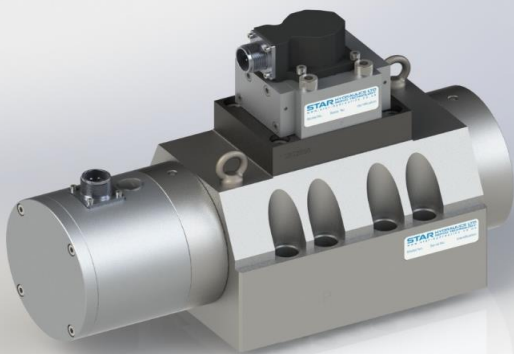


series  
**902HF**  
3-Stage Servo Valve  
Rated flows up to 900 l/m



## Features

- Standard & high response versions
- Maximum operating pressure 350 bar
- External pilot supply & return options
- Suitable for 3-way or 4-way applications
- Very low hysteresis & zero point drift
- High spool drive forces
- Spool in bushing design
- Dry torque motor with mechanical feedback
- Long life Sapphire Technology



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-902HF-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



## Safety

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

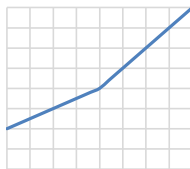
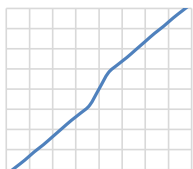
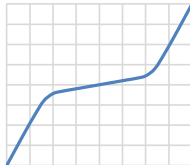
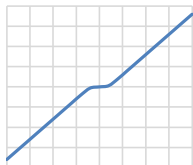
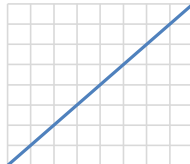


## Quality

- 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



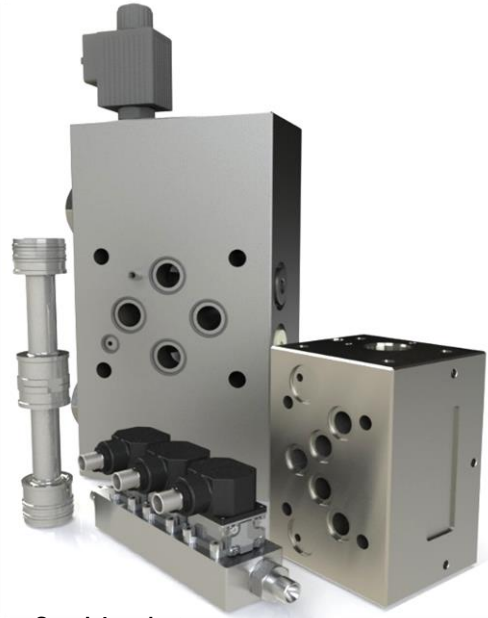
## Sapphire flow

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



## Special projects

- Compact servo designs
- Special interfaces
- Modular components



## Sealing materials

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



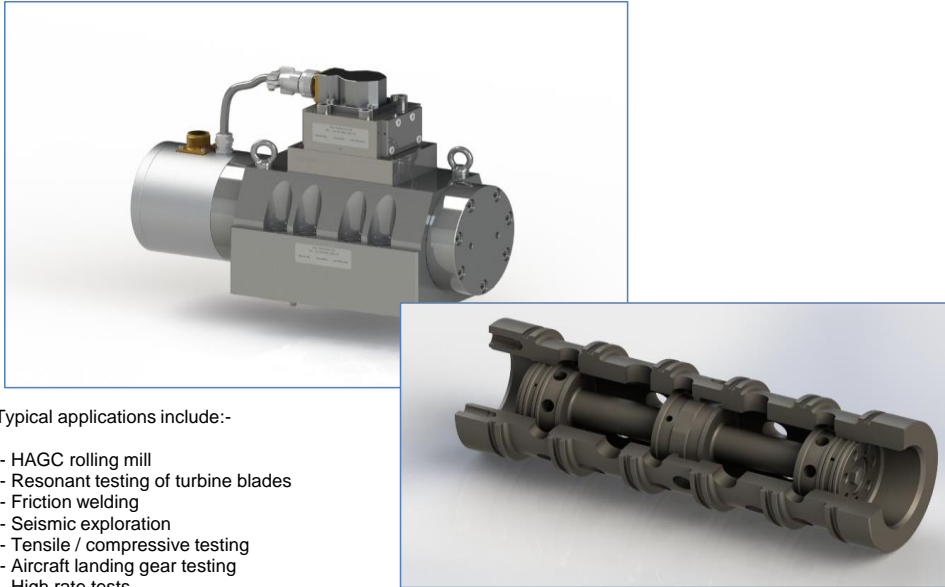
## Special connectors

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



## Function

The Star series 902HF is a 3-stage, high flow servo valve for use in 3-way or 4-way applications within a closed loop control system of position, pressure (force) or velocity.



Typical applications include:-

- HAGC rolling mill
- Resonant testing of turbine blades
- Friction welding
- Seismic exploration
- Tensile / compressive testing
- Aircraft landing gear testing
- High rate tests
- Dynamic ride simulators

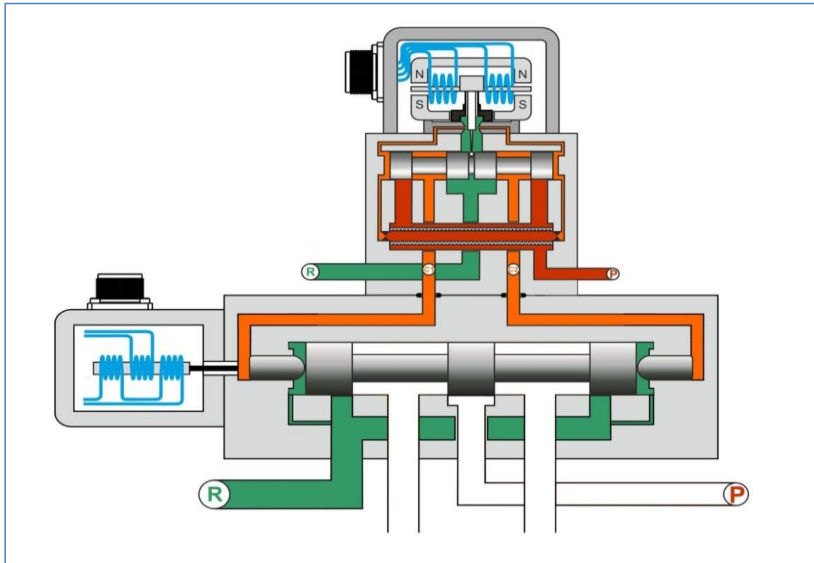
The design consists of a 4-way, 2-stage pilot nozzle-flapper spool servo valve (pilot) providing high fidelity control to a main stage spool with a large cross-sectional area. The pilot can be supplied with a variety of flow rates, build materials and band-widths offering high performance and stability whatever the application demands, other pilot stage designs are also available.

