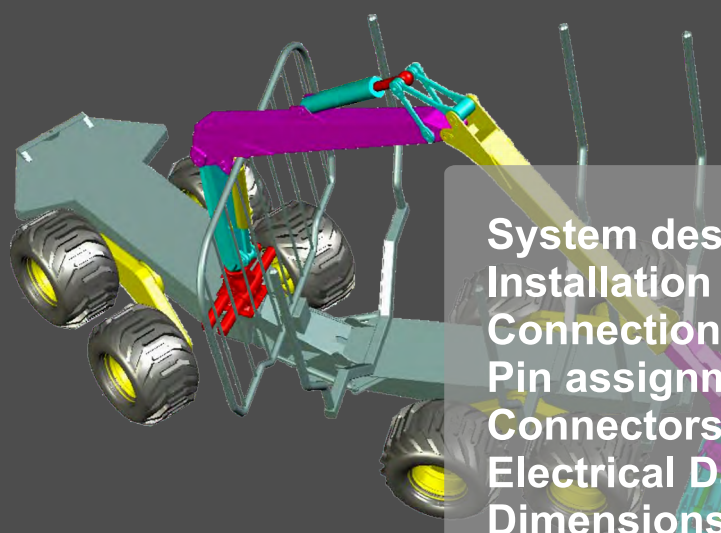
HYDRATRONICS

CANmaster®



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- Installation guidelines
- Connection diagrams
- Pin assignments
- Connectors & Cables
- Electrical Data
- Dimensions & Mounting
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Technical Data & Installation

User Manual

hydratronics

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Hydratronics CANmaster® Technical Data & Installation - User Manual

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About this manual

General information

This manual is designed to be a comprehensive reference tool for vehicle OEM design and engineering personnel. The manual provides technical data, general specifications, I/O configuration, environmental ratings, connection diagrams and installation details for the electronic control units in the CANmaster system. It is one of two primary sources of CANmaster product technical information. The other source is the CANmaster PC-Tool User Manual.

CANmaster Control- and Test units. Part Numbers.

This manual includes detailed descriptions and connection diagrams for CANmaster components listed in the table below:

Component	Part No.	Comment
MASTER-unit	5010 3000	
CRANE-unit	5010 3500	
EXPANSION-unit	5010 4000	
TERMINAL T2	5010 1000	
JOYSTICK H5-S50	5010 2500	
TEST unit - MASTER	5010 3050	*1)
TEST unit - CRANE	5010 3550	
TEST unit - EXPANSION	5010 4050	
TEST unit - JOYSTICK	5010 2550	
TEST unit -TERMINAL	5010 4550	

*1) Prepared connection cables for the test units, see Chapter 10, page 78.

Chapter 1

Safety & OEM responsibility

The OEM of the machine or vehicle in which CANmaster control system components are installed has the full responsibility for all consequences that might occur. Hydratronics AB has no responsibility of any consequences, direct or indirect, caused by failures or malfunctions. Hydratronics AB has no responsibility for any accidents caused by incorrectly mounted or maintained equipment and does not assume any responsibility for CANmaster components being incorrectly applied or the system being programmed in a manner that jeopardizes safety.

Basic safety requirements for the electric system design

Installation instructions in this manual appearing together with the safety/alert symbol must be followed. These instructions are of vital importance for the system´s basic functionality, reliability as well as product safety.

An emergency stop switch must be installed in the supply voltage to the control system, placed in a position that is easily accessed from the ordinary operator's station. When activated, the switch must cut the voltage to all control system components with a persistent mechanical circuit breaker function.

A chair or door activated switch must be installed to block all the machine's electronically controlled functions if the operator should leave the ordinary operator's station.

Recommended warning signs on the machine

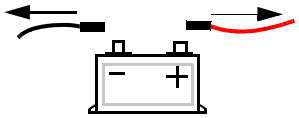
Following warning signs, intended as information for the operators and service personnel is recommended to be fastened to the machine and to be printed in the service manuals:

In the event of system errors, the electronics in the machine system can cause unforeseeable manoeuvres in controlled machine components. Ensure that no unauthorised persons are in the vicinity of the machine's work area when the diesel engine is running.

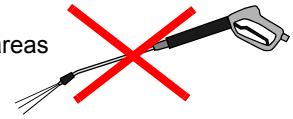
The machine may only be controlled from the ordinary operator's station.

The control system power supply must be cut completely during all work with the machine system cables, during welding work on the machine chassis, and when fast-charging the batteries that power the machine's electronic control system. Disconnect both the positive and negative cables from the batteries.

Disconnect both terminals!



Do not use high pressure cleaning in areas close to the electronic installations.



General system description

Hydratronics CANmaster® is a CAN-bus based electronic control system designed to control and monitor complete transmissions and working hydraulic systems in mobile machinery.

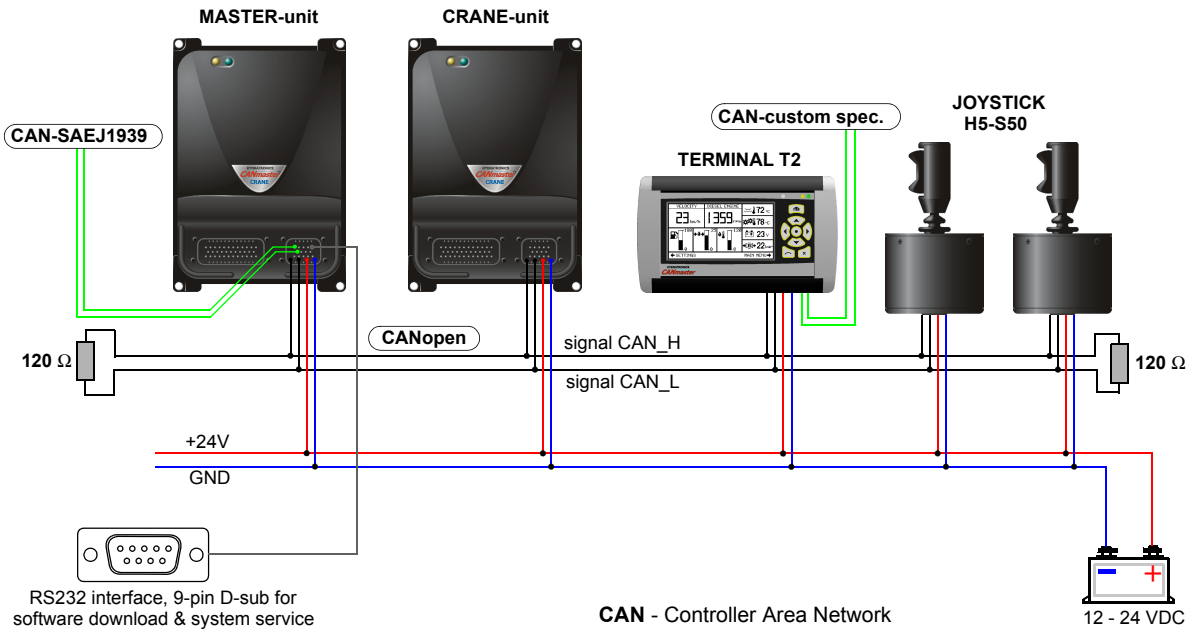
The system is comprised of separate electronic units with a Master unit as the overall control unit in the system. Communication between the electronic units takes place via the CAN-bus/CANopen protocol standard. Communication with external systems is via CAN-bus in accordance with SAE J1939 protocol standard. Two extra CAN ports are available in the system which can be used for special applications with demands on CAN-bus communication with customer-specified CAN protocols.

The minimum CANmaster system comprises a MASTER unit and a TERMINAL T2. The system is complemented according to I/O needs with the EXPANSION, CRANE, and JOYSTICK H5-S50 units.

System setup

The general system setup for a CANmaster control system comprising a MASTER-unit, a CRANE-unit, a TERMINAL T2, and two JOYSTICKS, type H5-S50 is shown in the diagram below:

Hydratronics CANmaster® control system with CAN-bus data communication



CAN-bus data commmunication

CAN-bus is a communication bus where data information is transferred serially between separate control units. The bus is comprised of two wires, designated CAN_L and CAN_H. All electronic units in the system are connected in parallel to the CAN-bus, with the outer ends of the wires connected to two 120 Ω terminating resistors. Connecting the electronic units to the data bus in parallel makes for a simple wiring and the communication possibilities between the units does not depend on unit placement in the network.

In the CANmaster control system, the Master unit comprises the central system unit. The Master unit's basic program contains data about which units are included in the system and which addresses they have. The controlled machine's application program and the program's configuration parameters are also stored in the Master unit and this unit controls and monitors all other units in the system.

Each electronic control unit contains a microprocessor with a built-in CAN-controller, which sends and receives data via the CAN-bus and each unit have a unique network address. The information sent out on the CAN-bus can be "monitored" by all electronic units in the system but each individual unit only processes data with that particular unit's address and the special data sent out as general 'broadcast messages' from the Master unit to all system units.

The CANmaster control system uses a derivative of the CANopen protocol standard between the control units with a connection speed of 500 kbps. The Master unit also has a separate CAN port for integrated control and monitoring of external systems, such as electronically controlled diesel engines and gearboxes that use CAN-bus in accordance to SAE J1939 protocol standard. Two extra CAN ports are available through the Expansion unit and the Terminal T2, which can be used for special applications with demands on CAN-bus communication with customer-specified CAN protocols.

Control units

Master

The Master unit comprises the central control unit in a CANmaster system. The Master unit contains the control system's basic program, the controlled machine's application program, and the program's configuration parameters. The communication between the Master unit and other CANmaster units takes place via the CANopen protocol standard.

A separate CAN port is included with CAN-bus communication according to SAE J1939 protocol for integrated control of electronically controlled diesel engines and gearboxes.

The Master unit contains 4 double-acting PWM outputs for controlling 8 proportional solenoid valves with a current capacity of 0-1600 mA and 23 I/Os for analogue and digital signals, of which 4 are frequency inputs for measuring rpm. Thirteen I/Os are user-configurable as alternative input or output. The configuration is determined during the initial programming process when setting up the I/O table for the unit using the CANmaster PC-Tool software. This increases flexibilty and the possibilty to use the same control unit for different type of machine applications.

The RS232 communication port on the Master unit is used as the main communication port between the control system and the system service-computer. A permanent RS232 9-pin D-sub female connector should be mounted in the machine for this purpose.

The Master unit contains a central error log where all errors that occur in the entire system are saved; errors programmed as error levels in the application program, errors in the basic software and errors in the electronic hardware for each connected control unit. Unit address, error type, time stamp and date are registered for simple and effective service follow-ups. In order to view all datas in the error log, a service computer with installed CANmaster PC-TOOL software must be connected to the RS232 port on the Master unit. A summary of the error log, but with less information can also be viewed on the Terminal.

A CANmaster system must always contain one MASTER unit and the minimum system includes the Master unit and a Terminal.

Crane

The CRANE unit is specially adapted to the control of complex groups of working hydraulics systems, such as the complete valve system for a crane, hoisting crane or excavator arm, and contains 8 double-acting PWM outputs for controlling 16 proportional solenoid valves with a current capacity of 0-1600 mA. The unit also contains five analogue inputs that can be used, for example, in the measurement of load weights, positions, and angles when the application program includes weight measurement, overload protection, or similar functions.

The CRANE unit can be placed in the vicinity of the valve systems irrespective of the environment, which keeps cable lengths for the power outputs between the control unit and the valves to a minimum.

A CANmaster system can be configured with 0 - max. 4 CRANE units.

Expansion

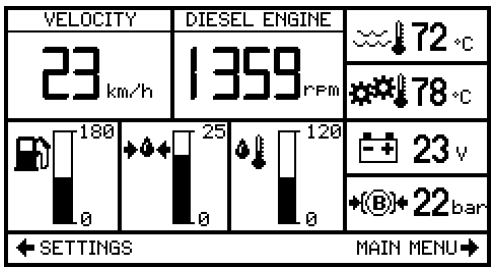
The EXPANSION unit is mainly used to supplement the system with additional analogue inputs, digital inputs, and digital outputs. The expansion unit also includes an output for the control of a servomotor.

The expansion unit, like the Master unit, has 4 double-acting PWM outputs for controlling 8 proportional solenoid valves with a current capacity of 0-1600 mA. A number of the analogue inputs and digital outputs can be configured as alternative inputs or outputs in the same way as for the Master-unit. The expansion unit also contains a separate CAN-port that can be used if there is a need for integrated control of external systems with customer-specified CAN protocols.

A CANmaster system can be configured with 0 - max. 4 EXPANSION units.

Terminal T2

The TERMINAL T2 is included in a CANmaster system as an important component in communication between the user and the control system. The terminal is used in daily work to display the machine's operating data, to select an operating mode, and to display error messages and operational warnings. Error messages appear as separate "pop-ups" on the screen.



Terminal T2 display showing main operating data for the diesel engine and transmission.

The terminal is equipped with a white-LED backlit 240 x 128 pixel LCD display with adjustable brightness and contrast. A photocell on the front panel of the terminal provides automatic brightness adjustment according to ambient lighting. Terminal functions are accessed via a standard menu structure wherein navigation between menus and changes to parameters are made using backlit membrane pushbuttons. Instructions for the different menus are shown on the display.

The terminal can also be used as an advanced service tool for adjusting parameters, calibrating sensors, troubleshooting inputs and outputs, and retrieving the central system error log from the Master unit. It is

possible to show signal values for all inputs and outputs in the entire control system and to log selected signals with a graphic display when a separate service computer is not available.

All terminal functions, the basic menu structure and screen visuals, including function symbols, can be customized to suit the machine application and user with the aid of the Terminal Design program, which is included as a part of the CANmaster PC TOOL software package.

Terminal T2, like the Expansion unit, contains a separate CAN-port that can be used if there is a need for integrated control of external systems with customer-specified CAN protocols. The terminal is also fitted with 3 digital I/Os that can be configured as alternative digital inputs or digital outputs for the connection of indicator lamps or on/off switches.

A CANmaster system can only contain one Terminal T2.

Joystick H5-S50

The JOYSTICK H5-S50 unit is included as a main component in the CANmaster control system. This control functions as a combined standard triple-axis joystick and an advanced I/O unit in the system. All signals from the joystick are transferred via CAN-bus data communication to the system's MASTER unit.

In addition to the three built-in analogue joystick axes X/Y/Z, with 10-bit resolution, 10 digital inputs and 2 analogue inputs are also available for the connection of external on/off switches, potentiometers, and linear levers. Two of the digital inputs are also equipped with multiple-function capability and can be used as alternative low power digital outputs or low power PWM outputs for such things as indicator lamps or analogue display instruments. The power supply for the external inputs is available through the joystick connector, with two separate +5V outputs, one for analog input devices and one for digital input devices.

The ability to connect a large number of control switches and separate potentiometers to the joystick for direct transfer to the system's MASTER unit via the CAN-bus enables the cabling around the operator's seat to be kept to a minimum compared to conventional technics where each control must be connected separately to the control system's central control unit.

A CANmaster system can be configured with 0 - max. 4 JOYSTICK H5-S50 units.

Power supply

Each control unit in the CANmaster control system is powered separately. The units are designed to operate with a 12 or 24 VDC power supply voltage within the range 11- 30 VDC. See Chapter 7 for maximum required current for each control unit.

Installation guidelines

Basic requirements

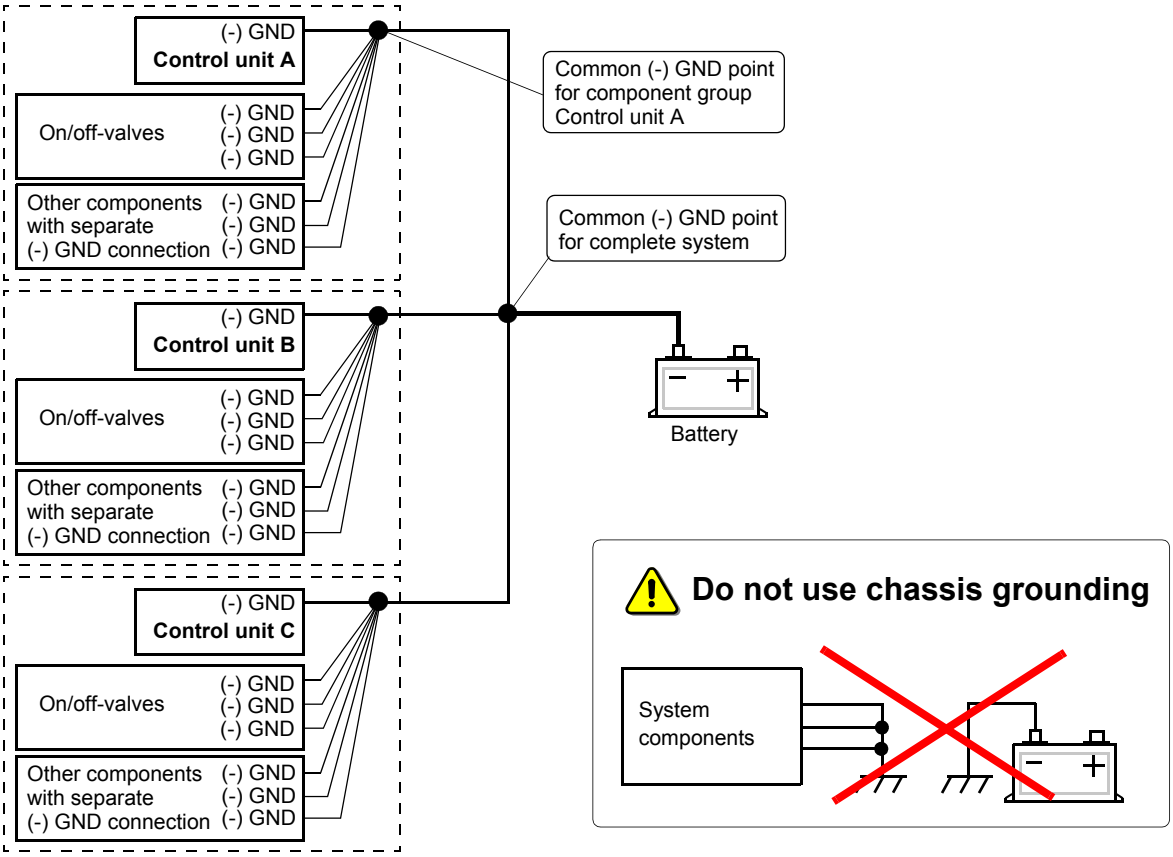
Chair or Door safety switch

A chair or door activated switch must be installed to block all the machine's electronically controlled functions if the operator should leave the ordinary operator's station.

Emergency stop

An emergency stop switch must be installed in the supply voltage to the control system, placed in a position that is easily accessed from the ordinary operator's station. When activated, the switch must cut the voltage to all control system components with a persistent mechanical circuit breaker function.

Grounding principles



Enclosure class & Mounting position

The MASTER, EXPANSION and CRANE units use the same robust die-cast aluminium housing with O-ring sealed cover and heavy duty AMPSEAL® connectors. The units can be placed freely on the machine, but must be protected from direct soaking with water, mechanical knocks, impact and powerful high-frequency vibrations. In order for air to be exchanged between the enclosure and the surroundings without water or impurities intruding, a GORE-TEX® membrane is mounted in the bottom cover and this must not be blocked. The enclosure has an enclosure class equivalent to IP65 and is dust and waterproof.

The TERMINAL's enclosure is made from robust aluminium with moulded end-pieces of ABS/PC plastic. The display is protected by a plexiglass cover and protective film. The terminal shall be placed in a protected place by the ordinary operating position and must not be directly exposed to water. Enclosure class IP40.

The enclosure for the JOYSTICK H5-S50 unit is made from a robust, deep drawn, aluminium enclosure with rubber bellows seals. It is protected against direct intrusion from water and dirt in its standard mounting position with the connector facing down. The joystick shall be placed in a protected location in the machine's operator's cab. Enclosure class IP52.

Wiring guidelines

- Use 85º C wire with abrasion resistant insulation. 105º C wire should be considered near hot surfaces.
- The cables for data communication CAN_L and CAN_H must be twisted-pair in order to reduce the risk of electromagnetic interference from external systems. For cables longer than 5 m, the use of shielded twisted-pair cable is recommended. See section 'Connectors & Cables' in this manual.
- Ensure that the stripping of wires and crimping of contacts is carried out in accordance with the instructions provided by the connector manufacturer. Never attach more than one wire to each connector pin.
- Run all cables for the control units separately from other cables on the machine that can generate electromagnetic interference, such as communication equipment, antenna cables, alternators etc. Avoid long stretches of loose cable and if possible run the cables in interference suppressing steel tubing, beams etc. that have good contact with the machine chassis.
- Ensure that the cables for the electronic units are installed so that water cannot run along the cables and into the connectors.
- Ensure that the machine's basic power supply source (battery/alternator and main supply wires) have enough capacity to supply the correct voltage-level for the control units in the worst case. Measure the voltage supply at low ambient temperatures with all electric powered equipment turned on, all working lights, aircondtioning, fans etc. including all optional electric powered equipment. Run the machine in normal operation and test all functions with all the extra loads activated.
- All electronic units in the CANmaster control system fulfil EMC requirements in accordance with the applicable standard for individual components in mobile machinery (95/54/EC-automotive standards). Be sure to follow the applicable general instructions for the design of the machine's electrical system and cabling so that the machine as a whole can be EMC-approved in accordance with the EU directives for the appropriate machine class. Correct groundings for the main electrical system and for the electronic control system is of vital importance for both the EMC-approval as well as the basic function of the control system.

Chapter 4

Connection diagrams

General

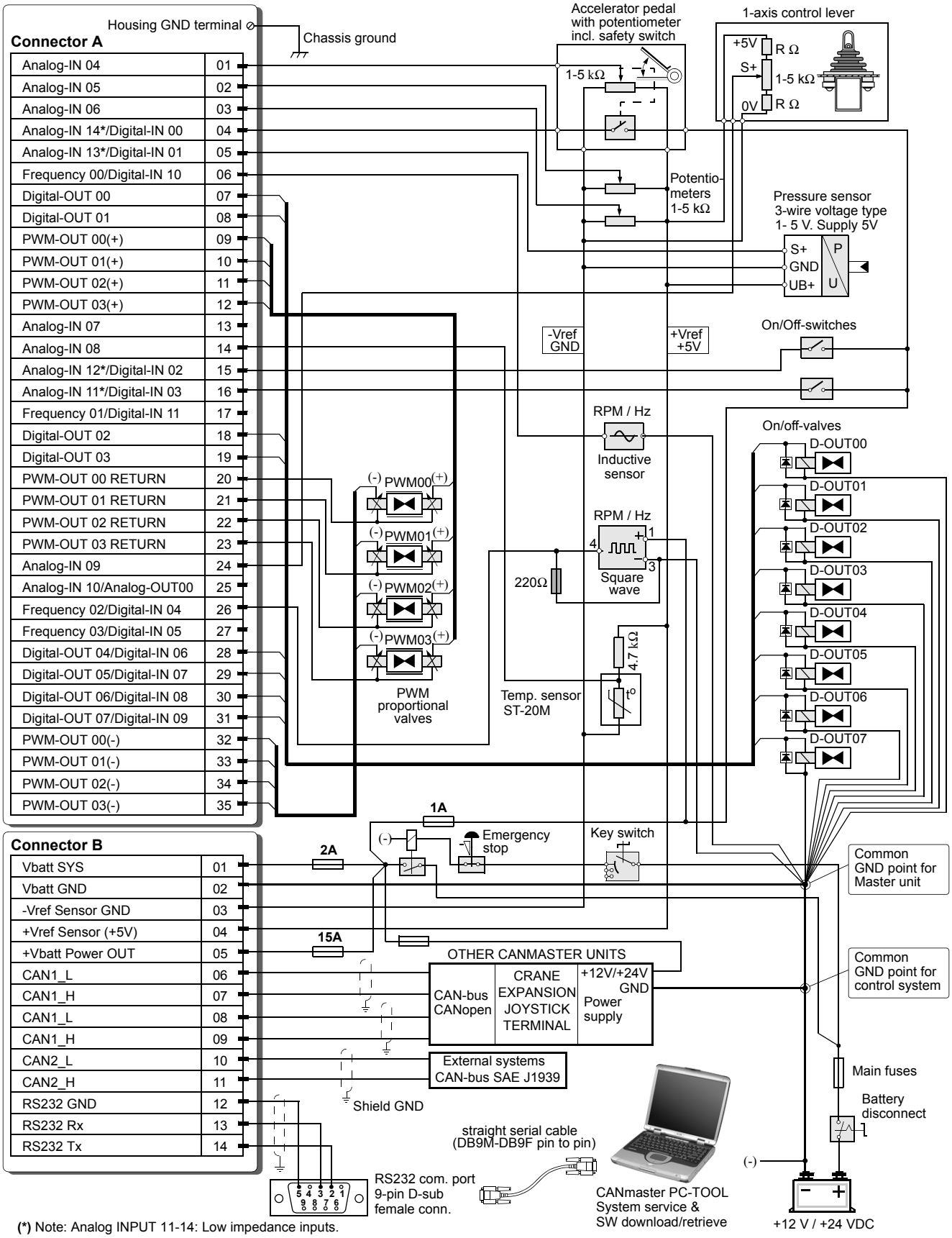
The wiring diagrams included in this chapter give examples of how sensors, potentiometers and control levers are to be connected to the control units and how the power supply for each unit should be arranged.

All control units must have a separately fused power supply and the (-) connection from each control unit group of components must be connected to a (-) point that is common for the entire system. CANmaster control units may not be grounded to the chassis. See also Chapter 3, section "Grounding principles" on page 9.

Note that the Master unit and the Expansion unit each have two separate power supply connections. One of the connections only supplies the control unit's internal electronics while the other supplies the power outputs. These components are separated in the control unit and they must be provided with separate fuses so that the power supply to the control unit's electronic components does not cut out if a power output becomes short-circuited and the external fusing cuts the power supply.

