IQ SIL Option
IQ actuators for use in applications up to SIL 3
Keeping the World Flowing

RELIABILITY IN FLOW CONTROL
CRITICAL APPLICATIONS

RELIABLE OPERATION WHEN IT MATTERS

Assured reliability for critical applications and environments. Whether used 24/7 or very infrequently, Rotork products will operate reliably and efficiently when called upon.

QUALITY-DRIVEN GLOBAL MANUFACTURING

Rotork products are designed with 60 years of industry and application knowledge. Research and development across all our facilities ensures cutting edge products are available for every application.

CUSTOMER-FOCUSED SERVICE WORLDWIDE SUPPORT

Rotork focus on solving customer challenges and developing new solutions, from initial enquiry through to product installation, long-term after-sales care and client support programmes.

LOW COST OF OWNERSHIP

Long-term reliability prolongs service life, reducing long term cost of ownership and providing greater efficiency to process and plant.
Rotork believes that being a responsible business leads to being the best business. We are socially, ethically, environmentally responsible and committed to embedding CSR across all our processes and ways of working.
The most robust actuator design in the industry providing exceptional reliability

*Suitable For Use in Safety Systems up to SIL 2/3*

*As Standard, IQ has the Ability to Stayput in a SIL 2 Safety System*

*IQ SIL Option Allows an ESD Safety Function*

*Partial Stroke Capabilities*

*Full Datalogger Available*
Keeping the World Flowing

Compliments Rotork’s Range of Electro-Hydraulic Spring-Return Actuators

For Part-Turn Applications the IQT has the Ability to Stayput in Safety Systems up to SIL 2

Supported by Rotork

Externally Certified

Supported by Full Reliability Data
Rotork IQ actuators including the SIL Safety Function Control Module option are SIRA certified for use in SIL 2 safety applications using a 1 out of 1 actuated valve configuration (1oo1). Safety functions are “Stayput” and “ESD”. Where SIL 3 is required, IQ SIL may be used in a 1oo2 actuated valve configuration (redundant mode).

For the types shown below there is no restriction on actuator size or speed. Refer to publication PUB002-038 for actuator sizes, speeds and torque performance details.

Due to the strict design and implementation requirements necessary, IQ SIL option is limited to the actuator type, power supply and duty rating displayed in the table below. For more information on control and monitoring options available with the IQ SIL option, refer to page 8.

**Operation**

The SIL option replaces the standard IQ control board to provide diagnostic coverage and redundant control in order to carry out the specified safety function. In addition, electro-mechanical and mechanical component reliability has been assessed and quantified, meeting reliability requirements of SIL 1/2/3 applications.

A safety function status relay provides indication of the actuator’s safety function ability to complete. Status is also duplicated locally on the actuator display.

In order to meet the requirements of SIL as certified by SIRA, IQ SIL actuators must be installed, commissioned, operated and maintained/proof tested in accordance with the safety manual publication PUB002-057.

**Safety Functions**

The two safety functions applicable to valve actuators are:

**Safety Function 1 – Stayput (High Demand)**

The actuator shall not move without a valid Motor Enable command signal. If an internal failure is detected the actuator will give an alarm signal.

In order to meet the requirements of SIL 2 for safety function 1 the actuator must be controlled for opening and closing using 2 input signals; motor enable and a control command from a remote input or a network command. If the motor enable signal is not present, the actuator will not move. If the motor enable signal is removed while in operation, the actuator will stop. Safety function 1 can be configured for operation in local control mode in addition to remote operation.

**Safety Function 2 – ESD (Low Demand)**

If an ESD signal is active, the actuator will perform the commissioned ESD action (open, close or stayput). If an internal failure is detected the actuator will give an alarm signal.

For safety function 2, a single, maintained ESD signal derived from a normally closed contact (break to ESD) is required. ESD operation will override any existing remote open or close signal while applied. Safety function 2 can be configured for operation in local and/or stop mode in addition to remote mode.

**Combined Safety Functions 1 & 2 – Motor Enable with ESD**

To stayput as per safety function 1 or perform the commissioned ESD action as per safety function 2. Safety function 1 or safety function 2 can be set as the priority action. Safety function operation can be configured for local and/or stop in addition to remote mode.

