

IQ Pro SIL option

TÜV Certified for use in SIL 2 & 3 applications

rotork®
Controls



IQ Pro range including "SIL" Safety Function Control Module option is TÜV certified for use in SIL 2 safety applications using a 1 out of 1 actuated valve configuration (1oo1). Safety functions are "Stayput" and "ESD".

The SIL option can be included with any new IQ or IQT range actuator or be retrofitted to existing actuators supplied since 2000.

Where SIL 3 is required, IQ Pro-SIL may be used in a 1oo2 actuated valve configuration.

**TÜV Approval Certificate:
Z10 07 09 64590 001**

For 50 years Rotork have held reliability as the dominant factor in both the design and manufacturing of electric actuators and accordingly have gained industry recognition for reliable actuation.

With the advent of standards for determining process functional safety requirements, the reliability of equipment within Safety Instrumented System (SIS) to carry out the required safety function and meet the target Safety Integrity Level (SIL) must be defined by design with auditable reliability data.

Rotork have brought inherent design rigor of the IQ Pro range together with the design requirements of Standards IEC61508 and IEC 61511 to provide the first "SIL" certified electric valve actuator independently certified by TÜV.



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Issue 10/07

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Operation

The SIL option monitors the standard IQ Pro control board and provides diagnostic coverage and redundant control in order to carry out its safety function if required. In addition, electro-mechanical and mechanical component reliability has been assessed & quantified, meeting reliability requirements of SIL2/3 applications.

A safety function status relay provides indication of the actuator availability, redundant safety function operation and control signal status. Status is also duplicated locally on the actuator display.

In order to meet the requirements of SIL2/SIL3 as certified by TÜV, IQ Pro-SIL actuators must be installed, commissioned, operated and maintained/ proof tested in accordance with the safety manual publication E173E3.

Available IQ Pro – SIL Actuator types

For the types shown below there is no restriction on actuator size or speed. Refer to Publication E110E for actuator sizes, speeds and torque performance details.

Due to the strict design and implementation requirements necessary, IQ Pro – SIL option is limited to the actuator types and options ONLY displayed in the table below:

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 remote open or close command signal. If an internal failure is detected the actuator will give an alarm signal.

Dual hardwired control input signals are required for remote control. Signals must be maintained, "push to run" type only. Safety function 1 is available with IQ and IQT Pro ranges.

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.

ESD signal must be derived from a contact breaking and must be maintained during ESD. Safety function 2 is available with IQ Pro range only.

Combined Safety Functions 1 & 2 – Stayput with ESD

To stayput as per safety function 1, else perform the commissioned ESD action as per safety function 2. ESD has priority. Combined Safety function 1 & 2 is available with IQ Pro range only.

	Type	Duty	Power supply	Duty rating	Starts/Hr	Basic Circuit Diagram	Plus 4-20mA Indication**
Safety Function 1: Stayput	IQ	Multi-turn Isolating & ¼ Turn isolating*	3 phase only	S2 - 25%	60	3000S000	3060S000
	IQT	¼ turn Isolating	1, 3 phase or 24V DC	S2 - 20%	60	6000S000	6060S000
	IQTM	¼ turn Modulating	1, 3 phase or 24V DC	S4 - 50%	1200	7000S000	7060S000
	IQTF	Part-turn Isolating	1, 3 phase or 24V DC	S2 - 20%	60	6000S000	6060S000
Safety Function 2: ESD	IQ	Multi-turn Isolating & ¼ Turn isolating*	3 phase supply only	S2 - 25%	60	3000S000	3060S000

* requires addition of second stage gearbox

** Where a 4-20mA position feedback signal is required, option Current Position Transmitter (CPT) is available. CPT Output signal is not part of the safety function. CPT is 24V DC (nominal) loop powered and will output 4mA on loss of actuator power supply irrespective of position.

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IQ - SIL Reliability data for SIL 2 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.