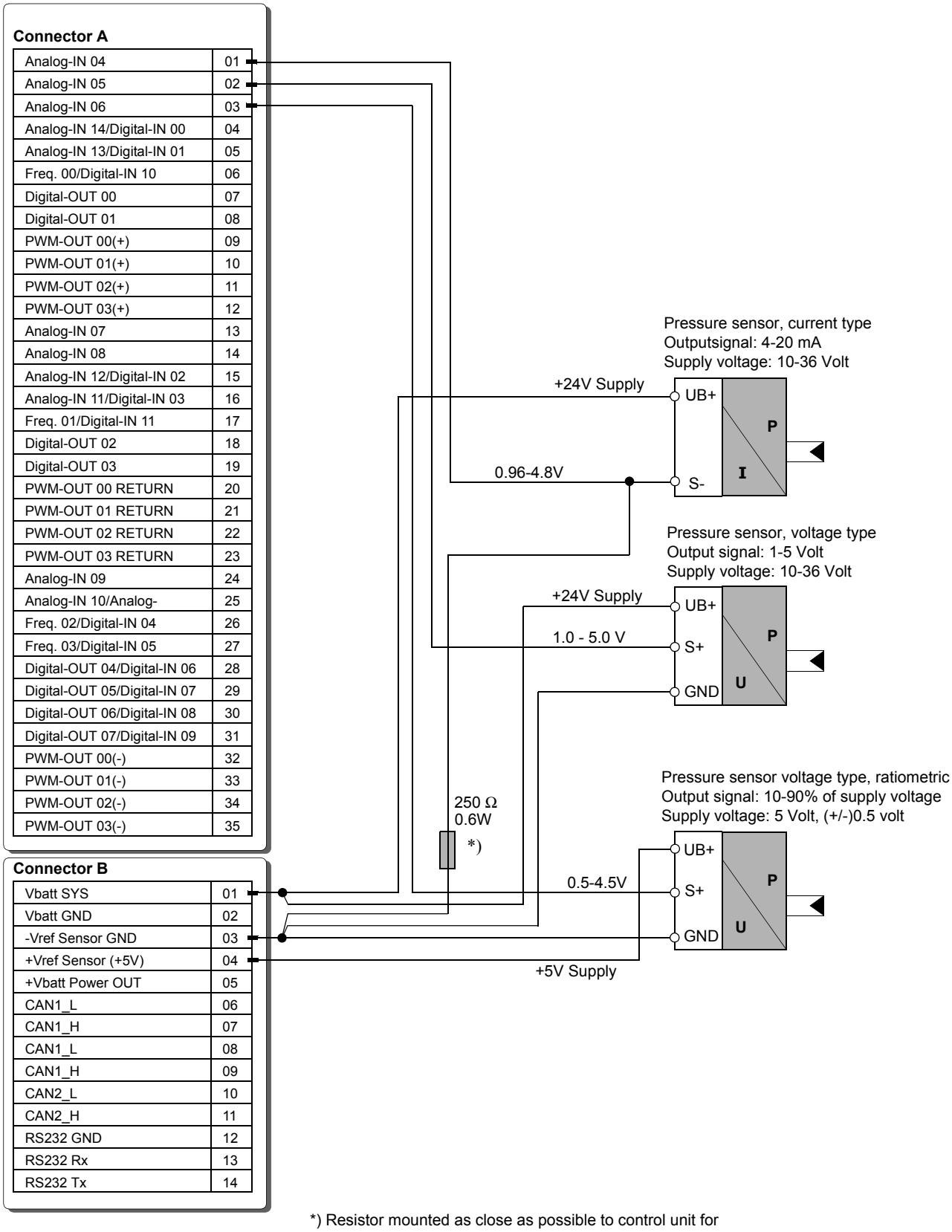
Connection examples are given for each control unit and for how the addressing is done when using several control units of the same type. At the end of this chapter is an illustration of how the CAN-bus/CANopen is connected depending on the types of control units. There is also an example showing the addressing of a complete system with different types of control units, and how the connection is to be made between a service computer and the RS232 communication port on the Master unit.

MASTER unit



(*) Note: Analog INPUT 11-14: Low impedance inputs.

MASTER unit - Pressure sensors with voltage or current output



*) Resistor mounted as close as possible to control unit for minimum electrical disturbance.

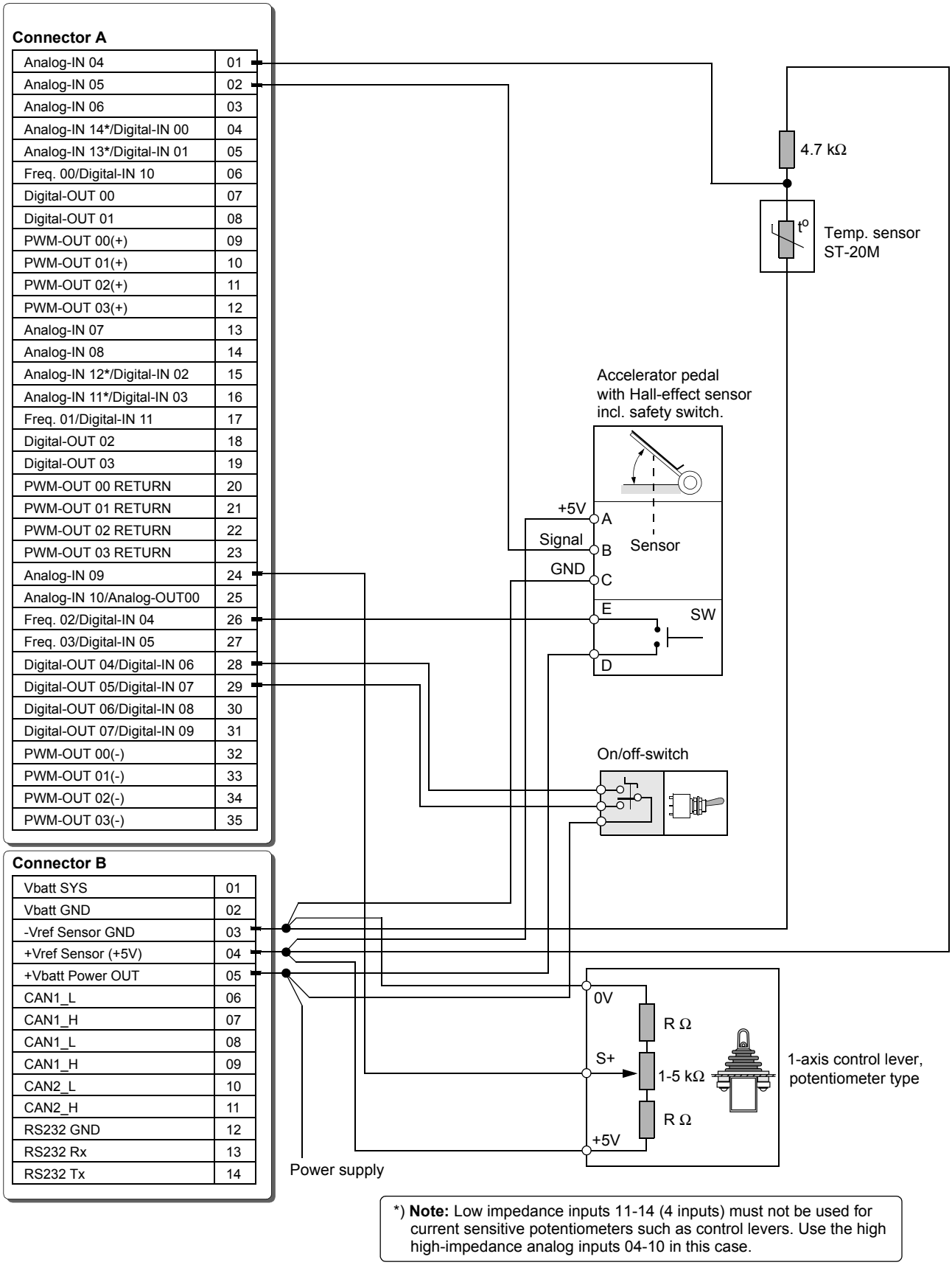
MASTER unit - Accelerator pedal, potentiometers & temperature sensor

Connector A

Analog-IN 04	01
Analog-IN 05	02
Analog-IN 06	03
Analog-IN 14*/Digital-IN 00	04
Analog-IN 13*/Digital-IN 01	05
Freq. 00/Digital-IN 10	06
Digital-OUT 00	07
Digital-OUT 01	08
PWM-OUT 00(+)	09
PWM-OUT 01(+)	10
PWM-OUT 02(+)	11
PWM-OUT 03(+)	12
Analog-IN 07	13
Analog-IN 08	14
Analog-IN 12*/Digital-IN 02	15
Analog-IN 11*/Digital-IN 03	16
Freq. 01/Digital-IN 11	17
Digital-OUT 02	18
Digital-OUT 03	19
PWM-OUT 00 RETURN	20
PWM-OUT 01 RETURN	21
PWM-OUT 02 RETURN	22
PWM-OUT 03 RETURN	23
Analog-IN 09	24
Analog-IN 10/Analog-OUT00	25
Freq. 02/Digital-IN 04	26
Freq. 03/Digital-IN 05	27
Digital-OUT 04/Digital-IN 06	28
Digital-OUT 05/Digital-IN 07	29
Digital-OUT 06/Digital-IN 08	30
Digital-OUT 07/Digital-IN 09	31
PWM-OUT 00(-)	32
PWM-OUT 01(-)	33
PWM-OUT 02(-)	34
PWM-OUT 03(-)	35

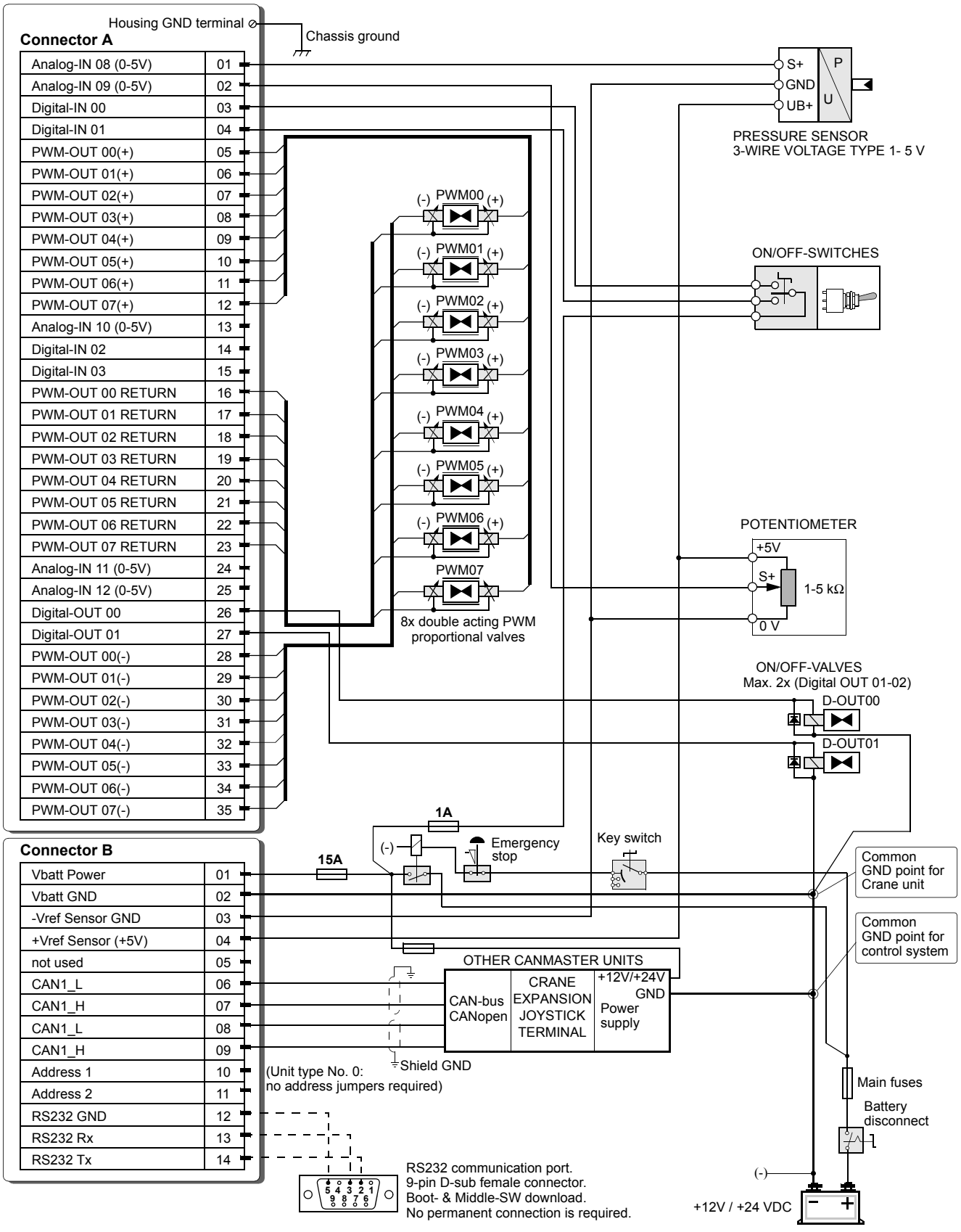
Connector B

Vbatt SYS	01
Vbatt GND	02
-Vref Sensor GND	03
+Vref Sensor (+5V)	04
+Vbatt Power OUT	05
CAN1_L	06
CAN1_H	07
CAN1_L	08
CAN1_H	09
CAN2_L	10
CAN2_H	11
RS232 GND	12
RS232 Rx	13
RS232 Tx	14

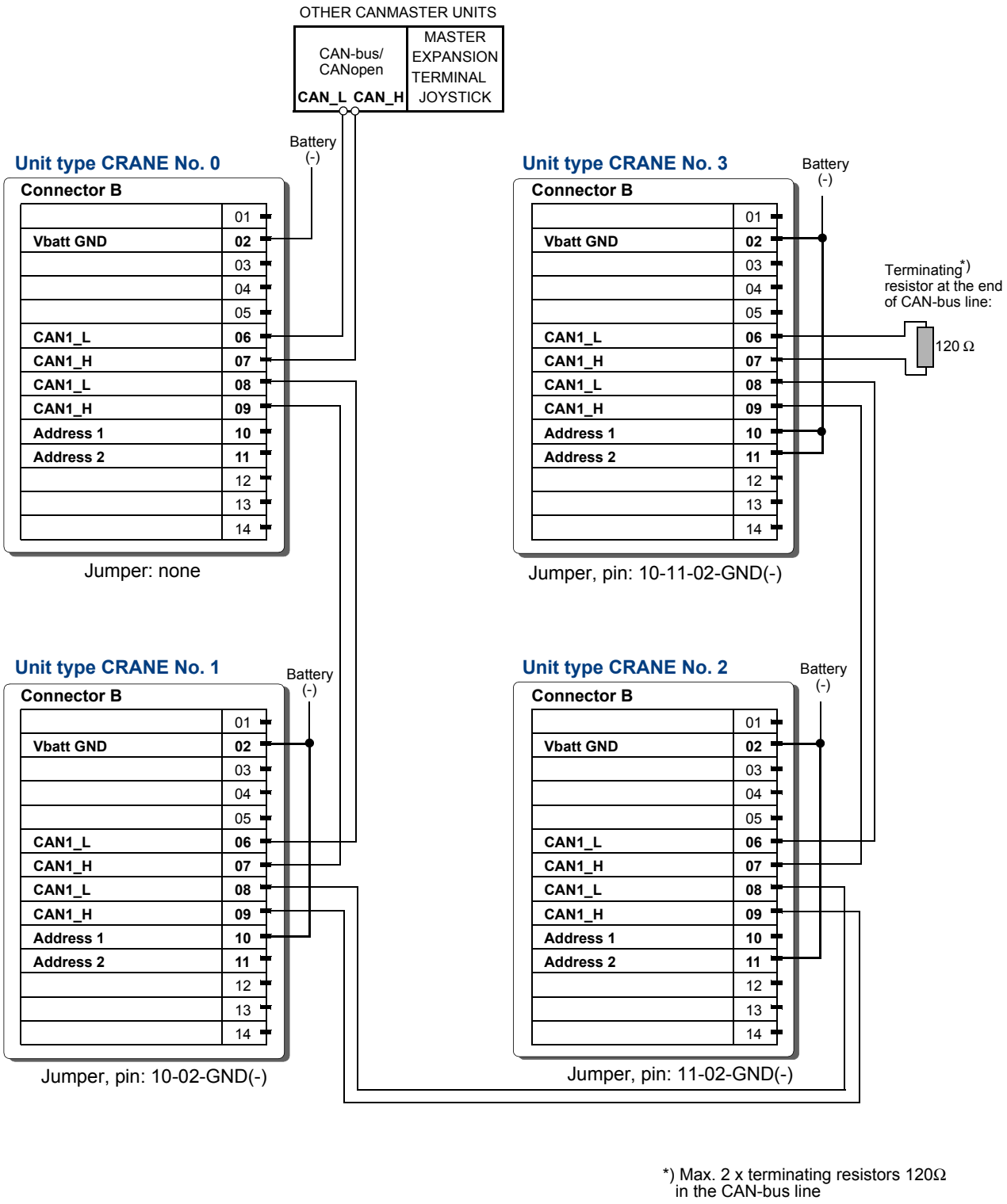


*) **Note:** Low impedance inputs 11-14 (4 inputs) must not be used for current sensitive potentiometers such as control levers. Use the high high-impedance analog inputs 04-10 in this case.

CRANE unit

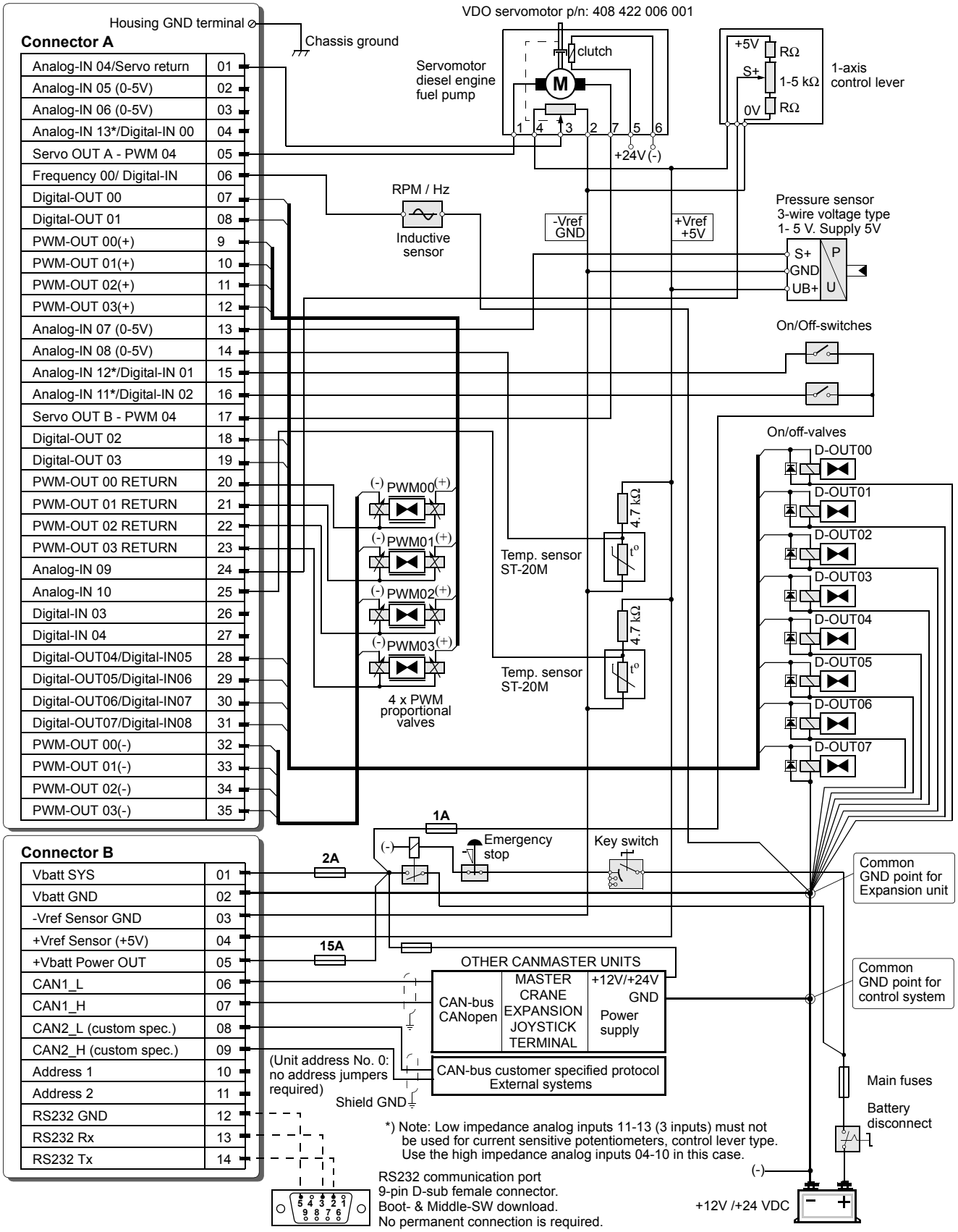

Housing GND terminal
Chassis ground
Connector A
Analog-IN 08 (0-5V) 01
Analog-IN 09 (0-5V) 02
Digital-IN 00 03
Digital-IN 01 04
PWM-OUT 00(+) 05
PWM-OUT 01(+) 06
PWM-OUT 02(+) 07
PWM-OUT 03(+) 08
PWM-OUT 04(+) 09
PWM-OUT 05(+) 10
PWM-OUT 06(+) 11
PWM-OUT 07(+) 12
Analog-IN 10 (0-5V) 13
Digital-IN 02 14
Digital-IN 03 15
PWM-OUT 00 RETURN 16
PWM-OUT 01 RETURN 17
PWM-OUT 02 RETURN 18
PWM-OUT 03 RETURN 19
PWM-OUT 04 RETURN 20
PWM-OUT 05 RETURN 21
PWM-OUT 06 RETURN 22
PWM-OUT 07 RETURN 23
Analog-IN 11 (0-5V) 24
Analog-IN 12 (0-5V) 25
Digital-OUT 00 26
Digital-OUT 01 27
PWM-OUT 00(-) 28
PWM-OUT 01(-) 29
PWM-OUT 02(-) 30
PWM-OUT 03(-) 31
PWM-OUT 04(-) 32
PWM-OUT 05(-) 33
PWM-OUT 06(-) 34
PWM-OUT 07(-) 35
S+
GND
UB+
P
U
PRESSURE SENSOR
3-WIRE VOLTAGE TYPE 1- 5 V
(-) PWM00 (+)
(-) PWM01 (+)
(-) PWM02 (+)
(-) PWM03 (+)
(-) PWM04 (+)
(-) PWM05 (+)
(-) PWM06 (+)
PWM07
8x double acting PWM
proportional valves
ON/OFF-SWITCHES
POTENTIOMETER
+5V
S+
1-5 kΩ
0 V
ON/OFF-VALVES
Max. 2x (Digital OUT 01-02)
D-OUT00
D-OUT01
1A
(-)
Emergency
stop
Key switch
15A
Connector B
Vbatt Power 01
Vbatt GND 02
-Vref Sensor GND 03
+Vref Sensor (+5V) 04
not used 05
CAN1_L 06
CAN1_H 07
CAN1_L 08
CAN1_H 09
Address 1 10
Address 2 11
RS232 GND 12
RS232 Rx 13
RS232 Tx 14
Common
GND point for
Crane unit
Common
GND point for
control system
OTHER CANMASTER UNITS
CAN-bus
CANopen
CRANE
EXPANSION
JOYSTICK
TERMINAL
+12V/+24V
GND
Power
supply
Shield GND
(Unit type No. 0:
no address jumpers required)
Main fuses
Battery
disconnect
(-)
+12V / +24 VDC
RS232 communication port.
9-pin D-sub female connector.
Boot- & Middle-SW download.
No permanent connection is required.

