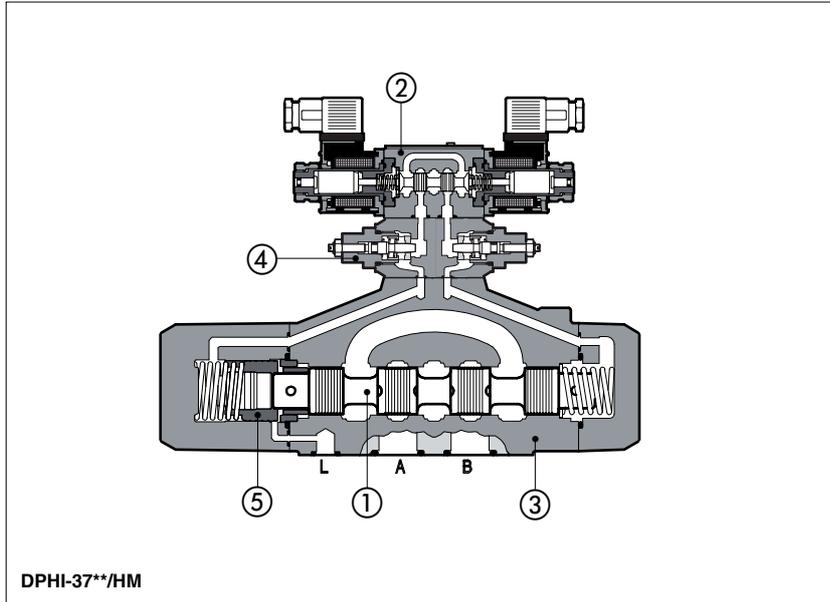


# Solenoid directional valves type DPHI, DPHU

two stage, ISO 4401 size 10, 16, 25 and 32



DPHI and DPHU are spool ① type, two or three position directional two stage solenoid valves designed to operate in oil hydraulic systems.

They are operated by a direct solenoid valve ② with coils certified according to the North American standard **C UR US**:

- DHI suitable for AC and DC supply;
- DHU suitable for DC supply with improved performances.

Shell-moulding castings ③ machined by transfer lines and then cleaned by thermal deburring. Optimized flow paths largely cored with extrawide channels to tank for low pressure drops.

Valves can be supplied with optional devices for control of switching times ④ and with optional hydraulic centering device of main spool ⑤.

In DPHI and DPHU, coils are easily replaceable without aid of tools.

Rugged execution suitable for outdoor use.

**Surface mounting: ISO 4401, size 10, 16, 25 and 32**

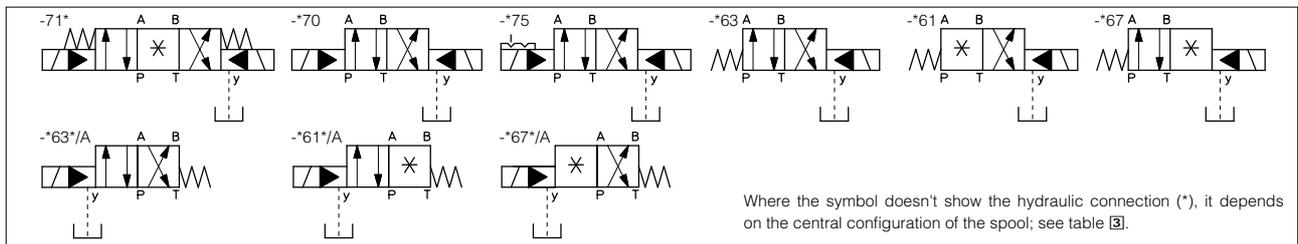
**Max flow up to 160, 300, 650, 1000 l/min.**

