VARIABLE SPEED CONTROLLER

Operating Manual

VASCO 409

Index

1. VASCO Introduction

VASCO is a variable frequency drive, designed to control and protect pumping systems by varying the supply frequency.

VASCO can be applied to new and existing pumping systems resulting in:

- cost and energy savings
- simplified installation and lower system costs
- longer system life
- improved reliability

VASCO, when connected to any standard pump, controls the system keeping constant a certain physical dimension (pressure, differential pressure, delivery, temperature, etc..) regardless of the conditions of use. The pump, or the system, is switched on only how and when required, thus avoiding energy waste and ensuring a longer life for the pumping system.

VASCO is capable of:

- protecting the motor from overload and dry-running
- "soft" start and stop of system to improve components life expectancy and reducing current absorption (i.e. starting current of an asynchronous motor)
- displays motor input current and voltage
- keeps a record of run-time and display errors and faults in the system
- connects several VASCO's together, via an RS485 interface, in a synchronized multi-pump application
- drives other 2 pumps at fixed speed (Direct On Line)

Through the use of inductive filters (optional) VASCO eliminates dangerous over-voltage spikes induced in long cables, so VASCO can safely control submersible pumps.

2. Safety Instructions

VASCO strongly suggests carefully reading this operating instruction manual before using and installing its products.

Any operation (installation, maintenance and repair) must be carried out by trained, skilled and qualified personnel.

Failure to observe and follow the directions of this manual may result in dangerous electric shock.

Pay attention to all standard safety and accident prevention regulations.

 	**Equipment must be connected to the main power through a switch in order to disconnect the power before operation** **Disconnect VASCO from the mains before commencing any work.** **Do not remove, for any reason, the cover and the cable plate without having disconnected the VASCO from the mains and waiting at least 5 minutes** **VASCO and pump have to be grounded properly before system operation.** **For the entire period if VASCO is powered an high voltage is present on the output connection of the inverter independently if it is running or not the pump . Disconnect VASCO for the main before commencing any work on the inverter and/or on the motor .**

Avoid any electrical shock or serious impact during transportation.

Check the VASCO immediately upon delivery and check for damage and/or missing parts. In either case, immediately notify the supplier.

Damages due to transportation, incorrect installation, or improper use of the device will null and void the warranty.

VASCO cannot be held responsible for any damage to people and/or property due to improper use of its products.

3. Technical features

model	Voltage Supply	Motor voltage	Max motor current	P2 motor power
VASCO 409	3 x 380-460 V ± 15%	0-100% Vin	9 A	4 kW

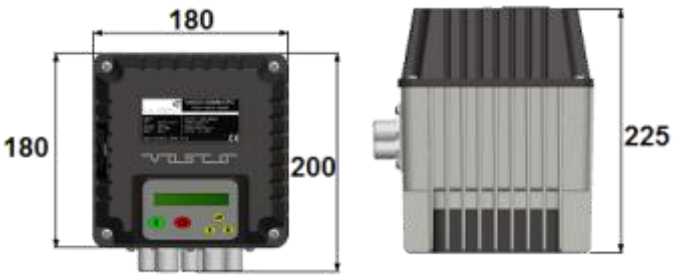
- Max. Ambient Temperature : 40°C (104 °F)
- Max. Altitude : 1000 m
- Protection Degree: IP 55 (NEMA 4) **
- Output : 2 x digital
- Input: 4 analog (4-20 mA) + 4 digital
- Comunication interface : serial RS 485
- EMC normatives applied: EN 55011 Class A,EN 61000-4-2,EN 61000-4-4,EN 61000-4-5,EN 61000-4-6

