rexroth
A Bosch Company

RE 18350-50/03.21
Replaces: RE 18350-50/06.19

Technical data for:

Mechanical and Solenoid cartridge valves, Hydraulic integrated circuits, Load holding / Motion control valves, Compact power modules.

Introduction:
Do not apply the below technical data to the following sections:

- *High pressure cartridge valves and Proportional pressure reducing valves & Remote control manifolds (RE 90010-05 chapter 5 and 6). Please refer to the information included on the individual data sheet and/or contact the sales network indicated on it for any doubts.*
- *Compact Directional Valves (RE 90010-06 chapters 2, 3, 4 and 5). Please refer to the information included on the dedicated data sheet RE 18350-49 and/or contact the sales network indicated on the individual data sheet for any doubts.*

For Compact Power Modules (RE 90010-06 chapter 6), please refer to the information included on this data sheet (see page 11) and on the individual data sheet for technical and usage details. In case of doubt, contact the sales network indicated.

1. General

Bosch Rexroth Product Area 2 - Compact Hydraulics (CH) proposes a wide range of hydraulic components for applications in hydraulic circuits of mobile machinery. Detailed information about product performance, selection, installation and technical data can be obtained from our Customer Service Organization; here you may find a summary of general specifications which apply to all our CH hydraulic products with the aim to provide general guidance only. All our CH hydraulic products may be installed in hydraulic circuits of industrial machinery: however it is strongly recommended to contact in advance our Customer Service Organization.

2. Hydraulic fluids

Mineral oil based hydraulic fluids suitable for hydraulic systems can be used; they should have physical lubricating and chemical properties as specified by:

- MINERAL OIL BASED HYDRAULIC FLUIDS HL (DIN 51524 part 1)
- MINERAL OIL BASED HYDRAULIC FLUIDS HLP (DIN 51524 part 2).

For use of environmentally friendly fluids (vegetable or polyglycol base), or other fluids, please consult CH.

2.1 Fluid viscosity

When not differently specified in the individual data sheet, the fluid viscosity should remain within the range 3 to 400 cSt (centistokes). Hydraulic fluids are available in different viscosity classes identified by the ISO VG number, which corresponds to the kinematic viscosity at 40°C (104°F). Here is a table showing typical viscosity changes between 0°C and 100°C (32°F and 212°F) for mineral oil based fluids having various viscosity classes. The fluid should be selected with the aim to achieve an appropriate operating viscosity at the expected working temperatures.

VISCOSITY CLASS	KINEMATIC VISCOSITY - (cSt)		
	MAX at 0°C (32°F)	MED at 40°C (104°F)	MIN at 100°C (212°F)
ISO VG 10	90	10	2.4
ISO VG 22	300	22	4.1
ISO VG 32	420	32	5
ISO VG 46	780	46	6.1
ISO VG 68	1400	68	7.8
ISO VG 100	2560	100	9.9

Note: all main performance curves and specifications shown in CH technical literature are obtained using mineral based fluid ISO VG 46, i.e. 46 cSt at 40°C (104°F), with an oil temperature of 30-40°C (86-104°F).
More detailed technical characteristics are available at CH.

2.2 Fluid temperature recommendation

CH components are generally equipped with BUNA-N seals and, for this reason, the fluid temperature should remain within the -30°C and +100°C range (-22°F and +212°F). In case of temperatures outside this range, consult CH.
Warning: be careful! During operation the valve can heat up to oil temperature!

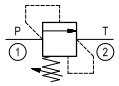
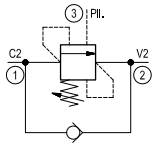
2.3 Fluid cleanliness requirements

The cause of malfunctions in hydraulic systems and components is often found to be excessive fluid contamination. The hard contaminant particles in the fluid wear the hydraulic components and prevent the poppets from re-seating, with consequent internal leakage and system inefficiency. For the correct operation of CH components it is necessary to adopt filtration methods which guarantee for life the specified fluid cleanliness level. It is important to ensure that hydraulic fluids are brought to the appropriate cleanliness level prior filling up the systems, and, when in doubt, also to flush the hydraulic components prior to installation. Fluid filtration must comply with recommended fluid contamination indicated on each single valve datasheet.
ISO 4406:1999 presently is the preferred standard; it defines the fluid cleanliness by three numbers respectively representing the maximum number of particles larger than **4µm**, **6µm** and **14µm** contained in one ml of fluid.

