RE18324-40/2023-09
Replaces: 2023-07

rexroth
A Bosch Company

Compact Hydraulics Controller CHC 12-1/20 with Base SW application

- Application to drive 12 hydraulic valves with current control
- For open-loop control of hydraulic components
- 3 different input commands:
  - CANbus
  - analogic linear
  - analogic ratiometric

Features

- 32-bit multi-core processor with 142 MHz clock frequency and hardware safety module (HSM)
- Robust and compact design meeting specifications for mobile applications
- High Electromagnetic Compatibility (EMC)
- Inputs and outputs with fault detection
- Inhibit logic for safety-relevant outputs
- Pulse-Width-Modulated (PWM) solenoid currents
- Closed-loop control of solenoid currents, i.e. not dependent on supply voltage and temperature

Main components

- 12 power outputs, which are current-controlled
- One CAN bus interfaces

Contents

Ordering code

R930080235

Notes:

- The CHC controllers are supply with BASE-Software.

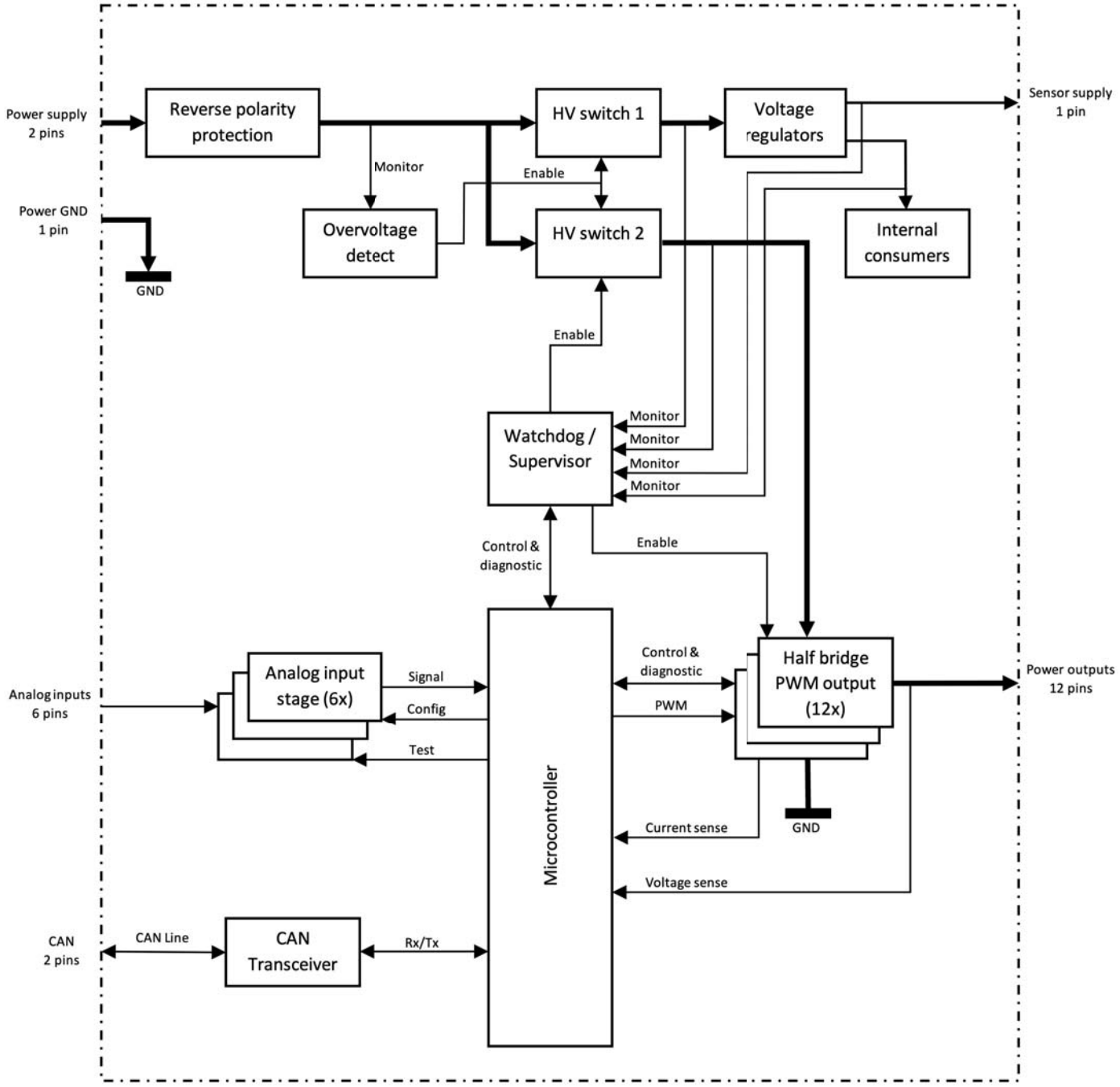
- **CHC DT Service software**
  The windows-based PC software CHC DT Service is used for displaying functions, errors and system variables as well as for setting parameters via a PC. It is also used for flashing programs from a PC onto the controller. CHC DT Service is based on the UDS standard. Details on RE18324-43.

