

series
990
2-Stage Servovalve
Flight Simulation
Motion Control



Features

Maximum operating pressure 140 bar
ISO 10372-06-05-0-92 mounting pattern
External pilot supply (4 port)
Low hysteresis & zero point drift
High spool drive forces
Spool in bushing design
Dry torque motor with mechanical feedback
Long life Sapphire Technology
Integrated abort module (model 990-2)
Abort sense switch (model 990-3)



HYDRAUSTAR
ZA des Garennes
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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

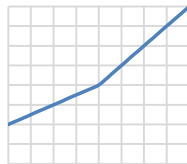
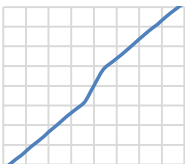
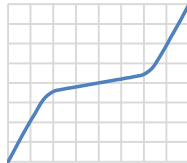
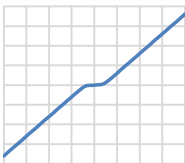
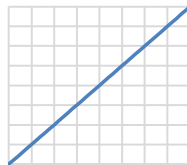


Quality

- 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



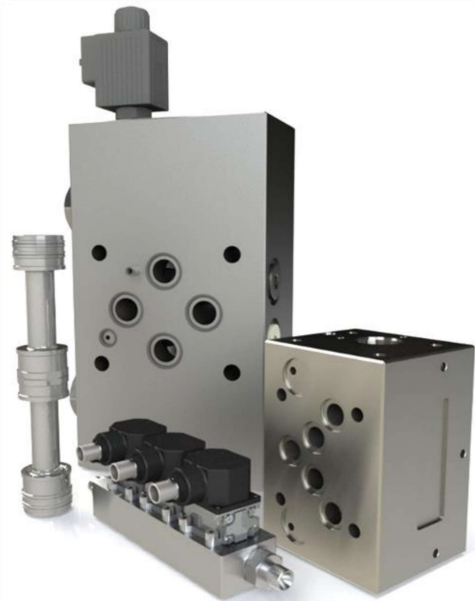
Sapphire flow

- 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

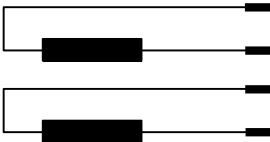
Nominal flow ratings [±10%]	at 70 bar Δp	300 l/m	
Operating pressure (max)	Ports	P, C1, C2	R
		140 bar	140 bar
Fluid viscosity range (recommended)		10 to 100 mm ² /s (cSt)	
Fluid type		Mineral oil to ISO 11158, DIN 51524 or equivalent	
Filter rating (recommended)	Pressure line	Beta 10 = 200 (10 μm abs), non by-pass & indicator	
	Off-line	Beta 2 = 1000 (2 μm abs)	
Fluid cleanliness	ISO 4406: 1999		
	minimum	16/ 14/ 11	
	recommended	15/ 13/ 10	

Operational parameters

Hysteresis		$\leq 4.0\%$ without dither
Threshold		$\leq 1.5\%$ without dither
Null shift	ΔT 40°C	$\leq 3.0\%$
Internal leakage	140 bar supply (underlap)	≤ 8.0 l/m
Load pressure difference	1% input	$\geq 30\%$ of supply pressure
Response time	0-100% rated spool stroke 230 l/m	50 ms
Abort response time + or - 100% spool position		0.5 s
Mounting pattern		ISO 10372-06-05-0-92 without X port
Mounting position		Any, fixed or movable (1)
Weight	std unit optional abort module	5.7 kg 7.8 kg
Design protection	EN 60529	IP 65
Shipping protection		Sealed base plate
Vibration		20 g all axis
Seal material options		FPM
Temperature range		-20 to 85 °C