3. Internal leakage

Here is a table with general information about the sealing properties of CH valves and components with leak proof seat design; the allowed leakage tolerance may change depending on the design, number of poppets and valve size; this general information is given for guidance only and, for many valves, specific details about the permissible leakage tolerance can be found in the relevant data sheet.

The LEAKAGE for different valve families is expressed in cm^3/min, or drops/min and is measured in the specified test conditions.
The ratio between cm^3 and drops is approximately:
1 cm^3 (or 0.06 in^3) = 15 – 18 drops.
For pressure relief valves the leakage is indicated at re-seating conditions, identified as X% of pressure relief setting.

CHART OF SEALING PROPERTIES	
HYDRAULIC FUNCTION	Max leakage
Pressure relief 	15 drops at 80% of std pressure setting
Check valve 	5 drops/min
Pilot assisted counterbalance 	15 drops/min at 70% of pressure setting in re-seating conditions (cracking pressure)

4. Pressure setting

CH valves are supplied pre-set at the standard pressure setting shown by the relevant catalogue sheet. Whenever the application requires a re-adjustment, please ensure that the limits of the indicated pressure range and maximum working pressure are never exceeded.

5. Sealing of valve adjusters

Special plastic sealing caps for service are available for most CH valves and cartridges. Upon request, valves can be supplied factory sealed.

6. Storage of new components

The components shall not be exposed to direct sun light nor to sources of heat or ozone (like electric motors running), and should be stored in their original, protective packing at ambient temperature within the range -20°C and +50°C (-4°F and 122°F).

7. Ports

G type ports (ISO 228-1) are often standard on components with body for line connection; SAE sizes (straight thread), JIS or metric ports can be manufactured upon request.

8. Body materials

- Valves and integrated manifolds for high pressure and/or heavy duty applications are manufactured with high quality leaded steel, zinc plated with yellow trivalent chrome treatment.
- Valves and integrated manifolds for medium working pressure (up to 210 bar) can be made of high strength wrought aluminium, black anodized upon request.
- Housings for modular, solenoid operated directional valves and flow diverters are made of high strength cast iron, zinc plated with yellow trivalent chrome treatment.

9. Seals

O-Rings: Buna N (acrylonitrile butadiene), also named NBR (according to ASTM), compatible with fluids having mineral oil base, water-in-oil emulsions, and water-glycol fluids. These seals are standard for temperatures within the range -30°C and +100°C (-22°F and +212°F).
Back-up rings and Slide rings: strengthened PTFE (Politetrafluoroetilene like Teflon®, Lubriflon®, Ecoflon®, or similar).
Special FPM (Viton®) seals are available on request.
Note: the seal materials are compatible with the fluids normally used in hydraulic systems; in case of special fluids, if you suspect incompatibility between the fluid used and the standard seals, contact the CH service network.

9.1 Seal kits

- for cartridge valves: the kits include all the external seals;
- for components assembled as parts in bodies or housings: the kits include all external seals for flange fitting, or for matching different units together.
- in general seal kits contain seals for 10 valves.