**Pressure up to 350 bar**

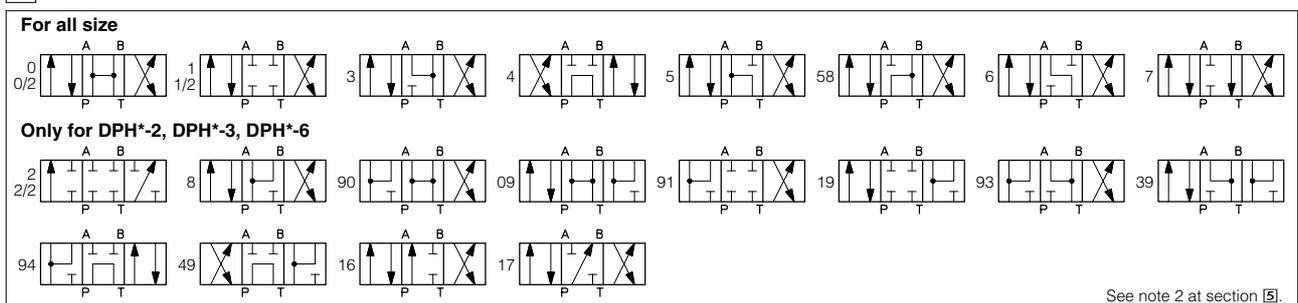
## 1 MODEL CODE

<b>DPH</b>	<b>I</b>	<b>-</b>	<b>2</b>	<b>71</b>	<b>1</b>	<b>/A</b>	<b>-</b>	<b>X</b>	<b>24DC</b>	<b>**</b>	<b>/*</b>
Two stage directional control valve											Synthetic fluids: WG = water-glycol PE = phosphate ester
Solenoid pilot valve: I = DHI for AC and DC supply U = DHU for DC supply											Series number
Valve size: 1 = 10 2 = 16 3 = 25 6 = 32											Voltage code, see section 7: 00 = solenoid valve without coils
Valve configuration, see section 2: 61 = single solenoid, center plus external position, spring centered 63 = single solenoid, 2 external positions, spring offset 67 = single solenoid, center plus external position, spring offset 70 = double solenoid, 2 external positions, without springs 71 = double solenoid, 2 external positions, spring centered 75 = double solenoid, 2 external positions, with detent Other configurations are available on request											X = without connector See section 6 for available connectors, to be ordered separately
											Options, see note 1 at section 5
											Spool type, see section 3

## 2 CONFIGURATION



## 3 SPOOLS - for intermediate passages, see tab. E001.



#### 4 MAIN CHARACTERISTICS OF SOLENOID DIRECTIONAL VALVES TYPE DPHI, DPHU

Installation position	Any position for all valves except for type -*70 (without springs) that must be installed with horizontal axis if operated by impulses.
Subplate surface finishing	Roughness index $\sqrt{0.4}$ flatness ratio 0,01/100 (ISO 1101)
Ambient temperature	from -20°C to +70°C
Fluid	Hydraulic oil as per DIN 51524 .... 535; for other fluids see section 11
Recommended viscosity	15 ÷ 100 mm <sup>2</sup> /s at 40°C (ISO VG 15 ÷ 100)
Fluid contamination class	ISO 19/16, achieved with in line filters at 25 µm value to $\beta_{25} \geq 75$ (recommended)
Fluid temperature	-20°C +60°C (standard and /WG seals) -20°C +80°C (/PE seals)
Flow direction	As shown in the symbols of tables 2 and 3
<b>Operating pressure</b>	P, A, B, X = <b>350 bar</b> T = <b>250 bar</b> for external drain (standard) <b>120 bar</b> DPHI with option /D <b>210 bar</b> DPHU with option /D Ports Y and L (if required): 0 bar Minimum pilot pressure for correct operation is 8 bar (10 bar with hydraulic centering device - option /M)
Rated flow	See diagrams Q/Δp at section 8
<b>Maximum flow</b>	DPH*-1: <b>160 l/min</b> ; DPH*-2: <b>300 l/min</b> ; DPH*-3: <b>650 l/min</b> ; DPH*-6: <b>1000 l/min</b> (see rated flow at section 8 and operating limits at section 9)

#### 4.1 Coils characteristics

Insulation class	H (180°C) Due to the occurring surface temperatures of the solenoid coils, the European standards EN563 and EN982 must be taken into account
Connector protection degree	IP 65
Relative duty factor	100%
Supply voltage and frequency	See electric feature 7
Supply voltage tolerance	± 10%
Certification	<b>C UR US</b>

#### 5 NOTES

##### 5.1 Options

/A = Solenoid mounted at side of port A of main body (only for single solenoid valves). In standard version, solenoid is mounted at side of port B.

/D = Internal drain.

/E = External pilot pressure.

/FC = Microswitch for monitoring spool position (only for DPH\*-2, -3, -6).

/F\* = With proximity switch for monitoring spool position: see tab. E110.

/H = Adjustable chokes (meter-out to the pilot chambers of the main valve).

/H9 = Adjustable chokes (meter-in to the pilot chambers of the main valve).

/M = (only for three position valves and DPH\*-2, -3, -6) = Hydraulic pressure centering: For operation with pressure higher than 250 bar and high rates of flow, the use of hydraulic centering device may be recommended.

/R = Pilot pressure generator (4 bar on port P - only for DPH\*-2, -3, -6), see section 11.

/S = Main spool stroke adjustment (only for DPH\*-2, -3, -6).

/WP = prolonged manual override protected by rubber cap.

/L1, /L2, /L3 = device for switching time control (dimension L1, L2, L3) on A and B ports of the pilot valve.

##### 5.2 Spools

- spools type **0** and **3** are also available as 0/1 and 3/1. With them, when in centre position, oil passage from ports to tank are restricted.

- spools type **1, 4, 5, 6** and **7** are also available as 1/1, 4/8, 5/1, 6/1 and 7/1 (1/1, 6/1 and 7/1 only for DPH\*-2, -3, -6) that are properly shaped to reduce water-hammer shocks during the switching (to use with option /L).

- spools type **9, 9\*, \*9, 16** and **17** are not available for DPH\*-6.

- other types of spools can be supplied on request.

