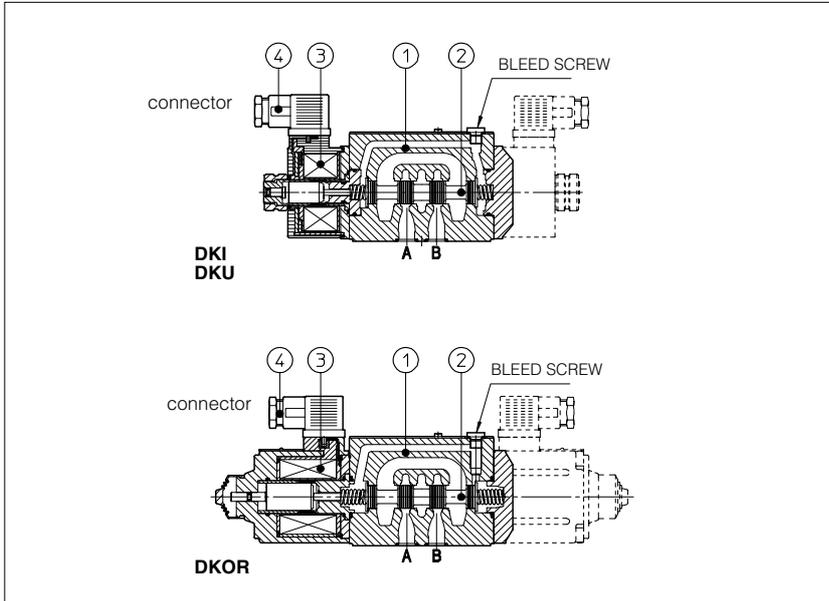


Solenoid directional valves type **DKI, DKU, DKOR**

direct operated, ISO 4401 size 10



DKI, DKU and DKOR are spool type, three or four way, two or three position direct operated solenoid valves designed to operate in oil hydraulic systems.

They are operated by wet and pressure sealed solenoid ③ with manual override:

- AI solenoid suitable for AC supply;
- AU solenoid for DC supply with improved performance;
- AOR solenoid for DC supply with high performance.

Moving parts are protected, lubricated and cushioned in oil.

Shell-moulding casting ① are 5 chambers machined by transfer lines and then cleaned by thermal deburring.

Optimized flow paths largely cored with extrawide channels to tank for low pressure drops.

Interchangeable spools ② available in a wide variety of configurations.

DKU and DKOR valves can be supplied with optional devices for control of switching times.

Standard electric/electronic connectors ④ able to satisfy the requirements of modern machines for electric interfaces characteristics.

Coils are fully encapsulated (class H). In DKI and DKU coils are easily replaceable without the aid of tools.

Rugged execution suitable for outdoor use.

Surface mounting ISO 4401 size 10.
Max flow up to 100 l/min for DKI/DKU and up to 120 l/min for DKOR.
Max pressure: 315 bar.

1 MODEL CODE

DKI - 1 63 1/2 /A - X 24 DC ** /*

Directional control valves ISO 4401 size 10
DKI-1 = solenoid AI for AC supply
DKU-1 = solenoid AU for DC supply
DKOR-1 = solenoid OO for DC supply

Valve configuration, see table 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, 3 positions, spring centered
75 = double solenoid, 2 external positions, with detent
77 = double solenoid, center plus external position, without springs
 Other configurations are available on request.

Spool type, see table 3.

Synthetic fluids
WG = water glycol
PE = phosphate ester

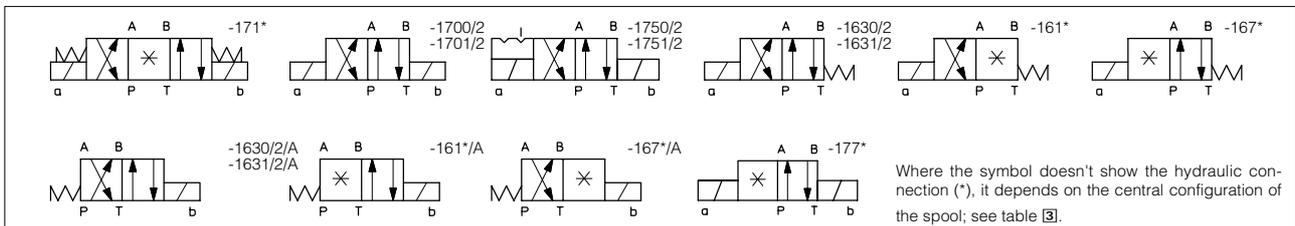
Design number

External supply voltage see section 6
00 = valve without coils (only for DKI and DKU).