10. Installation

- Only trained and competent personnel may carry out any work on Bosch Rexroth Oil Control valves.
- During any operation on Bosch Rexroth Oil Control valves, it is recommended to pay attention to valves surfaces temperature.
- Ensure that all matching surfaces are clean, without contamination.
- Ensure that all seals and back-up rings for the matching surfaces are flawless and correctly placed.
- Do not put any sealing material other than the standard seals.
- During the assembly of the valve and/or the group of valves, refer to the hydraulic scheme and to the name assigned to each port.
- Do not hang the valves and/or the group of valves to the hydraulics pipes, but always use the specific fixing holes.
- In case of use of screw and push and twist overrides, the command must be removed before starting the machine.
- Place in position the valve, then, by hand, insert the fittings and the locating screws.
- In case of cartridge valve, check that the cavity is clean, without sharp edges or chips. Dip the cartridge in clean oil, then insert it into the cavity and screw it in by hand, until you begin to compress the top O-Ring.
- Finally tighten with a calibrated torque wrench and torque up to the specifications shown in the catalogue.
- Use gloves in order to avoid accidental injuries during installation or maintenance.
- Do not grab / handle product from moving parts (i.e. cables, levers, upper side of cartridges,...etc.
- All valves or groups of valves are attributable to pressure vessels. It‘s always recommended to place the components in a closed but ventilated compartment, able to protect the environment and users in case of accidental ejection of material under pressure (fittings, pipes, plugs expander ... etc.)
- Do not tamper with the valve. Only the substitution of the valve itself, the coil or permitted seals (part ok Bosch Rexroth seal kit) are generally allowed.
- Before removing or disassembling the valve or allowed parts (as pressure gauge ports, purge plugs, ...etc) it is strongly recommended to vent all hydraulic pressure from the system.
- Remove tension from the coils before any kind of maintenance / installation operation.
- Check the connections and the cable section with reference to the coils nominal current.
- During the first start of the machine, please ensure that the grounding system is connected and stay away from moving parts.
- In case of allowed adjustments on the valve, any maximum protrusion or other admissible maximum value indicated in valve datasheet must not be exceeded.
- Do not install the valve under the tank level to prevent air inside the valve.

11. Cavities for screw-in cartridges

CH has developed a complete range of cartridges which fit the cavity patterns with UN/UNF threads, according to SAE standards, nominal sizes 08-10-12-16-20. Internal parts of cartridges are designed with a global view of our comprehensive variety of hydraulic products; accordingly, our technology has been optimized in order to employ few basic parts for many different valves for best reliability, cost effectiveness and availability. Further, we can propose our cartridges in different versions, with a variety of external shells in order to fit other cavity patterns, such as ISO/METRIC, or special industrial patterns.

12. **Coils**

12.1 **Coil installation on solenoid cartridges**

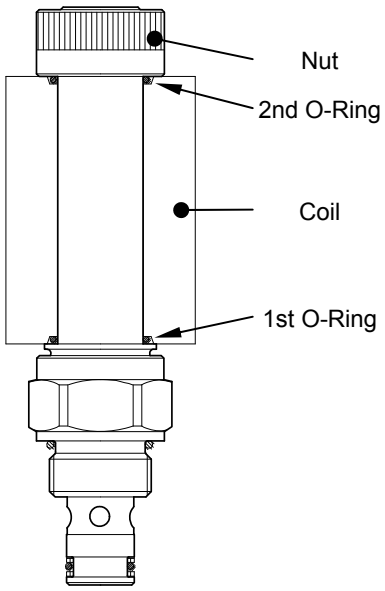
COIL INSTALLATION

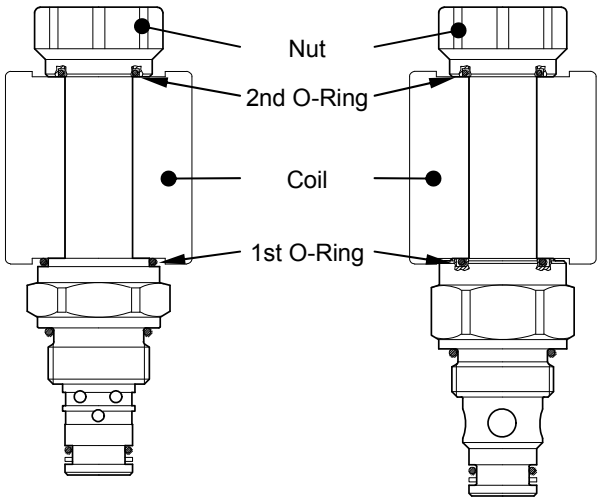
COIL WITH O-RING SEATS (S7-S5-R7)

- It is recommended to follow these steps:
- Insert 1st O-Ring (see drawing)
- Insert coil
- Insert 2nd O-Ring (see drawing)
- Tighten BY HAND coil retaning nut (in any case do not exceed the torque specified in the catalogue page).

