# SMARTDRIVE CT

## HYDROSTATIC TRANSMISSIONS

TECHNICAL CATALOG

POCLAIN Hydraulics

HIGH PERFORMANCE

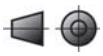
**Methodology :**
This document is intended for manufacturers of machines that incorporate Poclain Hydraulics products. It describes the technical characteristics of Poclain Hydraulics products and specifies installation conditions that will ensure optimum operation.
This document includes important comments concerning safety. They are indicated in the following way:

| | |
|---|---|
|  | **Safety comment.** |

This document also includes essential operating instructions for the product and general information. These are indicated in the following way:

| | |
|---|---|
|  | **Essential instructions.** |
|  | **General information .** |
|  | **Information on the model number.** |
|  | **Weight of component without oil.** |
|  | **Volume of oil.** |
|  | **Units.** |
|  | **Tightening torque.** |
|  | **Screws.** |
|  | **Information intended for Poclain-Hydraulics personnel.** |

The views in this document are created using metric standards.
The dimensional data is given in mm and in inches (inches are given in brackets in italic)



# CONTENT





# FOREWORD

## Introduction

Poclain Hydraulics has created and developed Smart Drive™ CT (Controller Transmission), a system that simplifies and optimizes the running of hydrostatic transmissions (e.g. mobile machinery).
It includes a computer that regulates the running of the hydrostatic transmission components (engine, hydraulic pump, hydraulic motors and brakes) through sensors and actuators.
The embedded software manages the machine's ground drive speed according to the driver setting, and the programmed acceleration and deceleration ramps. These ramps, which are among the many parameters that enable the machine's behavior to be customized, determine the vehicle's responsiveness and progressiveness.
The combination of the flexibility of the electronics and the power of the hydraulics makes this a system that can be adapted and set up for all driving styles.

**Functions**

Specific to each application, in general, the system offers:
• Hydrostatic transmission control;
• Automatic displacement shift;
• Management of engine rotation speed;
• Power limitation;
• Anti-stall;
• Brake management;
• Signalling,
• Speed regulation (Cruise control),
• Limp mode management.

**Examples of parameters**

The parameters can be set for each application, using either the PHASES™ CT software. They may also be subject to special access authorization.
They govern:
• The pump (displacement threshold for shifting from 1st to 2nd displacement; maximum permitted displacement);
• Engine (speed, etc.);
• Hydraulic motors (displacement);
• Brake valves (dynamic brake pressure at rest);
• Sensors (emergency brake pressure detection threshold, etc.);
• Cruise control function;
• Driving modes, (automotive etc).

## Examples of available functions

**SmartDrive™ CT controller is delivered without embedded software.Contact your Poclain Hydraulics sales engineer to define embedded software which fits to your application.**

**Driving modes**
The driver can have two standard operating configurations:

**[ Road Mode ]**
This is an **automotive** type of driving, similar to an automatic transmission. The transmission ratio is determined automatically by the load management of the engine, pump displacement and hydraulic motor displacement. The load on the engine is therefore related to the vehicle speed, resulting in the reduction of pollution and fuel consumption.

**[ Field Mode ]**
The speed of the engine is constant; the auxiliary tools consume most of its power.

**It is possible to define other modes, depending on the nature of the work to be carried out and the environment. Contact your Poclain Hydraulics sales engineer.**

The ground drive parameters may thus be different from one **[ Field Mode ]** to another.
Shifting between modes is done under different safety conditions managed by the SmartDrive™ CT controller.

**Automatic displacement shift**
The SmartDrive™ CT transmission varies speed continually.
Depending on the acceleration or brake settings issued by the driver, hydraulic motor displacement shift is seamless. This is accomplished by simultaneous pump displacement control and motor displacement shift control.
Therefore, since the operation is practically entirely automatic, the driver can focus on tasks with higher added value, such as the machine's working functions, and, particularly, tool management.

**Management of engine rotation speed**
The SmartDrive™ CT controller can fully manage the engine via the CAN Bus.
The SmartDrive™ CT controller optimizes the rotation speed of the engine for the requested power level.

**Anti-stall function**
This function reduces the pump displacement to prevent the engine stalling if the power required by the hydrostatic transmission exceeds the engine's available power.

**Limitation of ground drive power**
Some machines have engines that are oversized for the ground drive power requirement when the on-board tools are turned-off **[ Field Mode ]**. In [ **Road Mode ]**, there is no protection and the engine's full power is available. Limiting the integrated power in a transmission controlled by a SmartDrive™ CT controller therefore protects the hydrostatic transmission from possible excess output, which could cause irreversible damage over time.

**Brake management**

**Service brake (dynamic)**
The brake pedal:
• Activates mechanical braking,
• Reduces pump displacement via the SmartDrive™ CT controller.
The braking system is of the **combined type**, i.e. the mechanical braking torque combines with the hydrostatic transmission's braking torque (pump displacement reduced).
The SmartDrive™ CT controller manages the pump and hydraulic motor displacement reduction by taking account of the level of mechanical braking.

**Brake pedal only**
Adjusts the hydrostatic braking.

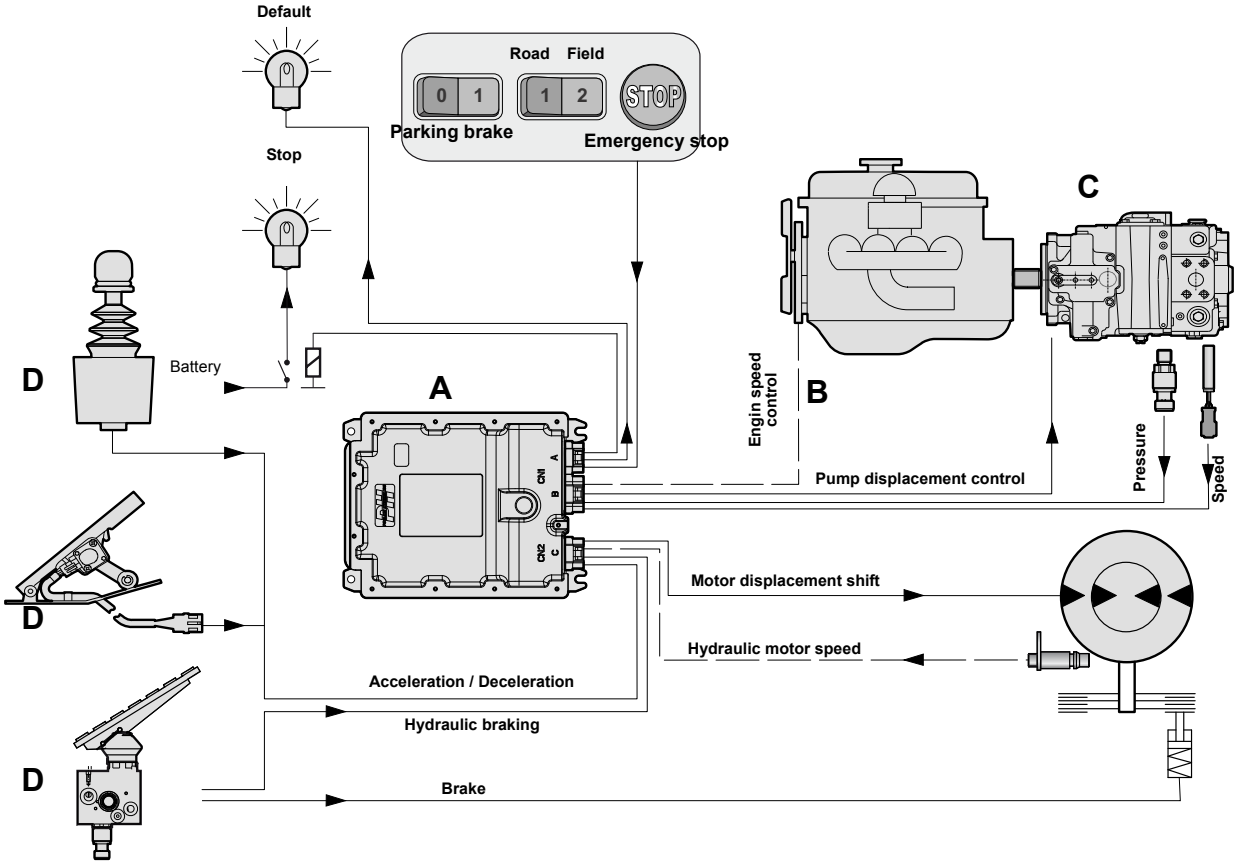
**Parking brake**
The parking brake is held by the spring force.
To deactivate this brake, the driver operates a switch, a lever or a foot control. These components then transmit pressure to the brake pistons, which cancel out the spring force.

**Emergency stop**

**If the parking brake switch is activated for an emergency stop, the mechanical parking brakes acts and the hydrostatic brake engages by means of a pump displacement ramp managed by the SmartDrive™ CT controller.**

**Constant speed with combined auxiliary control**
In **[ Field Mode ]**, the machine's ground drive speed remains constant in spite of the acceleration of the engine required for the auxiliary functions.
The operator, now freed from controlling the speed, can concentrate on tasks with higher added value.

## Example of hydrostatic transmission control on a vehicle.




Description :
**A** - An SmartDrive™ CT controller that controls transmission,
**B** - An engine command with a CAN Bus link,
**C** - A pump fitted with displacement control solenoids, a speed sensor and a 600-bar pressure sensor,
**D** - A joystick or pedal, mode selection switch, default light, stop light, speed sensor display, etc.

**Signalling**
The SmartDrive™ CT controller manages signalling (braking, reverse lights, warning beep, etc.) depending on the ground drive condition.

**CAN Bus Communication**
The SmartDrive™ CT controller presents a standard 2.0A or extended 2.0B CAN interface.
When connected to the machine's CAN network, the SmartDrive™ CT controller can therefore:
• Receive messages (joystick, selectors, reading engine rotation speed, etc.)
• Send messages (engine setting, signalling, fault indicator, error message, etc.)

**CAN adjustment requires a configuration that depends on the complexity of the CAN architecture for each manufacturer. Contact your Poclain Hydraulics sales engineer.**

## SmartDrive™ CT controller characteristics

**Contact your Poclain Hydraulics sales engineer for all adaptations.**

| Commercial name | | SD-CT-200 | SD-CT-300 |
|---|---|---|---|
| Part number | | A46841P | A46842Q |
| Operating voltage | | 8 V to 32 V | |
| Operating temperature | | - 40°C to 85°C [-40 °F to 185°F] | |
| Overall dimensions | | See below | |
| Material | | - Aluminum $AlSi_9Cu_3$ (Box)<br>- PA66 plastic with 20% of fiberglass (cap)<br>- Silicon (seal) | |
| Mass | | 1,270 kg ±10%<br>*[2,76 lb]* ±10% | |
| Mounting | | 4 x Ø 7 mm<br>*4 x [0.275" dia.]* | |
| Controller Ingress Protection with counterpart connectors mounted | | IP 67 (according to EN60529 oct 1992) | |
| Max. quiescent current consumption (ignition switched off with VBAT_Dx switched on) | | <5 mA | |
| Max. quiescent current consumption (ignition switched off with VBAT_Dx switched off) | | <100 µA | |
| 12V system max current | | 35,4 A | |
| 24V system max current | | 17 A | |
| Maximum usage profile: | 12V System:<br>(Supply voltage 16V) | - 6 HSD PWM outputs 400Hz, 95% 8 Ω loads<br>- 4 HSD digital outputs on, 6.15 Ω loads | - 8 HSD PWM outputs 400Hz, 95% 8 Ω loads<br>- 4 HSD digital outputs on, 6.15 Ω loads<br>- 4 HSD digital outputs on, 8Ω loads |
| | 24V System:<br>(Supply voltage 32V) | - 6 HSD PWM outputs 400Hz, 95% 32Ω loads<br>- 4 HSD digital outputs on, 32Ω loads | - 8 HSD PWM outputs 400Hz, 95% 32Ω loads<br>- 8 HSD digital outputs on, 32Ω loads |
| Performance level | | Capacity to reach PL d level according to ISO13849:2015 standard | |
| Mean Time To Failure (MTTF) | | 85,1 years (ambient temperature of 40°C *[104°F]*) with operating profil of 11,87% (4 hours per day, 5 days per week, 52 weeks per year) | 66,7 years (ambient temperature of 40°C *[104°F]*) with operating profil of 11,87% ( 4 hours per day, 5 days per week, 52 weeks per year) |
| Mean Time To Dangerous Failure (MTTFd) | | 224.2 years | 173.1 years |
| Diagnostic Coverage (DC) | | 90,9% (medium) | 90,7% (medium) |
| Category | | 2 | 2 |
| Electrical protection | | Over-voltage, reverse polarity, ground and battery short circuit | |
| Microcontroller | | One 32 bits microcontroller and one 8 bits microcontroller | |
| ECU programming | | Programming with a PC using the PHASES™-CT software application | |
| ECU set-up | | Set-up with the software PHASES™-CT | |
| Universal inputs (UN) | | 9 | 15 |
| Analog inputs (AN) | | 11 | 17 |
| Frequency inputs (FIN) | | 5 | 8 |
| Wake-Up Input (WUI) | | 1 | 1 |
| Ground sense input (GND_SENSE) | | 1 | 1 |
| HSD PWM 2A outputs* | | 6 | 8 |
| HSD DIG 2,6A outputs* | | 4 | 4 |
| HSD DIG 2A outputs* | | 0 | 4 |
| Low Side Digital output (LSD) 4A | | 0 | 3 |
| Low Side Digital output (LSD) 5,2A | | 3 | 3 |
| Sensor supply 5V | | 1 | 1 |

| *Max. current following usage profile | SD-CT-200 | | SD-CT-300 | |
|---|---|---|---|---|
| | 12V system | 24V system | 12V system | 24V system |
| Sum of HSD PWR output current | ≤12A | ≤6A | ≤16A | ≤8A |
| Sum of HSD digital output current | ≤10,4A | ≤4A | ≤18,4A | ≤8A |

