SMARTDRIVE EASY SYSTEM

HYDROSTATIC TRANSMISSIONS

POCLAIN HYDRAULICS

PH

INNOVATION
INTERMAT 2006
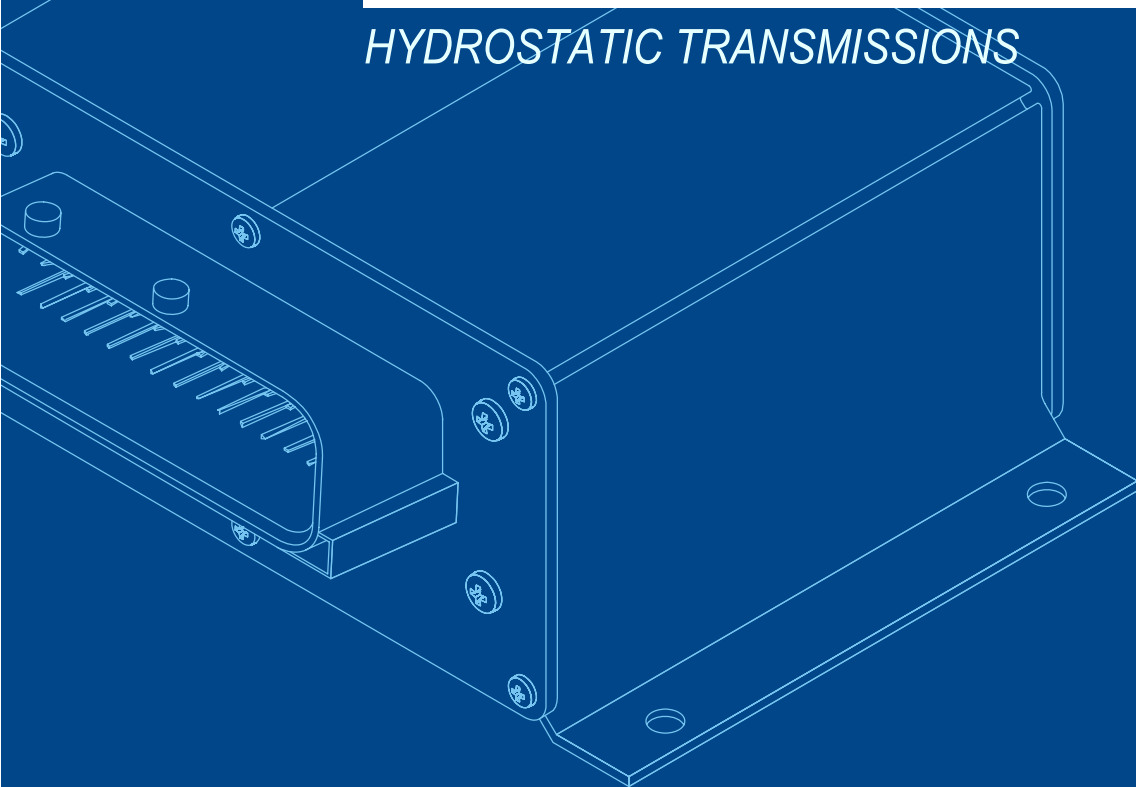
Methodology :
This document is intended for manufacturers of machines that incorporate Poclain Hydraulics products. It describes the technical characteristics of Poclain Hydraulics products and specifies installation conditions that will ensure optimum operation.
This document includes important comments 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 code.

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 between brackets and italic)

CONTENT

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FOREWORD

Introduction

Poclain Hydraulics has created and developed SMART DRIVE™ EASY, 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 on-board software calculates 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 software or the portable hand held terminal. 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).

Characteristics

Installation

Characteristics of the regulating ECU (SD Easy)

> **Contact your PoclainHydraulics sales engineer for all adaptations.**

Model code	SD EASY
Supply voltage	12 V DC 24 V DC
Operating temperature	- 40°C à 85°C *[-40 °F à 185°F]*
Overall dimensions	See below
Material	Aluminum
Mass	0.5 kg *[1.1 lb]*
Mounting	4 x Ø 5.5 mm *4 x [0.22" dia.]*
ECU regulator protection index with its connectors	IP 65(weather proofing)
Maximum current	14 A
Electrical protection	Excess voltage, reverse polarity, short circuit
Microprocessor	16 bits
Microprocessor frequency	25 MHz
ECU programming	Programming with a PC using the PHASES™ software application
ECU set-up	Set-up with the software PHASES™ or the HHT

