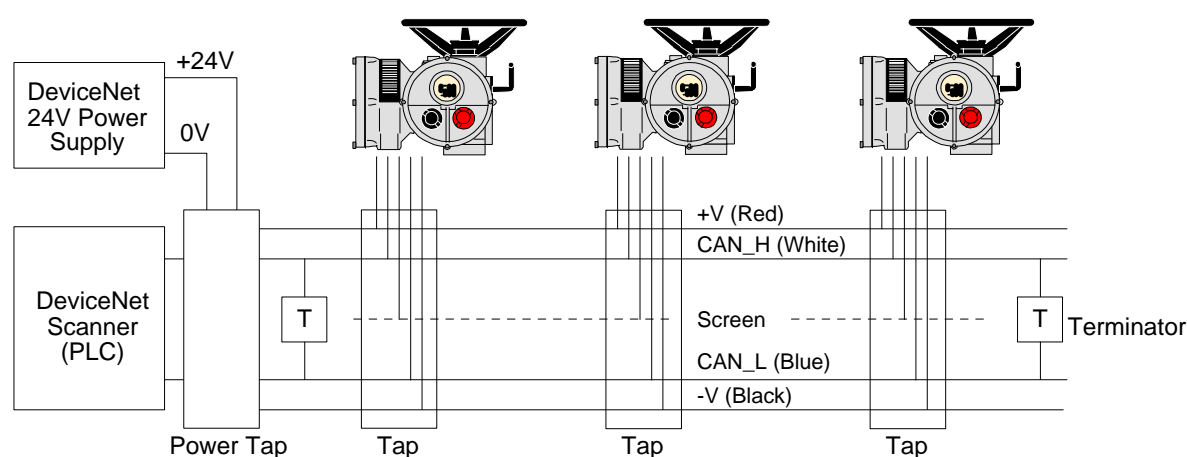


Fig 5: Typical DeviceNet Data Highway

The data highway must be terminated with proper balancing devices at either end. The highway itself can use tapped spur or stub connections to the actuators but it is recommended to keep any stub lengths to a minimum for successful operation. Alternatively the connection can be made in and out of each actuator in a daisy chain arrangement. The length of the highway and number of devices connected will vary from project to project. The standard permits up to 64 (address 0-63) devices to be connected, though address 63 is best not used in a live system as this is the standard default address.

The length of the highway will determine the maximum speed for the data transmission. The greatest length obtainable is achieved using 'flat' cable, but this is not very practical for actuator wiring. Most systems will use round 'thick' cable where a distance of 500 metres can be achieved. With this cable and speed the maximum drop length for a spur is 6 metres, with a cumulative total that must not exceed 156 metres. With the smaller cross section round 'thin' cable the distance reduces to 100 metres.

Each network will require a suitable DeviceNet power supply. Although virtually no power is drawn from this supply by the Rotork actuator or the DFU it has to be connected to ensure that the common mode voltage level between the different site locations remains within the maximum permitted by DeviceNet. The -V line (0V) is used as the system reference.

4.2 Highway Topography

A variety of different connection topologies can be used for DeviceNet. The basic system is a trunk line with various drop lines from it. This system will require the location of the taps in junction boxes near to the actuators. Alternately the actuators can be directly connected to the trunk line in a daisy chain, or a drop line can daisy chain a number of actuators together. All the configurations require the cumulative total of the drop lines and stub lines to be kept within the permitted maximum for the network speed to be used.

It is good practice to avoid drop lines wherever possible.

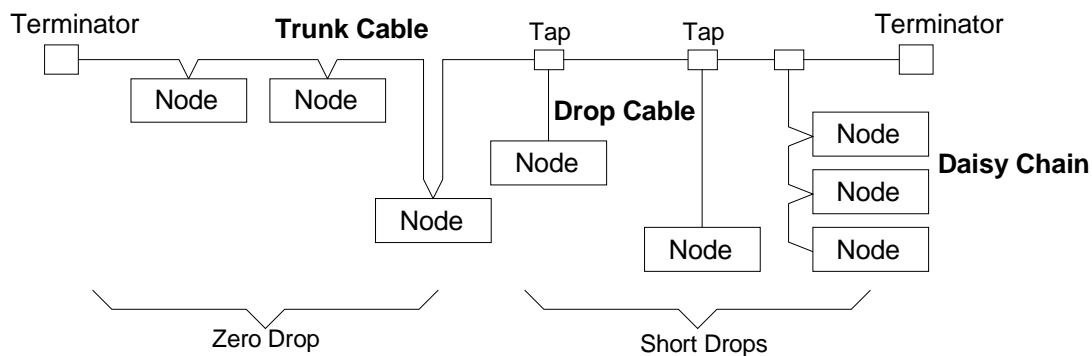


Fig 6: DeviceNet Data Highway Topology

Connections onto the trunk line are made using 'taps' that are designed to minimise the possibility of connection errors. Where a power supply is to be connected then a power tap should be used as this includes a fuse and protection circuit.

The maximum length of each drop line and the cumulative total are dependent on the system speed in use. The table below gives the maximum figures for each cable type.

Data Rates	125 kbaud	250 kbaud	500 kbaud
Trunk Length (Thick)	500 metres	250 metres	100 metres
Trunk Length (Thin)	100 metres	100 metres	100 metres
Trunk Length (Flat)	380 metres	200 metres	75 metres
Max Drop Length	6 metres	6 metres	6 metres
Cumulative Drop	156 metres	78 metres	39 metres
Number of Nodes	64	64	64
(Note that each actuator includes up to 0.67 metres of Drop length)			

Within each actuator there is a short drop line or stub connection wire from the terminals to the DFU itself. This length must be included in any calculation for total and individual drop lengths.

Actuator Type	IQ/IQT	Q
Internal Drop length (metres)	0.67	0.3

4.3 DeviceNet Cable

The network must be connected using a suitable cable. Four conductors plus a shield and drain wire are required for the 5 connections to the devices. There are thick and thin round cables and also a special flat cable. In general the thick round cable will be most suited for actuator wiring.

Amongst the cable manufacturers Belden have the PVC jacketed 3082A round thick cable which provides a typical example of the cable requirements. Information on the Belden cable may be found on the Belden web site (www.belden.com) or at <http://bwcecom.belden.com/>, where a search on DeviceNet will reveal technical papers and cable information.



