Keeping the World Flowing
for Future Generations

Skilmatic SI Range

Product Datasheet

Spring-return self-contained electro-hydraulic actuators

Rotork's SI range of self-contained electro-hydraulic actuators combine the simplicity of electrical operation with the precision of hydraulic control and the reliability of mechanical spring-return fail-safe action.

With Rotork's continuous development and improvement policy, and to meet new applications and customer needs, Rotork has introduced the next generation of SI actuators. The new SI range includes quarter-turn actuators with torque output from 75 to 200,000 Nm (55 to 147,500 lbf.ft) and linear actuators with thrust output up to 400 kN (90,000 lbf).

With over 30 years' experience of manufacturing electro-hydraulic actuators, Rotork's SI range has been specifically designed to meet today's control and safety needs for both two-position and positioning control applications. The actuators are offered with a wide range of operating speeds, Emergency Shutdown (ESD) inputs, partial stroke testing, analogue, HART® and Fieldbus communication capabilities to comply with all control configurations.

The SI range has been designed primarily for fail-safe applications where functional safety is paramount. Actuators within the range can be configured to fail-safe in three ways; loss of ESD signal and/or power supply, loss of ESD signal only and loss of power supply only. The actuators are suitable for use in Safety Instrumented Systems (SIS), certified to IEC 61508:2010.

The SI can also be supplied to stayput on loss of power supply for non fail-safe applications. Positional feedback is provided along with selectable status and alarm indication, with volt free relay outputs as standard. Independent limit switches (numerous options) can also be provided.

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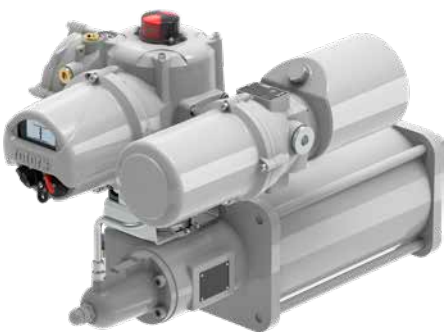
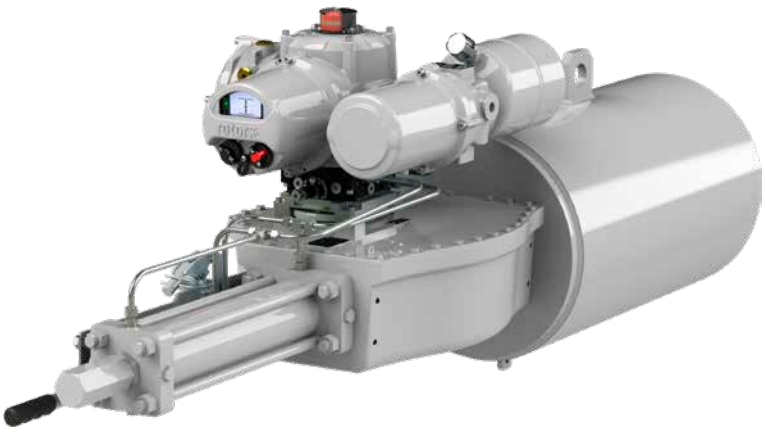




SI3 & SI4 Range Actuators

Introduction

The SI3 range of actuators is a standard offering for quarter-turn (up to 36 kNm / 26,550 lbf.ft) and linear (up to 235 kN / 52,830 lbf) valve/ damper applications and process conditions.

The SI4 range of actuators offers the flexibility to be customised to suit specific quarter-turn (up to 200 kNm / 147,500 lbf.ft) and linear (up to 400 kN / 90,000 lbf) valve/damper applications and process conditions.

Accumulators can also be offered on the SI4 range to provide multiple back-up strokes on loss of power supply along with increasing the hydraulic stroke speed on spring-return actuators.

Quarter-turn Actuators

Rotork RH and GH actuators are used as standard across the SI range. *Consult RH range brochure PUB019-004 and GH range brochure PUB011-001.*

Spring-return actuators can be assembled to provide fail-safe operation in either direction. The spring-return module is inherently safe since it can only be removed from the centre body after all the spring forces have been released.

All quarter-turn actuators are fitted with mechanical end stops to ensure accurate angular stroke adjustment ± 5°.

Efficiency and Long Life

Minimum friction is ensured by electroless nickel-plated cylinders and bronze sliding blocks on the torque arm. A dynamic floating piston seal further reduces friction and avoids stick-slip effect, even after prolonged periods without operation.

For quarter-turn applications with torque requirements below that of the GH range, we offer a robust range of rack and pinion actuators with outputs up to 3,700 Nm (2,730 lbf.ft).

Valve/Actuator Interface

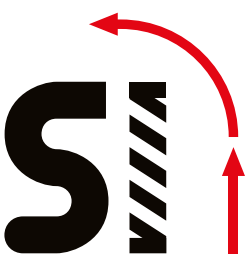
See PUB083-001 for dimensions of the GH actuator interface.
See PUB019-001 for dimensions of the RH actuator interface.

Linear Actuators

Rotork LH actuators are used as standard across the SI range. *Consult LH range brochure PUB020-001.*

Spring-return actuators can be assembled to provide fail-safe operation in either direction. The spring is totally enclosed with an additional safety feature to avoid injury during disassembly.

The cylinders are electroless nickel-plated to provide minimum friction and maximum protection against corrosion. The piston rods are carbon steel and chromium-plated. This helps prevent corrosion and minimises sliding friction on the dynamic seals. The rubber seals help to avoid slip effect, even after prolonged periods without operation.



Actuator Performance

SI3-SR Operating Torques

Fail-Safe Close

Below is the standard range of fail-safe, normally close actuators (assumes moving clockwise when looking down from above in the spring direction). Other sizes are available up to and including SI3-161 size.

Actuator Size	Hydraulic Direction (Open)			Spring Direction (Close)		
	BTO	RTO	ETO	BTC	RTC	ETC
SI3-030-035[1]/C0	**187**	**168**	**150**	**114**	**94.5**	**75**
	138	124	111	84	70	55
SI3-030-035[1]/C1	**191**	**149.5**	**108**	**213**	**175.5**	**138**
	141	110	80	157	129	102
SI3-060-045[1]/C2	**447**	**371.5**	**296**	**425**	**357**	**289**
	330	274	218	313	263	213
SI3-120-060[1]/C3	**827**	**669.5**	**512**	**804**	**661.5**	**519**
	610	494	378	593	488	383
SI3-240-070[1]/C2	**1,407**	**1,123.5**	**840**	**1,275**	**1,019**	**763**
	1,038	829	620	940	752	563
SI3-240-070[1]/C3	**1453**	**1289.5**	**1126**	**1308**	**1160**	**1012**
	1072	951	830	965	856	746
SI3-085S-050[1]/C2D	**2597**	**1251**	**1646**	**2373**	**1147**	**1516**
	1915	923	1214	1750	846	1118
SI3-085S-060[1]/C3D	**3,261**	**1,395**	**1,581**	**3,820**	**1,826**	**2,381**
	2,405	1,029	1,166	2,817	1,347	1,756
SI3-085C-060[1]/C3D	**5,120**	**1,163**	**1,186**	**3,285**	**1,974**	**3,778**
	3,776	858	875	2,423	1,456	2,787
SI3-085S-070[1]/C6D	**4,419**	**1,968**	**2,349**	**5,036**	**2,448**	**3,259**
	3,259	1,452	1,733	3,714	1,806	2,404
SI3-085C-070[1]/C6D	**6,939**	**1,683**	**1,780**	**4,327**	**2,629**	**5,171**
	5,118	1,241	1,313	3,191	1,939	3,814
SI3-085S-080[1]/C7D	**5,640**	**2,608**	**3,264**	**6,415**	**3,197**	**4,388**
	4,160	1,924	2,407	4,731	2,358	3,236
SI3-085C-080[1]/C7D	**8,856**	**2,276**	**2,493**	**5,504**	**3,400**	**6,962**
	6,532	1,679	1,839	4,060	2,508	5,135
SI3-130S-080[1]/C1D	**9,255**	**4,420**	**5,760**	**9,496**	**4,713**	**6,439**
	6,826	3,260	4,248	7,004	3,476	4,749
SI3-130C-080[1]/C1D	**14,532**	**3,919**	**4,427**	**8,149**	**5,021**	**10,217**
	10,718	2,891	3,265	6,010	3,703	7,536
SI3-130S-090[1]/C5D	**10,976**	**5,146**	**6,554**	**12,628**	**6,371**	**8,879**
	8,095	3,795	4,834	9,314	4,699	6,549
SI3-130S-100[1]/C6D	**13,849**	**5,882**	**6,608**	**16,955**	**8,187**	**10,815**
	10,214	4,338	4,874	12,505	6,038	7,977
SI3-130C-100[1]/C6D	**21,634**	**4,831**	**4,889**	**14,513**	**8,771**	**17,036**
	15,956	3,563	3,606	10,704	6,469	12,565
SI3-161A-100[1]/C2D	**18,189**	**9,506**	**13,812**	**16,307**	**8,506**	**12,332**
	13,415	7,011	10,187	12,027	6,274	9,096
SI3-161A-110[1]/C3D	**21,880**	**11,820**	**17,846**	**18,998**	**10,194**	**15,274**
	16,138	8,718	13,163	14,012	7,519	11,266
SI3-161B-110[1]/C3D	**34,356**	**11,056**	**13,982**	**16,220**	**10,550**	**24,237**
	25,340	8,154	10,313	11,963	7,781	17,876
SI3-161A-125[1]/C4D	**28,345**	**15,344**	**23,224**	**24,385**	**13,094**	**19,635**
	20,906	11,317	17,129	17,985	9,658	14,482
SI3-161B-125[1]/C4D	**44,506**	**14,366**	**18,201**	**20,818**	**13,548**	**31,156**
	32,826	10,596	13,424	15,355	9,992	22,979

Torque	Nm	lbf.ft

Actuator Performance

SI3-SR Operating Torques

Fail-Safe Open

Below is the standard range of fail-safe, normally open actuators (assumes moving anti-clockwise when looking down from above in the spring direction). Other sizes are available up to and including SI3-161 size.