CRANE unit addressing

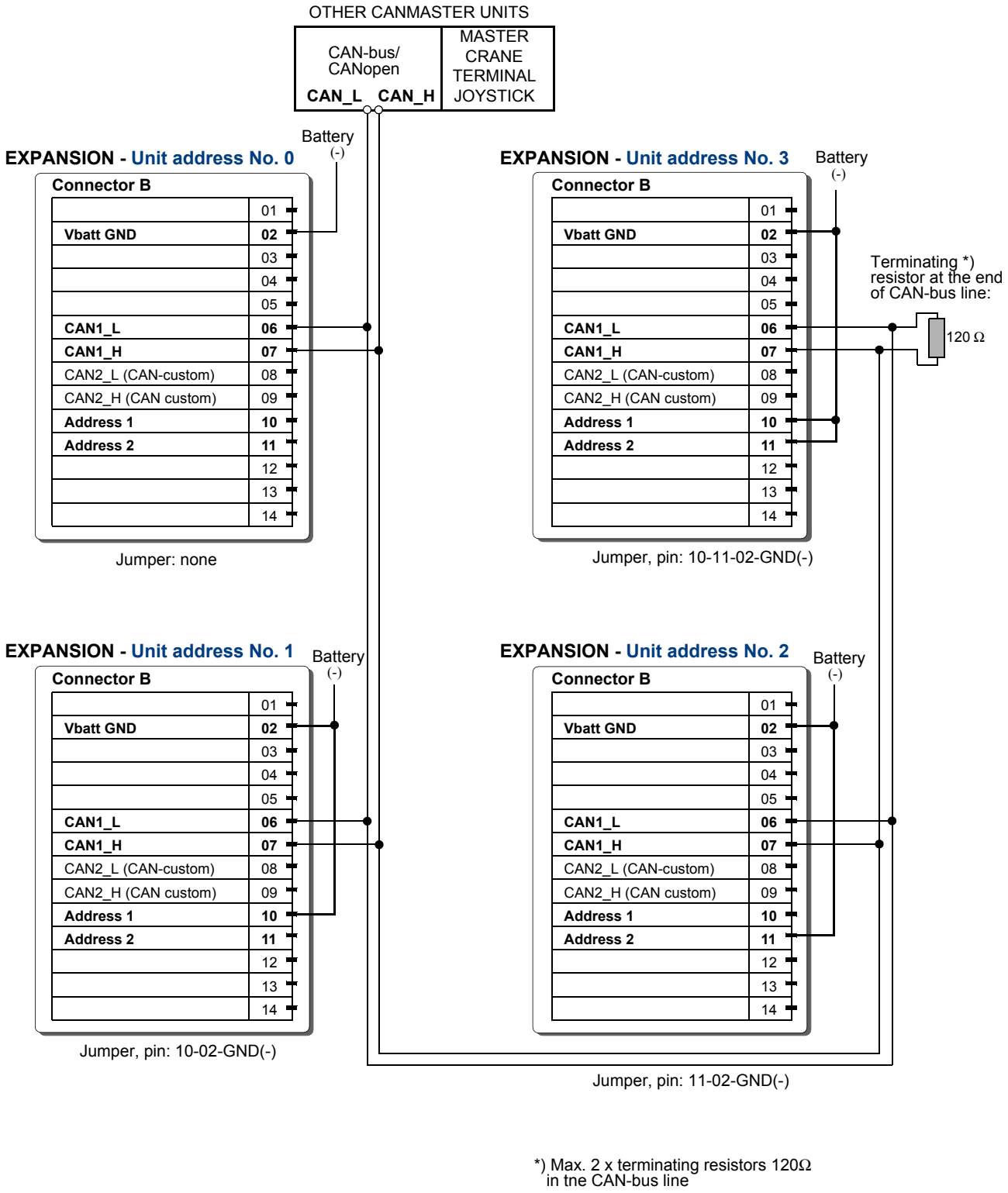


*) Max. 2 x terminating resistors 120Ω in the CAN-bus line

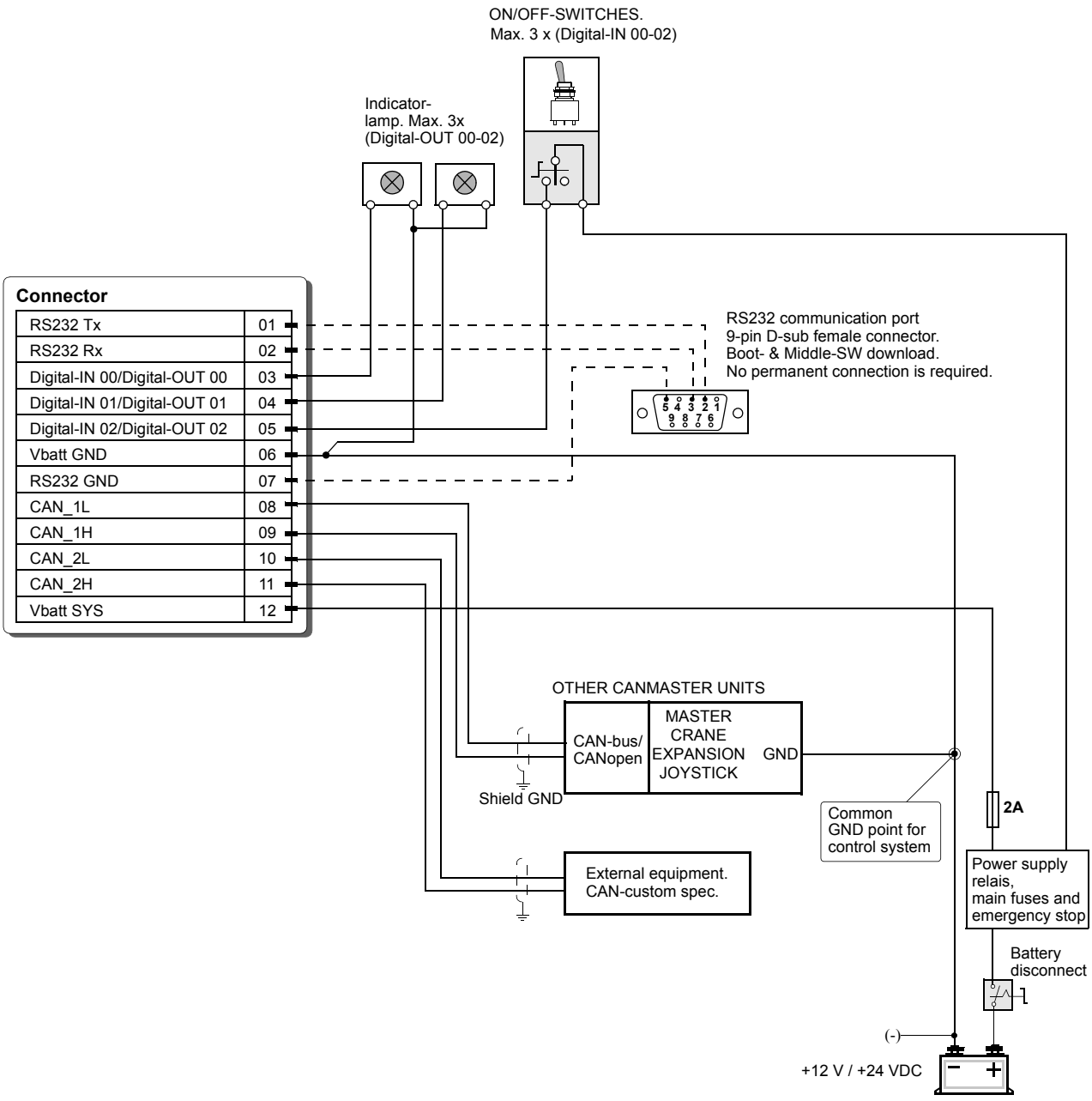
EXPANSION unit



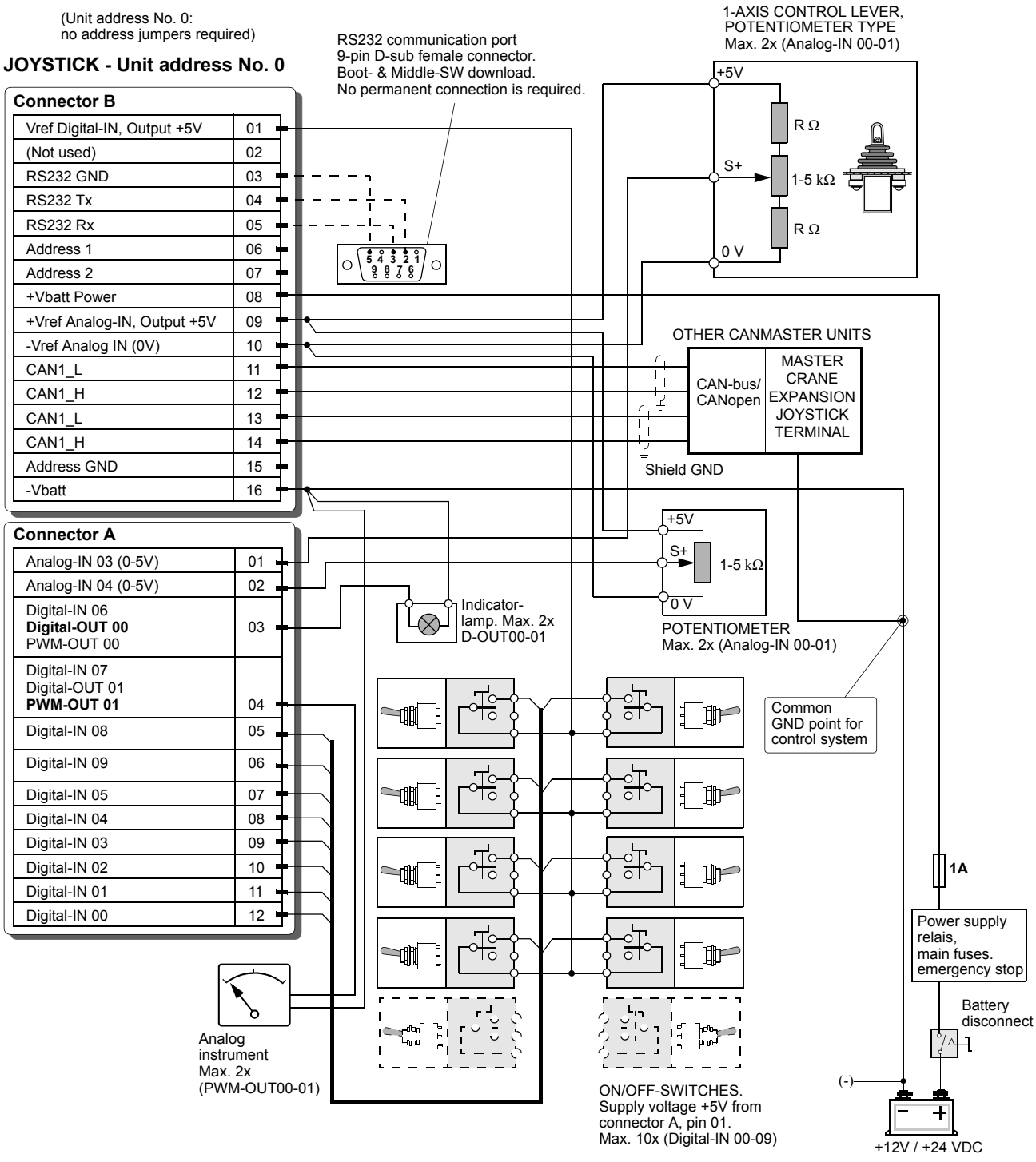
EXPANSION unit adressering



TERMINAL T2

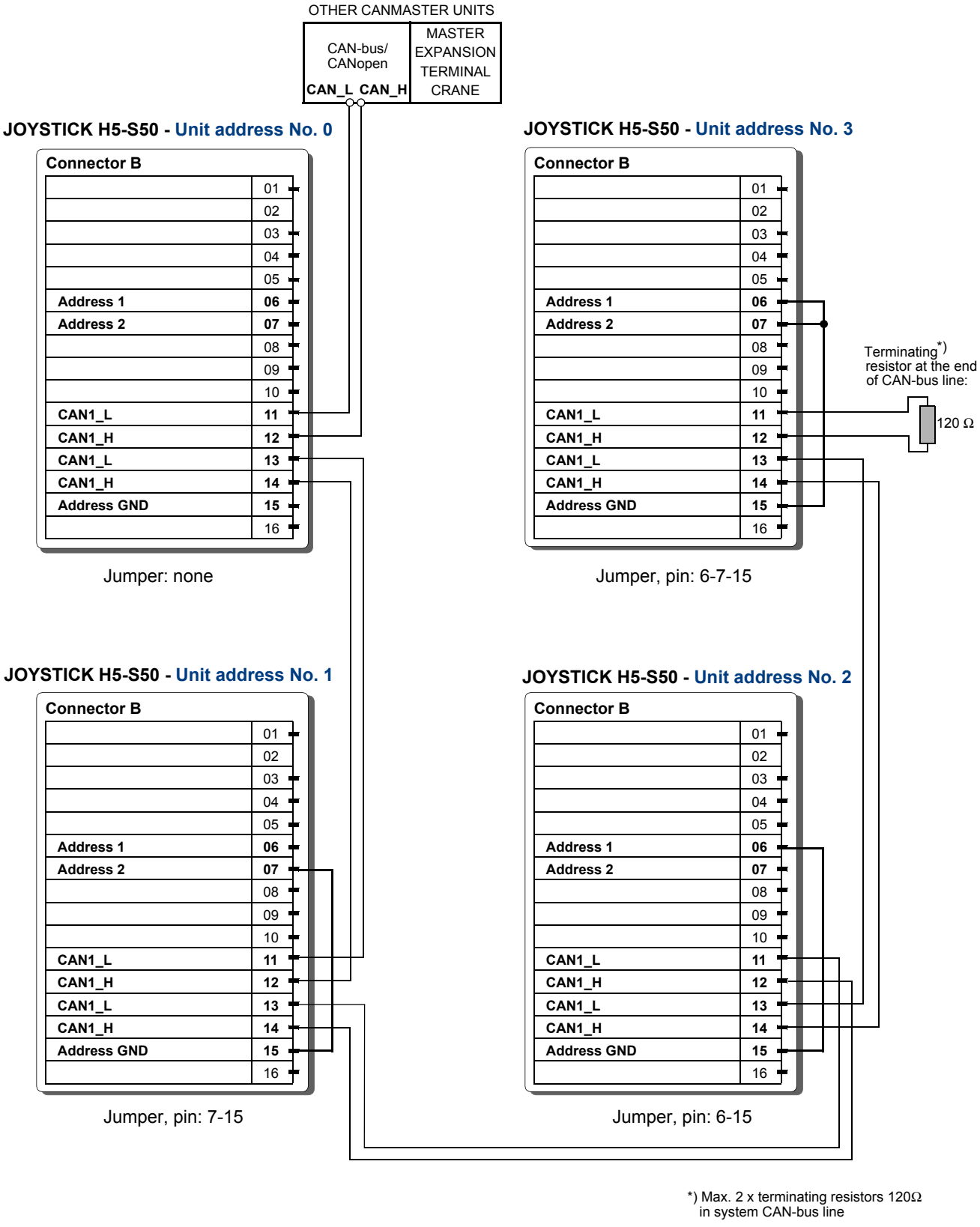

ON/OFF-SWITCHES.
Max. 3 x (Digital-IN 00-02)
Indicator-
lamp. Max. 3x
(Digital-OUT 00-02)
Connector
RS232 Tx 01
RS232 Rx 02
Digital-IN 00/Digital-OUT 00 03
Digital-IN 01/Digital-OUT 01 04
Digital-IN 02/Digital-OUT 02 05
Vbatt GND 06
RS232 GND 07
CAN_1L 08
CAN_1H 09
CAN_2L 10
CAN_2H 11
Vbatt SYS 12
RS232 communication port
9-pin D-sub female connector.
Boot- & Middle-SW download.
No permanent connection is required.
5 4 3 2 1
9 8 7 6
OTHER CANMASTER UNITS
CAN-bus/
CANopen
MASTER
CRANE
EXPANSION
JOYSTICK
GND
Shield GND
Common
GND point for
control system
2A
Power supply
relais,
main fuses and
emergency stop
Battery
disconnect
External equipment.
CAN-custom spec.
(-)
+12 V / +24 VDC

JOYSTICK H5-S50



Note: Vref (+5V) for external Analog input supply and Vref (+5V) for Digital input supply must be used to supply the externally connected analog and digital input devices and must not be used to supply any other separate circuits.

JOYSTICK H5-S50 unit addressing



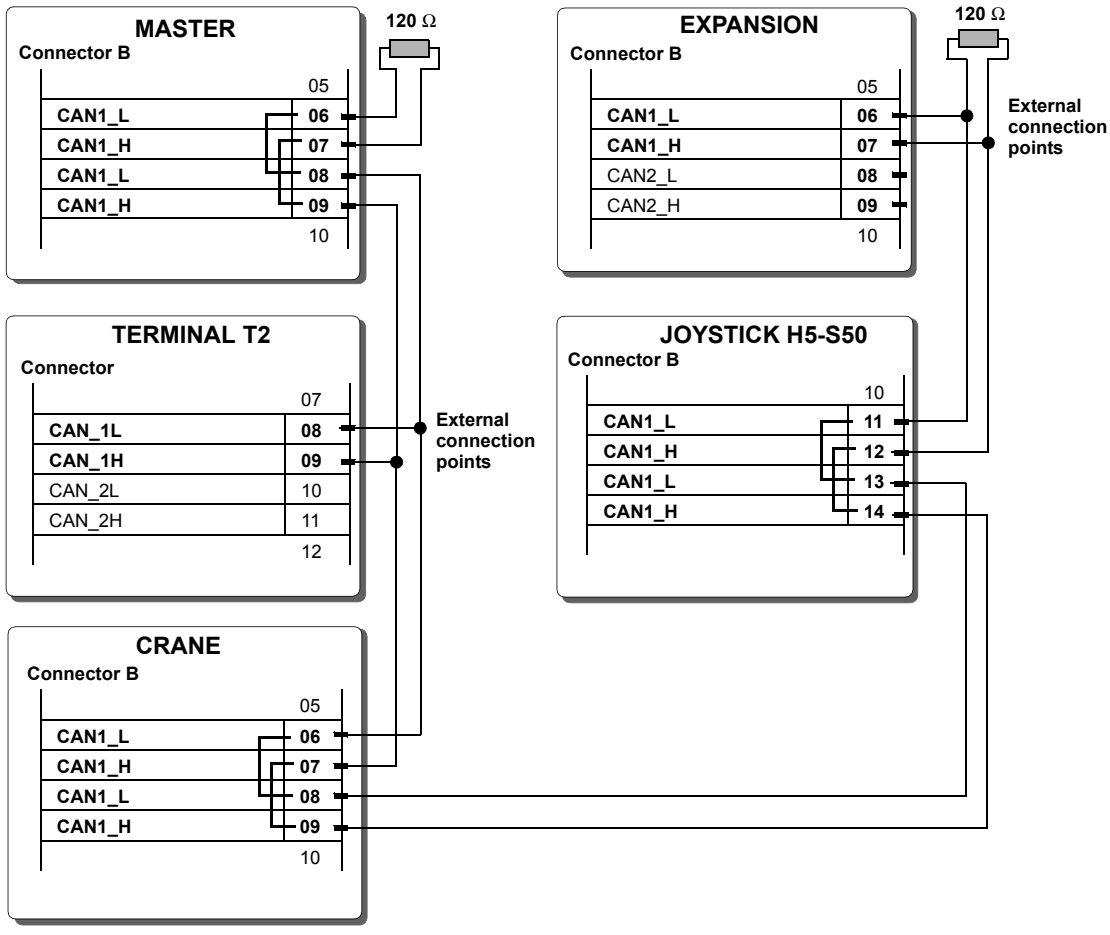
*) Max. 2 x terminating resistors 120Ω in system CAN-bus line

CAN-bus/CANopen network

When connecting a unit to the CAN bus network, the CAN1_L and CAN1_H are connected in parallel for all units. Note that the MASTER, CRANE and JOYSTICK control units are fitted with twin pairs of contact pins for CANopen in order to simplify connection to the CAN-bus. The EXPANSION unit and the TERMINAL T2, on the other hand, have only one single pair of contact pins for CAN1_L and CAN1_H respectively, as the other pins in these units are used for other functions. For these units, the CAN-bus connection points must be extended externally with cables.

See the connection diagram below that includes all type of CANmaster control units and the general connections diagram for each type of control unit in the beginning of this chapter.

Note that the control units can be connected to the CAN-bus network where desired. The connection diagram below is just one example in order to show connecting principles:

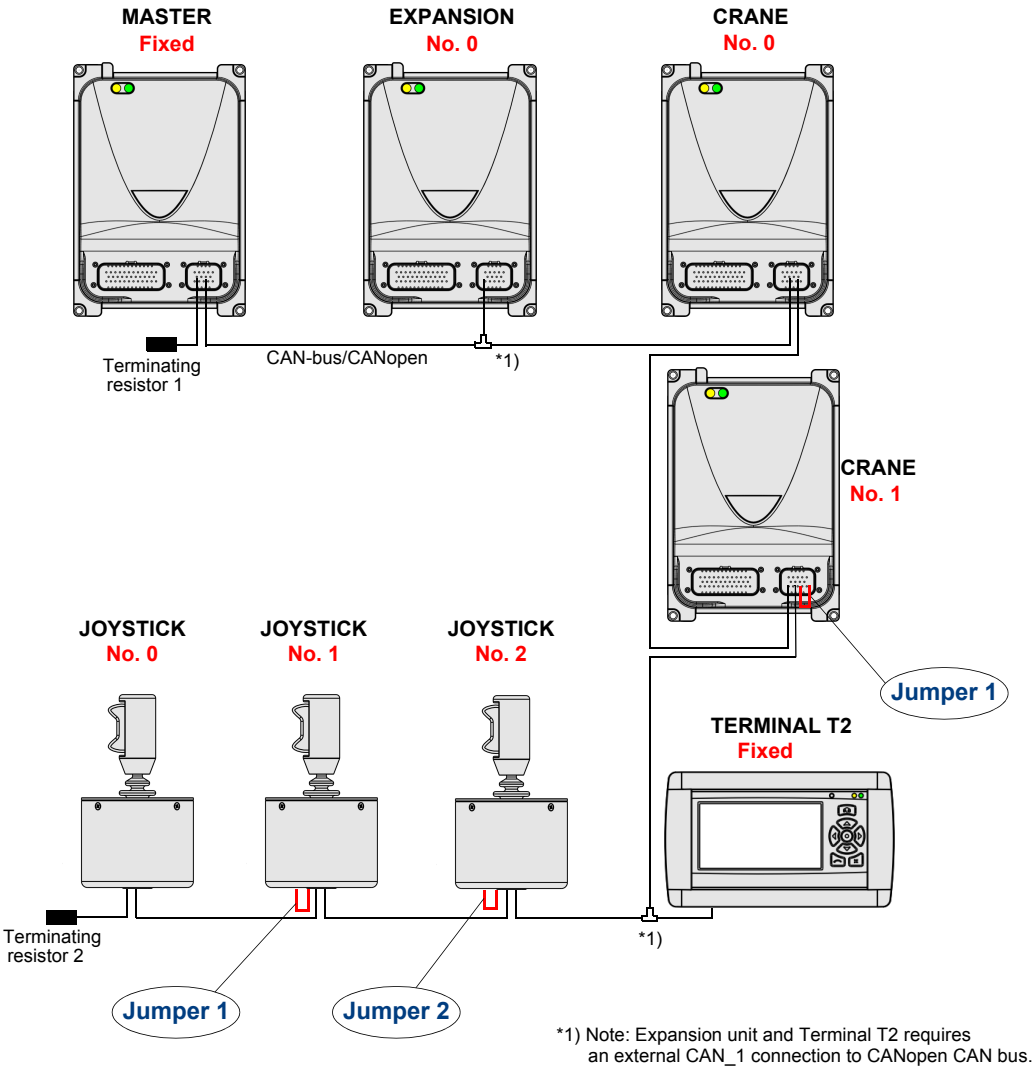


CANmaster control unit addressing

In order for the electronic units in the CAN-bus system to be identified by the MASTER unit, each unit has a unique address that is determined by the external jumpers in each connector. The address refers in part to the **type of unit** and in part to the **unit number** in a group of the same type. A group in the CANmaster system can consist of a maximum of 4 units that are designated as **No. 0, 1, 2 or 3**.

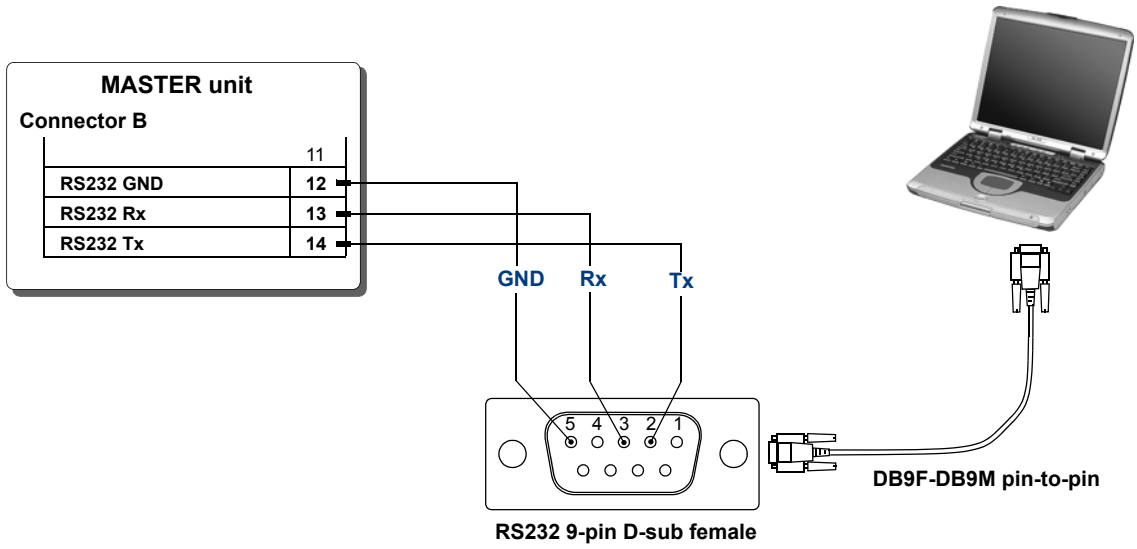
For the MASTER unit and the TERMINAL, the address is permanently defined in the basic software and a system can only contain one MASTER and one TERMINAL. In addition to these unit types, there are three other unit types: CRANE, EXPANSION and JOYSTICK H5-S50. The unit designated No. 0 is the unit type without jumpers.

An example of a system consisting of a MASTER unit, TERMINAL T2 , 2 CRANES, 1 EXPANSION unit, and 3 JOYSTICKS would be addressed as shown in the diagram below.



Note: *The control units can be connected to the CAN-bus network where desired and unit numbers do not need to follow any particular order with regard to their placement in the CAN-bus network.*

RS232 communication interface



The RS232 communication port on the MASTER-unit is used as the main communication port between the service computer and the control systems. A 9-pin D-sub female connector should be mounted in the machine for this purpose. A straight serial cable (DB9F-DB9M pin-to-pin) is used to connect to the service computer. This port is used for the all the normal service work, for downloading the application software, parameters, terminal font/menu-data and for system trouble shooting and logging of I/O-status.

The RS232 communication ports on the other control units in the system (Crane, Expansion, Terminal and Joystick H5-S50) are used for advanced system work only and does not have to have a permament connection to a RS232 D-sub.

Chapter 5

PIN ASSIGNMENT

This chapter contains tables showing the pin assignments for the control units included in CANmaster systems. For connector pin location in the connectors, see the chapter 'Cables & Connectors'.

Note that the pin assignments for connector **A** and connector **B** are different for all types of Master, Crane and Expansion control units.

Inputs and outputs are located in **Connector A.**

Power supply and data communication are located in **Connector B.**

MASTER unit - Connector A

Pin No.	Signal name		Comment
01	Analog-IN 04 (0-5V)		
02	Analog-IN 05 (0-5V)		
03	Analog-IN 06 (0-5V)		
04	Analog-IN 14 (0-5V)	Digital-IN 00	
05	Analog-IN 13 (0-5V)	Digital-IN 01	
06	Frequency 00	Digital-IN 10	
07	Digital-OUT 00		
08	Digital-OUT 01		
09	PWM-OUT 00(+)		
10	PWM-OUT 01(+)		
11	PWM-OUT 02(+)		
12	PWM-OUT 03(+)		
13	Analog-IN 07 (0-5V)		
14	Analog-IN 08 (0-5V)		
15	Analog-IN 12 (0-5V)	Digital-IN 02	
16	Analog-IN 11 (0-5V)	Digital-IN 03	
17	Frequency 01	Digital-IN 11	
18	Digital-OUT 02		
19	Digital-OUT 03		
20	PWM-OUT 00 RETURN (Analog-IN 00)		Common return PWM-OUT 00 (+)/(-)
21	PWM-OUT 01 RETURN (Analog-IN 01)		Common return PWM-OUT 01 (+)/(-)
22	PWM-OUT 02 RETURN (Analog-IN 02)		Common return PWM-OUT 02 (+)/(-)
23	PWM-OUT 03 RETURN (Analog-IN03)		Common return PWM-OUT 03 (+)/(-)
24	Analog-IN 09 (0-5V)		
25	Analog-IN 10 (0-5V)	Analog-OUT 00 (0-5V)	
26	Frequency 02	Digital-IN 04	
27	Frequency 03	Digital-IN 05	
28	Digital-OUT 04	Digital-IN 06	
29	Digital-OUT 05	Digital-IN 07	
30	Digital-OUT 06	Digital-IN 08	
31	Digital-OUT 07	Digital-IN 09	
32	PWM-OUT 00(-)		
33	PWM-OUT 01(-)		
34	PWM-OUT 02(-)		
35	PWM-OUT 03(-)		

MASTER unit - Connector B

Pin No.	Signal name	Function	Fuse (A)
01	Vbatt SYS	+12 V / +24 V power supply control electronics	2 A
02	Vbatt GND	0 V for MASTER-unit	
03	-Vref Sensor GND	0 V reference for analog sensors	
04	+Vref Sensor	+5 V output supply voltage for analog sensors	
05	+Vbatt Power OUT	+12V / +24 V power supply for power outputs	15 A
06	CAN1_L	CAN-bus signal L, CANopen	
07	CAN1_H	CAN-bus signal H, CANopen	
08	CAN1_L	CAN-bus signal L, CANopen	
09	CAN1_H	CAN-bus signal H, CANopen	
10	CAN2_L	CAN-bus signal L, CAN-SAE J1939	
11	CAN2_H	CAN-bus signal H, CAN-SAE J1939	
12	RS232 GND	Ground terminal RS232	
13	RS232 Rx	Receive data RS232 from PC	
14	RS232 Tx	Transmit data RS232 to PC	

CRANE unit Connector A

Pin No.	Signal name	Remarks
01	Analog-IN 08 (0-5V)	
02	Analog-IN 09 (0-5V)	
03	Digital-IN 00	
04	Digital-IN 01	
05	PWM-OUT 00(+)	
06	PWM-OUT 01(+)	
07	PWM-OUT 02(+)	
08	PWM-OUT 03(+)	
09	PWM-OUT 04(+)	
10	PWM-OUT 05(+)	
11	PWM-OUT 06(+)	
12	PWM-OUT 07(+)	
13	Analog-IN 10 (0-5V)	
14	Digital-IN 02	
15	Digital-IN 03	
16	PWM-OUT 00 RETURN (Analog-IN 00)	Common return PWM-OUT 00 (+)/(-)
17	PWM-OUT 01 RETURN (Analog-IN 01)	Common return PWM-OUT 01 (+)/(-)
18	PWM-OUT 02 RETURN (Analog-IN 02)	Common return PWM-OUT 02 (+)/(-)
19	PWM-OUT 03 RETURN (Analog-IN 03)	Common return PWM-OUT 03 (+)/(-)
20	PWM-OUT 04 RETURN (Analog-IN 04)	Common return PWM-OUT 04 (+)/(-)
21	PWM-OUT 05 RETURN (Analog-IN 05)	Common return PWM-OUT 05 (+)/(-)
22	PWM-OUT 06 RETURN (Analog-IN 06)	Common return PWM-OUT 06 (+)/(-)
23	PWM-OUT 07 RETURN (Analog-IN 07)	Common return PWM-OUT 07 (+)/(-)
24	Analog-IN 11 (0-5V)	
25	Analog-IN 12 (0-5V)	
26	Digital-OUT 00	
27	Digital-OUT 01	
28	PWM-OUT 00(-)	
29	PWM-OUT 01(-)	
30	PWM-OUT 02(-)	
31	PWM-OUT 03(-)	
32	PWM-OUT 04(-)	
33	PWM-OUT 05(-)	
34	PWM-OUT 06(-)	
35	PWM-OUT 07(-)	