## Environmental performances

**For any information request concerning qualification tests (steady state,transient,climatic,mechanical,corrosive atmosphere, ESD and ECM) , Contact your Poclain Hydraulics sales engineer.**

**ESD and EMC:**
Electromagnetic compatibility of vehicles is required by European Union. The vehicle manufacturers have to submit a technical file or a sample of their machine at a qualified service center certification.
The SmartDrive ™ CT controller passed with success the electromagnetic compatibility tests of electronic sub-assembly.

| Type | Standard | Parameters |
|---|---|---|
| EC marking | 2004/108/EC | |
| Electro-Magnetic Compatibility | EN/ISO14982:2009 | Agricultural and forestry machines |
| Electro-Magnetic Compatibility | EN13309:2010 | Construction machines |
| Electro-Magnetic Compatibility | EN12895:2000 | Forklifts |
| E marking | 2004/104/EC | Automotive EMC directive |

**On demand Poclain Hydraulics will deliver list and severity levels of EMC tests.**

# SmartDrive™ CT input characteristics

## Universal inputs (UN)

Inputs are software selectable as:
• 0-32V measurement
• 0-5V measurement (UN 01 to 08)
• Digital High Side switch
• Digital Low Side switch

The selection of the configuration is done individually from input UN01 to UN08 and by group of 4 for the other inputs. These inputs are protected against short circuits to ground, battery and negative voltage up to-1V.

| | |
|---|---|
| **0-32V measurement configuration** | |
| Input range | 0 to 32V |
| Input resistance | > 11,9 kΩ from UN01 to UN08 > 20,3 kΩ from UN09 to UN15 |
| Resolution | 12 bits |
| Sampling rate | 1 kHz |
| Full scale accuracy | ±5,5% |
| **0-5V measurement configuration** | |
| Input range | 0 to 5V |
| Input resistance | 100 kΩ |
| Resolution | 12 bits |
| Sampling rate | 1 kHz |
| Full scale accuracy | ±2,1% |
| **Digital High Side configuration** | |
| Input range | 0 to 32V |
| Threshold adjustable by software | Default values:<br>- Low level switchingthreshold : 3V<br>- High level switching threshold : 6 V |
| Switch current | 10,8 mA from UN 01 to 08<br>9,8 mA from UN 09 to 15 |
| **Digital Low Side configuration** | |
| Input range | 0 to 32V |
| Threshold adjustable by software | Default values:<br>- Low level switchingthreshold : 3V<br>- High level switching threshold : 6 V |
| Switch current | 8,4 mA<br>Input at 0V,supply voltage at 28V |

## Analog inputs (AN)

These inputs are populated to perform 0-5V measurement.
These inputs are protected against short-circuit to ground and battery and negative voltage until -1V.

| | |
|---|---|
| **0-5V measurement configuration** | |
| Input range | 0 to 5V |
| Input resistance | 100 kΩ |
| Resolution | 12 bits |
| Sampling rate | 1 kHz |
| Full scale accuracy | ±2,1% |

## Frequency inputs (FIN)

Inputs are software selectable as:
• Open Collector PNP VBAT voltage frequency measurement
• Open Collector NPN VBAT voltage frequency measurement
• Open Collector NPN 0-5V voltage frequency measurement (FIN_01 only)

Selection is made individually for each input.

These inputs are protected against short-circuit to ground and battery and negative voltage until -1V.

| **OC PNP VBAT voltage frequency measurement configuration:** | | |
|---|---|---|
| Input range | 0,1 Hz to 30 KHz<br>0 to 32V | |
| Switch current | 9,6 mA | input to 28V |
| Trigger levels | Low 2V<br>High 3,8V | Compatible with sensors supplied with 0-VBAT and 0-5V |
| Accuracy (Hz) | $\pm \left[ \text{Frequency} - \frac{1}{\frac{1}{\text{Frequency}} + 10^{-6}} \right]$ | |

| **OC NPN VBAT voltage frequency measurement configuration:** | | |
|---|---|---|
| Input range | 0,1 Hz to 30 KHz<br>0 to 32V | |
| Switch current | 9,3 mA | Input at 0V, battery voltage at 28V |
| Trigger levels | Low 2V<br>High 3,8V | Compatible with sensors supplied with 0-VBAT and 0-5V |
| Accuracy (Hz) | $\pm \left[ \text{Frequency} - \frac{1}{\frac{1}{\text{Frequency}} + 10^{-6}} \right]$ | |

| **OC NPN 0-5V voltage frequency measurement configuration:** | | |
|---|---|---|
| Input range | 0,1 Hz to 30 KHz<br>0 to 5V | |
| Switch current | 4,5 mA | Input at 0V |
| Trigger levels | Low 2V<br>High 3,8V | Compatible with sensors supplied with 0-VBAT and 0-5V |
| Accuracy (Hz) | $\pm \left[ \text{Frequency} - \frac{1}{\frac{1}{\text{Frequency}} + 10^{-6}} \right]$ | |

## Wake-up input (WUI)

This input allows to wake up or sleep the controller.
It has to be connected after ignition key (see supply wiring schematic page 33).

A voltage from 8V to 32V wakes up the controller.
A missing voltage sleeps the controller.

## Ground sense input (GND_SENSE)

**This input must be wired together with the other ground signals to a unique point.**

**As soon as GND_SENSE signal will be disconnected, the controller will de-activate all its outputs.**

## SmartDrive™ CT outputs characteristics

PWM and digital outputs are protected against short-circuit to ground / over-current and battery, over-temperature and under- voltage.
LSD outputs are protected against short-circuit to battery and over-temperature.
Sensor supply 5V output is protected against short-circuits to battery and ground and over-temperature.

### PWM outputs 2A

These outputs can be configured in PWM mode and current control.

| Description | |
|---|---|
| DC voltage (ON state) | >(Battery voltage - 1V) |
| DC current | 2 A max.* (see page 8 “Controller characteristics”) |
| PWM frequency | 100 to 400 Hz |
| PWM duty cycle | 0% or 5 to 100%<br>Resolution of 0,4% |
| Current sense range | 0 - 3 A |
| Current sense resolution | 2 mA |
| Current sense full scale accuracy | ±2% |

### Digital outputs 2,6A

| Description | |
|---|---|
| DC voltage (On state) | >(Battery voltage - 1V) |
| DC current | 2,6 A max.* (see page 8 “Controller characteristics”) |

### Digital outputs 2A

| Description | |
|---|---|
| DC voltage (On state) | >(Battery voltage - 1V) |
| DC current | 2 A max. * (see page 8 “Controller characteristics”) |

### LSD outputs 5,2 A

| Description | |
|---|---|
| DC voltage (On state) | 1V max. |
| DC current | 5,2 A max. |

### LSD outputs 4 A

| Description | |
|---|---|
| DC voltage (On state) | 1V max. |
| DC current | 4 A max. |

### Sensor supply 5V output

| Description | |
|---|---|
| DC voltage (On state) | 5V ±4% |
| DC current | 400 mA max. |

### Communication

SmartDrive™ CT controller has 3 CAN standard 2.0A or extended 2.0B buses, whose speed can reach 500kb / s max.

CAN 1 is used for downloading, diagnostic and communication with other Poclain Hydraulics components.

CAN 2 is used for communication with engine and other machine ECUs.

CAN 3 is available as additional communication channel.

### LED

Controller in sleep mode: the led is off.

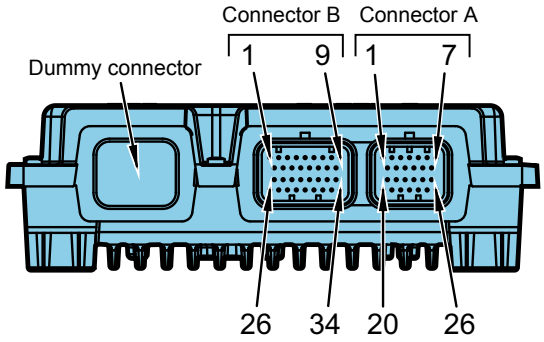
Controller is operational : the led flashes.

## Pin description

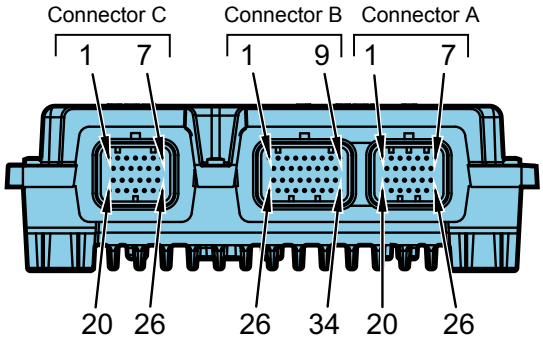
Number each wire using numbered plastic rings. Each cable must be securely fixed to the machine with clips placed every 200 mm *[7.87 in]*.

Sections are given (for information only) in mm² for a 10 meter *[39.37 in]* length at an operating temperature of < 85 °C [185 °F].

**SD-CT-200**




**SD-CT-300**




**Connector A:**

| PIN | Name | Function | Wire section mm² |
|---|---|---|---|
| **1** | VBAT_WUI | Wake Up Input | 0,75 to 1,25 |
| **2** | LSD_03 | Digital Low Side Output 5,2A | 1,25 |
| **3** | LSD_02 | Digital Low Side Output 5,2A | 1,25 |
| **4** | LSD_01 | Digital Low Side Output 5,2A | 1,25 |
| **5** | STOR_01 | Digital High Side Output 2,6A | 1,25 |
| **6** | CAN3_Low | CAN low | 0,75 to1,25 |
| **7** | VBAT_P | Power Supply (permanent) | 1,25 |
| **8** | PWM_01 | PWM high side output 2A | 1,25 |
| **9** | CAN_ID | CAN ID input | 0,75 to 1,25 |
| **10** | ANA_08 | Analog input 0-5V | 0,75 to 1,25 |
| **11** | UN_07 | Universal input (HS/LS/0-32V/0-5V) | 0,75 to 1,25 |
| **12** | CAN3_H120 | CAN termination resistor (to connect to CAN low) | 0,75 to 1,25 |
| **13** | CAN3_High | CAN high | 0,75 to 1,25 |
| **14** | UN_09 | Universal input (HS/LS/0-32V) | 0,75 to 1,25 |
| **15** | ANA_07 | Analog input 0-5V | 0,75 to 1,25 |
| **16** | UN_08 | Universal input (HS/LS/0-32V/0-5V) | 0,75 to 1,25 |
| **17** | ANA_09 | Analog input 0-5V | 0,75 to 1,25 |
| **18** | ANA_11 | Analog input 0-5V | 0,75 to 1,25 |
| **19** | 5V_sensor | 5V reference voltage output | 0,75 to 1,25 |
| **20** | AGND | Analog ground | 1,25 |
| **21** | FIN_05 | Frequency input (HS/LS) | 0,75 to 1,25 |
| **22** | FIN_04 | Frequency input (HS/LS) | 0,75 to 1,25 |
| **23** | -VBAT | Power ground | 1,25 |
| **24** | ANA_10 | Analog input 0-5V | 0,75 to 1,25 |
| **25** | UN_06 | Universal input (HS/LS/0-32V/0-5V) | 0,75 to 1,25 |
| **26** | -VBAT | Power ground | 1,25 |