COIL WITHOUT O-RING SEATS (S8-356)

- It is recommended to follow these steps:
- Insert 1st O-Ring (see drawing)
- Insert coil
- Tighten BY HAND coil retaining nut to the torque specified in the cartridge catalogue page. The 2nd O-Ring is fixed inside the nut.





IMPORTANT: O-Rings are the only protection against water infiltration between tube and coil, which may lead in short time to coil failure. The proper mounting of both O-Rings is therefore necessary to ensure normal life of coils. Bosch Rexroth Oil Control cannot guarantee any IP protection degree if both O-Rings are not properly mounted on coils.

12.2 **Working duty (DIN VDE 0580)**

The working duty ED of a coil is the ratio between energized time **ti** and full cycle time **tc** where **tc = ti + tr**, and **tr** = de-energized time.

ED = (ti / tc) • 100%

All CH coils are rated for **ED = 100%** (i.e. always energized), provided that the temperature limits of their insulation classes are not exceeded.

12.3 **Protection rating (DIN 40050 - Part 9 IEC 60529)**

Protection class is designated by the letter IP followed by two digits: the first digit refers to resistance against penetration of surrounding or foreign solid objects, the second against penetration of water. Protection class doesn't apply to explosion risks or to conditions such as moisture, corrosive agents, mildew etc.

- **IP65** means water protection against **LOW PRESSURE JETS**:water at 0.3 bar (43.5 psi) pressure sprayed from a distance of 2.5 – 3 m (8.2 – 9.8 ft) from every direction
  IP65 coils CANNOT BE PLUNGED INTO WATER OR REMAIN UNDER WATER.
- **IP67** means water protection against **30 MINUTES IMMERSION** under water 1 m (3.3 ft) deep.
- **IP69K** means water protection against **HIGH PRESSURE JETS**:

water at high pressure and temperature, 80-100 bar (1160–1450 psi) and 75-85°C (167°F-185°F), sprayed from a distance of 100–150 mm (3.9–5.9 in) from every direction.

12.4 Coil resistance to thermal shock dunk test

This test, well known and commonly applied in the construction, agricultural and mobile equipment markets, includes several steps :
1) Coil is maintained energized for 1 hour at nominal voltage and ambient temperature 25°C (77°F), or is not energized but heated for 2 hours in oven at 105°C (221°F).
2) Coil is immediately immersed in water at 20 - 25°C (68 – 77°F) for 30 minutes, at minimum depth 300 mm (11.8 in).
3) Coil, when still wet, is tested for moisture ingression and dielectric breakdown with a dielectric tester, like the “Hypot”. With this tester, a voltage differential of 500V DC is applied between the winding and the coil external surface in order to measure the current leakage which must not exceed 100µA (micro-amps).
4) The complete test is performed on samples of 10 coils minimum, and is repeated at least five times.

All coils with EN 175301-803 (ex DIN 43650) connector correctly mounted comply with IP65 protection class.
Coils with integrated Deutsch DT04-2P connector have IP69K protection class, and pass the thermal shock dunk test.

12.5 Heat insulation (DIN VDE 0580)

The actual coil temperature **T** is the result of (**TA** + Δ**T**), where:
TA = ambient temperature, and ΔT = temperature rise due to coil operation.
Example: with TA = 40°C (104°F) and ΔTmax = 115°C (239°F), **T = 155°C (311°F)**; with TA = 40°C (104°F) and ΔTmax = 140°C (284°F), **T = 180°C (365°F)**.
The coil ΔT is determined following a standard procedure (DIN VDE 0580):

- the coil is mounted on a standard cartridge, inserted in a standard steel manifold placed on a wooden surface.
- the coil is maintained energized for 1 hour at nominal voltage, with ambient temperature TA = 20-25°C (68-77°F) and with natural ventilation.