CRANE unit - Connector B

Pin No.	Signal name	Function	Fuse (A)
01	Vbatt Power	+12 V / +24 V power supply CRANE-unit	15 A
02	Vbatt GND	0 V for CRANE-unit	
03	-Vref Sensor GND	0 V reference for analog sensors	
04	+Vref Sensor	+5 V output supply voltage for analog sensors	
05	not used		
06	CAN1_L	CAN-bus signal L, CANopen	
07	CAN1_H	CAN-bus signal H, CANopen	
08	CAN1_L	CAN-bus signal L, CANopen	
09	CAN1_H	CAN-bus signal H, CANopen	
10	Address 1	Unit address pin 1	
11	Address 2	Unit address pin 2	
12	RS232 GND	Ground terminal RS232	
13	RS232 Rx	Receive data RS232 from PC	
14	RS232 Tx	Transmit data RS232 to PC	

EXPANSION unit - Connector A

Pin No.	Signal name		Comment
01	Analog-IN 04 (0-5V)		Servomotor potentiometer return
02	Analog-IN 05 (0-5V)		
03	Analog-IN 06 (0-5V)		
04	Analog-IN 13 (0-5V)	Digital-IN 00	
05	Servo OUT A - PWM 04		Servomotor output A
06	Frequency 00	Digital-IN 09	
07	Digital-OUT 00		
08	Digital-OUT 01		
09	PWM-OUT 00(+)		
10	PWM-OUT 01(+)		
11	PWM-OUT 02(+)		
12	PWM-OUT 03(+)		
13	Analog-IN 07 (0-5V)		
14	Analog-IN 08 (0-5V)		
15	Analog-IN 12 (0-5V)	Digital-IN 01	
16	Analog-IN 11 (0-5V)	Digital-IN 02	
17	Servo OUT B - PWM 04		Servomotor output B
18	Digital-OUT 02		
19	Digital-OUT 03		
20	PWM-OUT 00 RETURN (Analog-IN 00)		Common return PWM-OUT 00 (+)/(-)
21	PWM-OUT 01 RETURN (Analog-IN 01)		Common return PWM-OUT 01 (+)/(-)
22	PWM-OUT 02 RETURN (Analog-IN 02)		Common return PWM-OUT 02 (+)/(-)
23	PWM-OUT 03 RETURN (Analog-IN 03)		Common return PWM-OUT 03 (+)/(-)
24	Analog-IN 09 (0-5V)		
25	Analog-IN 10 (0-5V)		
26	Digital-IN 03		
27	Digital-IN 04		
28	Digital-OUT 04	Digital-IN 05	
29	Digital-OUT 05	Digital-IN 06	
30	Digital-OUT 06	Digital-IN 07	
31	Digital-OUT 07	Digital-IN 08	
32	PWM-OUT 00(-)		
33	PWM-OUT 01(-)		
34	PWM-OUT 02(-)		
35	PWM-OUT 03(-)		

EXPANSION unit - Connector B

Pin No.	Signal name	Function	Fuse (A)
01	Vbatt SYS	+12 V /+24 V power supply control electronics	2 A
02	Vbatt GND	0 V EXPANSIONS-unit	
03	-Vref Sensor GND	0 V reference for analog sensors	
04	+Vref Sensor	+5 V output supply voltage for analog sensors	
05	+Vbatt Power OUT	+12 V / +24 V power supply for power outputs	15 A
06	CAN1_L	CAN-bus signal L, CANopen	
07	CAN1_H	CAN-bus signal H, CANopen	
08	CAN2_L	CAN-bus signal L, CAN customer specified protocol	
09	CAN2_H	CAN-bus signal H, CAN customer specified protocol	
10	Address 1	Unit adress pin 1	
11	Address 2	Unit adress pin 2	
12	RS232 GND	Ground terminal RS232	
13	RS232 Rx	Receive data RS232 from PC	
14	RS232 Tx	Transmit data RS232 to PC	

TERMINAL T2 Connector

Pin No.	Signal name		Function	Fuse (A)
01	RS232 Tx		Transmit data RS232 to PC	
02	RS232 Rx		Receive data RS232 from PC	
03	Digital-IN 00	Digital-OUT 00		
04	Digital-IN 01	Digital-OUT 01		
05	Digital-IN 02	Digital-OUT 02		
06	Vbatt GND		Power supply GND for Terminal-unit, 0V	
07	RS232 GND		Ground reference RS232	
08	CAN_1L		CAN-bus signal L, CANopen	
09	CAN_1H		CAN-bus signal H, CANopen	
10	CAN_2L		CAN-bus signal L, CAN-customer spec.	
11	CAN_2H		CAN-bus signal H, CAN-customer spec.	
12	Vbatt SYS		+12V / +24V power supply Terminal-unit	2A

JOYSTICK H5-S50 Connector A

Pin No.	Signal name			Comment
Internal	Analog IN 00, joystick X-axis			
Internal	Analog IN 01, joystick Y-axis			
Internal	Analog IN 02, joystick Z-axis			
01	Analog-IN 03 (0-5V)			
02	Analog-IN 04 (0-5V)			
03	Digital-IN 06	Digital-OUT 00	PWM-OUT 00	
04	Digital-IN 07	Digital-OUT 01	PWM-OUT 01	
05	Digital-IN 08			
06	Digital-IN 09			
07	Digital-IN 05			
08	Digital-IN 04			
09	Digital-IN 03			
10	Digital-IN 02			
11	Digital-IN 01			
12	Digital-IN 00			

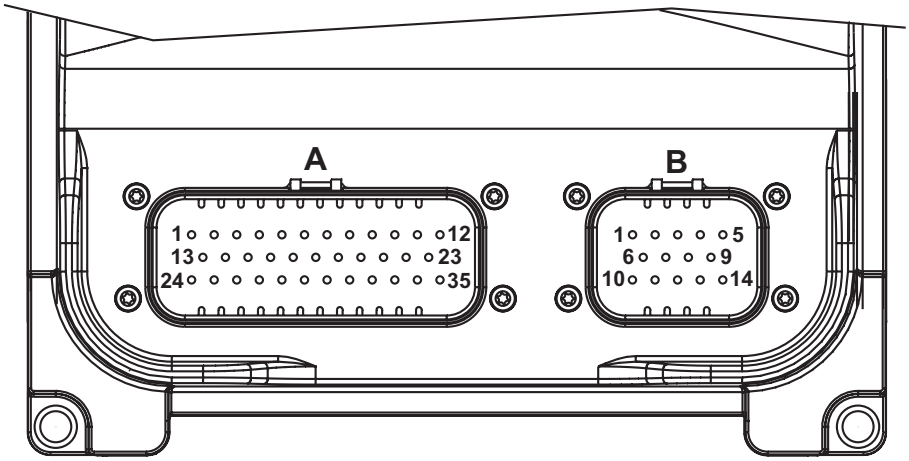
JOYSTICK H5-S50 Connector B

Pin No.	Signal name	Function	Fuse (A)
01	Vref Digital-IN	Power supply OUTPUT for external Digital-IN, +5VDC	
02	(Not used)		
03	RS232 GND	Ground reference RS232	
04	RS232 Tx	Transmit data RS232 to PC	
05	RS232 Rx	Receive data RS232 from PC	
06	Address 1	Unit address pin 1	
07	Address 2	Unit address pin 2	
08	+Vbatt Power	+12 V / +24VDC Power supply input for Joystick unit	1A
09	+Vref Analog-IN	Power supply OUTPUT for external Analog-IN, +5VDC	
10	-Vref Analog-IN	0 V reference for external Analog-IN	
11	CAN1_L	CAN-bus signal L, CANopen	
12	CAN1_H	CAN-bus signal H, CANopen	
13	CAN1_L	CAN-bus signal L, CANopen	
14	CAN1_H	CAN-bus signal H, CAnopen	
15	Address GND	Ground reference for unit address	
16	-Vbatt	0 V power supply for Joystick unit	

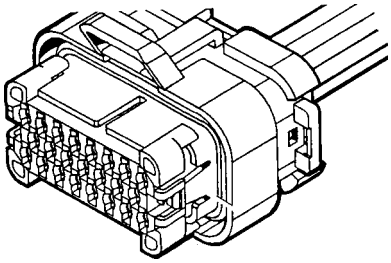
Connectors & Cables

MASTER, CRANE & EXPANSION

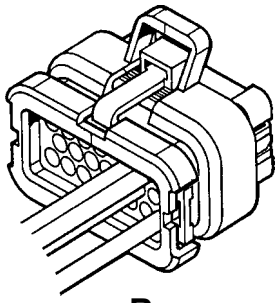
Connector pin location



Mating connectors - AMPSEAL®



A



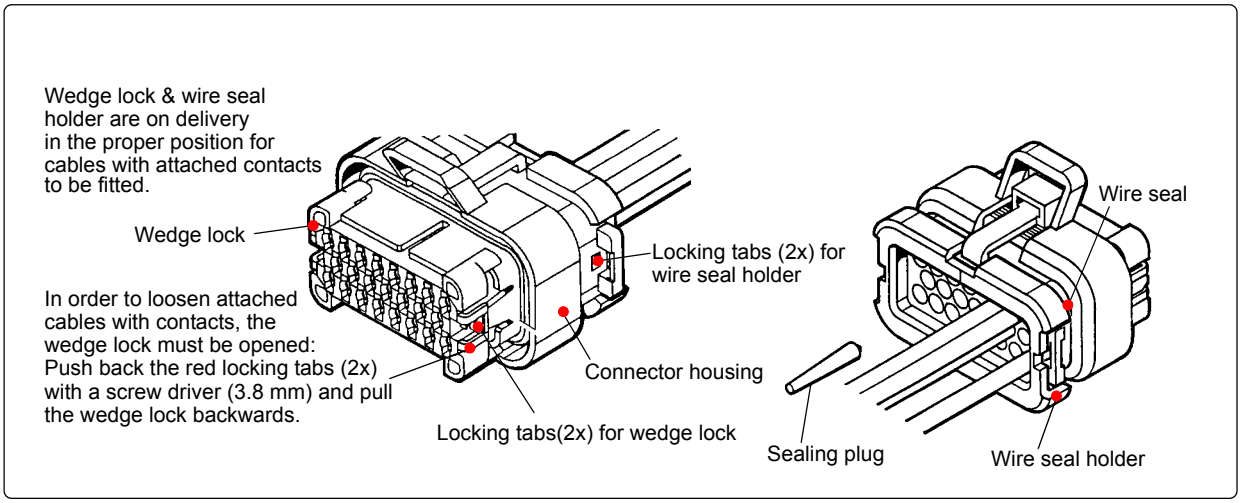
B

Mating connectors	A	B
AMP, type	AMPSEAL®	AMPSEAL®
Number of contacts	35	14
Color	Black	Black
AMP part no.	776164-1	776273-1
Assembly instruction	AMP document part no. 114 160-16/nov. 95 rev. D	
Contacts	**A**	**B**
AMP, type	Cu-Sn, 0.5-1.5 mm^2/16-20 AWG	Gold plated, 0.5-1.5mm^2/16-20 AWG
- Loose contacts, AMP part no.	770854-1	770854-3
- Contacts on strap, AMP part no.	770520-1	770520-3
- Sealing plug, nylon, AMP part no.	770678-1	

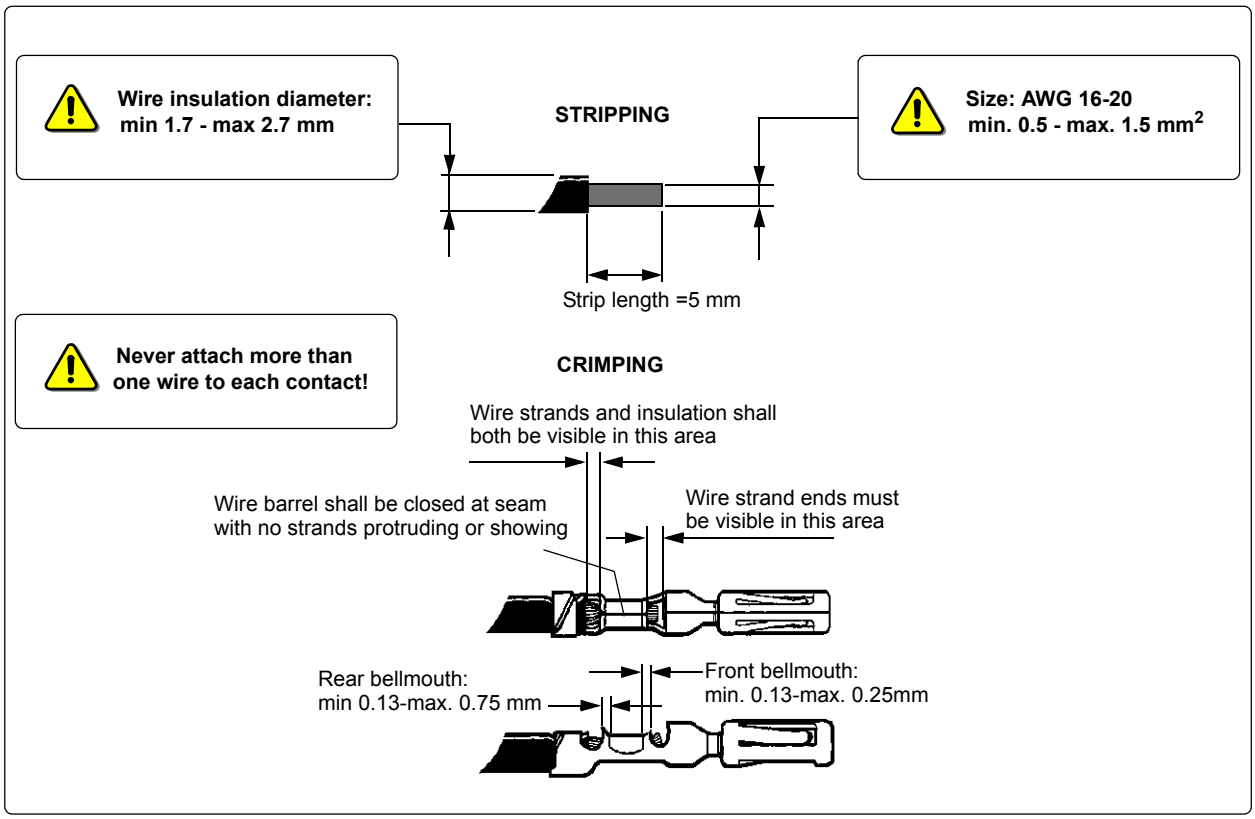
Assembly instructions- AMPSEAL® connector

For detailed assembly instructions for contacts and connector unit, see AMP service instructions, document part no.: 114 160-16/nov. 95 rev. D.

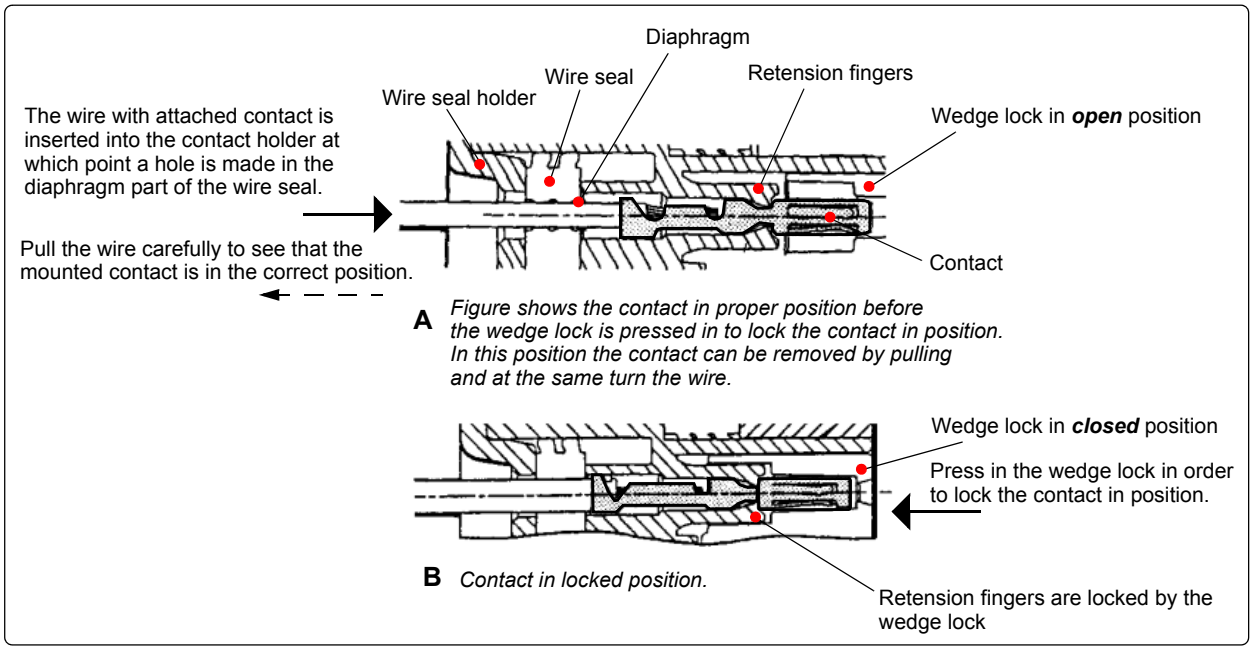
General design



Stripping & Crimpning



Attaching the cables



A hole is made in the sealing diaphragm when the wire with attached contact is inserted in the connector. Ensure that the contact is in the correct position for the the retention fingers to hold the contact. See figure above **position A.**

When all the wires with contacts have been attached, the contacts are locked in position by the wedge lock being pressed together with the connector housing until the locking tabs on both sides click into place. See the figure above, **position B.**

NOTE: If some connectors are not used, seal plugs are not required as long as no piercing is made. The diaphragm in the wire seal provides a suitable seal. If, on the other hand, the attached contacts with cables are removed, sealing plugs ***must be fitted*** in order for the holes in the diaphragm to be sealed. The conical sealing plugs is inserted with the *wider end first.* Se figure on page 37.

Tools for crimping and disassembly of connnector

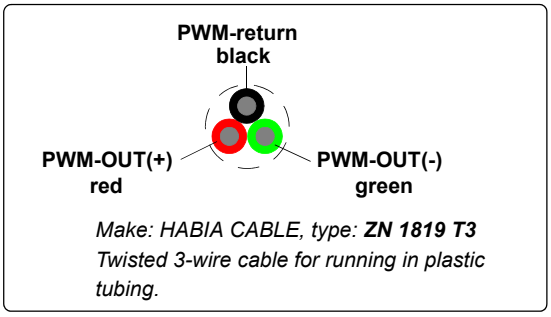
	Crimp tool	Disassembly of connector
Type	Hand tool	Standard screwdriver, 3.8 mm wide
AMP part no.	58529-1	-

MASTER, CRANE & EXPANSION - Recommended cable type

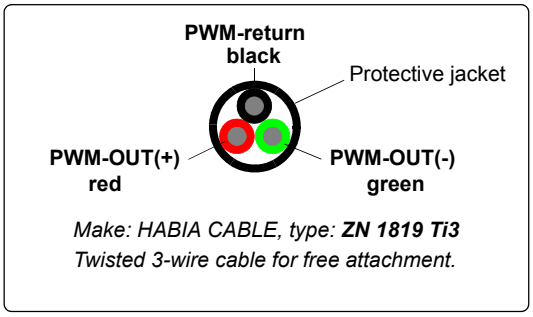
Connector A - Inputs & Outputs:

I/O	Recommended wire area mm^2	Recommended cable type	Recommended max. length (m)
PWM (+), (-) & retur	0.75 (3x)	Twisted 3-wire cable *1)	10
Others	0.75		

*1) 3-wire cable for double acting PWM-outputs:



Make: HABIA CABLE, type: ***ZN 1819 T3***
Twisted 3-wire cable for running in plastic tubing.



Make: HABIA CABLE, type: ***ZN 1819 Ti3***
Twisted 3-wire cable for free attachment.

Habia Cable Co. website: ***www.habia.se***

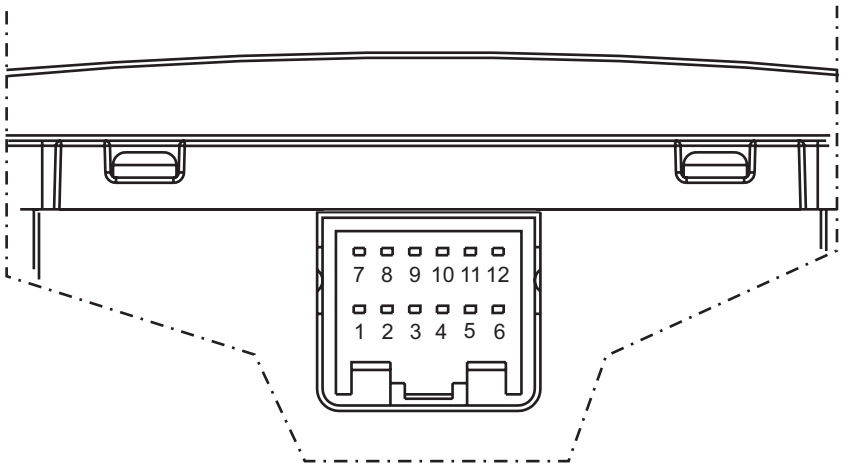
Connector B - Power supply & System communication:

I/O	Recommended wire area mm^2	Recommended cable type	Recommended max. length (m)
Power supply and supply voltage for sensors	1.5		
CAN	0.50 - 0.75	CAN_L + CAN_H : Low capacitance shielded data cable for CAN-bus. Twisted pair.	40
RS232	0.50 - 0.75	RS232 Rx/Tx/GND	15

Note: The cables for data communication CAN_L and CAN_H must be twisted-pair in order to reduce the risk of interference from external systems. For cables longer than 5 m, the use of shielded twisted-pair cable according to the table above is recommended.

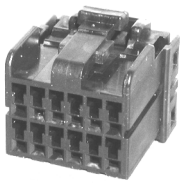
TERMINAL T2

Connector pin location



Terminal connector - terminal housing rear side

Mating connector & contacts



Connector	Data
Type	AMP Multilock®
Number of contacts	12
Color	Black
AMP part no.	174045-2
Contacts	**Data**
Type	Cu-Sn, 0.2-0.6 mm^2/20-24 AWG
Loose contacts, AMP part no.	175062-1
Crimp tool, AMP part no.	0-0091577-1

Note: The connector for the Terminal T2 unit is the equivalent of connector A for the Joystick H5-S50 unit.

Recommended cable type

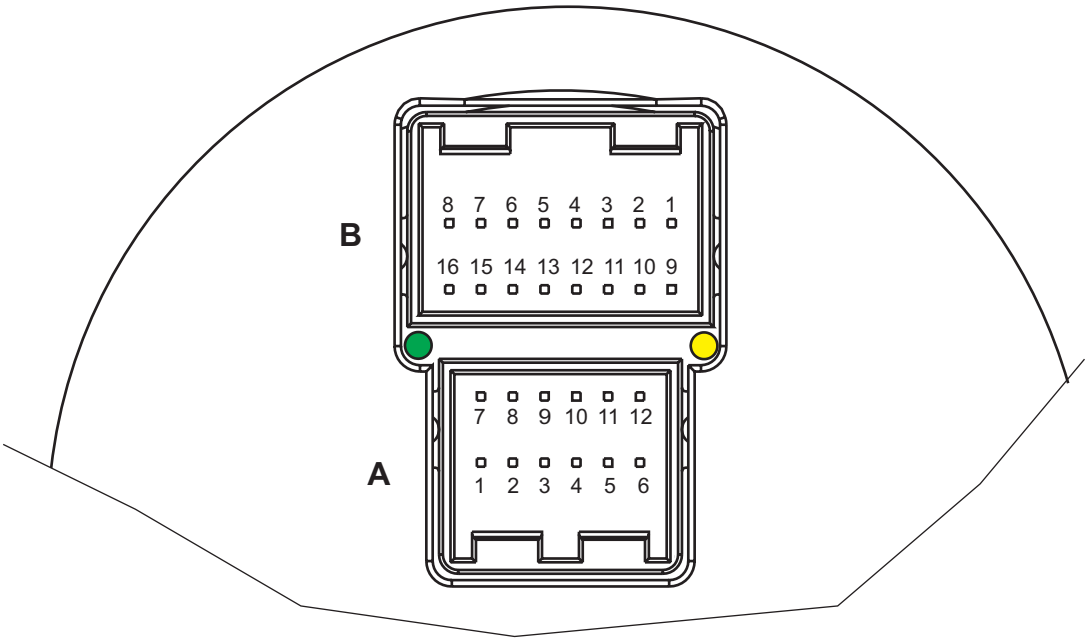
Connector

Pin No.	Recommended wire area mm^2	Recommended cable type	Recommended max. length (m)
06/12	0.50-0.75	Power supply / Supply GND	
01-02/07	0.50-0.75	RS232 Rx/Tx/GND	15
03-05	0.50-0.75	Digital-IN, Digital-OUT	
08-09 10-11	0.50-0.75	CAN 1 & CAN 2: CAN_L + CAN_H : Low capacitance shielded data cables for CAN-bus. Twisted pair.	40

Note: The cables for data communication CAN_L and CAN_H must be twisted-pair in order to reduce the risk of interference from external systems. For cables longer than 5 m, the use of shielded twisted-pair cable according to the table above is recommended.

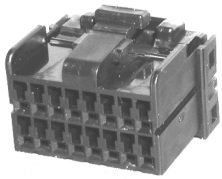
JOYSTICK H5-S50

Connector pin location

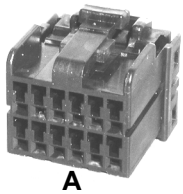


Joystick H5S50 connector bottom side

Mating connector & contacts



B



A

Connector	B	A
Type	AMP Multilock®	AMP Multilock®
Number of contacts	16	12
Color	Black	Black
AMP part no.	174046-2	174045-2
Contacts	**B**	**A**
Type	Cu-Sn, 0.2-0.6 mm^2/20-24 AWG	
Loose contacts - AMP part no.	175062-1	
Crimp tool, AMP part no.	0-0091577-1	

Recommended cable type

Connector A - Inputs & Outputs

Pin No.	Recommended wire area mm^2	Recommended cable type	Recommended max length (m)
01-12	0.5		

Connector B - Power supply & System communication

Pin No.	Recommended wire area mm^2	Recommended cable type	Recommended max length (m)
01	0.50-0.75		
02	(not used)		
03-05	0.50-075	RS232 Rx/Tx/GND	15
06-10	0.50-0.75		
11-12 13-14	0.50-0.75	CAN-1(CANopen): CAN_L + CAN_H: Low capacitance shielded data cables for CAN-bus. Twisted pair.	40
15-16	0.50-0.75		

Note: The cables for data communication CAN_L and CAN_H must be twisted-pair in order to reduce the risk of interference from external systems. For cables longer than 5 m, the use of shielded twisted-pair cable according to the table above is recommended.

Chapter 7

Electrical data

General

This chapter presents basic electrical data for all control units included in CANmaster control systems. The following control units are included:

- MASTER
- CRANE
- EXPANSION
- TERMINAL T2
- JOYSTICK H5-S50

Maximum operating data

The data indicated for maximum current consumption and the range for supply voltages must not be exceeded. The control units are supplied with all the necessary short circuit protection and protection against both under- and overvoltages, but despite these measures, exceeding the stated limits can result in serious and irreparable damage to the electronics.

Recommended fuses are indicated for each control unit in the chapter 'Pin assignments' under 'Power Supply & System communications'. See also the wiring diagrams in the chapter 'Connection diagrams'.

