

## 比例方向阀 Directional Proportional Valve

二位四通和三位四通比例方向阀直控式  
阀芯不带位移电反馈  
型号BFW和BFWN

The 4/2 and 4/3-way proportional directional valves, direct operated without electrical position feedback. Type BFW and BFWN

通径6和10 Nominal sizes 6 and 10  
2X系列 Component series 2X  
最高工作压力 Maximum operating pressure 315bar  
最大流量 Maximum flow 42L/min通径 6 (NS6)  
最大流量 Maximum flow 75L/min通径10 (NS10)

BFW		-2X / G24	V	*
不带内置放大器 Without integrated electronics	=无代号 No code			其他要求用文字说明 Further details in clear text
带内置放大器 With integrated electronics	=N			V= 氟橡胶密封, 适用于符合 DIN 51 524标准的液压油(HL,HLP) NBR seals suitable for mineral oil (HL, HLP) to DIN 51 524
通径(NS)6	=02			无代号 No code= 用于 BFW及BFWN For BFW and BFWN
通径(NS)10	=03			A= 给定位输入 input Command value ± 10V F1 = 给定值输入 input Command value 4至20mA
<b>图形符号 Spool Symbols</b> 				<sup>2</sup> K4= 电气接线 Electrical connection For BFW型: 带符合 DIN EN 175 301-803的插座参考第3页 with plug component DIN EN 175301-803 See page 3 For BFWN型: <sup>2</sup> K31= 带符合DIN 43 650-AM2的插座参考第4页 with plug component DIN 43 650-AM2 See page 4
对于图形符号 With spool symbols: 3C2(1)和 3C40(1) P→A: $q_{vmcx}$ B→T: $q_v/2$ P→B: $q_v/2$ A→T: $q_{vmcx}$ 说明: 对于阀芯3C40和2B40B, 在中位时A口至T口, 以及 B口至T口约有相当于额定值3%的通流面积 Note: With the spools 3C40 and 2B40B, in the neutral position there is a connection from A to T and B to T with approx. 3 % of the relevant nominal cross section				无代号 No code= 特殊保护 Special protection: <sup>1</sup> J= 无特殊保护 Without special protection 抗海水腐蚀(适用于通径6) Seawater-resistant(only for NS6)
		G24=		24V直流电源 24 volt DC
		2X=		20至29系列(20至29系列: 安装和连接尺寸不变) Component series 20 to 29 (20 to 29: unchanged installation and connection dimensions)
				阀的压差为10 bar时的额定流量 Nominal flow at valve pressure differential $\Delta p = 10 \text{ bar}$ .
		07=		通径(DN)6 7 L/min
		15=		15 L/min
		30=		26 L/min
				通径(DN)10
		30=		30 L/min
		60=		60 L/min

1)有关电气保护的内容请向我们谘询。

1.Other types of electrical protection on request

2)只用于6通径: 对于保护型式“J”抗海水腐蚀, 只能选“K31”!

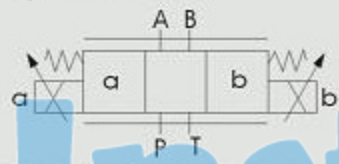
2.Only available with 6 DN: We can only supply “31” in seawater resistant design “J”!



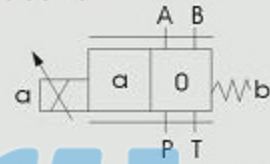
## 不带内置放大器的比例方向阀

Directional Proportional valve without integrated electronics

型号(type)BFW...



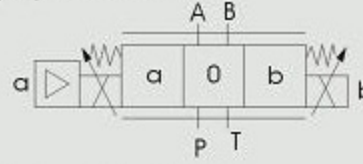
型号(type)BFW...A...



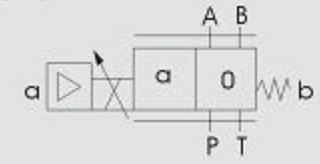
## 带内置放大器的比例方向阀

Directional Proportional valve with integrated electronics

型号(type)BFWN...



型号(type)BFWN...A...



## 功能说明和剖面图 Structure and function description, section

该二位四通和三位四通比例方向阀为直控，板式结构；由比例电磁铁操作，比例电磁铁带中心螺纹，线圈可单独拆卸，电磁铁的控制可通过外部放大器(BFW型)或内置的放大器(BFWN型)实现。

The 4/2-way and 4/3-way proportional directional valves are designed as direct operated components by subplate mounting. They are actuated by means of proportional solenoid with central removable coil. The solenoid are controlled either by external control electronics (type BFW) or integrated control electronics (type BFWN)

结构：该阀由下列部分组成：

- 一带安装底面的阀体(1)
- 一带对中弹簧(3和4)的控制阀芯(2)
- 一带中心螺纹的电磁铁(5和6)
- 可选带内置放大器(7)

工作原理：

- 电磁铁(5和6)不带电时，对中弹簧(3和4)将控制阀芯(2) 保持在中位
- 比例电磁铁得电被激励后，会直接推动控制阀芯(2)
- 例如：控制电磁铁 “b” (6)被激励
  - 控制阀芯(2)被推向左侧，位移与输入电信号成比例
  - 这时，P口至A口及B口至T口通过阀芯与阀体形成的节流口接通，节流特性为渐进式。
- 电磁铁(6)失电
  - 控制阀芯(2)被对中弹簧(3)重新推回中位

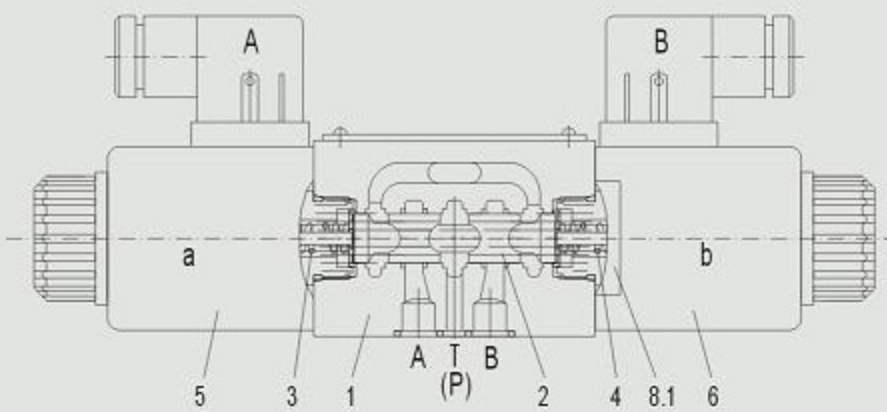
Design: The valves basically consist of:

- Housing (1) with mounting surface
- Control spool (2) with compression springs (3 and 4)
- Solenoids (5 and 6) with central coil
- Optional integrated electronics (7)