** auxiliary cooling fan of the VASCO, presents on wall mounted application, has protection grade IP20

	**In order to satisfy normative EMC 89/336/CEE, VASCO 409 must be installed with EMC filter.**

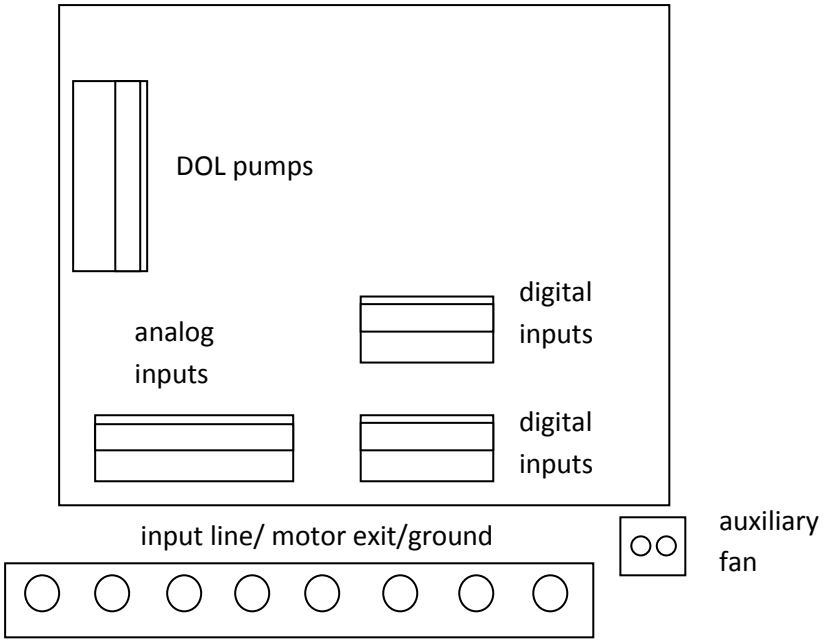
3.1 Weight and dimensions

model	weight [kg]
VASCO 409	4.4



* Dimensions in mm
* Weight with auxiliary cooling fan and without package

1. Electrical wiring

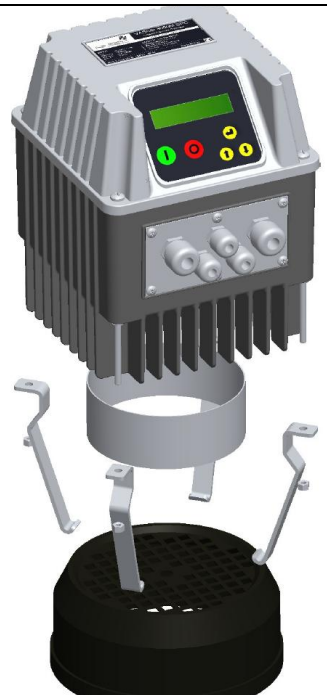


Input line : • L1,L2,L3 • ground	Analog input connector: • 0V,0V : ground • VAA,VBB,VCC,VDD: signal • +15,+15: power supply 15 V dc
Motor exit: • U,V,W, Ground	digital inputs: 1. A1,A0 2. B1,B0 3. TX0,TX1 4. RX0,RX1
Auxiliary cooling fan (24 Vdc) (available in wall mounted kit)	digital outputs to DOL pump relays: 1. DOL 1: Z0,Z1 2. DOL 2: W0,W1

	**Auxiliary relays driving DOL pumps is a relays with no powered contact and normally opened . Max. voltage to the contact is 250 V with max current of 5 A.** **It is suggestible to use the shortest inverter feeding cable, pressure transducer cable and motor cable** **Inductive filters are recommended in installations using cable lengths over 20 meters (filters are available upon request)**

2. VASCO Installation

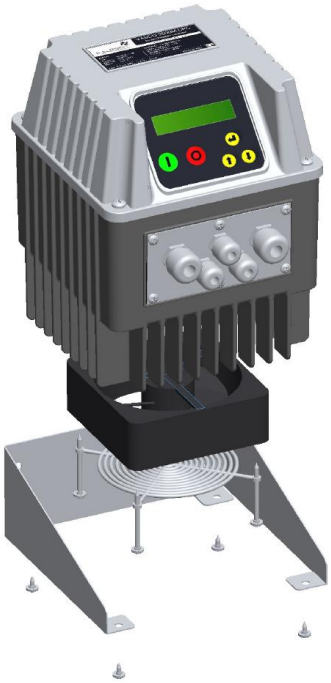
VASCO can be installed directly on the fan cover **of the motor** or mounted on the **wall**

<table>
<tr>
<td>  </td>
<td>In this application VASCO is cooled by motor fan

Motor kit (available upon request) allows a solid and robust coupling of the two units and it is composed by:

• n.° 4 rods
• n.° 4 x M5 nuts
• n.° 4 hooks
• n.° 1 cooling ring

It is suggestible to use the cooling ring for a better VASCO cooling effect during operation .