CLASS H coils are rated for **T max = 180°C (356°F)**:
if ambient temperature exceeds the value **Tx = 180°C (356°F)** - Δ**T**, a class H coil cannot be used under continuous duty cycle (ED = 100%); the coil must be periodically de-energized to prevent exceeding the MAX temperature.
In any case, for the correct operation of coils, it is always necessary to provide means for heat dissipation and, at least, natural ventilation.

Caution: when energized, the coil surface temperature can reach quickly (in few minutes of continuous operation) temperature levels of 80-100°C (176-212°F), which is not directly related to the coil ΔT: **care should be taken to avoid any accidental contact of people with the coil surface.**

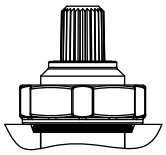
12.6 AC Service

All CH solenoid valves are designed to operate exclusively with DC power supply. All coil windings are DC.
AC operation is possible using EN 175301-803 (ex DIN 43650) connectors with rectifier.

12.7 **Optional manual emergency for solenoid cartridges**

Upon request, the solenoid cartridges can be equipped with tubes incorporating a manual emergency device for valve operation when the coil cannot be energized, like in case of voltage shortage.
IMPORTANT: manual emergency must always be released before the re-start of thew machine!
Here is a summary of the different options available:

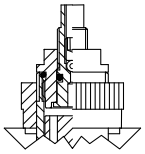
KNOB STYLE MANUAL OVERRIDE TYPE D (SCREW-OUT)



AVAILABLE ON FOLLOWING MODELS:
- 2 way 2 position pilot operated single lock normally closed.
- 2 way 2 position pilot operated double lock normally closed.
- 2 way 2 position direct acting poppet style single lock normally closed.
- 3 way 2 position spool style.
- 4 way 2 position spool style.

OPERATION
To operate manual override, screw out the knob turning it counterclockwise.
To return to normal valve operation, turn the knob clockwise.

SCREW-IN STYLE MANUAL OVERRIDE



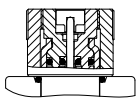
AVAILABLE ON FOLLOWING MODELS:
- Proportional valves series 5A.

OPERATION
To operate manual override, screw in the pin turning it clockwise with wrench.
To return to normal valve operation, turn the bolt counterclockwise.

PUSH STYLE MANUAL OVERRIDE TYPE B

AVAILABLE ON FOLLOWING MODELS:
- 2 way 2 position pilot operated single lock normally open.
- 2 way 2 position pilot operated double lock normally open.
- 2 way 2 position direct acting poppet style single lock normally open.
- 2 way 2 position direct acting poppet style double lock normally closed/open.

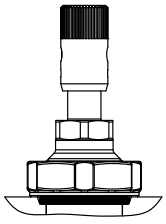
OPERATION
To operate manual override, push and hold override button.
To return to normal valve operation, simply release the button.



AVAILABLE ON FOLLOWING MODELS:
- 2 way 2 position direct acting poppet double lock normally closed
- 3 way 2 position direct acting poppet.

OPERATION
To operate manual override, push and hold override button with tool.
To return to normal valve operation, simply release the button.

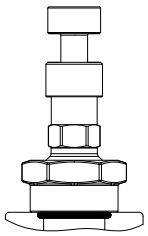
PUSH AND TWIST STYLE MANUAL OVERRIDE TYPE C



AVAILABLE ON FOLLOWING MODELS:
- 2 way 2 position pilot operated single lock normally open.
- 2 way 2 position pilot operated double lock normally open.
- 2 way 2 position direct acting poppet syle single lock normally open.
- 2 way 2 position direct acting poppet style double lock normally closed/open.