The main stage has manifold interface for clean access to all ports including the pilot stage and is supplied as standard (6 port) where the pilot supply (X) and pilot return (Y) can be set at higher or lower levels to that of the main stage. The design can also be configured to accept traditional side entry pipe fittings such as SAE O-ring or BSPP thread forms.

## Installation

When mounting the valve with the control ports positioned vertically the spool will tend to creep downwards when the main supply pressure is turned off. Care must be taken during startup to avoid bump due to instantaneous correction of the inner loop feedback signal.

**Never command the pilot stage servo when < 4 bar exists at the main stage P to R ports. Essential lubrication will be lost and could lead to severe damage to the spool and sleeve assembly.**



## Fluid cleanliness

In closed loop systems that require high degrees of resolution i.e. force or pressure control it is essential to equal or better the recommended ISO cleanliness levels.

Off-line filtration has been proven to effectively remove particulates across the main ISO classification levels without detriment to fluid composition. There is also a very significant reduction on the dependency of inline filters that can and do fatigue when high transient pressures exist.

Additional condition monitoring can provide warnings on a number of elements during service and effective flushing procedures. Please feel free to contact our sales team for further details.

## Technical data

### Hydraulic

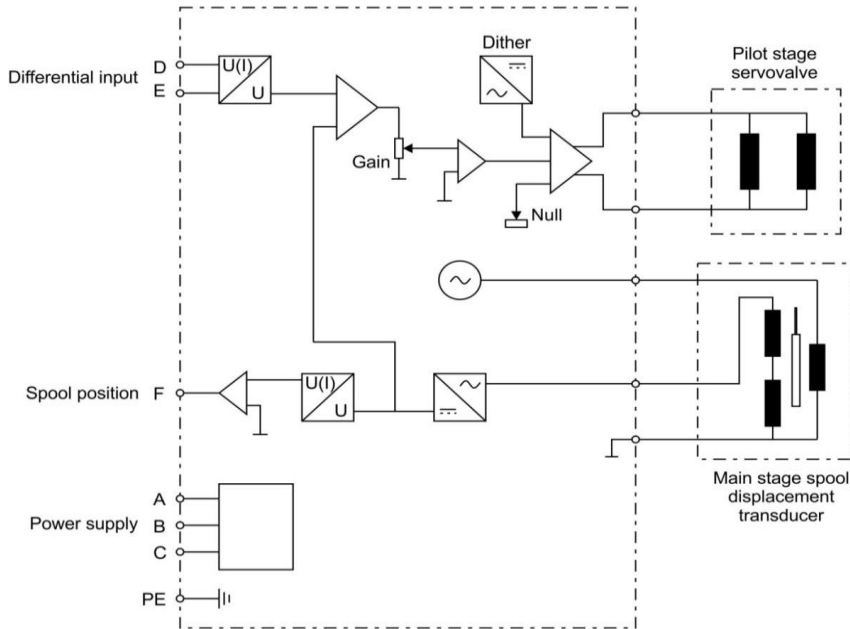
Nominal flow ratings [ $\pm 10\%$ ]	at 70 bar $\Delta p$	450, 620, 750, 900 l/m
Operating pressure (max)	Ports	P, C1, C2      R, Y      X
Pilot valve option	A, D	315 bar      315 bar      315 bar
	B, C	350 bar      315 bar      350 bar
Fluid viscosity range (recommended)		15 to 100 mm <sup>2</sup> /s (cSt)
Fluid type		Mineral oil to ISO 11158, DIN 51524 or equivalent MIL-H-5606 Kerosene Water glycols others on request
Filter rating (recommended)	Pressure line	Beta 10 = 200 (10 $\mu$ m abs), non by-pass & indicator
	Off-line	Beta 2 = 1000 (2 $\mu$ m abs)
Fluid cleanliness	ISO 4406: 1999	
	minimum	16/ 14/ 11
	recommended	15/ 13/ 10

### Operational parameters

Hysteresis		$\leq 1.0\%$
Threshold		$\leq 0.5\%$
Null shift	$\Delta T 40^\circ C$	$\leq 2.0\%$
Internal leakage	140 bar supply (0.5% overlap)	$\leq 4.0$ l/m
Load pressure difference	1% input	$\geq 30\%$ of supply pressure can be as high as 100%
Rated spool stroke		$\pm 2.5$ mm ( $\pm 3$ max)
Spool drive area	902HF...S	10.4 cm <sup>2</sup>
	902HF...H	2.8 cm <sup>2</sup>
Response time	0-100% rated spool stroke	
	902HF...S	13 ms
	902HF...H	6 ms
Fluid velocity ports P, C1, C2, R (max)		30 m/s
Mounting pattern		Special
Mounting position		Any, fixed or movable (1)
Weight	std unit	26 kg
Design protection	EN 60529	IP 65
Shipping protection		Sealed base plate
Vibration		30 g all axis
Seal material options		NBR
Temperature range		-20 to 80 °C

(1) Depending on valve orientation the main stage spool may drop when pilot supply pressure is switched off leading to unwanted startup bump. If so then apply pressure to the first stage pilot via the X port prior to applying pressure at the main stage.

# Technical data - Electrical details - Integrated electronics



Factory set options are as follows

Pin	Function	Dual rail power supply (code 'D')
A	Supply	+15 Vdc (+14.5 Vdc min...+18 Vdc max)
B	Supply	-15 Vdc (-14.5 Vdc min...-18 Vdc max)
C	Supply / signal ground	0 V
D	Input rated command (differential)	See order codes for V or I options
E	Inverse	
F	Main stage spool position O/P	See order codes for V or I options
PE	Protective earth	

Pin	Function	Single rail power supply (code 'S')
A	Supply	+24 V (+20 Vdc min...+28 Vdc max)
B	Supply / signal ground	0 V
C	n.c	
D	Input rated command (differential)	See order codes for V or I options
E	Inverse	
F	Main stage spool position O/P	See order codes for V or I options
PE	Protective earth	

## Power supply

Current (mA)	< 100 each rail (typically 50)
Ripple (mV p-p)	< 100

## Command signal

Phasing	When input at pin D = +ve with respect to pin E causes flow from P»A, B»T
Voltage input	impedance 1 Mohm
Current input	impedance 200 ohm
+4...+20 mA	at +12 mA spool is in centred position