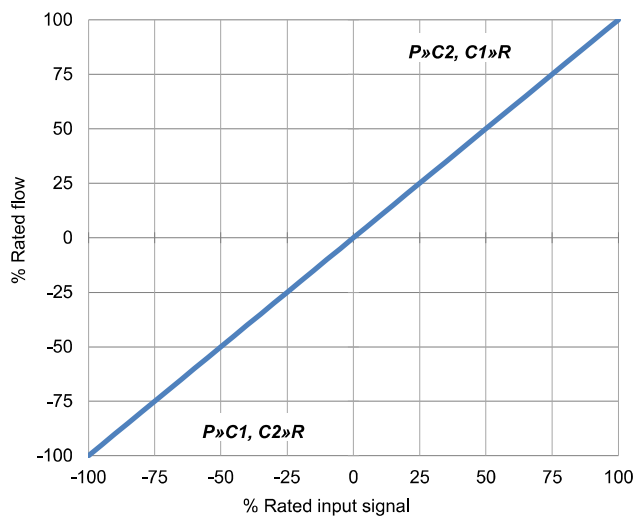
Technical data

Electrical

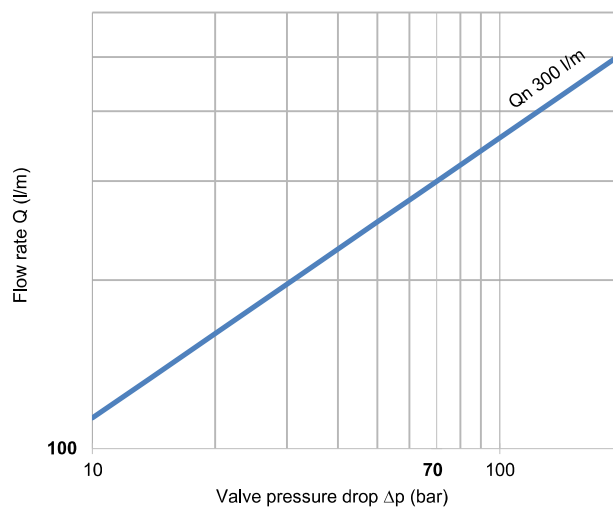
Rated input $\pm$ (mA)	single (differential)	20	60	40			
Other coil rates available	series	10	30	20			
	parallel	20	60	40			
Coil resistance (Ω)	per coil	1200	320	300			
Power (W)	single	0.48	1.152	0.48			
	series	0.240	0.576	0.240			
	parallel	0.240	0.576	0.240			
Connector pin out identification							
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		C2 port					
	also available over	C1 port; please advise when ordering					
Abort solenoid connector	model 990-2 & 990-3	MS3102E-14S-2P					
Abort sense connector	model 990-3	MS3102E-14S-2P					

Technical data

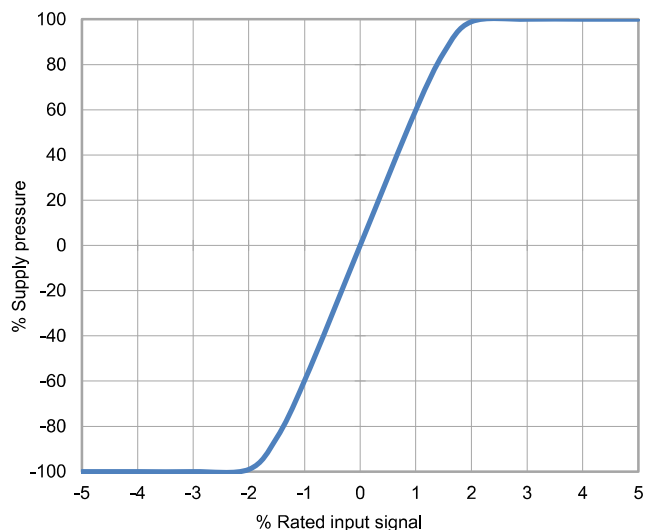
Output Polarity (per std wiring)



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 $\pm 10\%$ of the rated flow at 100% rated input signal.

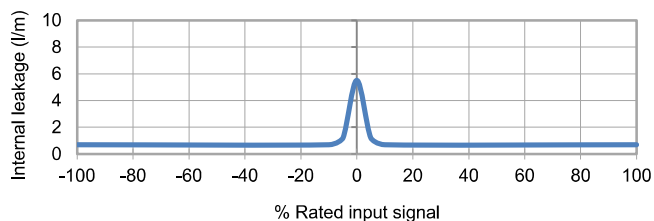
Rated Signal [In] is the specified input voltage or current of either polarity to produce rated flow. Rated input does not include null bias values.

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.