X = without connector
 See note 2 at section 5 for available connectors, to be ordered separately

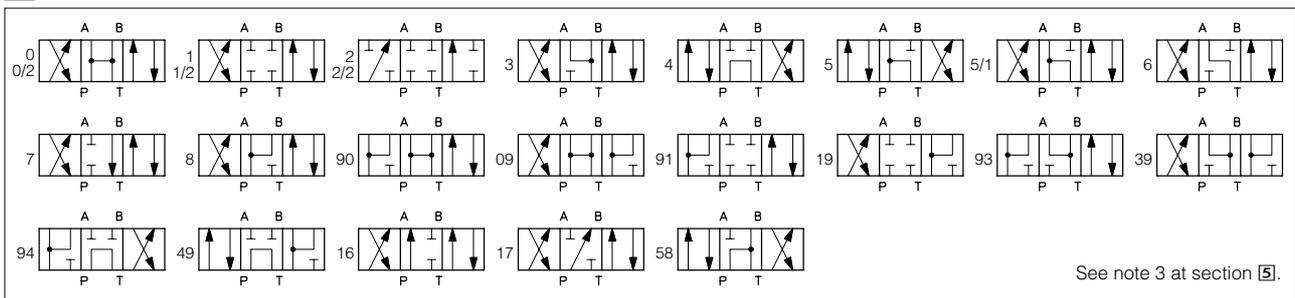
Options, see note 1 at section 5.

2 CONFIGURATION



Where the symbol doesn't show the hydraulic connection (*), it depends on the central configuration of the spool; see table 3.

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



See note 3 at section 5.

4 MAIN CHARACTERISTICS OF DK1, DKU AND DKOR DIRECTIONAL VALVES

Assembly position / location	Any position for all valves except for type - 170* (without springs) that must be installed with horizontal axis if operated by impulses
Commissioning	For correct AC operation, the valve must be full of hydraulic fluid, otherwise some vibrations may occur. In this case fill the valve with oil by opening the screw $\text{\textcircled{V}}$, see sketch at section $\text{\textcircled{10}}$ and $\text{\textcircled{11}}$. A check valve on T line aids to keep valve full.
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 $\text{\textcircled{1}}$.
Recommended viscosity	15 ÷ 100 mm ² /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 MWG seals) -20°C +80°C (/PE seals)
Flow direction	As shown in the symbols of tables $\text{\textcircled{2}}$ and $\text{\textcircled{3}}$.
Operating pressure	Ports P,A,B: 315 bar; Port T: 120 bar for DK1; 160 bar for DKU and 210 bar for DKOR; 315 bar for option Y. For versions with proximity switches (/FI/NC and /FI/NO versions) port Y must be drained
Rated flow	See diagrams Q/Δp at section $\text{\textcircled{7}}$.
Maximum flow	100 l/min for DK1 and DKU; 120 l/min for DKOR, see operating limits at section $\text{\textcircled{8}}$.

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 $\text{\textcircled{6}}$
Supply voltage tolerance	± 10%

5 NOTES

1 Options

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

WP = prolonged manual override protected by rubber cap (standard for DKOR models).

L, L1, L2, L3, LR, see sec. $\text{\textcircled{10}}$ = device for switching time control (only for DKU and DKOR models).

Not available for valves with connectors E-SA or E-SE. For spools 4, 4/8, 5/1 only device L1 is available.

F* = with proximity switch for monitoring spool position: see tab. E110.

Y = external drain - not available for DK1-163* and DK1-175* (standard for versions with proximity switches /F*)

2 Type of electric/electronic connector with connector DIN 43650 to be ordered separately

SP-666 = standard connector IP-65 for direct connection to electric supply source.

SP-667 = as SP-666, but with built-in signal led.

SP-669 = with built-in rectifier bridge for supplying DC coils by alternate current (AC 110V and 230V - I_{max} 1A).