### Available 3rd Generation IQ SIL Actuators

<table>
<thead>
<tr>
<th>Type</th>
<th>Duty</th>
<th>Power supply</th>
<th>Duty rating</th>
<th>Starts/Hr</th>
<th>Basic Circuit Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safety Function 1:</strong> Stayput</td>
<td>IQ</td>
<td>Multi-turn isolating and Quarter-turn isolating</td>
<td>3-phase supply</td>
<td>S2/S3, Class A &amp; B</td>
<td>60</td>
</tr>
<tr>
<td><strong>Safety Function 2:</strong> ESD</td>
<td>IQ</td>
<td>Multi-turn isolating and Quarter-turn isolating</td>
<td>3-phase supply</td>
<td>S2/S3, Class A &amp; B</td>
<td>60</td>
</tr>
</tbody>
</table>
IQ SIL Reliability Data for SIL Applications

The reliability data provided is applicable to the complete actuator up to and including the actuator output drive assembly. It does not include the valve, valve drive components or second stage gearboxes. The integrity/reliability of the electrical power supply and user derived control signals are not included in the actuator reliability assessment.

The reliability data in the tables below assume powered operation (PO) has been carried out at least once every six months. Refer to PUB002-057 or SIRA certificate FSP 150001 for full reliability data information.

<table>
<thead>
<tr>
<th>Safety Function 1: Stayput</th>
<th>Symbol</th>
<th>IQ10 - 18</th>
<th>IQ19 - 25</th>
<th>IQ35</th>
<th>IQ40</th>
<th>IQ70 - 95</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsystem Type</td>
<td></td>
<td>Type B</td>
<td>Type B</td>
<td>Type B</td>
<td>Type B</td>
<td>Type B</td>
</tr>
<tr>
<td>Hardware Fault Tolerance</td>
<td>HFT</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Safe Diagnosed Failures</td>
<td>λsd</td>
<td>1.15E-05</td>
<td>1.15E-05</td>
<td>1.15E-05</td>
<td>9.60E-06</td>
<td>9.60E-06</td>
</tr>
<tr>
<td>Safe Undiagnosed Failures</td>
<td>λsu</td>
<td>1.15E-05</td>
<td>1.15E-05</td>
<td>1.15E-05</td>
<td>9.60E-06</td>
<td>9.60E-06</td>
</tr>
<tr>
<td>Dangerous Diagnosed Failures</td>
<td>λdd</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dangerous Undiagnosed Failures</td>
<td>λdu</td>
<td>4.00E-07</td>
<td>5.00E-07</td>
<td>6.00E-07</td>
<td>4.40E-07</td>
<td>4.70E-07</td>
</tr>
<tr>
<td>Probability of failure per hour</td>
<td>PFH</td>
<td>5.00E-07</td>
<td>5.00E-07</td>
<td>5.00E-07</td>
<td>4.40E-07</td>
<td>4.60E-07</td>
</tr>
<tr>
<td>Safe Failure Fraction</td>
<td>SFF</td>
<td>96%</td>
<td>96%</td>
<td>96%</td>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>SIL Capability</td>
<td></td>
<td>SIL 2</td>
<td>SIL 2</td>
<td>SIL 2</td>
<td>SIL 2</td>
<td>SIL 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Safety Function 2: ESD (to move)</th>
<th>Symbol</th>
<th>IQ10 - 18</th>
<th>IQ19 - 25</th>
<th>IQ35</th>
<th>IQ40</th>
<th>IQ70 - 95</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proof Test Interval (Hours)</td>
<td>T1</td>
<td>8760</td>
<td>8760</td>
<td>8760</td>
<td>8760</td>
<td>8760</td>
</tr>
<tr>
<td>Mean Time to Repair</td>
<td>MTTR</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Subsystem Type</td>
<td></td>
<td>Type B</td>
<td>Type B</td>
<td>Type B</td>
<td>Type B</td>
<td>Type B</td>
</tr>
<tr>
<td>Hardware Fault Tolerance</td>
<td>HFT</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Safe Diagnosed Failures</td>
<td>λsd</td>
<td>1.98E-05</td>
<td>8.24E-06</td>
<td>8.24E-06</td>
<td>8.18E-06</td>
<td>8.18E-06</td>
</tr>
<tr>
<td>Dangerous Diagnosed Failures</td>
<td>λdd</td>
<td>7.34E-07</td>
<td>7.68E-07</td>
<td>7.68E-07</td>
<td>7.84E-07</td>
<td>7.84E-07</td>
</tr>
<tr>
<td>Dangerous Undiagnosed Failures</td>
<td>λdu</td>
<td>1.70E-06</td>
<td>1.96E-06</td>
<td>1.88E-06</td>
<td>1.77E-06</td>
<td>2.51E-06</td>
</tr>
<tr>
<td>Diagnostic Coverage</td>
<td>DC</td>
<td>30%</td>
<td>28%</td>
<td>29%</td>
<td>31%</td>
<td>37%</td>
</tr>
<tr>
<td>Safe Failure Fraction</td>
<td>SFF</td>
<td>98%</td>
<td>97%</td>
<td>97%</td>
<td>98%</td>
<td>97%</td>
</tr>
<tr>
<td>Probability of Failure on Demand</td>
<td>PFD</td>
<td>4.00E-03</td>
<td>4.60E-03</td>
<td>4.40E-03</td>
<td>4.10E-03</td>
<td>5.80E-02</td>
</tr>
<tr>
<td>SIL Capability (Low demand mode)</td>
<td></td>
<td>SIL 2</td>
<td>SIL 2</td>
<td>SIL 2</td>
<td>SIL 2</td>
<td>SIL 2</td>
</tr>
</tbody>
</table>

