

# rotork®



## IQ SIL Option

IQ actuators for use in applications up to SIL 3

**sira**  
CERTIFICATION

**cass**

# rotork®

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.

# IQ SIL Option

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## COMPREHENSIVE PRODUCT RANGE SERVING MULTIPLE INDUSTRIES

Rotork products and services are used in the Power, Oil & Gas, Water & Waste Water, HVAC, Marine, Mining, Food & Beverage, Pharmaceutical and Chemical industries around the world to improve efficiency, assure safety and protect the environment.

## MARKET LEADER TECHNICAL INNOVATOR

The recognised market leader for sixty years. Our customers have relied upon Rotork for innovative solutions to safely manage the flow of liquids, gases and powders.

## GLOBAL PRESENCE LOCAL SERVICE

Global company with local support. Manufacturing sites, offices and *Centres of Excellence* throughout the world provide unrivalled customer services and fast delivery.

## CORPORATE SOCIAL RESPONSIBILITY

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*





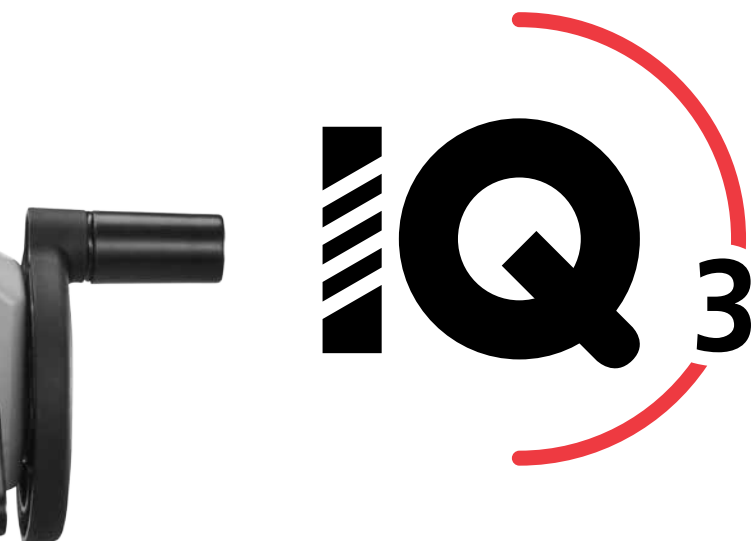
*Supported by Rotork*

*Externally Certified*

*Supported by Full Reliability Data*

*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*



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.

	Type	Duty	Power supply	Duty rating	Starts/Hr	Basic Circuit Diagram
Safety Function 1: Stayput	IQ	Multi-turn isolating and Quarter-turn isolating	3-phase supply	S2/S3, Class A & B	60	700B0000
Safety Function 2: ESD	IQ	Multi-turn isolating and Quarter-turn isolating	3-phase supply	S2/S3, Class A & B	60	700B0000

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.

Safety Function 1: Stayput	Symbol	IQ10 - 18	IQ19 - 25	IQ35	IQ40	IQ70 - 95
Subsystem Type		Type B	Type B	Type B	Type B	Type B
Hardware Fault Tolerance	HFT	0	0	0	0	0
Safe Diagnosed Failures	$\lambda_{sd}$	0	0	0	0	0
Safe Undiagnosed Failures	$\lambda_{su}$	1.15E-05	1.15E-05	1.15E-05	9.60E-06	9.60E-06
Dangerous Diagnosed Failures	$\lambda_{dd}$	0	0	0	0	0
Dangerous Undiagnosed Failures	$\lambda_{du}$	4.00E-07	5.00E-07	6.00E-07	4.40E-07	4.70E-07
Probability of failure per hour	PFH	5.00E-07	5.00E-07	5.00E-07	4.60E-07	4.60E-07
Safe Failure Fraction	SFF	96%	96%	96%	95%	95%
SIL Capability		SIL 2	SIL 2	SIL 2	SIL 2	SIL 2