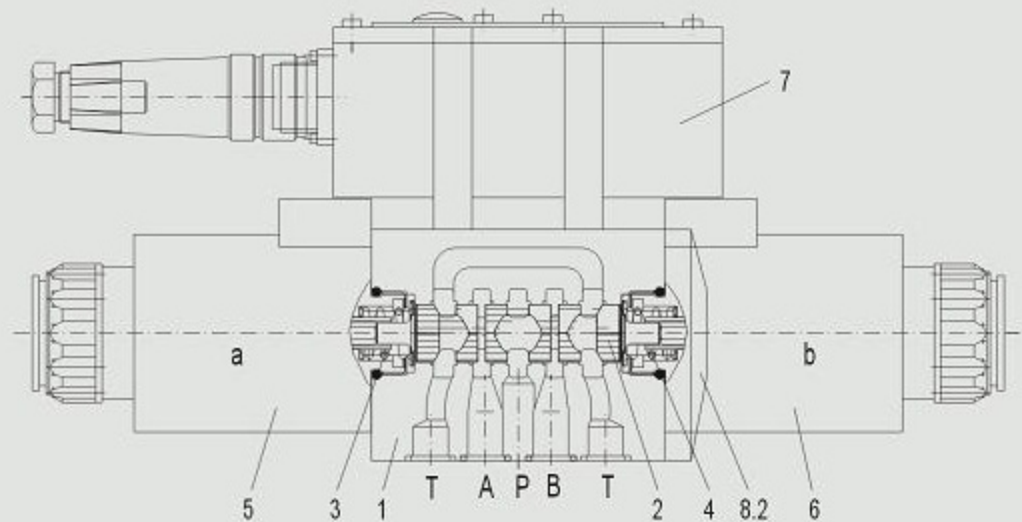
Function:

- With solenoids (5 and 6) release, the control spool (2) is held in the centre position by compression springs (3 and 4)
- Direct actuation of the control spool (2) by energising a proportional solenoid
- E.g. energisation of solenoid "b" (6)
  - The control spool (2) is moved to the left in proportion to the electrical input signal
  - connection from P to A and B to T via orifice-like crosssections with progressive flow characteristics
- releasing of the solenoid (6)
  - The control spool (2) is returned to the central position by compression spring (3)

型号 (type)BFW-02...2x/...



型号 (type)BFWN-03...2x/...



两位阀 Valve with 2 spool positions:

(型号(type)BFW...A...)

这种结构的阀从原理上来说与三位阀类似，两位阀只带有电磁铁“a”，对6通径的阀在第二个电磁铁的位置装上了一个丝堵(8.1)，对10通径的阀换成了盖(8.2)。

In principle, the function of this valve version corresponds to that of the valve with 3 spool positions. However, the valves with 2 spool positions are only fitted with solenoid "a". Instead of the 2nd proportional solenoid a plug (8.1) is fitted with a cover for NS 6 or for NS 10 (8.2).

对于型号BFW-02...2X/...说明：

必须避免回油管路中的油全部排空，必要时在回路中安装背压阀(背压约2 bar)。

Note for type BFW-02...2X/...:

Draining of tank line is to be avoided. With the appropriate installation conditions, a back pressure valve is to be installed (back pressure approx. 2 bar).

## 技术参数 (使用时如果超出了规定的技术参数的范围，请向华液公司咨询!)

Technical data (For application outside these parameters please consult with us)

概述 General

阀的型号 Type		BFW	BFWN
安装位置 Installation position		任意，建议优先水平安装 optional, preferably horizontal	
储藏温度 Storage temperature range	℃	-20~80	
使用环境温度 Ambient temperature range	℃	-20~70	-20~50
重量 Weight	通径DN6 kg	2.0	2.2
	通径DN10 kg	6.6	6.8



## 技术参数 Technical data

液压参数 Hydraulic

工作压力 Operating pressure	油口Port A,B, P bar	至 to315
	油口Port T bar	至 to210
额定流量 Nominal flow $Q_{vnom}$ 在 $\Delta p=10$ bar时	口径DN6 L/min	7, 15和(and)26
	口径DN10 L/min	30, 60
允许最大流量 Flow (max. Permissible)	口径DN6 L/min	42(双流量回路可达80) 80 with double flow
	口径DN10 L/min	75(双流量回路可达140) 140 with double flow
液压油 Pressure fluid	符合DIN 51 524标准的矿物油(HL, HLP); 使用其它油液请向我们咨询! Mineral oil (HL, HLP) to DIN 51 524; For other fluid please consult with us.	
介质温度范围 Fluid temp. Range	°C	-20~80(优先选择+40~+50 is preference)
介质粘度范围 Viscosity range	mm <sup>2</sup> /s	20~380(优先选择30~46 is preference)
油液清洁度 Fluid cleanliness	油液最高污染等级按 NAS 1638 第9级 推荐过滤器, 最小过滤精度 $\beta_x \geq 75$ X=10 Maximum permissible degree of contamination of pressure fluid to NAS 1638 to 9 Recommended filter $\beta_x \geq 75$ X=10	
滞环 Hysteresis	%	≤5
反向误差 Reversal span	%	≤1
灵敏度 Response sensitivity	%	≤0.5

## 电磁铁的电气参数 Electrical

阀的型号 Type	BFW		BFWN	
电压类型 Voltage type	直流电源 Direct Voltage			
带 (Type) BFWN	电压输入 Voltage input "A1"	V	±10	±10
给定值信号 Command signal	电流输入 Current input "F1"	MA	4~20	4~20
每个电磁铁最大电流 Max. current per solenoid	A	2.5	2.5	
电磁铁线圈 Solenoid coil	20°C时的冷值 Cold value at 20 °C	Ω	2	2
	电阻 Resistance	最大热值 Max. warm value	Ω	3
通电率 Duty cycle	%	100		
最高线圈温度 <sup>2)</sup> Coil temperature	°C	可达 up to 150		
电气连线 见3页 Electrical connection see P3	BFW	带符合DIN EN 175 301-803及ISO 4400标准的插座 Plug-in connection to DIN EN 175301-803 and ISO 4400		
	BFWN	插头符合DIN EN 175301-803及ISO 4400 Plug-in connection to DIN EN 175301-803 and ISO 4400 带符合E DIN 43563-AM6-3标准的插座 Plug-in connection to DIN 43563-AM-3 and		
阀的保护形式符合标准 Type of insulation to DIN 40 050	IP 65			

## 放大器的电气参数 Control electronics

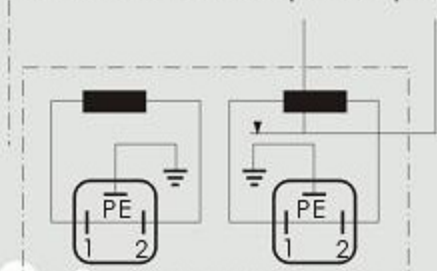
BFW型(type)	欧洲制式的放大器 <sup>3)</sup> Analogue amplifier in Eurocard format	VT-VSPA2-1-1X/... 参考 (RE)RC 30 112		
	欧洲制式的数字式放大器 <sup>3)</sup> Digital amplifier in Eurocard format	VT-VSPD-1-1 X 参考 (RE)RC 30 123		
BFWN型(type)	模拟式指令模组 Analogue command value module	内置于阀内, 参考第4页 Integrated into the valves, see page 4		
电源电压 Supply voltage	额定电压 Nominal voltage	VDC	24	
BFWN	下限值 Lower limiting value	V	21/22	19
BFW1	上限值 Upper limiting value	V	35	
放大器的电流消耗 Amplifier current consumption	$I_{max}$	A	1.8	1.8
	最大脉冲电流 Max. impulse current	A	3	3