Belden Part No.	AWG (stranding) dia. Inches Nom. DCR	Insulation material (colour code)	Nominal O.D.	Nom Impedance (ohms)	Nominal Capacitance	Test Frequency (MHz)	Maximum Attenuation dB/100ft
3082A	2 – 15 AWG (19 x 27) .067 tinned copper 11.8 ohm/km'	Power pair PVC/Nylon (Black/red)	12.2 mm	120	12.0 pF/ft	0.125 0.5 1	0.13 0.25 1.36
	2 – 18 AWG (19 x 30) .046 tinned copper 22.7 ohm/km	Data pair Cellular PE (blue/white)					

Fig 7: Typical DeviceNet cable

The cable is colour coded to help reduce installation errors. It is important to ensure that the correct colour sequence is used as all DeviceNet systems use the same colours. The terminals to which the wires connect in the each actuator type will be different and the actuator wiring diagram must be consulted to establish the connections.

The standard colour codes are indicated in the table.

Sleeve Colour	Function	Usage
Red	V+(24VDC)	Power
White	CAN_H	Data Signal
Bare	Drain	Shield
Blue	CAN_L	Data Signal
Black	V- (0VDC)	Power

4.4 Termination Network

In order to operate correctly all DeviceNet highways must be terminated at each end of the main trunk line using a 120 ohm resistor. These will usually be near the scanner PLC and near the furthest actuator. The resistors are connected across the CAN_H and CAN_L data lines. If the termination resistors are not fitted there is a possibility that the network communications will be unsatisfactory.

There are no termination facilities inside the actuator itself.

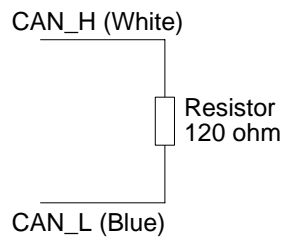


Fig 8: Termination for DeviceNet highway

4.5 Cumulative Volt Drop

To preserve the common mode noise immunity margins for the DeviceNet communications it is necessary to ensure that the volt drop between any two points on the V- conductor does not exceed 5V. The voltage drop that does occur will be due to the resistance of the conductor (ohms) multiplied by the current carried (in amps).

The current drawn by the DFU is minimal since the DeviceNet power supply is not used to power the module. The small current is drawn by the internal connection protection circuit that shuts down the DFU if the 24V power is applied incorrectly (the wrong way round).

The current drawn by the DFU varies with the applied voltage and is as follows:

Power Supply Voltage	Current Drawn (mA)
25	5 mA
24	5 mA
20	4 mA
15	3 mA
11	2 mA

5 THE ACTUATOR INPUT AND OUTPUT SIGNALS

The DFU is a Generic Device Type as defined by the ODVA since it does not fit into any predefined device types. It uses only one instance of the input and output assemblies within the device in order to simplify its use and application on a DeviceNet system.

In order to make proper use of the DFU it is necessary to set all the variable parameters to suitable values for the individual valve on which the actuator is mounted and the duty for which the actuator is intended. The setting of these parameters will require a suitable configuration tool and the installation of the Rotork EDS file for use by the configuration tool. An explanation of the EDS file and the adjustable parameters follows later in this manual.

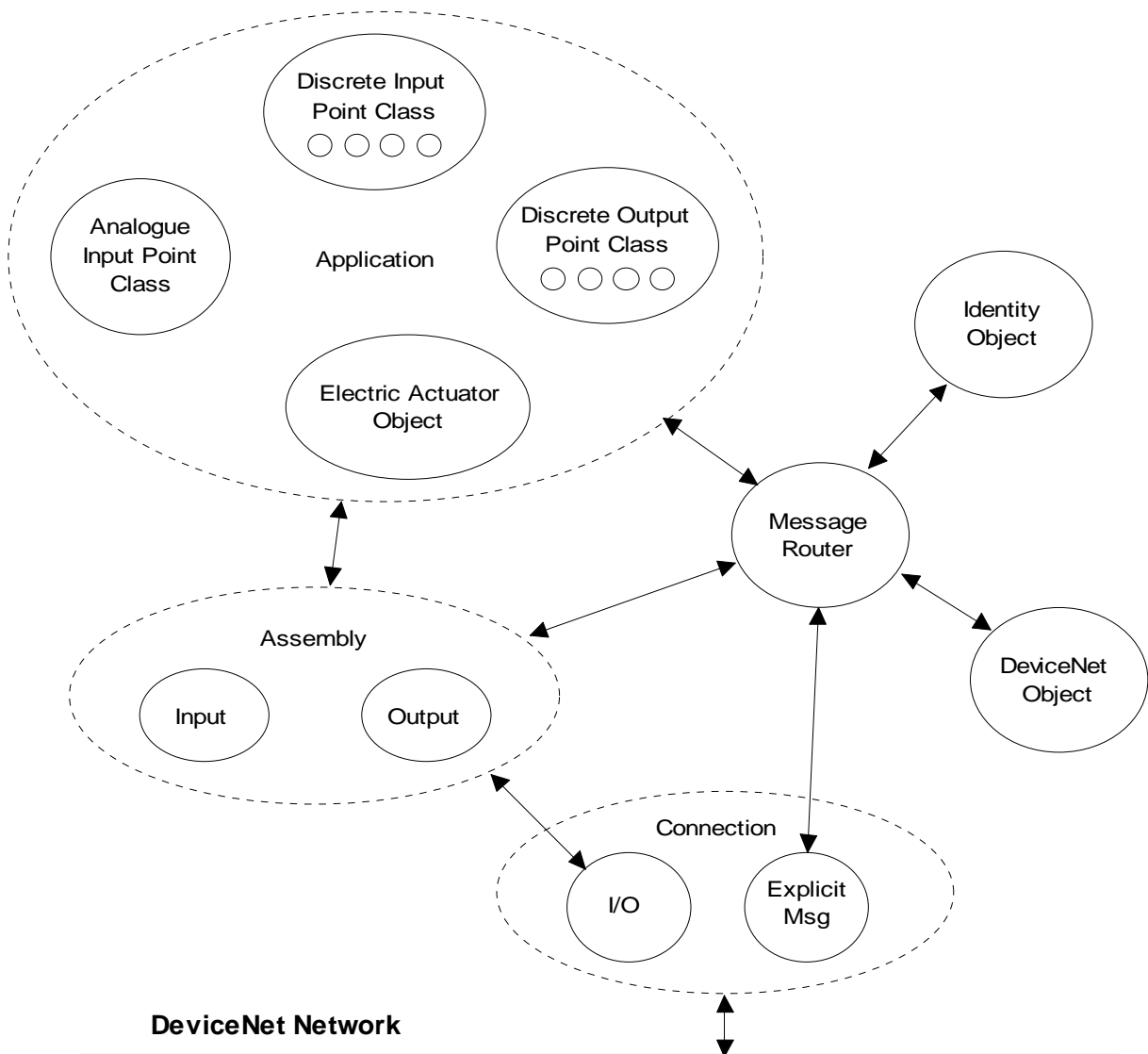


Fig 9: Actuator Object Model

5.1 Input/Output Assembly Instance

The DFU supports inputs and outputs via polled I/O connection through the Assembly Object as illustrated in the Object Model. There is only one input assembly instance and one output assembly instance for the DFU.