Safety Function 1: Stayput	IQ	IQT
Subsystem Type	B	B
HFT Hardware fault tolerance	0	0
λ_{sd} Safe detected failure rate	2603.7×10^{-9}	2599.29×10^{-9}
λ_{su} Safe undetected failure rate	9935.8×10^{-9}	9928.76×10^{-9}
λ_{dd} Dangerous detected failure rate	0.32×10^{-9}	0.32×10^{-9}
λ_{du} Dangerous undetected failure rate	33.32×10^{-9}	50.32×10^{-9}
PFH Probability of failure per hour	33.64×10^{-9}	50.64×10^{-9}
SIL Safety Integrity Level	2	2
SFF Safe failure Fraction	99.7	99.6

Safety Function 2: ESD	IQ	
Combined Subsystem Types	A	B
HFT Hardware fault tolerance	0	1
SFF Safe failure Fraction (subsystems)	85.02%	99.8%
λ_{sd} Safe detected failure rate	1359.8×10^{-9}	
λ_{su} Safe undetected failure rate	8674.4×10^{-9}	
λ_{dd} Dangerous detected failure rate	609.13×10^{-9}	
λ_{du} Dangerous undetected failure rate	933.32×10^{-9}	
PFH Probability of failure on demand (per annum)	4.1×10^{-3}	
SIL Safety Integrity Level	2	
MTTR Mean time to repair*	12 Hours	
TI Proof Test interval*	12 months	

* Approval for SIL 2 applications based on the stated periods. Users must ensure these intervals are not exceeded in service.

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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 E110E. An on-line 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 3 times supplied actuator/actuator-gearbox combination rated torque.
- If the SIL option takes over the control in order to carry out an ESD to a predetermined end of travel (safety function 2), the actuator may stall against the valve or gearbox stops for a time up to the stroke time +3 seconds.

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

Refer to control connection drawing RWS320 below and Example IQ Circuit Diagram 3000S000.

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.

Application of only one signal is invalid and will raise an error status feed back on the display and status relay.

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 open or close (local or remote) signal while applied.

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).

A full list of available functions is provided in publication E170E3.

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.

The monitor relay is not configurable. Refer to actuator circuit diagram for connections.