Analogue inputs

There are two types of analogue inputs with the voltage range 0-5V on the Master and Expansion unit. One group of these inputs has an input impedance of 100 kΩ, while the other group has an impedance of 18 kΩ. The inputs with18 kΩ should not be used for current-sensitive potentiometers, for example operating levers with potentiometers. In these cases use the inputs with the higher impedance of 100 kΩ.

PWM outputs on Master, Crane and Expansions units

The PWM outputs in CANmaster systems may only be used for valve coil-type inductive loads. Check that the resistances of the solenoids used are within the ranges for 12 V and 24 V systems, as shown in chart data for each control unit under the heading PWM outputs.

MASTER

MASTER unit - Part No: 5010 3000

Power supply

		Data range				
Function		**min.**	**typical**	**max.**	**Unit**	**Comment**
Supply voltage		11	24	30	V	Applies to both Vbatt SYS and Vbatt Power-OUT
Max. current	Vbatt SYS		1		A	Output configuration must be adapted to the maximum permissible total current for the control unit.
	Vbatt Power-OUT			15		
Ripple supply voltage				0.5	Vp-p	
Vref-Sensor 5V		4.95	5.00	5.05	V	
Load on Vref-Sensor 5V				200	mA	Internal short-circuit protection

Data communication

	Data range				
Function	**min.**	**typical**	**max.**	**Unit**	**Comment**
CAN port 1		500		kbps	Derivat of CANopen/CAN2.0B Physical layer: ISO11898
CAN port 2		250		kbps	CAN SAE J1939/CAN2.0B
RS232		9600		bps	8 bit, 1 stop bit, no parity check

Microprocessor and built-in functions

Function	**Comment**
Processor	ST Microelectronics 16-bit microprocessor
System SW, Application SW and configuration parameters	Flash memory
Primary memory	RAM
Error log	EEPROM
CAN controller	2 FULL CAN controllers/ CAN 2.0B
External communication	1 UART-RS232
A/D converter	10-bit
Watchdog	Internal for CPU and external for program execution

Analog-IN, Analog-OUT, Frequency-IN

		Data range				
Function		**min.**	**typical**	**max.**	**Unit**	**Comment**
ANALOG IN (0-5V)						
Low limit			0	0.05	V	
High limit		4.95	5.0	5.05	V	
Impedance, Analog IN 04-10			100		kΩ	
Impedance, Analog IN 11-14			18		kΩ	Not intended for joysticks
Signal resolution			5		mV	10-bit
Resistance range, external potentiometers			1-5		kΩ	
ANALOG OUT (0-5V)						
Low limit			0	0.05	V	
High limit		4.95	5.00	5.05	V	
Signal resolution			20		mV	8-bit
Current				20	mA	Short circuit protected
FREQUENCY IN						
Freq.- IN 00 & 01	Signal amplitude 1 V	3		1000	Hz	Inputs adapted to measure, for example, the rpm of diesel engines using inductive passive sensors.
	Signal amplitude 10 V	3		15000	Hz	
	Signal amplitude range	1		60	V	
Signal resolution			1		Hz	
Freq. -IN 02 & 03	Signal ampl. 11-30 V	3		15000	Hz	Opto-connected inputs adapted for pulse sensors (square-wave signal).
	Signal current range	10	-	40	mA	
Signal resolution			1		Hz	

Note:
Puls sensors (square wave output signal) can be used for all frequency inputs 00, 01, 02 and 03.
Inductive passive sensors is not recommended for the frequency inputs 02 and 03.

Digital-IN, Digital-OUT

Function	Data range			Unit	Comment
	min.	typical	max.		
DIGITAL IN (24V nom.)					
Low limit	0		0.8	V	OFF at open input
High limit	2.0		45	V	
Impedance		18		kΩ	
DIGITAL OUT - high side (24V nom.)					
Output activated	11	24	30	V	Equals system supply voltage
Output inactive		0		V	
Max. load			1.5	A	Load on each output
Max. load total		12		A	Total, activated outputs
The outputs are short circuit protected					

PWM-OUT

Function	Data range			Unit	Comment
	min.	typical	max.		
PWM OUT +/- (0-1600 mA)					
Current RMS (effective)	0		1600	mA	Accuracy +/- 2 mA
Resolution current value		1.6		mA	10-bit
Ripple current, amplitude	0	50	300	mA	Less than set min. current value
Ripple frequency	80	100	350	Hz	
Baseline frequency	5	20	20	kHz	
Valve coil resistance, 24 V coils	20	22	30	Ω	Supply voltage 20-30 V
Valve coil resistance, 12 V coils	5	8	10	Ω	Supply voltage 11-15 V
Short circuit protection		3.6		A	Triggered after 150-200 ms

Note: PWM outputs may only be used for valve coils (inductive loads).

Note:
For special applications, output PWM-OUT 03 (connector pin no. 12, connector A) can be configured as a non-feedback PWM output with Pulse Width Modulation:
Amplitude: Vbatt, nom. 24 V
Nominal output frequency: 500 Hz
Duty cycle: 7.5 - 92.5 %.
For further details, contact Hydratronics *Technical Support*.

Environmental & Mechanical data

Function	Data	Comment
Temperature range		
Operating temperature	min. -40 ^{o}C - max. +70^{o}C	
Storage temperature	min. -40 ^{o}C - max. +80 ^{o}C	
EMC class		
Radiated emission	95 / 54 / EC	Automotive
Radiated RF immunity	95 / 54 / EC	Automotive
Electrostatic discharge	ISO 10605	
Transient immunity	ISO 7637-2	
Mechanical environment		
Vibrations	IEC 60068-2-64	Random broad-band
Shock	IEC 60068-2-27	
Bump	IEC 60068-2-29	
Enclosure class	IP65 acc. to IEC 60529 / SS EN 60529 / EN60529	Dust and waterproof
Housing & Dimensions		
Weight	0.95 kg	Excl. connected contact
Housing material	Pressure die-cast alum., powder coating	
Housing breathing	GORE-TEX® membrane	
Outer dimensions	223 x 152 x 47 (mm)	

CRANE

CRANE unit - Part No: 5010 3500

Power supply

	Data range				
Function	**min.**	**typical**	**max.**	**Unit**	**Comment**
Supply voltage	**11**	**24**	**30**	V	Vbatt Power
Max. current			15	A	Output configuration must be adapted to the maximum permissible total current for the control unit.
Ripple supply voltage			0.5	Vp-p	
Vref-Sensor 5V	4.95	5.00	5.05	V	
Load on Vref-Sensor 5V			200	mA	Inernal short-circuit protection

Data communication

	Data range				
Function	**min.**	**typical**	**max.**	**Unit**	**Comment**
CAN port 1		500		kbps	Derivat of CANopen/CAN2.0B Physical layer: ISO11898
RS232		9600		bps	8 bit, 1 stop bit, no parity check

Microprocessor and built-in functions

Function	**Comment**
Processor	ST Microelectronics 16-bit microprocessor
System SW	Flash memory
Primary memory	RAM
Error log	EEPROM
CAN controller	1 FULL CAN controller /CAN 2.0B
External communication	1 UART-RS232
A/D converter	10-bit
Watchdog	Internal for CPU and external for program execution

Analog-IN

	Data range				
Function	**min.**	**typical**	**max.**	**Unit**	**Comment**
Analog IN (0-5V)					
Low limit		0	0.05	V	
High limit	4.95	5.0	5.05	V	
Impedance, Analog IN 08-12 (4 inputs)		100		kΩ	
Signal resolution		5		mV	10-bit
Resistance range, external potentiometers		1-5		kΩ	

Digital-IN, Digital-OUT

Function	**Data range**			**Unit**	**Comment**
	min.	**typical**	**max.**		
DIGITAL IN (24V nom.)					
Low limit	0		0.8	V	OFF with open input
High limit	2.0		45	V	
Impedance		18		kΩ	
DIGITAL OUT high side (24V nom.)					
Output activated	11	24	30	V	Equals system supply voltage
Output inactive		0		V	
Max. load			1.5	A	Load each output
Ma. load, total		3		A	Total, activated outputs
The outputs are short-circuit protected					

PWM-OUT

	Data range				
Function	**min.**	**typical**	**max.**	**Unit**	**Comment**
PWM OUT +/- (0-1600 mA)					
Current RMS (effective)	0		1600	mA	Accuracy +/- 2 mA
Resolution current value		1.6		mA	10-bit
Ripple current, amplitude	0	50	300	mA	Less than set min. current value
Ripple frequency	80	100	350	Hz	
Baseline frequency	5	20	20	kHz	
Valve coil resistance, 24 V coils	20	22	30	Ω	Supply voltage 20-30 V
Valve coil resistance, 12 V coils	5	8	10	Ω	Supply voltage 11-15 V
Short circuit protection		3.6		A	Triggered after 150-200 ms

Note: PWM outputs may only be used for valve coils (inductive loads).

Environmental & Mechanical data

Function	Data	Comment
Temperature range		
Operating temperature	min. -40 ^{o}C - max. +70^{o}C	
Storage temperature	min. -40 ^{o}C - max. +80 ^{o}C	
EMC class		
Radiated emission	95 / 54 / EC	Automotive
Radiated RF immunity	95 / 54 / EC	Automotive
Electrostatic discharge	ISO 10605	
Transient immunity	ISO 7637-2	
Mechanical environment		
Vibrations	IEC 60068-2-64	Random broad-band
Shock	IEC 60068-2-27	
Bump	IEC 60068-2-29	
Enclosure class	IP65 acc. to IEC 60529 / SS EN 60529 / EN60529	Dust and waterproof
Housing & Dimensions		
Weight	0.95 kg	Excl. connected contact
Housing material	Pressure die-cast aluminum, powder coating	
Housing breather filter	GORE-TEX® membrane	
Outer dimensions	223 x 152 x 47 (mm)	

EXPANSION

EXPANSION unit - Part No: 5010 4000

Power supply

		Data range				
Function		**min.**	**typical**	**max.**	**Unit**	**Comment**
Supply voltage		**11**	**24**	**30**	V	Applies to both Vbatt SYS and Vbatt Power-OUT
Max. current	Vbatt SYS		1		A	Output configuration must be adapted to the maximum permissible total current for the control unit.
	Vbatt Power-OUT			15		
Ripple supply voltage				0.5	Vp-p	
Vref-Sensor 5V		4.95	5.00	5.05	V	
Load on Vref-Sensor 5V				200	mA	Internal short-circuit protection

Data communication

	Data range				
Function	**min.**	**typical**	**max.**	**Unit**	**Comment**
CAN port 1		500		kbps	Derivat of CANopen/CAN2.0B Physical layer: ISO11898
CAN port 2			1000	kbps	CAN custom spec. /CAN2.0B Physical layer: ISO11898
RS232		9600		bps	8 bit, 1 stop bit, no parity check

Microprocessor and built-in functions

Function	**Comment**
Processor	ST Microelectronics 16-bit microprocessor
System SW	Flash memory
Primary memory	RAM
Error log	EEPROM
CAN controller	2 FULL CAN controllers / CAN 2.0B
External communication	1 UART-RS232
A/D converter	10 bit
Watchdog	Internal for CPU and external for program execution

Analog-IN, Analog-OUT, Frequency-IN

		Data range				
Function		**min.**	**typical**	**max.**	**Unit**	**Comment**
ANALOG IN (0-5V)						
Low limit			0	0.05	V	
High limit		4.95	5.0	5.05	V	
Impedance, Analog IN 04-10			100		kΩ	
Impedance, Analog IN 11-13			18		kΩ	Not for pot. joysticks
Signal resolution			5		mV	10-bit
Resistance range external potentiometers			1-5		kΩ	
SERVOMOTOR OUT						
PWM frequency			20		kHz	
Current				2	A	Overload protected
Signal resolution			1024		bits	
FREQUENCY-IN						
Freq.- IN 00	Signal amplitude 1 V	3		1000	Hz	Input are adapted to measure, for example, the RPM of diesel engines using inductive passive sensors.
	Signal amplitude 10 V	3		15000	Hz	
	Signal amplitude range	1		60	V	

Digital-IN, Digital-OUT

Function	**Data range**			**Unit**	**Comment**
	min.	**typical**	**max.**		
DIGITAL IN (24V nom.)					
Low limit	0		0.8	V	OFF with open input
High limit	2.0		45	V	
Impedance		18		kΩ	
DIGITAL OUT high side (24V nom.)					
Output activated	11	24	30	V	Equals supply voltage
Output inactive		0		V	
Max. load			1.5	A	Load per output
Max. load total		12		A	Total, activated outputs
The outputs are short-circuit protected					

PWM-OUT

	Data range				
Function	**min.**	**typical**	**max.**	**Unit**	**Comment**
PWM OUT +/- (0-1600 mA)					
Current RMS (effective)	0		1600	mA	Accuracy +/- 2 mA
Resolution current value		1.6		mA	10-bit
Ripple current, amplitude	0	50	300	mA	Less than set min. current value
Ripple frequency	80	100	350	Hz	
Baseline frequency	5	20	20	kHz	
Valve coil resistance, 24 V coils	20	22	30	Ω	Supply voltage 20-30 V
Valve coil resistance, 12 V coils	5	8	10	Ω	Supply voltage 11-15 V
Short circuit protection		3.6		A	Triggered after 150-200 ms

Note: PWM outputs may only be used for valve coils (inductive loads).

Environmental & Mechanical data

Function	**Data**	**Comment**
Temperature range		
Operating temperature	min. -40 °C - max. +70°C	
Storage temperature	min. -40 °C - max. +80 °C	
EMC class		
Radiated emission	95 / 54 / EC	Automotive
Radiated RF immunity	95 / 54 / EC	Automotive
Electrostatic discharge	ISO 10605	
Transient immunity	ISO 7637-2	
Mechanical environment		
Vibrations	IEC 60068-2-64	Random broad-band
Shock	IEC 60068-2-27	
Bump	IEC 60068-2-29	
Enclosure class	IP65 acc. to IEC 60529 / SS EN 60529 / EN60529	Dust and waterproof
Housing & Dimensions		
Weight	0.95 kg	Excl. connected contact
Housing material	Pressure die-cast aluminum, powder coating	
Housing breather filter	GORE-TEX® membrane	
Outer dimensions	223 x 152 x 47 (mm)	

TERMINAL T2

TERMINAL T2 - Part No: 5010 1000

Power supply

	Data range				
Function	**min.**	**typical**	**max.**	**Unit**	**Comment**
Supply voltage	**11**	**24**	**30**	V	Vbatt-SYS
Max. current		0.5		A	@ 24V
Ripple supply voltage			0.5	Vp-p	

Data communication

	Data range				
Function	**min.**	**typical**	**max.**	**Unit**	**Comment**
CAN port 1		500		kbps	Derivat of CANopen/CAN2.0B Physical layer: ISO11898
CAN port 2			1000	kbps	CAN customer spec. / CAN2.0B Physical layer: ISO11898
RS232		9600		bps	8 bit, 1 stop bit, no parity check

Microprocessor and built-in functions

Function	**Comment**
Processor	ST Microelectronics 16- bit microprocessor
System SW and Font/Meny data	Flash memory
Primary memory	RAM
Error log	EEPROM
CAN controller	2 FULL CAN controller /CAN 2.0B
External communication	1 UART-RS232
Watchdog	Internal for CPU

DIGITAL-IN, DIGITAL-OUT

Function	Data range			Unit	Comment
	min.	typical	max.		
DIGITAL IN (max. 24 V)					
Low limit		0.8		V	OFF with open input
High limit		2	24	V	
Impedance		18		kΩ	
DIGITAL OUT high side (24 V)					
Output activated	11	24	30	V	Equals supply voltage
Output inactive		0		V	
Max. load		200	250	mA	Limited with PTC-resistor
The outputs are short-ciruit protected					

Environmental & Mechanical data

Function	Data	Comment
Temperature range		
Operating temperature	min. -20 ^{o}C - max. +60^{o}C	
Storage temperature	min. -30 ^{o}C - max. +80 ^{o}C	
Alarm limits internal temp.	< -30 ^{o}C - and >+65 ^{o}C	
EMC class		
Radiated emission	95 / 54 / EC	Automotive
Radiated RF immunity	95 / 54 / EC	Automotive
Electrostatic discharge	ISO 10605	
Transient immunity	ISO 7637-2	
Display		
Type	Graphic LCD, white-LED lit	
Resolution	240 x 128 pixels	
Control buttons	Illuminated membrane buttons	
Mechanical environment		
Vibrations	IEC 60068-2-64	Random broad-band
Shock	IEC 60068-2-27	
Bump	IEC 60068-2-29	
Enclosure class	IP40 acc. to IEC 60529 / SS EN 60529 / EN60529	Dust protected
Housing & Dimensions		
Weight	0.50 kg	
Housing material	Aluminum / end pieces ABS-PC plastic	
Outer dimensions (mm)	204 x120 x 38	

JOYSTICK H5-S50

JOYSTICK H5-S50 - Part No: 5010 2500

Power supply

	Data range				
Function	**min.**	**typical**	**max.**	**Unit**	**Comment**
Supply voltage	**11**	**24**	**30**	V	Vbatt Power
Max. current		0.5		A	
Ripple supply voltage			0.5	Vp-p	
Vref-DIGITAL-IN +5V		5		V	Power output for DIGITAL-IN
Vref-ANALOG-IN +5V	4.95	5.00	5.05	V	Power output for ANALOG-IN

Data communication

	Data range				
Function	**min.**	**typical**	**max.**	**Unit**	**Comment**
CAN port 1		500		kbps	Derivat of CANopen/CAN2.0B Physical layer: ISO11898
RS232		9600		bps	8 bit, 1 stop bit, no parity check

Microprocessor & built-in functions

Function	**Comment**
Processor	ATMEL 8-bit microprocessor
System SW	Flash memory
Primary memory	RAM
Error log	EEPROM
CAN controller	1 FULL CAN controller enl. 2.0B
External communication	1 UART-RS232
A/D converter	10-bit
Watchdog	Internal for CPU

Analog-IN

	Data range				
Function	**min.**	**typical**	**max.**	**Unit**	**Comment**
ANALOG IN internal X/Y/Z-axis					
Signal resolution					10-bit
ANALOG IN external inputs (0- 5V)					
Low limit		0	0.05	V	
High limit	4.95	5.00	5.05	V	
Impedance		100		kΩ	
Signal resolution		5		mV	10-bit
Resistance range, external potentiometers		1-5		kΩ	

DIGITAL-IN, DIGITAL-OUT

Function	**Data range**			**Unit**	**Comment**
	min.	**typical**	**max.**		
DIGITAL IN (max. 5 V)					
Low limit		0		V	OFF with open input
High limit		5		V	
Impedance		22		kΩ	
DIGITAL OUT (24 V nom.)					
Output activated	11	24	30	V	Equals supply voltage
Output inactive		0		V	
Max. load			200	mA	Load per output
The outputs are short-circuit protected					

PWM-OUT

	Data range				
Function	**min.**	**typical**	**max.**	**Unit**	**Comment**
PWM OUT (0-200 mA) non current feed back outputs					
Output voltage	11	24	30	V	Supply voltage
Resolution current value		255		steps	
Max. output current			200	mA	
Baseline frequency	28	30	32	Hz	

Environmental & Mechnical data

Function	Data	Comment
Temperature range		
Operation temperature	min. -30 ^{o}C - max. +50^{o}C	
Storage temperature	min. -40 ^{o}C - max. +85 ^{o}C	
EMC klass		
Radiated emission	95 / 54 / EC	Automotive
Radiated RF immunity	95 / 54 / EC	Automotive
Electrostatic discharge	ISO 10605	
Transient immunity	ISO 7637-2	
Mechanical environment		
Vibrations	IEC 60068-2-64	Random broad-band
Shock	IEC 60068-2-27	
Bump	IEC 60068-2-29	
Enclosure class	IP52 acc. to IEC 60529 / SS EN 60529 / EN60529	Dust protected
Housing & Dimensions		
Weight	0.55 kg	
Housing material	Deep drawn aluminum	
Housing breather filter	-	
Outer dimensions (mm)	157 x 92	

Chapter 8

Dimensions & Mounting

General

This chapter describes dimensions and installation principles for each control unit in the CANmaster system.

MASTER, CRANE & EXPANSION

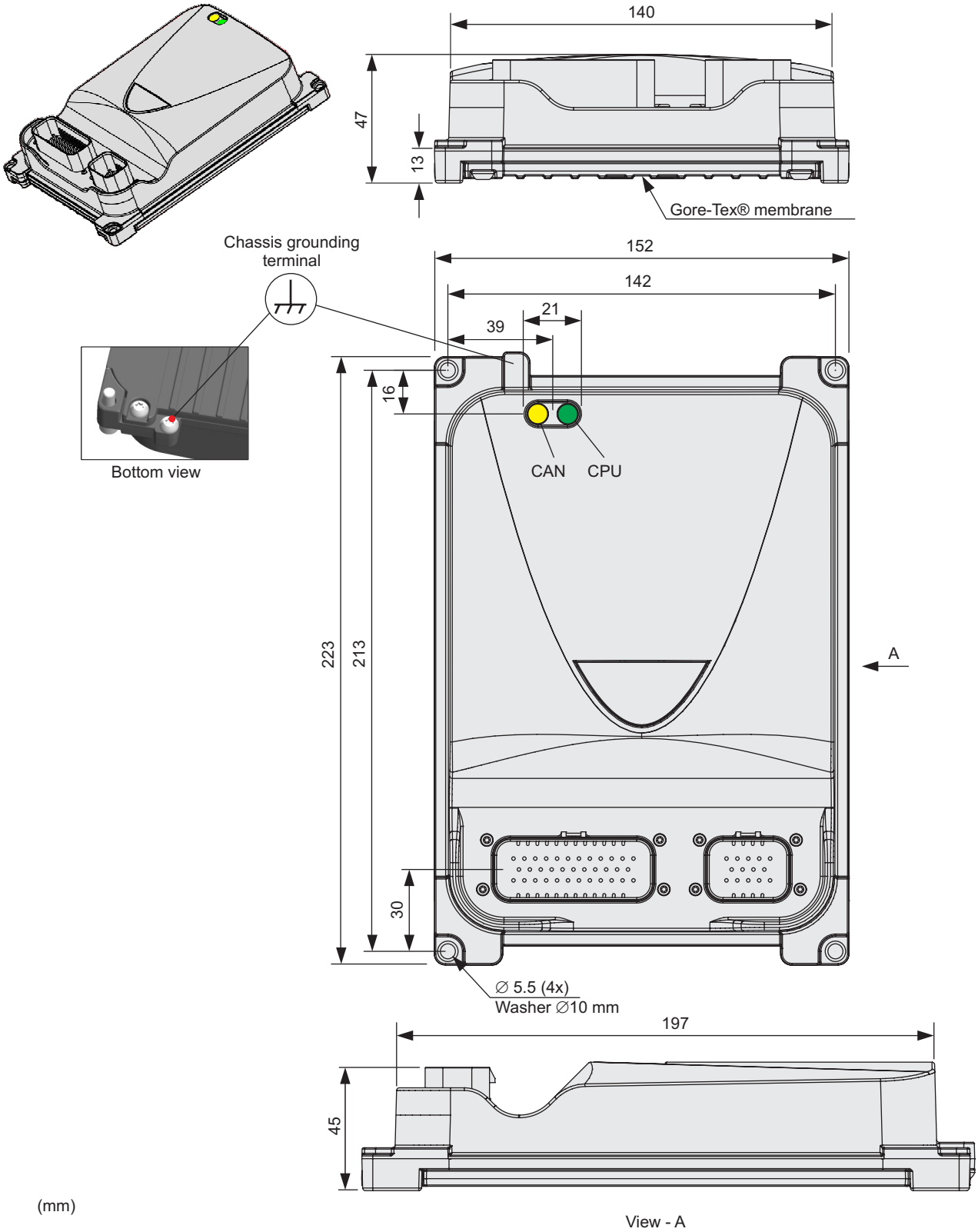
The Master, Crane and Expansion control units have identical dimensions and the same location options in the machine.

The units must be protected against mechanical knocks, impacts, powerful high-frequency vibrations and direct soaking with water, but otherwise they can be placed anywhere on the outside of the machine. The underside should never face upwards as this could allow water and contaminants to collect on the Gore-Tex membrane that is intended to provide ventilation to the enclosure. The units are classified as dust-proof and watertight with protection class IP65, though they must not be exposed to continuous soaking with water and they should not be washed using a high-pressure washer.

The mounting surface beneath the control unit must be flat to avoid the risk of the enclosure becoming deformed when tightening the mounting screws. An O-ring provides a seal between the bottom cover and the upper part of the enclosure.

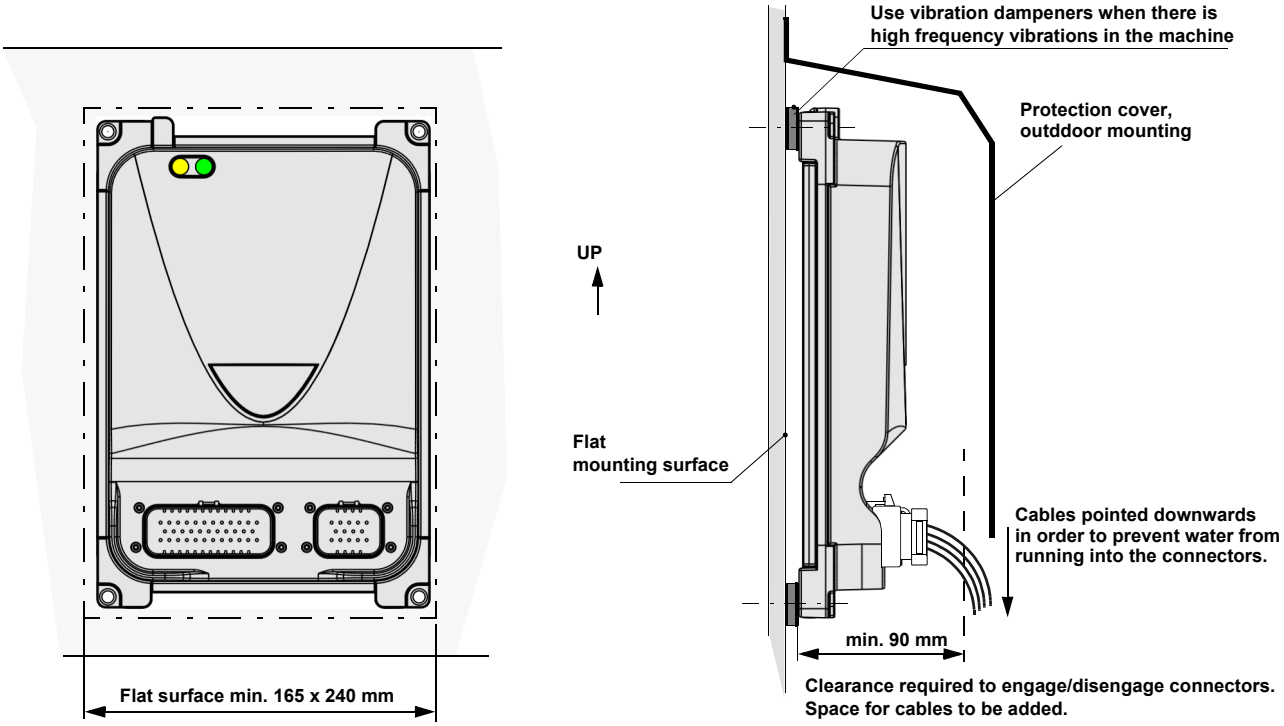
Make sure that the cabling to the connectors is fitted in such a way that water cannot run along the cables and accumulate in the connectors. Each wire in the outer contact is sealed with a rubber membrane, though accumulations of standing water must be avoided to prevent water getting into the contact housing, as this could otherwise cause corrosion and oxide formation. When fitting the wires to the contact, holes are pierced in the membrane for each individual wire. If a wire is removed from the contact, a sealing plug must be put in its place in order to prevent water getting into the contact housing. See also the chapter 'Connectors & Cables'.