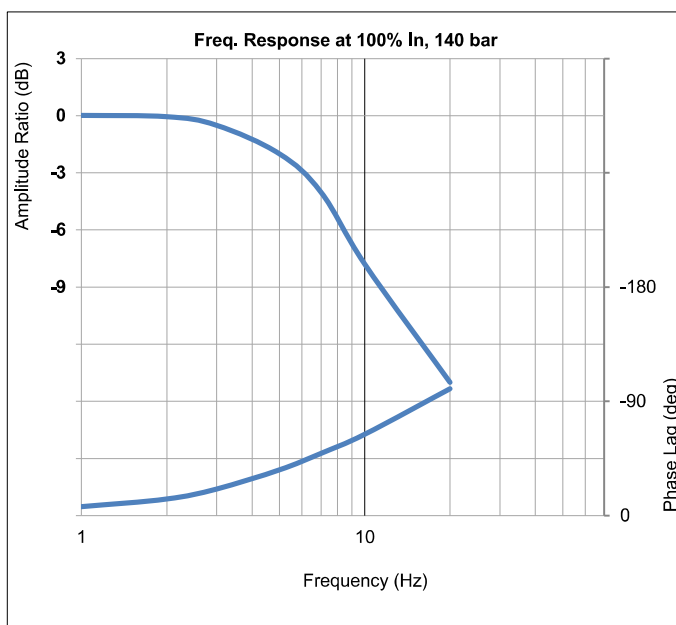
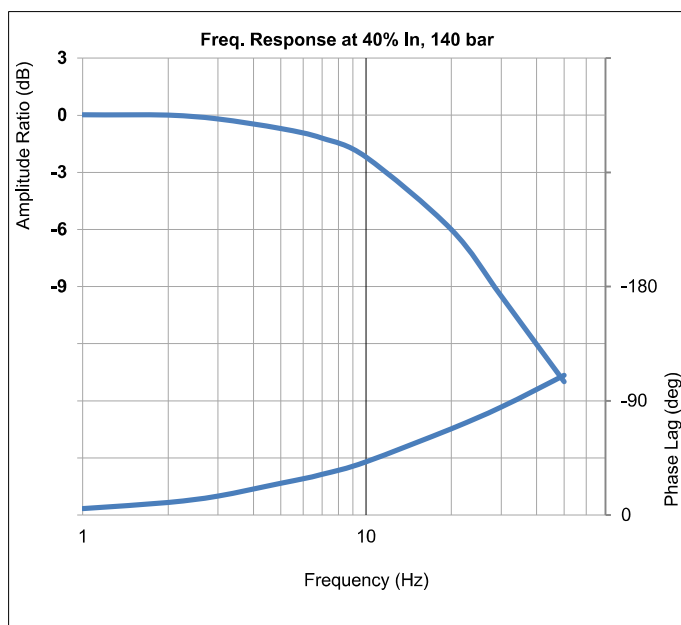
Load pressure difference versus input signal indicates typical differential pressure gain between ports C1 (A) and C2 (B) for standard lap spools. Negative and positive overlap change this characteristic significantly.

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.