OPERATION
To operate manual override button, turn clockwise and release.
To return to normal valve operation, push override button, turn counterclockwise and release.

PUSH AND PULL MANUAL OVERRIDE TYPE B



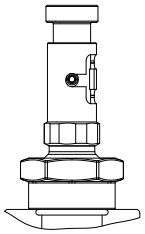
AVAILABLE ON FOLLOWING MODELS:

- 4 way 3 position spool style.

OPERATION

To operate manual override, push to override S2 coil or pull to override S1 coil and hold override button.
To return to normal valve operation, simply release the button.

PUSH AND PULL MANUAL OVERRIDE WITH DETENT TYPE C



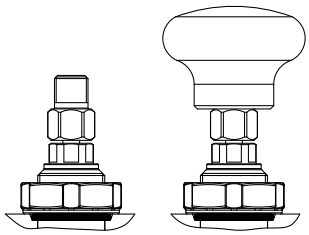
AVAILABLE ON FOLLOWING MODELS:

- 4 way 3 position spool style series size 08.

OPERATION

To operate manual override, push to override S2 coil or pull to override S1 coil.
The intermediate position of the override corresponds to the neutral position of the valve.

PULL STYLE MANUAL OVERRIDE TYPE E AND HAND OPERATED PULL STYLE MANUAL OVERRIDE TYPE F



AVAILABLE ON FOLLOWING MODELS:

- 2 way 2 position pilot operated normally closed.

OPERATION

To operate manual override, pull and hold the knob. This override is not detented. Force required to operate is approximately 50 N (11.2 lbs). This override can also be remote operated by a cable fixed to the M8 thread. In this case the spring may not provide enough force to overcome internal cable friction and the user must provide an external means of returning the cable.

13. Technical data for Proportional valves CH

GLOSSARY OF TERMS AND DEFINITIONS

Current is the flow of electrons in a conductor, measured in Amperes (A) or milli-amperes (mA) and abbreviated “I”.

Voltage is the potential for current flow in an electrical circuit. It is measured in Volts (V) and abbreviated “V.”

Resistance is a material’s opposition to the flow of electrical current. It depends on physical properties as well as temperature, size and shape of the material. It is measured in Ohms (Ω) and abbreviated “R”. The tolerance allowed on resistance at ambient temperature 20-25°C (68 - 77°F) is ± 7 %.

Hysteresis is the difference in regulated hydraulic parameter (flow / pressure) at a fixed current level when current is increasing vs. when current is decreasing. It is normally expressed as a percentage of the total change in regulated hydraulic parameter (flow / pressure).
Example: With 900 mA input current and increasing current, 20 bar (290 psi) regulated pressure is achieved. With 900 mA input current and decreasing current, 20.8 bar (302 psi) regulated pressure is achieved. There is a 0.8 bar (12 psi) difference in regulated pressure achieved with the same current depending on whether current is increasing or decreasing.
If Maximum Regulated Pressure = 25 bar (363 psi) and Minimum Regulated Pressure = 4 bar (58 psi), the total regulated parameter change is 25 (363) – 4 (58) = 21 bar (305 psi).
Hysteresis = (0.8 / 21) x 100 = 3.8%.

Proportional Controller is a device that converts a low-power input signal into an output signal that is capable of operating the valve. This output signal can be modified to include PWM, ramping, etc.
Pulse Width Modulation (PWM) is a method used to vary the average current induced in a coil using a square wave of fixed frequency, and variable ratios of on/off times.

Dither is a method used to reduce hysteresis by applying a square or triangle wave to the coil voltage. It can be applied to straight DC or PWM.

Maximum Control Current is the point where increasing current input no longer results in an increase in regulated hydraulic parameter (flow / pressure).

