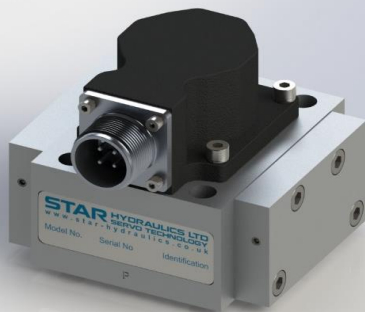


series  
**650**  
**2-Stage Servovalve**  
**Rated flows up to 80 l/m**



## Features

- Maximum operating pressure 315 bar
- ISO 10372-04-04-0-92 mounting pattern
- Internal pilot supply (4 port)
- Suitable for 3-way or 4-way applications
- High spool drive forces
- Spool in bushing design
- Dry torque motor with mechanical feedback



Star Hydraulics Limited  
Severn Drive  
Tewkesbury Business Park  
Tewkesbury  
Gloucestershire  
GL20 8SF  
England (UK)

[www.star-hydraulics.co.uk](http://www.star-hydraulics.co.uk)

ST-650-2016.1-En

## Benefits and Features

### Sapphire ball in slot design

- Incorporated into Star designs since 1988
- Many billions of cycles per service life
- Increased spool life due to spool rotation
- Ultra low coefficient of friction sapphire to steel
- Feedback mechanism unhindered by spool rotation
- Extended warranties available

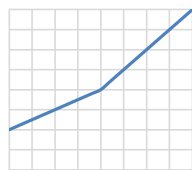
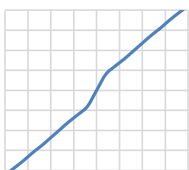
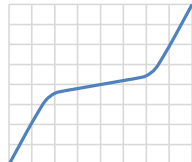
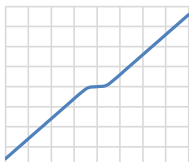
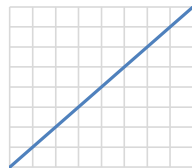


### Quality

- Independent audit process is our commitment on quality
- Focus on customer needs and expectations
- Delivery schedules on time
- Continual improvements on products and services
- Maintaining design and manufacturing integrity

### Custom spool lap & bushing port geometries

- Zero overlap
- Overlap (closed center)
- underlap (open center)
- Dual gain
- Asymmetric gain



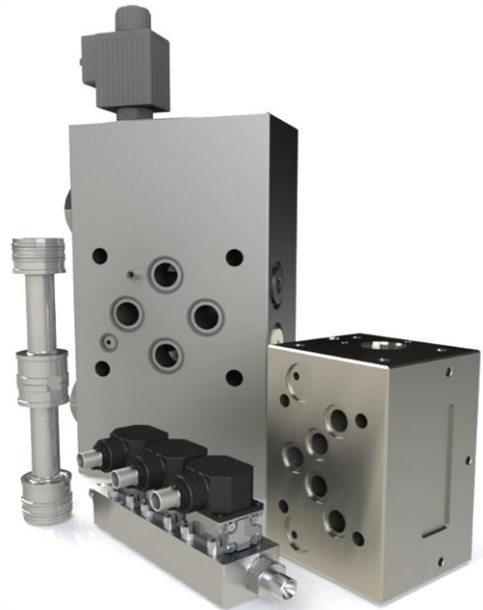
### Sapphire flow

- Ensuring first stage stability
- Precisely matched flow properties
- Long life in extreme environments



### Safety

- Flame proof
- Intrinsic safety
- Class, Div & Zone coverage
- Mechanical failsafe
- Double & triple coil redundancy



### Special projects

- Compact servo designs
- Special interfaces
- Modular components



### Sealing materials

- Nitrile
- Fluorocarbon (Viton)
- Ethylene-Propylene
- Fluorosilicone



### Special connectors

- MIL-C-5015
- MIL-DTL-38999
- Conduit style male/female
- Hermetic

## Technical data

### Hydraulic

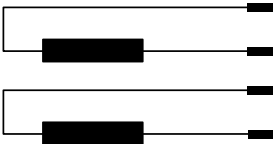
Nominal flow ratings [ $\pm 20\%$ ]	at 70 bar $\Delta p$	4, 10, 20, 40, 60, 80 l/m
Operating pressure (max)	Ports	P, C1, C2, R
Seal material	NBR, FPM	315 bar
Fluid viscosity range (recommended)		10 to 100 mm <sup>2</sup> /s (cSt)
Fluid type		Mineral oil to ISO 11158, DIN 51524 or equivalent MIL-H-5606 Kerosene Water glycols
Filter rating (recommended)	Pressure line Off-line	Beta 10 = 200 (10 $\mu$ m abs), non by-pass & indicator Beta 2 = 1000 (2 $\mu$ m abs)
Fluid cleanliness	ISO 4406: 1999	16/ 14/ 11