Actuator Size	Spring Direction (Open)			Hydraulic Direction (Close)		
	BTO	RTO	ETO	BTC	RTC	ETC
SI3-030-035[1]/O0	**114**	**94.5**	**75**	**187**	**168**	**150**
	84	70	55	138	124	111
SI3-030-035[1]/O1	**213**	**175.5**	**138**	**191**	**149.5**	**108**
	157	129	102	141	110	80
SI3-060-045[1]/O2	**425**	**357**	**289**	**447**	**371.5**	**296**
	313	263	213	330	274	218
SI3-120-060[1]/O3	**804**	**661.5**	**519**	**827**	**669.5**	**512**
	593	488	383	610	494	378
SI3-240-070[1]/O2	**1,275**	**1,019**	**763**	**1,407**	**1,123.5**	**840**
	940	752	563	1,038	829	620
SI3-240-070[1]/O3	**1453**	**1289.5**	**1126**	**1308**	**1160**	**1012**
	1072	951	830	965	856	746
SI3-085S-050[1]/O2D	**2598**	**1251**	**1648**	**2372**	**1146**	**1514**
	1916	923	1216	1749	845	1117
SI3-085S-060[1]/O3D	**3,820**	**1,826**	**2,381**	**3,261**	**1,395**	**1,581**
	2,817	1,347	1,756	2,405	1,029	1,166
SI3-085C-060[1]/O3D	**6,114**	**1,666**	**1,894**	**2,752**	**1,526**	**2,366**
	4,509	1,229	1,397	2,030	1,126	1,745
SI3-085S-070[1]/O6D	**5,036**	**2,448**	**3,259**	**4,420**	**1,968**	**2,350**
	3,714	1,806	2,404	3,260	1,452	1,733
SI3-085C-070[1]/O6D	**8,053**	**2,246**	**2,593**	**3,729**	**2,125**	**3,550**
	5,940	1,657	1,912	2,750	1,567	2,618
SI3-085S-080[1]/O7D	**6,415**	**3,197**	**4,388**	**5,640**	**2,608**	**3,265**
	4,731	2,358	3,236	4,160	1,924	2,408
SI3-100C-080[1]/O2D	**12,007**	**3,205**	**3,596**	**6,324**	**3,642**	**6,266**
	8,856	2,364	2,652	4,664	2,686	4,622
SI3-130S-080[1]/O1D	**9,496**	**4,713**	**6,439**	**9,255**	**4,420**	**5,760**
	7,004	3,476	4,749	6,826	3,260	4,248
SI3-130C-080[1]/O1D	**15,167**	**4,356**	**5,124**	**7,808**	**4,667**	**8,827**
	11,187	3,213	3,779	5,759	3,442	6,510
SI3-130S-090[1]/O5D	**12,628**	**6,371**	**8,879**	**10,976**	**5,146**	**6,554**
	9,314	4,699	6,549	8,095	3,795	4,834
SI3-130S-100[1]/O6D	**16,882**	**8,141**	**10,736**	**13,778**	**5,835**	**6,530**
	12,452	6,004	7,918	10,162	4,304	4,816
SI3-130C-100[1]/O6D	**27,008**	**7,451**	**8,541**	**11,626**	**6,409**	**9,753**
	19,920	5,496	6,300	8,575	4,727	7,193
SI3-161A-100[1]/O2D	**16,357**	**8,538**	**12,388**	**17,875**	**9,384**	**13,466**
	12,064	6,297	9,137	13,184	6,921	9,932
SI3-161A-110[1]/O3D	**18,998**	**10,194**	**15,274**	**21,882**	**11,820**	**17,848**
	14,012	7,519	11,266	16,139	8,718	13,164
SI3-161B-110[1]/O3D	**30,016**	**9,583**	**12,059**	**18,370**	**11,984**	**27,698**
	22,139	7,068	8,894	13,549	8,839	20,429
SI3-161A-125[1]/O4D	**24,385**	**13,094**	**19,635**	**28,344**	**15,344**	**23,223**
	17,985	9,658	14,482	20,905	11,317	17,128
SI3-161B-125[1]/O4D	**38,745**	**12,398**	**15,624**	**23,914**	**15,633**	**36,294**
	28,577	9,144	11,524	17,638	11,530	26,769

Torque	Nm	lbf.ft

Actuator Performance

SI3-SR Operating Times – General

All operating times stated are nominal values at +20 °C.

Operating times in the hydraulic direction are fixed (non-adjustable) and are based on a power supply frequency of 50 Hz. Times are subject to change due to build variances and differences in operating temperature.

Operating times in the spring direction are adjustable (except option 0) between the minimum and maximum values.

SI3-SR Operating Times – Hydraulic Direction

Actuator Size	Hydraulic Direction (seconds)		
	0.58 LPM	1.50 LPM	2.25 LPM
SI3-030-035[1]/[2]0	**5.3**	**2.4**	**1.7**
SI3-030-035[1]/[2]1	5.3	2.4	1.7
SI3-060-045[1]/[2]2	**10**	**4.5**	**3.1**
SI3-120-060[1]/[2]3	21	9.5	6.7
SI3-240-070[1]/[2]2	**39**	**17**	**12**
SI3-240-070[1]/[2]3	39	17	12
SI3-085S-050[1]/[2]2D	**33**	**15**	**10**
SI3-085S-060[1]/[2]3D	49	22	15
SI3-085C-060[1]/[2]3D	**52**	**23**	**16**
SI3-085S-070[1]/[2]6D	66	29	21
SI3-085C-070[1]/[2]6D	**70**	**31**	**22**
SI3-085S-080[1]/[2]7D	86	38	27
SI3-085C-080[1]/C7D	**92**	**41**	**29**
SI3-100C-080[1]/O2D	108	48	34
SI3-130S-080[1]/[2]1D	**132**	**58**	**41**
SI3-130C-080[1]/[2]1D	140	62	43
SI3-130S-090[1]/[2]5D	**167**	**73**	**52**
SI3-130S-100[1]/[2]6D	206	91	64
SI3-130C-100[1]/[2]6D	**219**	**96**	**68**
SI3-161A-100[1]/[2]2D	253	111	78
SI3-161A-110[1]/[2]3D	**306**	**135**	**94**
SI3-161B-110[1]/[2]3D	326	143	100
SI3-161A-125[1]/[2]4D	**395**	**174**	**122**
SI3-161B-125[1]/[2]4D	420	185	130