#### 6 ELECTRONIC CONNECTORS ACCORDING TO DIN 43650 - the connectors must be ordered separately

Code of connector	Function
<b>SP-666</b>	Connector IP-65, suitable for direct connection to electric supply source
<b>SP-667</b>	As SP-666 connector IP-65 but with built-in signal led, suitable for direct connection to electric supply source
<b>SP-669</b>	With built-in rectifier bridge for supplying DC coils by alternating current (AC 110V and 230V - I <sub>max</sub> 1A)

For other available connectors, see tab. E010 and K500

#### 7 ELECTRIC FEATURES

Valve	External supply nominal voltage ± 10%	Voltage code	Type of connector	Power consumption (2)	Code of spare coil		Colour of coil label
					DPHI	DPHU	
DPHI DPHU	6 DC	<b>6 DC</b>	SP-666 o SP-667	33 W	SP-COU-6DC/80	SP-COU-6DC/80	brown
	9 DC	<b>9 DC</b>			-	-	light blue
	12 DC	<b>12 DC</b>			SP-COU-12DC/80	SP-COUR-12DC/10	green
	14 DC	<b>14 DC</b>			SP-COU-14DC/80	SP-COUR-14DC/10	brown
	18 DC	<b>18 DC</b>			-	-	blue
	24 DC	<b>24 DC</b>			SP-COU-24DC/80	SP-COUR-24DC/10	red
	28 DC	<b>28 DC</b>			SP-COU-28DC/80	SP-COUR-28DC/10	silver
	48 DC	<b>48 DC</b>			SP-COU-48DC/80	-	silver
	110 DC	<b>110 DC</b>			SP-COU-110DC/80	SP-COUR-110DC/10	gold
	125 DC	<b>125 DC</b>			SP-COU-125DC/80	-	blue
	220 DC	<b>220 DC</b>			SP-COU-220DC/80	SP-COUR-220DC/10	black
	24/50 AC	<b>24/50/60 AC</b>			SP-669	60 VA (3)	SP-COI-24/50/60AC/80 (1)
	48/50 AC	<b>48/50/60 AC</b>	SP-COI-48/50/60AC/80 (1)	-			white
	110/50 AC	<b>110/50/60 AC</b>	SP-COI-110/50/60AC/80 (1)	-			yellow white
	120/60 AC	<b>120/60 AC</b>	SP-COI-120/60AC/80	-			-
	230/50 AC	<b>230/50/60 AC</b>	SP-COI-230/50/60AC/80 (1)	-			light blue silver
	230/60 AC	<b>230/60 AC</b>	SP-COI-230/60AC/80	-			-
	110/50 AC	<b>110RC</b>	SP-669	40 VA 35 VA	SP-COU-110RC/80	SP-COUR-110RC/10	gold
120/60 AC							
230/50 AC	<b>230RC</b>	SP-COU-230RC/80			SP-COUR-230RC/10	blue	

(1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10 ÷ 15% and the power consumption is 55 VA.

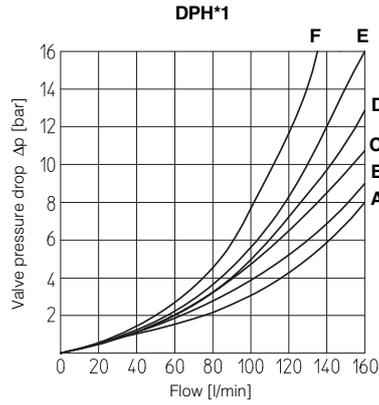
(2) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.

(3) When solenoid is energized, the inrush current is approx 3 times the holding current. Inrush current values correspond to a power consumption of about 150 VA.

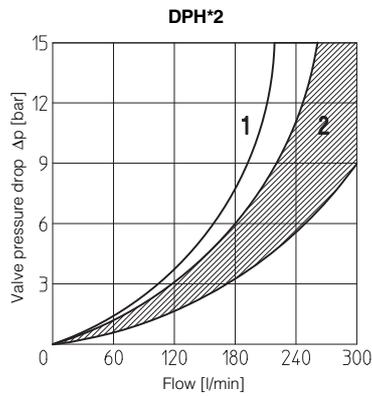
## 8 FLOW VERSUS PRESSURE DIAGRAMS

Based on mineral oil ISO VG 46 at 50°C

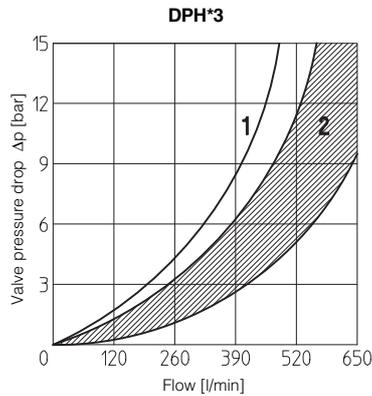
Flow direction \ Spool type	Flow direction				
	P→A	P→B	A→B	TB→T	TP→T
0/2, 1/2	D	E	D	C	-
0	D	E	C	C	E
1	A	B	D	C	-
3, 6, 7	A	B	C	C	-
4, 4/8	B	C	D	D	-
5, 5/8	A	E	C	C	F