Internal Leakage v Input Signal

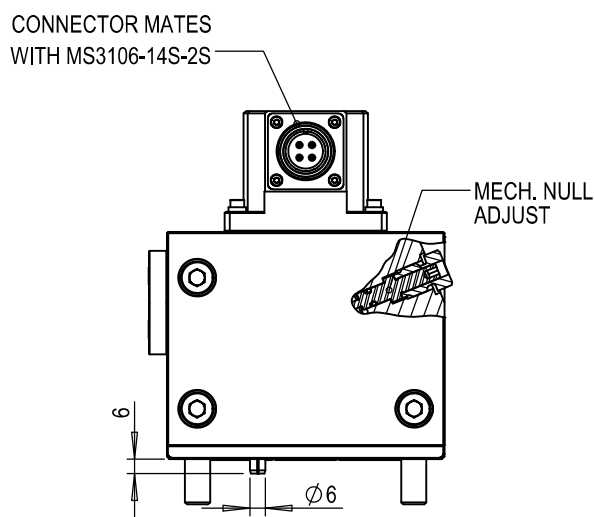
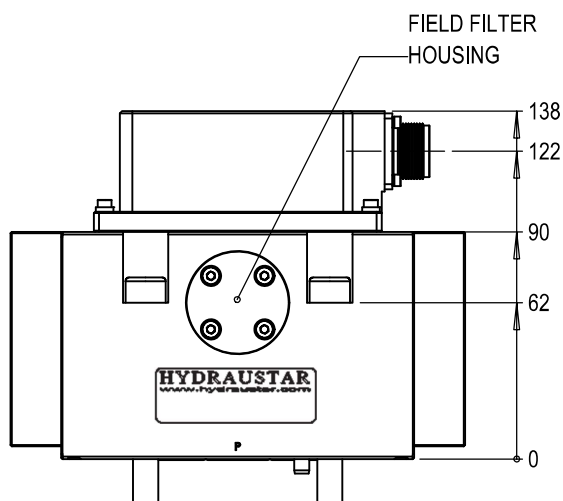
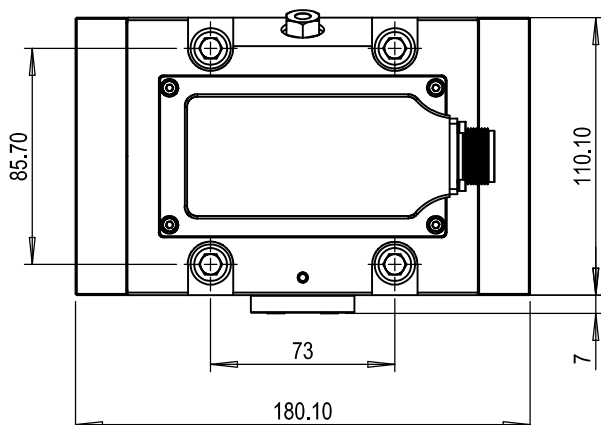


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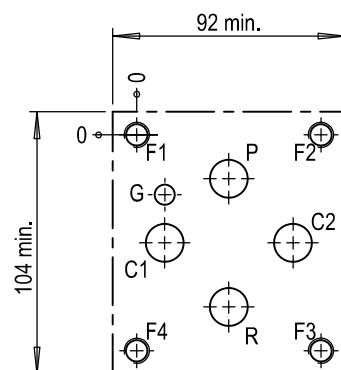


990-1 series INSTALLATION DETAILS

Mounting screws	Skt head cap screws M10 x 55 10.9 ISO 4762
Null adjust (Mechanical)	- 3.0 hex skt & 13 A/F lock nut - slacken lock nut (ccw) half-turn with 13 A/F ring spanner - insert 3.0 hex key into socket and rotate to obtain required null / offset value - hold hexagon key in desired position then tighten lock nut to 3 Nm
Porting details	P, C1, C2, R ports $\varnothing 18$, $\perp$ $\varnothing 25,3 \nabla 1.40$ on 50.8 P.C.D.
Interface seals	Ports P, C1, C2, R - ID 21.95 x $\varnothing 1.78$ O-Ring
Field filter	Replacement element PN: SRS1316A