1. Dependent on the operating temperature selected.
2. Dependent on spring direction.

Actuator Performance

SI3-SR Operating Times – Spring Direction

Actuator Size	Spring Direction (seconds)																	
	0		1		2		3		4		6		7		8		9	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
SI3-030-035$^{1}/^{2}$0	**0.1**	**0.1**	**0.2**	**0.4**	**0.2**	**0.8**	**0.8**	**2**	**1**	**5**	**2**	**4**	**2**	**5**	**3**	**5**	**3**	**7**
SI3-030-035$^{1}/^{2}$1	0.1	0.1	0.2	0.3	0.2	0.7	0.7	2	0.9	3	2	4	2	5	3	6	3	7
SI3-060-045$^{1}/^{2}$2	**0.2**	**0.2**	**0.3**	**0.5**	**0.3**	**1.2**	**1.3**	**3**	**1.7**	**6**	**4**	**7**	**4**	**8**	**4**	**11**	**5**	**13**
SI3-120-060$^{1}/^{2}$3	0.4	0.4	0.6	1.0	0.6	2.7	2.9	6	3.6	13	8	15	8	18	9	22	10	27
SI3-240-070$^{1}/^{2}$2	**0.7**	**0.8**	**1.0**	**2.0**	**1.1**	**5.2**	**5.3**	**12**	**6.1**	**26**	**14**	**28**	**15**	**32**	**16**	**39**	**18**	**49**
SI3-240-070$^{1}/^{2}$3	0.7	0.8	1.0	1.9	1.0	5	5.2	11	6.1	24	14	27	15	32	16	39	18	49
SI3-085S-050$^{1}/^{2}$2D	**0.5**	**0.6**	**0.7**	**1.3**	**0.7**	**4.1**	**4.2**	**8**	**5**	**16**	**12**	**23**	**13**	**26**	**14**	**34**	**15**	**40**
SI3-085S-060$^{1}/^{2}$3D	0.5	0.9	1.0	1.9	1.0	5.2	5.9	12	7.8	23	17	32	18	37	19	50	21	57
SI3-085C-060$^{1}/^{2}$3D	**0.5**	**1.0**	**1.0**	**2.0**	**1.1**	**5.5**	**6.3**	**13**	**8.2**	**24**	**18**	**35**	**20**	**40**	**20**	**53**	**23**	**61**
SI3-085S-070$^{1}/^{2}$6D	0.7	1.3	1.3	2.6	1.4	7.0	8.1	16	10.6	31	23	44	25	51	26	71	29	82
SI3-085C-070$^{1}/^{2}$6D	**0.7**	**1.3**	**1.4**	**2.7**	**1.5**	**7.5**	**8.6**	**17**	**11.2**	**32**	**24**	**47**	**26**	**54**	**28**	**76**	**31**	**87**
SI3-085S-080$^{1}/^{2}$7D	0.9	1.6	1.7	3.3	1.8	10	10.6	21	13	40	30	57	32	70	34	93	38	107
SI3-085C-080^{1}/C7D	**1.0**	**1.7**	**1.8**	**3.5**	**1.9**	**10**	**11.2**	**22**	**14**	**42**	**32**	**61**	**34**	**74**	**36**	**98**	**40**	**114**
SI3-100C-080^{1}/O2D	1.2	2.1	2.2	4.3	2.3	12	14	27	16	52	37	72	40	88	43	117	47	135
SI3-130S-080$^{1}/^{2}$1D	**1.5**	**2.5**	**2.7**	**5.2**	**2.8**	**17**	**15**	**32**	**20**	**66**	**45**	**93**	**49**	**107**	**52**	**143**	**58**	**164**
SI3-130C-080$^{1}/^{2}$1D	1.6	2.7	2.9	5.5	3.0	18	16	34	21	70	48	99	52	114	56	152	61	175
SI3-130S-090$^{1}/^{2}$5D	**1.8**	**3.1**	**3.3**	**6.3**	**3.4**	**20**	**19**	**39**	**25**	**80**	**57**	**117**	**62**	**135**	**65**	**178**	**73**	**206**
SI3-130S-100$^{1}/^{2}$6D	2.2	3.8	4.0	8	4.2	25	23	48	30	98	70	143	76	166	80	219	89	254
SI3-130C-100$^{1}/^{2}$6D	**2.4**	**4.0**	**4.2**	**9**	**4.4**	**26**	**25**	**51**	**32**	**104**	**75**	**153**	**81**	**176**	**85**	**233**	**94**	**270**
SI3-161A-100$^{1}/^{2}$2D	3.0	4.9	5.3	10	5.4	32	29	65	38	129	87	179	94	207	101	275	111	317
SI3-161A-110$^{1}/^{2}$3D	**3.7**	**6.0**	**6.5**	**14**	**6.7**	**39**	**36**	**80**	**46**	**157**	**105**	**216**	**114**	**250**	**122**	**333**	**135**	**384**
SI3-161B-110$^{1}/^{2}$3D	3.9	6.4	6.9	15	7.1	41	38	85	49	167	111	230	121	266	130	354	143	408
SI3-161A-125$^{1}/^{2}$4D	**4.8**	**7.8**	**8.4**	**18**	**8.7**	**50**	**46**	**103**	**60**	**203**	**135**	**280**	**147**	**323**	**157**	**430**	**174**	**496**
SI3-161B-125$^{1}/^{2}$4D	5.1	8.3	8.9	19	9.2	53	49	109	63	216	144	297	156	344	168	457	185	527

SI4 Operating Torques/Thrusts//Times

Consult Rotork for operating torques/thusts and times in relation to the SI4 range of actuators.

Actuator Specification

Design Specification

The SI range complies with the following standards where applicable:

- EN 15714-2:2009 – Electric actuators for industrial valves – Basic requirements
- ISO 12490:2011 – Mechanical integrity and sizing of actuators and mounting kits for pipeline valves

Design Life

Design life is mainly limited by the torque/thrust of the actuator; the values quoted below are the minimum requirements; for most actuator sizes the life will be extended above these values.

Actuator Type	Minimum Number of Cycles
RH all sizes	60,000
GH-085, GH-100 Linear < 48 kN	50,000
GH-130 Linear < 125 kN	25,000
GH-161 Linear < 200 kN	10,000
GH-201, GH271 Linear < 315 kN	5,000
GH-350 Linear < 500 kN	2,500

Duty Rating

Duty rating is mainly limited by the operating temperature. Values quoted below are the maximum that the actuator can be operated at without affecting normal functionality.

Duty Classification	Actuator Type	Duty Rating
On-Off & Positioning	SI3-SR & SI4-SR	< 15 cycles/hour (operating time not to exceed 15 minute in one hour)
Modulating	SI3-SR & SI4-SR	< 40°C: 300 starts/hour @ 75% rated torque > 40°C: 300 starts/hour @ 40% rated torque

Positional Accuracy

The following positional response is based on a 4-20 mA control system with the SI operating over its maximum stroke, rated speed (with 1.5 LPM selected) and constant force with minimum deadband set and with a linear demand/valve characteristic. Resolution is defined as the minimum change in input signal required for a guaranteed response.

Actuator Type	Accuracy	Resolution
RH-030 Linear < 48 kN	1%	3%
RH-060 & RH-120 Linear < 125 kN	0.5%	1.5%
RH-240 GH all sizes Linear > 200 kN	0.25%	0.5%

Actuator Specification

Vibration & Shock

Vibration can severely affect the performance of plant equipment and life and its effects are cumulative, therefore an actuator subjected to significant levels may have a reduced lifespan. Levels of vibrations can vary significantly, depending on process conditions such as start up and shut down, valve cavitation and at different flow rates, making it difficult to capture with mobile devices. Where excessive plant induced vibration is anticipated, mounting the actuator remote from the valve and driving via extension shafting (incorporating vibration absorbing couplings) may provide a satisfactory solution.

The SI Range also includes a vibration sensor (housed within the control module), as standard that measures and captures vibration levels within the range of 10 Hz to 1 kHz (RMS average) and peak acceleration (maximum g) in 3 axes (x, y and z). Vibration trend logs averaged over one hour can be viewed on the display or downloaded and viewed on a PC/ laptop using Rotork's Insight 2 software.

Operating Temperature

The SI range is suitable for operation within the ambient temperature ranges shown below. Prior to installation actuators should be stored in a dry location with a temperature range not exceeding the ambient temperature range supplied.

Temperature Range	Control/Power Module Seals	Actuator Seals	Hydraulic Fluid
-10 to +70 °C (+14 to +158 °F)	Nitrile	Nitrile (Viton option)	Mineral (32 cSt)
-20 to +70 °C (-4 to +158 °F)	Nitrile	Nitrile	Synthetic PAO (32 cSt)
-30 to +70 °C (-22 to +158 °F)			
-40 to +50 °C (-40 to +122 °F)	HNBR	Flourosilicone	Synthetic Ester (3 cSt)
-50 to +50 °C (-58 to +122 °F)			

Other limitations on operating temperatures are as follows:

- 24 VDC Power Supply option limited to -40 °C (-40 °F)
- 24 VDC Auxiliary Power option limited to -40 °C (-40 °F)
- Wide Input ESD option to -40 °C (-40 °F)

Mounting Orientation

See PUB021-089 for available mounting orientations.

Actuator Specification

Functional Safety

The SI range has been designed for fail-safe applications where functional safety is paramount. The actuators are certified to IEC 61508:2010 as an element/subsystem suitable for use in safety related systems performing safety functions with the following safety integrity levels (SIL):

- SIL 2 capable without diagnostics
- SIL 3 capable with diagnostics

The results with diagnostic capability are only valid if a PST (Partial Stroke Test) is carried out with a frequency of at least 10 times the full proof test interval. For example, if the proof test interval = 8760 hours, PST interval must be 876 hours or less.

Fail Mode

When used in a fail-safe application it can be configured through hardware selection to accept an ESD input as part of a SIS. In this configuration the actuator will only operate normally when the actuator detects a safe ESD input signal and will trip on loss of that signal. The actuator can be provided to operate in the following ESD modes.