Overall dimensions of the ECU regulator
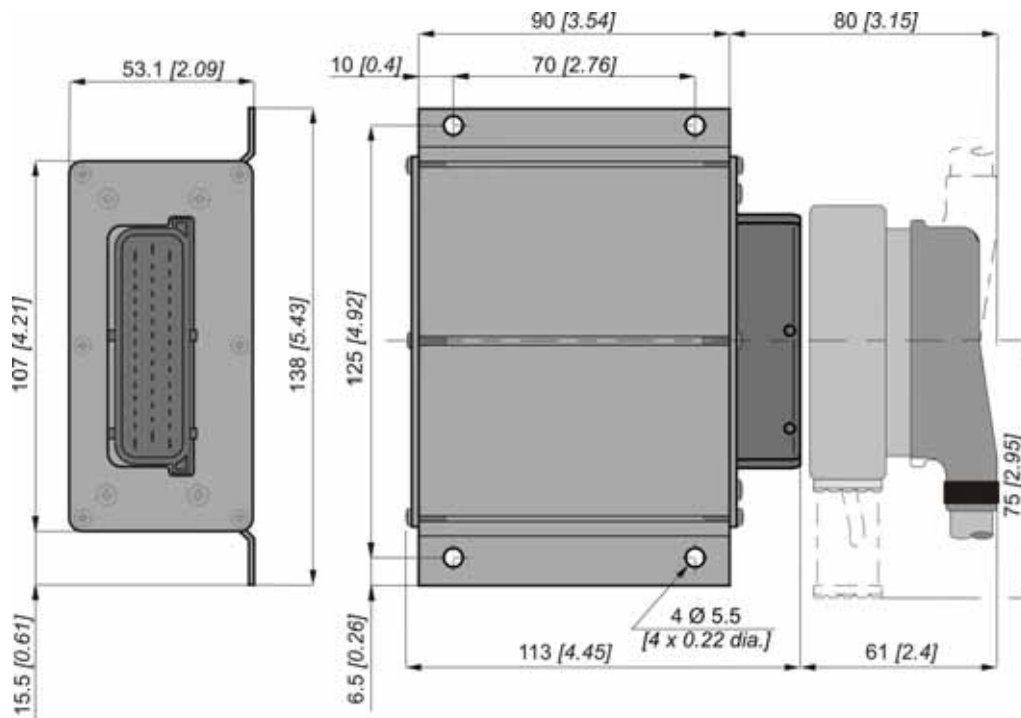
Electromagnetic compatibility

Electromagnetic compatibility of moving machinery is required by the European Union. Manufacturers must submit a technical summary or one of their machines to a qualified certification center.
The SD Easy ECU passed the electromagnetic compatibility tests for moving machinery components:
• ISO 14982: 1998
  Agricultural and forestry machinery - Electromagnetic compatibility;
• EN 13 309: 2000
  Construction machinery - Electromagnetic compatibility of machines with internal electrical power supply;
• EN 12895: 2000
  Industrial trucks - Electromagnetic compatibility.

SmartDrive™ Easy input/output characteristics

On-Off digital inputs
These inputs are of the ground pin type.
They are protected against short circuits on the ground, battery, 5 V and 12 V

Description	Min.	Max.
Maximum voltage for a low level		1.65 V
Minimum voltage for a high level	3.25 V	
Allowable voltage		30 V
Maximum resistance of pin for a low level		1.5 kΩ
Minimum resistance of pin for a high level	10 kΩ	

Analog inputs
They are protected against short circuits on the ground, battery, 5 V and 12 V.

Description	Min.	Max.
Measurement range	0 V	5 V
Accuracy		1 %
Allowable voltage		30 V
Input impedance		259 kΩ

Frequency inputs
The sensors read can be NPN, PNP and PUSH PULL on the two frequency inputs.
The differential sensors can only be read on the frequency input 2.

Description	Min.	Max.
Measurement range	0 Hz	8 500 Hz
Allowable voltage		30 V

Logical inputs
They are protected against short circuits at the ground, battery, 5 V and 12 V.
These outputs are protected against thermal overload.

Description	Min.	Max.
Maximum current		0.5A under 12V 0.25A under 24V
Output voltage	Vbat _1V	Vbat

PWM outputs 2A (pins 30, 6, 16 and 19)
These outputs are protected against short circuits on the ground, battery, 5 V and 12 V.
These outputs are protected against thermal overload.

| Description	Min.	Max.
Maximum current	0	2 A under 12 V 1 A under 24 V
Maximum frequency		3.125 kHz

PWM outputs 125 mA (pins 16, 20, 30 and 34)
They are protected against short circuits on the ground, battery, 5 V and 12 V.
These outputs are protected against thermal overload.