All products mentioned here are available from Bosch Rexroth.

Description

The CHC 12-1/20 is designed as universal controller for mobile working machines. The micro controller features an integrated hardware safety module offering procedures for information security like secure storage of keys and generation of random figures.
The controllers are used for the programmable control of proportional and switching solenoid and of additional electrical switching functions. Typical applications are electrohydraulically actuated work functions.
The micro controller, all input and output circuits, communication interfaces, voltage supplies for the sensors and a power supply unit for operation with 12 or 24 V supply voltages are integrated in a compact housing.
The power outputs have a maximum current capacity of 2.4 ampere. The power outputs lead current-controlled, by controlled pulse width modulation or switched ON/OFF. Current-controlled power outputs are used in particular for the activation of proportional solenoids. The closed-loop current control guarantees that the set-point current is kept even if the supply voltage or the temperature of the solenoid changes and it is characterized by minimal hysteresis.
The 6 analog input can be configured to read voltage signals 0-32 [V].
These work with the A/D converter of the microcontroller and have a short latency.
CAN bus interfaces are available for exchanging data with other controllers RC, I/O extension modules, joysticks, engine control units, displays, etc.
The basic software offers a CANbus propretary protocol. Communication with a service tool is also realized via CAN interfaces. The CHC-DT service tool is based on the UDS standard. This tool is used in application development, commissioning and service. It can be used to download programs to the controller. Base Software application allows to display errors and change process parameters.
The CHC controllers were developed specifically for use in mobile working machines and satisfy corresponding protection requirements regarding ambient temperatures, water and dust ingression, shock and vibration as well as electromagnetic compatibility (EMC).