**Connector B:**

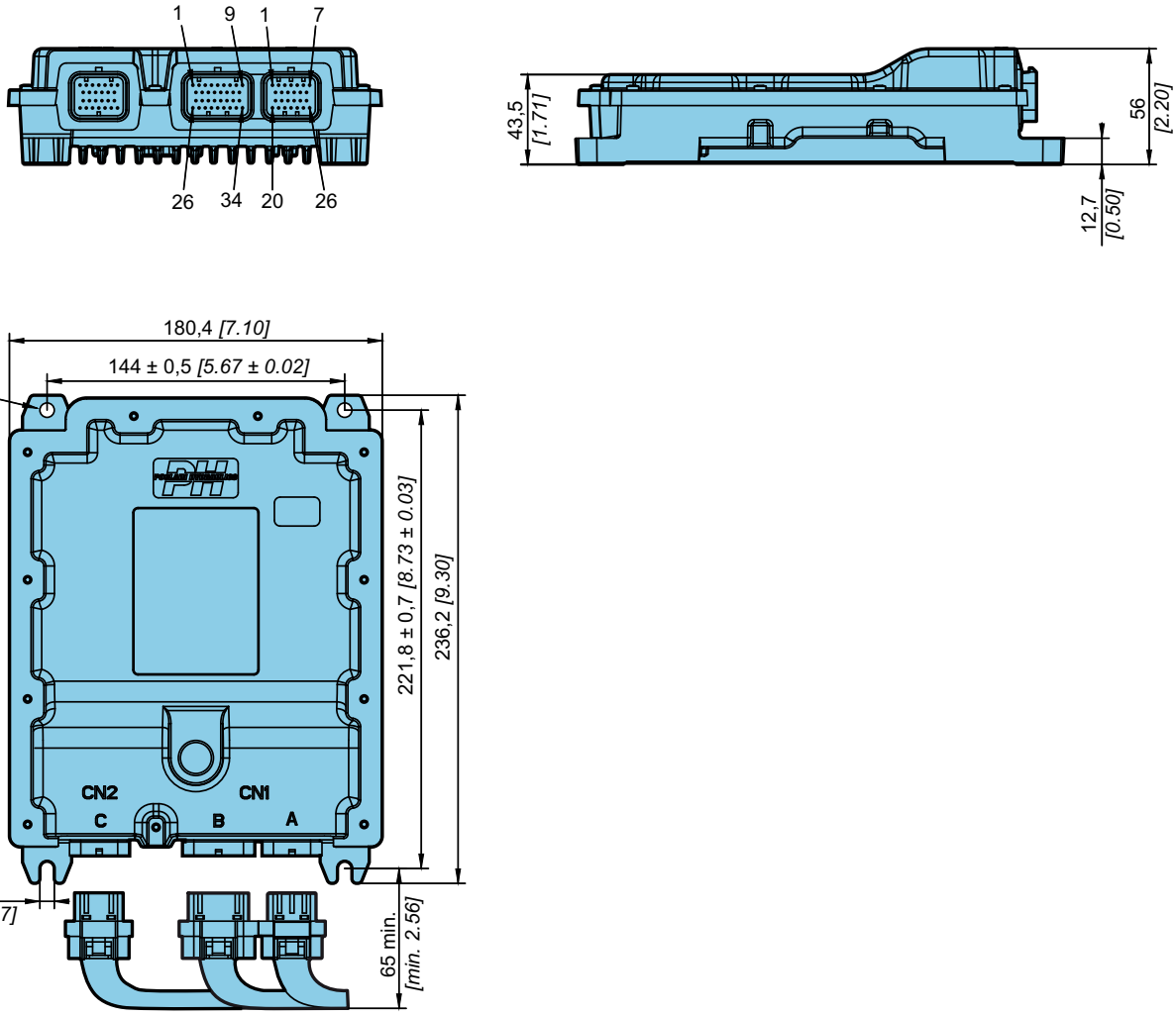
| PIN | Name | Function | Wire section mm² |
|---|---|---|---|
| 1 | CAN1_High | CAN high | 0,75 to 1,25 |
| 2 | CAN1_Low | CAN low | 0,75 to 1,25 |
| 3 | PWM_04 | PWM high side output 2A | 1,25 |
| 4 | PWM_05 | PWM high side output 2A | 1,25 |
| 5 | UN_01 | Universal input (HS/LS/0-32V/0-5V) | 0,75 to 1,25 |
| 6 | UN_03 | Universal input (HS/LS/0-32V/0-5V) | 0,75 to 1,25 |
| 7 | STOR_03 | Digital High Side Output 2,6A | 1,25 |
| 8 | VBAT_D1 | Power supply for outputs | 1,25 |
| 9 | VBAT_D1 | Power supply for outputs | 1,25 |
| 10 | CAN2_High | CAN high | 0,75 to 1,25 |
| 11 | CAN1_H120 | CAN termination resistor (to connect to CAN low) | 0,75 to 1,25 |
| 12 | STOR_04 | Digital High Side Output 2,6A | 1,25 |
| 13 | ANA_03 | Analog input 0-5V | 0,75 to 1,25 |
| 14 | UN_02 | Universal input (HS/LS/0-32V/0-5V) | 0,75 to 1,25 |
| 15 | UN_04 | Universal input (HS/LS/0-32V/0-5V) | 0,75 to 1,25 |
| 16 | PWM_03 | PWM high side output 2A | 1,25 |
| 17 | PWM_02 | PWM high side output 2A | 1,25 |
| 18 | CAN2_Low | CAN low | 0,75 to 1,25 |
| 19 | VBAT_D2 | Power supply for outputs | 1,25 |
| 20 | VBAT_D2 | Power supply for outputs | 1,25 |
| 21 | FIN_02 | Frequency input (HS/LS) | 0,75 to 1,25 |
| 22 | UN_05 | Universal input (HS/LS/0-32V/0-5V) | 0,75 to 1,25 |
| 23 | ANA_05 | Analog input 0-5V | 0,75 to 1,25 |
| 24 | ANA_01 | Analog input 0-5V | 0,75 to 1,25 |
| 25 | STOR_02 | Digital High Side Output 2,6A | 1,25 |
| 26 | PWM_06 | PWM high side output 2A | 1,25 |
| 27 | CAN2_H120 | CAN termination resistor (to connect to CAN low) | 0,75 to 1,25 |
| 28 | -VBAT | Power ground | 1,25 |
| 29 | FIN_01 | Frequency input (HS/LS Vbat/LS 5V/0-32V) | 0,75 to 1,25 |
| 30 | FIN_03 | Frequency input (HS/LS) | 0,75 to 1,25 |
| 31 | ANA_04 | Analog input 0-5V | 0,75 to 1,25 |
| 32 | ANA_06 | Analog input 0-5V | 0,75 to 1,25 |
| 33 | ANA_02 | Analog input 0-5V | 0,75 to 1,25 |
| 34 | GND_SENSE | Ground sense input | 0,75 to 1,25 |

**Connector C:**

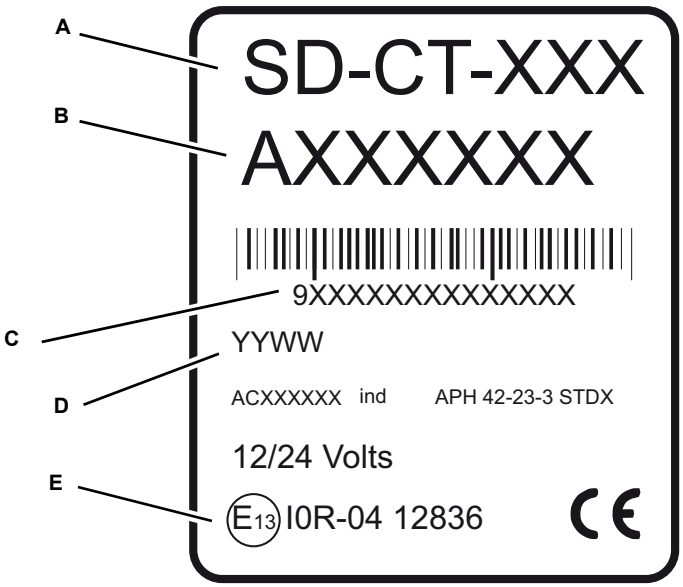
| PIN | Name | Function | Wire section mm² |
|---|---|---|---|
| 1 | STOR_08 | Digital High Side Output 2A | 1,25 |
| 2 | LSD_06 | Digital Low Side Output 4A | 1,25 |
| 3 | STOR_07 | Digital High Side Output 2A | 1,25 |
| 4 | PWM_07 | PWM high side output 2A | 1,25 |
| 5 | STOR_06 | Digital High Side Output 2A | 1,25 |
| 6 | STOR_05 | Digital High Side Output 2A | 1,25 |
| 7 | LSD_05 | Digital Low Side Output 4A | 1,25 |
| 8 | ANA_17 | Analog input 0-5V | 0,75 to 1,25 |
| 9 | UN_10 | Universal input (HS/LS/0-32V) | 0,75 to 1,25 |
| 10 | PWM_08 | PWM high side output 2A | 1,25 |
| 11 | UN_13 | Universal input (HS/LS/0-32V) | 0,75 to 1,25 |
| 12 | UN_14 | Universal input (HS/LS/0-32V) | 0,75 to 1,25 |
| 13 | LSD_04 | Digital Low Side Output 5,2A | 1,25 |
| 14 | VBAT_D3 | Power supply for outputs | 1,25 |
| 15 | FIN_08 | Frequency input (HS/LS) | 0,75 to 1,25 |
| 16 | UN_11 | Universal input (HS/LS/0-32V) | 0,75 to 1,25 |
| 17 | ANA_16 | Analog input 0-5V | 0,75 to 1,25 |
| 18 | ANA_15 | Analog input 0-5V | 0,75 to 1,25 |
| 19 | UN_15 | Universal input (HS/LS/0-32V) | 0,75 to 1,25 |
| 20 | -VBAT | Power ground | 1,25 |
| 21 | FIN_06 | Frequency input (HS/LS) | 0,75 to 1,25 |
| 22 | FIN_07 | Frequency input (HS/LS) | 0,75 to 1,25 |

| | | | |
|---|---|---|---|
| **23** | UN_12 | Universal input (HS/LS/0-32V) | 0,75 to 1,25 |
| **24** | ANA_14 | Analog input 0-5V | 0,75 to 1,25 |
| **25** | ANA_13 | Analog input 0-5V | 0,75 to 1,25 |
| **26** | ANA_12 | Analog input 0-5V | 0,75 to 1,25 |

## Overall dimensions of the Smart Drive™ CT controller



## Identification of the component




**A** : Commercial name
e.g. SD-CT-200 or SD-CT-300
**B** : Part number and update:
e.g. A46841P or A46842Q
**C** : Serial number (Shop number):
e.g. 925198745365874
**D** : Number of chronological order (2 digits for year + 2 digits for week):
e.g. 1344
**E** : E marking number

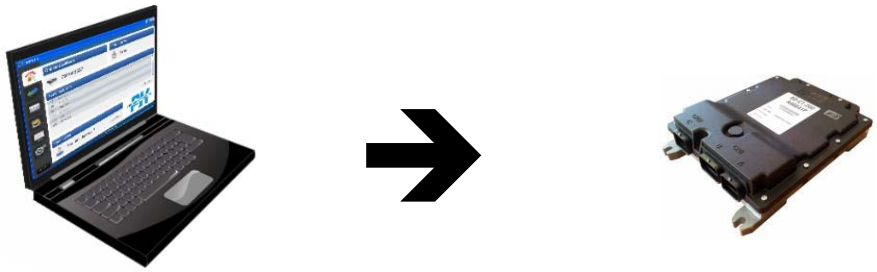
**The part number must be given for all replacement part orders.**

## Software installation

To work, your system needs a SmartDrive™CT controller as well as the embedded software that will be loaded onto the controller.
For loading this software:
Poclain Hydraulics or your distributor has sent you the embedded software on a CD-rom, by e-mail or by another means. Use the PC PHASES™ CT software to transfer the application to the SmartDrive™ CT controller.

## System setting

Use the PHASES™ CT software to set up the system:



For further information about the PHASES™ CT software application, consult the online help or PHASES™ CT catalogue.

**For further information, see PHASES™ CT user guide no. A48679M.**

## Set-up with the PHASES™ CT software application

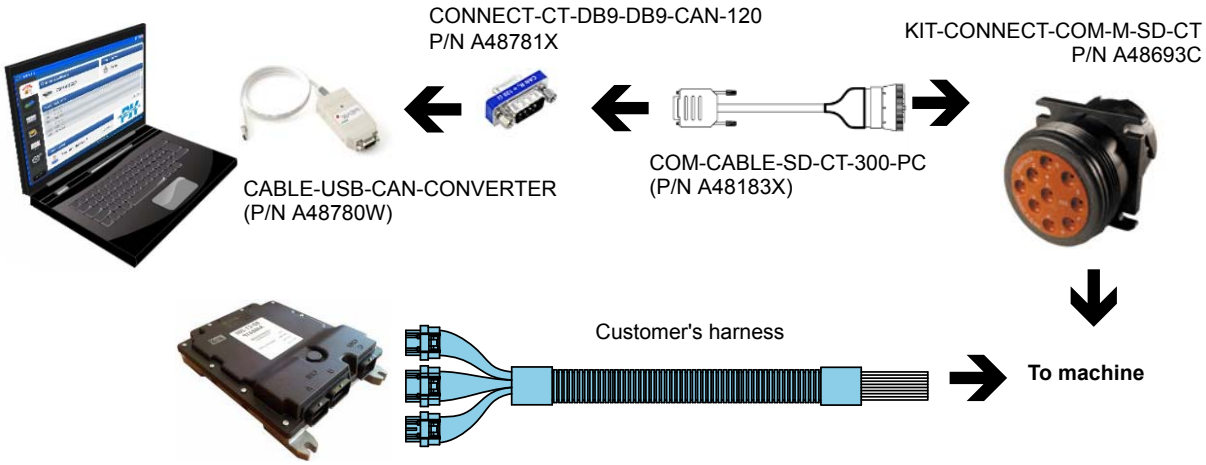
- Install the PHASES™ CT software (see installation guide n° A48679M).
- Connect the SmartDrive™ CT controller to the PC by connecting the PC's USB to controller's communication connector (CAN bus link) via cable COM-CABLE-SD-CT-300-PC (P/N A48183X), SUBD9 connector with integrated 120Ω termination resistor and adapter CABLE-USB-CAN-CONVERTER (P/N A48780W).

