CHEMSUN Electric Actuators

CSR / L - G06 Series: Compact and economical; Various Communication

Suitable for HVAC, petrochemical, metallurgy, nonferrous metals, light industry
Suitable for the special environment of small space required

Unique functions Optional one Operation Button，DC brushless Motor, Ultralow-power, Substitute configuration, Flow self balance, Multi-turn absolute encoder, Optional battery Version (with battery power supply) Optional two temperature or pressure sensors or PID control loop

Transducer Sensitivity 0.1%

Actuator Accuracy ≤0.3%

Rotary Output Torque 20 – 600 Nm

Linear Output Thrust 2 – 12 KN

General Technical Parameters

- Supply Power 24 VDC; 24/110/220 VAC (50/60Hz)
  Optional battery version (with battery power supply, no external power supply)
- Explosion Protected Non Ex
- Degree of protection IP65/66/67
- Ambient Temperature -40 to +80℃
- Input/output Signal
  Control type： 4 –20 mA / 0 –10(5)V
  On/off type： Dry contact switch
  Communication mode: Mod-bus / M-bus / NB / LOAR / 4G
- Alarm Way 2 – 4 Ways
- Power Fail Safe Reset Pos. FL (Fail Lock/Hold)
- Electrical connection 2 - M20x1.5
- Full Stroke time 7 – 300 Seconds
- Rotary output Torque 20 – 600 Nm
- Linear output Thrust 2 – 12 KN
- Rotary Strok 90° / Multi-turn
- Linear Stroke 20/40 mm

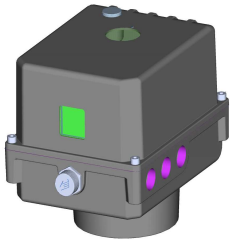


Fig.1: Type CSR-G06 Rotary E-Actuator
(With LCD and one button configuration button)

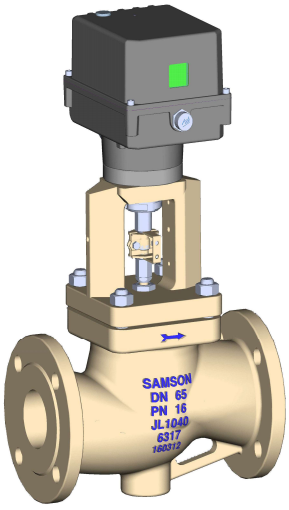


Fig.2: Type CSL-G06 Linear E-Actuator
(With SAMSON Globe Control valve)

Universal design standards

- American society of mechanical engineers (ASME)
- The fire protection association (NFPA)
- National Electrical Code (NEC)
- The electrical and electronic engineers (IEEE)
- ANSI/IEEE472

Structural Features

- Supply Power：24 VDC; 24/110/220 VAC (50/60Hz).
  Optional battery version (with battery power supply, no external power supply)
- High sensitivity and Low system deviation：0.1% transducer sensitivity, ≤0.3% actuator accuracy.
- Absolute encoder: The multi gear absolute encoder ensures that the valve position can be reliably detected when the power is off.

Even if the handwheel is turned after the power failure, the valve position can be accurately detected and feed back

- External gear transmission system, standard handle operation.
- DC brushless Motor, Maintenance free operation, continuous and unlimited regulation.
- Characteristic selecting: Linear/Equal percent/Quick open/ Self-definition.
- PID operation of built-in process is optional to realize closed-loop control of process loop.
- LCD display working parameters, optional external one button configuration button.
- Casting aluminum shell, protection grade IP65 / 66.
- Use Bluetooth or PC for non immersion configuration, calibration and parameter modification.
- Optional Mod-bus, M-bus, NB, LOAR, 4G Communication mode.