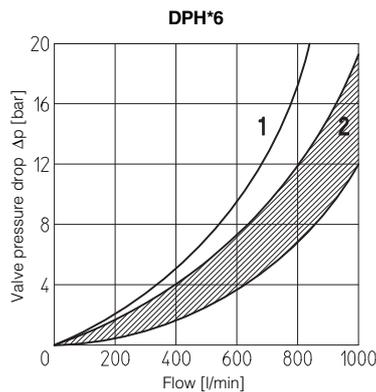
Flow direction \ Spool type	Flow direction				
	P→A	P→B	A→B	TB→T	TP→T
4, 4/8	2	2	2	2	1
Other	2	2	2	2	-



Flow direction \ Spool type	Flow direction				
	P→A	P→B	A→B	TB→T	TP→T
4, 4/8	2	2	2	2	1
Other	2	2	2	2	-



Flow direction \ Spool type	Flow direction				
	P→A	P→B	A→B	TB→T	TP→T
4, 4/8	2	2	2	2	1
Other	2	2	2	2	-



## 9 OPERATING LIMITS

The max recommended flow rates - l/min - for a correct operation are shown in the tables below for some typical spools and inlet pressure. For higher values the use of the hydraulic centering device is recommended.

Spool	Inlet pressure			
	70	160	210	350
0, 1, 3, 6, 7	160	160	160	145
4, 4/8	160	160	135	100
5, 5/8	160	160	145	110
0/1, 0/2	160	160	145	135

Spool	Inlet pressure			
	70	140	210	350
0, 1, 3, 6, 7, 8	300	300	300	250
2, 4, 4/8	300	300	240	140
5	260	220	180	100
0/1	300	250	210	180
*9, 9*	300	300	270	200

Spool	Inlet pressure			
	70	140	210	350
1, 6, 7, 8	650	650	650	600
2, 4, 4/8	500	500	450	400
5, 0/1	600	520	400	300
0, 3	650	650	600	540
*9, 9*	500	500	500	450

Spool	Inlet pressure			
	70	140	210	350
1, 6, 7, 8	1000	950	850	700
0	950	900	800	650
4, 4/8, 5	850	800	700	450
0/1	950	850	650	450

**10 SWITCHING TIMES** (average values in m sec)

**DPH\*1**

Configuration		Piloting pressure							
		70 bar		140 bar		210 bar		250 bar	
		DPHI	DPHI DPHU						
		Alternating current	Direct current						
71, 61, 67, 61*/A, 67*/A	Switch ON	35	50	30	45	25	40	20	35
	Switch OFF	50							
63, 63*/A	Switch ON	50	75	40	65	35	55	30	50
	Switch OFF	80							

**DPH\*2**

Configuration		Piloting pressure							
		70 bar		140 bar		210 bar		250 bar	
		DPHI	DPHI DPHU						
		Alternating current	Direct current						
71, 61, 67, 61*/A, 67*/A	Switch ON	40	55	30	50	25	45	20	40
	Switch OFF	60							
63, 63*/A	Switch ON	55	80	45	70	40	60	35	55
	Switch OFF	95							

**DPH\*3**

Configuration		Piloting pressure							
		70 bar		140 bar		210 bar		250 bar	
		DPHI	DPHI DPHU						
		Alternating current	Direct current						
71, 61, 67, 61*/A, 67*/A	Switch ON	60	80	45	60	35	50	30	45
	Switch OFF	80							
63, 63*/A	Switch ON	95	115	75	95	65	75	50	65
	Switch OFF	130							

**DPH\*6**

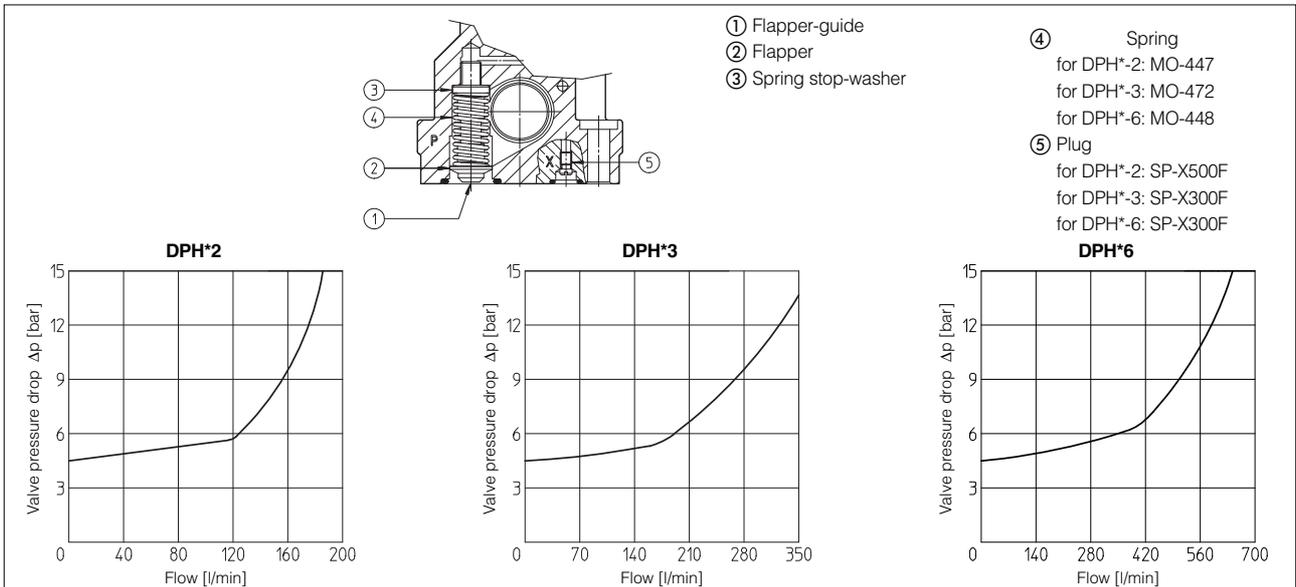
Configuration		Piloting pressure							
		70 bar		140 bar		210 bar		250 bar	
		DPHI	DPHI DPHU						
		Alternating current	Direct current						
71, 61, 67, 61*/A, 67*/A	Switch ON	70	95	55	70	45	60	40	55
	Switch OFF	150							
63, 63*/A	Switch ON	115	145	95	110	80	100	70	90
	Switch OFF	280							