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

On the communication link, 4 bytes are used for the output data to the actuator and 8 bytes for the feedback data during polling.

5.1.1 Output Assembly Instance

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Reserved	Reserved	Reserved	Position Enable	ESD	Run Open	Run Closed	Stop
1	Reserved	Reserved	Reserved	Reserved	DO-4	DO-3	DO-2	DO-1
2	Lower 8 bits Position DV							
3	Reserved						Upper 2 bits Position DV	

5.1.2 Input Assembly Instance

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Local Selected	Local Stop Selected	Remote Selected	Running Open	Running Closed	Open Limit	Close Limit	Actuator Moving
1	Watchdog Recovery	Position Control Enabled	Moving Inhibited	Valve Moving by Hand	Valve Jammed	Valve Obstructed	Monitor Relay	Thermostat Tripped
2	Slow Mode	DI-4	DI-3	DI-2	DI-1	Close Interlock	Open Interlock	Battery Low
3	8 bits Torque							
4	Lower 8 bits Position MV							
5	Reserved						Upper 2 bits Position MV	
6	Lower 8 bits Analogue Input							
7	Reserved						Upper 2 bits Analogue Input	

5.2 Control Outputs

The DFU may be used to control the actuator and position the valve. The valve may be moved fully closed, fully open or to an intermediate position. Additionally the actuator can make the valve adopt an Emergency Shut Down position. The actuator may also be operated from its local controls or by hard wired direct contact inputs (in the case of the IQ and IQT the Auxiliary Input Mask must be correctly set).

As well as controlling the actuator the DFU can also be used to operate 4 discrete output relays when fitted to an IQ/IQT actuator.

The control commands have three potential sources:

- DeviceNet generated commands
- Actuator Local Controls
- Direct contact input controls

The full list of commands applicable to each actuator type is shown in the table.

Command	IQ actuator	IQT actuator	Q actuator
DeviceNet Network			
Open	✓	✓	✓
Close	✓	✓	✓
Stop	✓	✓	✓
Emergency Shut Down	✓	✓	✓
Position Enable	✓	✓	✓
Relay output DO-1	✓ ^①	✓ ^①	✗
Relay output DO-2	✓ ^①	✓ ^①	✗
Relay output DO-3	✓ ^①	✓ ^①	✗
Relay output DO-4	✓ ^①	✓ ^①	✗
Analogue Position demand	✓	✓	✓
Local Controls			
Open	✓	✓	✓
Close	✓	✓	✓
Stop	✓	✓	✓
Direct Wired Inputs			
Open	✓	✓	✓ ^②
Close	✓	✓	✓ ^②
Stop/Maintain	✓	✓	✗ ^②
Emergency Shut Down	✓	✓	✓ ^②
Open Interlock (active prevents opening)	✓	✗	✗
Close Interlock (active prevents closing)	✓	✗	✗

Note: ① – Requires Extra Relay Indication board to be fitted

② – Push to Run action only. Maintained action not available if analogue positioning is used

The DeviceNet network commands will operate the actuator provided -

- the Local/Local Stop/Remote selector is in 'Remote',
- the DeviceNet commands are not inhibited by the 'Inhibit/DI4' input parameter setting and DI4 condition
- for IQ and IQT actuators there is no interlock active.
- there is no standing hard wired control input active (see priorities 5.2.1)
- 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.

Note: *Many IQ 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 dependant on the type of valve. The IQT, and Q normally operate 90-degree valves, use stop bolts on the actuator or gearbox, and stop when these are reached. 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.
- Position Enable** A digital command that enables the actuator to obey the position demand setpoint (DV).
- Relay Output DO1 to DO4** These 4 commands are used to energise and de-energise the internal relays on the additional relay board in an IQ or IQT actuator. (These outputs are referred to as S5-S8 in the standard actuator documentation when there is no DFU in the actuator.) The resulting outputs can be used for operating other equipment such as a pump or indication light. The IQ/IQT actuator is not able to control these relays directly from the main board when the DFU is fitted. They will maintain their last state if power is removed from the actuator.
- Analogue Position** This function is only available over the DeviceNet network. To initiate Analogue Position Control the Position Enable bit must be set and the appropriate value placed in the Position DV register (range 0-100.0%, resolution 0.1%), the valve will open to the appropriate

5.2.3 The IQ 'S' contacts (DeviceNet DO's).

The IQ/IQT 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 additional relay board can be fitted with four more relays. The status of these relays is then adjusted by DeviceNet commands on outputs DO-1 to DO-4. Note that these relays are latching and, if energised, will not change state when the actuator power is removed.

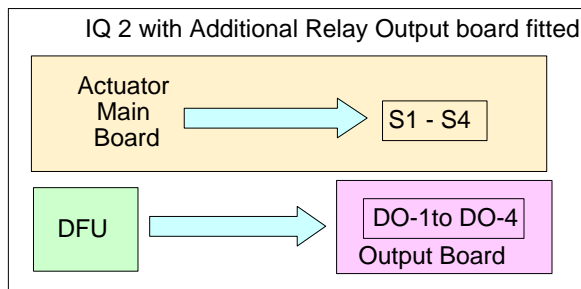


Fig 12: IQ/IQT relay outputs DO-1 to DO-4

5.2.4 IQ DeviceNet Control Disable feature

It is possible to set the IQ or IQT ESD/DI-4 input so that the IQ/IQT actuator ignores open, stop, close and position control signals sent over the DeviceNet. If the ESD DI4 / Net Disable parameter is set to Active (i.e. 24 volts applied to ESD) then when the ESD input is connected to made, DeviceNet control is not allowed. This feature is independent of the Auxiliary mask setting.