Safety Function 2: ESD (to move)	Symbol	IQ10 - 18	IQ19 - 25	IQ35	IQ40	IQ70 - 95
Proof Test Interval (Hours)	T1	8760	8760	8760	8760	8760
Mean Time to Repair	MTTR	24	24	24	24	24
Subsystem Type		Type B	Type B	Type B	Type B	Type B
Hardware Fault Tolerance	HFT	0	0	0	0	0
Safe Diagnosed Failures	$\lambda_{sd}$	1.98E-05	8.24E-06	8.24E-06	8.18E-06	8.18E-06
Safe Undiagnosed Failures	$\lambda_{su}$	6.62E-05	6.41E-05	6.45E-05	6.35E-05	6.25E-05
Dangerous Diagnosed Failures	$\lambda_{dd}$	7.34E-07	7.68E-07	7.68E-07	7.84E-07	7.84E-07
Dangerous Undiagnosed Failures	$\lambda_{du}$	1.70E-06	1.96E-06	1.88E-06	1.77E-06	2.51E-06
Diagnostic Coverage	DC	30%	28%	29%	31%	37%
Safe Failure Fraction	SFF	98%	97%	97%	98%	97%
Probability of Failure on Demand	PFD	4.00E-03	4.60E-03	4.40E-03	4.10E-03	5.80E-02
SIL Capability (Low demand mode)		SIL 2	SIL 2	SIL 2	SIL 2	SIL 2

Certificate reference: Size 1 = IQ10, IQ12, IQ18 Size 2 = IQ19, IQ20, IQ25 Size 3 = IQ35 Size 4 = IQ40, IQ70 Size 5 = IQ90, IQ91, IQ95



## 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](http://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 control

All IQ network and analogue control options are available with the SIL option. Process control and reporting will be available as normal, however to invoke safety function 1 or 2 hardwired control inputs must be used and have priority. This arrangement allows the actuator to be under control of the basic process control system (BPCS) for normal operation by network, analogue or hardwired control while also integrating it with the safety instrumented system (SIS) using hardwired signals to prevent operation or for priority safety shutdown (ESD).

With a network or analogue control option fitted or with basic hardwired control, for safety function 1 withdrawal of the motor enable input signal will prevent operation. In the case of safety function 2, on "ESD" (removal of the hardwired signal) the actuator will carry out the ESD action as configured. Refer to example IQ3 Circuit Diagram 700B0000 and control connection drawing RWS120 on the following pages. Safety function 1 and 2 can be combined and user configured as to which has priority.

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.

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 1 and safety function 2 can be configured to override local control and stop mode.