1) 华液公司的控制放大器另选 ;2) 由于电磁铁线圈表面温度可能升高, 请遵守欧洲标准EN 563及EN 982  
Due to the occurring surface temperature of the solenoid coils, the European Standards DIN EN 563 and DIN EN 982 must be taken into account! With HOYEAMachinery Manufacture CO. LTD. control electronics

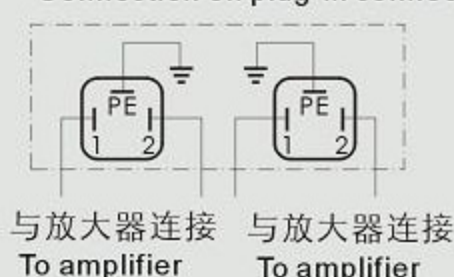
## 电气接线和插头 Electrical connection, plug-in connectors

BFW型(type) (不带内置放大器—不适用于结构形式“J”=抗海水腐蚀)  
(Without integrated electronics not for version "J" = sea water resistant)

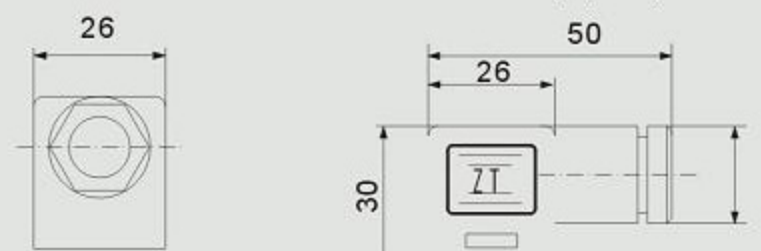
插座连接形式  
Connection on component plug



插头连接形式  
Connection on plug-in connector



插座符合标准 Plug-in connector: CECC 75 301-803-  
A002FA-H3D08-G/DIN EN 175 301-803和(and)ISO 4400

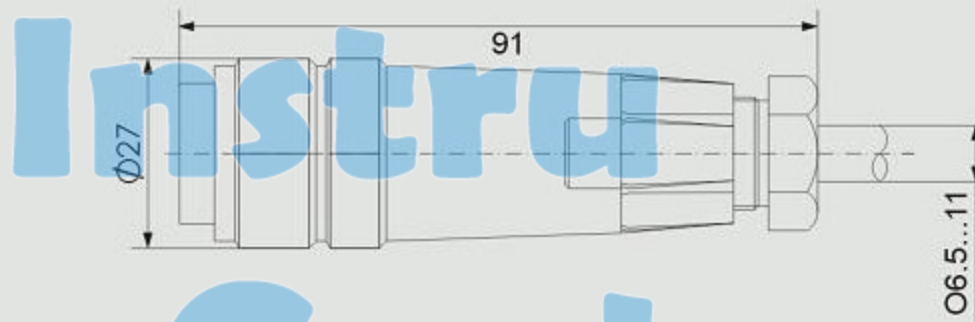




## BFWN型(type)

(带内置放大器, 适用于结构形式“J”=抗海水腐蚀) 插头设置参考第4页的方块图  
 For type BFWN (with integrated electronics (OBE) and for version "J" = sea water resistant)  
 Plug-in connector see page 4

插座符合标准 Plug-in connector:  
 DIN 43 563-BF6-3/Pg11



## BFWN型的内置放大器 Integrated electronics for type BFWN

插头的接线图 Pin allocation of the component plug



	接点 Contact	信号 Signal
电源 Supply	A	24VDC (19~35VDC)
电压 voltage	B	GND
	C	未接 <sup>1)</sup> n.c.
差动输入 Differential amplifier input	D	给定值 Com. Value (±10V/4-20mA)
	E	基准电位 reference potential
	F	未接 <sup>1)</sup> n.c.

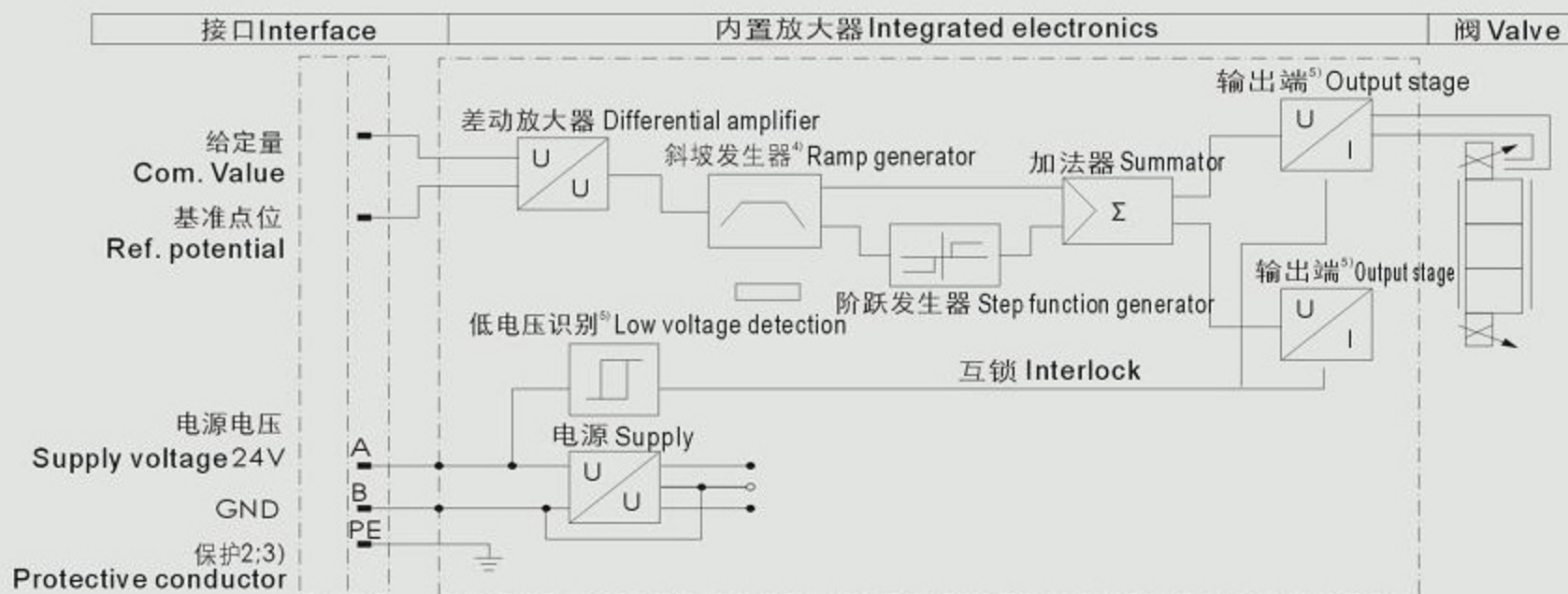
**给定值:** 加在D, E上正的给定输入值(0至10V或12至20 mA)会使阀上P口到A口, B口到T口接通。  
 加在D, E上负的给定输入值(0至-10V或12至4 mA)会使阀上P口到B口, A口到T口接通。  
 对于只在“α”侧装有电磁铁的阀(阀芯结构为EA和WA), 加在D, E上正的给定输入值。  
 (通路6: 4至20 mA和通路10:12至20 mA)会使P口到B口, A口到T口接通。

**Com. Value :** Positive command value (0 to 10 V or 12 to 20 mA) at D and reference potential to E causes flow from P to A and B to T. Negative command value (0 to -10 V or 12 to 4 mA) at D and reference potential to E causes flow from P to B and A to T. For valves with a solenoid on side α (spool variants EA and WA) a positive command value at D and reference potential to E (NS 6: 4 to 20 mA and NS 10: 12 to 20 mA) causes flow from P to B and A to T.