Fail Mode	Description of Operation
Fail-Safe (ESD & Power)	**Fail-Safe on Loss of ESD Signal or Power Supply** For applications where the loss of power supply is considered part of the SIS, the SI range is offered as fail-safe on either loss of ESD signal or power supply. In this mode the solenoid valve(s) that perform the safety function are powered from the power supply circuit with the following functionality: • Fail-safe on loss of ESD signal (20-60 VDC or 60-120 VAC) • Fail-safe on loss of power supply
Fail-Safe (ESD)	**Fail-Safe on Loss of ESD Signal only** For applications where the power supply is not critical to the functional safety of the process, the SI range can be offered for fail-safe on loss of ESD signal only. In this mode the solenoid valve(s) which perform the safety function will be powered from the ESD signal, which passes through a Pulse Width Modulation (PWM) circuit to reduce the power consumption with the following functionality: • Fail-safe on loss of ESD signal of 24 VDC nominal (21.6-28.8 VDC) • Stayput on loss of power supply *an option of having a wide input ESD signal of 20-60 VDC is also available on single ESD signal units
Fail-Safe (Power)	**Fail-Safe on Loss of Power Supply Only** For applications where only the loss of power supply is considered part of the SIS. In this configuration the ESD signal is not included.
Stayput	**Stayput on Loss of Power Supply Only** For applications where there isn't a fail-safe requirement.

Actuator Specification

ESD Signal

The standard fail-safe configuration of the SI range will accept a single ESD single, with the option of a second ESD signal by using an additional ESD option card. This allows it to operate from two shutdown systems such as ESD from a safety system and a Process Shutdown (PSD) from a DCS system without affecting the integrity of the safety system with the following functionality:

ESD Signal	Description of Operation
Single	A single ESD signal operates common solenoid valve(s). If the ESD signal is removed the actuator will perform the safety function by operating the same solenoid valve(s).
Dual	Dual ESD signals operate common solenoid valve(s). If either ESD signal is removed the actuator will perform the safety function by operating the same solenoid valve(s).
Independent	Independent ESD signals operating independent solenoid valve(s). If either ESD signal is removed then the actuator will perform the safety function by operating the associated solenoid valve.

Action on Temporary Loss of ESD Signal or Power Supply

The SI range can be configured to perform one of the actions listed below independently on temporary loss of ESD signal or power supply i.e., the actuator has not reached the fail-safe position before the ESD signal or power supply is re-instated:

- Stop and wait for a new command to move
- Return to the position before the temporary loss of ESD signal
- Continue to move to the safe position and wait for a new command to move
- Continue to move to the safe position and wait to be manually reset before reacting to a new command to move

Manual reset is carried out by moving the 'Red' selector on the local controls to a different position and then back again.

Note: this feature does not form part of the functional safety certification as it is carried out by software.

Actuator Specification

Non-Hazardous & Hazardous Area Approvals

All hazardous and non-hazardous area approvals on the SI range are watertight to IP66/68 or Type 4 & 6. The Rotork double-sealed terminal compartment features a seal at the terminal cover or a separate seal at the terminal bung. This results in the actuator internals being completely sealed from the environment for life, even with the terminal cover removed.

Through the use of non-intrusive commissioning and adjustment using the Rotork Bluetooth® Setting Tool *Pro*, covers never need removing and therefore the hermetic, factory-sealed enclosure protects internal components for life.

In addition, the Rotork Bluetooth® Setting Tool *Pro* is certified Intrinsically Safe permitting power-on commissioning in hazardous areas.

Actuators are available with the following enclosure types for which the ambient working temperature ranges are stated. Where option temperatures are indicated, changes to some actuator components are required and therefore the temperature requirement must be specified. Hazardous area approvals for other country standards are available; please contact Rotork.

The SI range is available in accordance with the following standards:

Non-Hazardous Area Approvals

Watertight (WT)

Region	Standard	Enclosure Rating	Temperature Range
United Kingdom & Europe	BS EN 60529:1992+A2:2013	IP66/68 (7 m for 72 Hrs)	-50 to +70 °C (-58 to +158 °F)
Canada	CAN/CSA-C22.2 No. 60529:16 CAN/CSA-C22.2 No. 94.1-15 & 94.2	IP66/68 (7 m for 72 Hrs) Type 4 & 6	-40 to +70 °C (-40 to +158 °F)
USA	ANSI/IEC 60529:04 (R2011) UL50 & UL50E	IP66/68 (7 m for 72 Hrs) Type 4 & 6	-40 to +70 °C (-40 to +158 °F)

Hazardous Area Approvals

United Kingdom – UKEX (2016 No. 1107)

Product	Area Classification	Equipment Marking	Temperature Range
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1) **SI4** (Manifold Configuration 2)	Zone 1	II 2 G Ex db h IIB T4 Gb II 2 G Ex db eb h IIB T4 Gb	-50 to +70 °C (-58 to +158 °F)
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1)	Zone 1	II 2 G Ex db h IIC T4 Gb II 2 G Ex db eb h IIC T4 Gb	-50 to +70 °C (-58 to +158 °F)
SI4 (Manifold Configuration 2)	Zone 1	II 2 G Ex db h IIC T4 Gb II 2 G Ex db eb h IIC T4 Gb	-20 to +70 °C (-4 to +158 °F)

Europe – ATEX Directive (2014/34/EU)

Product	Area Classification	Equipment Marking	Temperature Range
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1) **SI4** (Manifold Configuration 2)	Zone 1	II 2 G Ex db h IIB T4 Gb II 2 G Ex db eb h IIB T4 Gb	-50 to +70 °C (-58 to +158 °F)
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1)	Zone 1	II 2 G Ex db h IIC T4 Gb II 2 G Ex db eb h IIC T4 Gb	-50 to +70 °C (-58 to +158 °F)
SI4 (Manifold Configuration 2)	Zone 1	II 2 G Ex db h IIC T4 Gb II 2 G Ex db eb h IIC T4 Gb	-20 to +70 °C (-4 to +158 °F)

International – IECEx

Product	Area Classification	Equipment Marking	Temperature Range
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1) **SI4** (Manifold Configuration 2)	Zone 1	Ex db IIB T4 Gb Ex db eb IIB T4 Gb	-50 to +70 °C (-58 to +158 °F)
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1)	Zone 1	Ex db IIC T4 Gb Ex db eb IIC T4 Gb	-50 to +70 °C (-58 to +158 °F)
SI4 (Manifold Configuration 2)	Zone 1	Ex db IIC T4 Gb Ex db eb IIC T4 Gb	-20 to +70 °C (-4 to +158 °F)

Actuator Specification

Hazardous Area Approvals *cont.*

Canada – cCSAus

Product	Area Classification	Equipment Marking	Temperature Range
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1) **SI4** (Manifold Configuration 2)	Class I, Zone 1	Ex db IIB T4 Gb Ex db eb IIB T4 Gb	-40 to +70 °C (-40 to +158 °F)
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1)	Class I, Zone 1	Ex db IIC T4 Gb Ex db eb IIC T4 Gb	-40 to +70 °C (-40 to +158 °F)
SI4 (Manifold Configuration 2)	Class I, Zone 1	Ex db IIC T4 Gb Ex db eb IIC T4 Gb	-20 to +70 °C (-4 to +158 °F)

USA – cCSAus

Product	Area Classification	Equipment Marking	Temperature Range
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1) **SI4** (Manifold Configuration 2)	Class I, Zone 1	AEx db IIB T4 Gb AEx db eb IIB T4 Gb	-40 to +70 °C (-40 to +158 °F)
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1)	Class I, Zone 1	AEx db IIC T4 Gb AEx db eb IIC T4 Gb	-40 to +70 °C (-40 to +158 °F)
SI4 (Manifold Configuration 2)	Class I, Zone 1	AEx db IIC T4 Gb AEx db eb IIC T4 Gb	-20 to +70 °C (-4 to +158 °F)

China – CCC

Product	Area Classification	Equipment Marking	Temperature Range
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1) **SI4** (Manifold Configuration 2)	Zone 1	Ex db IIB T4 Gb Ex db eb IIB T4 Gb	-50 to +70 °C (-58 to +158 °F)
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1)	Zone 1	Ex db IIC T4 Gb Ex db eb IIC T4 Gb	-50 to +70 °C (-58 to +158 °F)
SI4 (Manifold Configuration 2)	Zone 1	Ex db IIC T4 Gb Ex db eb IIC T4 Gb	-20 to +70 °C (-4 to +158 °F)

India – CCoE

Product	Area Classification	Equipment Marking	Temperature Range
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1) **SI4** (Manifold Configuration 2)	Zone 1	Ex db IIB T4 Gb	-50 to +70 °C (-58 to +158 °F)
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1)	Zone 1	Ex db IIC T4 Gb	-50 to +70 °C (-58 to +158 °F)
SI4 (Manifold Configuration 2)	Zone 1	Ex db IIC T4 Gb	-20 to +70 °C (-4 to +158 °F)

EAC (incl. Armenia, Kazakhstan & Kyrgyzstan)

Product	Area Classification	Equipment Marking	Temperature Range
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1) **SI4** (Manifold Configuration 2)	Zone 1	1 Ex d IIB T4 Gb 1 Ex d e IIB T4 Gb	-50 to +70 °C (-58 to +158 °F)
SI3 (Manifold Configuration 1) **SI4** (Manifold Configuration 1)	Zone 1	1 Ex d IIC T4 Gb 1 Ex d e IIC T4 Gb	-50 to +70 °C (-58 to +158 °F)
SI4 (Manifold Configuration 2)	Zone 1	1 Ex d IIC T4 Gb 1 Ex d e IIC T4 Gb	-20 to +70 °C (-4 to +158 °F)

Rotork Bluetooth® Setting Tool *Pro* Approval

Refer to the Safe Use, Installation and Maintenance Manual (PUB095-013) for approval details.