## 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

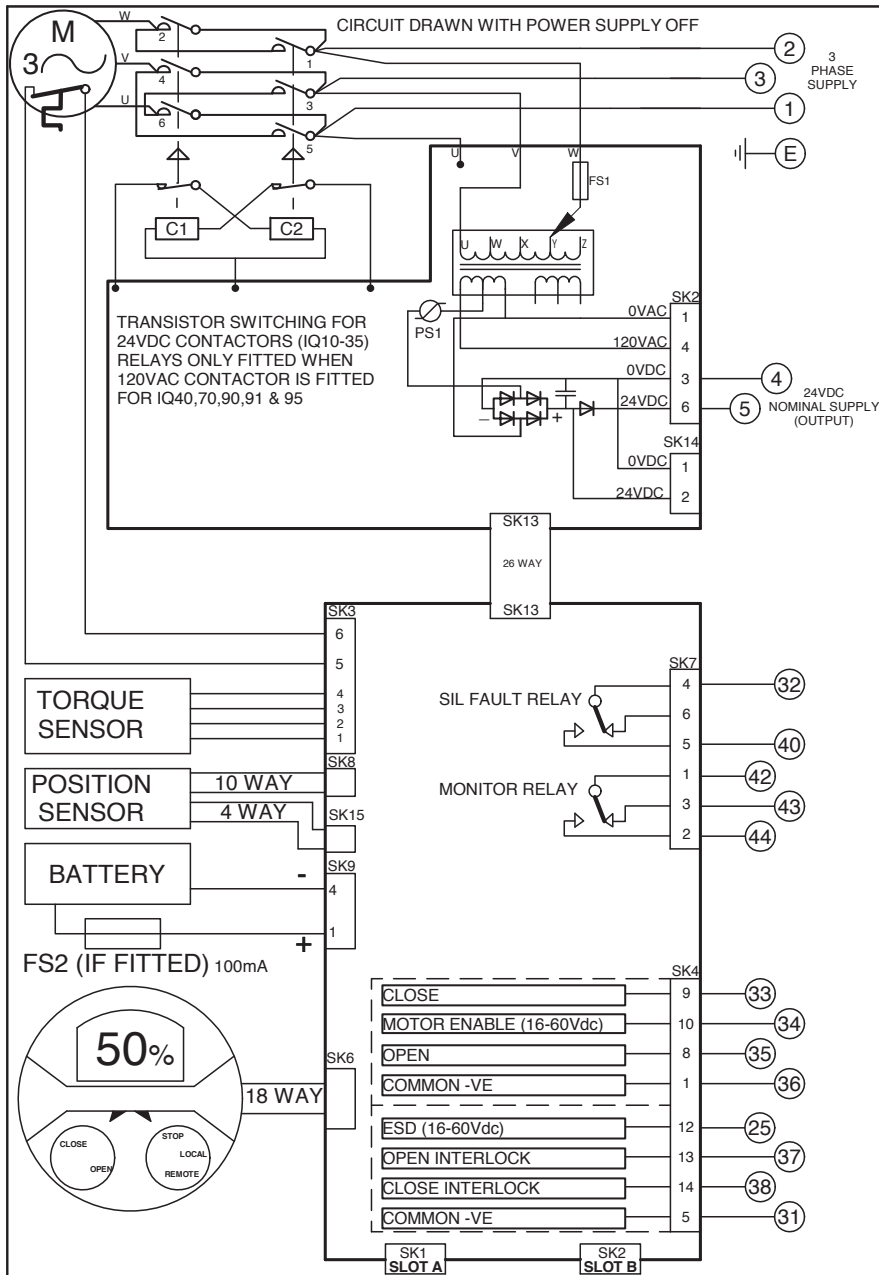
The Current Position Transmitter (CPT) provides a non-contacting internally or externally fed 4-20 mA analogue signal proportional to valve position. Selectable for minimum signal corresponding to fully Closed or fully Open position with automatic zero and span setting.

**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 SIS.**

**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



FOR TYPICAL REMOTE CONTROL DETAILS, SEE DOCUMENT  
**RWS120**

TRANSFORMER TAPPING OPTIONS	
Tap	Nominal 50/60Hz
TYPE 1	
W	220/230
X	380/400
Y	400,415/420
Z	440/460
FUSE FS1= 250mA ANTI-SURGE	
TYPE 2	
W	346/380
X	480/500
Y	240/240
Z	550/575
FUSE FS1= 250mA ANTI-SURGE	
TYPE 3	
X	660/660-690
Y	690/-
FUSE FS1= 150mA ANTI-SURGE	

REFER TO SHEET 2 FOR NOTES & OPTION PCB'S IF FITTED

**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- 60VDC. MOTOR ENABLE IS NOT REQUIRED FOR LOCAL OPERATION.

## SIL NOTES (Superseding Sheet 2 Notes)

- 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 (1001) and SIL 3 (1002). Must be installed, commissioned and operated in accordance with the Safety Manual. Refer to SIL Safety Publication - PUB002-057