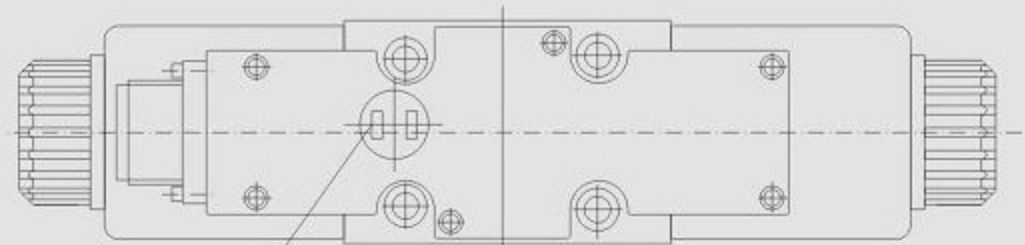
**连接电缆:** 推荐: ——可长至25m,型号LiYCY 5 x 0.75mm<sup>2</sup>  
 ——可长至50m,型号LiYCY 5 x 1.0mm<sup>2</sup>  
 电缆外径为6.5至11mm  
 屏蔽只允许接在电源端的PE。

**Connection cable :** Recommendation:  
 - up to 25 m cable length type LiYCY 5 x 0.75 mm<sup>2</sup>  
 - up to 50 m cable length type LiYCY 5 x 1.0 mm<sup>2</sup>  
 External diameter 6.5 to 11 mm  
 Connect screen to PE only on the supply side

## 内置放大器的方框图/接线图 Block circuit diagram / connection allocation



- 1) 接点C和F不允许连接在一起! 内置放大器的方框图/接线图
- 2) PE与阀体和温度较低的物体相接
- 3) 保护线与阀体端盖相接
- 4) 斜坡时间可从外部在0到2.5s范围内调较; 同样适用T<sub>up</sub>和T<sub>down</sub>
- 5) 输出端为电流输出
- 6) BFWN 10-2X型不带低电压识别



- 1) Contacts C and F must not be connected! Block circuit diagram / connection allocation
- 2) PE is connected to the cooling body and the valve housing
- 3) Protective conductor screwed to the valve housing and cover
- 4) Ramp can be externally adjusted from 0 to 2.5 s; the same applies for T<sub>up</sub> and T<sub>down</sub>
- 5) Output stages current regulated
- 6) Low voltage detection is not carried out for component type 4WRAE 10-2X



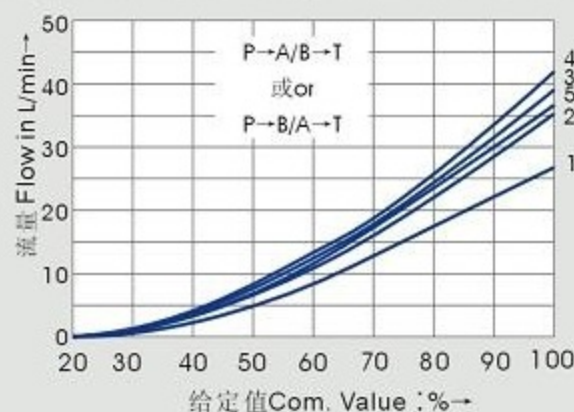
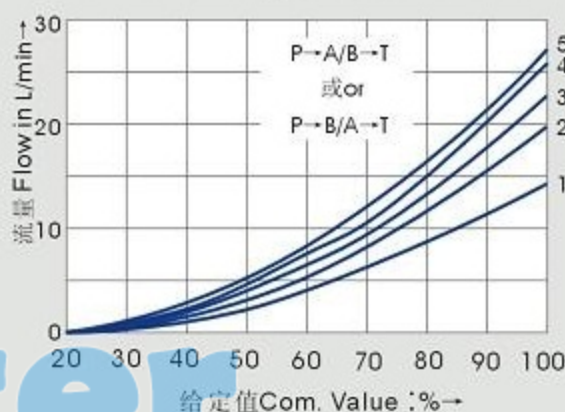
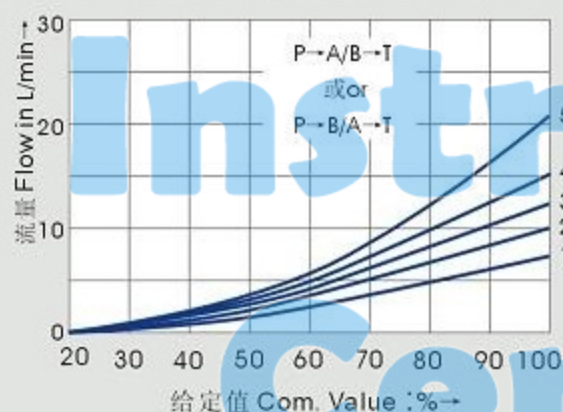
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特性曲线 (矿物油HLP46温度在40°C ± 5°C时测得) 口径6 Characteristic curves (measured with HLP46, Voil = 40 °C ± 5 °C) Ns6

阀的压差为10 bar时, 额定流量为7 L/min  
7 l/min nominal flow at pressure differential 10 bar

阀的压差为10 bar时, 额定流量为15 L/min  
15 l/min nominal flow at pressure differential 10 bar