E-SA = electronic connector (only for DK1 and DKU valves) which improves performances and give faster shifting times for DC solenoid supplied by AC power.

E-SE = electronic connector (only for DK1 and DKU valves) which improves performances and reduces power consumption for DC solenoid supplied by DC power.

E-SR = electronic connector which permits switching of solenoid valves by a low power signal (max 20mA).

E-SD = electronic connector which eliminates electric disturbances when solenoid valves are de-energized.

Note: disturbance suppressor devices, similar to E-SD are, standard, built in all E-SA, E-SE, E-SR.

3 Spools

- spools type 0/2, 1/2, 2/2 are only used for two position valves: single solenoid valves, type DK*-163*/2; double solenoid valves type DK*-170*/2 and DK*-175*/2.
- spools type 0 and 3 are also available as 0/1 and 3/1 that, when in centre position, oil passage from ports to tank are restricted.
- spools type 1,4 and 5 are also available as 1/1, 4/8 and 5/1. They are properly shaped to reduce water-hammer shocks during the swiching. Note that the configuration of spool 5/1 is inverted in respect with spool 5: see section $\text{\textcircled{3}}$.
- spools type 1,3 and 1/2 are also available as 1P, 3P and 1/2P to limit valve leakage.
- Other types of spools can be supplied on request.

6 ELECTRIC FEATURES

Valve	External supply nominal voltage ± 10%	Type of connector	Power consumption (2)	Code of spare coil		Colour of coil label		
				DK1	DKU			
DK1 DKU	6 DC	SP-666 or SP-667	52 W	-	SP-CAU-6DC / 80	brown		
	9 DC			-	SP-CAU-9DC / 80	light blue		
	12 DC			-	SP-CAU-12DC / 80	green		
	14 DC			-	SP-CAU-14DC / 80	brown		
	18 DC			-	SP-CAU-18DC / 80	blue		
	24 DC			-	SP-CAU-24DC / 80	red		
	28 DC			-	SP-CAU-28DC / 80	silver		
	48 DC			-	SP-CAU-48DC / 80	silver		
	110 DC			-	SP-CAU-110DC / 80	gold		
	125 DC			-	SP-CAU-125DC / 80	blue		
	220 DC			-	SP-CAU-220DC / 80	black		
	24/50 AC			E-SE	13 W (3)	SP-CAI-24/50/60AC / 80 (1)	-	
	24/60 AC							
	48/50 AC					SP-CAI-48/50/60AC / 80 (1)	-	
	48/60 AC	SP-CAI-110/50/60AC / 80 (1) SP-CAI-120/60AC / 80 SP-CAI-230/50/60AC / 80 (1) SP-CAI-230/60AC / 80	-			yellow white light blue silver		
	110/50 AC	E-SA (4)	105 VA 95 VA	-	SP-CAU-6DC / 80	green		
	120/60 AC			-	SP-CAU-12DC / 80			
	230/50 AC			-	SP-CAU-24DC / 80	red		
	230/60 AC			-	SP-CAU-48DC / 80	silver		
	110/50 AC	SP-669	58 VA 53 VA	-	SP-CAU-110RC / 80	gold		
120/60 AC	-			SP-CAU-110RC / 80				
230/50 AC	-			SP-CAU-230RC / 80	blue			
230/60 AC	-			SP-CAU-230RC / 80				