**Notes:**

- For configuration 70 and 75, times of switching ON and switching OFF are the same: this value is equal to time of switch ON of configuration 63.
- TEST CONDITIONS
  - Nominal voltage supply DC (direct) and AC (alternating) with connector type SP-666. The use of other connectors can affect the switching time;
  - 2 bar of counter pressure on port T;
  - mineral oil: ISO VG 46 at 50°C
- The response time is affected by elasticity of the hydraulic circuit, by variation of hydraulic characteristics and temperature.

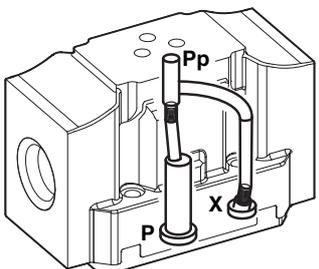
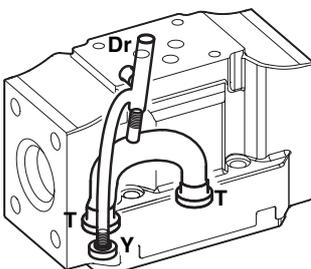
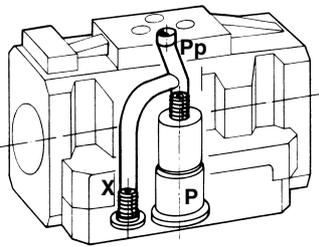
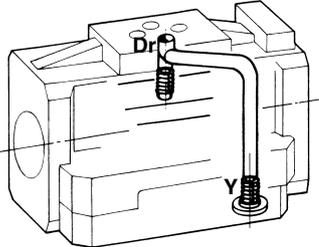
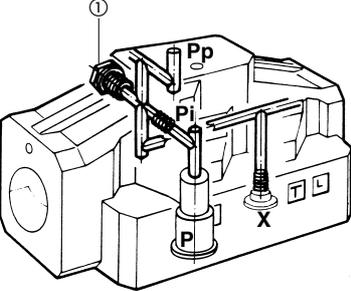
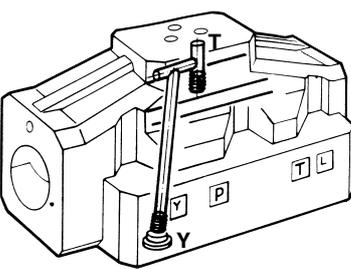
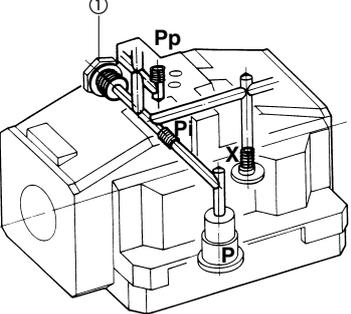
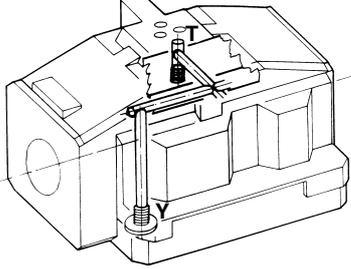
**11 PILOT PRESSURE GENERATOR (OPTION /R)**

The device /R generates an additional pressure drop, in order to ensure the minimum pilot pressure, for correct operation of the valves with internal pilot and fitted with spools type **0, 0/1, 4, 4/8, 5, 58, 09, 90, 94, 49**. The device /R has to be fitted when the pressure drop in the valve, verified on flow versus pressure diagrams, is lower than the minimum pilot pressure value.