Dimensions

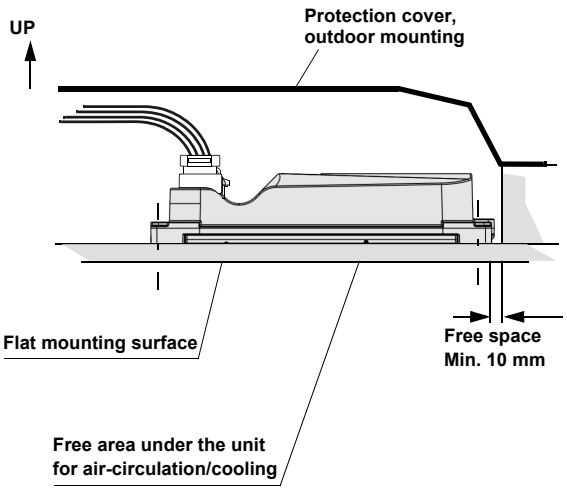

140
47
13
Gore-Tex® membrane
Chassis grounding terminal
152
142
21
39
16
CAN
CPU
Bottom view
223
213
30
A
∅ 5.5 (4x)
Washer ∅10 mm
197
45
(mm)
View - A

Mounting

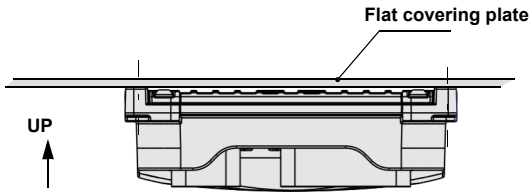
1. STANDARD VERTICAL MOUNTING POSITION WITH THE CONNECTORS FACING DOWN



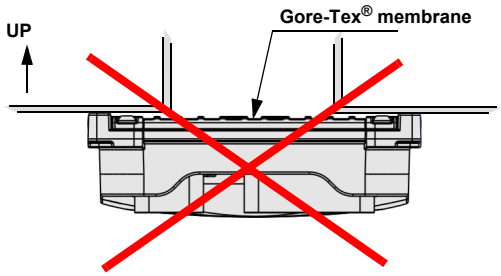
2. HORIZONTAL MOUNTING POSITION



3. MOUNTING POSITION WITH BOTTOM SIDE UP



NOT RECOMMENDED MOUNTING POSITION

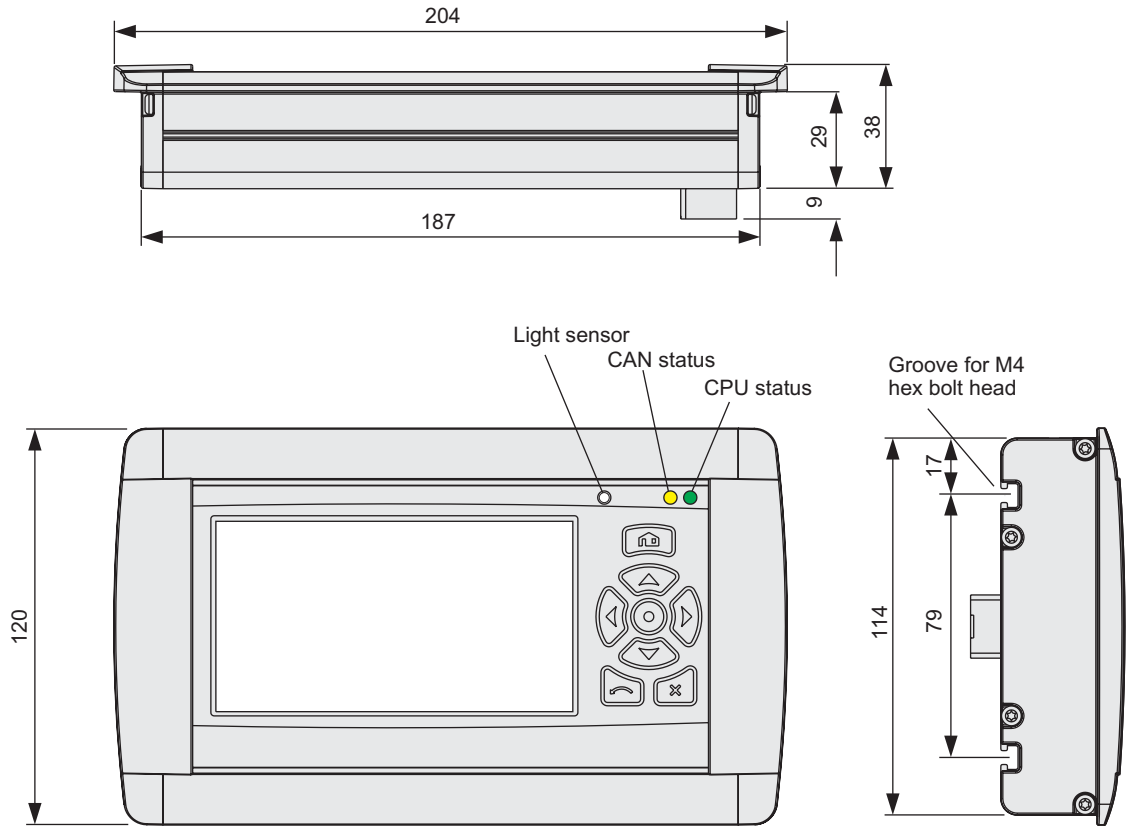


The control unit should be installed such a way that it is protected from mechanical damage and must not be exposed to direct contact with water continously.

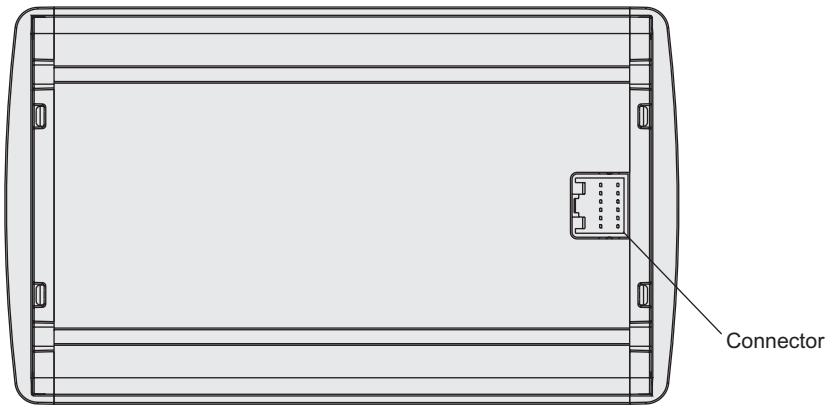
Do not use high pressure cleaning.

TERMINAL T2

Dimensions



Display b/w 240 x 128 pixles

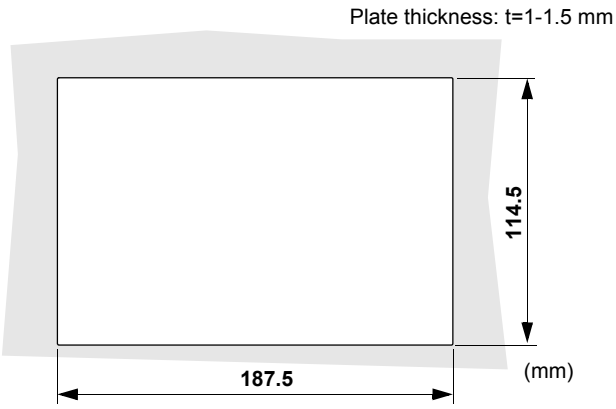


(mm)

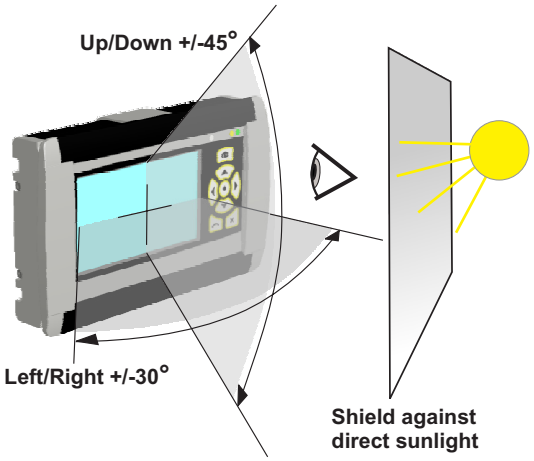
Rear view

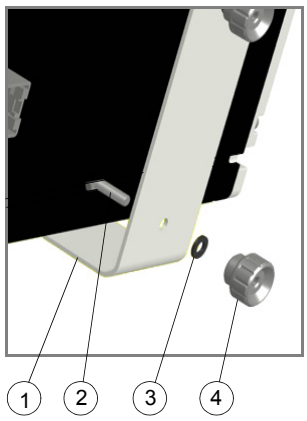
Panel mounting

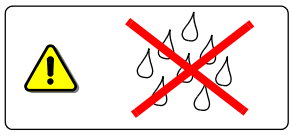
Panel cut-out



Viewing angles





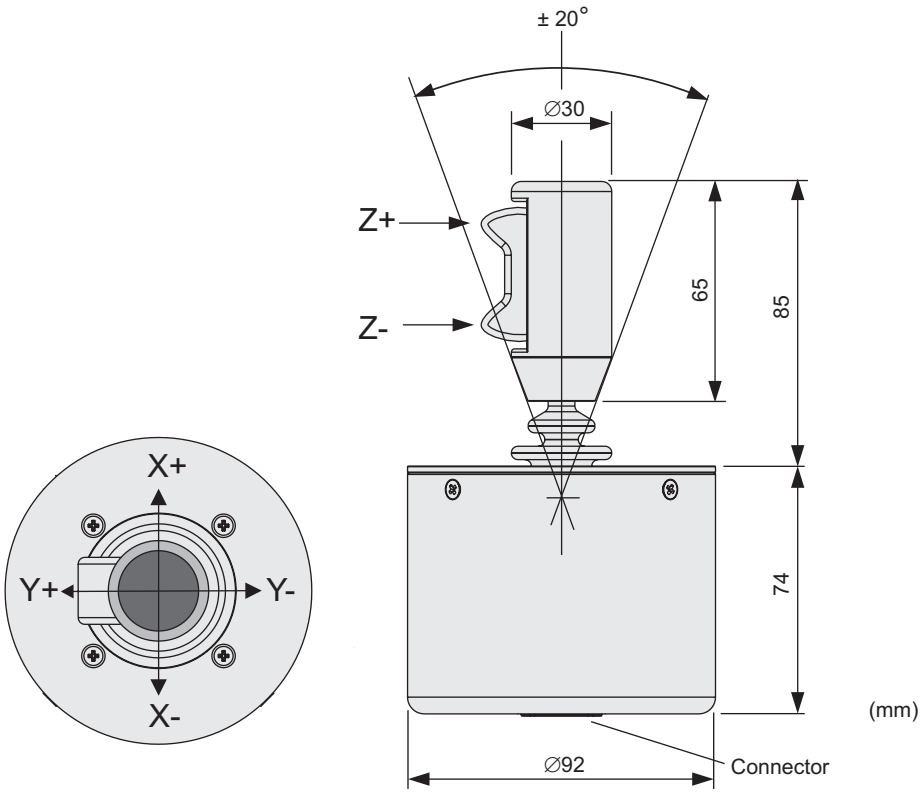


Fastening kit for panel mounting, compl., part no: 5010 1500
Included parts:

Pos no.	Part no.	Qty	Designation	Description
1	5010 1501	1	Clamp	
2	5010 1502	2	Hex bolt	M4x20
3	5010 9003	2	Lock washer	DIN6798A, 4.3 fzb
4	5010 1503	2	Knob	M4

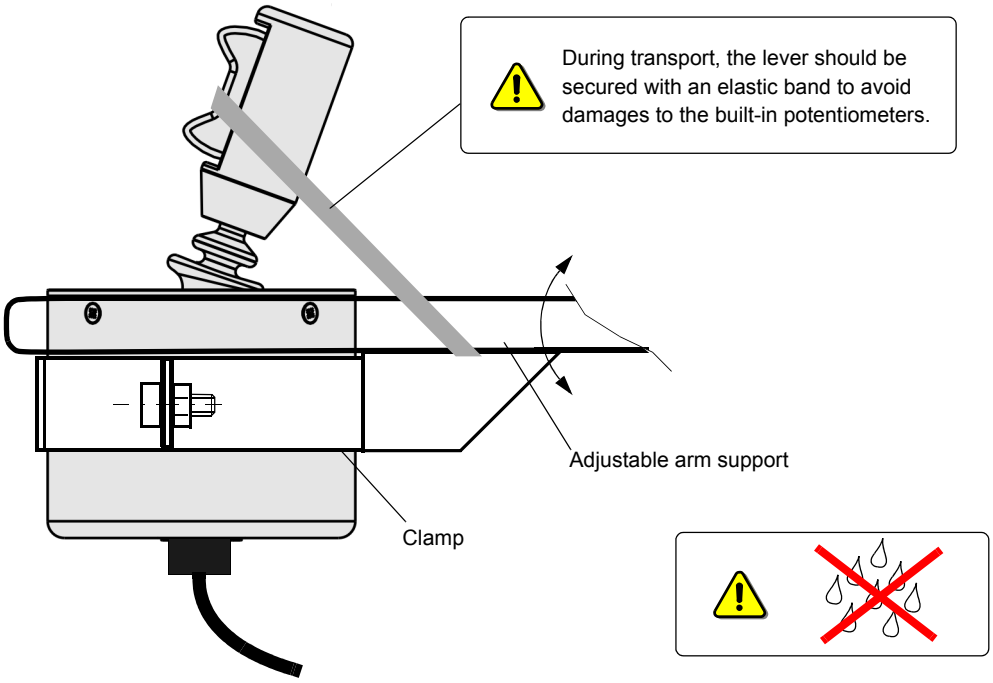
JOYSTICK H5-S50

Dimensions



Mounting

Recommended mounting: Bracket with clamp around joystick housing.

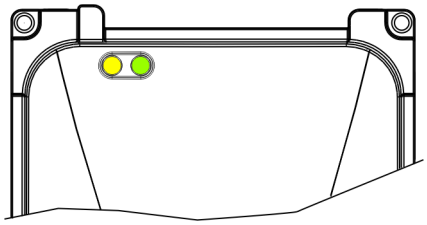


External system LED indicators

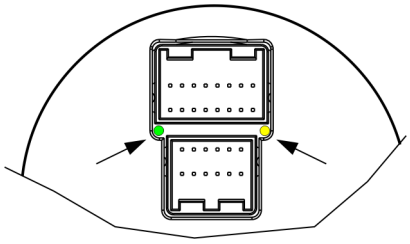
LEDs for indication of the system's operational status

All units in the CANmaster system are equipped with 2 LEDs to indicate operational status, a YELLOW LED for CAN-bus status and a GREEN LED for CPU status. The Master unit indicates when errors occur in any of the units in the system. When the CAN-bus communication and all parts in the system works as intended, both LEDs on the Master unit glow steadily.

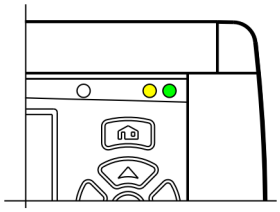
MASTER, CRANE & EXPANSION



JOYSTICK H5-S50

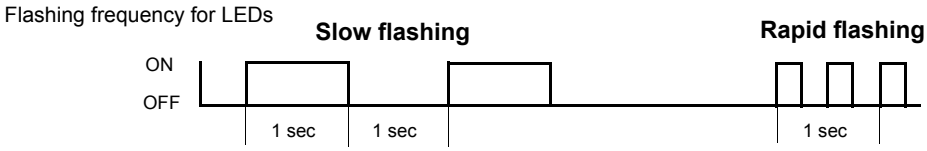


TERMINAL T2



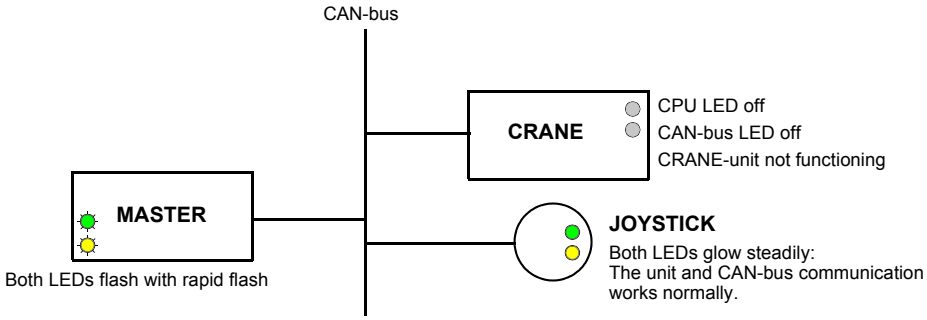
LED status	CAN STATUS (Yellow)
OFF	Unit lacks power or will not start.
Slow flash	No communication via CAN-bus.
Rapid flash	Fault in CAN-bus communication in the unit. For the Master-unit: Fault in Master unit's CAN-bus communication or in another part of the system.
Steady glow	CAN-bus communication works normally for the unit. For the Master-unit: CAN-bus communication works normally for the entire system.
LED status	**CPU STATUS (Green)**
OFF	Unit lacks power or will not start.
Slow flash	Standby position or configuration position.
Rapid flash	Internal fault in the unit. For the Master-unit: Fault in the Master unit or in other units connected to the system.
Steady glow	Unit works normally. For the Master-unit: The entire system works normally

LED flash frequency



Example of fault indication

A fault in the CRANE-unit with faults in both the CPU and the CAN-bus for the unit



For advanced trouble shooting, see CANmaster PC-Tool User Manual- Developer.

Chapter 10

Test units

General description

This chapter describes the separate test units used in CANmaster system to facilitate testing of the control system's program functions without the control units needing to be connected to the machine's various operating levers, valves and sensors.

For every type of control unit - MASTER, CRANE, EXPANSION, JOYSTICK and TERMINAL there is a corresponding unique test unit with the same I/O configuration as the control unit. The test units are connected to the relevant control unit via the unit's normal connector with a complete pin-to-pin cabling for I/O signals, power supply and CAN-bus communication.

The input signals to the control system are regulated with the aid of the test units' built-in potentiometers, on/off switches and frequency generators. The outputs are connected to indicating lights for on/off outputs and built-in solenoids for PWM outputs.

The test units can also be used as an easy way of downloading the various software programs that are to be stored in the control units, with the possibility of standardised test procedures run immediately after the download to verify that the downloaded program functions in accordance with the set specifications.

To log signal values of inputs and outputs as a function of time, the separate logging program that forms a part of the CANmaster PC-Tool (see separate manual) is used. In these instances the system computer with its pre installed CANmaster PC-Tool is connected to the test unit's RS232 port on the front panel. The logging program is started up and run in parallel with manual regulation of input signals. Logging of I/O signals is necessary for complex programs where the output signals are dependent on many simultaneously activated input signals, and also constitutes an important component when documenting a specific program sequence.

The test unit for JOYSTICK includes a facility for testing two three axis joysticks in the same unit.

To facilitate testing and troubleshooting of the components (valves and sensors) that are used in the machine applications, there are also a limited number of I/Os on each control unit for connection of external PWM-controlled valves, on/off switches, potentiometers, operating levers and sensors. For each internal frequency input on the test units there is also the possibility of connecting an external frequency signal to the input.

Potentiometers and sensors of the voltage type must always be provided with +5V from the control system's built-in voltage source corresponding to the connections 'Vref sensor +5V' and 'Vref sensor GND'. Sockets for this purpose are included in the test units and must be used for tests using externally connected components. Conversion to a voltage signal is required for tests using a current-based sensor. See circuit diagrams Chapter 4, on page 13, which describes how this should be carried out.

Communication between control units uses the normal ports for CANopen and is available on the test units' rear panel. (I/O designation CAN_1). For the MASTER test unit there is also the system's communication port for external systems that communicate with CANbus in accordance with the SAE J1939 protocol standard. (I/O designation: CAN_2).

General design and connection to system

The test units have the same basic design with on/off switches for control of digital inputs and adjusting knobs for analog inputs and frequency inputs. What mutually differentiates the test units is the number and type of I/Os in accordance with the configuration for the corresponding control unit. All test units are equipped with two connecting ports for the CAN bus CANopen (I/O designation CAN_1) for easy connection of the test units to the CAN bus. Prepared cabling is available for this connection.

Page 71 shows a connection diagram for a complete system in which all test units are included. The maximum number of connectable test units of the same type corresponds to the maximum number of control units, i.e. 4 units of the Crane and Expansion type and two units of the double test unit for Joysticks. Addressing of the units (address 00, 01, 02 or 03) is performed using the dip switches on the rear panel.

I/O with alternative function

For the I/Os that can be configured as an alternative type of I/O, there is a marking in the form of a bidirectional arrow symbol on the front panel of the test units. In these cases the relevant 3-position on/off switch has a double function and regulates the status of the digital input in question (ON or OFF) and selection of the alternative I/O positioned right above the switch. With the switch set to the upper position, the function to be found right above the switch applies. With the switch set to the central position the digital input is active with status = OFF, and in the lower position, active with status = ON.

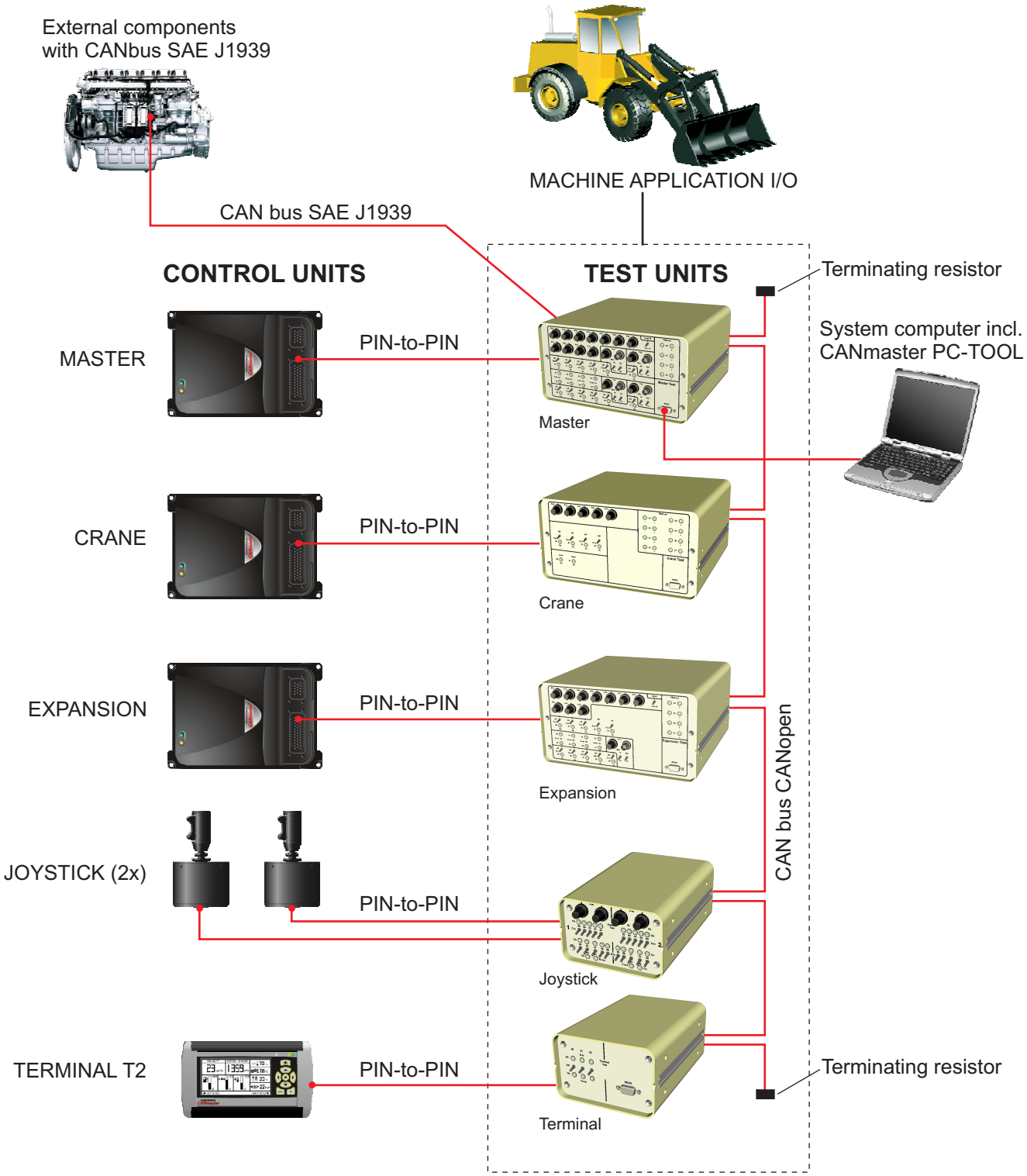
Selection between various types of I/O is defined in the application program, and all relevant switches on the test units must be set to the correct position in accordance with the program so that testing can be performed correctly.

Test of external components

The connection diagrams for the test unit show how external components of various types can be connected to the test units by breaking the internal circuit for an I/O with a removable connecting bridge. When a bridge is removed the blue I/O-socket on the testunit is connected directly to the corresponding contact pin (I/O pin) on the control unit and is galvanically insulated from the test unit. The standard configuration for the test units is with all connecting bridges installed, and it is only for testing of external components that the bridges need to be removed. Note that the yellow socket on the test unit, which is open when a bridge is removed, must not be connected to a component, but must be left open.

Standard cabling that has been specially adapted for the test equipment can be ordered using the Article No. in accordance with the specification on page 78.

Test units - Connection diagram overview

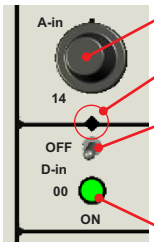


Note: The test units can be connected to the CAN-bus network where desired.

Test unit MASTER - Front panel

The appropriate parts of the description below also apply to the front panel of the test units Crane and Expansion.

Analog-IN 14 or Digital-IN 00:



Adjusting knob for Analog-IN 14 (potentiometer).

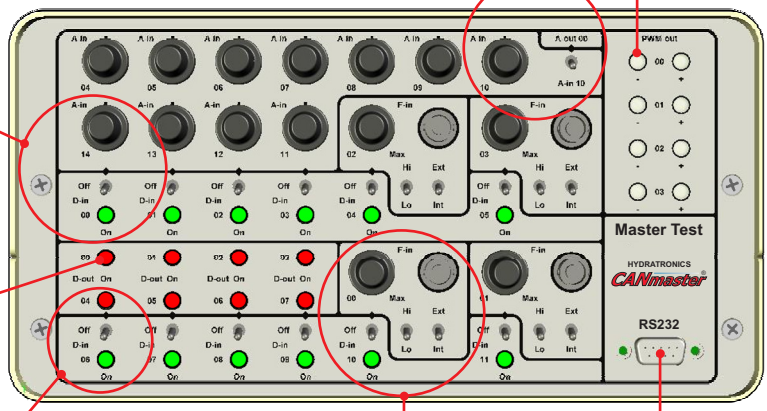
Symbol stipulating that the switch regulates an alternative I/O.