Description	Min.	Max.
Measurement range	0	125 mA
Maximum frequency		3.125 kHz

Characteristics

Installation

Example of hydrostatic transmission control on a vehicle.
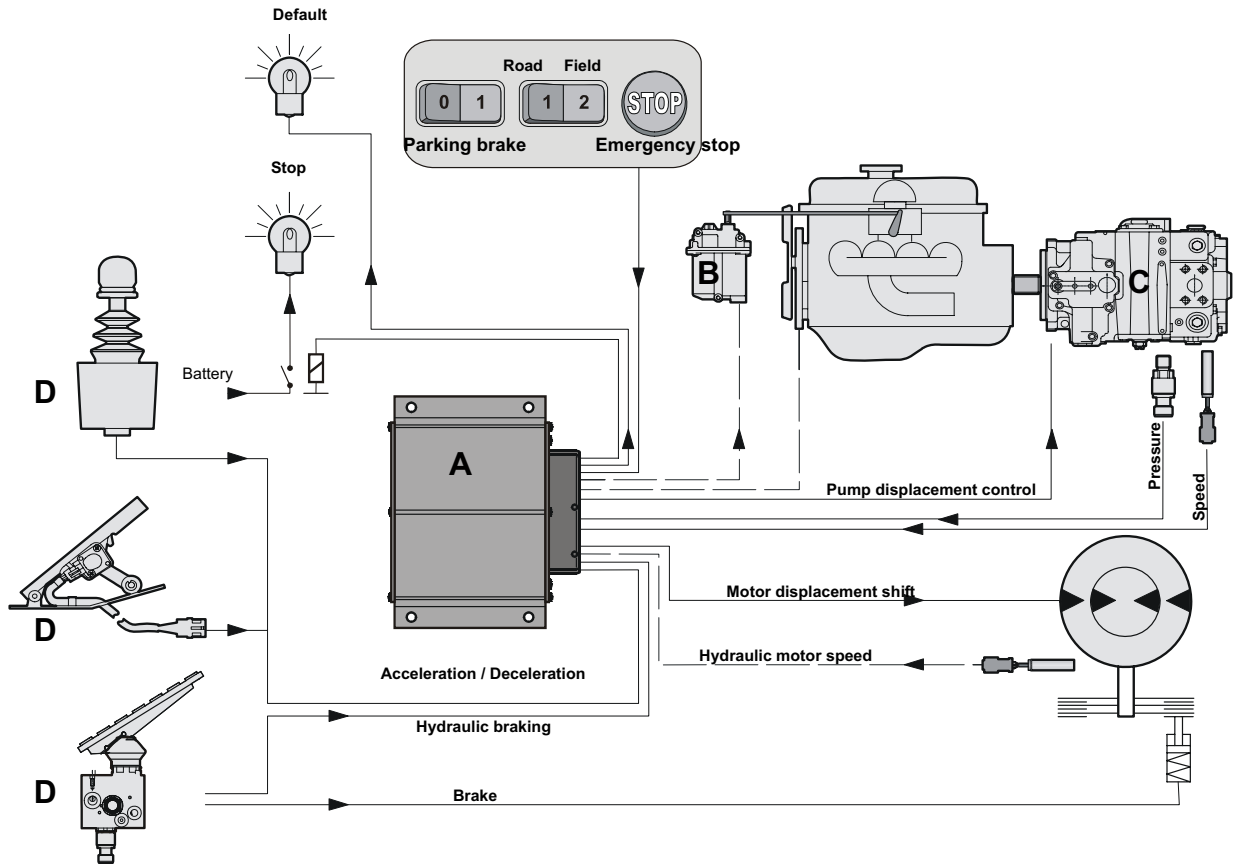
Description :
  A - An SD Easy regulating ECU that controls transmission,
  B - An internal combustion engine (optional) that drives the engine if not equipped with a CAN link,
  C - A pump fitted with displacement control solenoids, a speed sensor and a 600-bar pressure sensor,
  D - A joystick or pedal, mode selection switch, default light, stop light, speed sensor display, etc.

Signalling
The ECU manages signalling (braking, reverse lights, warning beep, etc.) depending on the ground drive condition.

CAN Bus Communication
The ECU presents a standard 2.0A or the applied 2.0B CAN interface.
When connected to the machine's CAN network, the SD Easy ECU 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.**

Description of functions

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 SD EASY ECU.

Automatic displacement shift
The SmartDrive™ EASY 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 SD Easy ECU can fully manage the engine in two ways:
• Via the actuator (optional);
• Via the CAN Bus.
The ECU 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™ EASY 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 **SD EASY ECU.**
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™ EASY** manages the pump and hydraulic motor displacement reduction by taking account of the level of mechanical braking, so that the hydrostatic transmission prevents possible wheel lock.

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™ EASY.**

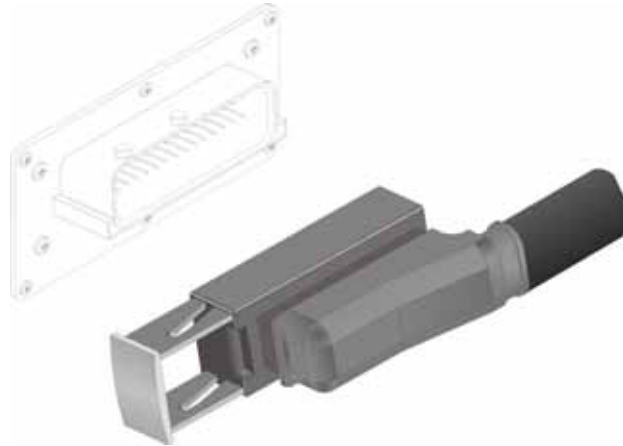**Constant speed with combined auxiliary control**
In **[Field Mode]**, the machine's ground drive speed remains constant in spite of the acceleration of the engine required for the auxiliary functions.
The operator, now freed from controlling the speed, can concentrate on tasks with higher added value.

Characteristics

Installation

Auxiliaries

Connector

Characteristics		Description	AMP reference	Poclain Hydraulics reference
Commercial code		**KIT-CONNECTEUR-SD-EASY**		**A02809D**
Components	Power	AMP Connector	1-967281-1	
		AMP protective cover	0-965643-1	
		7 AMP female contacts	929937-3	
		7 AMP insulants	828905-1	
		6 AMP stoppers	828922-1	
	Signals	40 AMP female contacts	962876-1	
		40 AMP insulants	963530-1	
		36 AMP stoppers	963531-1	

Mounting tools for the connector

Description	AMP reference
Crimpers	539635-1
Chuck-jaw for power spindles	539737-2
Chuck-jaw for control spindles	539651-2
Extractor for power spindles	1-1579007-6
Extractor for control spindles	726534-1

> ℹ️ **The characteristics and installation of the components below are described in catalogue n° A01888C.**

Joystick
Controls the direction of the ground drive and provides the acceleration/deceleration and speed settings.

Suspended or floor pedal
Controls the direction of the ground drive and provides the acceleration/deceleration and speed settings. Another pedal can also be used for braking.

Position sensors
These potentiometers (rotary or linear) are linked to controls other than those described above, which already incorporate a potentiometer. They indicate the position of the control levers.

Internal combustion engine (optional)
Controls the internal combustion engine injection. It is required if the engine does not have a CAN Bus.