**These cables are supplied with PHASES™ CT in the B29588K-KIT-CABLE-PHASES-CT kit.**

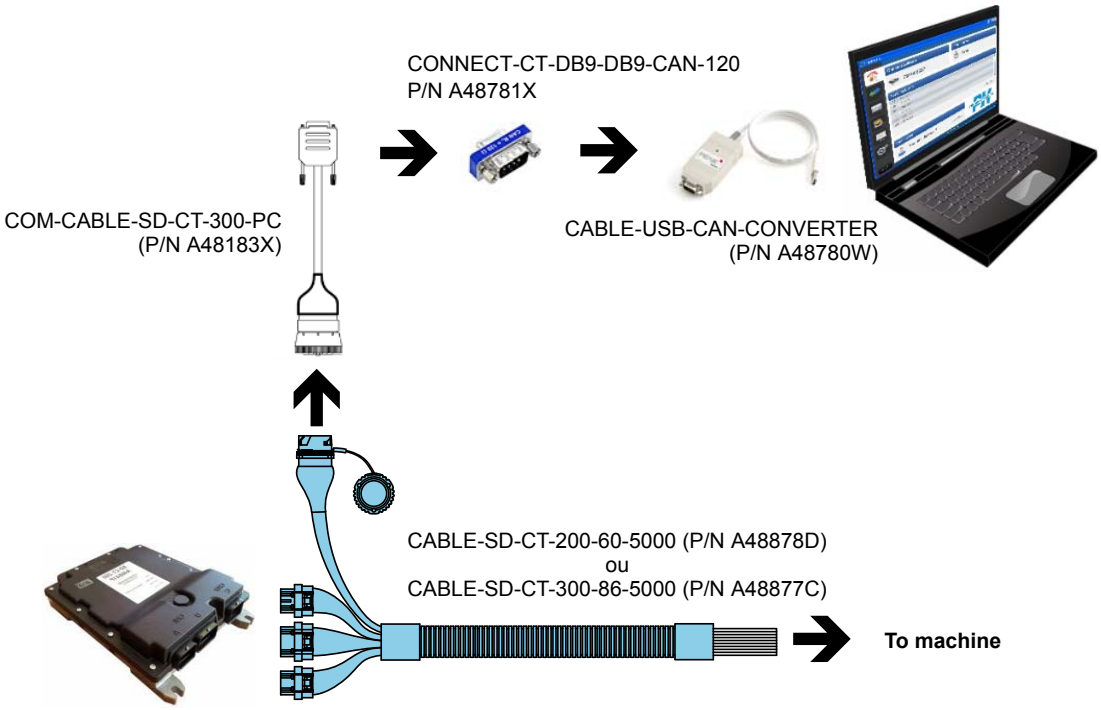
## We propose two solutions for communicating with the SmartDrive™ CT controller:

**Via the communication connector installed on the machine.**

For the wiring of the connector see the table on page 20.




**Via SmartDrive™ CT cable.**

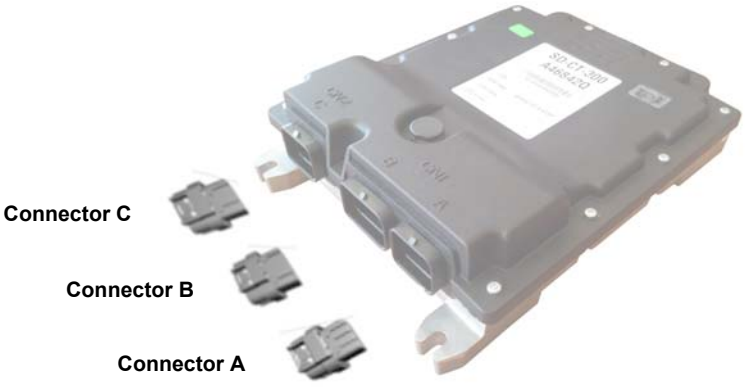



## Checking the installation before starting up

**The elements to be checked depend on the application of each vehicle. Please remember that each manufacturer is ultimately responsible for checking their machinery at the end of the line.**

## Auxiliaries

### Main connectors




| Characteristics | SD-CT-200 | SD-T-300 |
|---|---|---|
| **Commercial name** | KIT-CONNECT-SD-CT-200 | KIT-CONNECT-SD-CT-300 |
| **Poclain Hydraulics part number** | A48149L | A48140B |
| Function | SmartDrive™ CT controller's Counter-part connectors | |
| Compatibility | Electronic transmission management with SmartDrive™ CT controller | |

| Component | | AMP reference | SD-CT-200 | SD-T-300 |
|---|---|---|---|---|
| Connector A |  | 1473416-1 | x1 | x1 |
| Connector B |  | 4-1437290-1 | x1 | x1 |
| Connector C |  | 3-1437290-7 | 0 | x1 |
| Sockets |  | 3-1447221-3 | x65 | x90 |
| Stoppers |  | 4-1437284-3 | x50 | x75 |

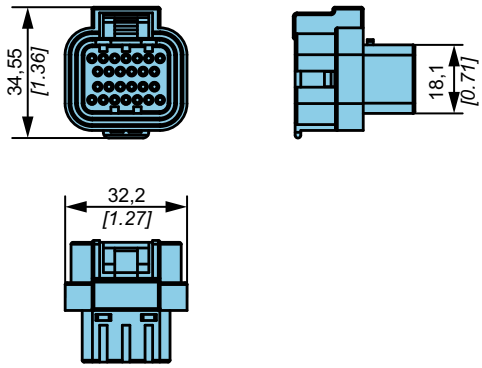
| | |
|---|---|
| Wire section | 0,75 to 1,25 mm² *[0.00116 to 0.00194 in²]* |
| Insulation diameter | for wire section 0,75 to 1,25 mm² *[0.00116 to 0.00194 in²]* : 1,6 to 2,4 mm *[0.063 to 0.094 in]* |
| Operating temperature | -40°C to 85°C *[-40°F to 185°F]* |
| Ingress Protection | IP67 |

### Mounting tools for the connector

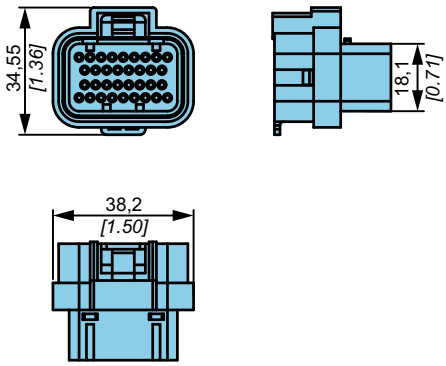
| Description | | AMP reference |
|---|---|---|
| Crimpers |  | 1454509-1 |

## Overall dimensions

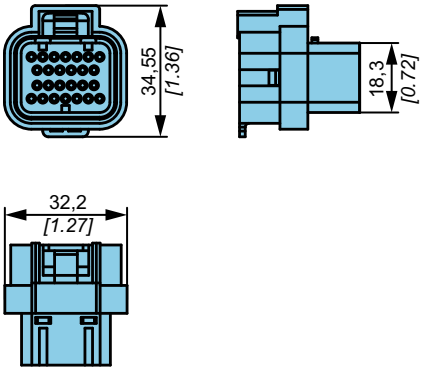
Connector A: 1473416-1



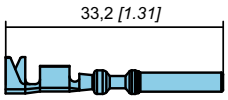

Connector B: 4-1437290-1



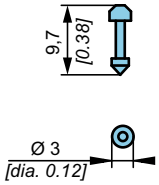

Connector C: 3-1437290-7




Socket:3-1447221-3




Stopper: 4-1437284-3




**If some wires are removed, stoppers must be inserted in connector cavity to ensure the sealing.**

**Male connector communication**

**This connector has to be present on the machine to permit SmartDrive™ CT maintenance.**

| Commercial name | KIT-CONNECT-COM-M-SD-CT |
|---|---|
| Part number Poclain Hydraulics | A48693C |
| Function | Diagnosis and download the software embedded in the SmartDrive ™ CT controller via CAN bus |
| Compatibility | Electronic transmission management with SmartDrive™ CT controller |
| Manufacturer | DEUTSCH |

| Features | | | Référence |
|---|---|---|---|
| Components |  | 1x Receptacle | HD10-9-1939PE |
| |  | 1 x Closing cap | HDC9-JDL082397 |
| |  | 1 x Gasket | HD10-9-GKT |
| |  | 7 x pins | 0460-202-1631 (AWG16-20) |
| |  | 4 x Stoppers | 114-017 |
| Operating temperature | For the connector: -55°C to 125°C *[-67°F to 257°F]* | | |
| | For the gasket: -57°C to 107°C *[-70.6°F to 224.6°F]* | | |
| Ingress Protection | IP67 | | |
| Wire section | 0,5 to 1.0 $mm^2$ *[0.019 to 0.039 $in^2$]* (16, 18, 20 AWG) | | |
| Insulation diameter | 1,35 to 3,05 mm *[0.053 to 0.12 in]* | | |

**Mounting tools for the connector**

| Description | | AMP reference |
|---|---|---|
| Crimpers |  | HDT-48-00 |
| Extractor |  | 0411-310-1605 |

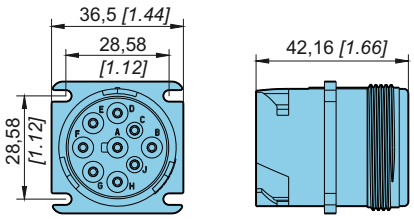
## Connector mounting

Strip the wires to a length of 5 mm *[0.19 in]*.
Crimp the wires onto the pins as shown in the table below.

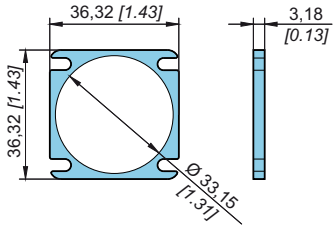
| N° pin connector on SmartDrive™ CT controller | | Function | N° pin male communication connector |
|---|---|---|---|
| | | Ground | A |
| | | VBAT_P | B |
| CAN 2 vehicle | Connector B pin 10 | CAN 2 H | C |
| | Connector B pin 18 | CAN 2 L | D |
| - | - | - | E |
| CAN 3 diagnosis | Connector A pin 13 | CAN 3 H | F |
| | Connector A pin 6 | CAN 3 L | G |
| CAN 1 diagnosis | Connector B pin 1 | CAN 1 H | H |
| | Connector B pin 2 | CAN 1 L | J |

## Overall dimensions

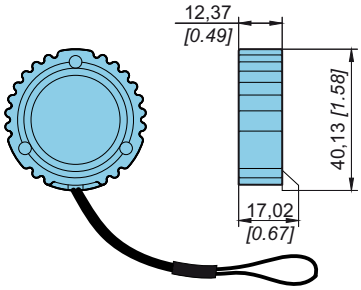
Receptacle: HD10-9-1939PE



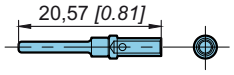

Gasket: HD10-9-GKT



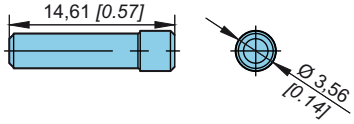

Cap: HDC9-JDL082397



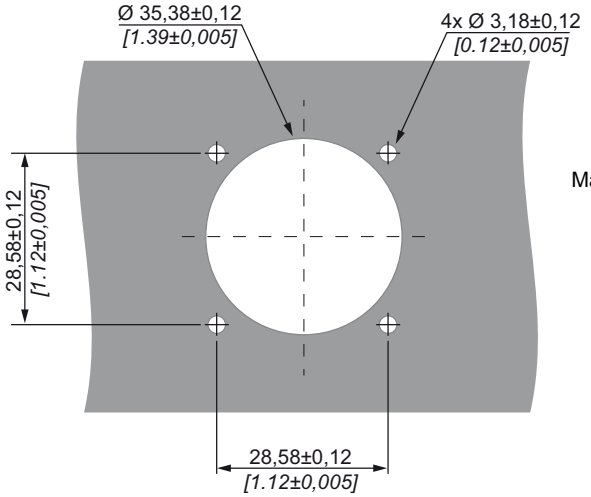

Pin: 0460-202-1631




Stopper: 114017




## Panel cutout




Maximum panel thickness: 6,35 mm *[0.25 in]*

**Connector kit 120Ω**

| Commercial name | KIT-PLUG-120-DTM-2S |
|---|---|
| Part number | A52539H |
| Manufacturer | 120Ω termination resistor for CAN bus |
| Compatibility | Electronic transmission management with SmartDrive™ CT controller |

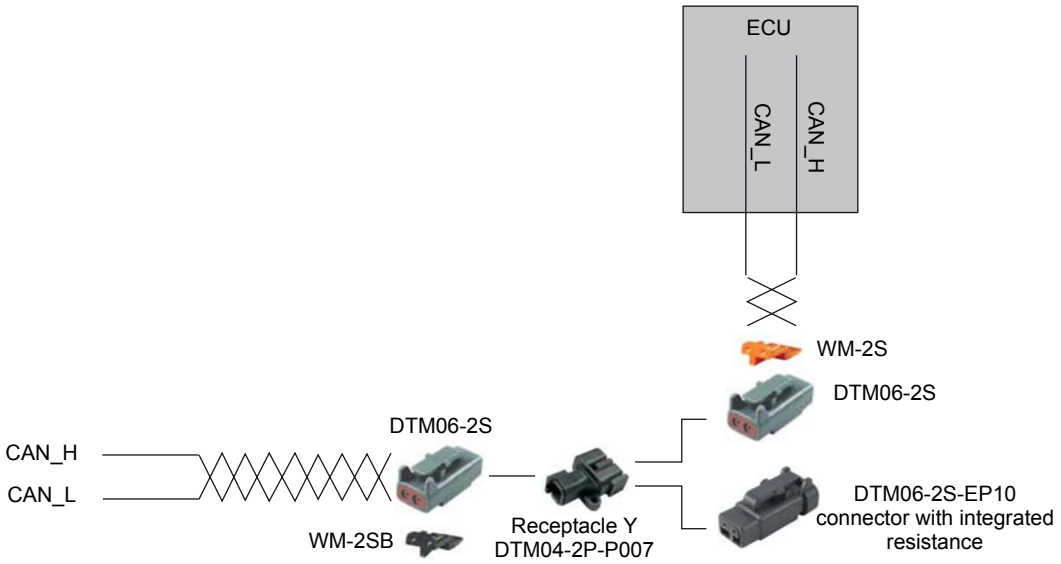
| Features | | | Référence |
|---|---|---|---|
| Components |  | 1 x receptacle | DTM04-2P-P007 |
| |  | 2 x connectors | DMT06-2S |
| |  | 1 x wedgelock | WM-2S |
| |  | 1 x wedgelock | WM-2SB |
| |  | 1 x connector with integrated resistance | DMT06-2S-EP10 |
| |  | 7 x sockets | 0462-201-2031 |
| Operating temperature | | -55°C to 125°C *[-67°F to 257°F]* | |
| Wire section | | 0,2 to 0,5 $mm^2$ *[0.008* to *0.019 in²]* | |
| Insulation diameter | | 1,35 to 3,05 mm *[0.053* to *0.12 in]* | |
| Pin material | | Gold plated | |
| Contact size | | 20 | |

**Mounting tools for the connector**

| Description | | AMP reference |
|---|---|---|
| Crimpers |  | HDT-48-00 |

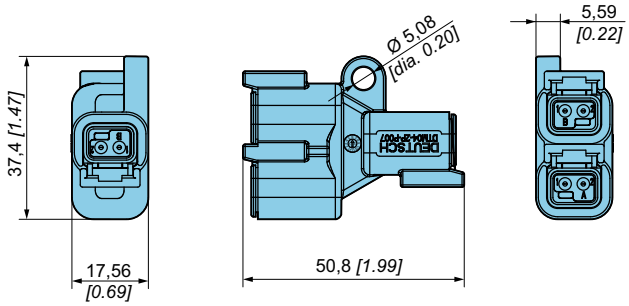
**Connector mounting**

Strip the wires to a length of 5 mm *[0.19 in]*.
Crimp the wires onto the sockets as shown in the diagram below.

