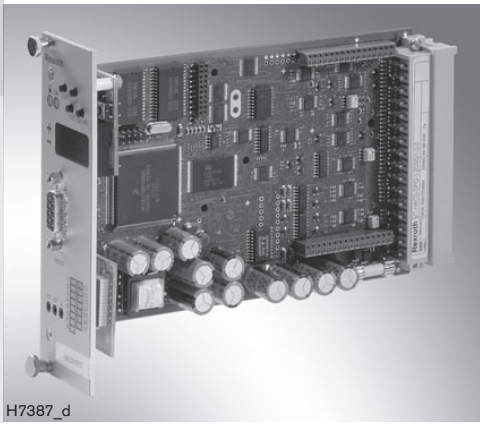
Rexroth
Bosch Group

Digital Control Card for hydraulic clamp units

RE 30147/08.07 1/10
Replaces 05.06

Type VT-HACD-DPC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Component series 2X

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Features

- Preselection of the target positions via parameter
- Actual value acquisition possible by means of SSI encoder Incr or analogue position measuring system
- Set-up operating mode with separate preselection of close clamp tonnage, decompression and open clamp
- Enable input and OK output
- ±0 V reference voltage output
- Front display with keys for displaying and changing parameters as well as for diagnosis purposes
- RS232 serial interface
- Up to 32 control electronics for parameterization and diagnosis can be interconnected via local bus
- Overlap compensation for valves with positive overlap
- Optional Stop screen (e.g. blow moulding)
- Emergency ramp

Ordering code

VT-HACD-DPC – 1 – 2X / V0 / 1 – – 0

Digital controller card

Component series 20 to 29 **= 2X**
(20 to 29: unchanged installation and connection dimensions

Basic unit **= V0**

1 = With display

0 = Without bus interfacing
C = CANopen
D = DeviceNet

0 = Without valve output stage

Standard types	Material number
VT-HACD-DPC-1-2X/V0/1-0-0	R901062452
VT-HACD-DPC-1-2X/V0/1-C-0	R901119888

Required accessories:

- PC program BODAC: Ordering code of the CD: SYS-HACD-BODAC-01 (R900777335) or free download on the Internet at www.boschrexroth.com/hacd
- Interface cable: Cable set VT-HACD-1X/03.0/ HACD-PC (R900776897) or commercial 1:1 cable
- USB adapter optionally available VT-ZKO-USB/S-1-1X/V0/0

Suitable card holders:

- 19“ rack types VT 19101, VT 19102, VT 19103 and VT 19110 (see RE 29768)
- Enclosed card holder type VT 12302 (see RE 30103) (standard), mat. no. R900784153
- Open card holder type VT 3002-2X/64G (see RE 29928), mat. no. R900991843 (for installation in control cabinet only!)
- Connection adapter VT10812-2X/64G (see RE 30105), mat. no. R900713826

Suitable power supply unit

- Compact power supply unit type VT-NE30, see RE 29929

Functional description

The VT-HACD-DPC is a digital control card for clamp control type applications. It includes proven control techniques and advanced options for controlling the hydraulic axis. Ultimately, the control system is bound to the mechanical and hydraulic limits of the machine. The VT-HACD-DPC is a tool for closed loop control that can define the performance limits of the machine. Results are a function of proper machine design, installation, environment and laws of physics.

Overview

The VT-HACD-DPC is a digital platform, industrial clamp controller. It optimizes the control of a hydraulic axis for velocity and pressure force-/ pressure control.

- Velocity profiles are controlled completely by use of closed loop position control. An advanced position command profile is calculated automatically based on the operator input velocity profile.
- Because the VT-HACD-DPC is a position control device it requires a position feedback transducer. Both analog (0-10 V; ±10 V; 0-20 mA; 4-20 mA) and digital types (SSI, INC) are supported.
- The VT-HACD-DPC uses constant acceleration type ramping to allow smooth acceleration of the clamp.
- The VT-HACD-DPC includes force/pressure-limiting control that can be configured to work with or 2 pressure transducers or a load cell.
- Advanced control techniques like Active Damping allow precise closed loop control of the most demanding low-naturalfrequency systems.
- The velocity profile and force profiles may be controlled with one proportional directional type hydraulic flow control valve, or using separate valves for flow and pressure.