3- position switch for Digital-IN 00 and selector Digital-IN 00 / Analog-IN 14:
- position UP = Analog-IN 14 active / Digital-IN 00 inactive
- position CENTER = Digital-IN 00, status=OFF / Analog-IN 14 inactive
- position DOWN = Digital-IN 00, status=ON / Analog-IN 14 inactive

Indicating light for Digital-IN 00 (light ON = input status ON).

Analog-IN 10 or Analog-OUT 00
Sockets for Analog OUT, see rear panel.

*2)
Proportional lights for PWM OUT 00-03:
(+) = control current in (+) direction
(-) = control current in (-) direction



Indicating lights for Digital OUT 00-07 (8 outputs)

3-position switch for Digital-IN 06 or Digital-OUT 04:
- positon UP: Digital-OUT 04 active / Digital-IN 06 inactive
- position CENTER: Digital IN 06, status=OFF / Digital OUT 04 inactive
- position DOWN: Digital IN 06, status=ON / Digital OUT 04 inactive

1

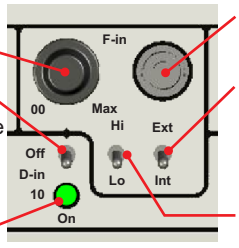
RS232 PC communication port.
9 pin D-sub female connector.

***1) Frequency input Freq.-IN 00 or Digital-IN 10:**

Built-in frequency generator for Freq. IN 00

3-position switch for Digital-IN 10 or Freq-IN 00:
- position UP: Freq.-IN 00 active / Digital-IN 10 inactive
- position CENTER: Digital IN 10, status=OFF / Freq-IN 00 inactive
- position DOWN: Digital IN 10, status=ON / Freq-IN 00 inactive

Indicating light for Digital-IN 10.



Connection for external frequency signal, Freq.-IN 00.

2-position selector switch external / internal frequency signal, Freq.-IN 00:
- position EXT: external frequency signal
- position INT: internal frequency signal

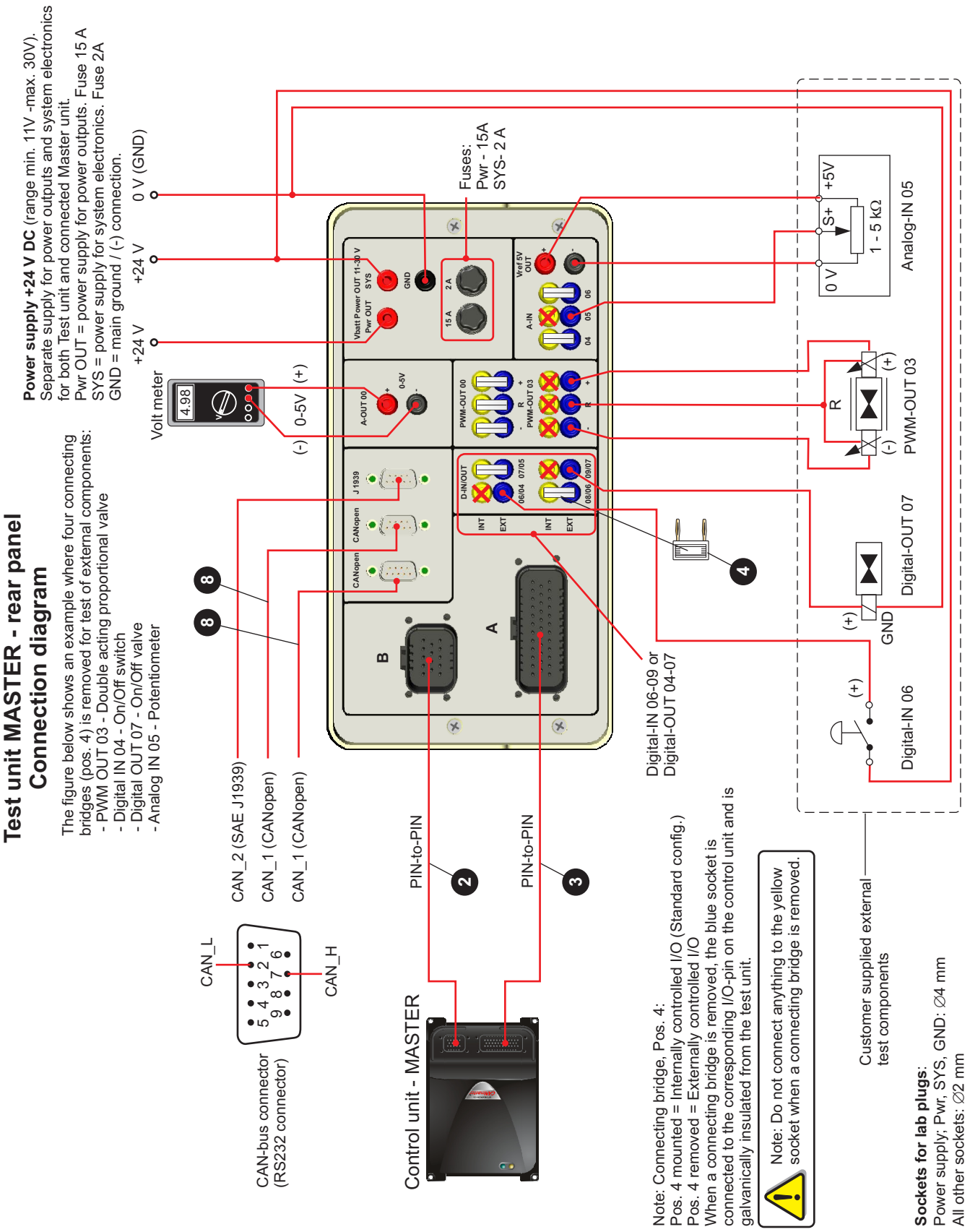
2-position switch for frequency range, internal frequency signal, Freq.-IN 00: *3)
- position LOW: approx. 10 Hz - 5 kHz (± 1%)
- position HIGH: approx. 30 Hz - 15 kHz (± 1%)

*1) Note:
The description above for Freq.-IN 00 applies to all frequency inputs for test unit Master (Freq. IN 00-03) and Freq-IN 00 for test unit Expansion.

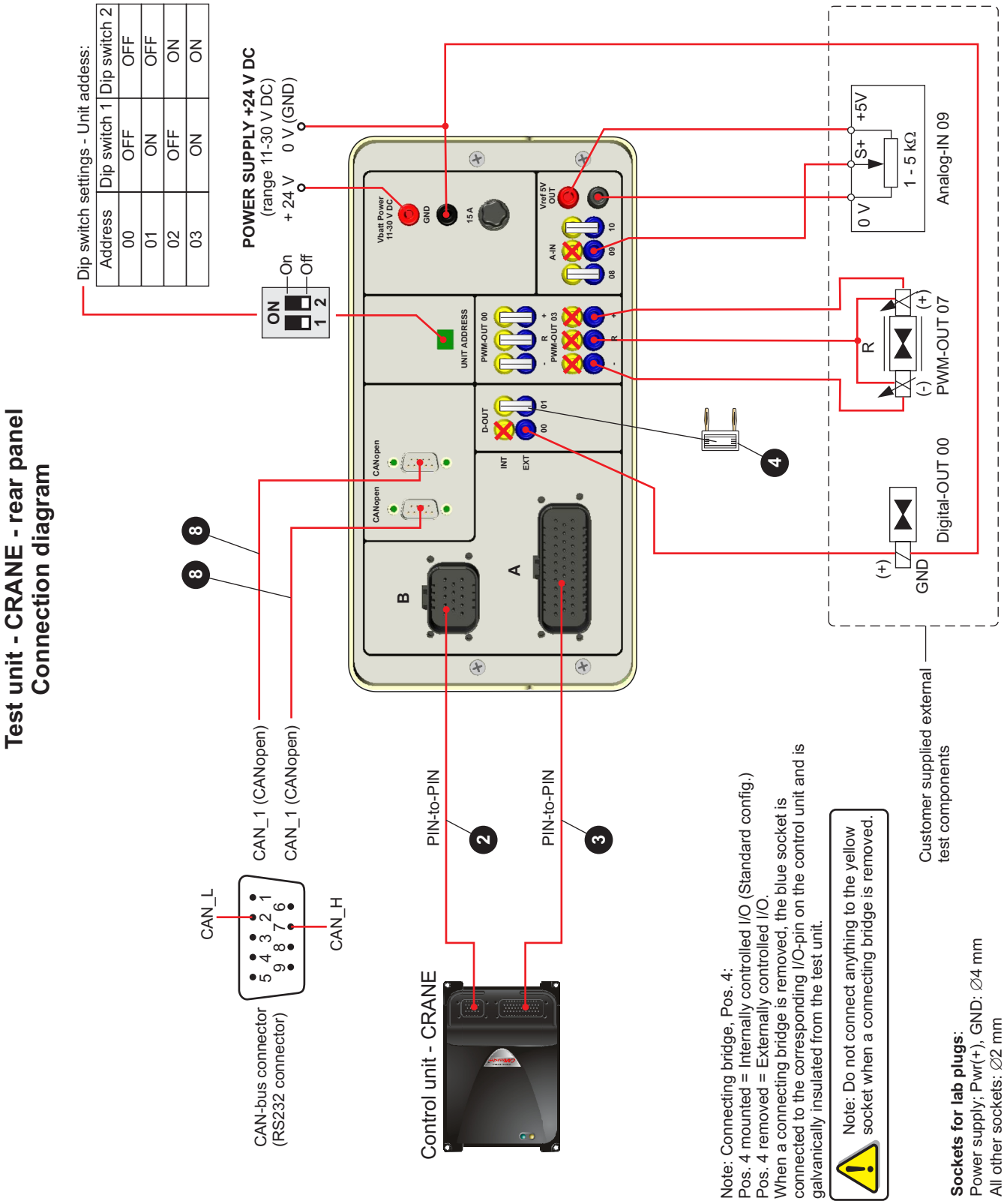
*3) Note:
A high resolution frequency signal may require an external frequency generator.

*2) Note:
The test unit have built-in valve solenoids for all double acting PWM-outputs. This also applies to the test units Crane and Expansion.
Solenoid control current capacity: 0 - 1600 mA.

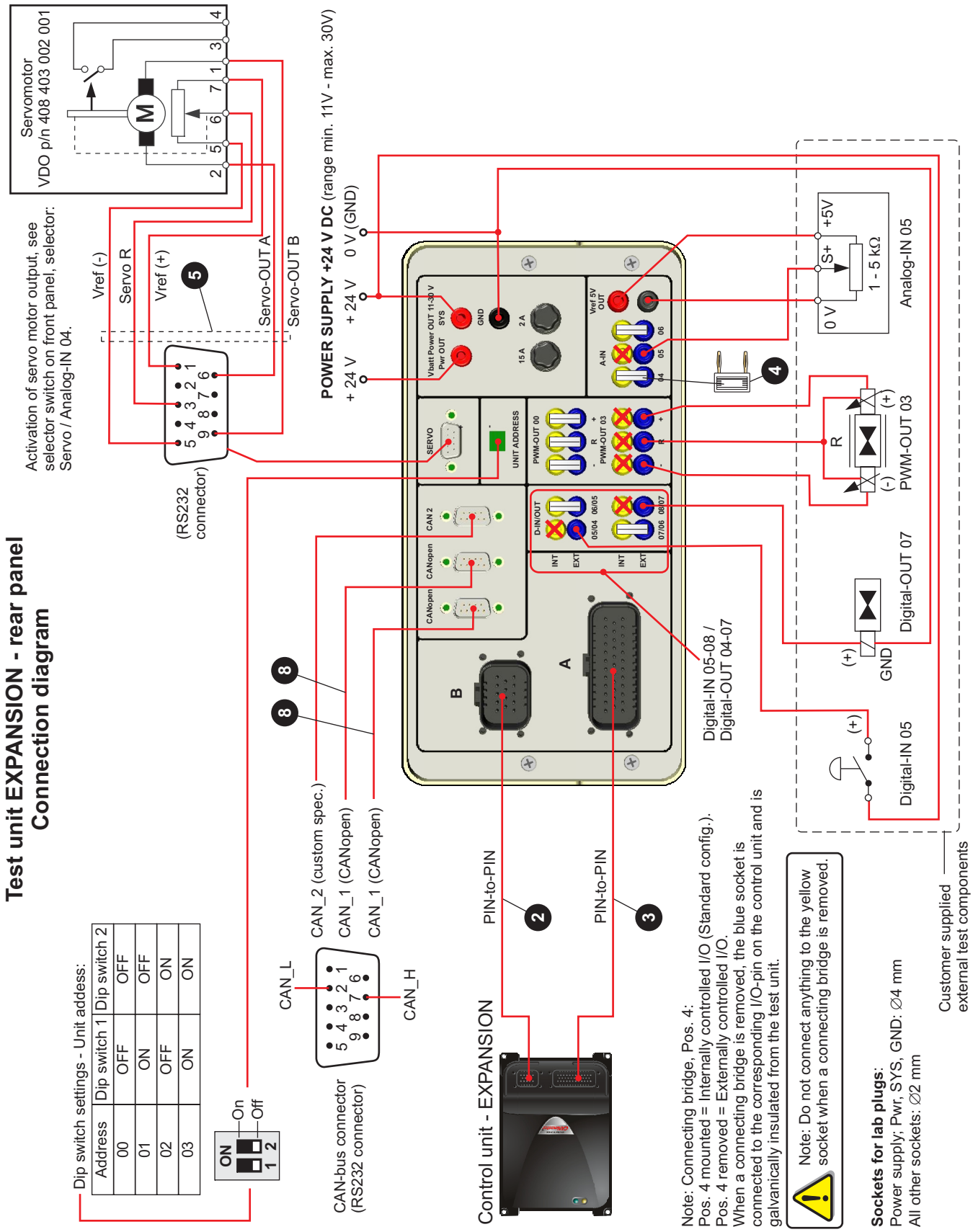
Test unit MASTER - Rear panel - Connection diagram



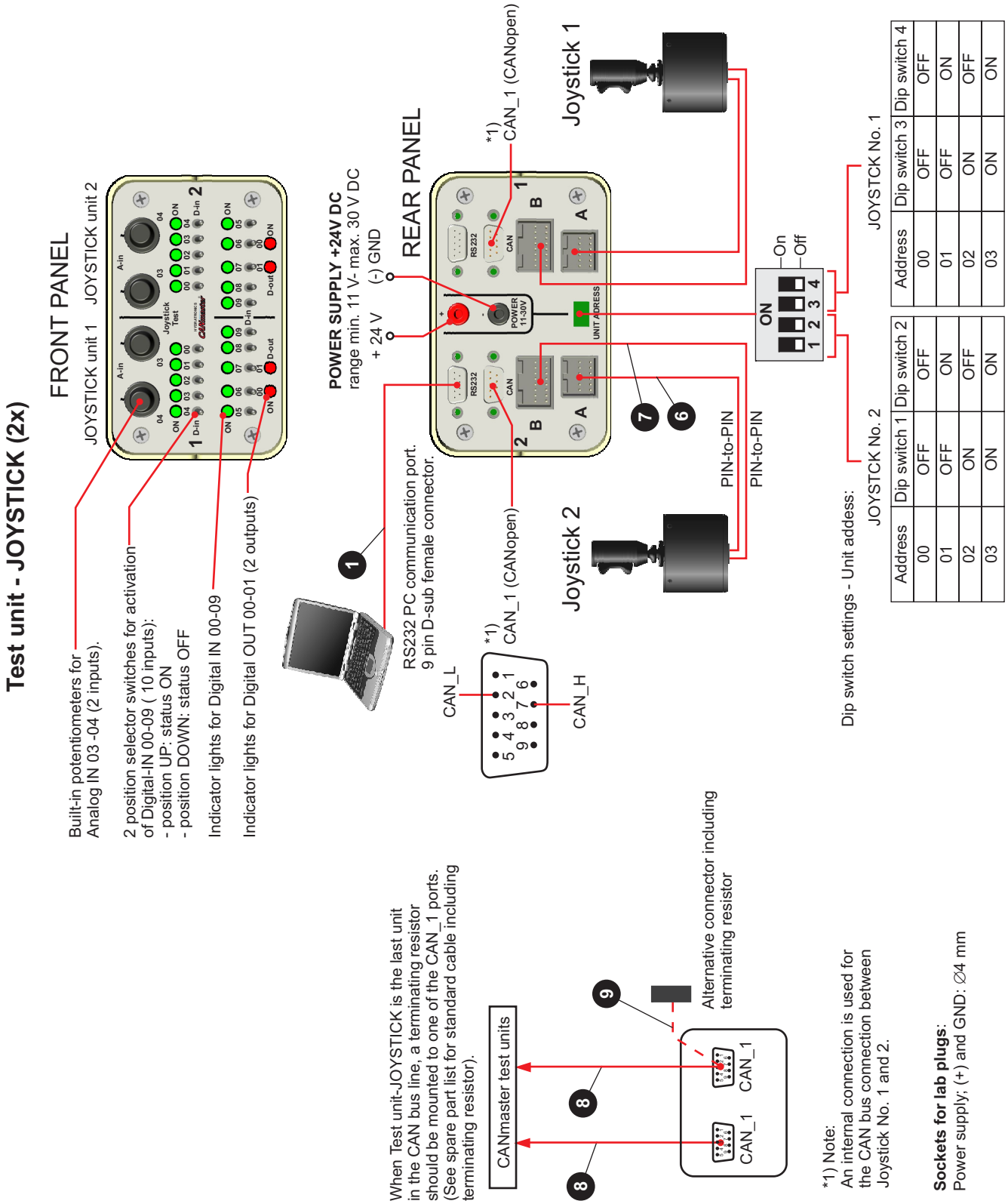
Test unit CRANE - Rear panel - Connection diagram



Test unit EXPANSION - Rear panel- Connection diagram



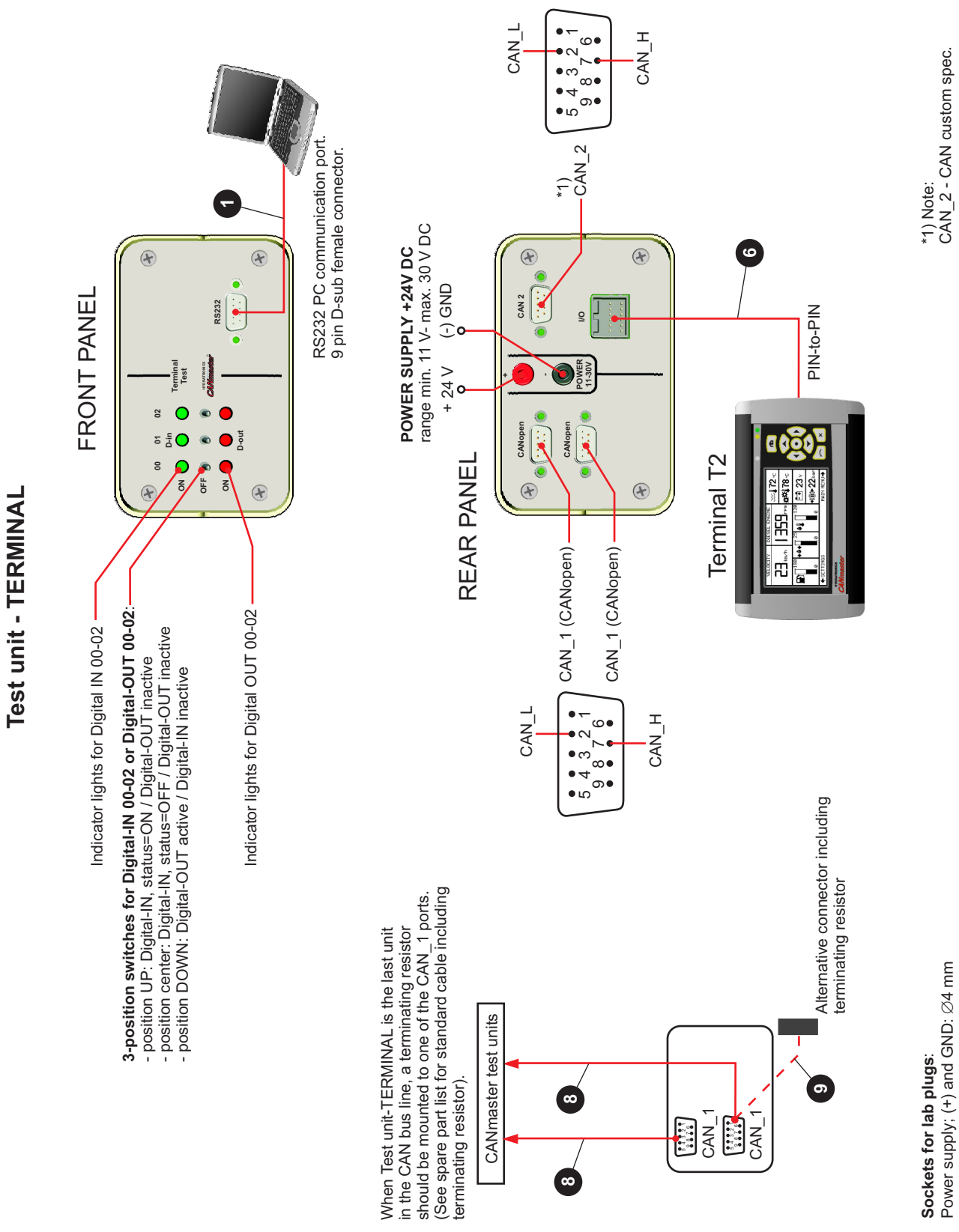
Test unit JOYSTICK- Frontpanel, Rearpanel - Connection diagram



Address	Dip switch 1	Dip switch 2
00	OFF	OFF
01	OFF	ON
02	ON	OFF
03	ON	ON

Address	Dip switch 3	Dip switch 4
00	OFF	OFF
01	OFF	ON
02	ON	OFF
03	ON	ON

Test unit TERMINAL - Front panel, Rear panel - Connection diagram



Spare parts

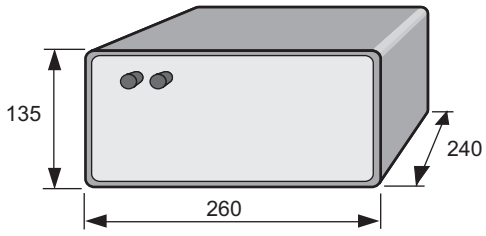
Ref. No., see connection diagrams for Test units.

Ref. No.	Component	Part No.	Comment
1	Connection cable	5010 3057	System PC - Test unit. RS232 communication cable
2	Connection cable	5015 1020	Test unit Master/Expansion/Crane, **B** connector, 14-pin
3	Connection cable	5015 1025	Test unit Master/Expansion/Crane, **A** connector, 35-pin
4	Connecting bridge	5010 3059	Test unit rear panel. Bridge, external I/O socket.
5	Connection cable	5010 4055	Test unit Expansion, Servo-OUT *1)
6	Connection cable	5015 1030	Test unit Joystick/Terminal, **A** connector, 12-pin
7	Connection cable	5015 1035	Test unit Joystick, **B** connector, 16-pin
8	Connection cable	5010 3055	CAN-bus
9	Terminating resistor	5010 3058	Connector including CAN-bus terminating resistor
10			
11			
12			

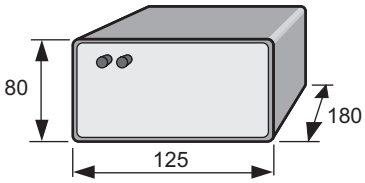
*1) Cable adapted for VDO servo motor p/n: 408 403 002 001

Dimensions

Test unit MASTER, CRANE and EXPANSION:



Test unit JOYSTICK and TERMINAL



(mm)

Chapter 11

Sensors

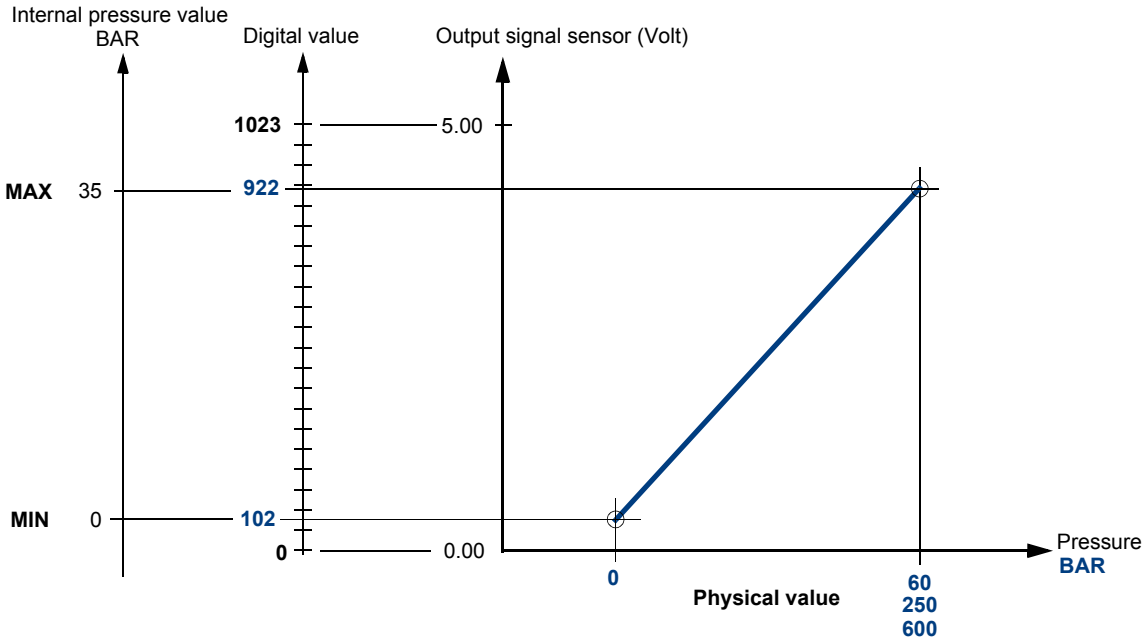
Calibration values for analog sensors

For detailed instructions how to calibrate sensors, see the CANmaster PC-Tool User Manual. The information in this chapter is indended as general information showing actual average values for some of the sensors often used in combination with CANmaster control system.