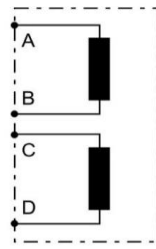
## Spool position output

Voltage output	Output impedance <10 ohm, minimum receiver impedance 1 kohm
Current output	Output impedance > 100k ohm, minimum receiver impedance 30 ohm, maximum receiver impedance 400 ohm

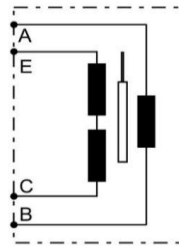
## Protection

Reverse Polarity	Indefinite
Over-voltage	Absolute max +/- 20 V DC

Technical data - Electrical details - Externally conditioned spool position



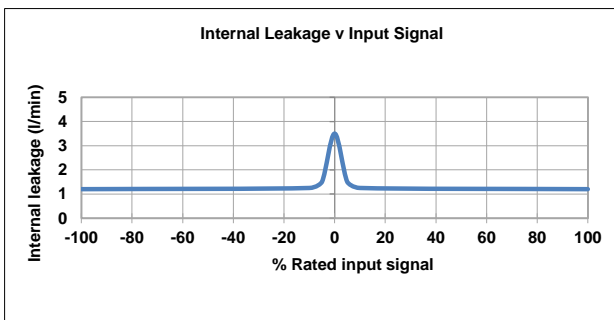
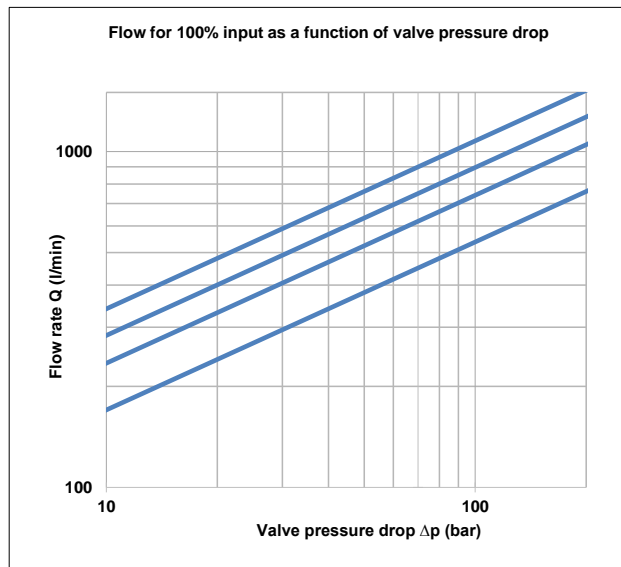
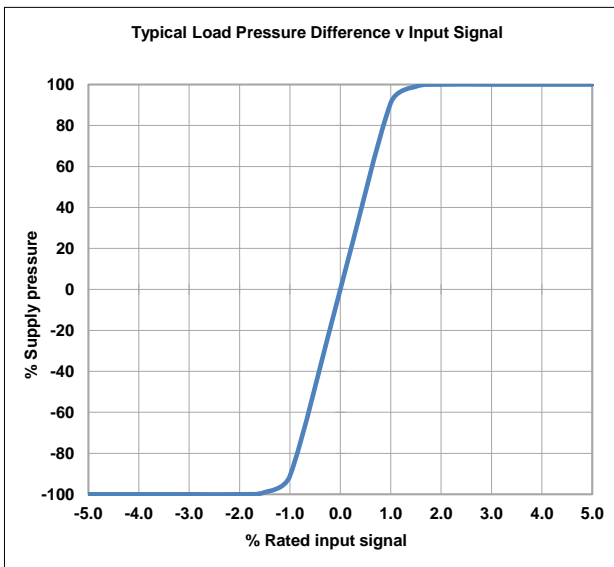
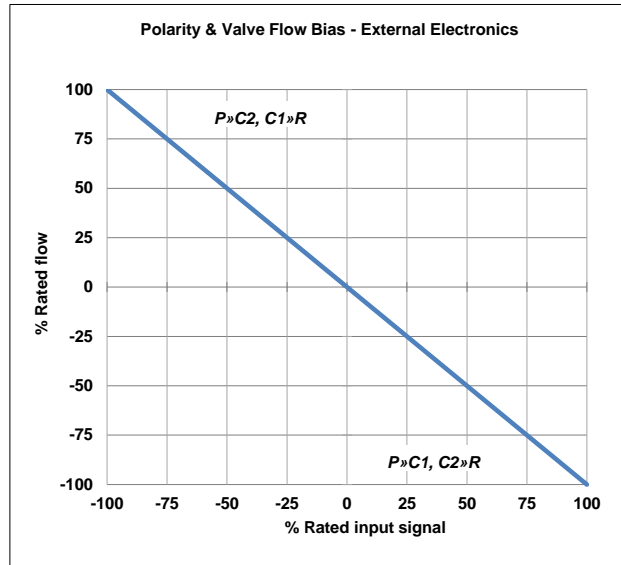
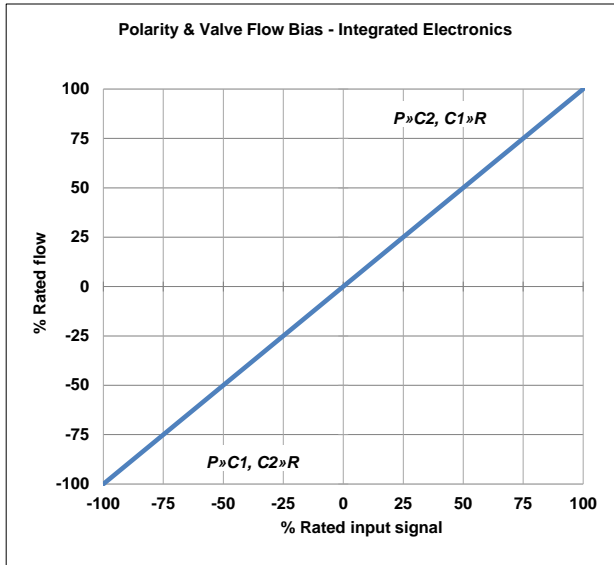
Pilot stage servovalve



Main stage spool displacement transducer

<b>Mating connector</b>	MS3106-14S-2S
<b>Rated Input</b>	±40 mA
<b>Effective resistance</b>	40 ohms
<b>Mating connector</b>	MS3106-14S-5S
<b>Input voltage</b>	3 Vrms sine wave
<b>Input frequency</b>	0.5 to 10 kHz
<b>Sensitivity</b>	95 mV/V/mm @ 2.5 kHz
<b>Resistance primary</b>	70 ohms
<b>Resistance secondaries</b>	102 ohms
<b>Phase shift</b>	-3 dB

# Technical data



The flow tolerance for standard servovalves is  $\pm 10\%$  of the rated flow at 100% rated input signal.