Operational description

The VT-HACD-DPC controller is a complete hydraulic clamp axis control solution. A clamp motion profile is created from parameters that are entered by the machine operator. Parameter changes may be individually loaded into the card, or the entire profile loaded at one time. The card maintains the last saved profile in non-volatile flash memory. A single clamp motion profile is stored on the card. The VT-HACD-DPC controller includes the following control features and functionality.

Functional description (continuation)

Completely Closed Loop Control

All segments of the motion profile are controlled by implementation of closed loop position control of the clamp cylinder. Active damping technology allows stable and smooth closed loop control of even springy, low natural frequency systems. At the start of clamp motion the internal position command is set equal to the current cylinder position feedback and then ramped toward the next segment's start position. The rate of movement of the position command corresponds to the velocity command in the current profile segment. Each step in the profile is initiated when the internal position command reaches a segment start position as defined in the profile. Repeatability of the profile is insured because the internal position command is moved at a rate controlled by the internal VT-HACD-DPC clock, and the cylinder follows the command profile. This type of system is used because it is relatively unaffected by changes in friction, oil temperature and other system variables. Smooth acceleration of the clamp to the selected traverse velocity is controlled by a constant acceleration ramp. Deceleration of the clamp to slow velocity is controlled by use of position dependant braking technique that assures fast, smooth, and repeatable slowdown.

Close Mold Profile

A two-segment profile is provided to close the mold; the traverse segment and the mold protect segment. A maximum closed or open loop pressure force limit may be set for each profile segment. There is a discrete output available to indicate when mold touch position is achieved. The profile may optionally be adjusted to stop the clamp during the mold protect segment before mold touch) using the pre close stop position. Two additional final close velocity segments are available to then complete the closing profile.

Tonnage Pressure Profile

A two-segment profile is provided for mold closed pressure control, the tonnage segment and the low-hold segment. The tonnage segment is started automatically when the tonnage start position is reached during the mold close or final close profile. A timer (tonnage start) is available to delay the start of the tonnage profile and allow the hydraulic pump system time to build pressure, which prevents undesirable initial windup of the closed loop control. Tonnage pressure control may be closed or open loop. For toggle clamp applications there is a discrete output available to indicate when tonnage position is achieved. The flow valve output may be limited to separate open loop values during the tonnage and low-hold pressure control segments.

Decompress

Prior to opening the mold the clamp cylinder(s) must be decompressed to prevent hydraulic shock. A decompress segment is provided with an adjustable pressure set point and decompress rate control. A discrete output is provided to indicate when the pressure has decreased below the decompress set point. The decompress complete discrete output is a permissive that is required to allow the clamp to begin the mold open profile or the jog open function.

Open Mold Profile

A three-segment profile is provided to open the mold; the breakaway segment, the traverse segment and the open slow segment. A maximum open loop pressure limit may be set for each profile segment when using a separate pressure control valve. A timer (start open delay) is available to delay the start of the mold open profile and allow the hydraulic pump system time to build pressure, which prevents undesirable initial windup of the closed loop control.

Jog Functions

In addition to the closed loop profile control there are two open loop jog modes, open and close. The valve outputs may be reset to an independent value for each jog mode. There are separate increasing and decreasing ramp adjustments for each output in jog mode. Typical applications of these modes are for manual operation of the clamp (setup function).

Applications

The VT-HACD-DPC is configured to control clamp type applications and all parameters are labeled to be recognizable in clamp applications. There is, however, many other applications that could benefit from the quality of control afforded by the VT-HACD-DPC.

Typical applications include:

– Mechanical handling devices
– Lift and Transfer machines
– Powder metal presses
– Angular position for rotary axis
– Shuttle and Transport axis

Configuration Options

The card can be applied in one of two basic configurations depending on the hydraulic system.

1. Closed loop velocity profile and closed loop pressure control using one proportional directional valve and one analog valve output. This type of system will control the clamp velocity profile and closing pressure limit using one proportional directional control valve. The available dynamic response using this type of system is higher than systems that use separate valves for flow and pressure control. Mold protect pressure typically can be a lower value using a single control valve system.