Pressure sensors
They inform the ECU of the High Pressure Line pressure (from the 600-bar sensor) and the brake circuit pressure (from the 160-bar sensor).

Options
Speed sensor
See the motor brochures.

PC PHASES software combined with SD Easy

PHASES™ enables :

Set-up
The settings of the SD Easy may need to be changed if there is a change in characteristics or operating conditions.
The PHASES™ 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™ software allows to :
• Download the software to the SD Easy;
• Send and retrieve set-up files.
The hand held terminal only allows you to modify the data item per item.

> **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™ 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™ user guide no. 801378161B and HHT user guide no. 801478140Z.**

Diagnostics
The PHASES™ software enables the user to download the system's operating data. The data collected is used to identify possible malfunctions.
Likewise, the hand held terminal is used to identify a malfunction through a system of codes and error messages.

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.

Characteristics

Installation

Identification of the component

A : Model code
     e.g. SD EASY
 B : Code (Part number):
     e.g. A05939F
C : Serial number (Shop number):
     e.g. 01
D : Number (Number of chronological order):
     e.g. 7572
E : Country of manufacturing
F : Place of manufacturing

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

List of SmartDrive™ Easy components

ECU and its connections

	Model code	Part number
REGULATING ECU	SD EASY	A05939F
BOX CONNECTOR	KIT CONNECTEUR SD EASY	A02809D

Setting parameters

	Model code	Part number
CONTROL SOFTWARE (including SD PC LT cable)	PHASES Easy	A04903E
CABLE (extra)	CABLE SD PC LT	006142212S
SETUP TERMINAL (including SD HHT LT cable)	TERMINAL EQ. ST2000	005142202A
CABLE (extra)	CABLE SD HHT LT	006142213T
SD EASY COM ADAPTER	CABLE DE COM SD EASY	A05362D

Auxiliaries

	Model code	Part number
600-bar PRESSURE SENSOR - 1/4G connector	CAPT PRES 600b MH2 G 1/4"	003241171M
160-bar PRESSURE SENSOR - 1/4G connector	CAPT PRES 160b MH2 G 1/4"	003241164E
600-bar PRESSURE SENSOR - 9/16 connector	CAPT PRES 600b MH2 9/16"	003241170L
160-bar PRESSURE SENSOR - M10 connector	CAPT PRES 160b MH2 M10	003241167H
PRESSURE SENSOR CONNECTOR	KIT CONNECT. CAPT. PRESSION	007142237B

Control elements

	Model code	Part number
SUSPENDED PEDAL		003442787K
FLOOR PEDAL		003442786J
PEDAL CONNECTOR		007142212Z
JOYSTICK	JOYSTICK ELEC JC 150 Y	003442799X
JOYSTICK CONNECTOR	KIT CONNECTEUR JOYSTICK	007142223L
ROTARY POTENTIOMETER	POTENTIOMETRE ROTATIF	002041407V
STEERING SENSOR CONNECTOR	KIT CONNECTEUR CAPTEUR DE VIRAGE	007142222K
LINEAR POTENTIOMETER	POTENTIOMETRE LINEAIRE ML10	003241108T

Engine environment

	Model code	Part number
12 V ENGINE ACTUATOR (optional)	ACTIONNEUR E GAS 12V	005743902W
24 V ENGINE ACTUATOR (optional)	ACTIONNEUR E GAS 24V	005743901V
ACTUATOR CONNECTOR	KIT CONNECTEUR ACTIONNEUR	007142219G

Hydraulic engine environment

	Model code	Part number
SPEED SENSOR KIT	CAPT TACHY EQ LU59 CONNECT	003241138B
	CAPT TACHY EQ LU50 CONNECT	003241139C
	CAPT TACHY EQ LU59 CABLE	003241141E
	CAPT TACHY EQ LU50 CABLE	003241140D
SPEED SENSOR CONNECTOR	KIT CONNECTEUR CAPT TACHY	007142205R

Commercial codes and item numbers may change during the lifetime of the system. Contact your Poclain Hydraulics sales engineer.
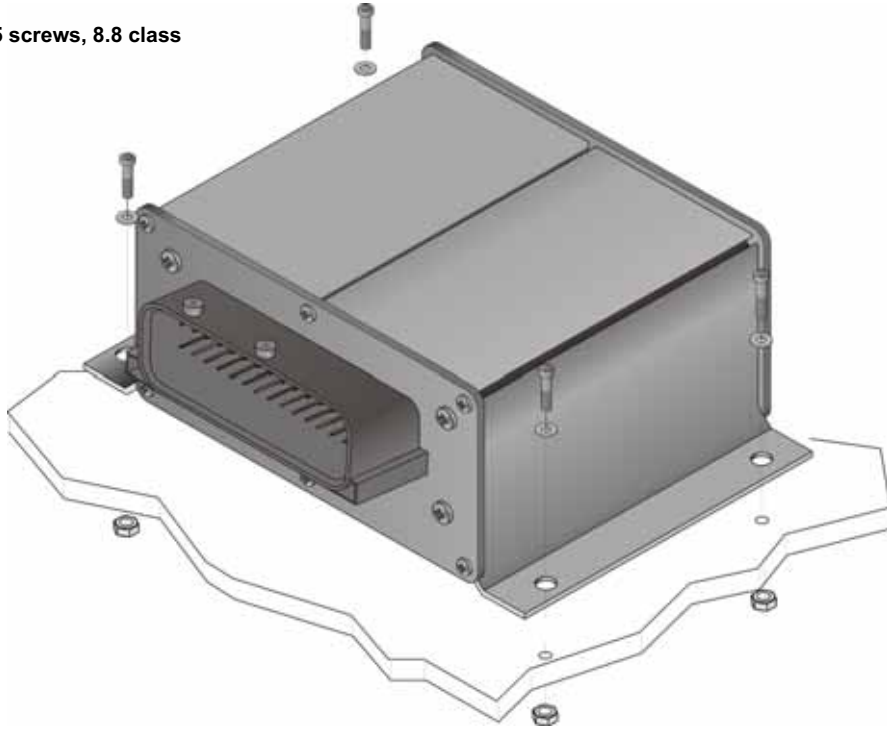
INSTALLATION