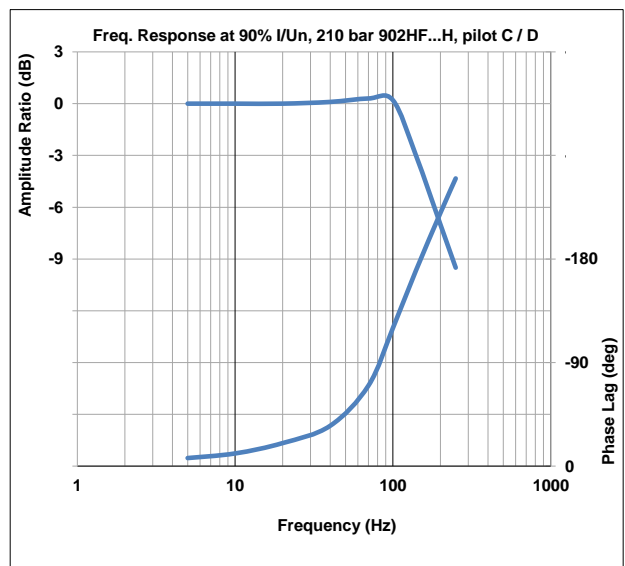
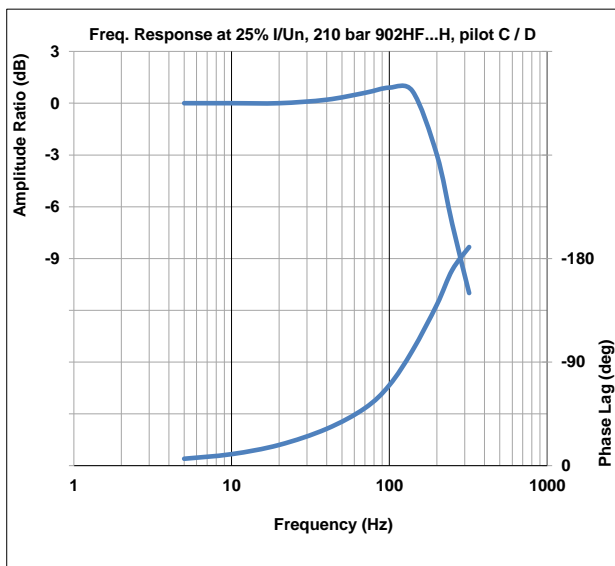
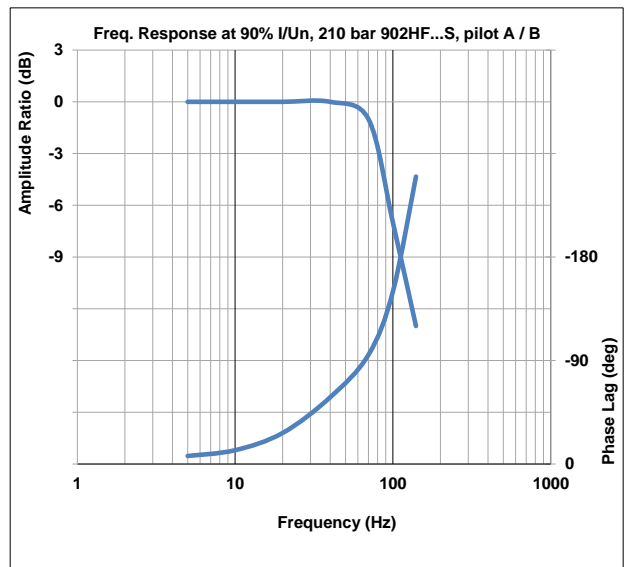
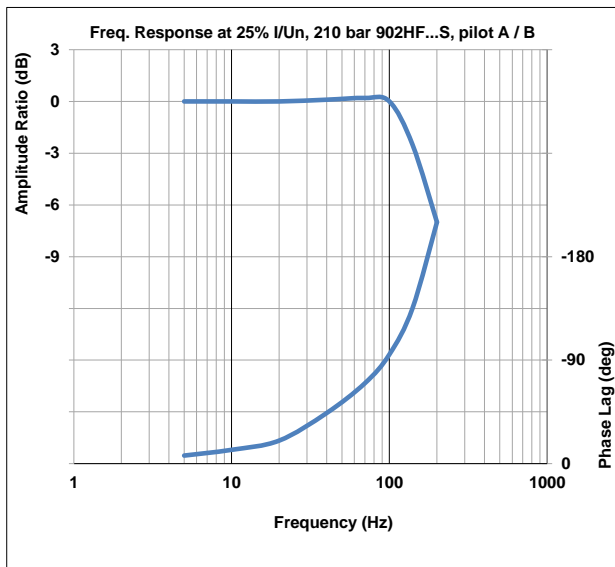
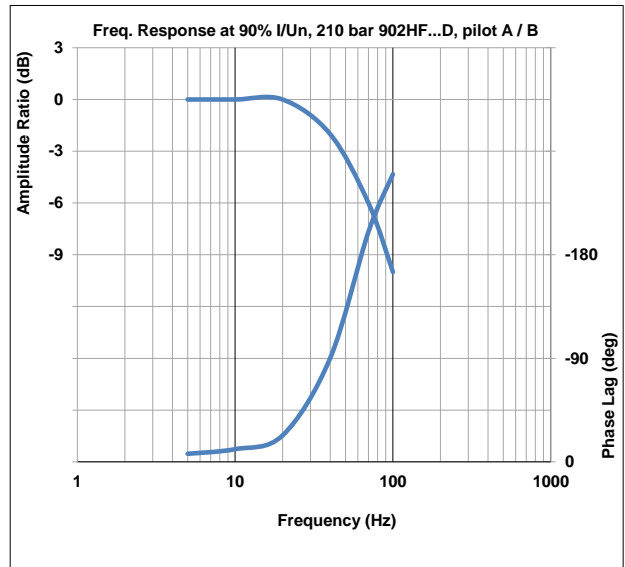
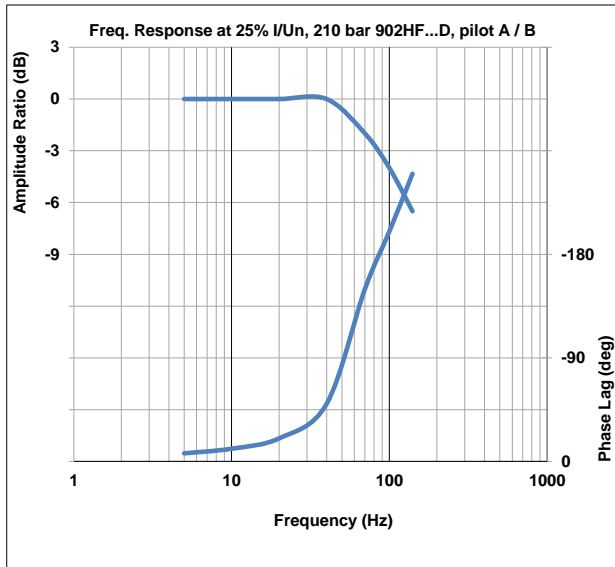
Rated Signal [In] is the specified input voltage or current of either polarity to produce rated flow. Rated input does not include null bias values.