Certificate reference: Size 1 = IQ10, IQ12, IQ18 Size 2 = IQ19, IQ20, IQ25 Size 3 = IQ35 Size 4 = IQ40, IQ70 Size 5 = IQ90, IQ91, IQ95
Advanced IQ Features for SIL Applications

Actuator selection and sizing
The selection of actuator type and size is dependent on the valve type (multi-turn or part-turn) and the required operating forces (torque and/or thrust). Actuator performance data is provided in publication PUB002-038. An online actuator sizing guide is available at www.rotork.com. Contact Rotork for further help or advice.

The following conditions will be applied:
- Rotork will size the actuator based on the supplied valve data. No additional safety factors will be added unless expressly requested.
- The valve or valve drive components must be capable of safely withstanding the supplied actuator stall torque and/or developed thrust at stall torque. For design purposes, stall torque must be considered to be at least 2 times supplied actuator/actuator-gearbox combination rated torque.
- Under ESD operation to open or close (safety function 2), torque protection at the set value is active for valve seating unless set to stop on position. If the valve is obstructed mid travel during stroke, the actuator will apply up to stall torque in an attempt to complete the safety function. In the unlikely event of position sensor failure, stall torque may be developed at any position (obstructed / seating).

Actuator power
The actuator electrical power supply integrity does not fall within the scope of the actuator reliability data. Users must ensure the integrity of the actuator power supply meets the requirements of the target SIL for the SIS.

Actuator indication
Fault status relay
The SIL option includes a status relay contact providing remote indication that the system has detected an invalid or fault condition and has performed the safety function, or, the safety function cannot be applied or could be overridden. The actuator LCD display also provides fault status indication.

Indication contacts
The actuator has 4 configurable contacts, S1 to S4 available for indication, including open and closed position limit indication and intermediate position indication (configurable). An optional 4 configurable contacts, S5 to S8 can be provided if additional relay indication is required.

A full list of available functions is provided in publication PUB002-040.

Monitor relay
The monitor relay will indicate one or more of the following conditions:
- Loss of one or more of the power supply phases
- Loss of control circuitry supply
- Actuator selected for local control
- Thermostat tripped
- Local / remote control pushbutton set to Local stop

Analogue 4-20 mA position indication
The Current Position Transmitter (CPT) provides a non-contacting internally or externally fed 4-20 mA analogue signal proportional to valve position. Selectable for minimum signal corresponding to fully closed or fully open position with automatic zero and span setting.

NOTE: Indication outputs S1 to S8, Monitor Relay and the CPT analogue position signal do not fall within the scope of the actuator reliability assessment and therefore should not form part of the SIL.

User must ensure the integrity of indication meets the requirements of the SIL target for the SIS. If necessary, limit position indication should be derived from devices external to the actuator and driven directly from the valve obdurator.
Typical Remote Control Circuit Diagram

- ESD + Motor Enable are for DC only.
- Positive Switch Only Allowed
- Certified to IEC61508-2 (2010) as an element suitable for use in safety related systems up to and including SIL 2 (1oo1) and SIL 3 (1oo2). Must be installed, commissioned and operated in accordance with the Safety Manual. Refer to SIL Safety Publication - PUB002-057

SIL NOTES (Superseding Sheet 2 Notes)

Motor Enable Remote Function
A Motor Enable Signal must be applied to Terminal 34 before an Open or Closed signal will operate the actuator. Motor Enable Signal must be 16-60 VDC. Motor Enable is not required for local operation.
IQ Remote Control Circuitry for SIL Applications

IQ Remote Control Circuitry for SIL Applications
– DC Voltage Only

To meet the requirements of SIRA certificate FSP 15001 for SIL applications the following DC remote control connections must be made. The safety integrity assessment for the remote control circuits is the responsibility of others and does not form part of the actuator assessment.

Before putting the actuator into service, it must be installed and commissioned in accordance with IQ3 SIL safety manual publication PUB002-057.

The Bluetooth® wireless setting tool enables configuration of all actuator settings.

Note:
Actuator remote control signals may be internally or externally supplied with DC voltage according to wiring diagram. A valid open or close remote control command consists of a control input signal and Motor Enable input signal being applied simultaneously. Invalid signals will not cause operation and will invoke a “MOTOR ENABLE LOSS” alarm on the display and status relay (make contact). For full status alarm conditions refer to PUB002-057.