Analogue 4-20mA position indication

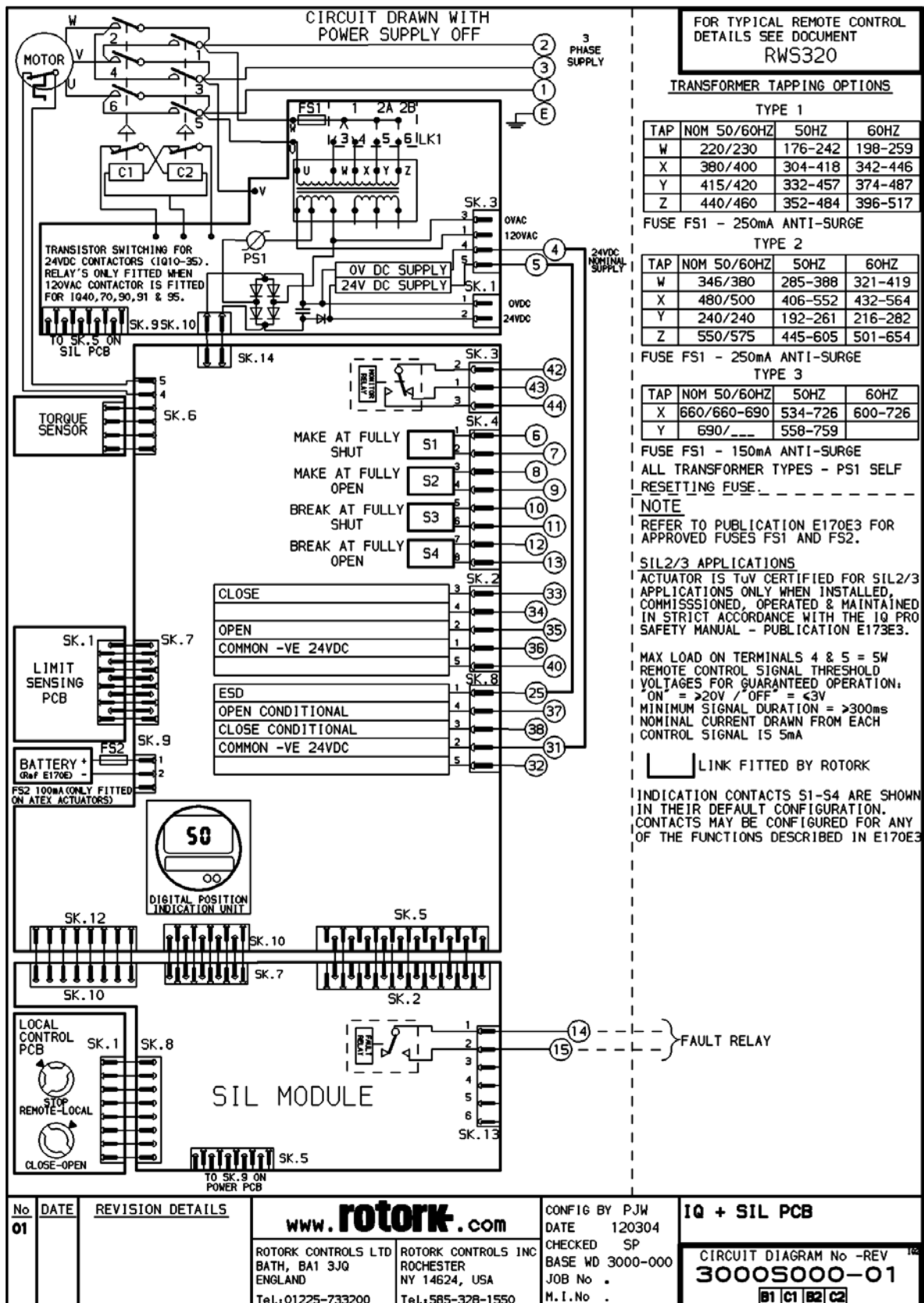
Where the CPT option is fitted - refer to actuator circuit diagram, a 4-20mA loop powered signal is available for analogue position indication. The CPT must be powered from an external source with a nominal supply of 24V DC. On loss of main actuator power supply, the CPT output will default to 4mA regardless of actuator position.

Note:

Indication outputs S1 to S4, 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