Fitting the ECU

The ECU box must be fixed on a rigid support. Make sure that there is enough space to fit the connector.

4 M5 screws, 8.8 class


Machine wiring recommendations

- All the cables must be encased in flexible metal or plastic sheaths;
- All cables or sheaths must be held well in place and locked in to prevent pull-ou;
- Bring the sheath supports close together;
- The sheaths must be able to slide into the anchoring;
- Avoid mechanical stresses in the cables;
- Do not place the cables or sheaths close to moving or vibrating parts;
- Do not lay the sheaths along sharp angles. Protect them at each bend;
- Avoid laying the sheaths too close to high heat sources;
- Use wires with abrasion-resistant sheaths;
- Use cables that resist temperatures between 85°C and 105°C close to heat sources;
- 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.

Description of pins

Number each wire using numbered plastic rings. Each cable must be securely fixed to the machine with clips placed every 20 cm.
Sections are given (for information only) in mm² for a 10 meter length at an operating temperature of < 80 °C *[176 °F]*.

PIN	J1	Function	Wire section mm²
1	VBAT+	Battery power (+)	1.5 to 2.5
2	NC	Not connected	
3	NC	Not connected	
4	POUT1	Digital output 1	0.5 to 1
5	POUT4	Digital output 4	0.5 to 1
6	PWM1(-) 2A	PWM1 terminal (-) in case of 2A command	0.5 to 1
7	5 V OUT	5V sensors power supply	0.5 to 1
8	12V OUT	12V sensors power supply	0.5 to 1
9	ANIN3	Analog input 3	0.5 to 1
10	FIN2_DIF+	Differential frequency input 2 (+)	0.5 to 1
11	NC	Not connected	
12	CANL	Low CAN signal	0.5 to 1
13	CANH	High CAN signal	0.5 to 1
14	CANH_120	Connexion for CAN bus end 120 Ω	0.5 to 1
15	VBAT- (GND)	Analog input ground	1.5 to 2.5
16	PWM2(+)	PWM2 (+) terminal	0.5 to 1
17	NC	Not connected	
18	POUT3	Digital output 3	0.5 to 1
19	PWM2(-) 2A	PWM2 terminal (-) in case of 2A command	0.5 to 1
20	PWM2(-) 120mA	PWM2 terminal (-) in case of 120 mA command	0.5 to 1
21	NC	Not connected	
22	ANIN2	Analog input 2	0.5 to 1
23	ANIN5	Analog input 5	0.5 to 1
24	FIN2_DIF-	Differential frequency input 2 (-)	0.5 to 1
25	NC	Not connected	
26	RX232	Receive signal (serial link)	0.5 to 1
27	TX232	Transmit signal (serial link)	0.5 to 1
28	VBAT- (GND)	Battery power (-) (ground)	1.5 to 2.5
29	VBAT+	Battery power supply (+)	1.5 to 2.5
30	PWM1(+)	PWM1(+) terminal	0.5 to 1
31	NC	Not connected	
32	POUT2	Digital output 2	0.5 to 1
33	5 V OUT	5V sensors power supply	0.5 to 1
34	PWM1(-) 120mA	PWM1 terminal (-) in case of 120 mA command	0.5 to 1
35	NC	Not connected	
36	ANIN1	Analog input 1	0.5 to 1
37	ANIN4	Analog input 4	0.5 to 1
38	FIN1	Frequency input 1	0.5 to 1
39	DIN1	Digital input 1	0.5 to 1
40	DIN2	Digital input 2	0.5 to 1
41	DIN3	Digital input 3	0.5 to 1
42	VBAT- (GND)	Battery power (-) (ground)	1.5 to 2.5
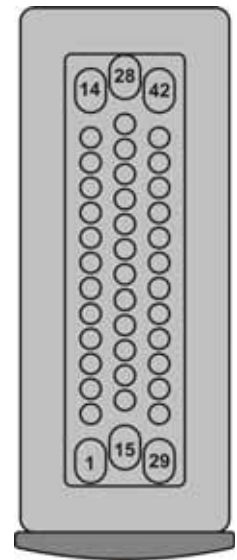
Characteristics

Communication cable

PIN	J1	Function	Wire section mm²
A	SV OUT	5V sensors power supply	0.22
B	NC	Not connected	
C	NC	Not connected	
D	NC	Not connected	
E	CANL	Low CAN signal	0.22
F	CANL	Low CAN signal	0.22
H	RxRS232	Receive signal (serial link)	0.22
J	NC	Not connected	
K	CANH_120	Connexion for CAN bus end 120 Ω	0.22
L	TxRS232	Transmit signal (serial link)	0.22
M	CANH	High CAN signal	0.22
N	CANH	High CAN signal	0.22
P	GND	ground	0.22
R	GND	ground	0.22
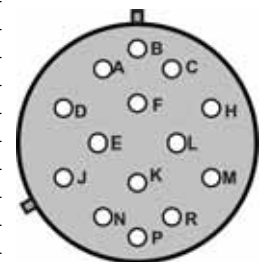
Installation

Machine safety recommendations

⚠ **The machine manufacturer is responsible for safety measures during the installation of our products. They must comply with applicable laws in the country or state.**

⚠ **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 SD Easy box.**

A lamp on the dashboard must be wired parallel to the parking brake operating coil to give the actual status of the parking brake. The logic must be as follows:
• Lamp on, parking brake applied;
• Lamp off, parking brake released.