Coupling hooks have to be fixed, if possible, to the motor shield instead of cooling fan cover. This last one has to be fixed with screws to the motor case.</td>
</tr>
<tr>
<td>  </td>
<td>In this application VASCO is cooled independently by its auxiliary cooling fan integrated in the radiator.

Wall-mounted kit is composed by :

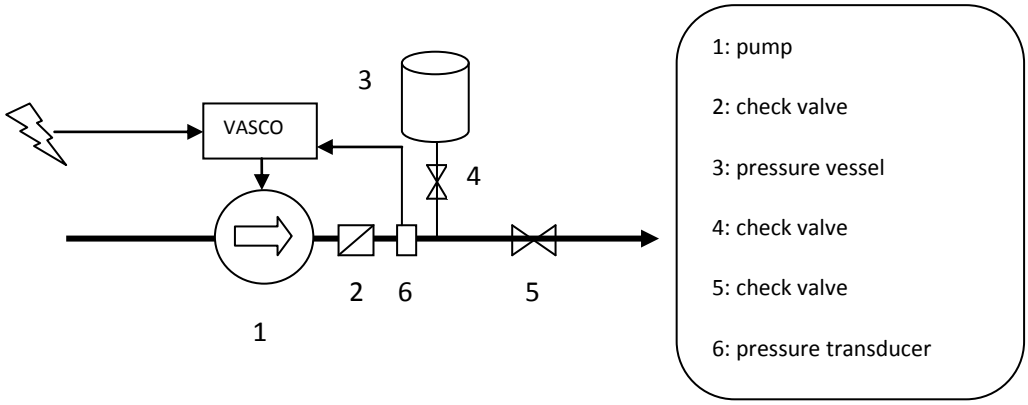
• n.° 1 24 Vdc cooling fan
• n.° 4 screws to fix cooling fan
• n.° 1 protection grill
• n.° 1 metal bracket in AISI 304
• n.° 4 screws to fix the bracket to the wall</td>
</tr>
</table>

	**Be sure motor is suitable to be powered by inverter .** **Make sure to have fixed properly the grill of auxiliary cooling fan .** **Make sure to remove the auxiliary cooling fan if VASCO is coupled to the motor. Otherwise high risk of overheating of motor and VASCO unit .**

5.1 VASCO installation for pressure control operation

VASCO can control the pump speed to have constant pressure on an interesting point independently from the water demand of the system.

A basic schematic is shown below:



5.1.1 Pressure tank

Installation of a pressure tank in the hydraulic system is recommended to compensate the leakage of water in the system (or by minimum water request) and avoiding continuous start/stop cycling of pump (check the appendix for more information) .

Selecting the proper volume and pre-charge pressure of the tank is very important . Smaller tank volumes will not compensate the minimum water request or leakage, while larger volumes makes difficulties to VASCO to control the pressure evenly.

Recommended tank volume is equal to the 10% of the maximum water flow of the system

Example: if the max water flow is 60 liters/min, the pressure tank should have a capacity of 5 liters

Pre-charge pressure of the pressure tank should be at least 1 bar less than the set-pressure of the system.

Example: if the set-pressure of system is 4 bar, pre-charge pressure of tank should be 3 bar

5.1.2 Pressure transducer

VASCO requires a pressure sensor with a linear signal powered by a voltage range of 9 - 33 V and an output signal range 4 – 20 mA.
It is necessary to set the pressure sensor characteristics in the start configuration menu or in the professional menu (please check the relevant chapter on setting parameters).
To wire the pressure sensor to the VASCO unit :

- 0V (ground, if required)
- VAA (signal 4-20mA)
- +15 (power supply 15 Vdc)

If you are using the NASTEC pressure transducer SP01 red wire to +15 while the black wire to the terminal VAA.

3. VASCO Use and Programming

VASCO software is extremely simple to use, but allows a variety parameters to be set for ideal system calibration.

Setting Parameters are organized in 3 levels:

1: **End user level**
No need of password for this first level. Improper setting of these parameters will not compromise the VASCO nor the pump.