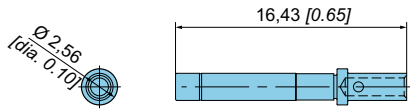



## Dimensions

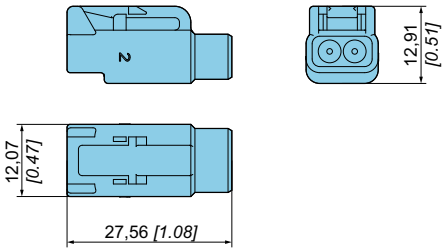
Receptacle Y: DTM04-2P-P007



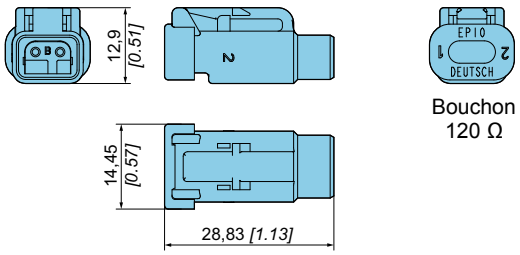

Socket: 0462-201-2031




Connector: DTM06-2S

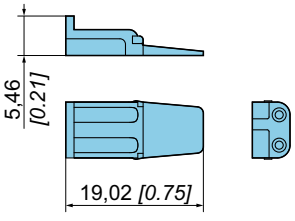



Connector with integrated resistance: DTM06-2S-EP10

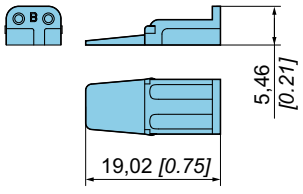



Bouchon
120 Ω

Orange wedgelock: WM-2S




Black wedgelock: WM-2SB



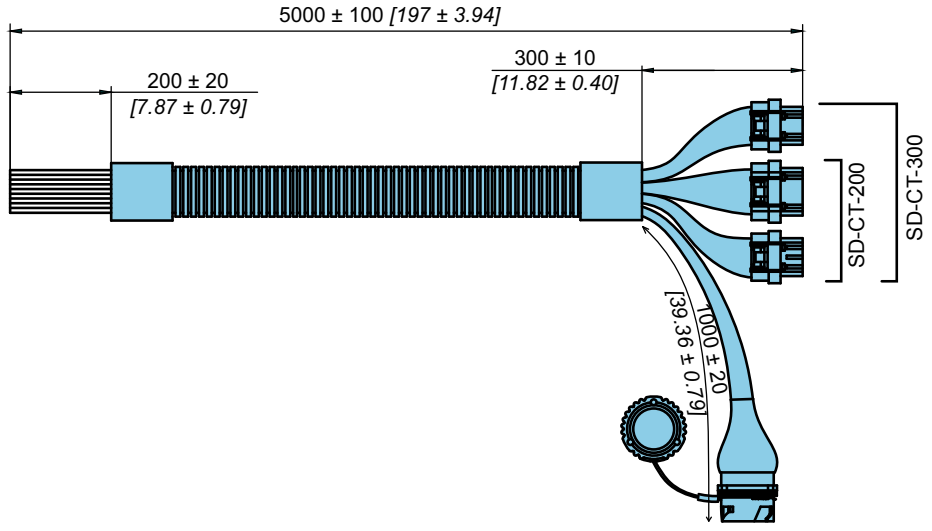
**SmartDrive™ CT cable**

| Commercial name | CABLE-SD-CT-200-60-5000 | CABLE-SD-CT-300-86-5000 |
|---|---|---|
| Part number | A48878D | A48877C |
| Function | Connect SmartDrive™ CT ECU to the machine wiring and have a male communication connector. | |
| Compatibility | Transmission management with SmartDrive™ CT ECU. | |
| **Features** | | |
| Length of cable | 5m | 5m |
| Operating temperature | - 40°C to 85°C [-40 °F to 185°F] | |
| Ingress protection | IP67 according to IEC 60529 | |
| Number of wires | 60 | 86 |
| Number of stoppers | 50 (Tyco ref : 4-1437284-3) | 75 (Tyco ref : 4-1437284-3) |
| Wire section | 0,75 mm² *[0.029 in²]* for signals<br>1 mm² [*0.039 in²*] for VBAT_P and power outputs<br>1,25 mm² [*0.049 in²*] for VBAT_D1, VBAT_D2, VBAT_D3 and -VBAT | |
| Insulation diameter | 1,6 to 2,2 mm *[0.063* to *0.086 in]* | |

Each wire is numbered with locating pin and connector.
For the CAN bus, the identification is performed by different colour for each pin. (see table- CAN Wire colour)

| CAN Wire colour | |
|---|---|
| Function | Colour |
| CAN1_High | White |
| CAN1_Low | Green |
| CAN2_High | White |
| CAN2_Low | Red |
| CAN3_High | White |
| CAN3_Low | Blue |

## Dimensions




**The non used wires should be individually insulated because of possible voltage.**

**In case of some wires are removed, stoppers must be inserted in connector cavity to ensure the sealing.**

## PC PHASES™ CT software combined with SmartDrive™ CT

PHASES™ CT enables :

**Set-up**
The settings of the SmartDrive™ CT may need to be changed if there is a change in characteristics or operating conditions.
The PHASES™ CT software manages 3 access levels to settings:
• Service,
• Manufacturer,
• Expert.
The last two levels are restricted to technicians with specific training (access restriced through password).

**Downloading**
Using a PC and the PHASES™ CT software allows to :
• Download the software to the SmartDrive™ CT;
• Send and retrieve set-up files.

**Any modification of the value of a setting must be carried out by a qualified engineer trained by the machine manufacturer. The Poclain Hydraulics technical support team can advise you in defining your settings.**
**Modifications to the settings may require a new qualification of the machine. If in doubt, contact your Poclain Hydraulics sales engineer.**

**Calibration**
The PHASES™ CT software allows to calibrate the minimum, maximum and neutral positions of the sensors installed on the machine in order to optimize the system's operation.

**For further information, see PHASES™ CT user guide no. A48679M.**

**Diagnostics**
The PHASES™ CT software enables the user to download the system's operating data. The data collected is used to identify possible malfunctions.

**Study of the system**
Our sales engineers will analyze your specific needs to facilitate the integration of Poclain Hydraulics components into your system.

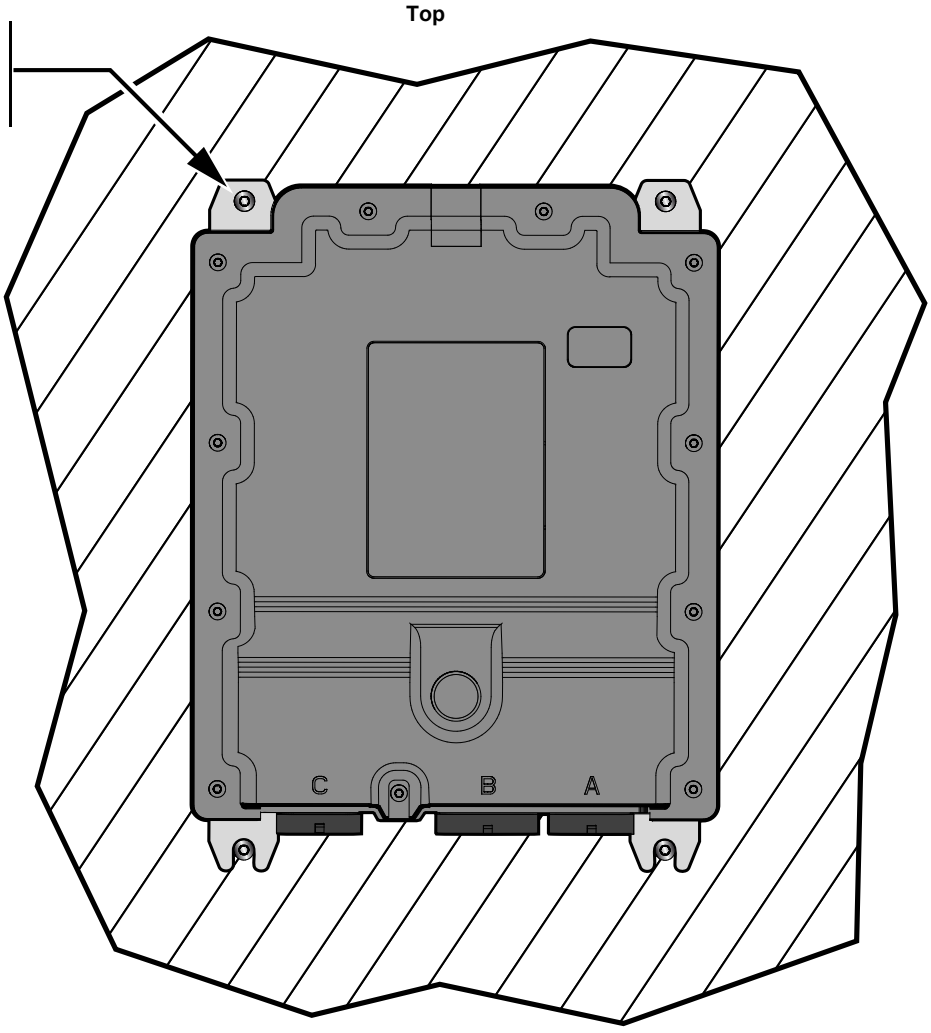
**Training**
Available on request.

# INSTALLATION

## Fitting the controller

The controller must be fixed on a rigid support. Make sure that there is enough space to fit the connector (min. 65 mm *[min. 2.56 in]*).
The controller shall be preferably mounted in vertical position (connectors at the bottom) to enhance ventilation and avoid dust accumulation on cooling fins.
The controller's housing has to be connected to the ground (chassis) of the vehicle and to be installed on a flat surface (flatness of 0,5/ 100x100mm *[3.94x3.94 in]*).

Screw (X4): M6
Nut (x4): M6
Shim (x4) : M6
Tightening torque: 6 Nm




## Machine wiring recommendations

- All the cables must be encased in flexible metal or plastic sleevings;
- All cables or sleevings must be held well in place and locked in to prevent pull-out;
- Bring the sleeving supports close together;
- The sleevings must be able to slide into the anchoring;
- Avoid mechanical stresses in the cables;
- Do not place the cables or sleevings close to moving or vibrating parts;
- Do not lay the sleevings along sharp angles. Protect them at each bend;
- Avoid laying the sleevings too close to high heat sources;
- Use wires with abrasion-resistant sleevings;
- Use cables that resist temperatures between 85°C *[185°F]* and 105°C *[221°F]* close to heat sources;
- Use cables that resist temperature of -40°C *[-40°F]*;
- Separate power cables from control cables;
- Pass the cables inside the machine, ensuring as much contact as possible with metal surfaces (steel). This will act as a shield against electromagnetic radiation.

## Recommandations for use of SmartDrive™ CT controller

**Temperature:**

**• Do not put the controller in a storage environment <-40 ° C *[-40 ° F]* and> + 90 ° C *[194 ° F]*.**
**• Do not place the controller operating in an environment <-40 ° C *[-40 ° F]* and> 85 ° C *[185 ° F]*.**

**Sealing:**

**Controller shall not be open during life cycle.**

**Shock:**

**Controller shall not drop on concrete floor or on any other similar surface.**

**Software:**

**Controller shall be dowloaded with applicative software before any use on machine.**

**Communication:**

**It is imperative to respect the maximum length of CAN bus according to the speed as described in the ISO 11898-2 standard.**

## Machine safety recommendations

Poclain Hydraulics has identified requirements for the controller, sensors and actuators to meet and satisfy the requirements of a performance level d according to ISO 13849-1 (PLd) at the vehicle system. To qualify for a performance level d (PLd) it is imperative to adhere to at least the following.