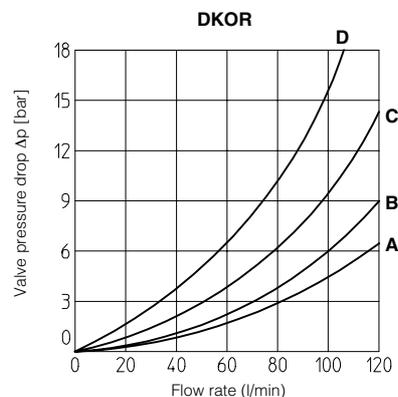
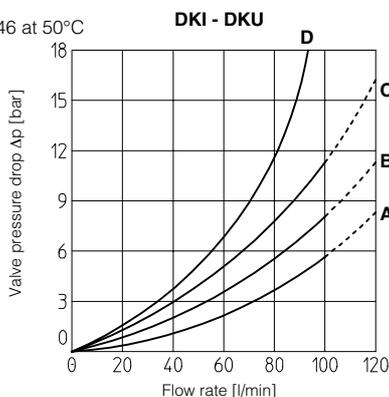
- (1) Coil can be supplied also with 60 Hz of voltage frequency: in this case the performances are reduced by 10÷15% and the power consumption is 90 VA.
- (2) Average values based on tests performed at nominal hydraulic condition and ambient/coil temperature of 20°C.
- (3) In a cycle, where solenoid is energized/deenergized in 1 second (1 Hz), the average power consumption is 13 W; for longer cycles, the power consumption is lower.
When solenoid is energized the inrush current is 9 A at 12 V_{DC} and 6 A at 24 V_{DC} corresponding to power consumption peak of 130 W. These current peaks persist for a period shorter than 100 msec and they must be considered when electric circuit is designed.
- (4) When solenoid is energized the inrush current is 7 A at 110 V_{AC} and 3,5 A at 230 V_{AC}; the power consumption peak is 800 VA; these current peaks persist for a period shorter than 40 msec and they must be considered when electric circuit is designed.
- (5) When solenoid is energized, the inrush current is approx 3 times the holding current. Inrush current values correspond to a power consumption of about 350 VA.

Valve	External supply nominal voltage ± 10%	Type of connector	Power consumption (2)
DKO	12 DC	SP-666 or SP-667	40 W
	24 DC		
	110 DC	46 W	
	220 DC		

Valve	External supply nominal voltage ± 10%	Type of connector	Power consumption (2)
DKOR	110/50 AC	SP-669	46 W
	120/60 AC		42 W
	230/50 AC		46 W
	230/60 AC		42 W

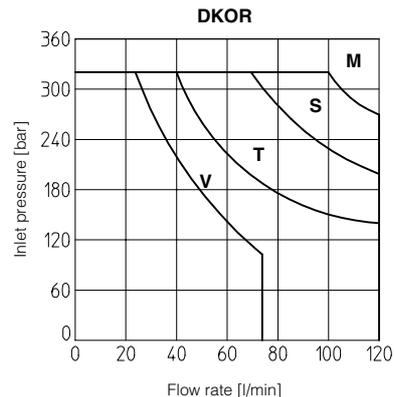
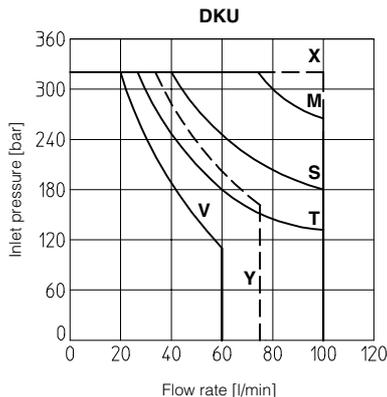
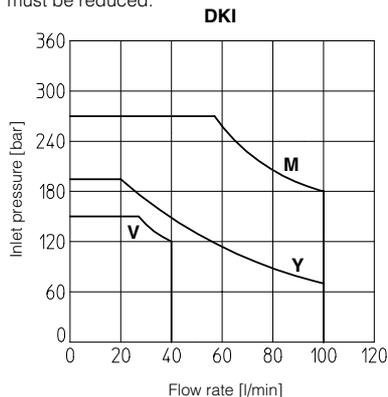
7 Q/AP DIAGRAMS based on mineral oil ISO VG 46 at 50°C

Flow direction Spool type	P→A	P→B	A→T	B→T	P→T
	0, 2, 3	B	B	B	B
0/2, 1, 8	B	B	A	A	
1/2, 2/2	C	C	B	B	
4, 5, 9*	D	D	D	D	C
6	B	B	A	B	
7	B	B	B	A	



8 OPERATING LIMITS based on mineral oil ISO VG 46 at 50°C

The diagrams have been obtained with warm solenoids and power supply at lowest value ($V_{nom} - 10\%$). The curves refer to application with symmetrical flow through the valve (i.e. P→A and B→T). In case of asymmetric flow and if the valves have the devices for controlling the switching times the operating limits must be reduced.