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.

Technical data



Order code **902HF** - [ ] - [ ] - [ ] - [ ] - [ ] - [ ] - [ ] - [ ] - [ ]

Body style	
Max. flow	Code
900 l/m	902HF

Rated flow at 70 bar Δp		
Qn	Code	
902HF	450 l/m	120
	620 l/m	160
	** 750 l/m	200
	900 l/m	240

Response level		
Pilot	Description	Code
Qn = 10 l/m	High stability	D
Qn = 20 l/m	Standard	S
Qn = 20 l/m	High response	H

Operating pressure (main stage)		
Description	Code	
280 bar	28	
350 bar	35	

Pilot flow		
Description	Code	
(std)	X <sub>1</sub> external, Y <sub>1</sub> external	EE
	X <sub>1</sub> internal, Y <sub>1</sub> internal	II
	X <sub>1</sub> external, Y <sub>1</sub> internal	EI
G3/8	X <sub>2</sub> external, Y <sub>2</sub> external	G
SAE 1/2 (3/4-16 UNF)	X <sub>3</sub> external, Y <sub>3</sub> external	F

Pilot model		
Description	Code	
Model 550	A	
≠ Model 500-2	B	
≠ Model 590-2	C	
Model 590	D	

Special order code  
Factory defined

Connector	
Code	Description
5	5-Way (MS3102-14S-5P) *
6	6-Way (MS3102-14S-6P)
7	6+PE (MS3102-14SA-7P)
X	Special

Spool overlap condition		
Code	Description	
A	2% positive, linear	(std)
X	Special	

De-energized control spool position	
Code	Description
A	100% P » C2, C1 » T
B	100% P » C1, C2 » T
X	Not defined

Seal material	
Code	Description
N	NBR

Electronics		
Code	Rated signal I/P	Spool O/P
X	Not fitted †	
1	±10 Vdc	±10 Vdc
2	±10 mA	±10 mA
4	±10 Vdc	+4...20 mA
5	±10 mA	+4...20 mA

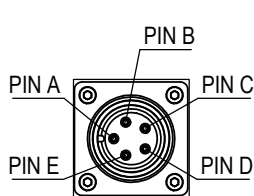
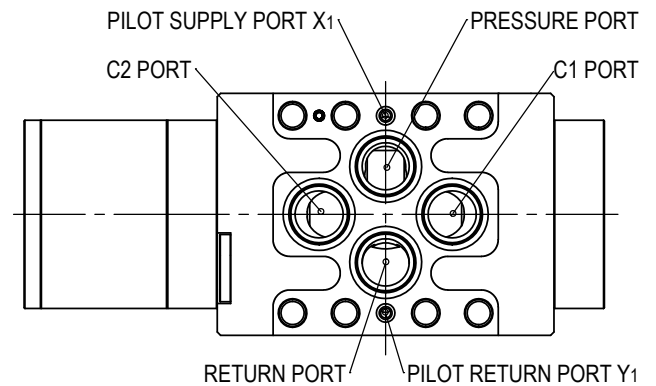
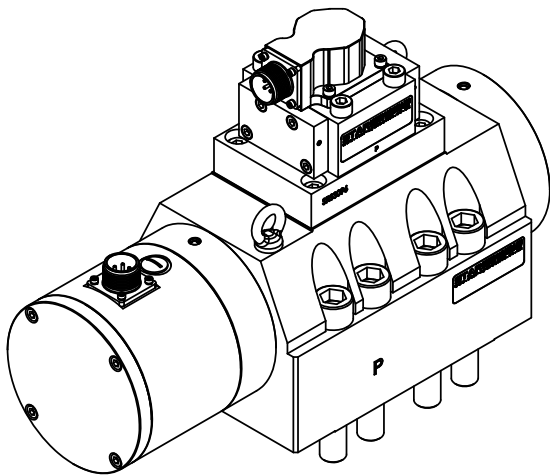
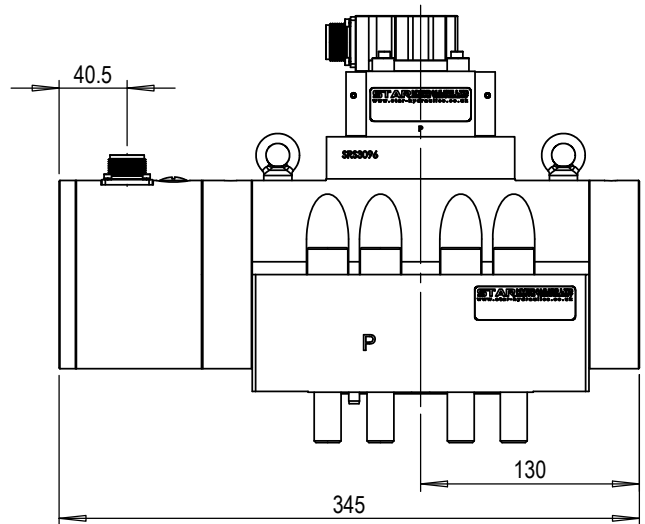
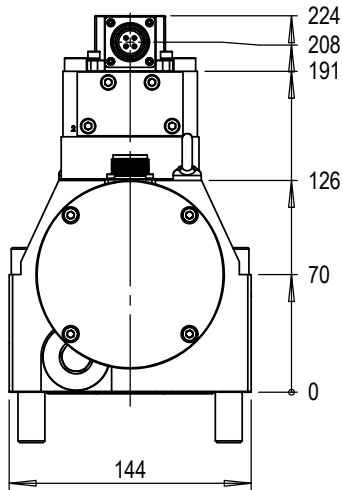
Code	Supply voltage
D	Dual rail +15/0/-15 Vdc (pin outs A, B, C)
S	Single rail +24 Vdc (pin outs A, B)