Fig.3: CSR-G06 Series E-Act.
(Without Configuration keys)

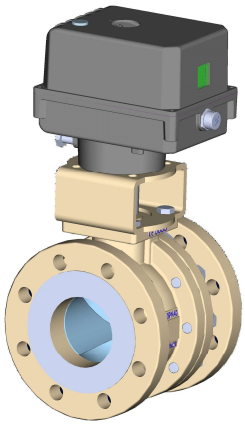


Fig.3: CSR-G06 Series Rotary E-Act.
(With CHEMSUN V-Ball Control Valve)

Standard Functions

- Diversified display functions: input, output, alarm, fault, etc. All menus can be displayed in English, German or Chinese.
- Mechanical transmission features: External gear transmission system.
- The control of motor driving mode and running speed: the DC brushless motor is driven by FOC software algorithm. Through PID calculation, the valve position can be slowly opened, fast accelerated close to the set valve position, and then slowly accelerated to the set valve position. The opening and closing time of the regulating valve can be realized by setting or modifying the operating speed.
- The output torque is adjustable: within the maximum rated output torque of the actuator, the output torque that best matches the valve can be set, and the overload protection value can be set within the range of ± 0 ~ 100%.
- Flow Characteristics Compensation: you can optimize the flow characteristics of the valve, to achieve the best process control quality.
- Stroke limit: two ways to choose, mechanical limit and software limit. The mechanical limit is adjusting the stroke switch in the main cabin, to realize the reliable and safe operation of the actuator. The software limit is completed by parameter configuration.
- Self-diagnosis function: automatic identification and protection for blocking, operation fault, power or signal failure, over current, over temperature, phase sequence, etc. Chemsun operating software can be selected to add diagnosis contents such as valve operation and spare parts replacement prediction.
- Self-inspection and alarm function: fault self diagnosis and display alarm.
- High positioning precision and frictionless electronic brake technology: when the actuator receives the opening or closing signal, the control unit performs PID calculation to accelerate the running. When approaching the signal position, it slows down the running speed and starts braking to avoid over adjustment or emergency braking, so as to ensure the positioning accuracy.
- The electronic commutation technology is applied to ensure smooth operation and adjustable speed.
- Blocking and overload protection: when the valve is blocked, the valve can not normally reach the valve position of the input signal, and the actuator will automatically try to impact the position for three times. If the automatic impact operation is not successful, the alarm will be given.
- Substitute configuration: Replace or repair the electric actuator online. In the production process, if the actuator fails,

the sub initialization mode can replace or repair the control boards without shutdown. The Substitute configuration function ensures that the plant continues to operate with this valve position.

- One control signal (such as 4-20mA) output by the controller can control two or more electric valves (connected in series).

Permanent magnet BLDC Motor

Motor is an important part of electric actuator. The application of Brushless DC motor in electric actuator has brought a great leap to drive control technology.

Permanent magnet brushless DC motor is composed of main body and driver. The motor is a typical mechatronics product. The rotor of the motor is composed of Nd-Fe-B and other rare-earth permanent magnetic alloy materials. Position sensors are installed in the motor to detect the polarity of the electric rotor. The driver composed of integrated circuits and electronic devices controls the start, stop, speed change, forward and reverse rotation of the motor, and provides protection and display.

Fig.5: Permanent magnet BLDC motor

Brush and brushless Motor technical analysis

Brush motor adopts mechanical commutation, short life, high noise, electric spark and low efficiency. When it is used for a long time, the carbon brush is seriously worn and easy to be damaged. In addition, a large amount of carbon dust is produced by the wear of carbon brush, which causes the bearing oil to dry up quickly and the motor noise increases further. If the brush motor is used continuously for a certain period of time, it is necessary to replace the carbon brush in the motor.

Brushless motor replaces mechanical commutation with electronic commutation, which has no mechanical friction, no wear, no electric spark, no maintenance and can be more sealed, so it is better than the brush motor in technology. Brushless DC motor (BLDCM) has a permanent magnet composed of rare earth materials, such as NdFeB. Its volume is one grade smaller than that of brushless motor or three-phase asynchronous motor with the same capacity.