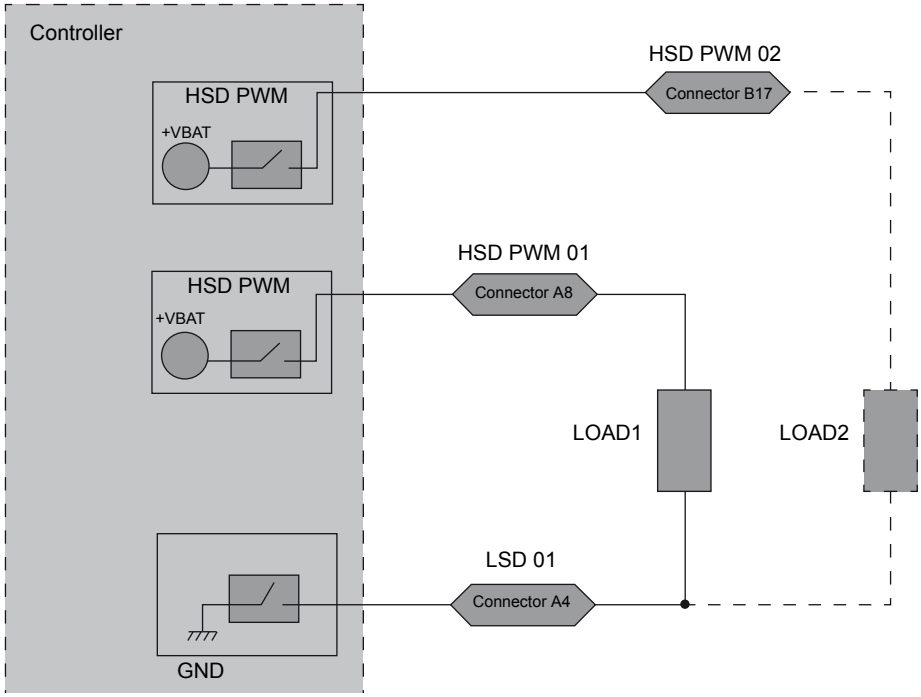
**A risk analysis must be conducted by the manufacturer to ensure the non-hazardous nature of the machine in case of failure of one of these components.**

**The safe state is the opening of HSD ans LSD. The customer must realize a safety analysis of the machine to check that there is no safety aspect due to the opening of the HSD and LSD.**

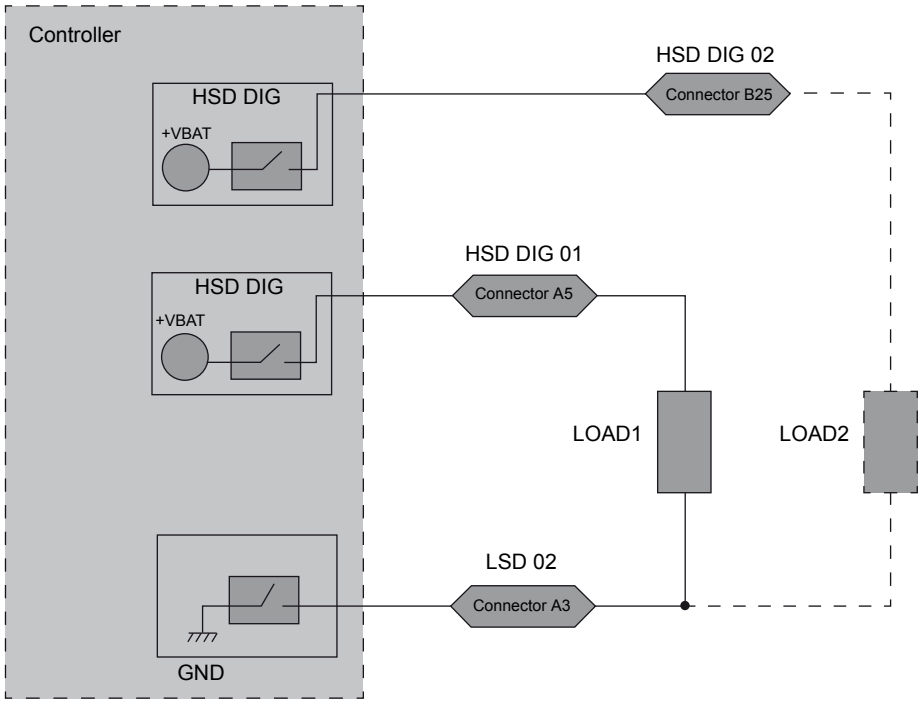
**HSL/LSD wiring :**

Any safety critical actuator or load must be wired to one HSD, and must have its ground return wired to one LSD. Several actuators or loads can be wired on HSD or LSD, provided they meet the maximum current delivered by HSD and LSD.

**In the case of one (or two) PWM output(s)**



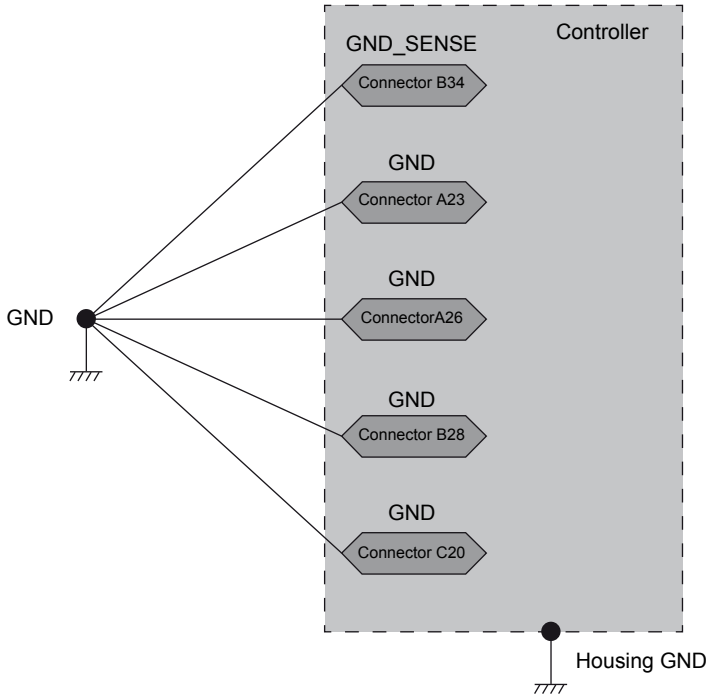
**In the case of one (or two) digital output(s)**




For safe wiring with 2 loads, it is imperative to check the maximum current through the load named LOAD1 and this through the load named LOAD2 is compatible with the maximum current of LSD receiving these two currents.

**GND_SENSE Wiring:**

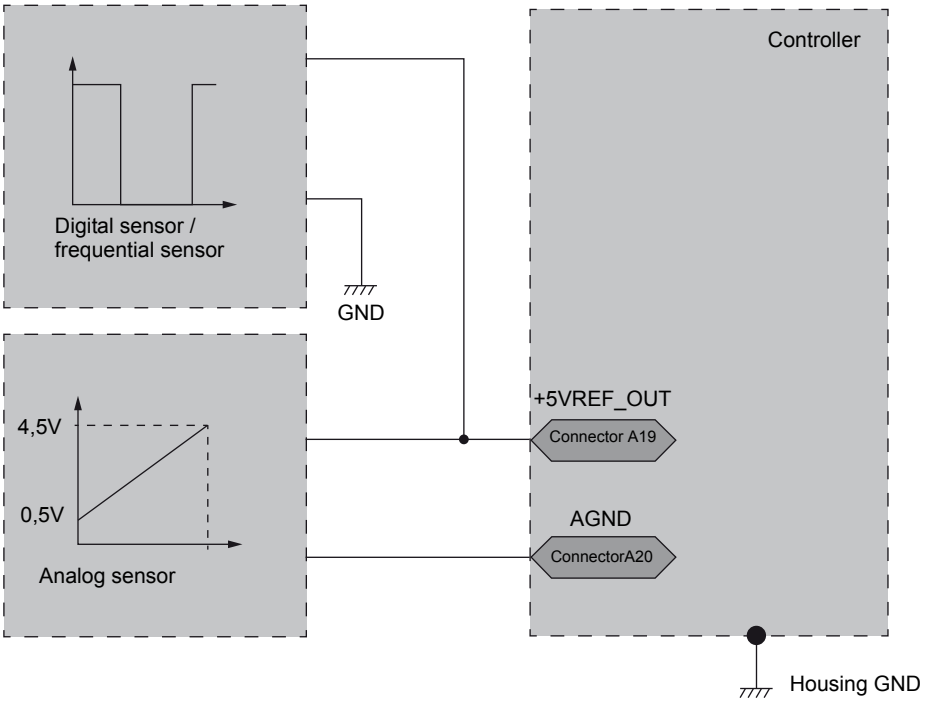
Wiring must be observed is illustrated in the following figure:




The function of this pin enables the controller to cut the outputs in the event of loss of GND.
GND_SENSE pin and GND pins must always be connected together in a single connection point (for information GND Pin C-20 is only available on SD-CT-300).
The housing of the controller must be connected to ground (chassis) of the vehicle.

**Sensors with sensitive signals:**

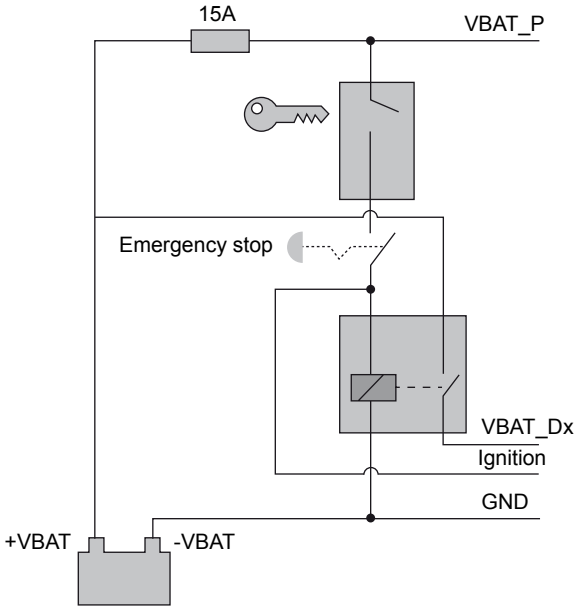
All analog sensors must be wired on the ground A_GND (analog ground) without any other connections to ground vehicle. All digital and frequency sensors must be wired to GND.




**Emergency stop:**

Poclain Hydraulics recommends that you first do the wiring for an emergency stop button that can be easily accessed by the driver. The button should stop the engine and cut off the power supply of the controller SmartDrive™ CT.

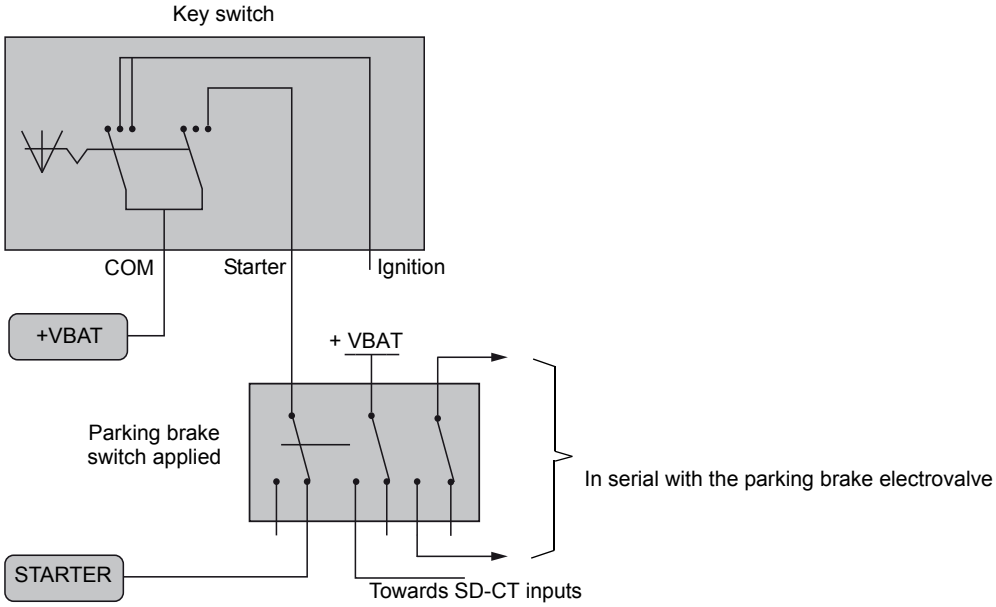
Diagram:



**Parking brake:**

To prevent vehicle movement during engine start, it is recommended to wire parking brake switch in serial with starter.

Diagram:




**Do not connect the SD-CT input with the parking brake electrovalve.**

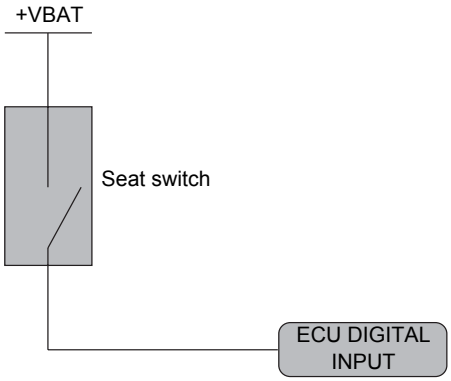
**Parking brake lamp:**

A lamp on the dashboard must give the real status of the parking brake.

The logic must be as follows:
- Lamp on, parking brake applied;
- Lamp off, parking brake released.