### Operational parameters

Hysteresis		$\leq 5.0\%$ without dither
Threshold		$\leq 2.0\%$ without dither
Null shift	$\Delta T$ 40°C	$\leq 3.0\%$
Internal leakage	140 bar supply (0.5% overlap) 4, 10 l/m 20, 40, 60, 75 l/m	$\leq 1.5$ l/m $\leq 2.5$ l/m
Load pressure difference	1% input	40% of supply pressure
Response time	0-100% rated spool stroke	25 ms
Mounting pattern		ISO 10372-04-04-0-92 without X port
Mounting position		Any, fixed or movable
Weight	std unit	1.1 kg
Design protection	EN 60529	IP 65
Shipping protection		Sealed base plate
Vibration		30 g all axis, 5 Hz to 2,000 Hz
Shock		30 g all axis
Seal material options		NBR, FPM
Temperature range		-30 to 135 °C

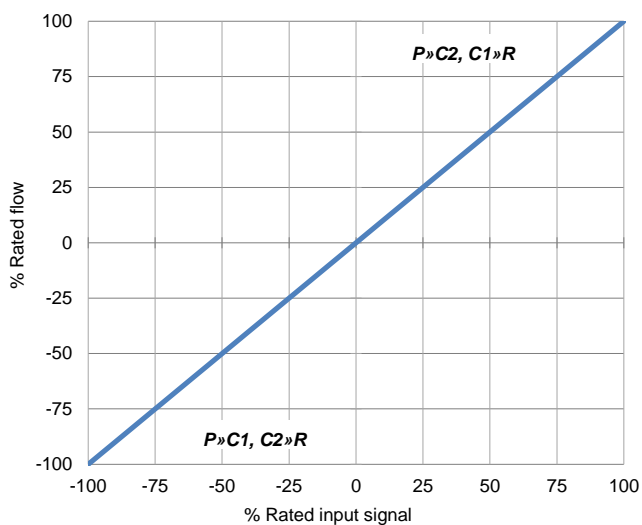
# Technical data

## Electrical

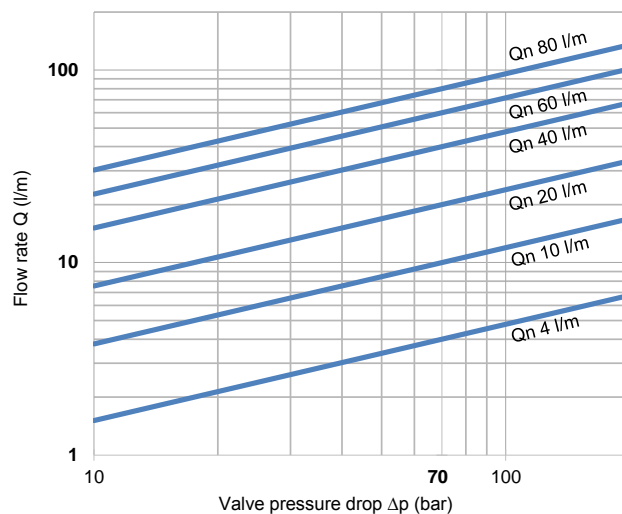
Rated input ± (mA)	single (differential)	<b>8</b>	<b>15</b>	<b>30</b>	<b>40</b>	<b>100</b>	<b>200</b>
	series	4	7.5	15	20	50	100
	parallel	8	15	30	40	100	200
Coil resistance (Ω)	per coil	1000	200	300	80	28	22
Power (W)	single	0.064	0.045	0.27	0.128	0.280	0.88
	series	0.032	0.023	0.135	0.064	0.140	0.440
	parallel	0.032	0.023	0.135	0.064	0.140	0.440
Connector pin out identification							
Polarity P»C2, C1»R	single	A +, B - or C +, D -					
	series	A +, D -, B & C linked					
	parallel	A & C linked +, B & D linked -					
Valve connector type	MIL-C-5015	MS3102E-14S-2P      mates with MS3106F-14S-2S Consult factory for more options					
Standard connector orientation		P port					
	also available over	C1, C2 or R port; please advise when ordering					