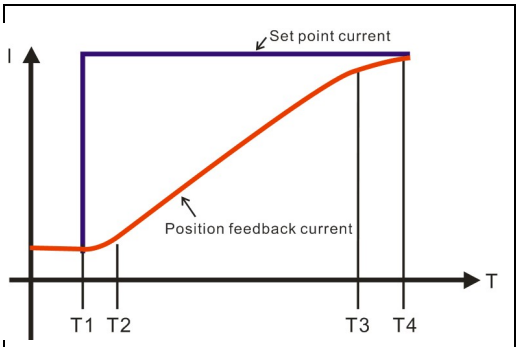


Fig.6a The relation graph between the set current and position feedback current

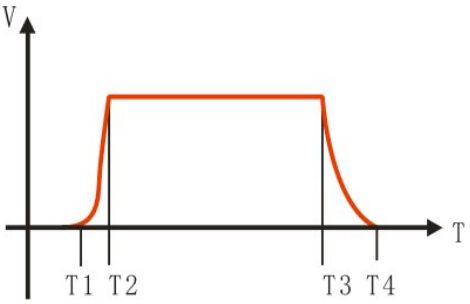


Fig.6b： Analysis chart of working speed and actuator output process of BLDCM

Permanent magnet BLDC Motor Advantages

- High speed and wide adjustment range, uniform and stable controllable speed, suitable for steady speed, speed regulation, and precision positioning.
- The operation of the motor adopts PID control technology to realize the positive acceleration to steady state and the negative acceleration to stop at the control position. (see Fig. 6b: Analysis chart of working speed and actuator output process of BLDCM).
- It adopts electronic commutation technology, with long service life, high operation reliability, high controllable precision, allowable locked rotor and maintenance free.
- The speed regulation ratio of the motor under constant torque load can reach 1:50~100, which is incomparable with other types of motor.
- The motor has large starting torque, small current, strong overload capacity, good dynamic performance and low calorific value, which is very suitable for long-term continuous operation.

- The operation of the motor does not interfere with the power grid, control system and other electrical equipment, with low power consumption, energy saving and environmental protection.
- It has excellent temperature resistance.

BLDC motor speed and actuator output process analysis

Figure 6a: The relationship between the given current and the position feedback current.
Figure 6b: Analysis chart of working speed and actuator output process of BLDCM.
T1：When there is a deviation between the given signal and the position feedback signal, the motor starts at low speed and accelerates uniformly.
T2：The motor speed gradually increases to the maximum value, and the high constant speed operation is close to the set position.
T3：The deviation decreases and the motor begins to decelerate.
T4：The deviation is eliminated, then the motor stops running.

Internal structure of electric actuator (Pig.7)

External gear transmission system: 5-stage drive

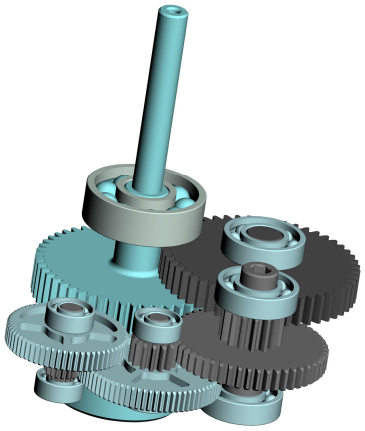


Fig.7: External gear transmission system

Detection and feedback of valve position

- The multi gear absolute encoder ensures that the valve position can be reliably detected when the power is off. Even if the handwheel is turned after the power failure, the valve position can be accurately detected and feed back.
- The encoder is composed of at least three Hall chips and detection gears, which measure the rotation angle of their own gears. In the case of normally power supply, the absolute angle and the number of running turns are detected by the main gear and its Hall chip, and the signal is transmitted to the CPU of the main control board, which is converted into the valve position data. In the case of power failure, the encoder's main gear and three driven gears have absolute angle difference due to the different number of teeth. The current position data of the valve can be calculated effectively through the specific software algorithm based on the difference between the two angles. And the encoder redundancy design, even if there is a gear or hall fault, it can also ensure the correct detection of valve position.
- The absolute hall encoder has a very high detection accuracy of valve position, which can reach 1 / 10000.