Note: *An ESD signal sent over the DeviceNet will operate the actuator even when this feature is set to disable DeviceNet control.*

5.3 Actuator Digital Input Status Feedback

The DFU module reports over the network a comprehensive data set relating to the status of the valve and actuator as indicated in the table below. This information is contained within the 8 byte return message in routine polling mode. The conventional contact indications are also available from the actuator limit switches and indication contacts.

Status Feedback	IQ actuator	IQT actuator	Q actuator	Location
Actuator Moving	✓	✓	✓	Byte 0 Bit 0
Close Limit	✓	✓	✓	Byte 0 Bit 1
Open Limit	✓	✓	✓	Byte 0 Bit 2
Running Closed	✓	✓	✓	Byte 0 Bit 3
Running Open	✓	✓	✓	Byte 0 Bit 4
Remote selected	✓	✓	✓	Byte 0 Bit 5
Local Stop selected	✓	✓	✓	Byte 0 Bit 6
Local selected	✓	✓	✓	Byte 0 Bit 7
Thermostat Tripped	✓	✓	✓	Byte 1 Bit 0
Monitor Relay	✓	✓	✓	Byte 1 Bit 1
Valve Obstructed	✓	✓	✓	Byte 1 Bit 2
Valve Jammed	✓	✓	✓	Byte 1 Bit 3
Valve Moving by Hand	✓	✓	✓	Byte 1 Bit 4
Moving Inhibited	✓	✓	✓	Byte 1 Bit 5
Position Control Enabled	✓	✓	✓	Byte 1 Bit 6
Watchdog Recovery	✓	✓	✓	Byte 1 Bit 7
Battery Low	✓	✓	✗	Byte 2 Bit 0
Open Interlock input	✓	✓	✗	Byte 2 Bit 1
Close Interlock input	✓	✓	✗	Byte 2 Bit 2
DI -1	✓	✓	✗	Byte 2 Bit 3
DI -2	✓	✓	✗	Byte 2 Bit 4
DI -3	✓	✓	✗	Byte 2 Bit 5
DI -4	✓	✓	✗	Byte 2 Bit 6
Slow Mode	Note 1	✓	Note 1	Byte 2 Bit 7

Note1. This bit is reported when within the slow mode band, but does not affect the actuator.

5.3.1 Digital Inputs from All Actuator Types

- Actuator Moving** Reported in Byte 0 Bit 0, whenever the actuator position is changing due to the motor running or in the case of the IQ or IQT if the centre column is moving, this bit will be set true (1).
- Close Limit** Reported in Byte 0 Bit 1, 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** Reported in Byte 0 Bit 2, 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** Reported in Byte 0 Bit 3. Whenever the actuator motor contactor used to drive the actuator in the closing direction is energised this bit will be true (1).
- Running Open** Reported in Byte 0 Bit 4. Whenever the actuator motor contactor used to drive the actuator in the opening direction is energised this bit will be true (1).
- Remote Selected** Reported in Byte 0 Bit 5, 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 DeviceNet control to be permitted.
- Local Stop** Reported in Byte 0 Bit 6. 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** Reported in Byte 0 Bit 7, 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** Reported in Byte 1 Bit 0. 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, 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** Reported in Byte 1 Bit 1. This signal is true (1) when actuator control is not available. The actuator Monitor Relay status is a composite signal for a number of 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 the monitor relay 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** Reported in Byte 1 Bit 2. This bit will be true (1) if the actuator stops in mid travel, following a command, when not expected to do so. 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 setpoint position. The bit will remain true (1) until the actuator position changes by 2% or more.

Note: *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** Reported in Byte 1 Bit 3. 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 DFU fails to see movement and reports this status after the time set in the associated parameter during the DFU set up. The bit will remain true (1) until the actuator position changes by 2% or more.

Note: *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.*

- Valve Moving by Hand** Reported in Byte 1 Bit 4. 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 DFU 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** Reported in Byte 1 Bit 5. This bit will be true (1) when the Motion Inhibit Timer is active or the Interrupter Timer is active (IQ/IQT only), 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 in the IQ/IQT can be used over part or all of the 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 action will continue once the time has elapsed.

- Position Control Enabled** Reported in Byte 1 Bit 6. This bit will be true (1) when the control command for Position Enable is true. This data can be used to indicate that positioning mode is likely to take control of the actuator.
- Watchdog Recovery** Reported in Byte 1 Bit 7. The DFU watchdog automatically resets the processor if it is tripped. The processor is also reset by a MAC ID address change, and this also trips the watchdog. This bit will be true (1) following a watchdog trip for the time period set in the associated watchdog timeout parameter.

5.3.2 Digital Inputs from IQ and IQT Actuator

- Battery Low** Reported in Byte 2 Bit 0, applicable to IQ and IQT actuators only. The status of the internal battery is monitored and should it fall below a critical level this signal will become true (1). The battery is used to power the circuits used to keep track of the valve position when the actuator mains power is switched off. This battery is used only when the actuator has no power feed and the valve is actually moved.
- Open Interlock** Reported in Byte 2 Bit 1, applicable to IQ and IQT actuators only. The input contact to the Open Interlock is monitored by the DFU. 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 this bit will indicate the existence of an interlocking input that can prevent the actuator from opening.
- Close Interlock** Reported in Byte 2 Bit 2, applicable to IQ and IQT actuators only. The input contact to the Close Interlock is monitored by the DFU. 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 this bit will indicate the existence of an interlocking input that can prevent the actuator from closing.
- Digital Input DI-1** Reported in Byte 2 Bit 3, applicable to IQ and IQT actuators only. 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** Reported in Byte 2 Bit 4, applicable to IQ and IQT actuators only. 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** Reported in Byte 2 Bit 5, applicable to IQ and IQT actuators only. 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** Reported in Byte 2 Bit 6, applicable to IQ and IQT actuators only. 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 Fieldbus Control' input. In this mode when the input is made (irrespective of the Auxiliary Mask setting) the actuator cannot be controlled over the DeviceNet. This can be useful during plant commissioning to prevent unwanted valve movement.

5.3.3 Digital Inputs from IQT Actuator

- ❑ **Slow Mode** Reported in Byte 2 Bit 7, applicable to IQT actuators only. In positioning mode, when the IQT actuator approaches its setpoint the motor automatically switches to 'slow mode' and the actuator runs at a lower speed. This allows any developed inertia to be dissipated and a better positional accuracy to be achieved without overshoot. The deviation from the setpoint at which slow mode is adopted is set in the associated parameter.
When slow mode is in use this bit will be true (1).
The IQ and Q actuators also report this bit, but these actuators do not have a slow mode capability.