M = Spools 0, 1, 1/2, 3.
Y = Spools 0/2, 4, 5, 6, 7.
V = Spools 2, 2/2, *9, 9*.

X = Spools 0, 0/2, 1, 1/2, 3, 6, 7, 8 with E-SA or E-SE connector.
M = Spools 0, 1, 1/2, 8.
S = Spools 0/2, 3, 6, 7.
Y = Spools 2, 2/2, *9, 9* with E-SA or E-SE connectors.
V = Spools 2, 2/2, *9, 9*.
T = Spools 4, 5.

M = Spools 0, 0/2, 1, 1/2, 8.
S = Spools 3, 6, 7.
V = Spools 2, 2/2, *9, 9*.
T = Spools 4, 5.

9 SWITCHING TIMES (average values in msec)

Valve	DKI		
	Switch-on AC	Switch-on DC	Switch-off
DKI + SP-666 SP-667	35	60	30

Valve	DKU		
	Switch-on AC	Switch-on DC	Switch-off
DKU + SP-666 SP-667	—	60	30
DKU + SP-669	60	—	90
DKU + E-SA	25	—	45
DKU + E-SD E-SR	—	60	60
DKU + E-SE	—	40	40
DKU-*L*	—	75-150	45-150

Valve	DKOR		
	Switch-on AC	Switch-on DC	Switch-off
DKOR + SP-666 SP-667	—	65	35
DKOR + SP-669	65	—	95
DKOR + E-SD E-SR	—	65	65
DKOR-1**L*	—	75-150	50-150

Test conditions:

- 50 l/min; 150 bar
- nominal voltage
- 2 bar of counter pressure on port T
- mineral oil ISO VG 46 at 50°C

The elasticity of the hydraulic circuit and the variations of the hydraulic characteristics and temperature affect the response time.

10 DEVICES FOR SWITCHING TIME CONTROL

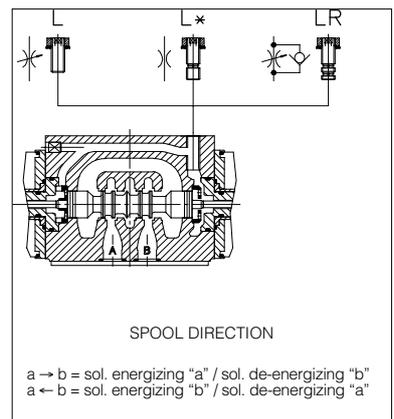
These devices are only available for DKU and DKOR without E-SA or E-SE and can check the switching time and therefore reduce the coil hammering in the circuit. The different types available are shown in the figure.

The functionality of the device depends on the type of regulating element.

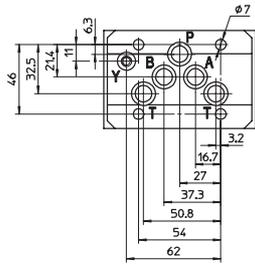
- **L**: checks and regulates the switching time in both moving directions of the spool: regulation is carried out by screwing/unscrewing the element itself (regulating choke);
- **L1/L2/L3**: checks the switching time in both moving directions of the spool with fixed regulation of this time (gauged flow)
ØL1 = 1,25 mm; ØL2 = 1 mm; ØL3 = 0,75 mm;
- **LR**: checks and regulates the switching time in the b→a direction of the spool movement. The device does not intervene in the control of the switching time (standard time) in the opposite direction a→b of the spool movement.

In all cases where it is necessary to obtain damped switching, pair these devices with progressive spools (1/1, 4/8, 5/1) which in the intermediate passages are properly shaped to reduce reversal shocks.

The passage in which the regulating element is inserted must be completely full of fluid for it to function properly, see also "commissioning" at section 4.