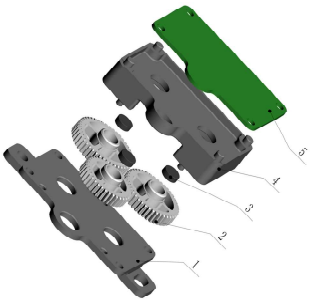
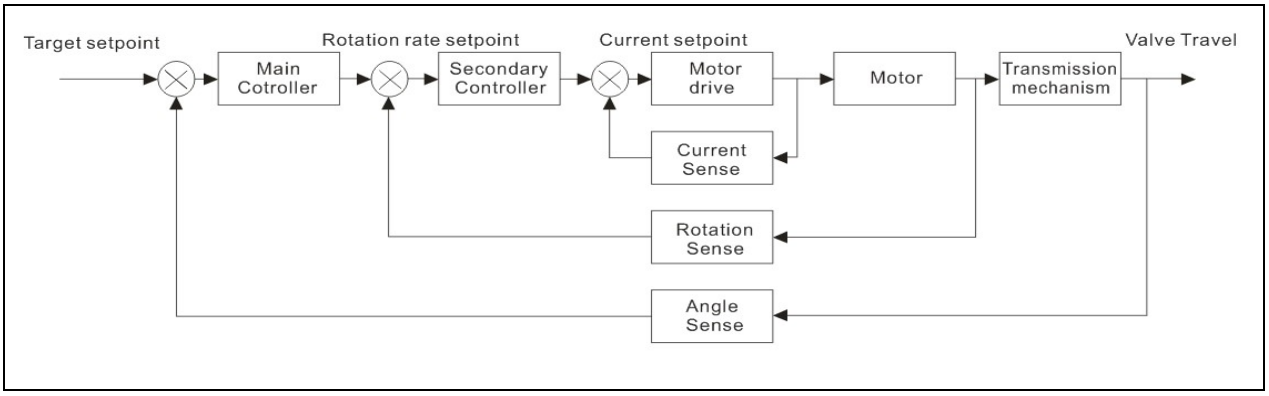


Fig. 8: Actuator master control board

Fig. 9: Actuator masterinterface board

Powerful fault diagnosis and protection function

- **Diagnosis and protection of input control signal failure:** it can automatically identify the fault of input signal, including line drop, short circuit, signal beyond normal range, etc. It can send out and display alarm immediately when the fault occurs, and can automatically run to the designated position according to the user's selected signal fault processing mode (full open, full close, hold, any position).
- **Diagnosis and protection of position feedback signal failure:** automatic judgment of position sensor fault. Once the fault occurs, it outputs the diagnostic alarm signal to avoid miss-operation due to the fault of detection signal.
- **Torque detection and over torque protection：** accurate measurement of actuator output torque through torque sensor is the basis and guarantee for torque protection. At the same time, double detection technology is used to analyze and calculate the measured values of working current and voltage to ensure accurate setting of torque and torque limit and protection. When the actuator is initializing, the over force protection is set. Once the torque is over, the control circuit will stop the motor immediately and send out and display alarm to ensure that the actuator and the driven object are not damaged by excessive torque.
- **Motor over-current and over temperature protection：** Although the starting current and working current of BLDC motor are much smaller than that of AC motor, CHEMSUN has set protection for possible over-current of DC motor and configured with output alarm signal. The temperature sensor is built into the motor to monitor the temperature and temperature rise of the motor anytime. In case of over temperature or abnormal temperature rise, an alarm will be sent and displayed immediately, and the motor power supply will be cut off. When the temperature drops to the set value, the motor will automatically resume normal operation.
- **Automatic blockage removal function:** when the valve is stuck or other mechanical fault causes, the valve to stop moving, the actuator will automatically try three impact actions according to the setting. In case of jam, the control unit instructs the motor to rotate in reverse direction for a small step, and then operate in the original direction. Each impact torque does not exceed the torque protection value, so it is repeated three times. If the jam disappears, the actuator will return to normal operation; if the jam still exists, the motor power will be shut off automatically, and an alarm will be sent out and displayed.
- **Emergency situation handling (ESD) function:** in case of emergency, under the intervention of ESD command, the actuator can directly run to the set position: full open, close, hold or set to any position.
- **Dual protection of valve position limit:** (1) software protection: the upper and lower valve position limits are set through the panel configuration, and the alarm, jump action and motor power cut-off are output when the position is over. (2) Hardware protection: when the upper and lower valve position reaches the limit, the contact switch will interlock alarm, jump action, cut off the motor power supply, etc.
- **Manual mechanism operation:** Standard supply handle operation.



Control principle and main control module

Three stage cascade PID control: drive motor control circuit + motor operation control circuit + final position output control circuit. Customers can adjust the parameters of each control loop according to the site process and working condition requirements, so as to achieve the optimal control quality and control accuracy.

Note: Due to the mutual coupling of each loop of cascade control, the change and adjustment of PID coefficient must be completed under the guidance of professionals or manufacturers.

Independent power supply module

The power supply can be selected 24 VDC or 24VAC, 220VAC, 110VAC or 380VAC. The independent power module converts all kinds of input power into three isolated power supply for motor drive, chip operation and LCD display. It provides a strong guarantee for the reliable operation of various components, and greatly improves the anti-interference ability of the equipment.