5.4 Actuator Analogue Input Feedback

The DFU module reports over the network a number of analogue variables. These contain information about the valve and actuator as well as one associated plant measurement. This information is contained within the 8 byte return message in routine polling mode.

Analogue Feedback	IQ actuator	IQT actuator	Q actuator	Location
Actuator Instantaneous Torque	✓	✓	✗	Byte 3
Valve Position	✓	✓	✓	Byte 4 and 5
Analogue Input	✓	✓	✓	Byte 6 and 7

- Torque** Reported in Byte 3, applicable to IQ and IQT actuator only. The currently developed torque value is reported as an Integer Value in the range 0 to 120 (0-78 hex) representing the percentage of actuator rated torque generated.
- Valve Position** Reported in Byte 4 and Byte 5. The current valve position is reported as an Integer Value in the range 0 to 1000 (0 – 3E8 hex) representing the percentage position to 0.1% resolution. Byte 4 contains the low order 8 bits and byte 5 the high order 2 bits of the 10 bit number. The IQ/IQT actuator automatically scales the valve position value reported from the setting of the limit switches. The Q actuator needs the valve to be stroked fully between the open and close limit switches for the value to be automatically scaled. This scaling is retained in EEPROM when the actuator power is removed. If Limited Range Positioning is invoked by setting the appropriate parameters, then the reported valve position 0 to 100% follows the limited range of valve travel.
- Analogue Input** Reported in Byte 6 and Byte 7. The current value of the analogue input is reported as an Integer Value in the range 0 to 1000 (0 – 3E8 hex) representing the percentage value to 0.1% resolution. Byte 6 contains the low order 8 bits and byte 7 the high order 2 bits of the 10 bit number. The input may be 0 to 5V or 0 to 20mA d.c. from an externally powered field transmitter (the actuator does not provide the power for the transmitter). The input must be calibrated during the set up of the DFU using the Analogue Input Max parameter. Apply a 100% signal and access the parameter, the current value will then be reported as 100%. The scaling is retained in EEPROM when the actuator power is removed.

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6 EDS PARAMETERS

In order to make the best use of the DFU the module has a number of configurable parameters that may be adjusted to optimise the performance of the actuator. All the parameters have factory default setting designed to meet the most common requirements for the actuator. If these are not suitable for a particular application then by using a DeviceNet configuration tool such as Rockwell's RSNetWorx(r) the values can be changed. The use of these tools requires the Electronic Data Sheet (EDS) file to be loaded so that the Rotork DFU is correctly identified. If you do not have the EDS file, it may be found on the Rotork web site at <http://www.rotork.com>.

The EDS file contains 56 parameters, with the IQ and IQT actuator some of these can be altered by using the infra-red communications link and the setting tool. By using a suitable configuration tool connected to the DeviceNet highway all the parameters may be reviewed and altered to suit the particular application for the actuator.

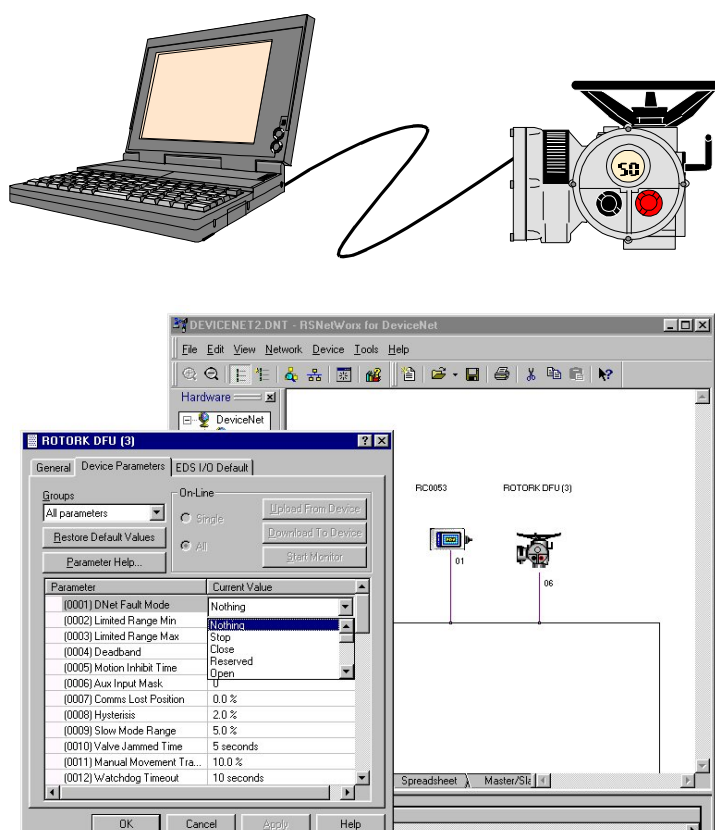


Fig 13: DeviceNet Configuration Tools

This section of the manual describes each variable parameter and should be used for reference when using the configuration tools. The following tables list the parameters.

Actuator Related Network Configurable Parameters

Param No.	Description	Range	Default Value
1	Dnet Fault Mode (Action on Loss of Comms)	Nothing (No Action), Stop, Close, Open, ESD, Position	Nothing
2	Limited Range Position Minimum	0 – 100%	0%
3	Limited Range Position Maximum	0 – 100%	100%
4	Deadband	0.0 - 25.0%*	5.0%
5	Motion Inhibit Time	0 – 255 sec	3 sec
6	Aux Input Mask	0 – 255 (00 - FF hex)	15 (0F)
7	Comms Lost Position	0.0 - 100.0%	0.0%
8	Hysteresis	0.0 - 25.0%	2.0%
9	Slow Mode Range	0.0 - 100.0%	5.0%
10	Valve Jammed Time	0 – 255 sec	5 sec
11	Manual Movement Travel	0.0 - 100.0%	10.0%
12	Watchdog Timeout	0 – 255 sec	10 sec
13	ESD DI4/Net Disable	ESD/DI4 or Disable	ESD/DI4
14	Analogue Input Max	0 – 1023	0
15	Comms Fault Timer	0 – 255 sec	10 sec