## Technical data

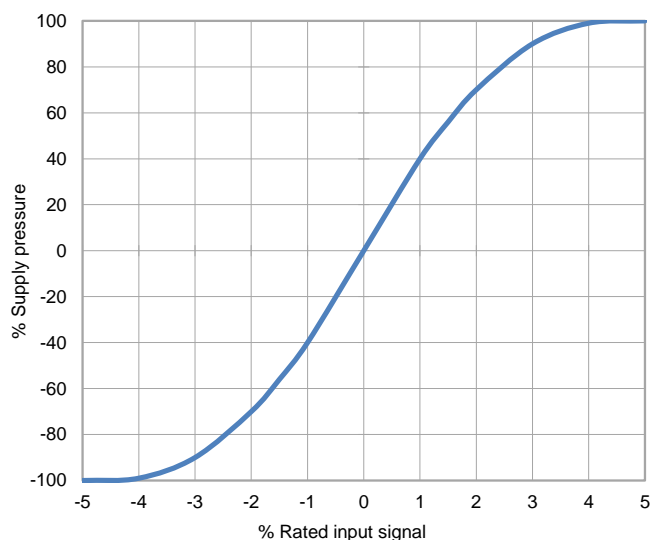
Output Polarity (per std wiring)



Flow for 100% input as a function of valve pressure drop



Typical Load Pressure Difference v Input Signal



The flow tolerance for standard servovalves is  $\pm 20\%$  of the rated flow at 100% rated input signal.

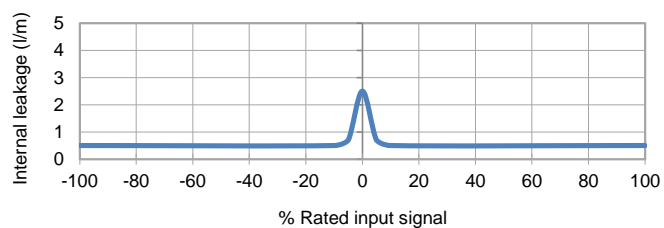
Rated Signal [In] is the specified input voltage or current of either polarity to produce rated flow. Rated input does not include null bias values.

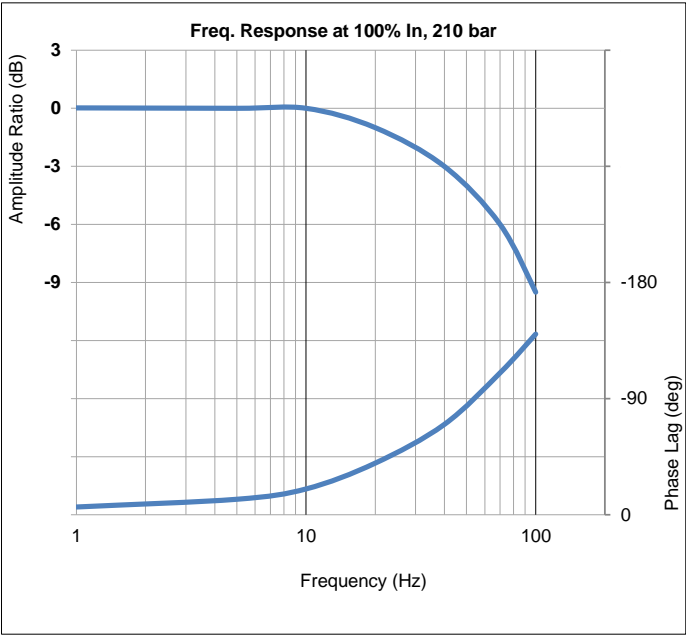
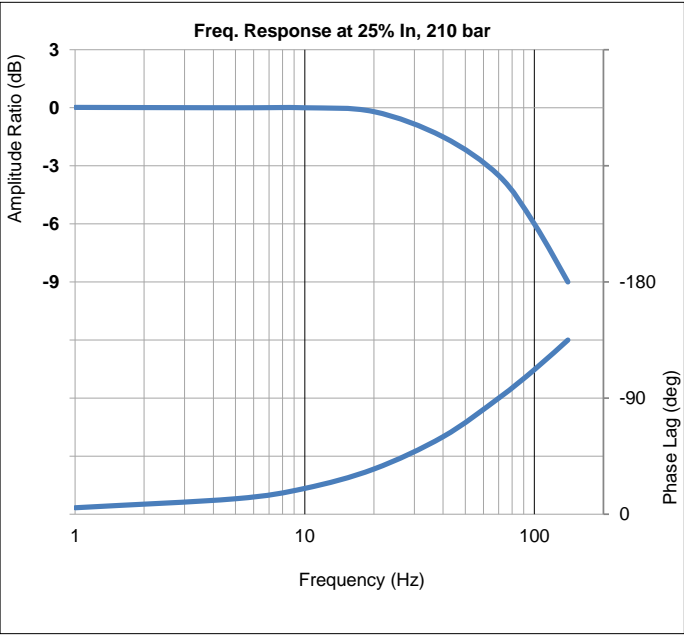
Rated flow corresponds to the flow at rated input at 10 bar or 70 bar, with no load, therefore in 4-way valves there will be a pressure drop of 5 bar or 35 bar respectively across each land.