Pressure sensors

Pressure sensors, 0-60, 0-250 and 0-600 BAR. Voltage signal, ratiometric 10-90%. Supply voltage, 5 Volt.
Hydratronics, Part No.: 0-60 bar: 5010 90 16
0-250 bar: 5010 90 20
0-600 bar: 5010 9030

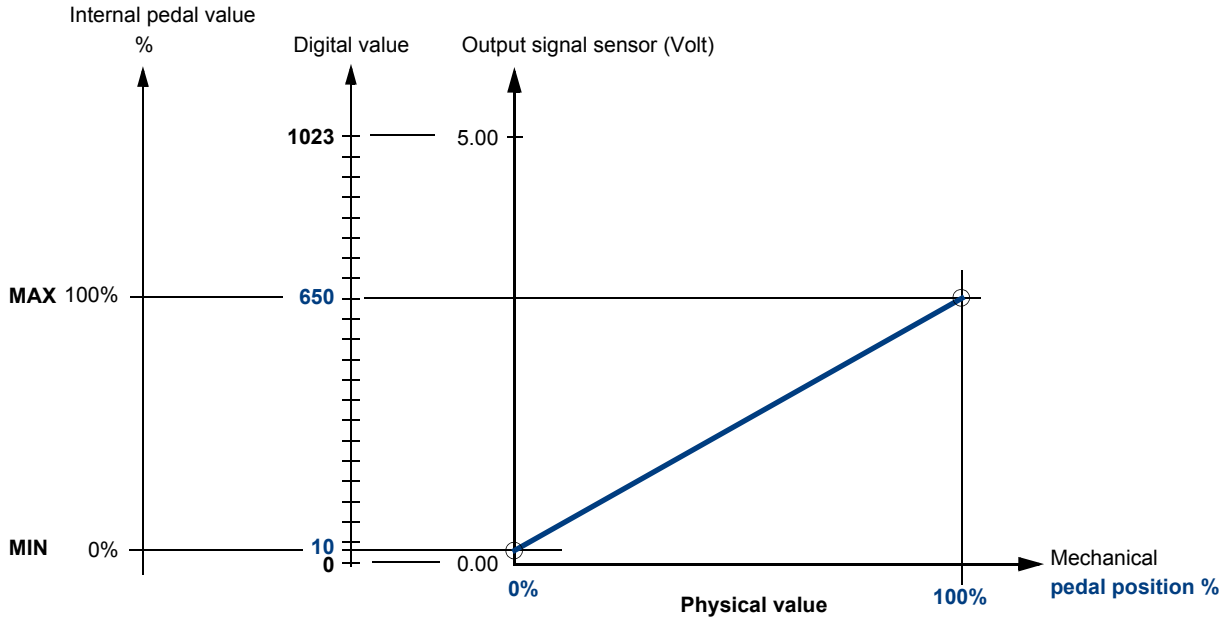
Note: Diagram shows typical values:



Electric accelerator pedal (speed pedal) with VDO-potentiometer

Electric accelerator pedal with VDO potentiometer nominal 1 kΩ .
Hydratronics, Part No: 8104 1600

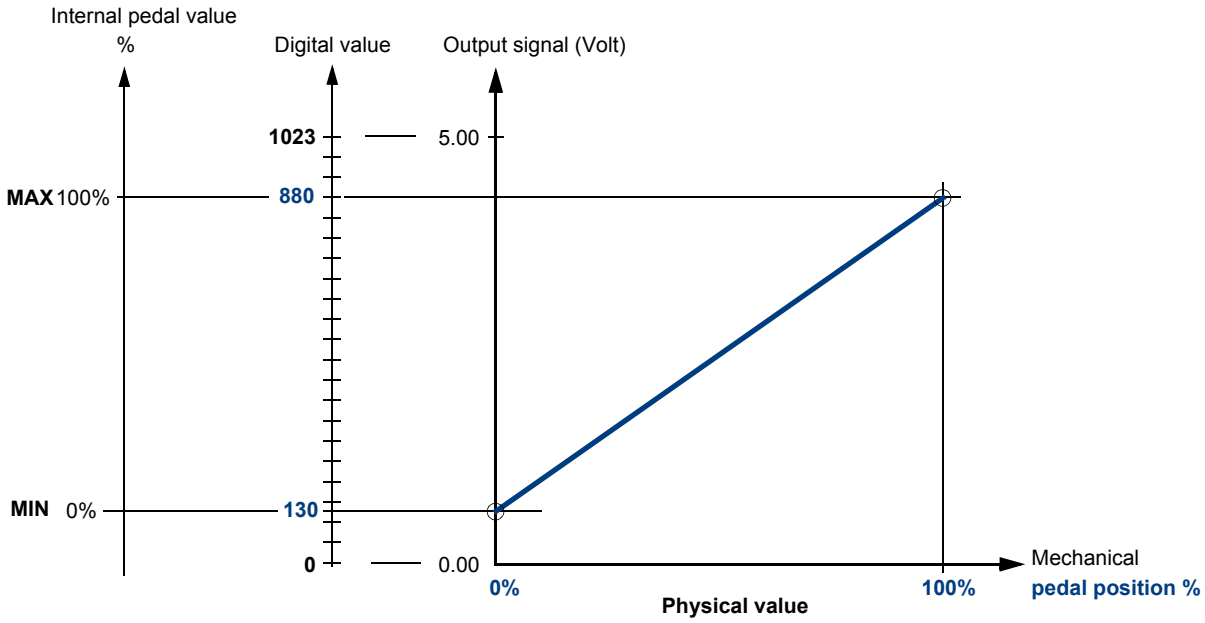
Note: Diagram shows typical values:



Electric accelerator pedal (speed pedal) with Hall-effect sensor

Electric accelerator pedal with Hall-effect sensor and voltage output 0- 5 Volt .
Hydratronics, Part No.: 5010 9010

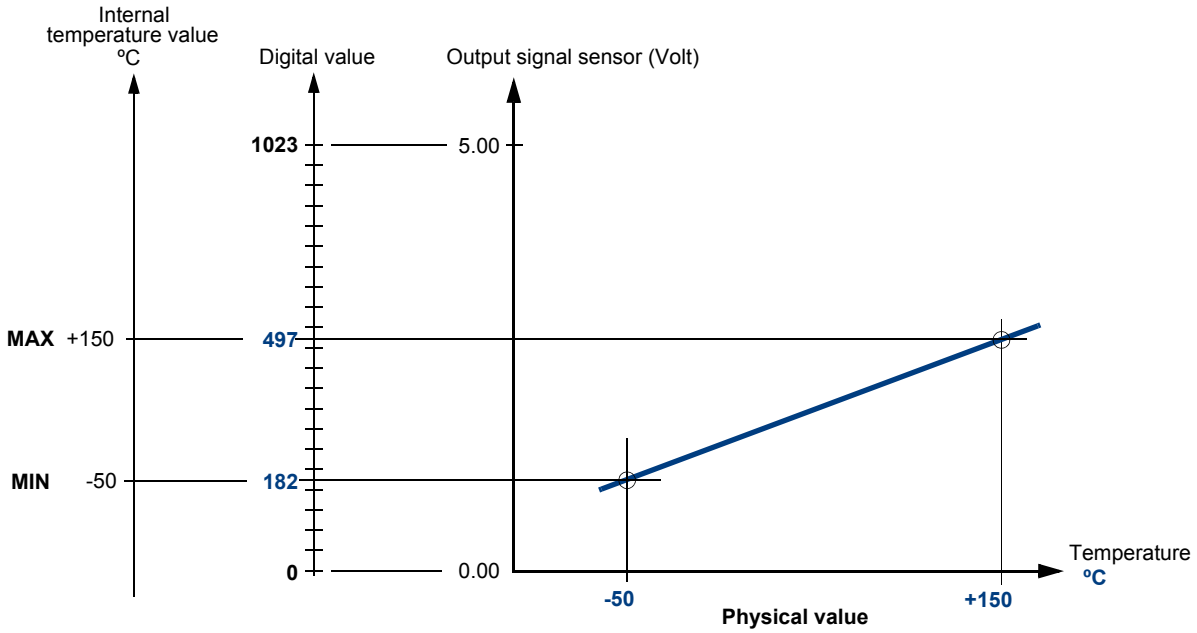
Note: Diagram shows typical values:



Temperature sensor

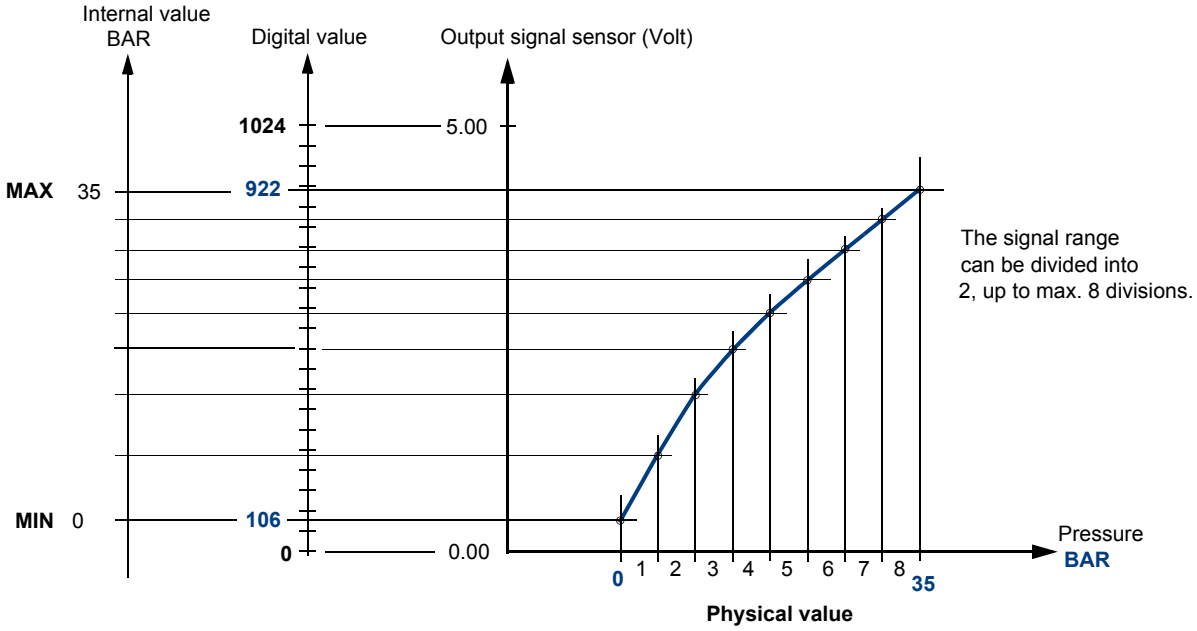
Temperature sensor, ST-20M (KTY19-6M).
Hydratronics, Part No.: 8104 4010

Note: Diagram shows typical values:



Non-linear sensors

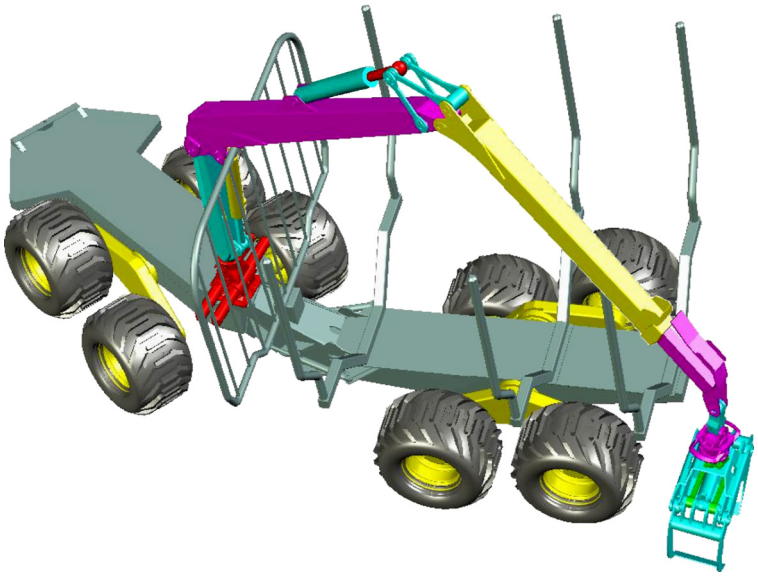
In the CANmaster PC-TOOL, there is a function that allows you to store values for non-linear sensors. The sensor range is split into a minimum of 2 and a max. of 8 equal divisions. Measured signal values contra digital values are specified in a chart. The program uses chart data to calculate actual physical values from recorded digital values. For detailed information, see the on-line Function reference, within CANmaster PC-TOOL program.



Application examples

This chapter gives a number of examples of different types of machines with CANmaster control systems in order to give some idea as to which CANmaster control units are used for various applications and how these can best be used to build up a control system to meet the functional requirements. The examples should only be seen as a number of ways of providing a control system for a particular type of machine. There might be considerable variations depending on make, machine equipment and area of application.

Forwarder - All-terrain timber transporter

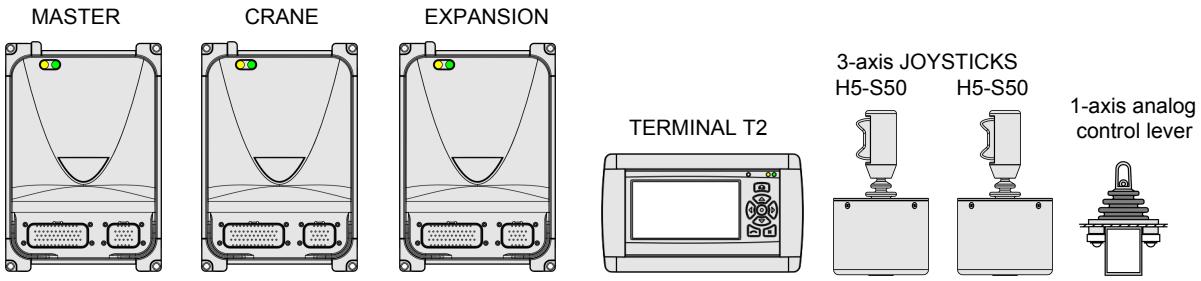


Description of the machine type

The Forwarder is used to transport timber from the logging zone to navigable roads for further transport by lorry. The machine's articulated chassis is constructed in two parts on forward and rear bogie axles with outputs for four drive wheels per axle. Diesel engine, main hydraulics, pumps etc. and cab are mounted on the forward bogie axle. The rear bogie axle comprises the load-bearing part of the vehicle chassis. The bogie axles are driven via a hydrostatic driven gearbox with two main drive outputs, one for rear bogie axle and one for the front bogie axle. The machines' max. speed is about 25 km/h, usually divided between two speed ranges (terrain/transport operation) via a 2 or 3-speed powershift gearbox or a simple 2-speed gearbox where the machine must be stationary when changing gears. Typical machine weight is in the range of 9-17 tons with a load capacity and maximum tractive effort equal to its own weight. The machine is equipped with a swivel driver seat with two tripple-axis joysticks assembled in the armrests and dual pedal arrays for controlling the transmission and braking.

CANmaster control units

The following CANmaster units are used for the application:



In addition to these primary components, there are a large number of sensors and controls of various types, electric pedals, buttons, potentiometers and indicator lamps.

For electronically-controlled diesel engines, the diesel engine's speed and power output are controlled via the Master unit's extra CAN-port using CAN-bus acc. to SAEJ1939. For conventional diesel engines with mechanically controlled fuel pumps, the servomotor output on the Expansion unit is used in combination with external engine rpm measurement with a sensor mounted to the flywheel housing. The sensor is connected to one of the frequency inputs on the Master-unit.

These machines come in a range of different designs, depending on manufacturer and application area. Below, is an example of outputs that can be required for a conventionally equipped forwarder, incl. optional equipment.

Output list - main functions

Function	Output	Comment
Hydrostatic transmission - Pumpcontrol	PWM-OUT (+) / (-)	**Transmission & chassis system**
Gear box - low/high gear	Digital-OUT	
Differential locks front & rear bogie axles	Digital-OUT (2x)	
Articulated steering	PWM-OUT(+) / (-)	
Parking brake / Cabin ladder	Digital-OUT	
Automatic brake - loading	Digital-OUT	
Center pivot lock	Digital-OUT	
Clutch, rear axle drive input	Digital-OUT	
Cooler fan motor - proportional pressure	PWM-OUT(+)	
Boom lift	PWM-OUT(+) / (-)	**Crane & carrier functions**
Boom swing	PWM-OUT(+) / (-)	
Outer boom dump	PWM-OUT(+) / (-)	
Outer boom telescope	PWM-OUT(+) / (-)	
Grapple	PWM-OUT(+) / (-)	
Grapple rotator	PWM-OUT(+) / (-)	
Bunk gate	PWM-OUT(+) / (-)	
Bogie lift front bogie axle- left & right side	PWM-OUT(+) / (-) (2x)	**Optional equipment**
Frame extension, load carriage	Digital-OUT (2x)	
Dozer blade	PWM-OUT(+) / (-)	
Winch	PWM-OUT(+) / (-)	

Control unit placement

Distribution of the I/Os on each control unit is dependent upon the opportunity to place the units on the machine and the distance to the sensors and valves for optimised cabling.

In those cases where the outputs rely on analogue sensors as a primary function of regulation with a high sample frequency for the sensor signal, the output and accompanying sensor inputs should be connected to the same control unit so as not to burden the CAN-bus and cause delays in regulation. When the controls rely on slow processes such as oil or water temperatures or on/off signals, the placement of the sensor inputs and corresponding outputs is not important. Functions where safety requirements are high, such as brakes, should be connected to the MASTER unit, which functions even if CAN-bus communication with all other units in the system ceases to function, due to cable breakage, for example.

The crane's hydraulic valves are placed on the boom pillar to reduce the length of the hydraulic hoses between the valves and the hydraulic cylinders. In order to minimize the electric cabling required for these functions, the CRANE unit is placed close to the valves on the boom. From the forward part of the carriage, only one cable for the CAN-bus, power supply +24V and ground connection is required.

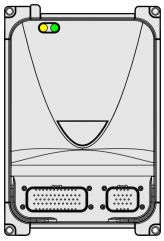
The Master unit and Expansion unit are placed in a suitable location close to the cab for connection to the machine's other valves and sensors, which are concentrated in the forward part of the carriage.

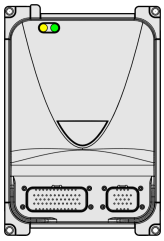
In the cab, all the controls with analogue and digital output signals connected to the joysticks' inputs for forwarding control signals from the driver's seat, are relayed to the Master unit via the CAN-bus cable. The terminal can, dependent upon placement, be connected to the CAN-bus cable by the driver's seat or to the Master unit.

One example of distribution of the I/Os on the various control units is shown on the following pages (excluding I/Os for system communication and power supply):

Distribution of I/Os

MASTER & EXPANSION unit





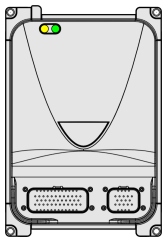
MASTER unit

Connector A		Function
Analog-IN 04	01	**Accelerator Pedal 1**
Analog-IN 05	02	**Accelerator Pedal 2**
Analog-IN 06	03	**Charge pump pressure**
Analog-IN 14/Digital-IN 00	04	**Lub. oil press. Engine**
Analog-IN 13/Digital-IN 01	05	**Pressure brakesystem**
Freq. 00/Digital-IN 10	06	**RPM hydraulic motor**
Digital-OUT 00	07	**Auto-brake loading**
Digital-OUT 01	08	**Center pivot lock**
PWM-OUT 00(+)	09	**Transm. pump (+) solenoid**
PWM-OUT 01(+)	10	**Fan motor press. (+)**
PWM-OUT 02(+)	11	**-**
PWM-OUT 03(+)	12	**-**
Analog-IN 07	13	**Temp. gearbox**
Analog-IN 08	14	**Temp. watercooler Engine**
Analog-IN 12/Digital-IN 02	15	**Temp. transmission**
Analog-IN 11/Digital-IN 03	16	**Temp. operating hydraulics**
Freq. 01/**Digital-IN 11**	17	**Park brake switch**
Digital-OUT 02	18	**Park brake/ Cabin ladder**
Digital-OUT 03	19	**Central alarm**
PWM-OUT 00 RETURN	20	**Transm. pump-Return**
PWM-OUT 01 RETURN	21	**Fan motor press.-Return**
PWM-OUT 02 RETURN	22	**-**
PWM-OUT 03 RETURN	23	**-**
Analog-IN 09	24	**-**
Analog-IN 10/Analog-OUT 00	25	**-**
Freq. 02/**Digital-IN 04**	26	**Safety switch Pedal 1**
Freq. 03/**Digital-IN 05**	27	**Safety switch Pedal 2**
Digital-OUT 04/Digital-IN 06	28	**Gearbox - high gear**
Digital-OUT 05/**Digital-IN 07**	29	**Terrain steering - on/off**
Digital-OUT 06/**Digital-IN 08**	30	**Sensor drivers seat forward**
Digital-OUT 07/**Digital-IN 09**	31	**Sensor drivers seat reverse**
PWM-OUT 00(-)	32	**Transm. pump (-) solenoid**
PWM-OUT 01(-)	33	**-**
PWM-OUT 02(-)	34	**-**
PWM-OUT 03(-)	35	**-**

EXPANSION unit

Connector A		Function
Analog-IN 04/Servo return	01	**-**
Analog-IN 05 (0-5V)	02	**Fuel level**
Analog-IN 06 (0-5V)	03	**Oil level transmission tank**
Analog-IN 13/Digital-IN 00	04	**Oil level oper. hydraulic tank**
Servo OUT A - PWM 04	05	**-**
Freq. 00/ Digital-IN 09	06	**-**
Digital-OUT 00	07	**Bogie-lift float-valve 1**
Digital-OUT 01	08	**Bogie-lift float-valve 2**
PWM-OUT 00(+)	9	**Bogie-lift left side (+)**
PWM-OUT 01(+)	10	**Bogie-lift right side (+)**
PWM-OUT 02(+)	11	**Dozer blade (+)**
PWM-OUT 03(+)	12	**Winch motor (+)**
Analog-IN 07 (0-5V)	13	**-**
Analog-IN 08 (0-5V)	14	**-**
Analog-IN 12/Digital-IN 01	15	**-**
Analog-IN 11/Digital-IN 02	16	**-**
Servo OUT B - PWM 04	17	**-**
Digital-OUT 02	18	**Diff. lock rear bogie axle**
Digital-OUT 03	19	**Diff. lock front bogie axle**
PWM-OUT 00 RETURN	20	**Bogie-lift left side - Return**
PWM-OUT 01 RETURN	21	**Bogie-lift right side - Return**
PWM-OUT 02 RETURN	22	**Dozer blade - Return**
PWM-OUT 03 RETURN	23	**Winch motor - Return**
Analog-IN 09	24	**-**
Analog-IN 10	25	**-**
Digital-IN 03	26	**-**
Digital-IN 04	27	**Coupling -rear axle drive**
Digital-OUT04/Digital-IN05	28	**Terrain steering indic. lamp**
Digital-OUT05/Digital-IN06	29	**Carrier frame extension (+)**
Digital-OUT06/Digital-IN07	30	**Carrier frame extension (-)**
Digital-OUT07/Digital-IN08	31	**Rear axle drive-coupling**
PWM-OUT 00(-)	32	**Bogie-lift left side (-)**
PWM-OUT 01(-)	33	**Bogie-lift right side (-)**
PWM-OUT 02(-)	34	**Dozer blade (-)**
PWM-OUT 03(-)	35	**Winch motor (-)**

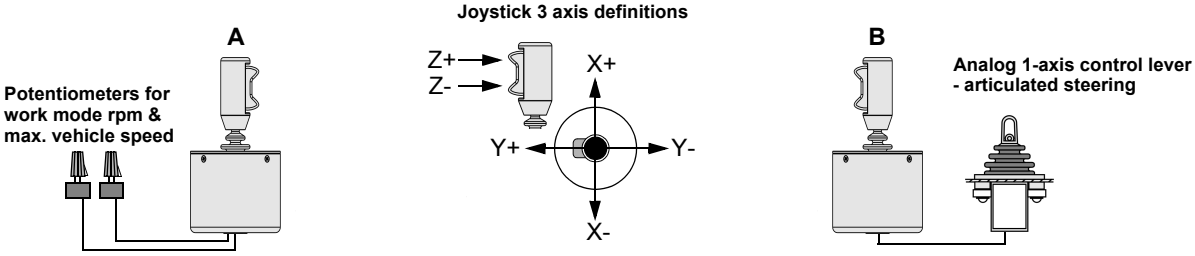
CRANE unit



CRANE unit

Connector A		Function
Analog-IN 08 (0-5V)	01	-
Analog-IN 09 (0-5V)	02	-
Digital-IN 00	03	-
Digital-IN 01	04	-
PWM-OUT 00(+)	05	**Dump (+)**
PWM-OUT 01(+)	06	**Swing(+)**
PWM-OUT 02(+)	07	**Telescope (+)**
PWM-OUT 03(+)	08	**Lift(+)**
PWM-OUT 04(+)	09	**Rotator (+)**
PWM-OUT 05(+)	10	**Grapple (+)**
PWM-OUT 06(+)	11	**Articulated steering (+)**
PWM-OUT 07(+)	12	**Gate (+)**
Analog-IN 10 (0-5V)	13	-
Digital-IN 02	14	-
Digital-IN 03	15	-
PWM-OUT 00 RETURN	16	**Dump -Return**
PWM-OUT 01 RETURN	17	**Swing-Return**
PWM-OUT 02 RETURN	18	**Telescope-Return**
PWM-OUT 03 RETURN	19	**Lift-Return**
PWM-OUT 04 RETURN	20	**Rotator-Return**
PWM-OUT 05 RETURN	21	**Grapple-Return**
PWM-OUT 06 RETURN	22	**Articulated steering-Return**
PWM-OUT 07 RETURN	23	**Gate-Return**
Analog-IN 11 (0-5V)	24	-
Analog-IN 12 (0-5V)	25	-
Digital-OUT 00	26	-
Digital-OUT 01	27	-
PWM-OUT 00(-)	28	**Dump (-)**
PWM-OUT 01(-)	29	**Swing (-)**
PWM-OUT 02(-)	30	**Telescope (-)**
PWM-OUT 03(-)	31	**Lift (-)**
PWM-OUT 04(-)	32	**Rotator (-)**
PWM-OUT 05(-)	33	**Grapple (-)**
PWM-OUT 06(-)	34	**Articulated steering (-)**
PWM-OUT 07(-)	35	**Gate (-)**

JOYSTICK H5-S50 units (2x) & Terminal T2



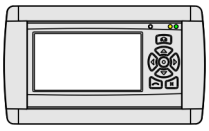
JOYSTICK H5-S50 address No. 0 (A)

Connector A		Function
Internal Analog-IN 00, X-axis		***) Dump (+)/(-)**
Internal Analog-IN 01, Y-axis		**Swing (+)/(-)**
Internal Analog-IN 02, Z-axis		**Telescope (+)/(-)**
Analog-IN 03 (0-5V)	01	**Work mode engine rpm**
Analog-IN 04 (0-5V)	02	**Max. vehicle speed**
Digital-IN 06 Digital-OUT 00 PWM-OUT 00	03	**Driving direction-forward**
Digital-IN 07 Digital-OUT 01 PWM-OUT 01	04	**Driving direction-reverse**
Digital-IN 08	05	**Bogie-lift left side-Up**
Digital-IN 09	06	**Bogie-lift left side - Down**
Digital-IN 05	07	**Bogie-lift right side - Up**
Digital-IN 04	08	**Bogie-lift right side - Down**
Digital-IN 03	09	**Carrier gate - Up**
Digital-IN 02	10	**Carrier gate - Down**
Digital-IN 01	11	**Diff. lock rear axle-on/off**
Digital-IN 00	12	**Diff. lock front axle-on/ff**

JOYSTICK H5-S50 address No. 1 (B)

Connector A		Function
Internal Analog-IN 00, X-axis		**Lift(+)/(-)**
Internal Analog-IN 01, Y-axis		**Rotator (+)/(-)**
Internal Analog-IN 02, Z-axis		**Grapple (+)/(-)**
Analog-IN 03 (0-5V)	01	**Steering (+/-), 1-axis lever**
Analog-IN 04 (0-5V)	02	**-**
Digital-IN 06 Digital-OUT 00 PWM-OUT 00	03	**Gearbox - High gear**
Digital-IN 07 **Digital-OUT 01** PWM-OUT 01	04	**Rear axle coupling indicator lamp**
Digital-IN 08	05	**Rear axel coupling**
Digital-IN 09	06	**Second function lever A**
Digital-IN 05	07	**Cruise control -Transport**
Digital-IN 04	08	**Auto float bogie-lift - Off**
Digital-IN 03	09	**Frame extension (+)**
Digital-IN 02	10	**Frame extension (-)**
Digital-IN 01	11	**Winch (+), wind**
Digital-IN 00	12	**Winch (-), rewind**

***) second function: Dozer blade up/down**



TERMINAL T2

Connector		Function
Digital-IN00/Digital-OUT00	03	**-**
Digital-IN01/Digital-OUT01	04	**-**
Digital-IN02/Digital-OUT02	05	**-**

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