* IQ pr IQT Setting tool only allows 0.0 to 9.9% deadband to be set

DeviceNet Related Network Configurable Parameters

Param No.	Description	Range	Default Value
16	MAC ID (Address)	0 – 63	63
17	Baud Rate (kbaud)	125k, 250k, 500k	125k
54	Bus Off Interrupt	Disable/Enable	Disable
55*	Bus Off Counter	0 – 5	0
56*	ID Object Status	Data 0000 to FFFF	0

* Read only

Actuator Digital Control Related Parameters

Param No.	Description	Range	Default Value
18	Run Open command	0 – 1	0
19	Run Closed command	0 – 1	0
20	Stop command	0 – 1	0
21	ESD command	0 – 1	0

Actuator Status Related Parameters

Param No.	Description	Range	Default Value
22	Close Limit	0 - 1	0
23	Open Limit	0 - 1	0
24	Actuator Moving	0 - 1	0
25	Manual Movement	0 - 1	0
26	Thermostat Tripped	0 - 1	0
27	Local Select	0 - 1	0
28	Remote Select	0 - 1	0
29	Local Stop	0 - 1	0
30	Running Open	0 - 1	0
31	Running Closed	0 - 1	0
32	Valve Obstructed	0 - 1	0
33	Valve Jammed	0 - 1	0
34	Monitor Relay	0 - 1	0
35	Activate Slow Mode	0 - 1	0
36	Battery Low	0 - 1	0
37	Motion Inhibit	0 - 1	0
38	Watchdog Reset	0 - 1	0
39	Target Position	0.0 - 100.0%	0.0%
40	True Position	0.0 - 100.0%	0.0%
41	User Analogue Input	0.0 - 100.0%	0.0%
42	Position Mode	Digital/Position Mode	Digital
43	Torque	0 - 120%	0%

 Discrete I/O Related Parameters

Param No.	Description	Range	Default Value
44	DI-1 (Digital Input 1)	0 - 1	0
45	DI-2 (Digital Input 2)	0 - 1	0
46	DI-3 (Digital Input 3)	0 - 1	0
47	DI-4 (Digital Input 4)	0 - 1	0
48	OIL (Open Interlock)	0 - 1	0
49	CIL (Close Interlock)	0 - 1	0
50	DO-1 (Digital Output 1)	0 - 1	0
51	DO-2 (Digital Output 2)	0 - 1	0
52	DO-3 (Digital Output 3)	0 - 1	0
53	DO-4 (Digital Output 4)	0 - 1	0

6.1 Actuator Related Configurable Parameters

These parameters set up the response of the actuator will take to various control and network actions.

6.1.1 Dnet Fault Mode (Parameter 1)

This parameter is used in conjunction with parameter 7 and 15, plus the actuator ESD setting.

Dnet Fault Mode defines the actuator action that will result after the time set for the Comms Fault Timer (Parameter 15) if there is no network communication activity detected by the DFU.

The action may be

- Nothing** No action, actuator will complete any command in process (the default setting)
- Stop** The actuator stops
- Close** The actuator will close the valve
- Open** The actuator will open the valve
- ESD** The actuator will adopt the ESD position set (close, open, stay put)
- Position** The actuator will adjust the valve position to the setting given in the Comms Lost Position (Parameter 7).

6.1.2 Limited Range Position Minimum and Maximum (Parameter 2 and 3)

These parameters 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 setpoint 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. 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 0.0 and 100.0 are set in these 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 0.0 and 100.0 values.

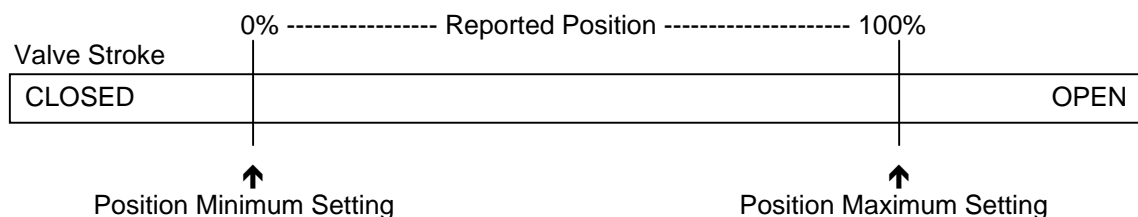


Fig 14: Limited Range Position Control and Reporting

6.1.3 Deadband and Hysteresis (Parameter 4 and 8)

When using position control by sending a setpoint DV to the actuator there are a number of parameters used to tune the position controller and reduce the possibility of damage to the actuator. These two parameters are set to prevent hunting around the setpoint 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 DFU 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 setpoint 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 setpoint.

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.

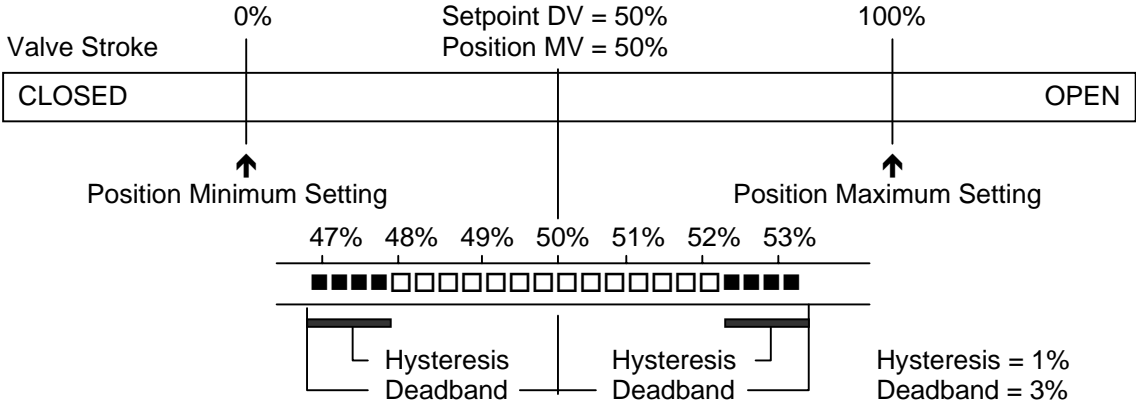


Fig 15: Deadband and Hysteresis settings

6.1.4 Motion Inhibit Timer (Parameter 5)

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.

6.1.5 Auxiliary Input Mask (Parameter 6)

This parameter relates to the IQ and IQT actuator only and allows 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 parameter is set as a decimal number in the range 0-255, but should be considered in its binary format. 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.