**Seat switch:**

The seat switch is used to check the presence of the driver of the machine, when the driver is seated the switch is closed.
The seat switch has to be wired according the following illustration:

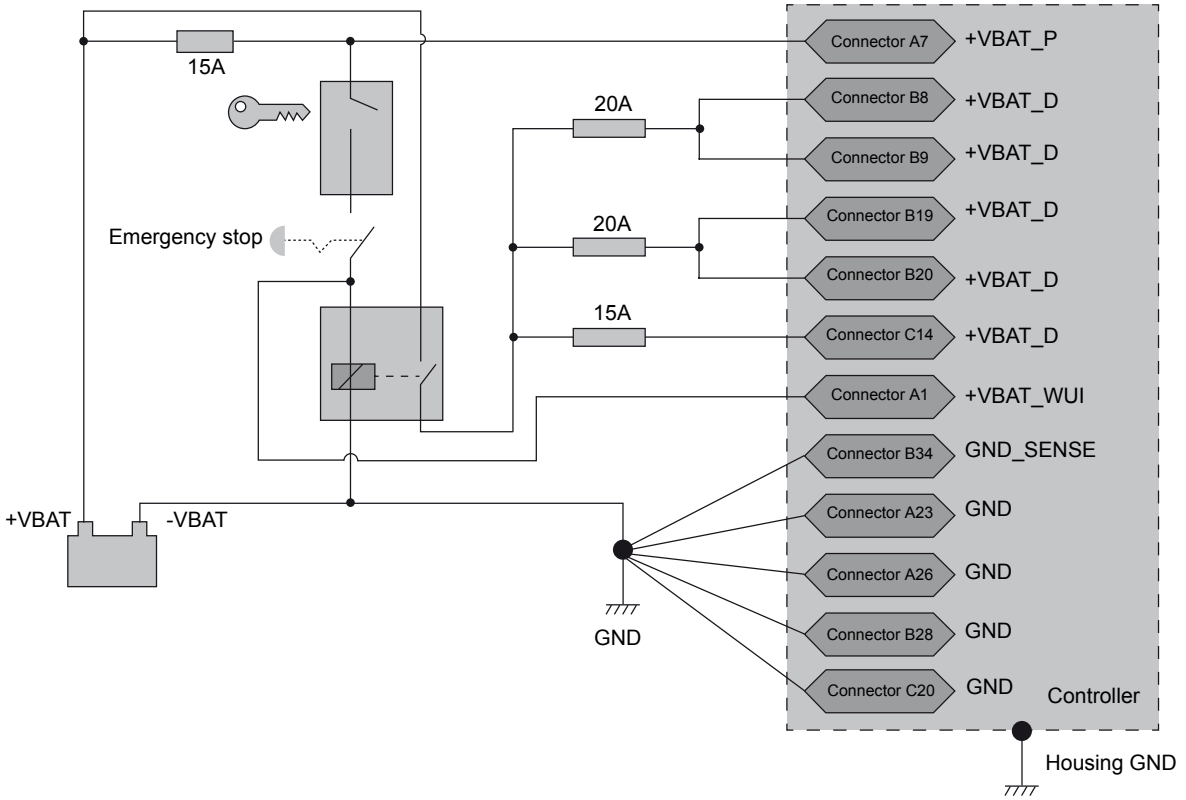



**Controller:**

**Controller safe state is de-activation of all outputs.**

**CAN bus:**
The CAN bus must be wired using shielded or unshielded twisted pair. CAN bus must be wired according to SAE J1939-11 or SAE J1939-15.
In case the controller SmartDrive™ CT is in end of the line, add a termination resistor of 120Ω. For this Poclain Hydraulics offers 120Ω connector kit (see page 22).

**Supply:**

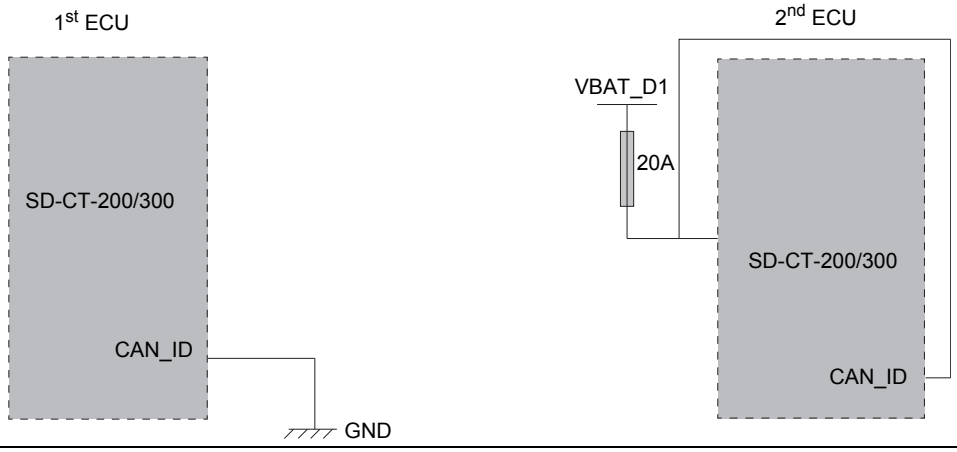



The correct wiring of the power supply pins ( +VBAT_P, + VBAT_Dx, VBAT_WUI+ ) and pin connected to ground, is shown in previous figure ( +VBAT_D3 only available on SD-CT-300).
Power rails must be connected through an automotive fuse SAE J1284 20A for +VBAT_D1 and + VBAT_D2 and 15A on + VBAT_D3.

**CAN messages information:**

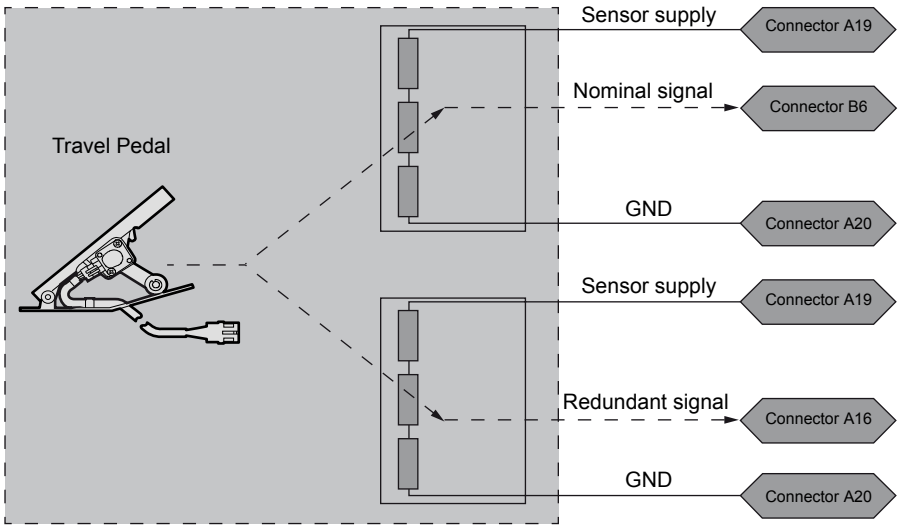
**All CAN messages information sent by Poclain ECU cannot be used for safety application. For safety critical data by CAN, please contact your Poclain Hydraulics application engineer.**

**CAN ID:**
The pin CAN ID (connector A pin 9) is not used when there is only 1 ECU. When 2 ECU´s are used, CAN ID has to be connected to GND on 1st ECU and to +VBAT with a fuse on 2nd ECU.
1st ECU: it´s necessary to connect CAN ID to the ground without intermediate device (resistor, fuse, ... in order to there is effect on the level on CAN ID).
2nd ECU: It´s necessary to connect CAN ID to the VBAT through a fuse-protected line main switch. This fuse has to be monitored so that a short circuit to ground resulting in blowing this fuse can be detected (either through VBATx other than VBATP monitoring or with a dedicated input).



**Sensors:**

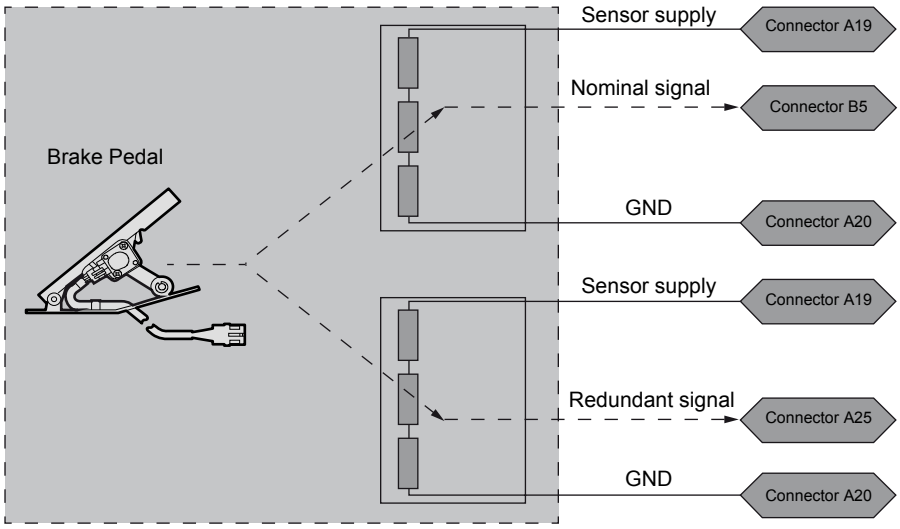
**Travel pedal**




Safety requirements for compliance PLd, the sensor must:
• be powered by the +5 V OUT (A-19) and A_GND (A-20)
• provide two independent signals:
- These signals must be between 0.5 V and 4.5 V to detect open circuits and short circuits.
- The signal source should be 0.5 V when the pedal is released and 4.5 V when the pedal is fully depressed.

It is imperative to perform a calibration in operations of installation / commissioning and maintenance / repair on safety-critical inputs (pedal, joystick, ...), to take account of the complete measurement chain (physical implementation,sensor, harness, controller ...).
In the case of potentiometric sensors, the additional requirement is taken into account:
500Ω <sensor resistance <5kΩ.
The customer has to use a travel pedal for EMC directive of machine application field (Offroad/Onroad).

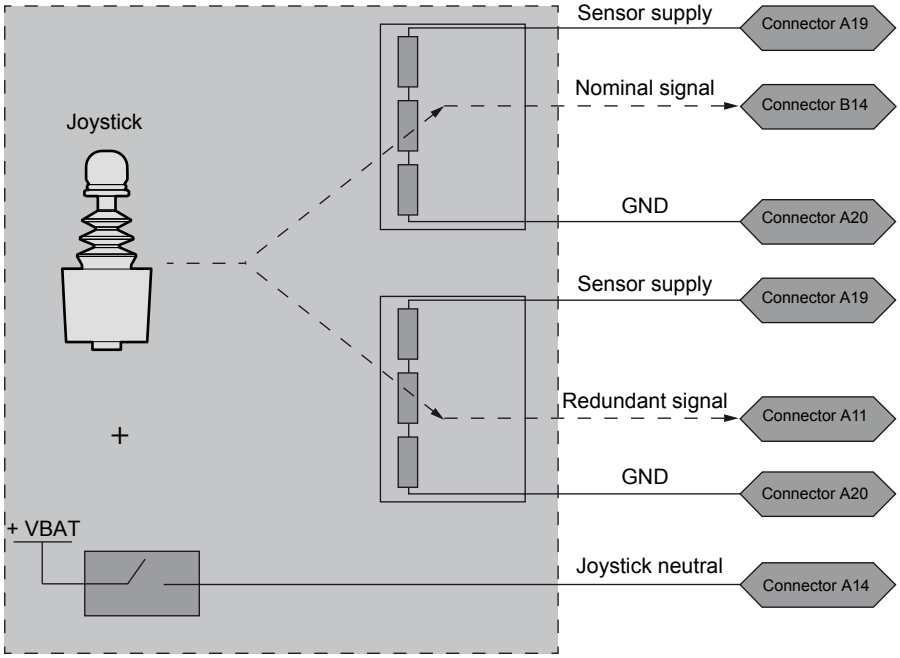
**Brake pedal**




Safety requirements for compliance PLd, the sensor must:
• be powered by the +5 V OUT (A-19) and A_GND (A-20)
• provide two independent signals:
- These signals must be between 0.5 V and 4.5 V to detect open circuits and short circuits.
- The signal source should be 0.5 V when the pedal is released and 4.5 V when the pedal is fully depressed.

It is imperative to perform a calibration in operations of installation / commissioning and maintenance / repair on safety-critical inputs (pedal, joystick, ...), to take account of the complete measurement chain (physical implementation,sensor, harness, controller ...).
In the case of potentiometric sensors, the additional requirement is taken into account:
500Ω <sensor resistance <5kΩ.
The customer has to use a brake pedal agreed for EMC directive of machine application field (Offroad/Onroad).

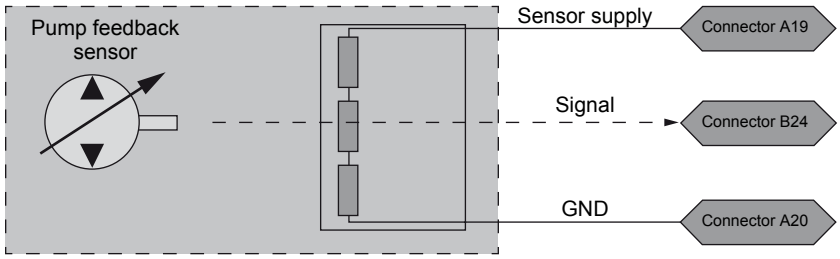
## Joystick




Safety requirements for compliance PLd, the joystick must:
• be powered by the +5 V OUT (A-19) and A_GND (A-20)
• provide two independent signals:
- These signals must be between 0.5 V and 4.5 V to detect open circuits and short circuits.
- The source signal will vary from 2.5 V to 4.5 V for forward and 2.5 V to 0.5 V for reverse.
- Provide a neutral signal (VBAT contact in forward or reverse).