**12 ORIFICE LOCATION FOR PILOT/DRAIN CHANNELS**

Depending on the position of internal plugs, different pilot/drain configurations can be obtained as shown below. To modify the pilot/drain configuration proper plugs must only be interchanged. The plugs have to be sealed using loctite 242. Standard valves have internal pilot and external drain

<p><b>DPH*-1</b></p> <p><b>Pilot channels</b></p> 	<p><b>Drain channels</b></p> 	<p><b>Internal piloting:</b> blinded plug SP-X300F in X; plug SP-X310F in Pp;</p> <p><b>External piloting:</b> blinded plug SP-X300F in Pp; plug SP-X310F in X;</p> <p><b>Internal drain:</b> blinded plug SP-X300F in Y;</p> <p><b>External drain:</b> blinded plug SP-X300F in Dr.</p>
<p><b>DPH*-2</b></p> <p><b>Pilot channels</b></p> 	<p><b>Drain channels</b></p> 	<p><b>Internal piloting:</b> blinded plug SP-X500F in X; plug SP-X512F in Pp;</p> <p><b>External piloting:</b> blinded plug SP-X500F in Pp; plug SP-X512F in X;</p> <p><b>Internal drain:</b> blinded plug SP-X300F in Y;</p> <p><b>External drain:</b> blinded plug SP-X300F in Dr.</p>
<p><b>DPH*-3</b></p> <p><b>Pilot channels</b></p> 	<p><b>Drain channels</b></p> 	<p><b>Internal piloting:</b> blinded plug SP-X300F in X; plug SP-X315F in Pi;</p> <p><b>External piloting:</b> blinded plug SP-X300F in Pi; plug SP-X315F in X;</p> <p><b>Internal drain:</b> blinded plug SP-X300F in Y;</p> <p><b>External drain:</b> blinded plug SP-X300F in T.</p>
<p>To reach the Pi orifice, remove plug ①</p>		
<p><b>DPH*-6</b></p> <p><b>Pilot channels</b></p> 	<p><b>Drain channels</b></p> 	<p><b>Internal piloting:</b> blinded plug SP-X300F in X; plug SP-X325A in Pp;</p> <p><b>External piloting:</b> blinded plug SP-X300F in Pi; plug SP-X325A in X;</p> <p><b>Internal drain:</b> blinded plug SP-X300F in Y;</p> <p><b>External drain:</b> blinded plug SP-X300F in T.</p>
<p>To reach the Pi orifice, remove plug ①</p>		

13 DIMENSIONS FOR DPH\*-1 AND DPH\*-2 [mm]

**DPH\*-1\***

ISO 4401: 2005

Mounting surface: 4401-05-05-0-05

Fastening bolts:

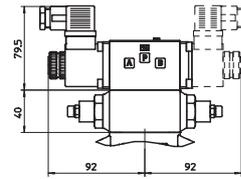
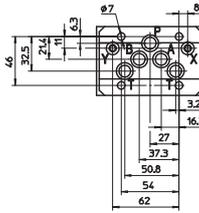
4 socket head screws M6x40 class 12.9

Tightening torque = 15 Nm

Diameter of ports A,B, P, T: Ø = 11 mm;

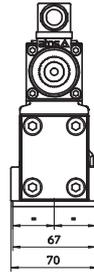
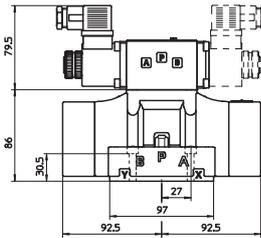
Diameter of ports X, Y: Ø = 5 mm;

Seals: 5 OR 2050, 2 OR 108



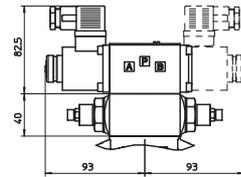
DPHI-1\*/H /H9

- P = PRESSURE PORT
- A, B = USE PORT
- T = TANK PORT
- X = EXTERNAL OIL PILOT PORT
- Y = DRAIN PORT



DPHI-1\*

Mass of basic versions:  
kg 6,5 (one solenoid)  
kg 6,8 (two solenoids)



DPHU-1\*/H /H9

Mass of valve with option /H\*:  
kg 6,9 (one solenoid)  
kg 7,6 (two solenoids)

**DPH\*-2\***

ISO 4401: 2005

Mounting surface: 4401-07-07-0-05

Fastening bolts:

4 socket head screws M10x50 class 12.9

Tightening torque = 70 Nm

2 socket head screws M6x40 class 12.9

Tightening torque = 15 Nm

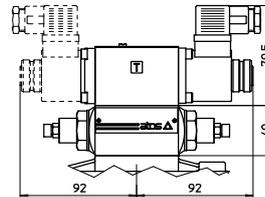
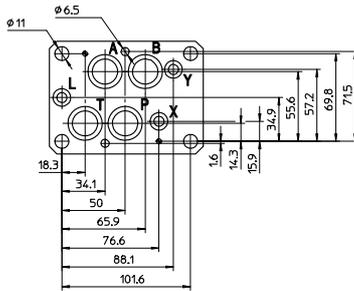
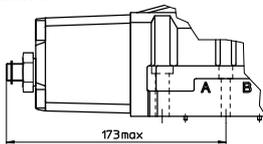
Diameter of ports A, B, P, T: Ø = 20 mm;

Diameter of ports X, Y: Ø = 7 mm;

Diameter of ports L: Ø = 5 mm;