6.1.6 Comms Lost Position (Parameter 7)

The setting in this parameter determines the position in the range 0.0 to 100.0% that the actuator will move to if the DeviceNet network communications stops being received, provided the Dnet Fault Mode (Parameter 1) is set to 'Position'. No action will be taken unless the communications stops for a period equal or greater than the setting in the Comms Fault Timer (Parameter 15).

6.1.7 Slow Mode Range (Parameter 9)

This parameter is only applicable to IQT actuators. The Slow Mode Range sets the deviation between the setpoint and current position in positioning mode inside which the actuator motor will slow to minimum speed.

If the setpoint (DV) is 50% and the setting for this parameter is 10%, then when the actuator moves within the range 40% to 60% the motor will adopt low speed. The actuator does not use slow mode for digital (Open/Close) commands.

6.1.8 Valve Jammed Time (Parameter 10)

Parameter 10 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.

6.1.9 Manual Movement Travel (Parameter 11)

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 over run 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.

6.1.10 Watchdog Timeout (Parameter 12)

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.

6.1.11 ESD DI4/Net Disable (Parameter 13)

In the IQ and IQT actuator 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 IQ/IQT when the contact input is closed.

6.1.12 Analogue Input Max (Parameter 14)

The DFU includes an analogue input channel for a process input. This input will require calibration to ensure it is accurately reported.

This parameter can only be set when the DFU is on line and the analogue input should be connected to a calibration source. When the parameter is set this causes the analogue input to be sampled and the value read to be used for the input to be reported as 100.0%. If the parameter is simply read then the value displayed is the raw analogue input value.

Apply a 100% input and enter any number between 1 and 1023, but different from the currently displayed value, download the new value and upload from the DFU. The number in the parameter will change to the raw A/D value equivalent to the currently applied analogue signal and the reported value for the Analogue Input in Parameter 43 will read 1000 (100.0%).

6.1.13 Comms Fault Timer (Parameter 15)

Parameter 15, the Comms Fault Timer setting, determines the number of seconds that network communication must be absent before the setting for the Dnet Fault Mode will be carried out.

6.2 DeviceNet Related Configurable Parameters

These parameters set up the DFU for network communications.

6.2.1 MAC ID (Parameter 16)

The Media Access Control Identifier is the address on the network that the DFU will respond to. The MAC ID address can be in the range 0 to 63, though 63 is generally not used as this is the default address and may be used by any newly introduced device on the network.

Changing the MAC ID will cause the DFU to reset. Changing the MAC ID does not affect the values set in the other parameters of the device.

6.2.2 Baud Rate (Parameter 17)

Parameter 17 sets the communication baud rate. Note that the setting will not become active until the DFU is reset. The DFU is reset by powering the actuator off and on.

6.2.3 Bus Off Interrupt (Parameter 54)

The CAN chip includes hardware detection for message errors such as framing errors, parity errors and transmission errors. If the number of these errors exceeds the internal counter limit of 255 without sufficiently good data transactions (which reduce the counter) then, when the Bus Off Interrupt is Disabled, the CAN chip will go to the Bus Off state, show a red led and disable the DFU. Recovery requires the actuator power to be cycled

If the parameter is Enabled the DFU will try up to 5 times to recover from the Bus Off condition before finally disabling itself.

Note that when a Bus Off occurs the comms will stop and the Dnet Fault condition specified in Parameter 1 will be carried out

6.2.4 Bus Off Counter (Parameter 55)

The number of times that a Bus Off has occurred since the last reset is recorded in this parameter. The count can reach 5 at which time the DFU will be disconnected and no further comms will be possible. The actuator power must be cycled to recover from this condition.

6.2.5 ID Object Status (Parameter 56)

The Identity Object Status word represents the current status of the entire device. Within the word, Bit 0 indicates the ownership of the device. When Bit 0 is true (1) this DFU is owned by a master. In addition Bit 4 is used to indicate the condition of the DFU EEPROM memory. When Bit 4 is true (1) this indicates a failure in the EEPROM and the device. If a failure is indicated a power cycle on the actuator may correct the problem. Alternatively the DFU should be replaced.

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7 SETTING UP AND MAINTAINING THE DEVICENET DFU

In most applications the majority of the default settings in the DeviceNet DFU 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 MAC ID address value since the default should never be used within a live system. (The default value of 63 is reserved for new devices, if any new actuator or other device is introduced it will appear as MAC ID 63.)

7.1 Using a Network Configuration Tool

DeviceNet provides one way to set up the variable parameters including the MAC ID over the network by use of explicit messages. In addition for the IQ actuator the infra-red setting tool can be used to alter some of the DFU parameters including the MAC ID.

In order to correctly set up a DeviceNet system each node must be correctly set for address and speed and also for the device to function correctly the variable parameters must be correctly set. To do this requires the use of a suitable configuration tool such as RSNetWorx[®] from Rockwell or a similar device. Using the tool will allow for any parameter to be set and the actuator functionality to be checked. The EDS device description file must be loaded into the configuration tool prior to attempting to set up the actuator.

Note: *Setting up will require each actuator to be brought on line individually so that it can be identified and correctly addressed*

The individual parameter values required may be different for each actuator and will depend on the application and process being controlled as well as the actuator size, speed and other design features.

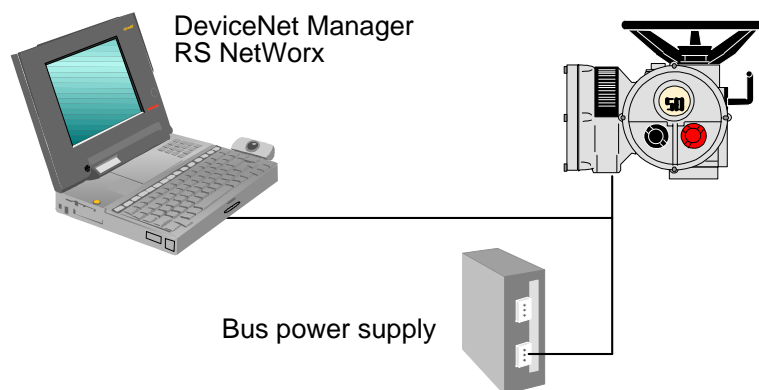


Fig 16: Using RS NetWorx to configure the DeviceNet DFU

The DeviceNet bus power should be applied when using the configuration tools to ensure correct operation of the scanner in the computer and the DFU card in the actuator.

7.2 Setting up an IQ and IQT with the Setting Tool

The IQ and IQT actuators include an infra-red 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 DeviceNet parameters in the DFU. The parameters of the DFU card will still require to be set up using a full configuration tool to be used to ensure optimum actuator and network compatibility.