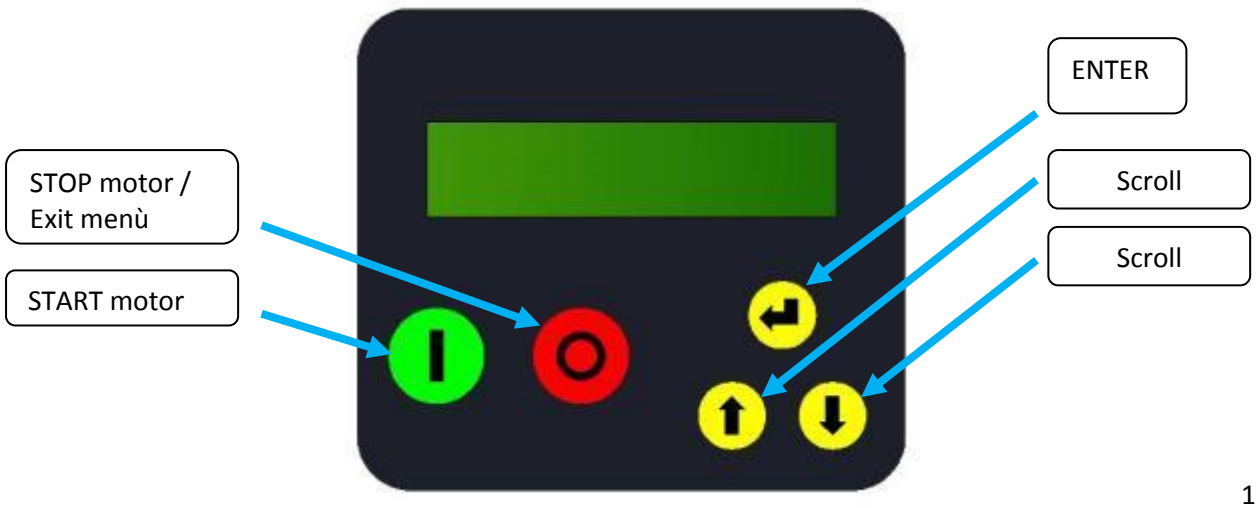
2: **Installer level**
A password is required for this level; these parameters are adjustable by trained professionals
Default **001**
From the menu a different password can be set up.

3. **Advanced level**
A second and different password is required; improper setting of these advanced parameters could compromise the integrity and the life of VASCO ; Default **002**
It is possible to set up a different password .

Advanced level can be entered with the right password; if not, it is impossible to set up any parameters but can be only displayed

The following flow chart illustrates the menu structure of the setting parameters.

6.1 Control Panel



Screen is a back-light LCD displaying 2 rows of 16 digits each. If the menu indication is longer than 16 digit, the row will scroll-

Alarms are indicated by an audible signal.

6.2 Initial setting

When the VASCO is switched on for the first time, the initial setting menu is displayed for the initial setting to configure pumps characteristics, pressure sensor range and system characteristics.

If the initial setting procedure is not ended properly, it is impossible to run the pump.

Anyhow the initial setting procedure can be repeated (by using 3rd level password) to configure again the VASCO or if VASCO is installed in a different system.

Advanced or critical parameters has to be set up and/or confirmed by pressing Enter; remaining parameters (some of them suggested) can be scrolled without any confirmation .

A brief description of parameters and their allowable ranges is listed below:

	Language Italian / English	End user comunication language
	Rated motor Volt V = XXX [V]	Motor rated voltage (as shown in the pump name plate)
	Voltage Boost V = XX [%]	Refers to the voltage increase during motor start-up N.B: An excessive value can cause damage to the motor. Contact the manufacturer for more information.
	Rated motor Amp. I = XX.X [A]	Motor rated current (as shown in the pump name plate). The inverter drop voltage at feeding motors connectors causes an increase of the input current of at least 10% ; make sure that the motor will accept this overcurrent.
	Rated motor freq f = XXX [Hz]	Nominal frequency of the motor (as shown in the pump name plate);
		Min. frequency of motor. Min. frequency depends on the selected pump