Sensors

⚠ **Sensors must be powered at (0V 5V) with the exception of wheel speed and thermal sensors that need to be powered at (0V 12V).**
The proportional sensors used must have a variation range of (0.5V to 4.5V) at the output.

5V Power supply: 0.5V < output signal < 4.5V, signal weaker at rest than when operating, for example in the case of a pedal.
Potentiometer sensor specifications:
• Resistance < 5 kΩ
• 1 kΩ < sensor resistance < 10kΩ (5kΩ recommended)
A joystick must have at least 1 switch open in neutral, that is otherwise closed.
The switch in neutral can be replaced by a forward switch and a reverse switch that are both open in neutral and closed depending on the required direction.

Parking brake wiring recommendations

If the box controls also the parking brake, you must IMPERATIVELY wire as shown opposite.

Warning: The switch used must-to be able to carry the current which circulates in the solenoid brake.

Is possible to use a switch which can not take the current, but that induces 2 constraints:
• The diagram should be carried out as shown opposite (switch placed on the pilot circuit of SmartDrive™ Easy).
• The driver of the machine cannot operate directly the parking brake, he must make sure that this one is well applied before leaving the machine.
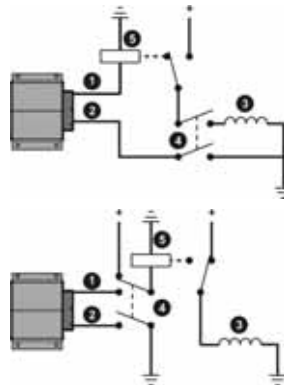
1- Exit orders parking brake.
2- Entry On/Off sensor.
3- Solenoid of parking brake
    (if supplied = brake).
4- Switch of parking brake.
5- Solenoid relay.

Installing the program

To work, your system needs an SD Easy ECU as well as the on-board software that will be loaded onto the computer.
There are two ways of loading the software.
• **First solution:**
    Poclain Hydraulics or your distributor has sent you the on-board software on a CD-rom, by e-mail or by another means. Use the PC PHASES Easy software to transfer the application to the SD Easy ECU.
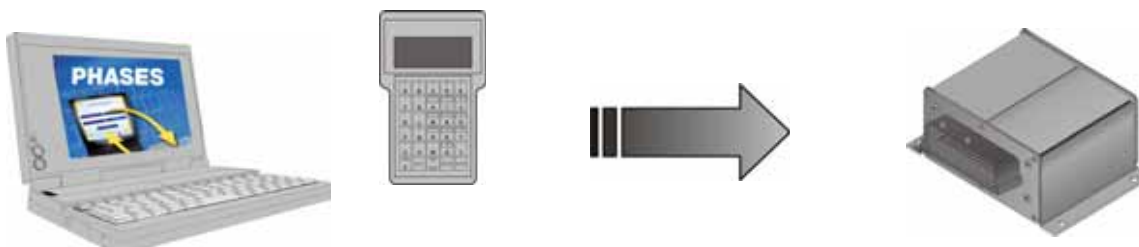• **Second solution:**
    You design your application directly with the PC PHASES™ Easy Design software. Follow the instructions described in documentation N°801378161B and then use PHASES™ Easy Design to transfer the software to the SD Easy ECU.

System set-up

Use the PHASES software to set up the system.

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

> ℹ️ **For further information, see PHASES™ user guide no. 801378162C and hand held terminal user guide no. A06618T.**

Set-up with the PHASES software application

Install the PHASES Easy software (see installation guide n° 801378162C).
Connect the ECU to the PC with the CABLE SD PC LT cable by connecting the PC's SUBD9 to the ECU's communication connector (serial link).
We propose two solutions for communicating with the SD Easy box:

1 - Via the communication connector installed on the machine. For the wiring of the connector see the table on page 15.

To machine

COM SD male connector kit: A05361C
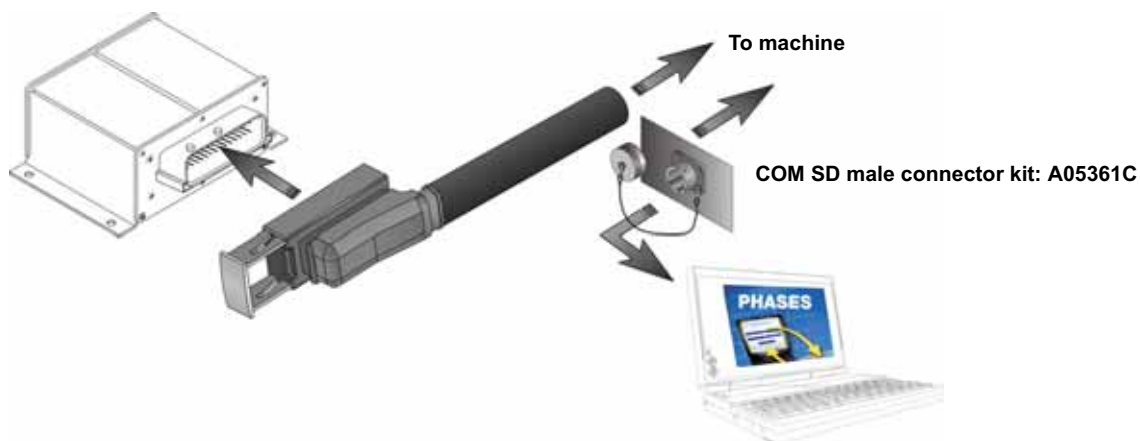
2 - Via the SD EASY communication adapter (Part number: A05362D), see the diagram below for the connection.