Block circuit diagram



Abbreviations	
PWM	Pulse width modulation
GND	Ground
CAN	Controller Area Network

Technical data

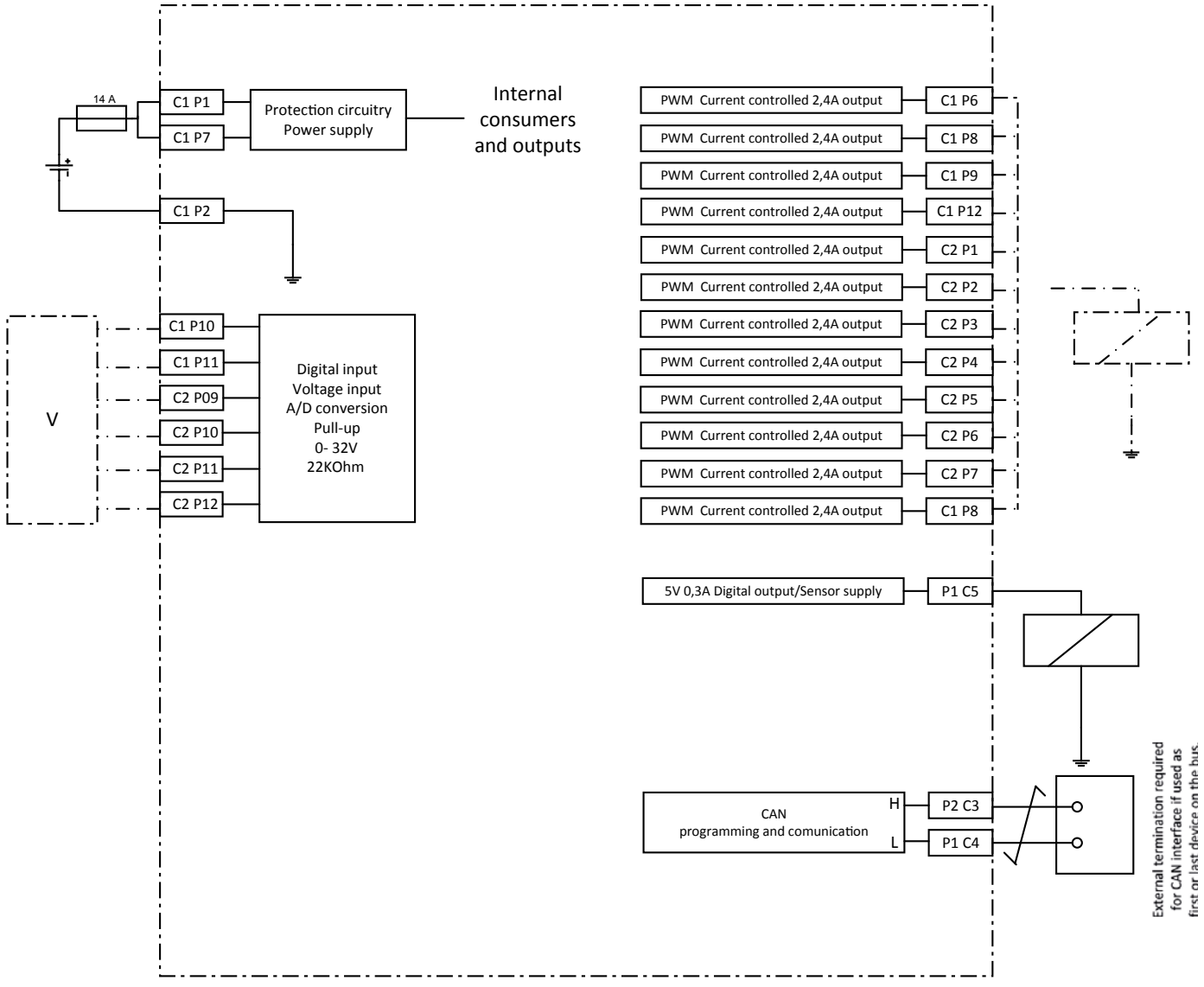
CHC12-1/20 controller		
Multicore processor with lockstep functionality		ARM Cotex M4
Clock frequency (processor clock)		142 MHz
Internal memory capacity in micro controller		
	SRAM	128 KB
	EEProm	8 KB
	PFlash	512 KB
Supply voltage		
Nominal battery voltage		12 V and 24 V
Supply voltage ranges		
	No function: µC is reset, outputs are off	< 5.5 V
	Very low voltage mode: only CAN communication is ensured At low temperatures, 7 V are required to start the controller.	5.5 V .. 8 V
	Normal operation: Controller is fully operational	8 V .. 32 V
	Extended voltage supply range: the controller is partially operational	32 V .. 36 V
	Absolute maximum rating: Controller is not operational, risk of damage at higher voltage	36 V
Current consumption		
Without load in a 12 V battery supply voltage		< 100 mA
Without load in a 24 V battery supply voltage		< 85 mA
Fuses		
Internal		none
An external fuse in the supply path (common supply line for internal electronics and high-side outputs) is mandatory		15 A
Constant voltage sources, total count		
5 V	300 mA	**1**