Seals: 4 OR 130, 3 OR 109/70

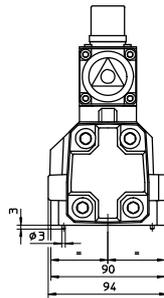
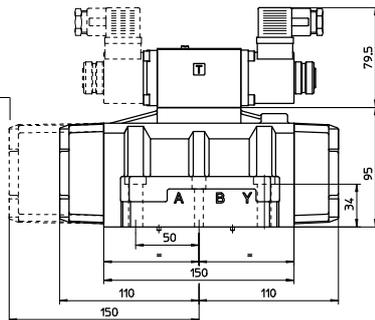
Stroke adjustment device for option/S



DPHI-2\*/H /H9

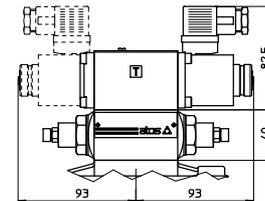
- P = PRESSURE PORT
- A, B = USE PORT
- T = TANK PORT
- X = EXTERNAL OIL PILOT PORT
- Y = DRAIN PORT
- L = DRAIN PORT FOR HYDRAULIC CENTERING DEVICE used only for /M versions

Only version DPH\*-27\*/M



DPHI-2\*

Mass of basic versions:  
kg 9 (one solenoid)  
kg 9,3 (two solenoids)



DPHU-2\*/H /H9

Mass of valve with option /H\*:  
kg 9,4 (one solenoid)  
kg 10,1 (two solenoids)

Overall dimensions refer to valves with connectors type SP-666

14 MOUNTING SUBPLATES FOR DPH\*-1 AND DPH\*-2

Valve	Subplate model	Ports location	Ports		Ø Counterbore [mm]		Mass [Kg]
			A, B, P, T	X, Y, (L)	A, B, P, T	X, Y, (L)	
DPH*-1	BA-428	Ports A, B, P, T, X, Y underneath;	G 3/4"	G 1/4"	36,5	21,5	5,6
DPH*-1	BA-434	Ports P, T, X, Y underneath; ports A, B on lateral side	G 3/4"	G 1/4"	36,5	21,5	5,5
DPH*-2	BA-418 (/DR)	Ports A, B, P, T, X, Y (L) underneath;	G 3/4"	G 1/4"	36,5	21,5	3,5
DPH*-2	BA-518 (/DR)	Ports A, B, P, T, X, Y (L) underneath;	G 1"	G 1/4"	46	21,5	8
DPH*-2	BA-519 (/DR)	Ports P, T, X, Y (L) underneath; ports A, B on lateral side	G 1"	G 1/4"	46	21,5	8

The drain port L (subplates /DR) is required only for valves with hydraulic pressure centering device (option /M)  
The subplates are supplied with fastening bolts. For further details see table K280

15 DIMENSIONS FOR DPH\*-3 [mm]

DPH\*-3\*

ISO 4401: 2005

Mounting surface: 4401-08-08-0-05

Fastening bolts:

6 socket head screws M12x50 class 12.9

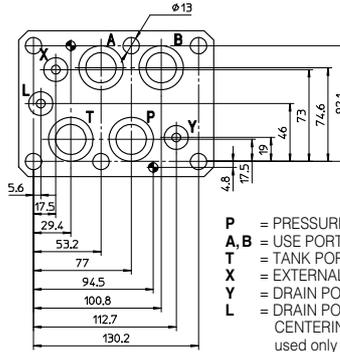
Tightening torque = 125 Nm

Diameter of ports A, B, P, T:  $\varnothing = 24$  mm;

Diameter of ports X, Y:  $\varnothing = 7$  mm;

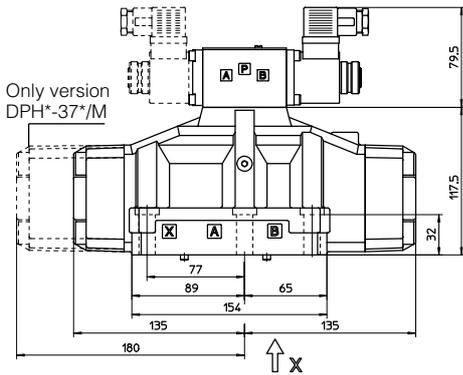
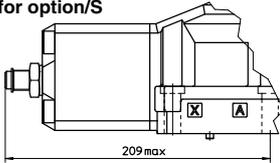
Diameter of port L:  $\varnothing = 5$  mm

Seals: 4 OR 4112, 3 OR 3056



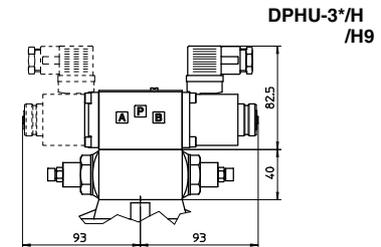
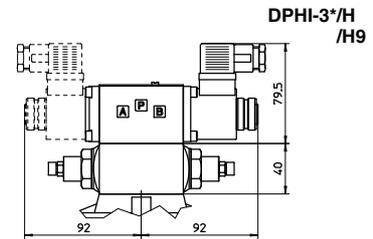
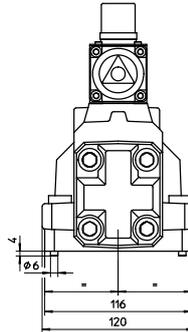
- P = PRESSURE PORT
- A, B = USE PORT
- T = TANK PORT
- X = EXTERNAL OIL PILOT PORT
- Y = DRAIN PORT
- L = DRAIN PORT FOR HYDRAULIC CENTERING DEVICE used only for /M versions