≠ High pressure versions 350 bar (stainless steel 2nd stage, secondary sealing incorporated)  
 † External signal conditioning and closed loop proportional amplifier required  
 \* Electronics option 'X' only, pilot valve connector 4-Way (MS3102-14S-4P) connector  
 \*\* Reduced rated spool stroke  
 Integrated electronics available with response level types D & S only

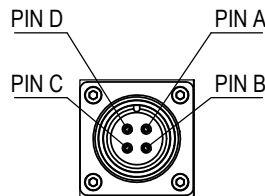
902HF series  
INSTALLATION DETAILS



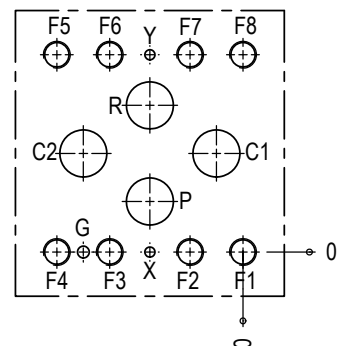
Pilot flow	Order code 'EE' (base entry ports X1 & Y1)
Pilot model	Order code 'A' (550)
Electronics	External signal conditioning and closed amplifier required
Mounting screws	Skt head cap screws M16 x 100 10.9 ISO 4762
Porting details	P, C1, C2, R ports $\varnothing 28.0$ , $\perp$ $\varnothing 42.9$ $\nabla 2.60$ X, Y ports $\varnothing 6.0$ , $\perp$ $\varnothing 11.0$ $\nabla 1.40$
Interface seals	Ports P, C1, C2, R - ID 36.10 x $\varnothing 3.53$ O-Ring Port X - ID 7.70 x $\varnothing 1.78$ O-Ring



LVDT CONNECTOR



PILOT VALVE CONNECTOR



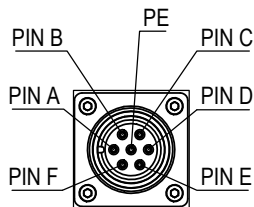
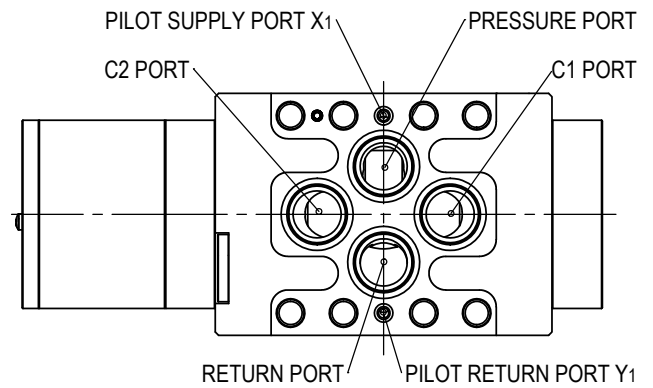
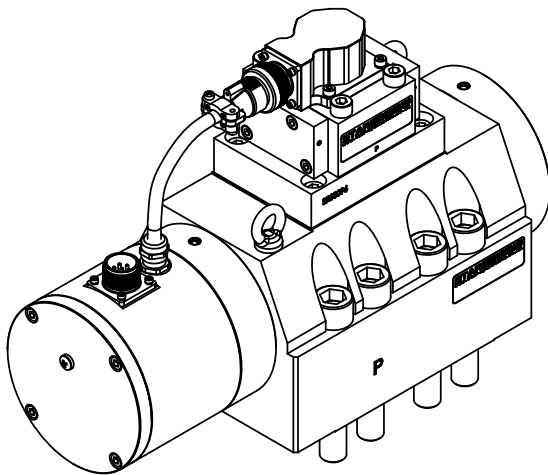
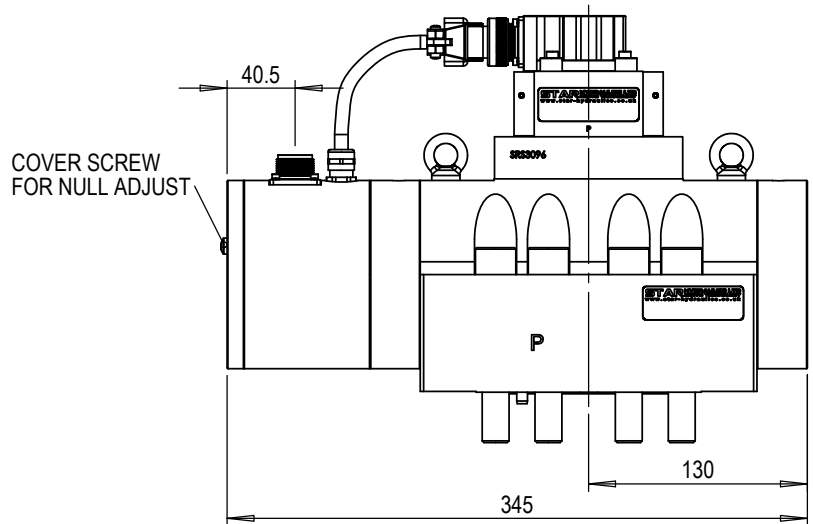
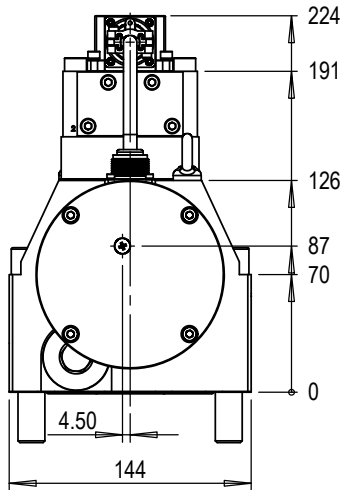
Mounting interface															
	P	C1	C2	R	X	Y	F1	F2	F3	F4	F5	F6	F7	F8	G
size	$\varnothing 28$	$\varnothing 28$	$\varnothing 28$	$\varnothing 28$	$\varnothing 6$	$\varnothing 6$	M16	M16	M16	M16	M16	M16	M16	M16	$\varnothing 8 \nabla 9$
x	55.40	15.80	95	55.40	55.40	55.40	0	31.50	79.30	110.80	110.80	79.30	31.50	0	95
y	30.10	58.70	58.70	87.30	0	117.40	0	0	0	0	117.40	117.40	117.40	117.40	0