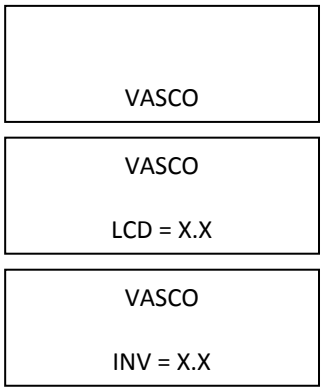
Min. Motor Freq. f = XXX [Hz]	type; for borehole application (with water filled motor) the min. frequency must be set higher than 20 Hz to prevent damage to the thrust bearings.
Ramp up time t = XX [sec]	Time to reach the speed required to achieve the set pressure Longer times delay the system to reach the set pressure but better protect components of the system. Long ramp up time can create difficulties in VASCO set up. Rump up time too long can caused overload
Ramp down time t = XX [sec]	Time to reach zero speed Long time keeps system pressurized, while protecting the components of the system. Long time can create difficulties in VASCO set up. Rump down time too short can caused overload
PWM f = XX [kHz]	Carrier frequency (switching frequency). It is possible to chose PWM in the range of 2,5 ,4, 8, 10, 12 kHz . Higher values give a more sinusoidal wave with less losses. If long cables are used (>20 m) (submersible pump) it is recommended to install an inductive filter between VASCO and the motor (available upon request) and to set the value of PWM to 2,5 kHz. This reduces risk to have voltage spikes, saving motor and cable insulation.
Control mode Constant Press/ Fix speed	Two controls modes offered by VASCO: It is possible to select: • Constant pressure control: VASCO changes the speed of pump to keep the pressure constant, independently from water requirement • Constant speed control: VASCO feeds the pump a set frequency, so the speed of motor is kept constant .
F.s. sensor pres. 20mA = XX.X [bar]	Set max pressure of pressure transducer; Set the pressure value of the transducer when output signal is 20 mA equivalent to the higher value of pressure range (i.e. 0 – 10 bars transducer range) 10 bars = 20 mA
Offset sensor pressure ENT for tuning	Zero point adjustment of the transducer (4mA) as offset compensation; automatically done by pressing Enter.

	Max system pres. p = XX.X [bar]	It' the maximum pressure suitable in the system. If the pressure goes over an alarm occurs and pump is stopped.
	Operating freq. f = XXX [Hz]	If the constant speed control mode is selected, digit the input frequency to run the motor at desired speed.
	TEST motor START/STOP	Press START/STOP to run a test at rated frequency **N.B: make sure to run the system without damaging pump and system**
	Rotation Sense NORMAL/REVERSE	If, during the test, motor runs in reverse, it is possible to change the wiring sequence via software without physically changing wires in the terminals.
	Dry run cosphi cosphi = X.XX	If pump is dry-running the cosphi reaches its lowest level. To set this value, contact the pump manufacturer or test by closing the suction and check the value on the VASCO display; a value can be set considering a dry cosphi equivalent to 60% of the rated cosphi declared by the manufacturer .
	Set pressure p = XX.X [bar]	Set the required pressure at the point at which the transducer is installed.
	Test min stop frequency ENT to begin	By pressing ENTER minimum stop frequency can be automatically detected; for the procedure see the next instruction window (for further information check the relevant paragraph).
	Press START and close discharge	Test procedure: press START with no pressure in the system (open valve 5). close the valve progressively up to completely closed position .
	TUNING: START/STOP ----------	Pressing START commences an automatic operation to calculate the min. frequency . Pressing START again switches the pump on. Completely close the discharge valve and then , once the frequency value is stabilized, press STOP. VASCO will record the min. frequency to stop the pump without water demand. Press STOP button again to go to next step.
	min f = XXX [Hz] a p = XX.X [bar]	Display shows the minimum stop frequency corresponding to set pressure. Pushing ENTER adjusts the detected minimum stop frequency to compensate possible small system leakage

	Set min stop f. fmin = XXX [Hz]	Once the min. frequency is detected by the software by pressing ENTER is possible to make, manually, some adjustments to compensate leakage
	Stop delay t = XX [s]	Delay in stopping pump once the minimum frequency is reached
	Delta start pressure p = XX.X [bar]	This value represents the pressure drop below the set pressure required to start the pump.
	INIT SETUP COMPLETED	Once the Setting procedure is completed you will get this indication on the display; set parameters are recorded by VASCO; these parameters can be singly set up in the INSTALLER Parameters menu or ADVANCED Parameters menu. If you with to reset to initial parameters use the DEFAULT Parameters menu .