The diagram illustrates the access route through the actuator menu screens to reach the settings that affect the DFU. Note that the **[Od]** function must be set to **[OP]**, if it is not then the card will not be able to control the actuator.

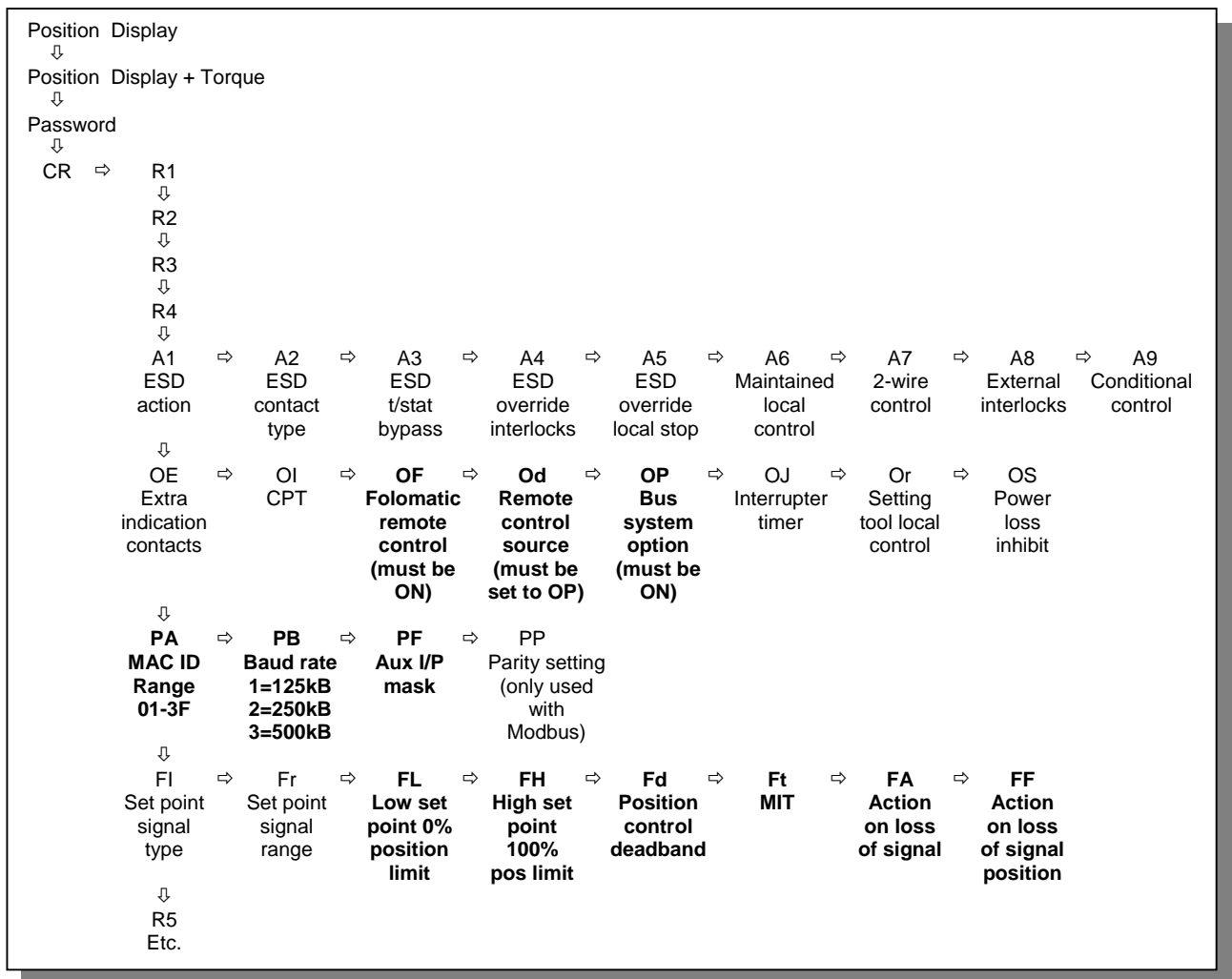


Fig 17: Setting tool menu structure and DFU settable parameters

DeviceNet parameters that may be set by using the IQ/IQT Setting Tool and the infra red link are listed below. The available range for the deadband setting when using the setting tool is less than the range found using the configuration tools.

Param No.	Description	Range	Default Value
1	Dnet Fault Mode (Action on Loss of Comms)	Nothing (No Action), Stop, Close, Open, ESD, Position	Nothing
2	Limited Range Position Minimum	0 – 100%	0%
3	Limited Range Position Maximum	0 – 100%	100%
4	Deadband	0.0 – 9.9%	5.0%
5	Motion Inhibit Time	0 – 255 sec	3 sec
6	Aux Input Mask	0 – 255 (00 – FF hex)	15 (0F)
7	Comms Lost Position	0.0 – 100.0%	0.0%
16	MAC ID (Address)	0 – 63	63
17	Baud Rate (kbaud)	125k, 250k, 500k	125k

7.3 Maintenance and Repair

There is no periodic service requirement for the DFU.

Repairs should not be attempted on the DFU. The Network Interface Card and Interface card are a pair and should never be separated. Replacing the complete DFU assembly with a new replacement device should rectify any failure. Static sensitive devices are used in the DFU, it is therefore mandatory to observe anti-static precautions when handling or working on the unit.

7.4 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 parameters. The table lists all the parameters that must be checked and set up for each DFU on a network. The data should be recorded for each DeviceNet Field Unit.

Note: *Make a note of all changes to Parameter settings to ensure that, in the case of a failure, the replacement device can be swiftly set to the correct values.*

Actuator Configurable Parameters

Param No.	Description	Setting
1	Dnet Fault Mode (Action on Loss of Comms)	
2	Limited Range Position Minimum	
3	Limited Range Position Maximum	
4	Deadband	
5	Motion Inhibit Time	
6	Aux Input Mask	
7	Comms Lost Position	
8	Hysteresis	
9	Slow Mode Range	
10	Valve Jammed Time	
11	Manual Movement Travel	
12	Watchdog Timeout	
13	ESD DI4/Net Disable	
14	Analogue Input Max	
15	Comms Fault Timer	

DeviceNet Configurable Parameters

Param No.	Description	Setting
16	MAC ID (Address)	
17	Baud Rate (kbaud)	
54	Bus Off Interrupt	

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