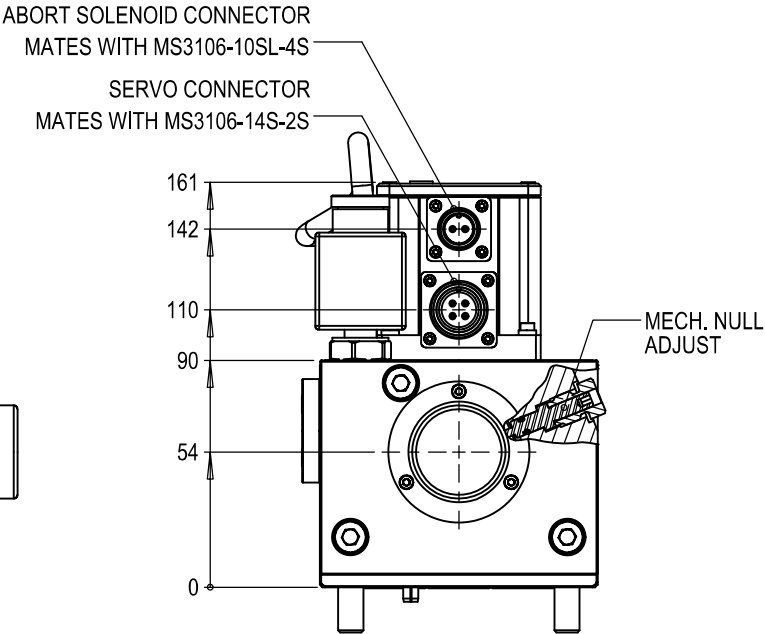
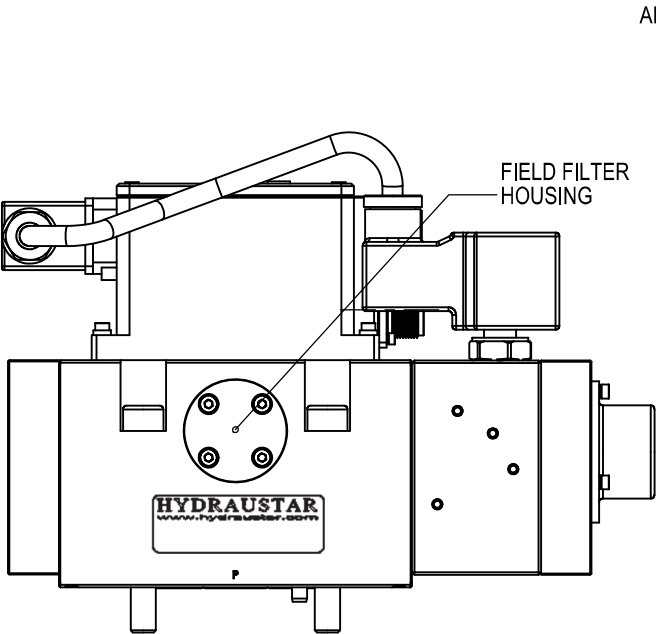
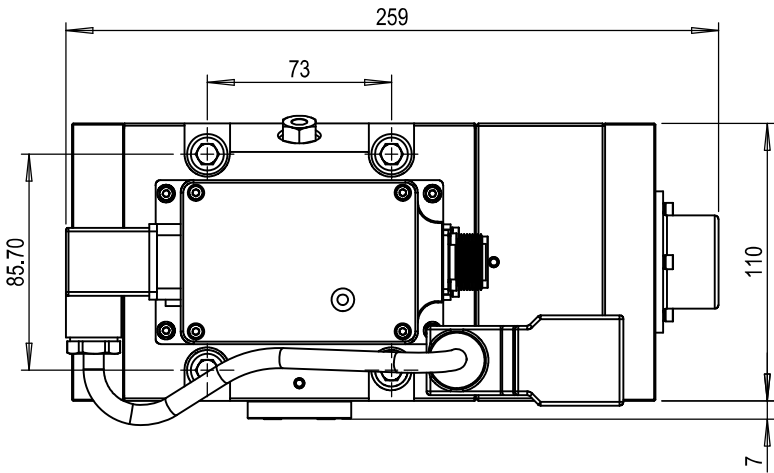


Mounting interface conforms to ISO 10372-06-05-0-92 (X port must not be used)										
	P	C1	C2	R	X	F1	F2	F3	F4	G
size	$\varnothing 18$	$\varnothing 18$	$\varnothing 18$	$\varnothing 18$	-	M10	M10	M10	M10	$\varnothing 8 \nabla 9$
x	36.50	11.10	61.93	36.50	-	0	73	73	0	11.10
y	17.38	42.80	42.80	68.23	-	0	0	85.60	85.60	23.70
Surface flat within 0.01 / 100 : finish better than 0.8 μm										

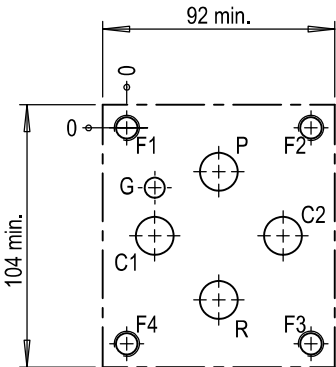


990-2 series
INSTALLATION DETAILS

Mounting screws	Skt head cap screws M10 x 55 10.9 ISO 4762
Null adjust (Mechanical)	- 3.0 hex skt & 13 A/F lock nut - slacken lock nut (ccw) half-turn with 13 A/F ring spanner - insert 3.0 hex key into socket and rotate to obtain required null / offset value - hold hexagon key in desired position then tighten lock nut to 3 Nm
Porting details	P, C1, C2, R ports $\varnothing 18$, $\square$ $\varnothing 25,3 \nabla 1.40$ on 50.8 P.C.D.
Interface seals	Ports P, C1, C2, R - ID 21.95 x $\varnothing 1.78$ O-Ring
Field filter	Replacement element PN: SRS1316A