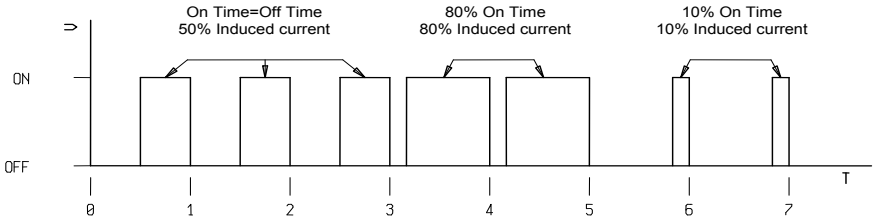
I-Min and I-Max represent the minimum and maximum control current induced into a proportional valve coil. The tolerance allowed is ± 10 % and depends largely from coil´s resistance tolerance.

Ramping is the ability to control the rate of change of the output of an electronic controller.

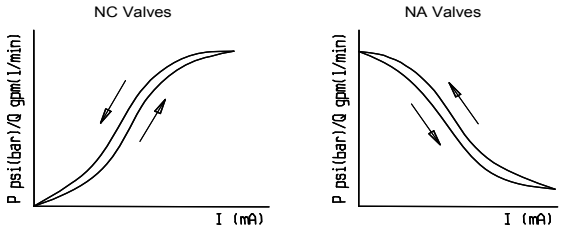
VERY IMPORTANT:

a. It is strongly recommended to use pulse-width-modulation (PWM) as input signal to coils rather than straight DC. Our tests indicate that PWM input signal allows best valve performance, significantly reducing hysteresis and response times of all our proportional valves. All features shown and explained in next pages are available from many industry-common electronic controllers, including Proportional Controllers described in this catalogue.
b. CH recommends to use always 12 V DC coils in combination with 24 V DC supply voltage to the electronic controller. This allows to use a much wider control current range independently from coil temperature, since anyway current is regulated by the electronic controller and there is no coil overheating risk.
c. in order to prevent air form collecting in the magnetic tube the valve should be mounted below the reservoir oil level.
d. if this is not possible horizontal installation will give the best results.
e. do not switch the valve unless properly installed in an oil filled circuit.
f. in case of air collected in the pole tube switching the valve back and forth few times will help getting rid of the air.

PULSE WIDTH MODULATION

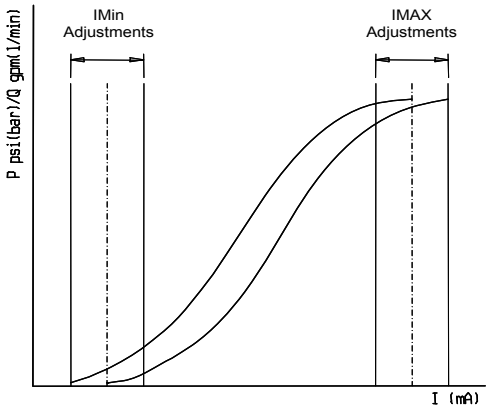


HYSTERESIS CHARACTERISTIC WITH 120 Hz PWM



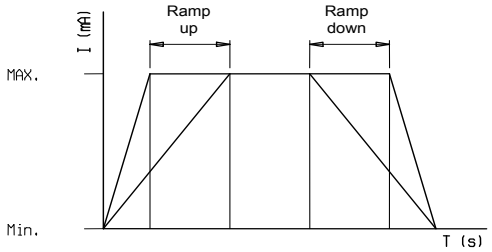
For normally closed proportional valves, the hysteresis curve with increasing current is always lower than the curve with decreasing current.
The opposite is true for normally open proportional valves as shown.

REPEATABILITY RANGE



An important control feature of electronic controllers is I-Min / I-Max adjustment.
This feature allows control of the regulated hydraulic parameter across the full range of the electronic controller by eliminating deadband.

RAMP SLOPE CONTROL



Many commercially available controllers also offer a ramping control feature.
This feature allows to adjust the current rate of change between the I-Min and I-Max setpoints.