The Motor Enable and ESD input signals can be configured to operate in local control. ESD can be user configured for Stayput, Close or Open. ESD signal must be derived from a normally closed contact breaking.

Internally supplied:
Fit link “#” as shown and connect remote control contacts to internal supply on terminal 5.

Externally supplied:
Connect control contacts to external supply DC +VE.
Connect supply DC-VE to terminal 36 & 31.

### SAFETY FUNCTION 1: STAYPUT
OPEN/CLOSE PUSH TO RUN CONTROL
(LOCAL CONTROL REMAINS SELF MAINTAINED)

### SAFETY FUNCTION 2: ESD
EMERGENCY SHUT-DOWN CIRCUIT.
The ESD CIRCUIT CAN BE ADDED TO THE CONTROL CIRCUIT SHOWN ABOVE WHEN SAFETY FUNCTION 1 AND 2 ARE REQUIRED. ANY EXISTING OPEN OR CLOSE CONTROL SIGNAL, MOTOR ENABLE OR ESD CAN BE CONFIGURED TO TAKE PRIORITY OVER ALL CONTROLS, REFER TO PUBLICATION PUB002-057.
THE DEFAULT ESD CONFIGURATION IS “STAY PUT”, DERIVED FROM A N/C CONTACT (SIGNAL REMOVED). FOR OTHER CONFIGURABLE ESD SETTING OPTIONS, REFER TO PUBLICATION PUB002-057.

<table>
<thead>
<tr>
<th>Customer Connection for Remote Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Supply</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SAFETY FUNCTION 1: STAYPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEN/CLOSE PUSH TO RUN CONTROL</td>
</tr>
</tbody>
</table>
(LOCAL CONTROL REMAINS SELF MAINTAINED) |

<table>
<thead>
<tr>
<th>SAFETY FUNCTION 2: ESD</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMERGENCY SHUT-DOWN CIRCUIT.</td>
</tr>
</tbody>
</table>
The ESD CIRCUIT CAN BE ADDED TO THE CONTROL CIRCUIT SHOWN ABOVE WHEN SAFETY FUNCTION 1 AND 2 ARE REQUIRED. ANY EXISTING OPEN OR CLOSE CONTROL SIGNAL, MOTOR ENABLE OR ESD CAN BE CONFIGURED TO TAKE PRIORITY OVER ALL CONTROLS, REFER TO PUBLICATION PUB002-057. TO THE DEFAULT ESD CONFIGURATION IS “STAY PUT”, DERIVED FROM A N/C CONTACT (SIGNAL REMOVED). FOR OTHER CONFIGURABLE ESD SETTING OPTIONS, REFER TO PUBLICATION PUB002-057. |

<table>
<thead>
<tr>
<th>ESD switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normally Closed (Break to ESD)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>To external supply or terminal 5 (see ‘Note:’ above)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD switch</td>
</tr>
<tr>
<td>Normally Closed (Break to ESD)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>To external supply or terminal 5 (see ‘Note:’ above)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD switch</td>
</tr>
<tr>
<td>Normally Closed (Break to ESD)</td>
</tr>
</tbody>
</table>
FUNCTIONAL SAFETY CERTIFICATE

This is to certify that the

**IQ3 Valve Actuator**

manufactured by

**Rotork Controls Ltd**

(A Division of Rotork PLC)

Brassmill Lane

Bath, BA1 3JQ

UK

have been assessed by Sira Certification Service with reference to the CASS methodologies and found to meet the requirements of

**IEC 61508-2:2010**

**Routes 1H & 1S**

**Systematic Capability (SC2)**

as an element/subsystem suitable for use in safety related systems performing safety functions up to and including

- **SIL 2 capable with HFT = 0 (1oo1)**
- **SIL 3 capable with HFT = 1 (1oo2)**

when used in accordance with the scope and conditions of this certificate.

* This certificate does not waive the need for further functional safety verification to establish the achieved Safety Integrity Level (SIL) of the safety related system

Certification Manager:

Wayne Thomas

Initial Certification : 26 August 2015
This certificate issued : 08 December 2015
Renewal date : 25 August 2020

This certificate may only be reproduced in its entirety, without any change.
As part of a process of ongoing product development, Rotork reserves the right to amend and change specifications without prior notice. Published data may be subject to change. For the very latest version release, visit our website at www.rotork.com.

The name Rotork is a registered trademark. Rotork recognises all registered trademarks. The Bluetooth® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of such marks by Rotork is under license. Published and produced in the UK by Rotork Controls Limited. POUI80516