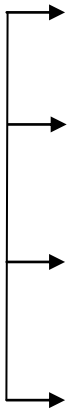
6.3Initial display

When first powering the VASCO or after setting parameters procedure is completed the display shows : VASCO model, , release of digit display software (LCD = X.X) and the release of inverter software (INV = X.X) as shown below:



The following End User messages are displayed by pushing the scroll buttons :

Inv ON/OFF Motor ON/OFF p_set = XX.X pm = XX.X	P_set is the set-pressure pm is the sensor transducer value detected in the field
Inv ON/OFF Motor ON/OFF f = XXX [Hz]	f value is the supply frequency to the motor; by pressing ENTER you can change the f value manually (word “set” is displayed) , pressing again ENTER you exit this set possibility (word “set” disappeared)
Inv ON/OFF Motor ON/OFF V = X.XX [V] I= XX.X [A]	V is the voltage supplied to the motor. This value is displayed only if motor is off; if motor is ON, I value, equivalent to the absorbed motor current, is displayed
Inv ON/OFF Motor ON/OFF cosphi = XXX	cosphi index means the angle phi between the voltage and current absorbed by the motor

	Inv ON/OFF Motor ON/OFF STATUS :NORMAL /ALARM life inverter xxxxx h : xx m life motor xxxxx h : xx m ALL. XXXXXXXXXXXXX XXXXXXX h : XX m		"NORMAL" status means no alarms If an alarm occurs a message blinks on the display and an audible signal is activated. By pushing ENTER accesses: VASCO lifetime , PUMP lifetime, alarm list . VASCO lifetime is activated when VASCO is powered. PUMP life time is activated when pump is powered. To come back to previous views press ENTER.
	Menu ENT to access		Return to Menu List By pressing ENTER

First row gives the VASCO status :

- **Inv: ON Mot: ON** VASCO is powered and feeding the motor
- **Inv: ON Mot: OFF** VASCO is powered but motor is not running (i.e. motor/pump was stopped due to minimum frequency being reached)
- **Inv: OFF Mot: OFF** VASCO is not powered

6.4Menu Display

Pressing ENTER where you are in [MENU' / ENT to access] in initial display, the following MENUs are displayed:

	MENU User Param.		Password not required
	MENU Instal. Param.		Installer password required to enter (level 1, default 001)
	MENU Adv. Param.		Advanced password required to enter 002 (level 2, defaults 2)

	MENU RetrieveInit.Set.		Installer password required to enter (default 001) It is possible to return to original default set parameters .
	MENU' Change Init.Set.		Advanced password required to enter (level 2 , default 002)

6.5 User parameters

	Set pressure p = XX.X [bar]		Set the required pressure at the point at which the transducer is installed.
	Operating freq. f = XXX [Hz]		If the constant speed control mode is selected, digit the input frequency to run the motor at desired speed.
	Language Italian / English		End user comunication language

6.6 Installer parameters

Control mode Costant Press/ Fix speed	Two controls modes offered by VASCO: It is possible to select: • Constant pressure control: VASCO changes the speed of pump to keep the pressure constant, independently from water requirement • Constant speed control: VASCO feeds the pump a set frequency, so the speed of motor is kept constant .
F.s. sensor pres. 20mA = XX.X [bar]	Set max pressure of pressure transducer; Set the pressure value of the transducer when output signal is 20 mA equivalent to the higher value of pressure range (i.e. 0 – 10 bars transducer range) 10 bars = 20 mA
Offset sensor pressure ENT for tuning	Zero point adjustment of the transducer (4mA) as offset compensation; automatically done by pressing Enter.