Functional description (continuation)

2. Closed loop velocity profile and either closed loop or open loop pressure control using one proportional directional or low control valve for the velocity profile and one proportional pressure control valve for the pressure control. There are two analog valve outputs available for this configuration. This configuration does not require as high dynamic response from the proportional directional control valve as the single calve configuration. Mold protect pressure control will not be as dynamic due to limitations of separating flow and pressure functions into multiple valves, and inherent dynamic limitations of proportional pressure control valves.

Front panel operation

The front display is used in conjunction with the 4 push buttons to display and change operator parameters.

Access is given to the following operator parameters:

– Mold close profile

– Tonnage pressure profile

– Decompress

– Mold open profile

For safety reasons, set-up and configuration parameters are not accessible through the front panel.

Fault messages will be displayed if they occur.

PC program BODAC

The PC program BODAC is used for the configuration, parameterisation and diagnosis of the VT-HACD-DPQ via a serial interface (RS 232). Up to 32 control electronics can be interconnected via the local bus. Each control electronics is assigned a bus address by means of BODAC. Re-plugging of the serial interface cable is not required. For further information, see RE 30147-01-B.

Performance limits of incremental encoders

The maximum frequency of the incremental encoder input (F_E) of the VT-HACD-DPC is 100 kHz. The decisive factors for the frequency are the maximum operating speed of the drive, the resolution (Res) of the encoder system used and possible signal evaluation by an EXE (interpolation and digitisation electronics).

Determination formulas

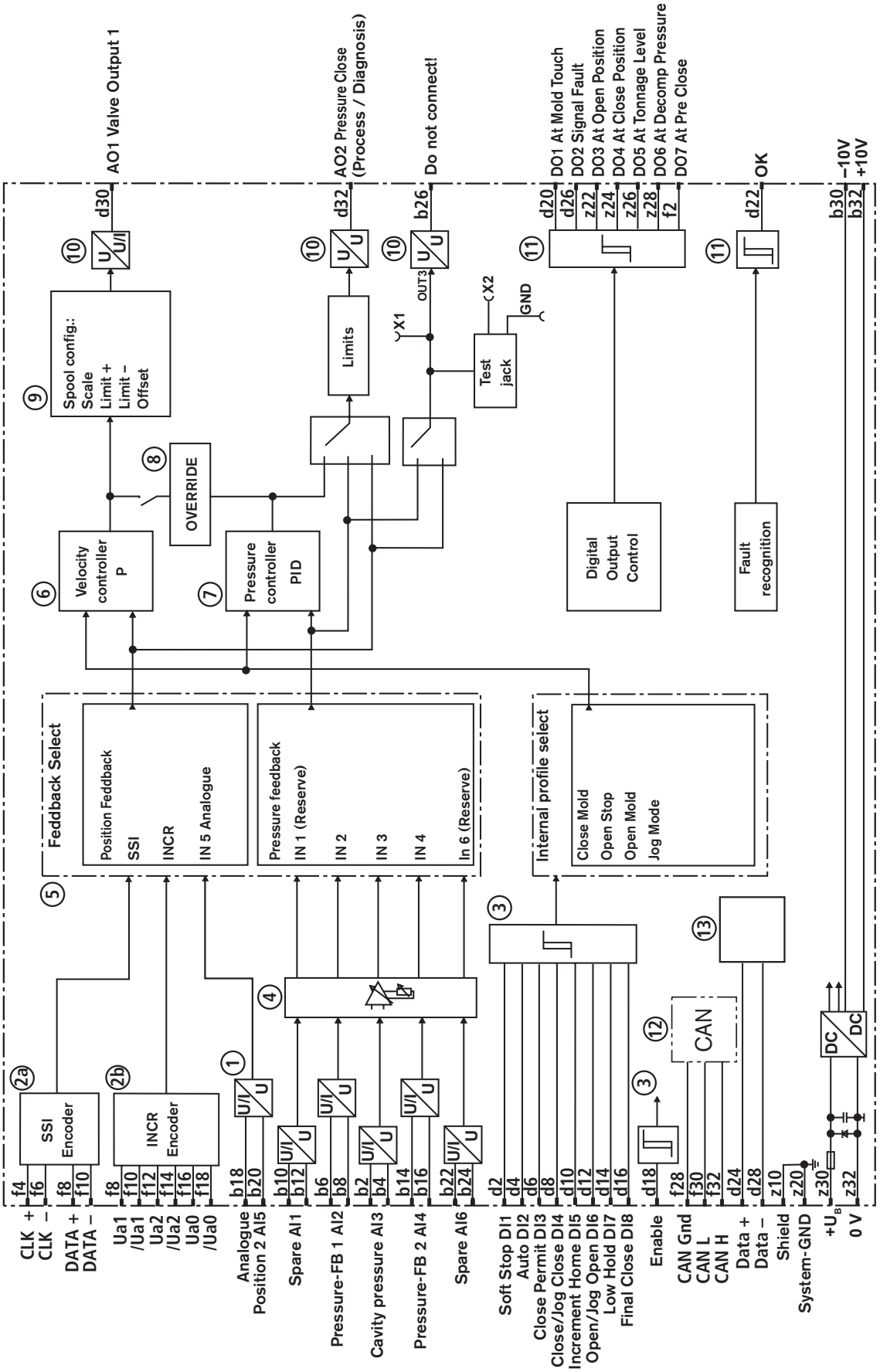
Encoder resolution at given maximum velocity:

$$\text{Res } [\mu m] \geq \frac{v \left[\frac{m}{s}\right] \times 10^3}{Fa\ [kHz] \times EXE}$$

Velocity at given encoder resolution:

$$v \left[\frac{m}{s}\right] \leq \frac{\text{Res } [\mu m] \times EXE \times F_E\ [kHz]}{10^3}$$

Block circuit diagram



1 Analogue inputs, voltage or current
2a SSI encoder
2b Incremental encoder
3 Enable input and digital input
4 Adjustment of analogue inputs
5 Math. linkage or controller
6 Velocity controller
7 Pressure controller
8 Alternating controller
9 Spool configuration
10 Analogue Outputs
11 OK-output and digital output
12 CAN-Interface, optional
13 Local bus

Technical Data (For applications outside these parameters, please consult us!)

Operating voltage	U_O	24 VDC
Operating range:		
– Upper limit value	$u_O(t)_{max}$	35 V
– Lower limit value	$u_O(t)_{min}$	21 V
Current consumption	I_{max}	150 mA
Fuse	I_S	4 A slow
Digital inputs	Signal	log 0 = 0 to 5 V
		log 1 = 16 V to U_O
Digital outputs	Signal	log 0 = 0 to 5 V
		log 1 = 16 V to U_O
		I_{max} = 30 mA
Analogue inputs		
Configuration as voltage		
Range	U	0 to 10 V or ±10 V (configurable)
Input resistance	R_i	100 kΩ, > 10 MΩ for Input AI 1
Resolution		5 mV for range ±10 V, 2.5 mV for range 0...10 V
Non-linearity		< 10 mV
Configuration as current input		
Range	I	0...20 mA or 4...20 mA (configurable)
Input resistange	R_e	100 Ω
Current loss		0.15 % (with 500 Ω between pin AI x– and 0 V)
Resolution	I	5 µA
Analogue outputs		
AO1 configuration as voltage output		
Output voltage	U	0...10 V or ±10 V (configurable)
Output current	I_{max}	10 mA
Load	R_{Lmin}	1 kΩ
Resolution		1.25 mV (14 bits)
Residual ripple content		±15 mV (without noise)
AO1 configuration as current output		
Output current	U	0...20 mA or 4...20 mA (configurable)
Load	R_{max}	500 Ω
Resolution		1.25 µA
Residual ripple content		±15 µA (without noise)
AO2 Output voltage		
Output voltage	U	±10 V
Output current	I_{max}	10 mA
Load	R_{min}	1 kΩ
Resolution		10 mV (11 bits)
Residual ripple content		±25 mV (without noise)
Reference voltage	U	±10 V
	I_{max}	30 mA
Residual ripple content		< 20 mV
Scanning rate	t	2 ms
Serial interface		RS232 (front panel), D-Sub-socket
Type of connection		64-pin male connector, DIN 41612, form G
Local bus, distance to the farthest station	l	Max. 280 m cable length