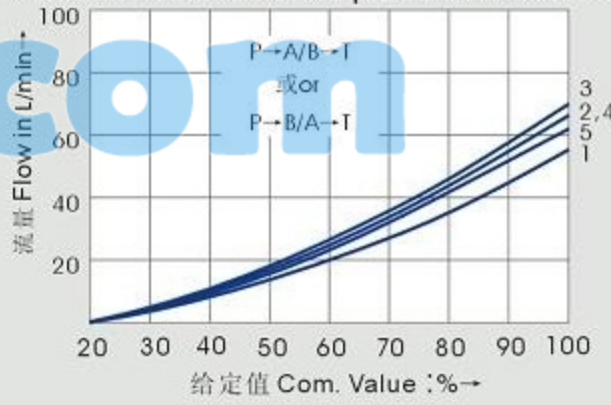
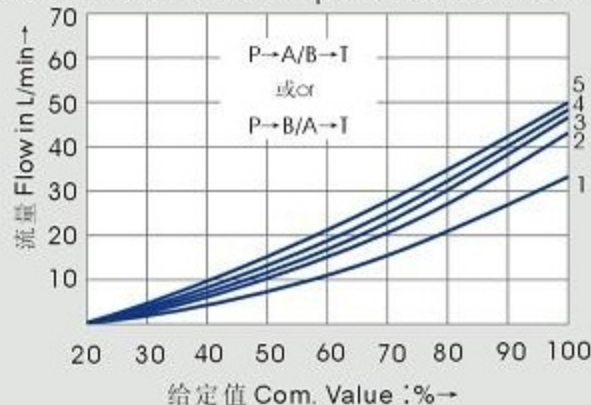
阀的压差为10 bar时, 额定流量为30 L/min  
30 l/min nominal flow at pressure differential 10 bar



特性曲线 (在p=100bar, 矿物油HLP46温度在40°C ± 5°C时测得) 口径10 Characteristic curves (measured with HLP46, Voil = 40 °C ± 5 °C)

阀的压差为10 bar时, 额定流量为30 L/min  
30 l/min nominal flow at pressure differential 10 bar

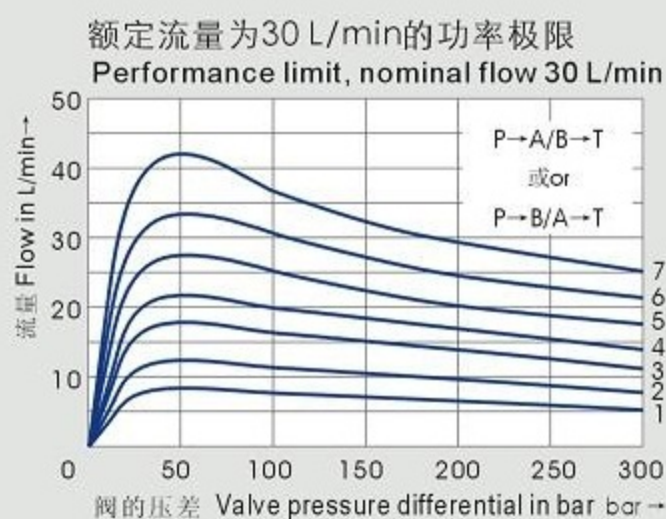
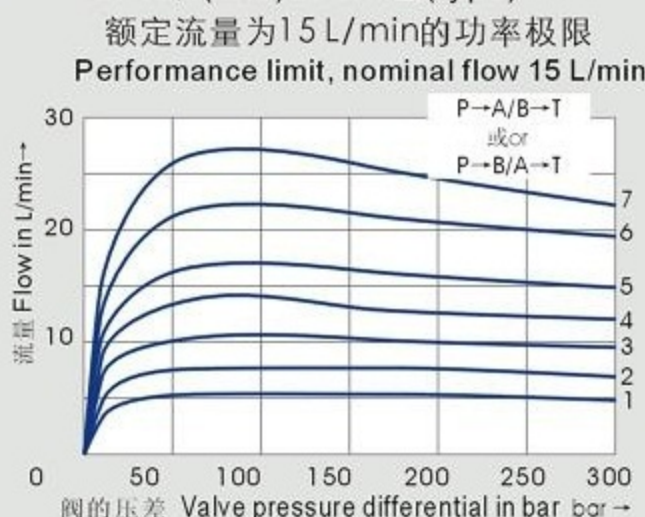
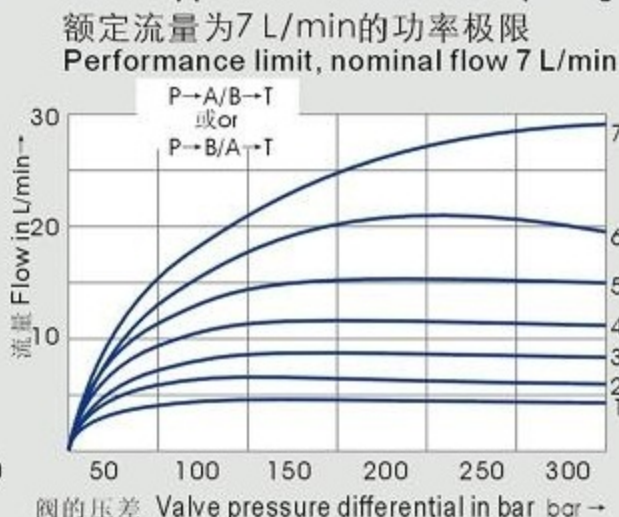
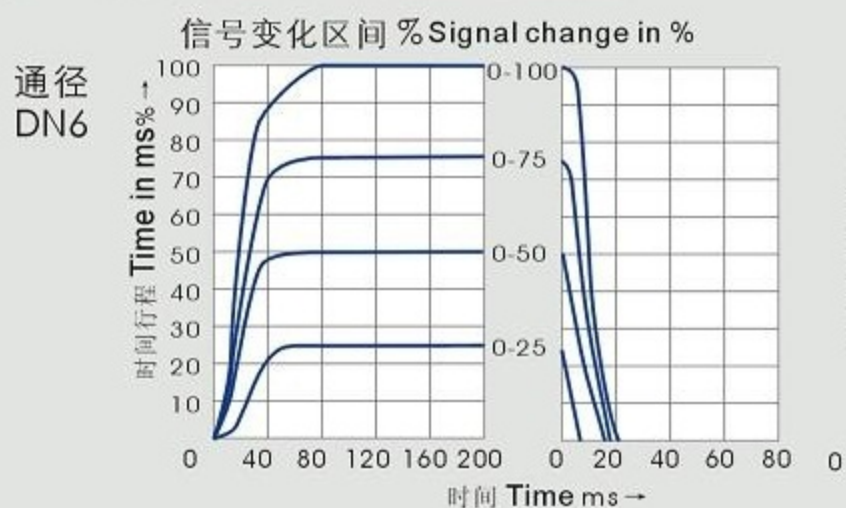
阀的压差为10 bar时, 额定流量为60 L/min  
60 l/min nominal flow at pressure differential 10 bar



- 1 Δp=10 bar 恒定 Constant
  - 2 Δp=20 bar 恒定 Constant
  - 3 Δp=30 bar 恒定 Constant
  - 4 Δp=50 bar 恒定 Constant
  - 5 Δp=100 bar 恒定 Constant
- Δp=阀的压差(入口压力P<sub>0</sub>减去负载压力P<sub>L</sub>并减去回油压力P<sub>T</sub>)  
Δp= Valve pressure differential (inlet pressure P<sub>0</sub> minus load pressure P<sub>L</sub> and minus return pressure P<sub>T</sub>)