Surface flat within 0.015 / 100 : finish better than 0.8  $\mu\text{m}$

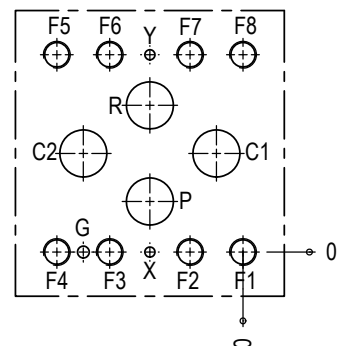
902HF series  
INSTALLATION DETAILS



Pilot flow	Order code 'EE' (base entry ports X1 & Y1)
Pilot model	Order code 'A' (550)
Electronics	Integrated
Mounting screws	Skt head cap screws M16 x 100 10.9 ISO 4762
Porting details	P, C1, C2, R ports $\varnothing 28.0$ , $\perp$ $\varnothing 42.9$ $\nabla 2.60$ X, Y ports $\varnothing 6.0$ , $\perp$ $\varnothing 11.0$ $\nabla 1.40$
Interface seals	Ports P, C1, C2, R - ID 36.10 x $\varnothing 3.53$ O-Ring Port X - ID 7.70 x $\varnothing 1.78$ O-Ring



MAIN CONNECTOR



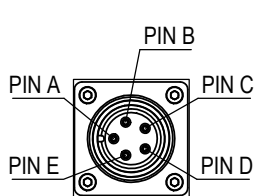
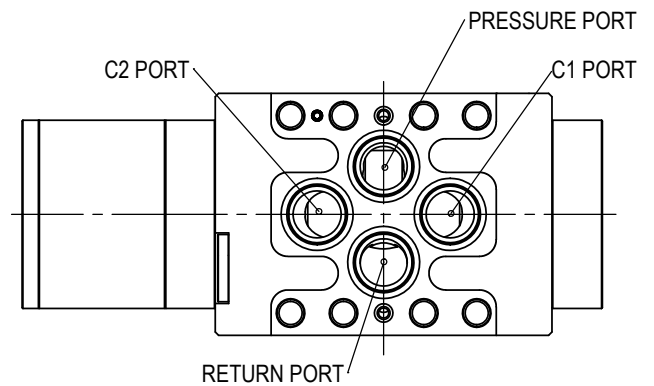
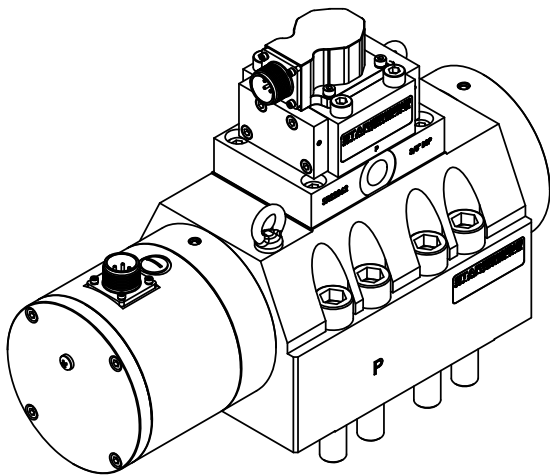
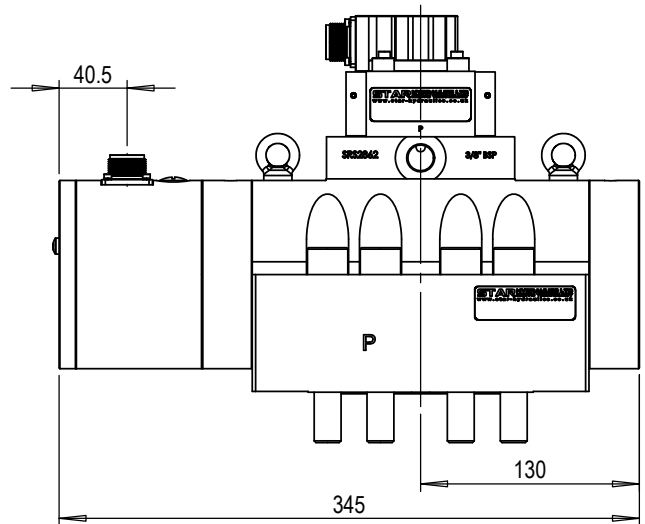
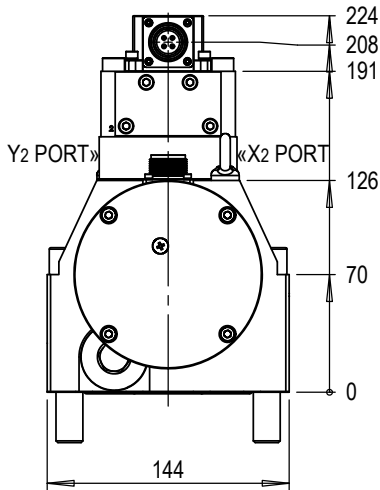
Mounting interface															
	P	C1	C2	R	X	Y	F1	F2	F3	F4	F5	F6	F7	F8	G
size	$\varnothing 28$	$\varnothing 28$	$\varnothing 28$	$\varnothing 28$	$\varnothing 6$	$\varnothing 6$	M16	M16	M16	M16	M16	M16	M16	M16	$\varnothing 8 \nabla 9$
x	55.40	15.80	95	55.40	55.40	55.40	0	31.50	79.30	110.80	110.80	79.30	31.50	0	95
y	30.10	58.70	58.70	87.30	0	117.40	0	0	0	0	117.40	117.40	117.40	117.40	0

Surface flat within 0.015 / 100 : finish better than 0.8  $\mu\text{m}$

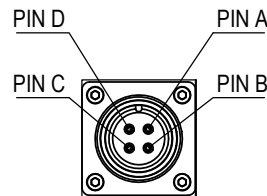
902HF series  
INSTALLATION DETAILS



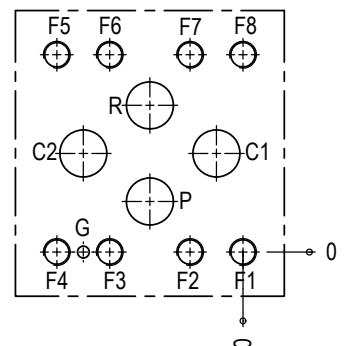
Pilot flow	Order code 'G' (G3/8 side entry ports X2 & Y2)
Pilot model	Order code 'A' (550)
Electronics	External signal conditioning and closed amplifier required
Mounting screws	Skt head cap screws M16 x 100 10.9 ISO 4762
Porting details	P, C1, C2, R ports $\varnothing 28.0$ , $\square$ $\varnothing 42.9$ $\nabla 2.60$
Interface seals	Ports P, C1, C2, R - ID 36.10 x $\varnothing 3.53$ O-Ring