Fig.11: Independent power supply module

Alarm settings

Generally, there are two groups, and at most four groups of alarm outputs can be selected. Each output is a normally open / closed dry node. The alarm content can be configured arbitrarily, and the alarm common terminal is independent, which is suitable for connecting different alarm power supplies.

Fig.12: G06 Series Operation varies Sensor

Control signals types

- Valve position control: According to the control signal (4 – 20mA or 0 – 10V, etc.) output by the controller, PLC or DCS, the actuator automatically and accurately runs to the corresponding valve position.
- Emergency control of ESD: In case of emergency and abnormal conditions, the actuator shall perform actions according to the settings (open, close or other positions) to meet the safety requirements of on-site process.
- On/off control: the actuator implements corresponding switch action according to the input switch signal, and the switch signal can be defined as inching or automatic holding type.
- Various communication modes can be selected: Mod bus, M-BUS, Nb, Loar, 4G and other optional control modes.

Optional One or two way temperature or pressure sensors

- **The actuator can be equipped with temperature or pressure sensor:** The sensor can be directly assembled on the valve body. When the valve is working, the electric actuator can read the temperature or pressure signal of the measuring point and upload this signal to the central control room by communication. The electric actuator can also directly process the read signal and compare the deviation with the set value. After PID calculation, Directly drive the valve action to realize local self-regulation.
- **The self balance of medium flow:** The electric actuator can calculate through the read pressure signal and directly control the valve to realize the self balance of fluid medium flow in the pipeline.