Inputs, total count		**6**
Digital voltage, analog voltage 0 V .. 5 V, 0 V .. 32 V		6
Power outputs, total count		**12**
High-side (battery-switching) in total		12
	Current-controlled 2.4 A power outputs, with current measurement	12
Communication interfaces, total count		**1**
	CAN 2.0 B	1
Fault detection in the event of cable break and short circuit		
	Inputs (depending on sensor type and input configuration the failure mode can be ambiguous)	•
	Outputs	•
	CAN	•
Protection against short circuits to supply voltage and ground (Requirement: controller is powered and running)		
	Inputs	•
	Outputs	•
	CAN	•
Reverse polarity protection		•
Software installation		
	Download in PFlash	•
CE Mark		
	Compliance with EMC Directive 2014/30/EU. The harmonized standards EN ISO 13766-1:2018, EN 133309:2010 and EN ISO 14982:2009 have been applied.	•
	Compliance with RoHS2 directive 2011/65/EU on the restriction of the use of certain hazardous substances.	•
Operating temperature		
	Housing temperature, housing mounted on cooling surface	–40 to +80 °C (–40 to +176 °F)
	Max. permissible temperature of cooling surface	+60 °C (+140 °F)
Type of protection according to ISO 20563		IP67 / IP69K
Weight		185 g, ± 5 %