Technical Data (continuation)

Card dimensions		Euro-card 100 x 160 mm, DIN 41494
Front panel dimensions: – Height – Width soldering side – Width component side		 3 HE (128.4 mm) 1 TE (5.08 mm) 7 TE
Permissible operating temperature range	ϑ	0 to 50 °C
Storage temperature range	ϑ	–20 to +70 °C
Weight	*m*	0.2 kg

Pin assignement of male connector

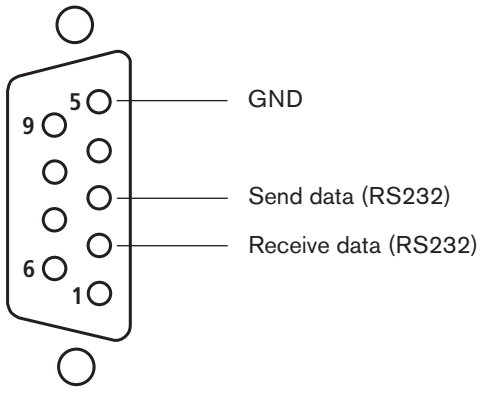
PIN	Row z	Row b	Row d	Row f
2	n.c.	n.c.	DI1: Soft Stop	DO7: Pre Close
4	n.c.	n.c.	DI2: Auto	SSI clock+
6	n.c.	AI2+: Pressure-FB 1 [1)]	DI3: Close Permit	SSI clock–
8	n.c.	AI2–: Pressure-FB 1 [1)]	DI4: Close / Jog Close	SSI-data+; Inc. Ua1
10	Shield	n.c.	DI5: Increment home	SSI-data–; Inc./Ua1
12	n.c.	n.c.	DI6: Open / Jog Open	Inc. Ua2
14	n.c.	AI4+: Pressure-FB 2 [1)]	DI7: Low hold	Inc./Ua2
16	n.c.	AI4–: Pressure-FB 2 [1)]	n.c.	Inc. Ua0
18	n.c.	AI5+: Clamp Cyl. FB [1)]	Enable	Inc./Ua0
20	System ground	AI5–: Clamp Cyl. FB [1)]	DO1: At Mold Touch	n.c.
22	DO3: At Open Position	n.c.	OK	n.c.
24	DO4: At Close Position	n.c.	Data+: Local bus	n.c.
26	DO5: At Tonnage Level	n.c. (Do not connect!)	DO2: Signal fault	n.c.
28	DO6: At Decomp Pressure	Analogue GND	Data–: Local bus	CAN Gnd
30	UB: +24 V	–10 V	AO1: Valve CMD Single or Velocity [2)]	CAN L
32	LO: 0 V	+10 V	AO2: Valve CMD Clamp Pressure	CAN H

[1)] The inputs can be set to 0...10 V, ±10 V or 4...20 mA by means of software.