11 INSTALLATION DIMENSIONS [mm]



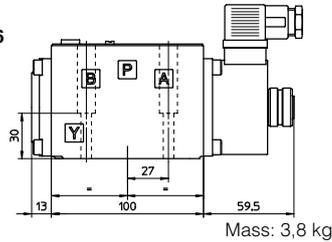
Mounting surface

ISO 4401-AC-05-4 size 10

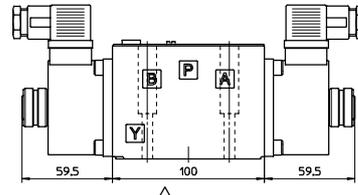
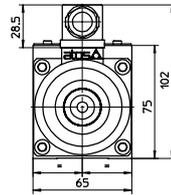
Fastening bolts: 4 socket head screws M6x40
 Seals: 5 OR 2050.1 OR 108
 Ports P,A,B,T: Ø = 11.5 mm (max)
 Ports Y: Ø = 5 mm

P = PRESSURE PORT
A, B = USE PORT
T = TANK PORT
Y = DRAIN PORT (only for option /Y)
 For the max pressures on ports, see section 4

**DKI-16
DKU-16**



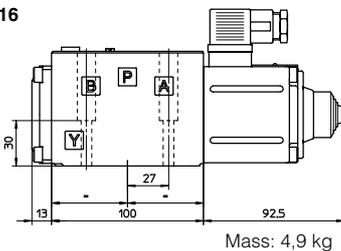
Mass: 3,8 kg



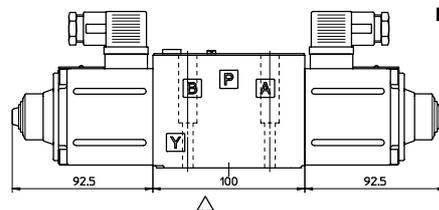
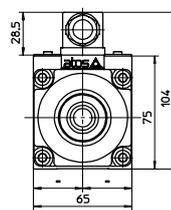
**DKI-17
DKU-17**

Mass: 4,4 kg

DKOR-16



Mass: 4,9 kg



DKOR-17

Mass: 6,1 kg

Overall dimensions refer to valves with connectors type SP-666

12 ELECTRIC/ELECTRONIC CONNECTORS ACCORDING TO DIN 43650 - The connectors must be ordered separately

<p>SP-666, SP-667 (for AC or DC supply) E-SD/DC (for DC supply)</p>	<p>SP-669 (for AC supply)</p>	<p>E-SA (for AC supply) E-SE (for DC supply) E-SR/AC (for AC supply)</p>	<p>E-SR/DC (for DC supply)</p>	<p>E-SD/AC (for AC supply)</p>
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CONNECTOR WIRING

<p>SP-666, SP-667 1 = Positive ⊕ 2 = Negative ⊖ ⊕ = Coil ground</p>	<p>SP-669 1,2 = Supply voltage Vac 3 = Coil ground</p>	<p>E-SA 1,2 = Supply voltage Vac 3 = Coil ground E-SE 1 = Positive ⊕ 2 = Negative ⊖ E-SR/AC 1,2 = Supply voltage Vac 3 = Coil ground 4 = Negative pilot signal Vac 5 = Positive pilot signal +24Vac</p>	<p>Power supply V_{cc}: RED = Positive ⊕ BLUE = Ground ⊖ Pilot signal V_{cc}: YELLOW = Positive +24V_{cc} WHITE = Negative ⊖ Supplied with 5 m long cable.</p>	<p>1,2 = Supply voltage VAC</p>
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SUPPLY VOLTAGES

<p>SP-666 All voltages</p>	<p>SP-667 AC or DC 24 110 220</p>	<p>E-SD-DC All DC voltages</p>	<p>110/50 AC 120/60 AC 230/50 AC 230/60 AC</p>	<p>E-SA 110/50 AC 120/60 AC 230/50 AC 230/60 AC</p>	<p>E-SE 12 DC 24 DC</p>	<p>E-SR-AC All voltages</p>	<p>12 DC 24 DC</p>	<p>All AC voltages</p>
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13 MOUNTING SUBPLATES

Model	Ports location	GAS Ports A-B-P-T (X-Y)	Ø Counterbore [mm] A-B-P-T (X-Y)	Mass [kg]
BA-308	(Y) Ports A, B, P, T (X, Y) underneath	1/2" (1/4")	30 (21,5)	2,5
BA-428	(Y) Ports A, B, P, T (X, Y) underneath	3/4" (1/4")	36,5 (21,5)	5,5
BA-434	(Y) Ports P, T, (X, Y) underneath; Ports A, B on lateral side	3/4" (1/4")	36,5 (21,5)	8,5