Pin configuration

PIN	Functions
C1-P1	Power supply +
C1-P2	Power supply -
C1-P3	CAN High
C1-P4	CAN Low
C1-P5	OUT DIG (5V/Power supply 0,3A)
C1-P6	OUT PWM #1 2,4A
C1-P7	Power supply +
C1-P8	OUT PWM #2 2,4A
C1-P9	OUT PWM #3 2,4A
C1-P10	IN 0-32V
C1-P11	IN 0-32V
C1-P12	OUT PWM #4 2,4A

PIN	Functions
C2-P1	OUT PWM #5 2,4A
C2-P2	OUT PWM #6 2,4A
C2-P3	OUT PWM #7 2,4A
C2-P4	OUT PWM #8 2,4A
C2-P5	OUT PWM #9 2,4A
C2-P6	OUT PWM #10 2,4A
C2-P7	OUT PWM #11 2,4A
C2-P8	OUT PWM #12 2,4A
C2-P9	IN #3 0-32V
C2-P10	IN #4 0-32V
C2-P11	IN #5 0-32V
C2-P12	IN #6 0-32V

Connection diagram



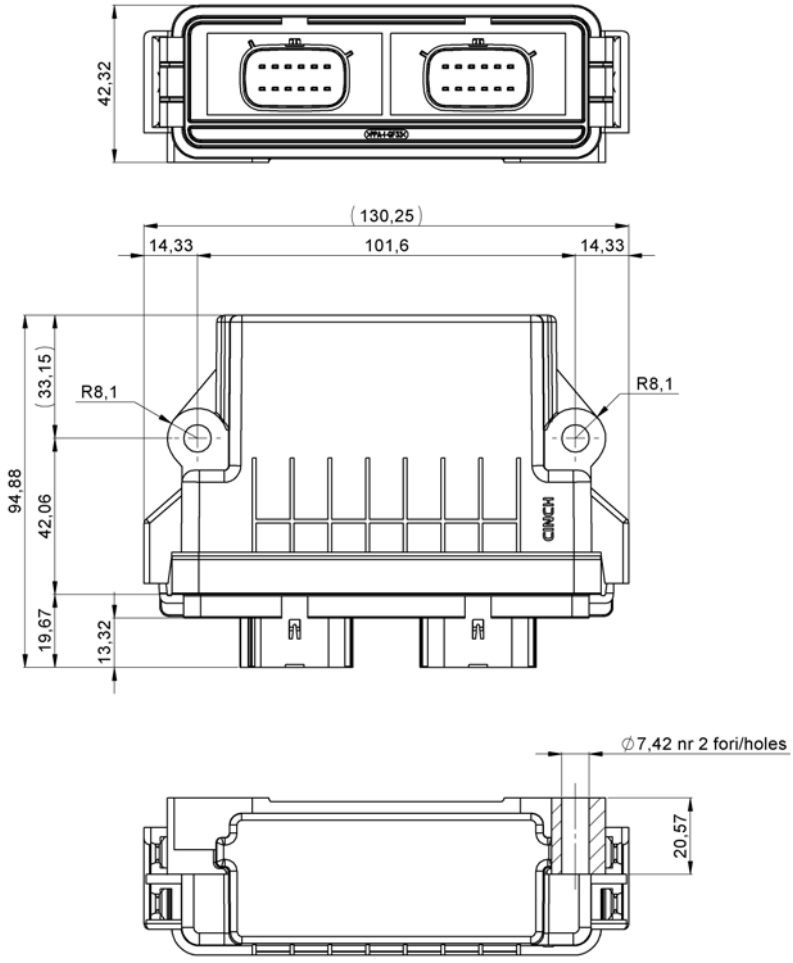
Overview of functions

Pin	Description	Main function	Software modes	Comments
C1-P17	**Power supply**	**Power supply for internal electronics and high-side output stages** Nominal supply voltage: 12 V or 24 V Normal operation: 11 V .. 32 V For other voltage ranges see technical data above These pins must not be used as current output, e.g. for supply of other devices.		A fuse in the supply line with max. 15 A is required. All two pins shall be used for an even current distribution.
C1-P2	**Power Ground**	**Ground for power supply** Internally connected to signal ground pins		
C1-P5	**Sensor Supply**	**Sensor supply** Ratiometric to ADC reference voltage Max. output current 300 mA Output voltage 5 V Output voltage tolerance ± 150 mV State after start-up active Admissible capacitive load ≤ 100 µF		
C1-P10, C1-P11, C2-P09, C2-P10, C2-P11, C2-P12	**Analog inputs** (discrete)	**Analog voltage inputs** Measuring range V..32V Accuracy at 32 V Input impedance 32V range 22 kOhm Resolution 12 bits (oversample 16 bit) Pull-Up resistor 14.7 kΩ	AIV	
C1-P6, C1-P8, C1-P9, C1-P12, C2-P1, C2-P2, C2-P3, C2-P4, C2-P5, C2-P6, C2-P7, C2-P8	**PWM**	**PWM signal output** PWM frequency up to 500 Hz Duty cycle 0.0 % .. 100.0 % Supply voltage Battery voltage Accuracy ± 2 % at 32 V Serial resistor (output current limiter) 3.5 kΩ	AOV	
C1-P3 C1-P4	**CAN High** **CAN Low**	**CAN bus interface** High speed CAN 2.0 b interface 250 Kbaud Standard CAN interface for flashing and diagnosis		When used as the first or last node of the CAN bus, a termination resistor with 120 Ω has to be applied.

PIN sizes
Contact type BDK 2.8

Software modes	
DI	Digital input (state)
AIV	Analog input voltage in mV
DO	Digital Output (on/off)
PO	Proportional output (duty cycle in 0.1 %)
POC	Proportional output current controlled (set current in mA)

Dimensions



Display without scale

Fixing:

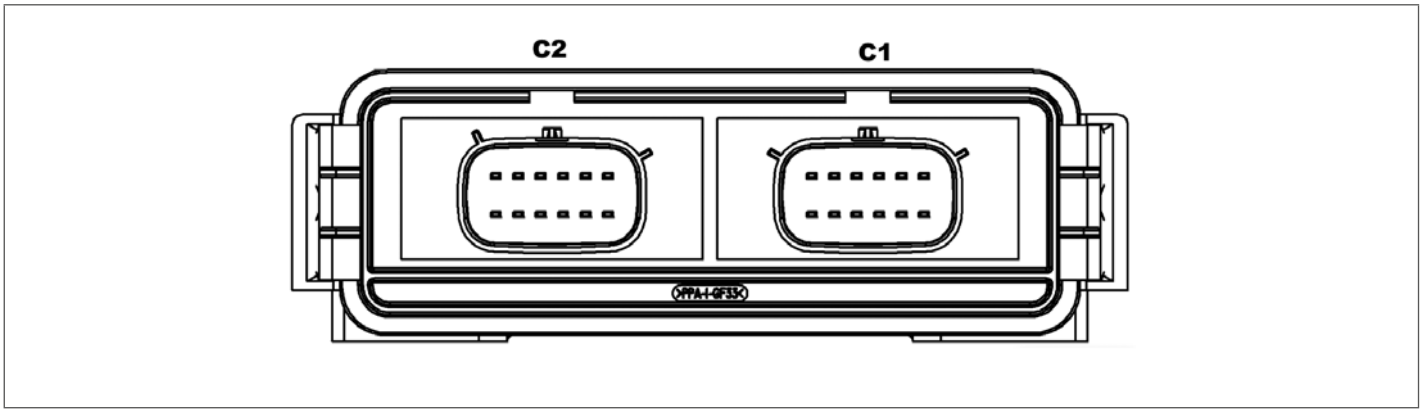
- The CHC controller has to be fastened in the vehicle so as to avoid bouncing against other vehicle parts and additional fastening elements of the controller.
- The maximum tightening torque for fastening the CHC controller with M6 screws is 10 Nm.
- This tightening torque applies for fitting without washer. The equivalent tightening torque must be calculated when using washers.
- Rexroth's consent is required if fixing is different from above.
- The minimum gap between the bottom and the screw on surface of the vehicle is 1 mm.
- The wiring harness should be fixated in the area in which the control unit is installed (spacing < 150 mm) in such a way that in-phase excitation with the control unit occurs (e.g. at the control unit tightening point).
- The wiring harness should be fixed such that the assembly has sufficient room to exit the controller without putting too much force on the mating connector.
- If the mounting surface is not sufficiently even, place flexible compensating elements between the fixing points of the CHC controller and the mounting surface

Mating connector

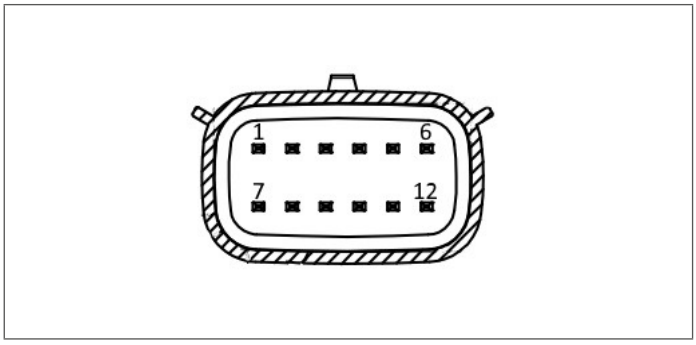
The 24-ways plug connector is divided in two connectors.
Technical details about these documents and part numbers are available at www.bosch-connectors.com.
The connectors are “Molex” MX 150 12 pins.
Chamber C1 has key A
Chamber C2 has key B .
Visit www.molex.com for information on these items.