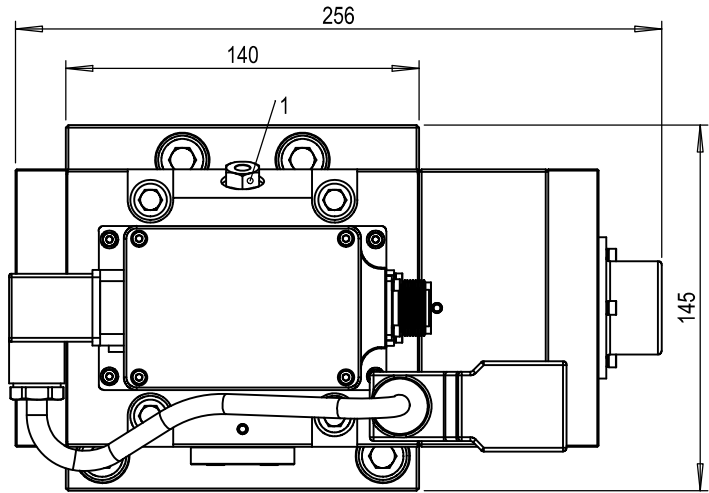
Mounting interface conforms to ISO 10372-06-05-0-92 (X port must not be used)										
	P	C1	C2	R	X	F1	F2	F3	F4	G
size	$\varnothing 18$	$\varnothing 18$	$\varnothing 18$	$\varnothing 18$	-	M10	M10	M10	M10	$\varnothing 8 \nabla 9$
x	36.50	11.10	61.93	36.50	-	0	73	73	0	11.10
y	17.38	42.80	42.80	68.23	-	0	0	85.60	85.60	23.70
Surface flat within 0.01 / 100 : finish better than 0.8 μm										



990-2004

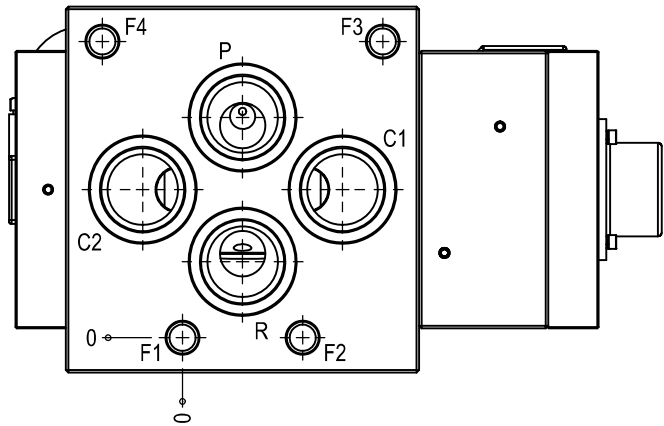
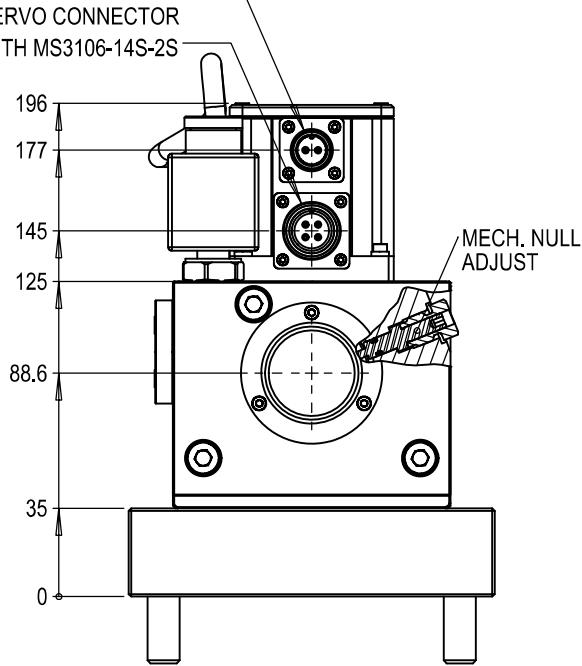
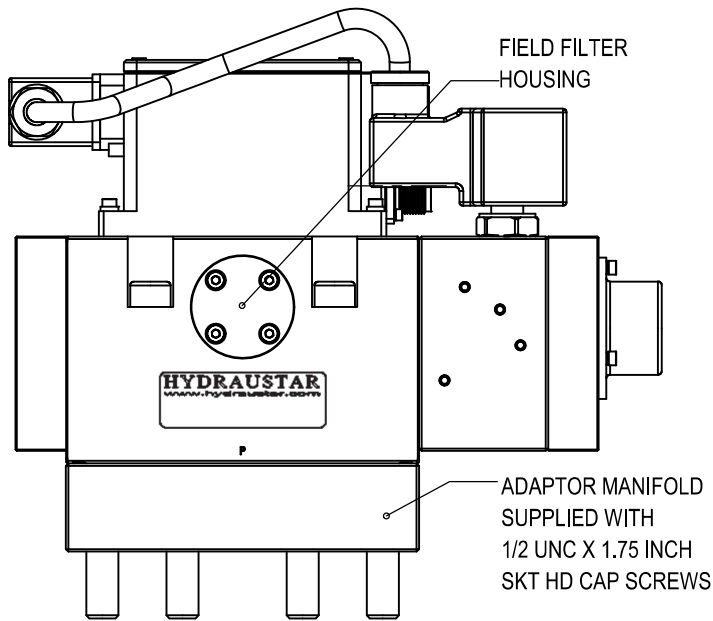
INSTALLATION DETAILS