Actuator Specification

Regulatory Standards

UKCA & CE Marking

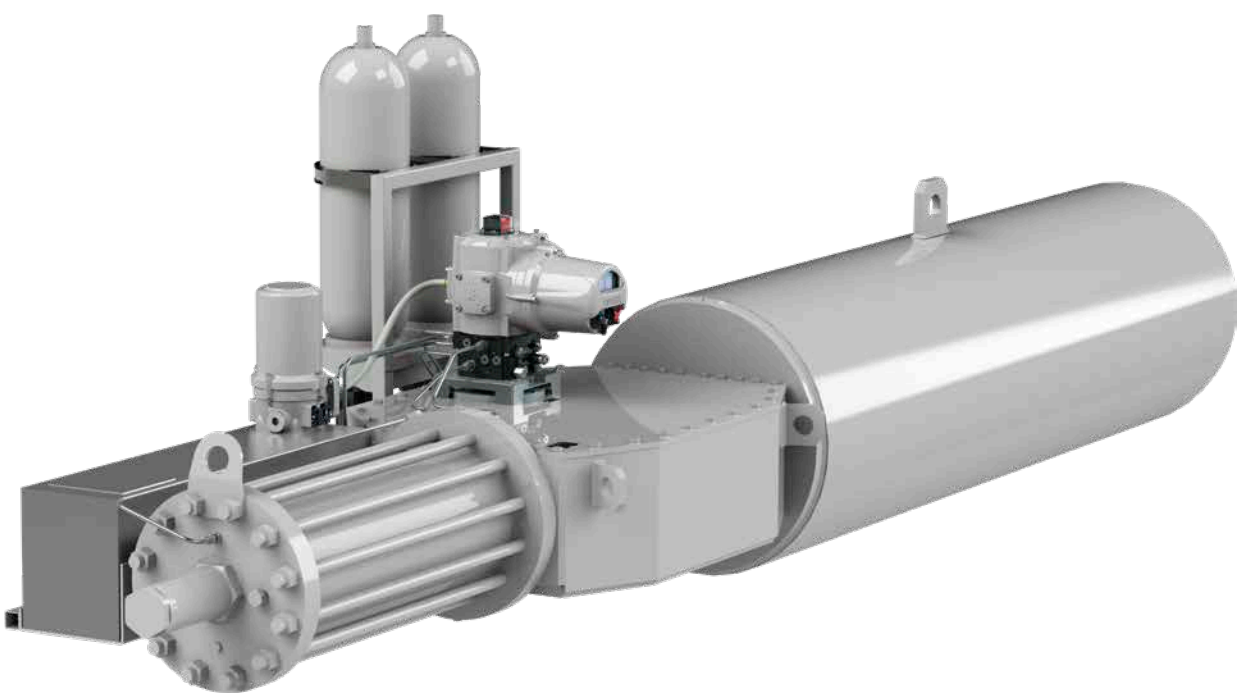
Compliance with the following United Kingdom Regulations and European Economic Community Directives permits the SI range to be UKCA and CE marked as follows:

Regulation/Directive	Standards used to show Compliance	Comments
Supply of Machinery (Safety) Regulation – 2008 Machinery Directive – 2006/42/EC	EN ISO 12100:2010 EN IEC 61010:2010	The SI range must not be put into service until the equipment into which it is being incorporated has been declared to be in conformity with the provisions of the applicable Machinery Regulation or Directive.
Radio Equipment Regulation – 2017 Radio Equipment Directive (RED) – 2014/53/EU	Section 3.1 a – EN 61010-1: 2010 Section 3.1 b – EN 61326-1: 2013 Section 3.2 – EN 301-489-1 V2.1.1, EN 301-489-17 V3.1.1, EN 300-328 V2.2.2	

Contact Rotork for a copy of our Declaration of Conformity and Incorporation.

Other Regulatory Standards

Standard	Product Effected	Comments
Federal Communications Commission	Bluetooth modules – Actuator and Rotork Bluetooth® Setting Tool *Pro*.	Contains FCC certified transmitter module.



Actuator Specification

Power, Control & Indication

Power Supplies

The SI range is suitable for operation with the following power supplies:

Voltage Type	Voltage
1-Phase (AC)	**50 Hz:** 230 V **60 Hz:** 110, 120 & 230 V
3-Phase (AC)	**50 Hz:** 380, 400, 415 & 440 V **60 Hz:** 380, 400, 415, 440, 480 & 575 V
DC	24 V
Voltage Tolerance	± 10 % – Applies to rated torque performance, duty cycle and speed is not guaranteed.
Frequency Tolerance	± 10 % – Applies to rated torque performance, duty cycle and speed is not guaranteed.
Uninterruptable power supplies	For AC systems the UPS output should conform to recognised supply standards such as EN 50160 in respect of waveform, harmonics etc.

LCD Display, Local Control, Indication & Set-up

The high resolution, dual stacked LCD display has a wide viewing angle making it easily legible from a distance. Consisting of a static, high-contrast positional display with characters that are 25 mm high and a fully configurable dot-matrix LCD behind to display text and graphical information. The LCD display operates from -50 up to +70 °C.

Non-intrusive selectors are provided on the control module cover which also includes a window showing actuator position, status and alarms.

The control module cover may be rotated through 360° (90° increments) to suit actuator orientation/operator access. Set-up is over a Bluetooth interface using the supplied Rotork Bluetooth® Setting Tool *Pro*.

Local Controls (Standard)

Operation	Type	Function	Comments
Position	Red, rotary selector	Selects "Local", "Stop" or "Remote" control	Can be padlocked in each position (stop remains available) for site operational protection.
Local Control	Black, rotary selector	Initiates local "Open" and "Close" operation	Spring-return to centre neutral position. Local control may be user configured for inching action.
Bluetooth	Rotork Bluetooth® Setting Tool *Pro*	Initiates local "Open" and "Close" operation	May be user configured for Bluetooth operation over a nominal distance of 10 m (30 ft).

Local Control Features

Feature	Description
Maintained or Push to Run	**Maintained** – The actuator will respond to a momentary local open or close control signal. It will run until it either receives a Stop command, reaches a travel limit or is reversed. **Push to Run** – The actuator will respond while the local open or close signal is manually held, once released the actuator will 'Stayput'.
Delay Control	If there is a risk of a local open or close control signal being applied due to the selector moving inadvertently or by being hit momentarily, a delay can be set to help prevent an unintended operation.
Dead Man Local	The actuator will move away from the fail-safe position while the local open or close signal (depending on spring-return direction) is manually held, once released the actuator will move back to the fail-safe position.
Loss of HMI	The HMI consists of the actuator display and red and black selectors. If for any reason the HMI stops responding, the actuator can be set to either 'Stayput' or 'Remote'.

Actuator Specification

LCD Display, Local Control, Indication & Set-up *cont.*

Local Indication (Standard)

Operation	Type	Function	Comments
Position Indication	LCD – large character (25 mm/1”)	Close icon – 0-99% (0.1% increments) – Open Icon	Power on (Back-lit) – operating temperature range -50 to +70 °C (-58 to +158 °F).
Position Indication	LED’s – coloured indication	Red (close), Green (open) Yellow (mid-travel)	Power on – LED indication, open/close colours can be reversed. The Yellow LED can be configured to indicate alarms.
Status and Alarms (multi-language)	LCD – status and alarm text	Status and alarm text integrated into position display	Power on – describes the current status and alarms (if present).
Alarms	LCD – general alarm icon	Alarm icon integrated into position display	Power on – at a glance indication, detail provided by status/alarm text.

Local Indication (Options)

Operation	Type	Function	Comments
Position Indication	Mechanical – UV resistant polycarbonate	Red (close) and Green (open) beacon	Available on quarter-turn actuators only – visible at over 10 m away.
Position Indication	Mechanical – Stainless Steel (316)	Red (close) and Natural (open) beacon	Available on quarter-turn actuators only – visible at over 10 m away.

Additional Options

Description	Comments
Display Window Protector	Protects against ultraviolet and abrasive environments.
Vandal-proof Cover	A lockable cover that protects the LCD display and local controls.