Assembly instruction	1 928 A01 09M
Technical customer documentation	1 928 A01 00T
Offer drawing (assembly)	1 928 A00 325
Offer drawing (carrier)	1 928 A00 326
Final check instruction	1 928 A00 05E

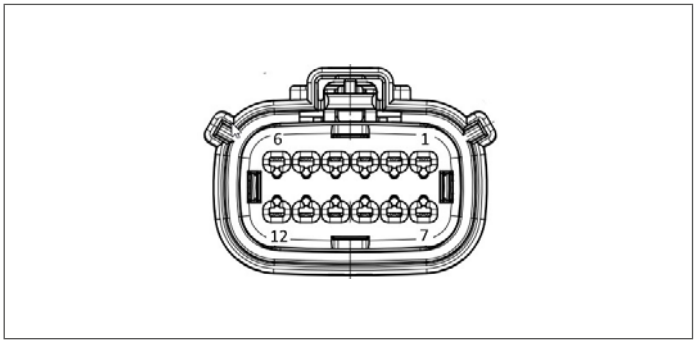
View of connector strip



Case side



Connector side



Connector MOLEX MX150 12 pins
Connector C1: p.n. 0334721206
Connector C2: p. n. 0334721207
Female Terminal p.n. 33012, 33001

Safety instructions

General instructions

- Reliable operation cannot be guaranteed if samples or prototypes are used in series production machines.
- The possible circuits for the system do not imply any technical liability for Bosch Rexroth.
- Incorrect connections could cause unexpected signals at the outputs of the controller.
- Incorrect programming or parameter settings on the controller may create potential hazards while the machine is in operation. It is the responsibility of the machine manufacturer to identify hazards of this type in a hazard analysis and to bring them to the attention of the end user. Rexroth is not liable for any hazards of this kind.
- The component firmware/software must be installed and removed by Bosch Rexroth or the responsible authorized partner in order to ensure that the warranty does not expire.
- It is not permissible to open the controller or to modify or repair the controller. Modification or repairs to the wiring could result in dangerous malfunctions.
  Repairs to the control unit may only be performed by Bosch Rexroth or by an authorized partner.
- The stop switch (two-channel deactivation) can be used for deactivation in emergency situations.
  The switch must be installed in an easily accessible position for the operator. The system must be designed in such a way that safe braking is ensured when the outputs are switched off.
- Make sure that the controller’s configuration does not lead to safety-critical malfunctions of the complete system in the event of failure or malfunction. This type of system behavior may lead to danger to life and/or cause much damage to property.
- System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- Whilst commissioning and maintenance of the controller, the machine may pose unforeseen hazards. Therefore the vehicle and the hydraulic system have to be in a safe condition during such operations.
- Therefore, make sure that nobody is in the machine's danger zone.
- Do not use defective components or components which are configured incorrectly. Failed or incorrectly operating components must be repaired immediately.
- Control units used to develop software must not be installed in series production machines as the number of flash cycles is limited and may have been reached or exceeded.

Information on installation location and position

- Do not install the control unit near parts which generate considerable heat (e.g. exhaust).
- Radio equipment and mobile telephones must not be used in the driver's cab without a suitable antenna or near the control electronics.
- A sufficiently large distance to radio transmission systems must be maintained.
- All connectors must be unplugged from the electronics during electrical welding and painting operations.
- Cables/wires must be sealed individually to prevent water from entering the device.
- The control unit must not be electrostatically charged, e.g. during painting.
- The controller will heat up beyond normal ambient temperature during operation. To avoid danger caused by high temperatures, it should be protected against contact.
- Install the control unit in such a way that the electrical plug is not facing upwards. This ensures that any condensation water that may form can flow out.
- Standing and permanently running water are not permitted anywhere near the circumferential groove (lid/base connector) or the pressure compensation element (PCE).
- The control unit must be fastened with metal screws in order to establish a good thermal connection between the housing and the cooling surface (heat sink).

Notices on transport and storage

- If it is dropped, the controller must not be used any longer as invisible damage could have a negative impact on reliability.
- Store control units at an average relative humidity of 60% and at a temperature between -10°C and +30°C. Momentary, a storage temperature of -20 °C to +40 °C is permissible for up to 100 hours.
- After a storage time of more than 5 years, the controller must be examined by the manufacturer.