Mounting screws	Skt head cap screws M10 x 55 10.9 ISO 4762
Null adjust (Mechanical)	- 3.0 hex skt & 13 A/F lock nut - slacken lock nut (ccw) half-turn with 13 A/F ring spanner - insert 3.0 hex key into socket and rotate to obtain required null / offset value - hold hexagon key in desired position then tighten lock nut to 3 Nm
Interface seals	Ports P, C1, C2, R - ID 21.95 x $\varnothing$ 1.78 O-Ring (servo) ID 36.10 x $\varnothing$ 3.53 O-Ring (adaptor manifold)
Field filter	Replacement element PN: SRS1316A



ABORT SOLENOID CONNECTOR
MATES WITH MS3106-10SL-4S

SERVO CONNECTOR
MATES WITH MS3106-14S-2S

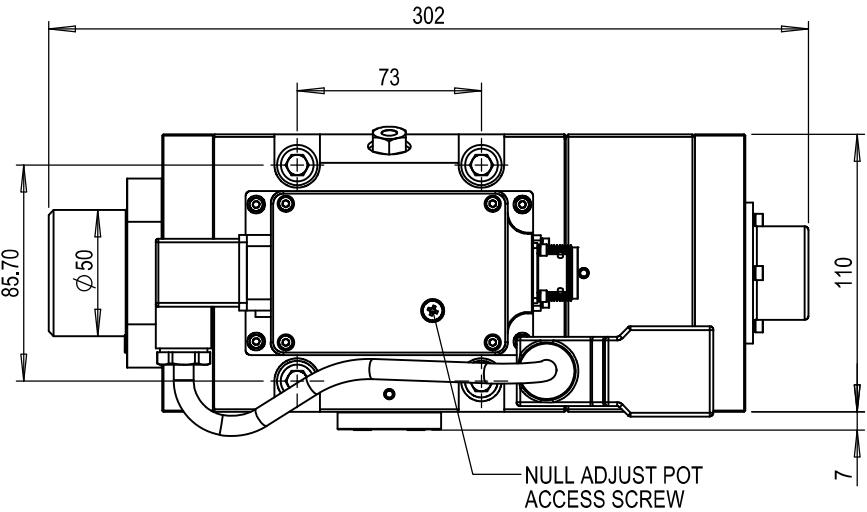


Adaptor manifold interface details								
	P	C1	C2	R	F1	F2	F3	F4
size	Ø 28	Ø 28	Ø 28	Ø 28	1/2UNC	1/2UNC	1/2UNC	1/2UNC
x	23.82	63.42	-15.78	23.82	0	47.64	79.39	-31.75
y	87.32	58.72	58.72	30.12	0	0	117.44	117.44
Mating surface flat within 0.01 / 100 : finish better than 0.8 µm								