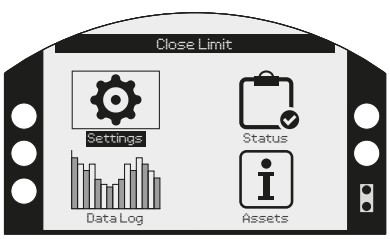
Actuator Specification

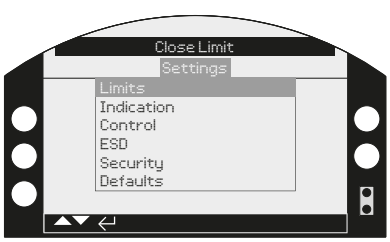
Actuator Set-up & Configuration

The SI range actuators are set up using the non-intrusive Rotork Bluetooth® Setting Tool *Pro*. Pressure limits, position limits, control and indication functions can all be accessed using the intrinsically safe, wireless handheld setting tool.

Bluetooth wireless connectivity allows easier use without direct line-of-sight and over greater distances, however security has to match. This is achieved by the initial 'pairing' of tool and actuator being carried out by a single infrared transaction after which a Bluetooth wireless connection automatically takes over. Configuration changes are password protected and the actuator is immune to connection by non-Rotork devices or programmes.

The SI range benefits from advances in human interface design. In addition to a configurable, information-rich display, they offer a highly intuitive menu system for commissioning, updates and diagnostics. This menu has been designed and structured to reduce reliance on having a written manual to hand. With large, clear characters available in many languages, setup and configuration has never been so easy.





Rotork's Insight 2 software facilitates actuator set-up by pre-defining complete sets of instructions and settings. Each collection of settings can be saved as a 'mission' and quickly applied to individual actuators via the handheld Rotork Bluetooth® Setting Tool *Pro*.

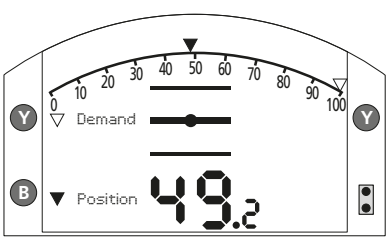
Reference documents

Refer to PUB021-069 for details of status and alarm text messages, alarm icons, help screens and actuator set-up procedure.

Refer to PUB095-001 for Rotork Bluetooth® Setting Tool Pro manual.

Configurable Home Screens

With a mixture of the static and dot-matrix displays, there are now three configurable home-screens available to the user. The screens reflect the parameters most commonly required to analyse operation at a glance:



Using the Rotork Bluetooth® Setting Tool *Pro*, each of these screens can be easily accessed with a press of a button. Alternatively you can select one of the three screens to be continually displayed in the setup menu.

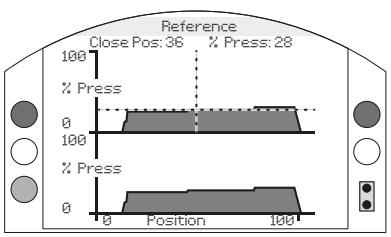
An additional screen can be selected on systems fitted with an accumulator, this will show the position and accumulator pressure in addition to the actuator pressure.

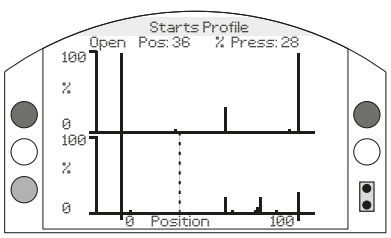
Actuator Specification

Graphical Data Logger

The internal data logger provides data of the actuator, valve and input signals. The data logger stores the configuration set up, events, trends, status and alarms with up to 3,000 events held in the actuator memory. The position, hydraulic pressure and temperature are also continuously monitored and stored.

The data can be viewed locally on the dot matrix display and can display graphs of position and pressure through to statistical operational data. All held data is secure and can be downloaded using the Rotork Bluetooth® Setting Tool *Pro* for viewing on a PC with Rotork Insight 2 software.





All configurations and data logger files are stored in non-volatile EEPROM memory, which means all settings are safe when the power is removed. An internal super capacitor is provided to maintain the real time clock when the actuator is not powered for periods of over two weeks should the power supply be disconnected.

The data logger provides comprehensive data capture and analysis for planned maintenance and troubleshooting issues with the valve and processes, which includes the following:

- Pressure profile logs
- Start profile logs
- Vibration and temperature trend logs
- Event logs
- Alarm logs
- Partial and full stroke test results

Asset Management

Asset management data regarding the actuator and the valve can be stored within the actuator, including actuator build data, valve tag and information along with service information. Specific asset management information includes:

- Average pressure
- Starts (total number and maximum per hour)
- Total motor running time
- Maximum pressure at both open and closed limits
- Maximum and minimum temperatures
- Number of times switched on
- Last service date

Actuator Specification

Remote Control & Indication

The actuator can be configured for remote control of a valve or damper in on/off or positioning control applications. It is available to meet the requirements of various site control systems from simple manual push-button control, remote two position control through to positioning control using hardwired switched signals, analogue or network systems.

Remote Control (Standard)

Operation	Type	Function	Comments
Hardwired Control (Open, Closed & Stop/ Maintain)	3 x opto-isolated inputs designed for pulsed or maintained contacts.	20 - 60 VDC 40 - 120 VAC	Positive switched – actuator derived 24 VDC or externally supplied from the control system. The current drawn for each control input: 8 mA at 24 VDC & 12mA at 120 VAC. Minimum 'ON' voltage: 16 V. Maximum 'OFF' voltage: 8 V. Minimum pulsed duration: 300 ms.
Partial Stroke Test	Opto-isolated input designed for pulsed or maintained contacts.	20 - 60 VDC 40 - 120 VAC	

Remote Control (Options)

Operation	Type	Function	Comments
Positioning Control (Analogue)	Opto-isolated input – Folomatic	4 - 20 mA 0 - 10 VDC	Proportional control over the whole or part of the valve stroke. Configurable for open, close or stayput on loss of analogue signal.

Remote Control Features

Feature	Description
Hardwired Control	The actuator can be connected for maintained or push to run (inching) control.
2-Wire Priority	Hardwired control by using one external switched contact.
Fast Remotes	Hardwired switching down to 100 ms pulses for precise positioning.
Stepping Control	To increase the stroke time in the hydraulic direction of travel only. The stepping control option allows the start and stop positions (between 0-100%) to be selected along with the stroke time and number of steps to be made. This feature will not operate on loss of power supply.
Modulating Duty (Slowmode)	Slowmode allows accurate positioning control to be achieved. The slowmode range is selectable in the menu and operates in conjunction with a flow control valve which is adjusted to suit the application. It operates from either an analogue or network signal.
Dual Speed	This allows the actuator to move in the spring direction at two different operating speeds with a 'Close' command giving a slower speed than an 'ESD' command. Both speeds are adjustable by separate flow control valves.

Actuator Specification

Remote Control & Indication *cont.*

Remote Indication (Standard)

Operation	Type	Range	Comments
Position, Status and Alarm Indication	Indication relays 4 x latching volt-free contacts – S1 to S4. Single pole – single throw (SPST), configurable NO or NC	5 mA to 5 A[1] 30 VDC 120 VAC	Independently configured using the Rotork Bluetooth® Setting Tool *Pro* to signal one of the following: **Valve Position:** Fully open, fully closed or any intermediate positions (0-99% open) **Status:** Valve opening, closing, moving, local-stop selected, local selected, remote selected, temperature trip, Partial Stroke Test (PST) active/pass/fail, Full Stroke Test (FST) active/pass/fail and motor running. **Control Alarms:** ESD active, manual reset, lost phase (3-phase only), and manual operation **Process Alarms:** Over pressure tripped at limit and/or mid travel, valve stalled at limit and/or mid travel, motor thermostat. **Actuator Alarms:** Customer 24 VDC supply lost, internal fault detected. **General Alarm:** Including all alarms above **Accumulator Alarms:** Accumulator charging/fully charged, high/low pressure, unavailable.
Actuator Availability / Fault Indication	Monitor Relay 1 x non-latching volt-free contact. Single pole – double throw (SPDT), NO or NC	5 mA to 5 A 30 VDC 120 VAC	The monitor relay will de-energise when the actuator is unavailable for remote control due to any one or more of the following conditions: • Loss of one or more of the power supply phases • Loss of control circuit supply • Local control selected* • Local stop selected* • Motor thermostat tripped • Internal faults detected that prevents movement *The monitor relay can be configured for faults only and will ignore the local control status.