Notes on wiring and circuitry

- Connections to systems with a different electrical ground or power source require galvanic isolation.
- Lines to the speed sensors are to be shielded and kept as short as possible and be shielded. The shielding must be connected to the electronics or to the machine or vehicle ground via a low-resistance connection (one side only).
- Twisted-pair wires have to be used for CAN, ISOBUS and 100Base-T1.
- The product may only be wired when it is de-energized.
- Lines to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- The wiring harness should be fixated mechanically in the area in which the controller is installed (spacing < 150 mm). The wiring harness should be fixated so that in-phase excitation with the controller occurs (e.g. at the controller bolting point).
- If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.
- Lines are to be routed with sufficient spacing to hot or moving vehicle parts.
- PWM outputs must not be connected to one another or bridged.
- The outputs must not be used to operate incandescent lamps due to the inrush current properties of these loads. Exceptions are permitted for signal lamps with low power if it is ensured that the inrush current does not exceed the limit values of this data sheet.
- The sensor supplies can be „pulled up” by an external connection, e.g. the application of a higher voltage, because they operate only as a voltage source but not as a voltage sink. Pulling up a sensor supply may result in unexpected malfunctions and damage of the controller in lasting operation.
- Restrictions apply for the operation of LEDs with internal electronics at the outputs. The in-rush current must be below diagnosis thresholds.
- If LEDs are operated at power outputs, the diagnostic current may cause the LEDs to flash.
- The "high-side" outputs may not be externally connected to battery.
- Loads connected to low side outputs (both power and low power) must be powered from a high side output and not directly from battery.

Note on proportional and switching solenoids and other wired inductive consumers

- Proportional solenoids used in current-controlled mode must not be wired with spark-suppression diodes.
- Switching solenoids at the outputs of the control unit do not need to be connected to free-wheeling diodes.
- The electronics may only be tested with the proportional solenoids connected.
- Other inductive loads that are in the system but not connected to the controller must be connected to free-wheeling diodes. This applies to relays (e.g. for de-energizing the controller) that have the same supply as the controller, too.

Intended use

- The controller is designed for the use in mobile working machines to drive electro-hydraulic valves.
- Operation of the control unit must generally occur within the operating ranges specified and released in this data sheet. This applies in particular to voltage, current, temperature, vibration, shock and other described environmental influences.
- Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- Any use of the controller other than that described in chapter "Intended use" is considered to be improper.
- Use in explosive areas is not permissible.
- Damage resulting from improper use and/or from unauthorized interference in the component not described in this data sheet render all warranty and liability claims void with respect to the manufacturer.
- Use of the CHC as the main controlling device, in an autonomous system, is not allowed.

Use in safety-related functions

- The customer is responsible for performing a risk analysis of the mobile working machine and for determining the possible safety-related functions.
- In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.)
- For example, a suitable assignment of input variables (e.g. by connecting the acceleration pedal signal to two independent analog inputs) can be used by the application software to detect faults and to activate specially programmed reactions.
- Special measures may be initiated if the plausibility check shows deviations between the set-point values and the values read back by the micro controller.
- Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

Safety features in the CHC controller

- Independent circuitry is provided for certain groups of inputs (e.g. two input devices with separate A/D converters). Through appropriate input connections, the micro controller and, when used, the software diagnostic function can detect faults.
- Faults in the supply voltage are detected by internal monitoring.
- All output signals can be monitored by the micro controller with the appropriate software.
- The controllers can be operated with all power outputs de-energized for service purposes.
- A watchdog module is provided to detect malfunctions in the program run. The power outputs are shut off in such a case.

Disposal

- The CHC controller and its packaging must be disposed of according to the national environmental regulations of the country in which the controller is used.

Further information

- In addition, the application-specific documents (connection diagrams, software descriptions, etc.) are to be observed.
- More detailed information on CHC controllers may be found at www.boschrexroth.com/mobile-electronics

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