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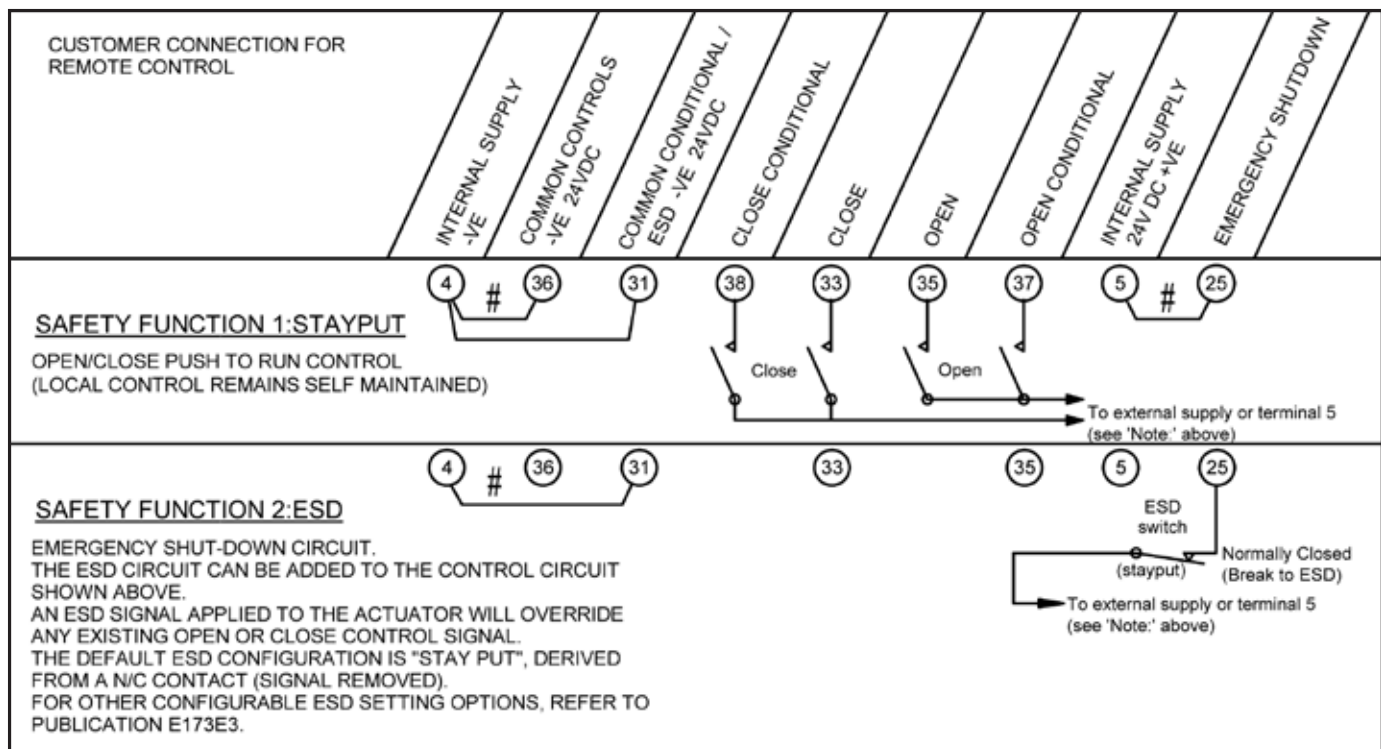
IQ/IQT Remote Control Circuitry for SIL2 applications - 24V DC

To meet the requirements of TÜV certificate for SIL2/3 applications the following 24V 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 IQ Pro SIL safety

manual publication E173E3. Unless specified with order, the actuator is despatched with default settings as listed in publication E173E3.

The infra red setting tool enables the configurable actuator settings to be made.



Note:

Actuator remote control signals may be internally or externally supplied at 24V DC (nominal). A valid open or close remote control command consists of a control input signal and conditional input signals being applied simultaneously for the required direction of operation. Invalid signals will not cause operation and will invoke an "ERR" alarm on the display and status relay (make contact). For full status alarm conditions refer to E173E3.

Conditional control input signals are not required for local control. ESD can be user configured for Stayput, Close or Open. ESD signal must be derived from a Stayput, 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 24V DC +VE. Connect supply 24V DC -VE to terminal 36 & 31.

Note

IQT Range actuators - Wiring Diagrams 6000S000/6060S000 and 7000S000/7060S000 are not certified for use in SIL2/3 applications requiring safety function 2:ESD.

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TÜV Certificate

ZERTIFIKAT ♦ CERTIFICATE ♦ 認証証書 ♦ CERTIFICADO ♦ CERTIFICAT



CERTIFICATE

No. Z10 07 09 64590 001

Holder of Certificate: Rotork Controls Limited

Brassmill Lane
Bath
BA1 3JQ
UNITED KINGDOM

Factory(ies): 64590

Certification Mark:



Product: Actuators

Model(s): IQ2 Pro

Parameters:

Drive:
220VAC bis 690VAC, 50Hz
208VAC bis 600VAC, 60Hz
Power supply:
110 bis 240VDC
110 bis 230VAC
SIL Level:
1oo1 configuration: SIL 2
1oo2 configuration: SIL 3

**Tested
according to:**

IEC 61508:2000
IEC 61511:2004, parts 1 to 3
IEC 61010-1:2001
EN 61326-1/A3:2003

The listed product was tested on a voluntary basis and complies with the relating standards or directives. The certification mark shown above can be affixed on the product. The certification mark must not be altered in any way. See also notes overleaf.

Test report no.: 717501028

Date, 2007-10-02

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