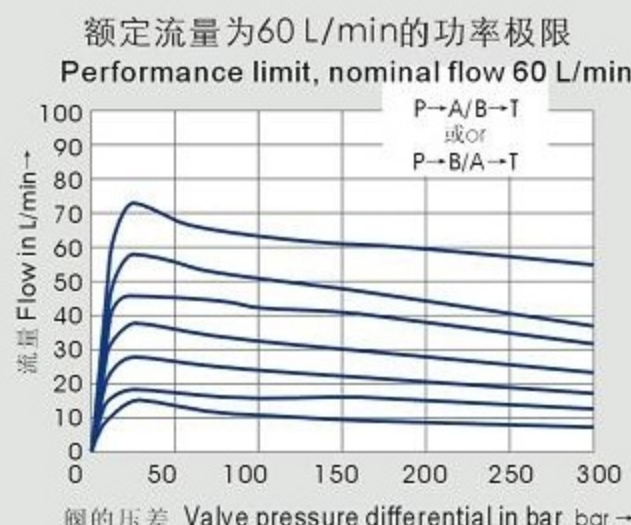
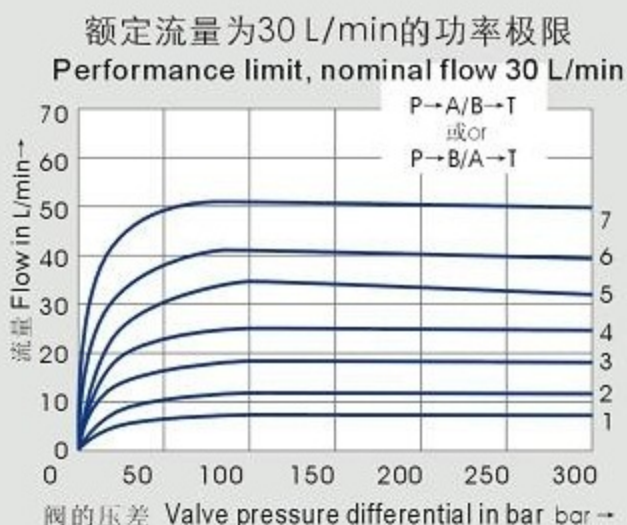
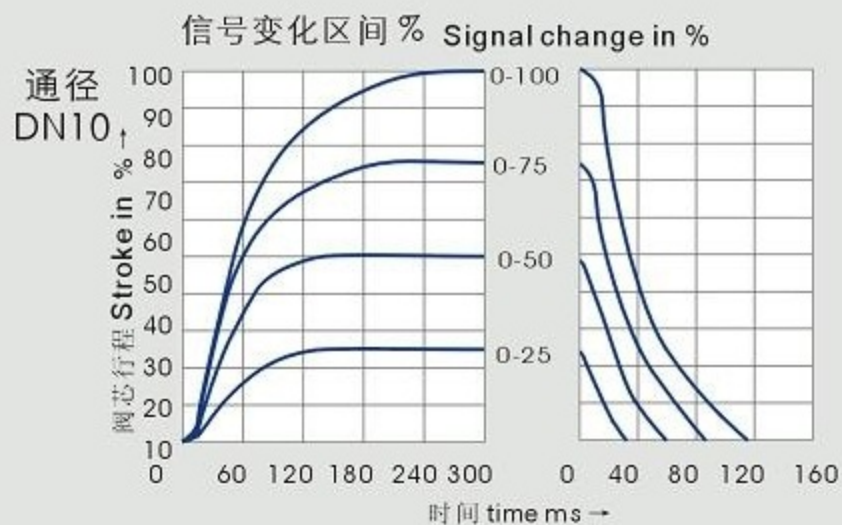
输入信号为阶跃信号时阀的过渡性能 Transient function with stepped form of electrical input signal

BFW和(and)BFWN型(type)



- 1 给定值 Com. Value=40%
- 2 给定值 Com. Value=50%
- 3 给定值 Com. Value=60%
- 4 给定值 Com. Value=70%
- 5 给定值 Com. Value=80%
- 6 给定值 Com. Value=90%
- 7 给定值 Com. Value=100%

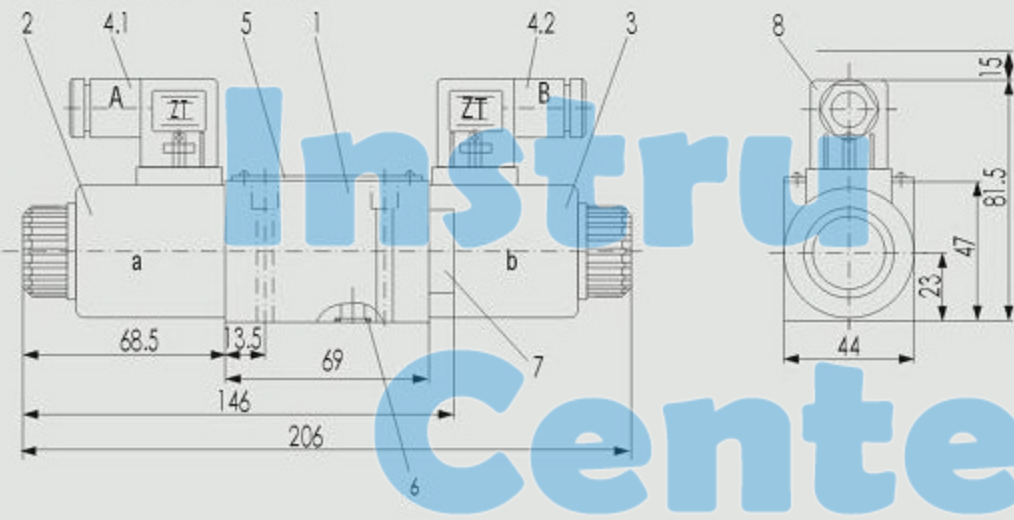
如果超过阀的功率极限, 阀芯的运动失稳。  
If the performance limits are exceeded then flow force occurs which lead the spool movement uncontrolled.