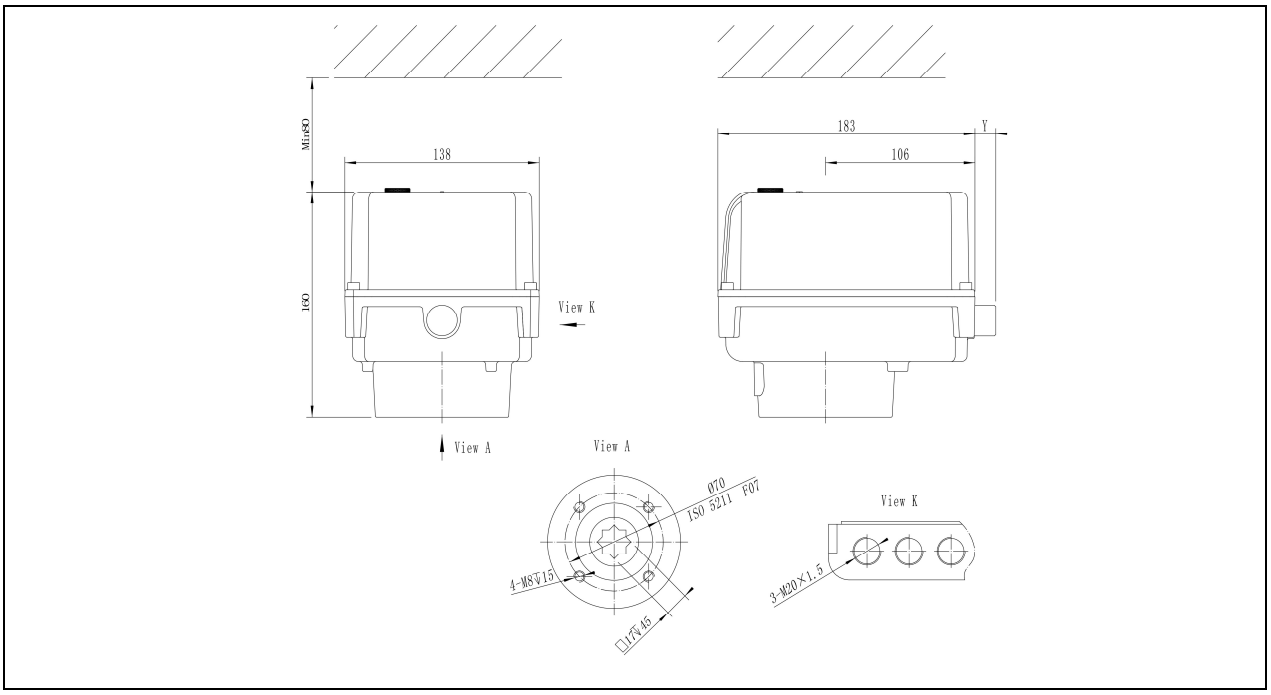
Table 1: Technical data

CHEMSUN CSR / L - G06 Series E-ActuatorS	
Rotary stroke output torque range	20 – 600 Nm
Linear stroke output thrust range	2 – 12 KN
Stroke range	R: 90° / Multi-turn ； L: 20 / 40 mm
Supply power	24 VDC , 24/110/220 (50/60 Hz), Optional battery version (with battery power supply, no external power supply)
Shell material	Cast Al. 3.2373
Explosion-proof type	Without Explosion Protection
Protection grade	IP 65 / 66
Input signal	4 – 20mA; 0 – 10(5)V; On-off Switch; Mod-bus; M-bus; NB; LOAR; 4G
Output signal	4 – 20mA; 0 – 10(5)V; On-off Switch; Mod-bus; M-bus; NB; LOAR; 4G
Power fail safe position	FL (Fail Lock)
Ambient temperature	Standard -25 to +85℃ ； Low temp. -40 to +70℃
Transducer Sensitivity	0.1 %
Actuator Accuracy	≤ 0.3 %
Response time	200 ms
Alarm configuration	2 – 6 Paths
Communication protocol	HART, PROFIBUS, MODBUS
Ambient humidity	100% RH
Adjusting speed range	15 – 100%
Torque adjustment range	10 – 100%
Seismic capacity	3 axis 6 g

Table 2: Basic parameters

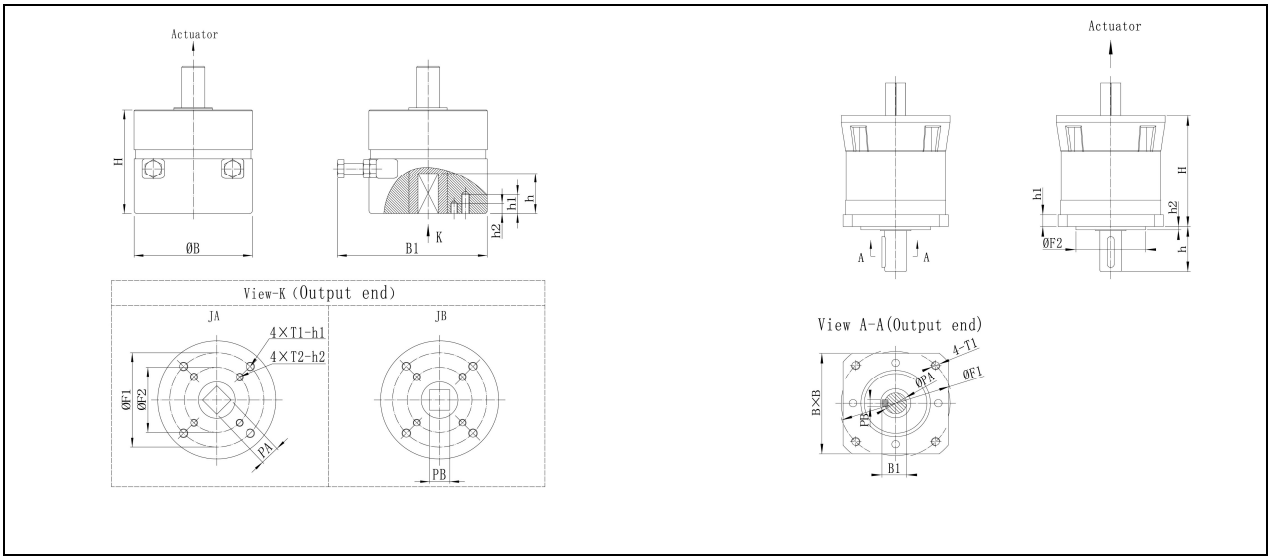
CHEMSUN CSR / L - G02 Series Teeny Smart E-Actuators		
Sell material		Cast Al. 3.2373
Motor Data	Type	Permanent magnet Brushless DC motor
	Body material	Cast Al. 3.2373
	Rated power	0.12 KW
	Rotation rate	600 – 4000 rpm Adjustable
	Cooling mode	Air cooling
	Temp. class	About 70℃
	Protection grade	IP 67
	Structural chara.	Electronic commutation, drive control motor action
	Insulation grade	Class H
	Moment of inertia	60 g·cm2
Mechanical drive		External gear transmission system
Hand wheel		Standard Handle
Position feedback		Absolute encoder

CSR / L - G06 Series E-Actuators Dimension drawing



Note: Flange standard according to DIN ISO 5211.