Remote Indication (Options)

Operation	Type	Range	Comments
Position, Status and Alarm Indication	Up to 8 configurable volt-free latching contacts – S5 to S12. Single pole – change over (SPCO)	5 mA to 5 A[1] 120 VAC 30 VDC	Independently configurable using the supplied Rotork Bluetooth® Setting Tool *Pro* as per contacts S1 to S4 above. S5 to S8 on one option card and S9 to S12 on a second option card.
Position Indication (Analogue)	Current Position Transmitter – CPT	4-20 mA output proportional to position	Auto range to set limits. Normally internally powered, available suitable for externally 'loop' powered.
Position Indication (Mechanical Limit Switches)	Single pole – single throw (SPST), NO or NC	Min. 5 mA or 2 mA Max. 5 A @ 250 VAC Max. 0.6 A @ 125 VDC	2 x SPST limit switches 4 x SPST limit switches
Position Indication (Proximity Limit Switches)	Single pole – single throw (SPST), NO or NC	5 A @ 250 VAC and 28 VDC	2 x SPST Nova V3-N1 switches 4 x SPST Nova V3-N1 switches
Position Indication (Proximity Sensors)	Inductive sensor, 2-wire, switched output	Voltage 5-60 VDC Current 4-100 mA	2 x Pepperl+Fuchs – NBB3-V3-Z4 sensors 4 x Pepperl+Fuchs – NBB3-V3-Z4 sensors
Pressure Indication (Analogue)	Current Pressure Transmitter – CTT	4-20 mA output proportional to pressure	Selected in the menu as an alternative to the analogue position feedback. Pressure can be selected as a range of 0% to 120% of rated pressure (4-20 mA).
24 VDC Auxiliary Power Supply	Maintains power to the actuator controls on loss of power supply	24 ± 10 % VDC 1 A (switching in-rush 8 A max)	Customer supply maintains backlit display, CPT analogue indication and bus network communications during actuator power outages. Customer supply is isolated from internal control power for protection.

1. Maximum total combined current through all four relays is not to exceed 8 A.

Actuator Specification

Network Control Options

With the addition of the appropriate option card, the SI range can be incorporated in a number of different network control systems, including Rotork *Pakscan*™, Profibus®, Foundation Fieldbus®, Modbus®, DeviceNet®, and HART®. All control functions, position and status indication can be communicated through the chosen network. When used in a functional safety application the actuator would be supplied with a hardwired ESD input which will take priority over all other commands.

Network Type	Description
Pakscan	An internally mounted *Pakscan* field unit for remote control and status indication. *Pakscan* Classic network operates on a 2-wire current loop containing up to 240 field devices with a loop length of up to 20 km without repeaters and host communication using Modbus protocol. For more information please refer to PUB059-007.
Modbus	Modbus modules suitable for single or dual communication highways may be included to provide Fieldbus communication of all the actuator control functions and feedback data. Data is carried on an RS485 data highway and the communications protocol used is Modbus RTU. System variables such as unit address and data baud rate are programmed over the Bluetooth data link. For more information please refer to PUB091-001.
Profibus	A Profibus DP interface module is available to allow the actuator to be integrated into a Profibus network. Full compatibility with EN 50170 is provided and the Profibus network allows full actuator control and feedback of data to the host. For more information please refer to PUB088-001.
Foundation Fieldbus	An IEC 61158-2 compliant Foundation interface module allows the actuator to be connected to a Foundation network. The device has link scheduler capability as well as digital and analogue function block capability. Foundation Fieldbus actuators can communicate directly between themselves without the need of a host supervisory system. For more information please refer to PUB089-001.
HART	HART (Highway Addressable Remote Transducer) is a process control communication protocol. The signal consists of two parts, the analogue 4-20 mA current loop and a superimposed digital signal. Traditionally the 4-20 mA loop is used for control and the superimposed digital signal for feedback, diagnostics and configuration. Configuration and feedback using the HART digital signal can be achieved using the host connected to the actuator to select the parameters required. The majority of the user configurable settings can be made over the HART communication protocol. For more information please refer to PUB092-001.
DeviceNet®	DeviceNet® is a communications protocol which utilises the CAN bus network. The DeviceNet® module Electronic Data Sheet (EDS) file is used to set up the actuator parameters and allow system performance to be optimised. Status, alarms and control functions are available over the DeviceNet® network. For more information please contact Rotork.

Actuator Specification

Protection and Operating Features

The SI range provides comprehensive fault detection of the process, control signals as well as self-diagnosis. Below is an abbreviated list of typical faults that the actuator can detect.

All faults and alarms listed below are indicated on the actuator display and can be remotely signalled unless otherwise stated.

Reference documents

Refer to PUB021-069 for details of status and alarm text messages, alarm icons, help screens and actuator set-up procedure.

Fault / Alarm	Cause / Consequence	Function
Obstructed valve	Valve meets an obstruction or process condition that prevents movement. Obstruction must be sensed to prevent damage to the valve and actuator.	**Overpressure (mid-position) Alarm** This alarm will trip if the monitored pressure within the actuator exceeds a pre-set value when commanded to move in the hydraulic direction between the end of stroke limits. The overpressure alarm can be set up to 100% of maximum system pressure. **Stall (mid-position) Alarm** This alarm will trip if no movement is detected when commanded to do so in the spring direction between the end of stroke limits.
Jammed valve	Valve is stuck in its seat at the close or open position and operation fails to move the actuator and clear the limit position.	**Overpressure (at limit) Alarm** This alarm will trip if the monitored pressure within the actuator exceeds a pre-set value when commanded to move in the hydraulic direction at the end of stroke limits. The overpressure alarm can be set between up to 100% of maximum system pressure. **Stall (at limit) Alarm** This alarm will trip if no movement is detected when commanded to do so in the spring direction at the end of stroke limits.
Torque hammer	Actuator repeatedly tries to move an obstructed valve in response to a standing control signal. This can cause damage to both valve and actuator.	**Anti-Hammer Protection** Once an overpressure or stall alarm occurs the controller will prevent repeated operation in the same direction as a response to a standing remote or local control signal. The actuator must be operated in the opposite direction and therefore moved away from the obstruction, which then has a chance to clear, before it can be commanded to run in the requested direction again.
Actuator fault	Detected actuator fault	**Self-Diagnostics** The SI range will detect any internal control system failure preventing operation. In addition, diagnostic screens can be accessed allowing the problem to be identified.
Incorrect phase rotation (3-phase actuators only)	Due to the 3-phase supply wiring being incorrectly connected to actuator, the motor and pump run in the wrong direction and no hydraulic pressure is generated to move the actuator.	**Phase Rotated Alarm** In-built protection ensures that the supply to the motor is removed if incorrect phase-rotation is detected to ensure the pump is not damaged. Indicated on the actuator display only.
Lost phase / motor overheating (3-phase actuators only)	"Single phasing". One of the three phases applied to the actuator is lost due to a fault causing the motor to single phase i.e. attempts to run with only 2 of the 3 phases applied. Motor may fail to start (stall) or run unbalanced causing overheating.	**Lost Phase Alarm** In-built protection ensures that if a phase is lost the motor will be prevented from being energised. If during operation one phase is lost then this cannot be detected due to back-feed through the motor windings, however once operation stops, re-energising of the motor will be prevented.
Motor overheating	Actuator duty cycle is exceeded causing the motor to overheat. This often occurs during factory acceptance testing/commissioning or during process start up.	**Motor Thermostat Protection** Two thermostats are embedded in the motor end windings (hottest part of the motor) which directly sense motor temperature. The thermostats will open circuit when the set temperature is reached causing the motor to be de-energised. Thermostats will auto-reset once the motor has cooled sufficiently allowing operation to continue.

Actuator Specification

Protection and Operating Features *cont.*

Fault / Alarm	Cause / Consequence	Function
Remote control circuit failure (actuator derived remote control supply only)	Loss of remote control	**Remote Control Supply** The 24 VDC internal power supply made available for remote control switching is protected by an auto-reset fuse device. Should the power drawn from the supply exceed its rating (due to a remote control wiring fault, etc.), the fuse will disconnect the supply. Once the fault is cleared the supply will automatically be reinstated.
Actuator left in manual override mode	When the manual override handle has been set to manual mode	**Manual Operation Alarm** When the manual override handle is turned to manual mode an internal reed switch detects this change and will trigger an alarm. Due to the design of the hydraulic schematic the actuator can't be operated remotely or by using the local controls when in manual mode (this includes the ESD).When the actuator is taken out of manual mode the reed switch will detect the change and the alarm will be cleared.
Solenoid Valve Fault	Over & under current	The solenoid driver circuit monitors the solenoid and will trigger a fault on incorrect current or temperature of the solenoid.
Manual reset	Manual reset required following the loss of either the ESD signal or power supply	If selected in the menu, the actuator will be prevented from moving after a loss of ESD signal or power supply until the action of moving the 'Red' selector on the local controls to a different position and back again has been carried out.
Accumulator Charge Fault	The accumulator may not be able to move the actuator with the correct torque and for the correct number of strokes.	During a accumulator charge test (ACT) the pre-charge pressure is derived and the time to charge is compared to the values recorded when the actuator was commissioned. If the new values fall outside a 10% tolerance around the ACT values then a fault is triggered and remains until the alarm has been cleared.

Actuator Specification

Components

Internal Power Supply

An internal power supply is incorporated within the actuator for the LCD display, control system, sensors, solenoid valves and motor control/switching components. It also provides an isolated external electrical supply for switched remote control operation.

Voltage	Internal Power Supply	Motor Switching
AC	Toroidal transformer providing isolation and powering control circuits, option cards and an isolated 24 VDC external supply for remote control.	Contactor assembly with a 24 VDC coil controlling a motor and pump in a single direction.
DC	Switch mode power supply providing isolation and powering control circuits, option cards and an isolated 24 VDC external supply for remote control.	Reverse polarity protection and solid state switching of a brushed DC motor and pump in a single direction.