	Max system pres. p = XX.X [bar]	It' the maximum pressure suitable in the system. If the pressure goes over an alarm occurs and pump is stopped.
	Operating freq. f = XXX [Hz]	If the constant speed control mode is selected, digit the input frequency to run the motor at desired speed.
	Dry run cosphi cosphi = X.XX	If pump is dry-running the cosphi reaches its lowest level. To set this value, contact the pump manufacturer or test by closing the suction and check the value on the VASCO display; a value can be set considering a dry cosphi equivalent to 60% of the rated cosphi declared by the manufacturer .
	Set pressure p = XX.X [bar]	Set the required pressure at the point at which the transducer is installed.
	Test min stop frequency ENT to begin	By pressing ENTER minimum stop frequency can be automatically detected; for the procedure see the next instruction window (for further information check the relevant paragraph).
	Press START and close discharge	Test procedure: press START with no pressure in the system (open valve 5). close the valve progressively up to completely closed position .
	TUNING: START/STOP ----------	Pressing START commences an automatic operation to calculate the min. frequency . Pressing START again switches the pump on. Completely close the discharge valve and then , once the frequency value is stabilized, press STOP. VASCO will record the min. frequency to stop the pump without water demand. Press STOP button again to go to next step.
	min f = XXX [Hz] a p = XX.X [bar]	Display shows the minimum stop frequency corresponding to set pressure. Pushing ENTER adjusts the detected minimum stop frequency to compensate possible small system leakage
	Set min stop f. fmin = XXX [Hz]	Once the min. frequency is detected by the software by pressing ENTER is possible to make, manually, some adjustments to compensate leakage
	Stop delay t = XX [s]	Delay in stopping pump once the minimum frequency is reached

	Delta start pressure p = XX.X [bar]	This value represents the pressure drop below the set pressure required to start the pump.
	Ki XXX Kp XXX	Kp and Ki parameters allow the dynamic control of VASCO; set value (Ki=100, Kp=002) are usually valid to get a good dynamic control but if the VASCO faces problems to keep constant the pressure increase or reduce the Ki value keeping Kp constant; if problems persists, Increase Kp value (higher than 002) and increase or reduce Ki value again till a good dynamic control is reached.
	Pump DOL 1 ON/OFF	Output signal to be used to start an additional pump with DOL connection (Direct on Line)
	Pump DOL 2 ON/OFF	Output signal to be used to start a second pump with DOL connection (Direct on Line)
	Time start AUX pumps t = XX [s]	Time to start the auxiliar pumps (DOL or COMBO) after the primary pump reaches its maximum value
	Time stop AUX pumps t = XX [s]	Time to stop the auxiliar pumps (DOL or COMBO) after the primary pumps reached again its minimum frequency .
	Rotation Sense NORMAL/REVERSE	If, during the test, motor runs in reverse, it is possible to change the wiring sequence via software without physically changing wires in the terminals.
	Digital input 1 NO/NC	If N.O. is selected , VASCO will feed the motor and will stop the motor if the contact is closed. Selecting N.C. (normally closed) VASCO will feed the motor and it will be stopping the motor when the signal will be N.A.
	Digital input 2 NO/NC	If N.O. is selected , VASCO will feed the motor and will stop the motor if the contact is closed. Selecting N.C. (normally closed) VASCO will feed the motor and it will be stopping the motor when the signal will be N.A.
	COMBO ON/OFF	Set ON or OFF COMBO function in order to keep constant pressure with more (up to 8) pumps in parallel (See Appendix).
	Address XX	Set address of VASCO if working in COMBO function. 00 is for master, 01..07 is for slaves.

Alternance ON/OFF	Set ON or OFF Alternance (in master unit)in order to have the same use of each pump of the group. In this way the master will reorganize the starting priority of the pumps checking the life of each of them.
Change PASSWORD 1 ENT	By pressing ENTER , PASSWORD 1 can be changed (level 1) (default 001)

6.7Advanced parameters

Ramp up Time t = XX [sec]	Time to reach the speed required to achieve the set pressure Longer times delay the system to reach the set pressure but better protect components of the system. Long ramp up time can create difficulties in VASCO set up. Rump up time too long can caused overload
Ramp down time t = XX [sec]	Time to reach zero speed Long time keeps system pressurized, while protecting the components of the system. Long time can create difficulties in VASCO set up. Rump down time too short can caused overload
PWM f = XX [kHz]	Carrier frequency (switching frequency). It is possible to chose PWM in the range of 2,5 ,4, 8, 10, 12 kHz . Higher values give a more sinusoidal wave with less losses. If long cables are used (>20 m) (submersible pump) it is recommended to install an inductive filter between VASCO and the motor (available upon request) and to set the value of PWM to 2,5 kHz. This reduces risk to have voltage spikes, saving motor and cable insulation.
Rated motor Volt V = XXX [V]	Motor rated voltage (as shown in the pump name plate)