It is imperative to perform a calibration in operations of installation / commissioning and maintenance / repair on safety-critical inputs (pedal, joystick, ...), to take account of the complete measurement chain (physical implementation, sensor harness, controller ...).
In the case of potentiometric sensors, the additional requirements are taken into account:
500Ω <sensor resistance <5kΩ
The customer has to use a joystick agreed for EMC directive of machine application field (Offroad/Onroad).

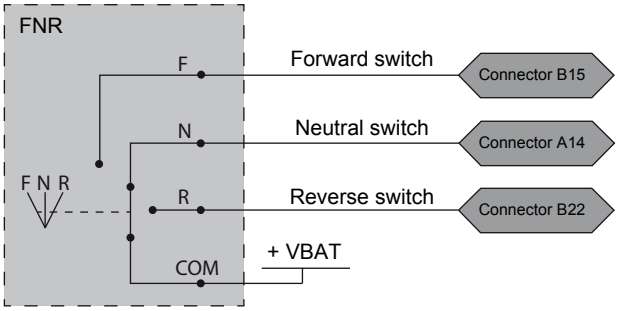
## Feedback sensor




Safety requirements for compliance PLd, the sensor must:
• be powered by the +5 V OUT (A-19) and A_GND (A-20)
• providing an output signal centered on 2.5 V and ranging from 0.5 V to 4.5 V to detect open circuits and short circuits.

The customer has to use a pump feedback sensor agreed for EMC directive of machine application field (Offroad/Onroad).

**FNR**




Safety requirements for compliance PLd, the sensor must:
• Provide three logic signals remain independent, compatible with universal input
• not be connected to loads (valve) in parallel
• have gold contacts

**Coherency between direction switches: the customer must use a neutral switch on joystick or a neutral switch on FNR lever.**

**Speed sensor**
The customer has to use a speed sensor agreed for EMC directive of machine application field (Offroad/Onroad).

**Redundant inputs**

| Primary input | Redundant input |
|---|---|
| UN_01 | UN_06 |
| UN_02 | UN_07 |
| UN_03 | UN_08 |
| UN_04 | UN_12 |
| UN_05 | UN_13 |
| AN_01 | AN_09 |
| AN_02 | AN_10 |
| AN_03 | AN_11 |
| AN_04 | AN_12 |
| AN_05 | AN_13 |
| FIN_01 | FIN_05 |
| FIN_02 | FIN_06 |
| FIN_03 | FIN_07 |

**Installation and commissioning:**

**Upon system design and configuration, it could be needed to perform calibrations of safety critical inputs, to take into account the complete measurement chain (physical implementation, sensor, harness, controller…).**

**Maintenance and repair:**

**Any maintenance or repair of the controller shall be done according to the warranty terms. Otherwise, the integrity of the controller and the effectiveness of safety principles can not be guaranteed.**

**Precaution before maintenance and repair:**

**Before any maintenance or repair or decommissioning the controller must be disconnected from the power source, in particular before disconnecting interfaces connectors. To perform this operation, it is recommended to disconnect the battery fully after complete stop of the vehicle and its engine.**

**Operation after maintenance and repair:**

**After maintenance or repair of the machine, it is necessary to perform a calibration of the safety inputs.**

**Caution during electric welding:**

**The connectors on the controller and associated sensors must be disconnected during the electric welding process.**

**Pump:**

**The safety state of a hydrostatic transmission is stopped vehicle by a rapid and mastered return to neutral of the pump.**

**To do so, it is necessary to add:**
**• restrictors to be correctly sized depending on the application, the machine ... When using multi- displacements motors, it could be necessary to use a bypass valve for these retrictors.**
**• A cut-off valve, allowing to bypass the supply of the pump. It´s customer responsibility to test it.**

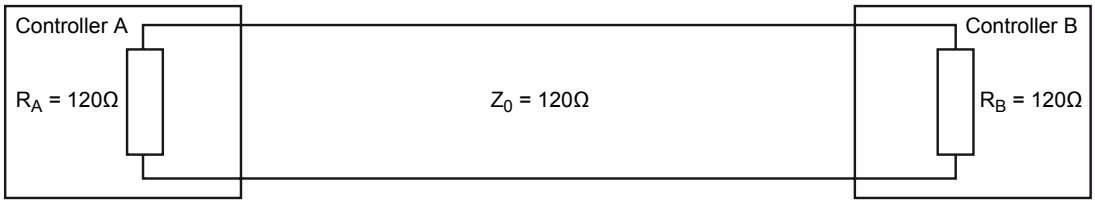
**Responsibility:**

**Safety measures when installing our products remain the responsibility of the machine manufacturer. They must comply with applicable laws in the country or state.**

## Recommendations for CAN communication wiring

**Communication:**

**To avoid glitches, mitigation signals or data collisions, it is required to use specific CAN bus cable with an impedance 120Ω characteristic (twisted pair), in order to achieve impedance matching (transmission of whole power).**




**Assembly instruction:**

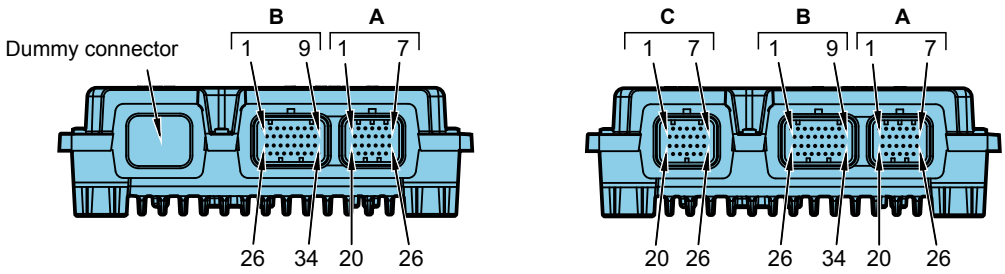
**The controller must be mounted in vertical position with the electrical connections at the bottom.**

**Wiring:**

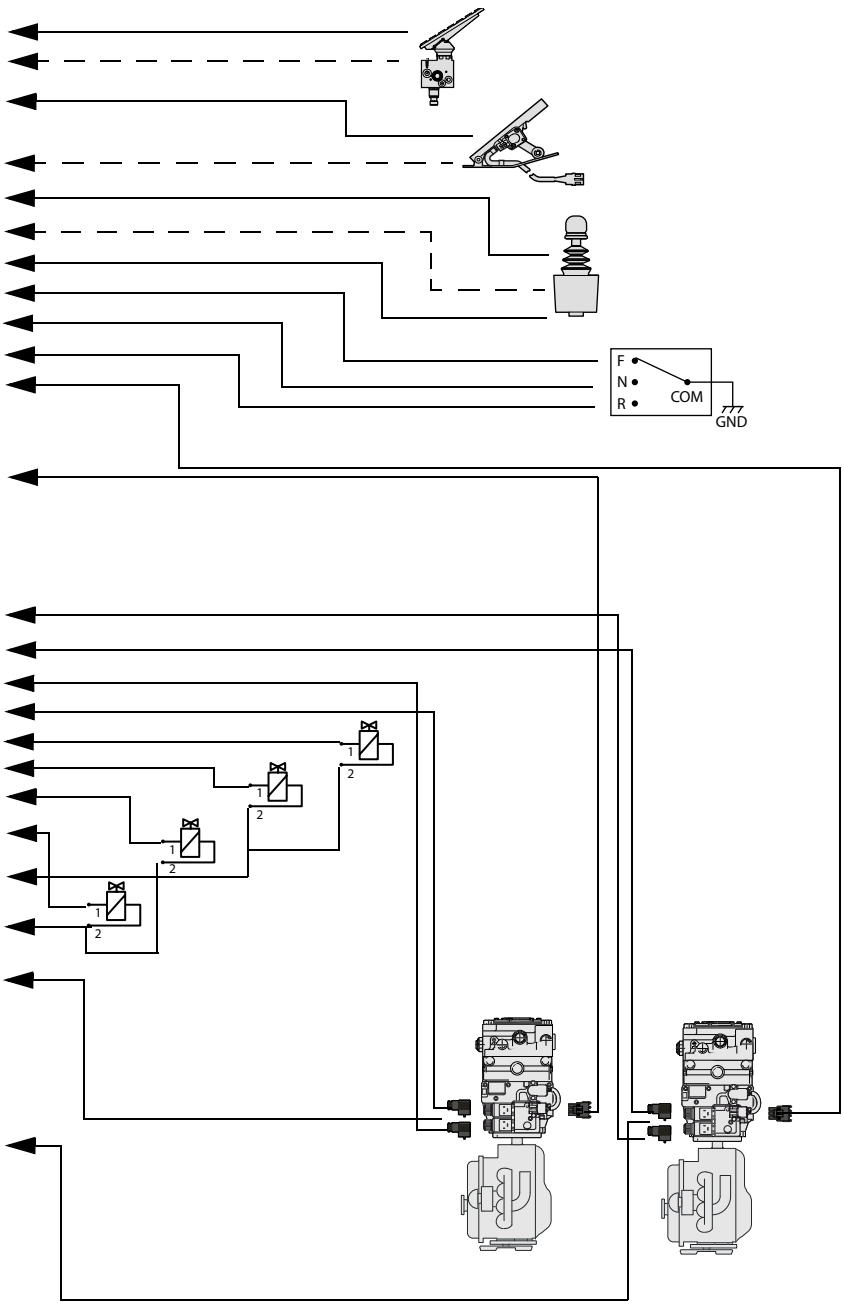
**The harness must meet the information and constraints of cables (see Table Pin description page 13).**

**The following assignments are to be respected so the safety features of controller SmartDrive™ CT still use the same input / output.**

Wiring schematic for transmission safety organs:




| | Connector | Function |
|---|---|---|
| Inputs | B-5 | Brake pedal |
| | A-25 | Redundant brake pedal |
| | B-6 | Acceleration / Brake pedal |
| | A-16 | Redundant acceleration / brake pedal |
| | B-14 | Joystick |
| | A-11 | Redundant joystick |
| | A-14 | Neutral joystick |
| | B-15 | Forward switch |
| | A-14 | Neutral switch |
| | B-22 | Reverse switch |
| | B-24 | Pump 1 feedback sensor |
| | B-31 | Pump 2 feedback sensor |
| Outputs | A-8 | S1 valve pump 1 |
| | B-17 | S2 valve pump 1 |
| | B-16 | S1 valve pump 2 |
| | B-4 | S2 valve pump 2 |
| | A-5 | Pump 1 cut-off valve |
| | B-25 | Pump 1 by-pass valve |
| | B-7 | Cut-off valve 2 |
| | B-12 | Pump 2 by-pass valve |
| | A-3 | Return of cut-off and bypass valves pump 1 |
| | A-2 | Return of cut-off and bypass valves pump 2 |
| | C-13 | Return of S1 & S2 valves pump 2 |
| | A-4 | Return of S1 & S2 valves pump 1 |



## Checking of the electrical environment

The PHASES™ CT software enables you to view any anomalies detected by the SmartDrive™ CT controller, by delivering an error code, a brief explanation and a list of possible causes. In particular, it indicates:
• Short-circuit type electrical anomalies on the ground, or the 5V;
• Cabling errors: switch allocated/not allocated to a given part;
• input/output malfunctions.

**Calibration can detect some cable configuration errors (see next chapter).**

## First level diagnostic

**Fault warning lamp on dashboard:**
The warning lamp flashes if there is a fault. Otherwise, it remains off.

## Checking of the hydraulic environment

**Refer to the information on commissioning provided in the "Motor generic installation" brochure n° 801478197L.**

## Starting up the engine

**Place the machine on the wheel blocks.**
**Set up a safety area.**
**Observe all personnel safety instructions.**

Put the **F/N/R** (Forward/Neutral/Reverse) shift lever in the neutral position. Apply the parking brake.
Switch on the controller.
Start the engine, and wait until the charge pressure is established.

**Press the emergency stop button and check that it stops the engine and cuts off power to the SmartDrive™ CT controller.**

Start the engine again and then use the PHASES™ CT software in the input/output diagnostic module to check that the readings of the various sensors (switch, potentiometer sensors, etc.) are displayed correctly when you actuate them.

**Calibrating all the parts**
This calibration is carried out using PHASES™ CT. See its user manuals.

**Activating pump displacement**
Release the parking brake.
Put the **F/N/R** shift lever (or switch or joystick) in the Forward Drive position.
Gently depress the travel pedal; the wheels must turn slowly forward.

**Limit the wheel rotation speed to 10% of their maximum speed when the machine is on wheel blocks.**

Check the pressure levels.

## Checking the system's specific functions on wheel blocks

**The forward/reverse ground drive direction** using the joystick or switch**.**

**Return to neutral**
• Put the gear shift in neutral when in ground drive: the machine will decelerate in accordance with the programmed deceleration ramp.

**Reversal**
• Reverse when in ground drive: the wheels of the machine will decelerate then accelerate in the opposite direction depending on the pedal position.

**Braking**
• Test the parking brake: activating it deactivates the travel pedal.
• Test the emergency brake by fully depressing the brake pedal.

## Checking that the system works on wheels

Repeat the previous tests (except tests of braking).
Test the functions that are specific to your application (anti-stall, cruise control, etc)

**A functional check of the parking brake must be carried out each time it is used as an auxiliary brake (or emergency brake). For all vehicles capable of speeds over 25 km/h, please contact your Poclain Hydraulics application engineer.**

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