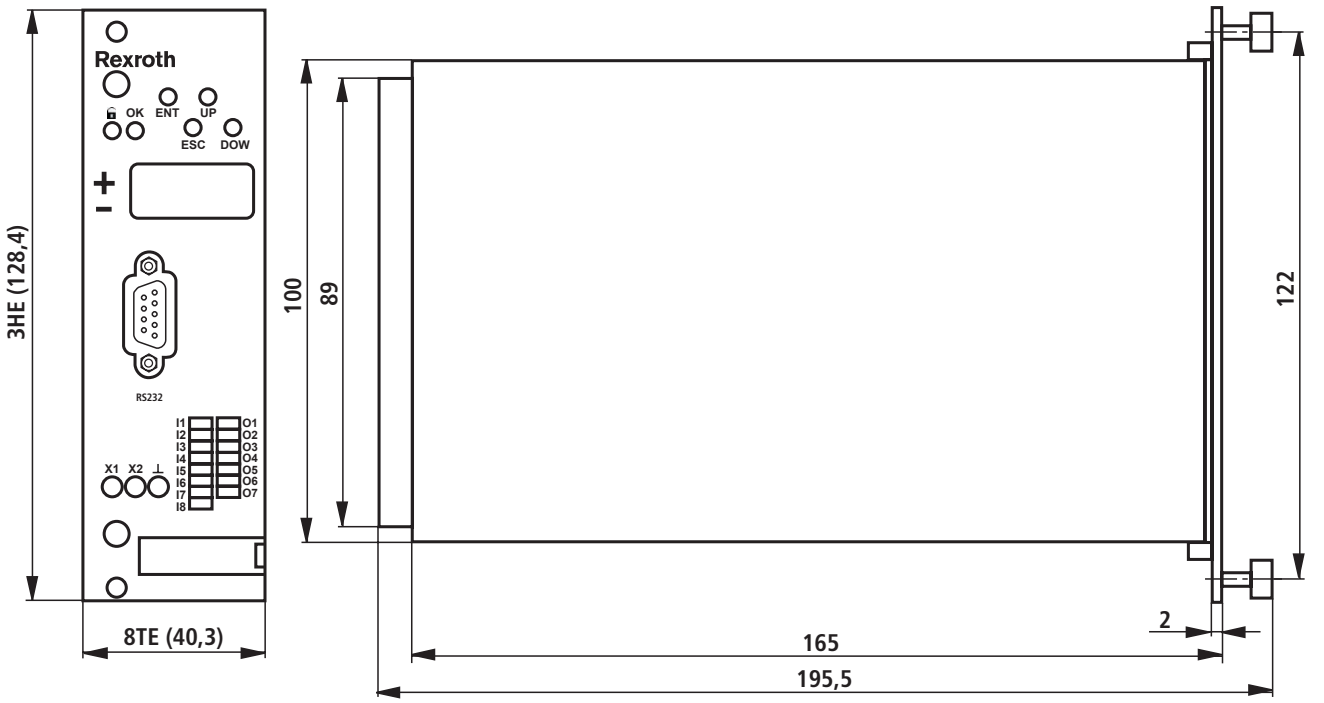
[2)] Output AO1 can be set to 0...10 V, ±10 V or 4...20 mA by means of software.

n.c. ... not assigned in the basic version, but reserved for extensions.

Pin assignment of D-Sub socket on the front panel



Unit dimensions (dimensions in mm)



Engineering / maintenance notes / supplementary functions

Product documentation for VT-HACD-DPC

- RE 30147
  Technical data sheet (this document)
- RE 30147-B
  IInstallation and operating instructions
- RE 30147-01-B
  Commissioning and operating instructions
- RE 30147-U
  Declaration on environmental compatibility
- RE 30147-02-Z
  Start-up CANopen Interface
- RE 30147-03-Z
  Start-up DeviceNet Interface

– Use low-capacitance cables. Whenever possible, establish cable connections without intermediate terminals.
– The arrangement of electromagnetic sources of interference (e.g. frequency converter) in the direct vicinity of the closed-loop control electronics is not permitted.
– Do not lay power cables in the direct vicinity of the controller card.
– Do not lay cables of the control electronics in the direct vicinity of power cables.
– Lay sensor cables separately.
– The distance to aerial lines, radio sources and radar equipment must be at least metre.
– Engineer the system so that when the differential inputs are used, both inputs are always activated or deactivated simultaneously.
– Use relays with gold-plated contacts for passing on command values (small voltages, small currents).
– Always shield command value and actual value cables. Connect the shield to „shield“ on the card side and leave the other end open, otherwise, there is a risk of earth loops.
– Use highly flexible CU conductors (min 2.5 mm^2) for connecting the system ground! The system ground is an essential part of EMC protection of the controller card. It discharges interference that is transported via data and supply voltage cables to the controller card. This function can only be ensured, if the system ground itself does not inject interference into the controller card. Rexroth recommends that solenoid cables be shielded as well.
– Electrical signals brought out via control electronics (e.g. the „OK“ signal) must not be used for switching safety-relevant machine functions!
  (See also European Standard „Safety requirements for fluid power systems and components - hydraulics“ EN982: 1996)

Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Telefon +49 (0) 93 52 / 18-0
Telefax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

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Bosch Rexroth AG
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Telefon +49 (0) 93 52 / 18-0
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documentation@boschrexroth.de
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