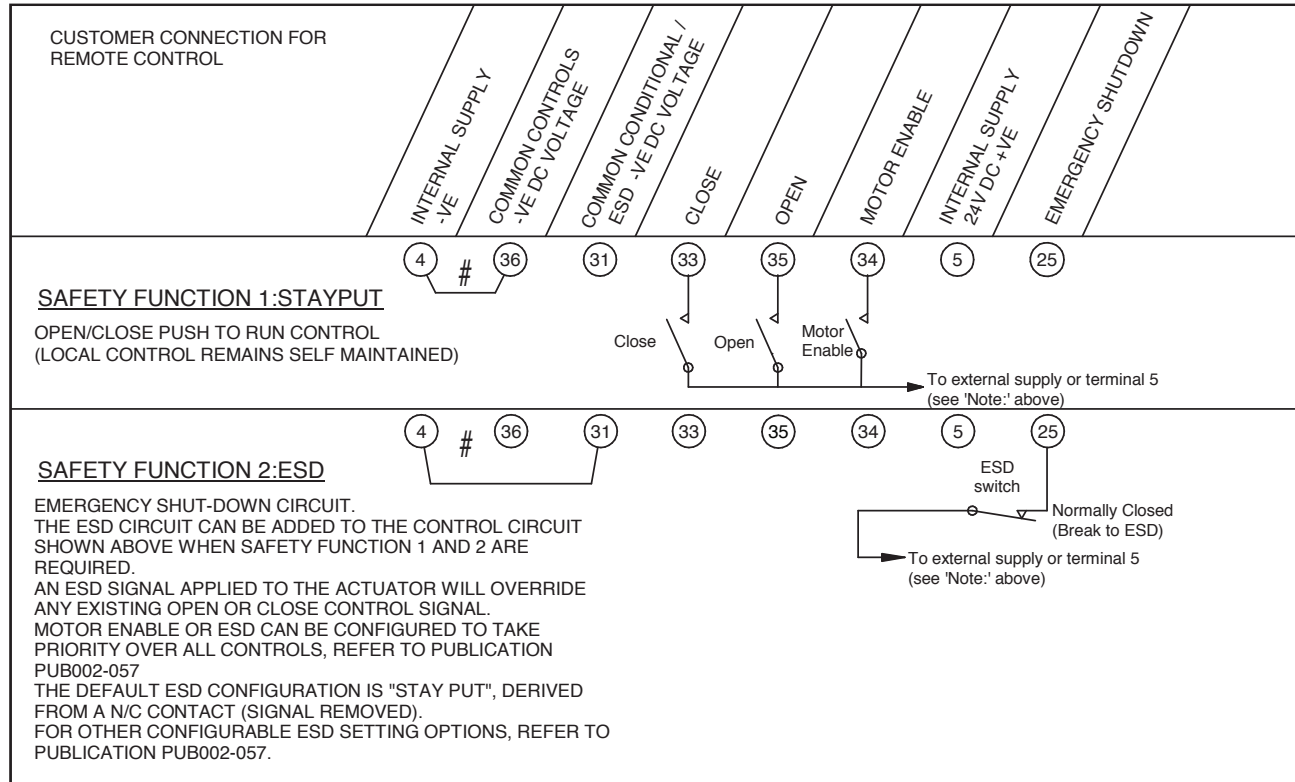
Iss	Date	Chkd	Revision Details	www.rotork.com		IQ + SIL			
1	030615	PMJ	FIRST ISSUE	ROTORK CONTROLS LTD BATH, BA1 3JQ ENGLAND Tel:01225-733200	ROTORK CONTROLS INC ROCHESTER NY 14624, USA Tel:585-247-2304	Drawn by: PMJ Date : 030614 Base WD: 700B0000 Job No : -- MI No : --	Circuit Diagram Number <b>700B0000</b>	Issue No <b>3</b>	Sheet <b>1</b> of 2
2	230715	PMJ	SIL note extended						
3	081215	PMJ	RWS WAS RWS100						
						B1 C1 B2 C2			

## 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.





## 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 1<sub>H</sub> & 1<sub>S</sub>**  
**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 (1001)\***  
**SIL 3 capable with HFT = 1 (1002)\***

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.



Certificate No.: Sira FSP 15001/02  
Form 7016 issue 5  
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