To the machine connector
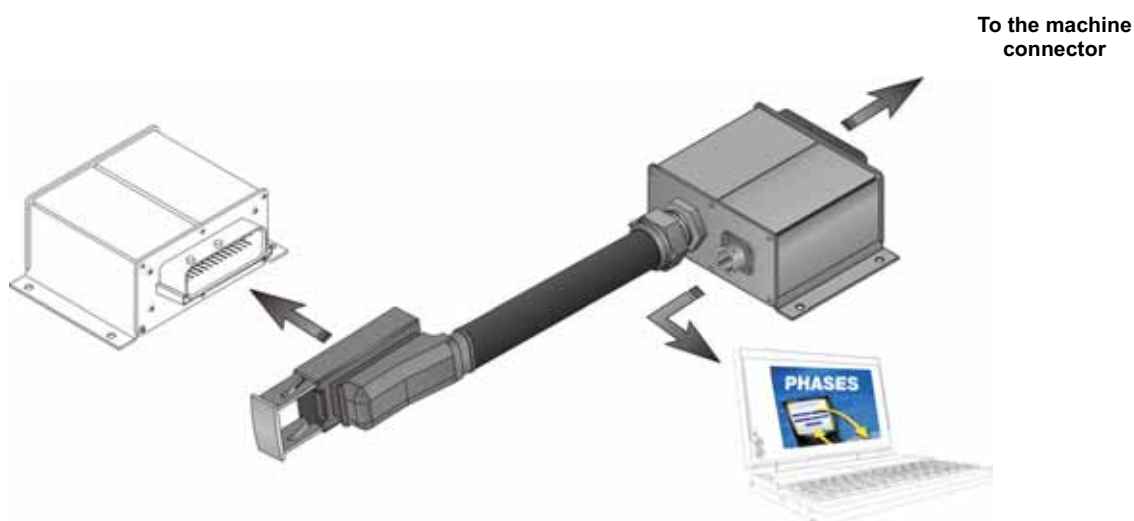
Characteristics

Installation

Set-up with the hand held terminal (HHT)

The hand held terminal is used only to modify the settings directly in the ECU. There is no way of saving a configuration file.
Connect the ECU to the hand held terminal with the CABLE SD HHT LT cable.
See user guide n° A06618T to set the system with the hand held terminal.

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.

Checking of the electrical environment

The PHASES™ software enables you to view any anomalies detected by the SD Easy ECU, 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.
The hand held terminal can also check these points without help files.

Calibration can detect 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.

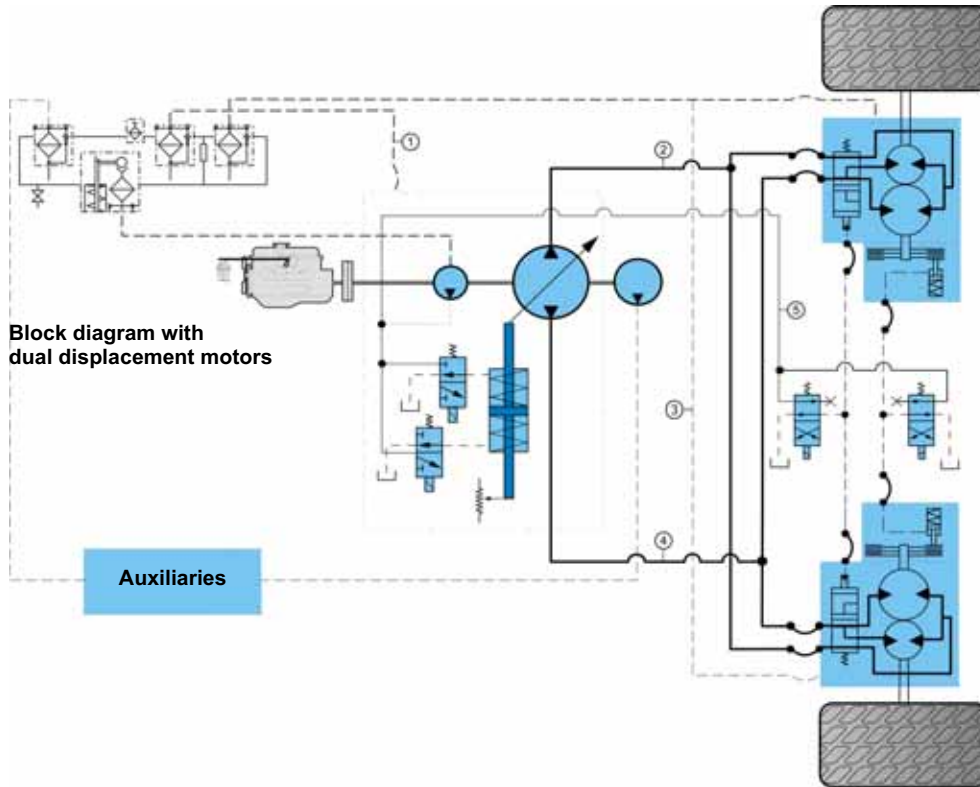## Checking of the hydraulic environment

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

Checking of hydraulic pressures

Fit the machine temporarily with pressure gauges and check the against the table below.