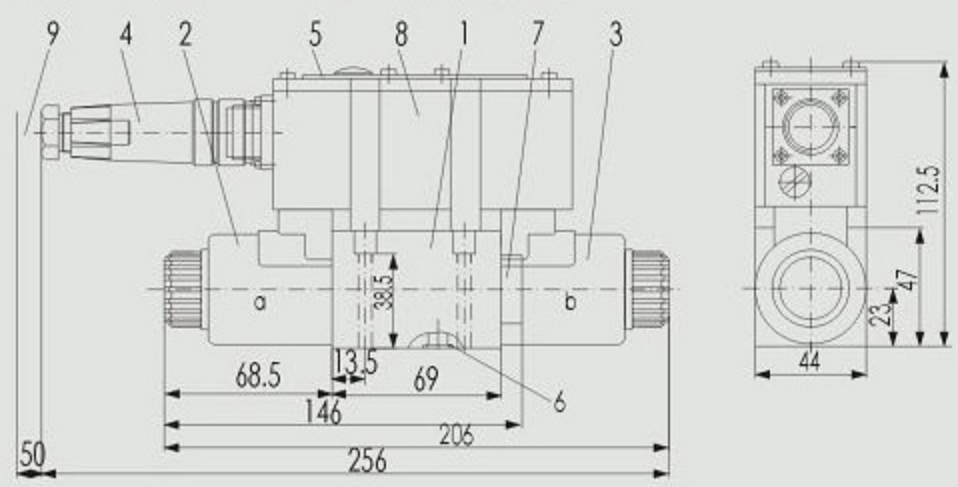


## 元件尺寸 Unit dimensions

## BFW-02型(type)



## BFWN-02.../...K31...V型(type)



- 1 阀体 Valve housing
- 2 比例电磁铁 Proportional solenoid "a"
- 3 比例电磁铁 Proportional solenoid "b"
- 4.1 4.2 黑色插头参考第3页 Plug-in connector, colour black, separate order see page 3
- 5 铭牌 Name plate
- 6 O形圈8.73 x 1.78 (用于油口 A, B, P, T)
- 8.73 x 1.78 Identical seal rings for ports A, B, P and T
- 7 带有一个电磁铁的阀的丝堵(两位阀, 机能为2B2B或2B40B)  
Plug for valves with one solenoid (2 switched positions, versions 2B2B or 2B40B)
- 8 取下插头所需空间 Space required to remove the plug-in connector
- 9 阀底面, 底板符合 Machined valve mounting surface, Connection location to DIN 24 340A, ISO4401和(and)CETOP-RP 121 H

- 1 阀体 Valve housing
- 2 比例电磁铁 Proportional solenoid "a"
- 3 比例电磁铁 Proportional solenoid "b"
- 4 插头符合Plug-in connector to E DIN 43 563-BF6-3/Pg11, 参考第4页 see page 4
- 5 铭牌 Name plate
- 6 O形圈8.73 x 1.78 (用于油口 A, B, P, T)
- 8.73 x 1.78 Identical seal rings for ports A, B, P and T
- 7 带有一个电磁铁的阀的丝堵(两位阀, 机能为2B2B或2B40B)  
Plug for valves with one solenoid (2 switched positions, versions 2B2B or 2B40B)
- 8 内置式放大器 Integrated electronics
- 9 连接电缆和取下插头所需空间 Space required for the connection cable and to remove the plug-in connector
- 10 阀底面, 底板符合 Machined valve mounting surface, Connection location to DIN 24 340A, ISO 4401和(and)CETOP-RP 121 H

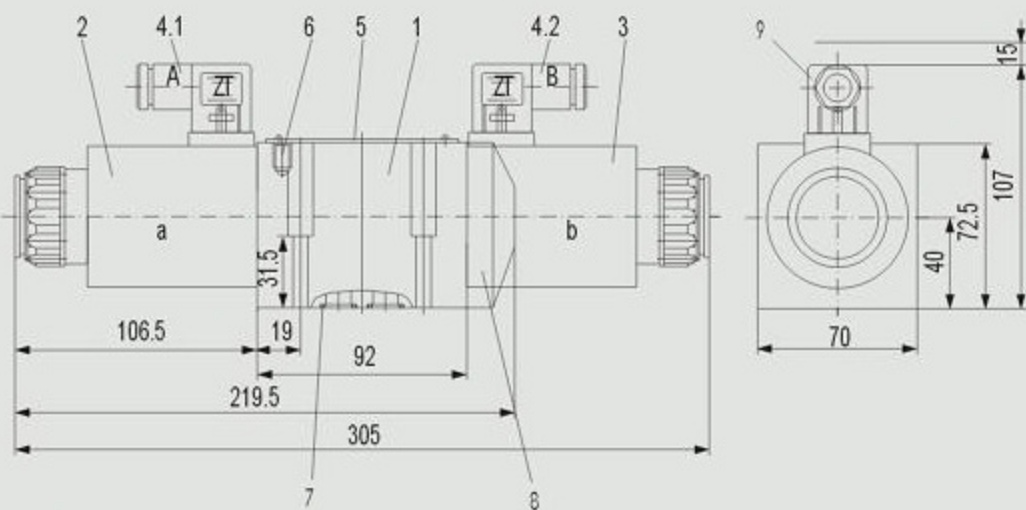
安装底板 Subplates: G341/01(G1/4)  
G342/01(G3/8) G502/01(G1/2)

阀固定螺栓 Valve fixing screws: 4个M5x 50 DIN 912-10.9;  
 $M_A=8.9$  Nm

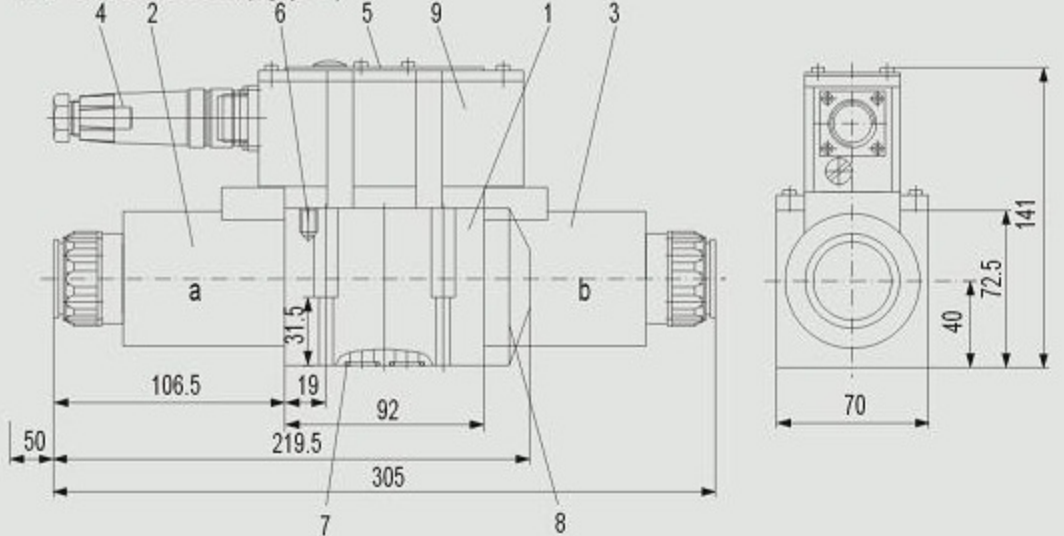
安装底板 Subplates: G341/01(G1/4)  
G342/01(G3/8) G502/01(G1/2)

阀固定螺栓 Valve fixing screws: 4个M5x50 DIN 912-10.9;  
 $M_A=8.9$  Nm

## BFW-03型(type)



## BFWN-03型(type)



- 1 阀体 Valve housing
- 2 比例电磁铁 Proportional solenoid "a"
- 3 比例电磁铁 Proportional solenoid "b"
- 4.1 4.2 黑色插头参考第3页 Plug-in connector, colour black, separate order see page 3
- 5 铭牌 Name plate
- 6 阀的排气螺栓 Valve deflation screw
- 7 O形圈12 x 2 (用于油口 A, B, P, T)
- 12 x 2 Identical seal rings for ports A, B, P and T
- 8 带有一个电磁铁的阀的丝堵(两位阀, 机能为2B2B或2B40B)  
Plug for valves with one solenoid (2 switched positions, versions 2B2B or 2B40B)
- 9 取下插头所需空间 Space required to remove the plug-in connector
- 10 阀底面, 底板符合 Machined valve mounting surface, Connection location to DIN 24 340A, ISO4401和(and)CETOP-RP 121 H