Stroke adjustment device for option/S



Mass of basic versions:  
kg 14 (one solenoid)  
kg 14,3 (two solenoids)

DPHI-3\*



Mass of valve with option /H\*:  
kg 14,4 (one solenoid)  
kg 15,1 (two solenoids)

Overall dimensions refer to valves with connectors type SP-666

16 MOUNTING SUBPLATES FOR DPH\*-3

Valve	Subplate model	Ports location	Ports		Ø Counterbore [mm]		Mass [Kg]
			A, B, P, T	X, Y, (L)	A, B, P, T	X, Y, (L)	
DPH*-3	BA-508 (/DR)	Ports A, B, P, T, X, Y (L) underneath;	G 1"	G 1/4"	46	21,5	7
DPH*-3	BA-509 (/DR)	Ports P, T, X, Y (L) underneath; ports A, B on lateral	G 1"	G 1/4"	46	21,5	12,5

The drain port L (subplates /DR) is required only for valves with hydraulic pressure centering device (option /M)  
The subplates are supplied with fastening bolts. For further details see table K280

17 DIMENSIONS FOR DPH\*-6 [mm]

DPH\*-6\*

ISO 4401: 2005

Mounting surface: 4401-10-09-0-05

Fastening bolts:

6 socket head screws M20x80 class 12.9

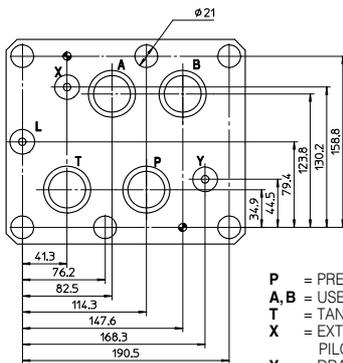
Tightening torque = 600 Nm

Diameter of ports A, B, P, T: Ø = 34 mm;

Diameter of ports X, Y: Ø = 7 mm;

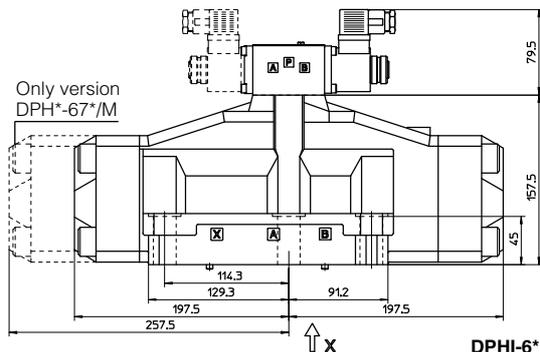
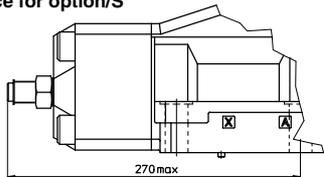
Diameter of ports L: Ø = 5 mm;

Seals: 4 OR 4137, 3 OR 3081

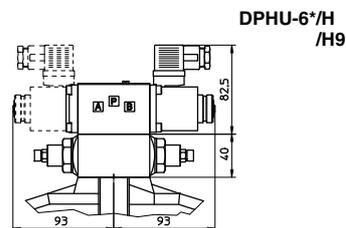
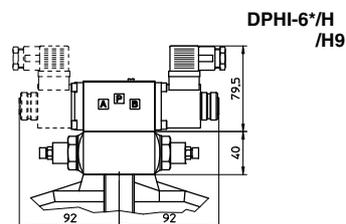


- P = PRESSURE PORT
- A, B = USE PORT
- T = TANK PORT
- X = EXTERNAL OIL PILOT PORT
- Y = DRAIN PORT
- L = DRAIN PORT FOR HYDRAULIC CENTERING DEVICE used only for /M versions

Stroke adjustment device for option/S



Mass of basic versions:  
kg 42 (one solenoid)  
kg 42,3 (two solenoids)



Mass of valve with option /H\*:  
kg 42,4 (one solenoid)  
kg 43,1 (two solenoids)

Overall dimensions refer to valves with connectors type SP-666

18 MOUNTING SUBPLATES FOR DPH\*-6

Valve	Subplate model	Ports location	Ports		Ø Counterbore [mm]		Mass [Kg]
			A, B, P, T	X, Y, (L)	A, B, P, T	X, Y, (L)	
DPH*-6	BA-708 (/DR)	Ports A, B, P, T, X, Y (L) underneath;	G 1 1/2"	G 1/4"	63,5	21,5	17

The drain port L (subplates /DR) is required only for valves with hydraulic pressure centering device (option /M)  
The subplates are supplied with fastening bolts. For further details see table K280