14. **European machine directive 2006/42/CE**

The CH valves or components described in this catalogue can be employed in machinery or systems which need to comply with the European Machine Directive
In such case, the CH valves, manifolds, components and assemblies must be fitted in compliance with all the relevant technical data sheet applicable to the product, and shall not be operated, adjusted or disassembled before the complete machinery where they are incorporated has been declared to be in compliance with the Machine Directive 2006/42/CE.

15. **General technical data for compact power modules**

Through the years DCOC has developed a highly evolved modular system resulting in powerful, flexible and cost effective power pack range, identified as **“compact power modules”**. In its easier configuration, a “compact power module” is an assembly of electric motor, central manifold with valves, pump, oil tank and a few connection elements. The central manifold, with its built-in valves, allows to achieve a large variety of hydraulic control circuits. If more complex circuits are needed, modular integrated blocks can be added by flange mounting, or interfacing, to the central manifold to extend its capabilities.

15.1 **Power module selection**

- Choose the circuit which meets your application requirements.
- Take note of all dimensions resulting from the basic components chosen for your application. NOTE: dimensions may vary slightly and should be confirmed by DCOC, if the assembly is to be installed in a space with narrow clearance.
- The tank capacity and the tank dimensions need to be large enough to assure proper pump suction: there must always be a reserve of oil in the tank when all cylinders are fully extended and avoid overflow when cylinders are fully retracted.
- The tank must be evaluated also for best separation of air from oil, and for settling down oil contamination. It should be placed in a space with, at least, natural ventilation and it should permit enough heat dissipation to prevent fluid temperature from exceeding 60°C (140°F).
- Select the electric motor by evaluating the power needed and the motor compliance with the heat developed during the expected run time (or “duty cycle”).
  Motor performance diagrams for “continuous running” (S1), “short time running” (S2) or “intermittent periodic running” (S3) are available in the catalogue. In case of doubt, consult the factory.

15.2 **Power module installation**

The mounting position is basically un-restricted; just avoid installations that could compromise the pump suction. It is recommended to support the power module on vibration dampening blocks when the mounting structure is expected to vibrate.

15.3 **Hydraulic fluid for power module**

It should meet all specifications given for the other DCOC valves and components, except that:

- **the viscosity** should remain within the range 10 to 300 cSt (centistokes); best 15 to 120 cSt.
- **the temperature** should remain within the range -15°C and +80°C (5°F and176°F). In fact, these are the temperature limits generally recommended for the gaskets employed in these power modules.

15.4 **Cleaning and maintenance**

All components of the hydraulic circuit, including hoses and actuators, must be flushed clean before assembling, because the power module only has a suction filter.
The hydraulic fluid should be replaced after the first 100 hours, and then every 3000 hours, or, at least, once a year.

15.5 **Wiring and starting-up**

The wiring between battery and electric motor should be selected in order to avoid excessive voltage drop (recommended less than 1 V).
It is strictly forbidden to allow the backwards rotation of the pump even at the first starting: to prevent reverse rotation, **the wiring polarities must be correctly connected**.

Caution: when energized, the surface temperature of the electric motor could reach temperature levels of 60–80°C (140–176°F): **care should be taken to avoid any accidental contact of people with the motor surface**.

16. **Disposal**

Careless disposal of the CH valves and units, the hydraulic fluid and packaging material can result in environmental pollution.
Observe the following points when disposing of the CH valves and units:

1. Completely drain the CH valves and units of hydraulic fluids.
2. Dispose of the CH valves and units and packaging material in accordance with the national regulations in your country.
3. Dispose of the hydraulic fluid according to the national regulations in your country. Also observe the applicable safety data sheet for the hydraulic fluid.
4. Disassemble the CH valves and units into them individual parts and properly recycle these parts.
5. For example, separate the parts into:
   - Cast parts
   - Steel
   - Aluminum
   - Non-ferrous metal
   - Electronic waste
   - Plastic
   - Seals

17. **Technical data for on-off valves CH**

RESPONSE TIME

Datasheet values indicated are based on measurements at DC-CH test benches at nominal flow and pressure; values may vary depending from different system configurations.

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