Quarter-turn gearbox dimensions:

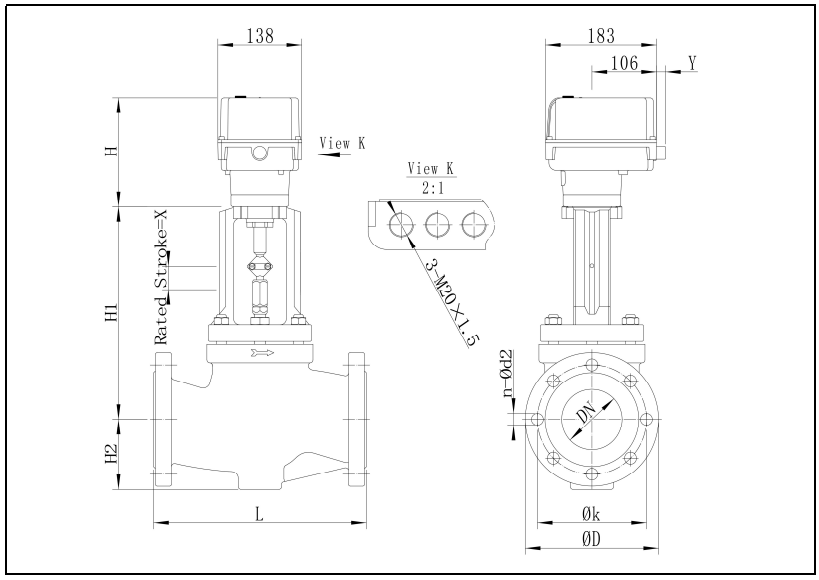


Note: Flange standard according to DIN ISO 5211.

Main dimension Unit：mm

Type	H	B	B1	PA	PB	h	h1	h2	T1	T2	F1	F2	Flange size	Weight
A1	113	128	165	22	22	35	25	20	M10	M8	102	70	F07/F10	4.5 Kgs
A1-S	128	154	175	27	27	46	30	25	M12	M10	125	102	F10/F12	5.5 Kgs

CSL-G06 Series Linear E-Actuators (With SAMSON type 3241 Globe control valve DIN PN16/40)



Main dimensions Unit：mm

DN	L	H1		H2		H	Y	X
				铸钢	锻钢			
25	160	220			70	180	15	15
32	180			72				
40	200				92			
50	230				98			
65	290	260		98	—	220		30
80	310				128			
100	350	350		118	—			
125	400	360	380	144				
150	480	390	415	175				

Note: According to DIN EN 1092 and DIN ISO 5211.

CHEMSUN E-Actuators

CSR - G06 Series Rotary E-Actuator Selection type table

CHEMSUN E-Actuator	Type CSR- G06-	X	X	X	X	X	X	X	X	X	X
Rotary Stroke											
90°（≤95°）		1									
Milt-turn		2									
Special Angle (On request)		9									
LCD Display											
Without			0								
With			1								
Supply power											
24 V DC				1							
230 V AC				2							
110 V AC				3							
24 V AC				5							
Battery version (with battery power supply, no external power supply)				6							
Special type (On request)				9							
Input signal type											
4 – 20 mA					1						
0 – 10(5) V					2						
On/off switch (Dry contacts)					3						
Communication mode（Mod-Bus/M-Bus/NB/LOAR/4G/5G; Detailed instructions）					4						
Special type（On request / Detailed instructions, when ordering）					9						
Feedback signal type											
4 – 20 mA						1					
0 – 10(5) V						2					
On/off switch (Dry contacts)						3					
Communication mode（Mod-Bus/M-Bus/NB/LOAR/4G/5G; Detailed instructions）						4					
Special type（On request / Detailed instructions, when ordering）						9					
Power fail safe position											
FL（Fail Lock/Hold）							0				
Max. Output torque. Nm（Gear Box A1 / A1-S）											
NON	≤20							0			
NON	75							1			
A1	260							2			
A1-S1	600							3			
Special	＞600 (On request / Recommend G01 or G03 Series)							9			
Number of alarm terminals											
NON（Standard）									0		
2 Groups（Standard）									2		
> 2 Groups (On request / Max. 4 Groups, and Detailed instructions are required when ordering.)									9		
The environment temperature											
Standard：-25 ～ +80℃										0	
Lower Temp.：-40 ～ +70℃										1	
Special Function											
Without											0
PID loop; With temperature or pressure sensor; Flow characteristic compensation; With Mechanical Moment Switch, etc. (On request, Detailed instructions, when ordering)											9