Motors

The SI3 range utilises purpose designed motors that are integral to the actuator. As such, these motors do not fall within the scope of IEC 60034, however they do meet the applicable requirements, where appropriate, of motor design for actuator operation. All motors are started under no load to increase the reliability over the life of the product. Insulation Class F (155 °C).

Voltage	Comments
1-phase (AC)	1-phase capacitor run squirrel cage motor incorporating thermostat protection.
3-phase (AC)	3-phase squirrel cage motor incorporating thermostat protection.
DC	Permanent magnet DC brush motor incorporating thermostat protection.

Solenoid Valves (SOV's)

All SOV's are housed internally and are therefore protected from the environment. A combination of normally open and normally closed SOV's can be fitted depending on the application. All fail-safe actuators use normally open SOV's as the final elements. All SOV's are energised by applying full power to them before reducing this by a factor of four to hold them through a pulse-width modulation circuit (PWM). Insulation Class N (200°C).

Position Sensor

The SI range monitors the position through a high-resolution non-contacting sensor. On quarter-turn actuators it is incorporated within the control module and within the cylinder on linear actuators. The sensors are designed for high duty cycling with minimum moving parts and are directly connected to the valve drive shaft in all applications to provide a resolution < 0.25%. The actuator display will read position as 0.0% at the closed limit and 100.0% at the open limit.

The actuator is capable of setting the open and closed limits on position or hydraulic pressure (torque).

Pressure Sensor

Hydraulic pressure sensor(s) are integrated within the actuators control module to monitor the pressure generated to overcome the valve throughout the actuator stroke along with separately monitoring the pressure stored in the accumulator(s) to ensure the correct charge pressure is maintained, if fitted.

The pressure sensor will detect obstructions in mid-travel and will trip an alarm should a high pressure be detected. When torque seating is required, an option is included for the system to maintain the internal hydraulic pressure by starting the motor/pump automatically if the pressure drops below the required pressure.

Hydraulic pressure changes due to thermal expansion or contraction will also be automatically compensated for.

Actuator Specification

Manual Override (Option)

The manual override consists of a hydraulic hand pump and a lockable selector valve. A manual selector valve is normally locked in the electrical operating position for normal actuator operation. When the power supply or control signal is not available the pipeline valve can be operated manually by removing the lock on the manual override selector valve and rotating the selector valve to the manual position.

The hand pump can then be operated to move the actuator in the hydraulic direction. The manual selector valve is also used to return the actuator in the spring direction.

SI4 actuators can also be operated with the manual selector valve if accumulators are fitted and there is sufficient stored energy available to move the actuator. Accumulators can be sized to give multiple strokes of operation on loss of power supply or control signal.

Care must be taken when using the manual override; in the manual position the actuator will not be part of the SIS and will not respond to an ESD command. The manual selector valve will detect when manual mode has been selected and prevent electrical operation until the valve has been returned to the normal electrical control position. The local mechanical position indicator will continue to show the position of the valve.

Should the power supply be reinstated while the actuator is in manual mode the actuator will display a manual alarm.

Materials

Product	Component	Material	Grade	Corrosion Protection
SI3 & SI4	Actuator	Carbon Steel Ductile Iron	See GH, RH and LH data sheets for full details	Painted
SI3 & SI4	Control module (castings)	Aluminium	BS EN 1706, AC-42000 (LM25) BS EN 1706, AC-42100 (L99) ASTM B5 GRADE A360	Painted
SI3 & SI4	Control module (manifold)	Aluminium	BS EN 573-1, 6082 T6	Plasma-Electrolytic Oxidisation
SI3 & SI4	Bracket (actuator to control module)	Carbon steel	BS EN 10025, S275JR BS EN 10028, P275NL1	Electrodeposition Coating
SI3 & SI4	Fluid reservoir	Carbon steel or Stainless steel	EN 10025, S275JR BS EN 10088, 1.4401 (316)	Painted None
SI4	Brackets for fluid reservoir	Carbon steel	BS EN 10025, S275JR	Painted
SI4	Accumulators	Carbon steel or Stainless steel	Consult Factory	Painted None
SI4	Brackets for accumulators	Carbon steel or Stainless steel	BS EN 10025, S275JR BS EN 10088, 1.4401 (316)	Painted None
SI4	Motors (third party)	Cast Iron	ISO 185, G200	Painted
SI3 & SI4	Fasteners	Stainless steel	A4-80 (316)	None
SI3 & SI4	Fittings & tubing	Stainless steel	BS EN 10088, 1.4401 (316)	None
SI3 & SI4	Solar Shields	Carbon Steel	BS EN 10083	Painted

Actuator Specification

Corrosion Protection

The standard paint systems used on the SI range have been developed over the past 20 years to offer suitable protection for the vast majority of actuation applications. Other systems are available on request.

The standard paint colour is Light Grey to BS4800 00-A-05. Other colours are available on request.

All components (ferrous and non-ferrous) go through a multi-stage cleaning process to provide an excellent surface for the paint process to be applied with strong adhesion.

Paint System	Actuator – GH, RH & LH (Ferrous)	Controller (Ferrous & Non-ferrous)
P1	• Primer - zinc rich epoxy • Build coat - epoxy • Top coat - polyurethane • Overall thickness - nominal: **225 µm**	• Etch Primer - two pack • Primer - two pack epoxy • Top coat - two pack acrylic • Overall thickness - nominal: **75 µm**
P2		• Etch Primer - two pack • Primer - two pack epoxy • Top coat - two pack acrylic • Overall thickness - nominal: **165 µm**
P3		• Primer - two pack epoxy • Tie coat - two pack epoxy • Build coat - two pack epoxy • Top coat - two pack acrylic • Overall thickness - nominal: **450 µm**
P4 (NACE Inspected)		• High build - epoxy • High build - epoxy • Top coat - polyurethane • Overall thickness - nominal: **480 µm**

The tables below shows which paint system is suitable for the environment that the actuator will be installed in along with the durability required:

Corrosivity Category	Durability		
	Low (2-5 Years)	Medium (5-15 Years)	High (>15 Years)
C1	P1	P1	P1
C2	P1	P1	P1
C3	P1	P1	P1
C4	P2	P2	P2
C5-M (Marine)	P3/P4	P3/P4	P4
C5-I (Industrial)	P3/P4	P3/P4	P4

For reference, ISO 12944-2 category definitions are shown below:

Corrosivity Category	Typical Environments – Exterior	Typical Environments – Interior
C1	N/A	Heated buildings with clean atmospheres, e.g. offices, shops, schools hotels.
C2	Atmospheres with low levels of pollution. Mostly rural areas.	Unheated buildings where condensation may occur, e.g. depots, sports halls.
C3	Urban and industrial atmospheres, moderate sulphur dioxide pollution. Coastal areas with low salinity.	Production rooms with high humidity and some air pollution, e.g. food processing plants, laundries, breweries, dairies.
C4	Industrial and coastal areas with moderate salinity.	Chemical plants, swimming pools, coastal ship/ boatyards.
C5-M (Marine)	Coastal and offshore areas with high salinity.	Buildings or areas with almost permanent condensation and with high pollution.
C5-I (Industrial)	Industrial areas with high humidity and aggressive atmospheres.	Buildings or areas with almost permanent condensation and with high pollution.

Actuator Specification

Cable/Conduit Entries

The SI Range have a separately sealed terminal compartment incorporating a terminal block and five M25 x 1.5P cable/conduit entries as standard (not all entries are accessible on all builds, consult Rotork for details). The SI range is supplied with plastic transit plugs fitted into the cable/conduit entries as standard. It is the responsibility of the installer to ensure the appropriate cable/conduit adapters, cable glands and/or blanking plugs are fitted in order to maintain hazardous area certification and ingress protection levels. Certified adapters and blanking plugs are available as optional extras, see table below:

Adaptor Material	Adaptor Thread
Nickel Plated Brass or Stainless Steel (316)	M20 x 1.5 P M32 x 1.5 P ½" NPT ¾" NPT 1" NPT 1¼" NPT

Terminals

The SI Range incorporates a terminal block containing segregated metric thread inserts. M5 (power) and M4 (control/indication) terminal screws and washers are supplied with the actuator. Terminals are designed to accept field wiring with ring crimps and conductors up to 16 mm^2 for power and 4 mm^2 for control/indication. Each actuator is also supplied with the applicable wiring diagram and instructions for safe use, installation, basic set-up and maintenance.

Wiring

The SI range utilises jig built wiring harnesses of individually numbered stranded conductors that are tropical grade PVC insulated. All internal control connections to the printed circuit boards are via plugs and sockets. Wiring of contacts to outgoing terminals are sized for the maximum applicable current.

Skilmatic SI3 & SI4 Range

Product Data Sheet

A full listing of the Rotork sales and service network is available on our website.

www.rotork.com

Corporate Headquarters
Rotork plc
tel +44 (0)1225 733200
email mail@rotork.com

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