Mating surface flat within 0.01 / 100 : finish better than 0.8 μm

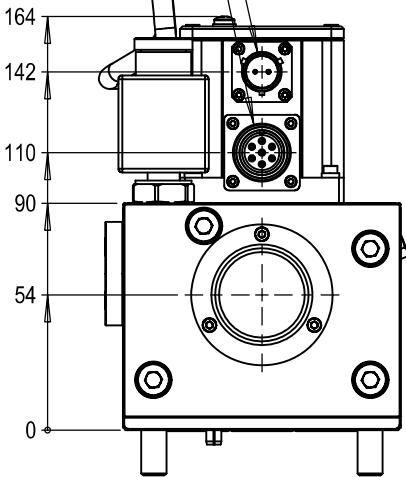
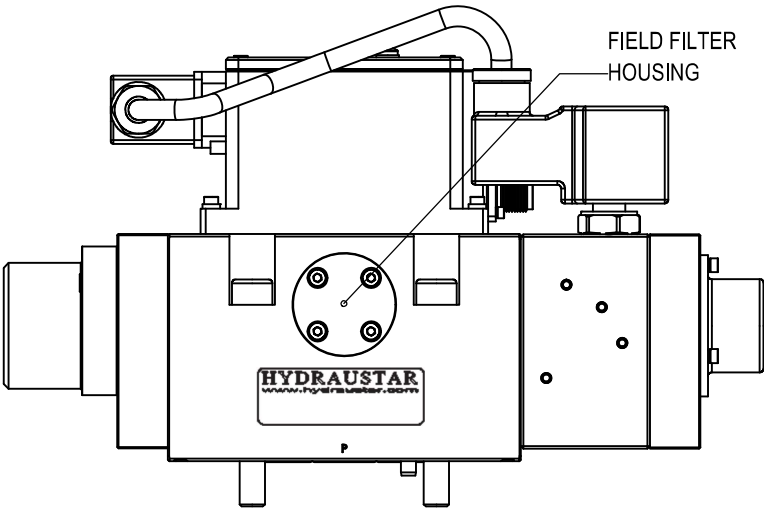
990E4 series
INSTALLATION DETAILS

Mounting screws	Skt head cap screws M10 x 55 10.9 ISO 4762
Null adjust	- remove access screw - insert 2mm flat blade scw driver and locate potentiometer drive slot - rotate to obtain required null / offset value
Porting details	P, C1, C2, R ports $\varnothing 18$, $\sqcap \varnothing 25.3 \nabla 1.40$ on 50.8 P.C.D.
Interface seals	Ports P, C1, C2, R - ID 21.95 x $\varnothing 1.78$ O-Ring
Field filter	Replacement element PN: SRS1316A

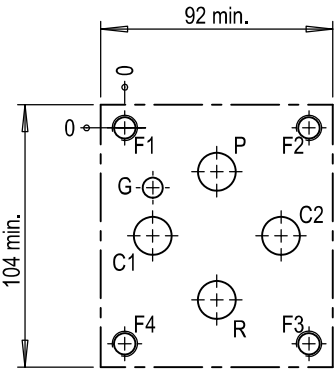


ABORT SOLENOID CONNECTOR
MATES WITH PT06E10-2S

SERVO CONNECTOR
MATES WITH MS3106-14-SA-7SN



Mounting interface conforms to ISO 10372-06-05-0-92 (X port must not be used)										
	P	C1	C2	R	X	F1	F2	F3	F4	G
size	$\varnothing 18$	$\varnothing 18$	$\varnothing 18$	$\varnothing 18$	-	M10	M10	M10	M10	$\varnothing 8 \nabla 9$
x	36.50	11.10	61.93	36.50	-	0	73	73	0	11.10
y	17.38	42.80	42.80	68.23	-	0	0	85.60	85.60	23.70
Surface flat within 0.01 / 100 : finish better than 0.8 μm										



F		8				7	6	5	4	3	2	1	F
E													E
D													D
C													C
B													B
A													A

8		7		6		5		4		3		2		1	
IF IN DOUBT ASK!		THIRD ANGLE PROJECTION								DO NOT SCALE DRAWING					