LVDT CONNECTOR



PILOT VALVE CONNECTOR



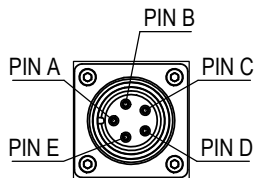
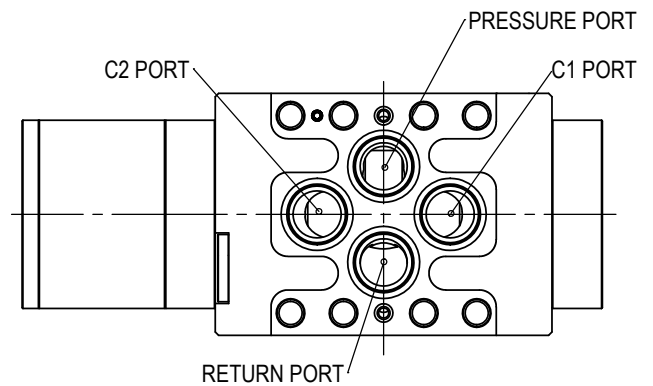
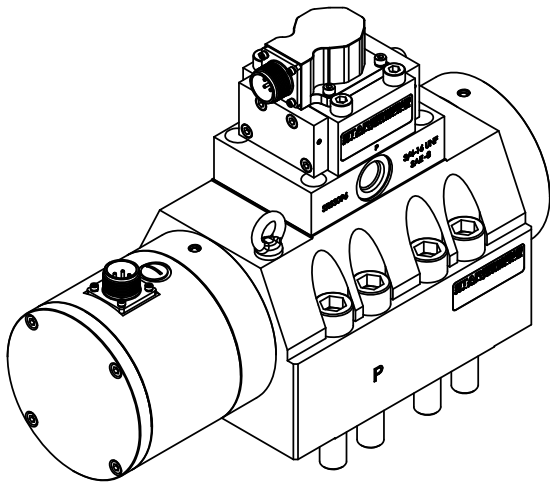
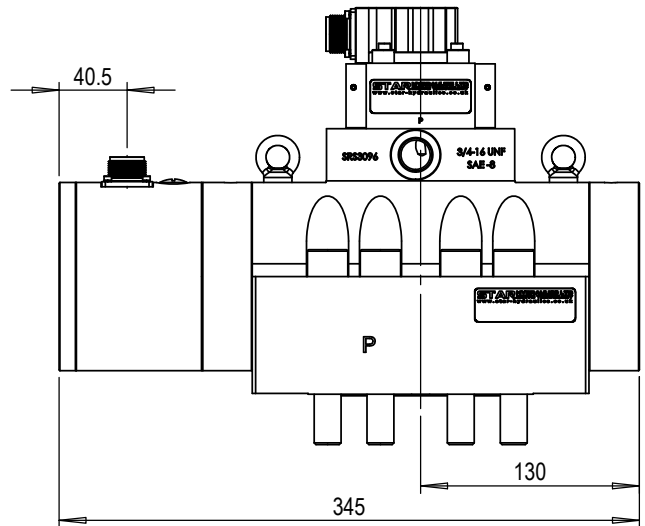
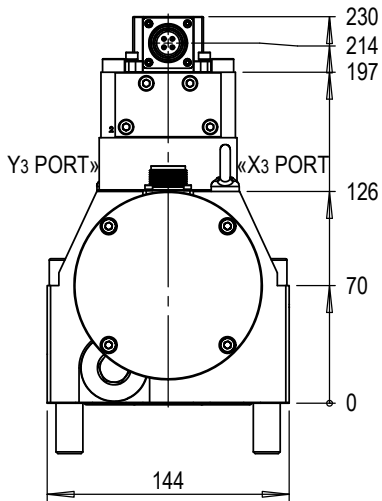
Mounting interface (without X & Y ports)															
	P	C1	C2	R	X	Y	F1	F2	F3	F4	F5	F6	F7	F8	G
size	$\varnothing 28$	$\varnothing 28$	$\varnothing 28$	$\varnothing 28$	-	-	M16	M16	M16	M16	M16	M16	M16	M16	$\varnothing 8 \nabla 9$
x	55.40	15.80	95	55.40	-	-	0	31.50	79.30	110.80	110.80	79.30	31.50	0	95
y	30.10	58.70	58.70	87.30	-	-	0	0	0	0	117.40	117.40	117.40	117.40	0

Surface flat within 0.015 / 100 : finish better than 0.8  $\mu\text{m}$

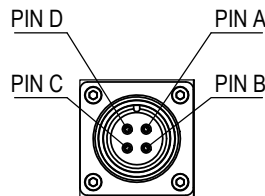
902HF series  
INSTALLATION DETAILS



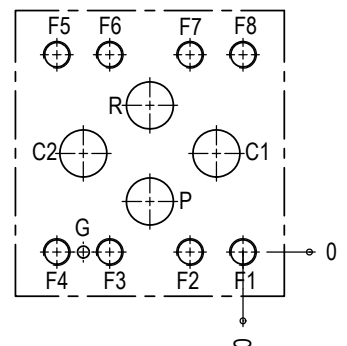
Pilot flow	Order code 'F' (SAE 1/2 [3/4-16 UNF] side entry ports X3 & Y3)
Pilot model	Order code 'A' (550)
Electronics	External signal conditioning and closed amplifier required
Mounting screws	Skt head cap screws M16 x 100 10.9 ISO 4762
Porting details	P, C1, C2, R ports $\varnothing 28.0$ , $\square$ $\varnothing 42.9$ $\nabla 2.60$
Interface seals	Ports P, C1, C2, R - ID 36.10 x $\varnothing 3.53$ O-Ring



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Mounting interface (without X & Y ports)															
	P	C1	C2	R	X	Y	F1	F2	F3	F4	F5	F6	F7	F8	G
size	$\varnothing 28$	$\varnothing 28$	$\varnothing 28$	$\varnothing 28$	-	-	M16	M16	M16	M16	M16	M16	M16	M16	$\varnothing 8 \nabla 9$
x	55.40	15.80	95	55.40	-	-	0	31.50	79.30	110.80	110.80	79.30	31.50	0	95
y	30.10	58.70	58.70	87.30	-	-	0	0	0	0	117.40	117.40	117.40	117.40	0

Surface flat within 0.015 / 100 : finish better than 0.8  $\mu\text{m}$