Load pressure difference versus input signal indicates typical differential pressure gain between ports C1 (A) and C2 (B) for standard lap spools. Negative and positive overlap change this characteristic significantly.

Internal leakage comprises of tare first stage and laminar leakage between spool and sleeve. With critical lap conditions in 4-way designs the leakage peaks through the null region.

Internal Leakage v Input Signal

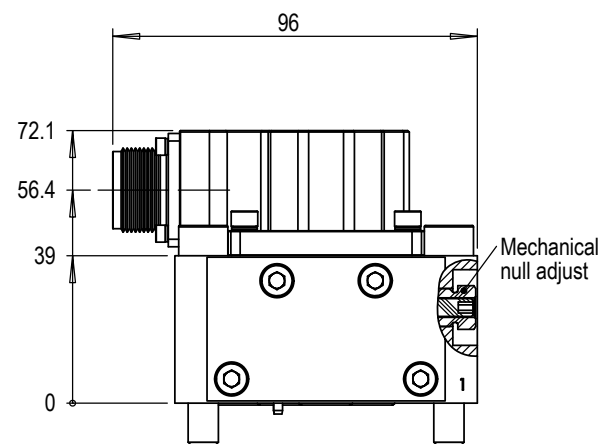
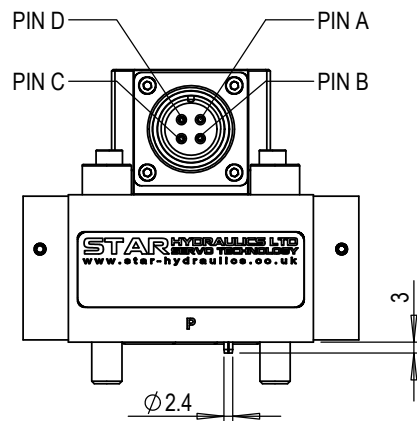
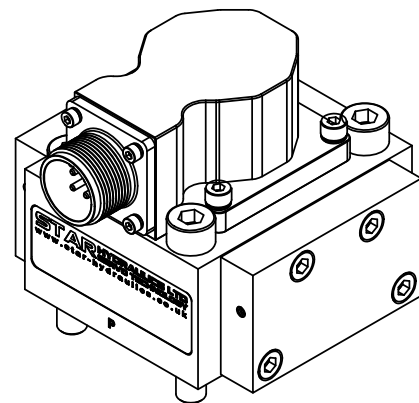
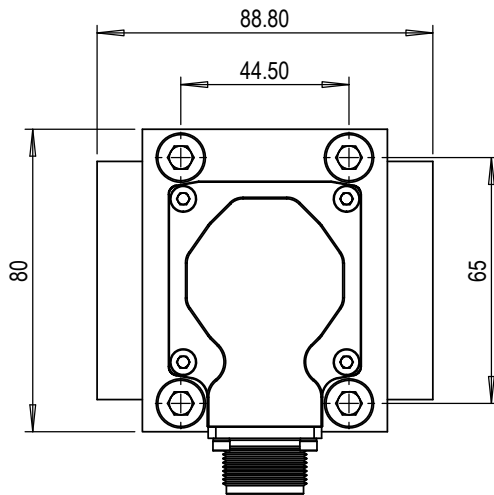




# 650 series INSTALLATION DETAILS

**STAR**

Mounting screws	Skt head cap screws M8 x 50 - 10.9 ISO 4762
Null adjust (Mechanical)	<ul style="list-style-type: none"> <li>- 2.5 hex skt &amp; 10 A/F lock nut</li> <li>- slacken lock nut (ccw) half-turn with 10 A/F ring spanner</li> <li>- insert 2.5 hex key into socket and rotate to obtain required null / offset value</li> <li>- hold hexagon key in desired position then tighten lock nut to 2 Nm</li> </ul>
Porting details	P, C1, C2, R ports $\varnothing 9.0$ , $\square$ $\varnothing 14.25 \nabla 1.40$ on 22.2 P.C.D.
Interface seals	Ports P, C1, C2, R - ID 10.82 x $\varnothing 1.78$ O-Ring



Mounting interface conforms to ISO 10372-04 (X port must not be used)									
	P	C1	C2	R	F1	F2	F3	F4	G
size	$\varnothing 9$	$\varnothing 9$	$\varnothing 9$	$\varnothing 9$	M8	M8	M8	M8	$\varnothing 3 \nabla 5$
x	22.25	11.14	33.35	22.25	0	44.50	44.50	0	12.35
y	21.39	32.50	32.50	43.61	0	0	65	65	19.80
Surface flat within 0.01 / 100 : finish better than 0.8 $\mu\text{m}$									