CHEMSUN E-Actuators

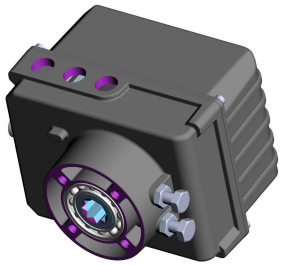
CSL - G06 Series Linear E-Actuator Selection type table

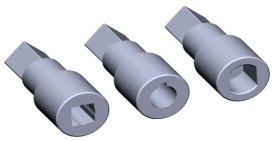
CHEMSUN E-Actuator Type CSL- G06-	X	X	X	X	X	X	X	X	X	X
Linear Stroke										
20mm	1									
40mm	2									
LCD Display										
Without		0								
With		1								
Supply power										
24 V DC			1							
220 V AC			2							
110 V AC			3							
24 V AC			5							
Battery version (with battery power supply, no external power supply)			6							
Special type (On request)			9							
Input signal type										
4 – 20 mA				1						
0 – 10(5) V				2						
On/off switch (Dry contacts)				3						
Communication mode（Mod-Bus/M-Bus/NB/LOAR/4G/5G; Detailed instructions）				4						
Special type（On request / Detailed instructions, when ordering）				9						
Feedback signal type										
4 – 20 mA					1					
0 – 10(5) V					2					
On/off switch (Dry contacts)					3					
Communication mode（Mod-Bus/M-Bus/NB/LOAR/4G/5G; Detailed instructions）					4					
Special type（On request / Detailed instructions, when ordering）					9					
Power fail safe position										
FL（Fail Lock/Hold）						0				
Max. Output thrust. KN										
≤1.0							0			
5.0							1			
8.0							2			
12							3			
＞12 (On request / Recommend G01 or G03 Series)							9			
Number of alarm terminals										
NON（Standard）								0		
2 Groups（Standard）								2		
> 2 Groups (On request / Max. 4 Groups, and Detailed instructions are required when ordering.)								9		
The environment temperature										
Standard： -25 ～ +80℃									0	
Lower Temp.：-40 ～ +70℃									1	
Special Function										
Without										0
PID loop; With temperature or pressure sensor; Flow characteristic compensation; With Mechanical Moment Switch, etc. (On request, Detailed instructions, when ordering)										9

Output mechanical connection

The connection design conforms to the ISO5211 international standard, and suitable for each kind of form mechanical connection, guarantees with all valves reliable connection。

CHEMSUN all electric actuators can be used in different assembly objects, there are different forms of terminal output mode, can be based on customer requirements to provide special output terminal size。





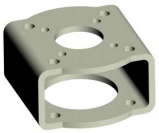


Fig.16: Actuator output connecting shaft and connecting bracket

Ordering text 01

Rotary E-Actuator	Type CSR-G06- …
Explosion-proof type	Non Explosion
Max. Torque	20-600Nm, A1/A1-S1
Supply Pow	24VDC ; 24/220/110 (50/60Hz); Battery version
Input / Output Signal	4 -20mA ; 0 – 10(5)V; On-off Switch，Mod-Bus / M-Bus / NB / LOAR / 4G / 5G，
Power Fail Safe Position	FL (Fail Lock/Hold)
Valve Type	V-Ball Control Valve; Rotary-plug Valve; Butterfly Valve; O-Ball Valve …

Ordering text 02

Linear E-Actuator	Type CSL-G06- …
Explosion-proof type	Non Explosion
Max. Stroke	H=20,40 mm
Max. Thrust	2 – 12 KN
Supply Powe	24VDC ; 24/220/110 (50/60Hz); Battery version
Input / Output Signa	4 -20mA ; 0 – 10(5)V; On-off Switch，Mod-Bus / M-Bus / NB / LOAR / 4G / 5G，
Power Fail Safe Position	FL (Fail Lock)
Valve Type	Globe Valve; Knife Gate Valve; Gate Valve …

*** Specifications subject to change without notice.

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