- 1 阀体 Valve housing
- 2 比例电磁铁 Proportional solenoid "a"
- 3 比例电磁铁 Proportional solenoid "b"
- 4 插头符合E DIN 43 563-BF6-3/Pg11, 参考第4页 Plug-in connector, colour black, separate order see page 4
- 5 铭牌 Name plate
- 6 阀的排气螺栓 Valve deflation screw
- 7 O形圈12 x 2 (用于油口 A, B, P, T)
- 12 x 2 Identical seal rings for ports A, B, P and T
- 8 带有一个电磁铁的阀的丝堵(两位阀, 机能为2B2B或2B40B)  
Plug for valves with one solenoid (2 switched positions, versions 2B2B or 2B40B)
- 9 内置式放大器 Integrated electronics
- 10 连接电缆和取下插头所需空间 Space required for the connection cable and to remove the plug-in connector
- 11 阀底面, 底板符合 Machined valve mounting surface, Connection location to DIN 24 340A, ISO4401和(and)CETOP-RP 121 H

安装底板 Subplates: G66/01(G3/8)  
G67/01(G1/2) G534/01(G3/4)

阀固定螺栓 Valve fixing screws: 4个M6x 40 DIN 912-10.9;  
 $M_A=15.5$  Nm

安装底板 Subplates: G66/01(G3/8)  
G67/01(G1/2) G534/01(G3/4)

阀固定螺栓 Valve fixing screws: 4个M6x 40 DIN 912-10.9;  
 $M_A=15.5$  Nm



**H-AP-110-0.8****(Single)proportional amplifier**

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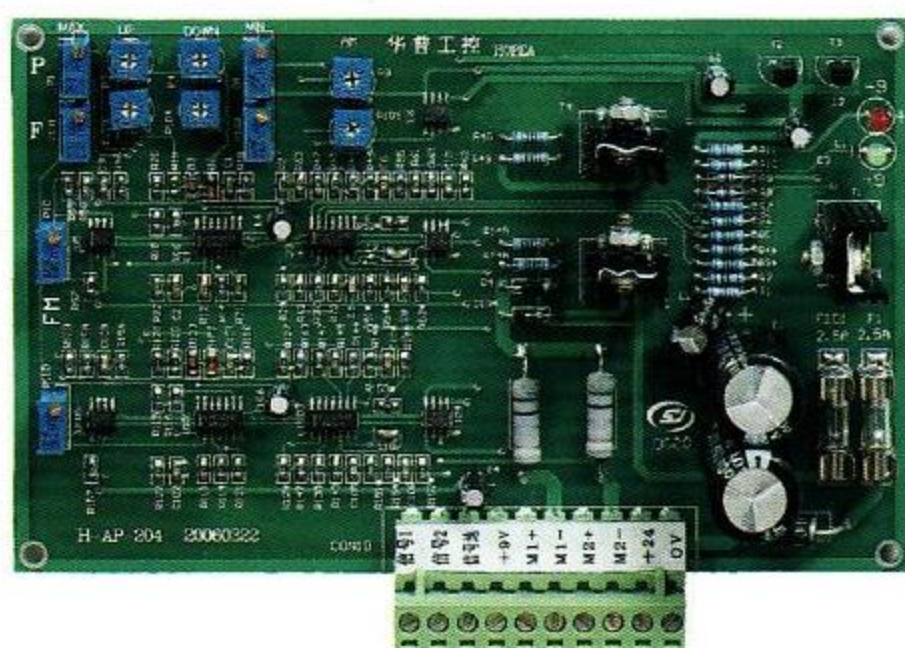
**Technical specification**

Supply voltage ( V )	24±10%
Power ( VA )	30
Fuse ( A )	2
Control voltage ( alternative ) ( V )	0~5
	0~10
Max output current ( mA )	800
Max load resistance(Ω)	20
Operating environment temperature ( °C )	0~70
Temperature drift ( mA/°C )	0.70
Dimension ( mm )	170x100
Weight ( g )	110

Supply voltage: 24VDC, rated current amplitude: 0~800mA  
 Components: filter circuit, voltage regulator, one switch power amplifier, ramp regulator, differential input, gain regulator, zero regulator, high precision & low temperature drift amplifying circuit

**Application range:**

- 1.BYZ Proportional directly operated pressure relief valve (Load Resistance: 10、19.5)
- 2.BY Proportional pilot-operated relief valve (Load Resistance: 10、19.5)
- 3.BFW 2-position 4-way Proportional directional valve (Load Resistance: 18)
- 4.BFWH 2-position 4-way Proportional electro-hydraulic directional valve (Load Resistance: 19.5)
5. BCL Proportional cartridge restrictive valve (Load Resistance: 19.5)
- 6.BCY Proportional screw-in cartridge relief valve (Load Resistance: 10)

**H-AP-202-0.8****(Double)proportional amplifier**

24VDC,

0~800mA

**Technical specification**

Supply voltage ( V )	24±10%
Power ( VA )	60
Fuse ( A )	2
Voltage Control ( V )	0~10
Max output current ( mA )	800
Max load resistor(Ω)	20
Operating environment temperature ( °C )	0~70
Temperature drift ( mA/°C )	0.70
Dimension ( mm )	160x110
Weight ( g )	115

Supply voltage: 24VDC, Rated Current Amplitude: 0~800mA  
 Components: filter circuit, voltage regulator, two switch power amplifiers, ramp regulator, differential input, gain regulator, zero regulator, high precision & low temperature drift amplifying circuit

**Application range:**

- 1.BFW 3-position 4-way Proportional directional valve (Load Resistance: 18)
- 2.BFWH 3-position 4-way Proportional electro-hydraulic directional valve (Load Resistance: 19.5)
- 3.BYL/BYLZ Proportional electro-hydraulic control P-Q valve (Load Resistance: 10、20)



## Basic characteristic

Power: 12VDC      Maximal control current: 1500mA      Control range: 0~5V

PIN1: First loop control signal input

PIN2: Second loop control signal input

+9V: +9V output power

M1+: Solenoid positive terminal of first loop

M1-: Solenoid negative terminal of first loop

M2+: Solenoid positive terminal of second loop

M2-: Solenoid negative terminal of second loop

+24V: +12VDC power input.

0V: +12VDC power ground

Note: When connecting the wires, signal ground can not connect with power ground.

## Open loop and test

Minimum current adjustment: adjust the I min potentiometer to get the required minimum current. (Adjust clockwise and the current increases)

Maximal current adjustment: adjust the I min potentiometer to get the required minimum current.

(Adjust clockwise and the current increases)

Incline adjustment: adjust UP, adjust clockwise to increase the time of climbing incline

adjust DOWN, adjust clockwise to increase the time of declining incline

Using potentiometer F to adjust buffeting frequency of input current, when adjust clockwise, its value increases

Using potentiometer A to adjust buffeting amplitude of input current, when adjust clockwise, its value increases