**Block diagram with
dual displacement motors**

Auxiliaries

Pressure gauge	Pressure		Informations
	bar	*[PSI]*	
1	0 - 4	*[0 - 58]*	Pump case pressure
2	0 - 450	*[0 - 6 530]*	HP (high pressure) pressure supply
3	0 - 4	*[0 - 58]*	Motor case pressure
4	0 - 450	*[0 - 6 530]*	HP (high pressure) pressure supply
5	0 - 40	*[0 - 580]*	Charge pressure

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 ECU.
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 SD Easy box.**

Start the engine again and then use the PHASES 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.

Checking the wiring of the engine actuator (option)
When you press on the travel pedal, the actuator must rotate:
• Clockwise (as seen from shaft end) for a clockwise connection;
• counter-clockwise (as seen from shaft end) for a counter-clockwise connection.
Check that the feedback signal from the actuator potentiometer sensor is increasing with voltmeter.

This checking can also be made using the HHT, from the calibration menu.
The terminal gives a real-time display of the voltage and the actuator excitement sensor percentage.

Calibrating all the parts
This calibration can be carried out using either PHASES or the HHT. See their respective 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/hour,**
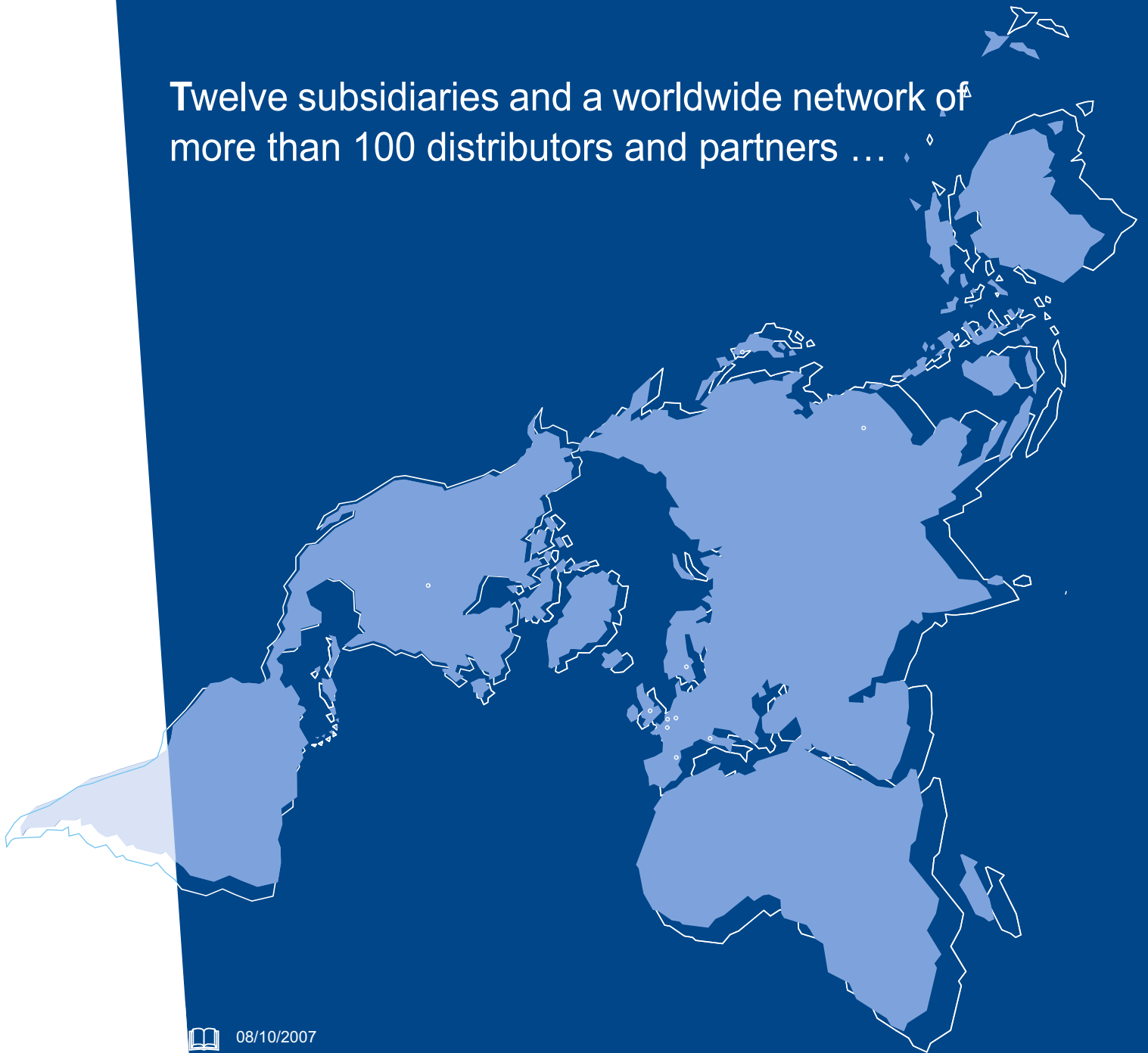> **please contact your Poclain Hydraulics application engineer.**

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