Voltage Boost V = XX [%]	Refers to the voltage increase during motor start-up N.B: An excessive value can cause damage to the motor. Contact the manufacturer for more information.
Rated motor Amp. I = XX.X [A]	Motor rated current (as shown in the pump name plate). The inverter drop voltage at feeding motors connectors causes an increase of the input current of at least 10% ; make sure that the motor will accept this overcurrent.
Rated motor freq f = XXX [Hz]	Nominal frequency of the motor (as shown in the pump name plate);
Min. Motor Freq. f = XXX [Hz]	Min. frequency of motor. Min. frequency depends on the selected pump type; for borehole application (with water filled motor) the min. frequency must be set higher than 20 Hz to prevent damage to the thrust bearings.
AutoRestart ON/OFF	If ON is selected, after a lack of voltage, VASCO returns to its normal status ; if VASCO was powering the pump before voltage drop, it returns to feed the pump without any kind of advise. Warning, read again the advice of the chapter 1 .
Change PASSWORD 2 ENT	By pressing ENTER , PASSWORD 2 can be changed (level 2) (default 002)

4. Protections and alarms

Anytime a protection occurs a blinking message is displayed together an acoustic alarm; on STATUS on INITIAL VIEW the protection is displayed ; by pressing STOP button the acoustic alarm stops.

ALARM MESSAGE	ALARM DESCRIPTION	POSSIBILE SOLUTION
MOTOR OVERCURRENT	Motor overload: input current of the motor is higher the rated motor current set as parameters Motor drop voltage caused by the inverter forces motor to have input current 10% higher than the rated one. Contact motor manufacturer to check if motor accepts this over current.	• Make sure that the motor current set as parameters is 15% higher than the rated one. • Check other possible causes about the over current
UNDERVOLTAGE	Supply voltage Vin < 160V	Check possible causes of undervoltage
OVERVOLTAGE	Supply voltage Vin > 275V	Check possible causes of overvoltage
INVERTER OVERTEMPERATURE	Inverter over temperature	• Make sure than ambient temperature is less than 40 °C. • Check if auxiliary cooling fan works properly and if mounting space is enough for good cooling. • Reduce the PWM value (*Advance Parameter Menu*)
NO LOAD	No load	• Check if a load is properly connected to the VASCO terminals
	Motor cosphi is lower than the set value of dry running cosphi	

NO WATER		• Check if the pump is primed • Check the set value if dry running cosphi. Dry running cosphi is about the 60% of the rated cosphi (at rated frequency) declared on the motor plate. If pumps cosphi is lower than the set dry running cosphi for at least 2 seconds, VASCO stops the pump. VASCO tries to run the pumps every 10, 20, 40, 80, 160 minutes and then the pump is definitely stopped. WARNING : if dry running protection occurs, VASCO try to start the pump automatically without any advice. Be sure to have cut power supply before to make maintenance
PRESSURE SENSOR FAULT	Pressure sensor error	• Check the pressure transducer • Check the wiring of pressure transducer
OVERPRESSURE	Checked pressure of the system is higher than the max.set system pressure	• Check possible causes of system overpressure • Check the max. system set pressure *(initial setting configuration or installers parameters)*

If pumps cosphi is lower than the dry running cosphi for at least 2 seconds, VASCO stop the pump. VASCO try to run the pumps every 10, 20, 40, 80, 160 minutes and then the pump is definitely stopped.

ATTENTION : if dry running protection occurs, VASCO try to start the pump automatically without any advice.

Be sure to have cut power supply before to make maintenance

VASCO will stop the pump if the input motor current is higher than the set motor current for long time . By pressing START button is possible to run the pumps again.

VASCO will stop the pump if the input voltage is higher than the set voltage for long time . By pressing START button is possible to run the pumps again.

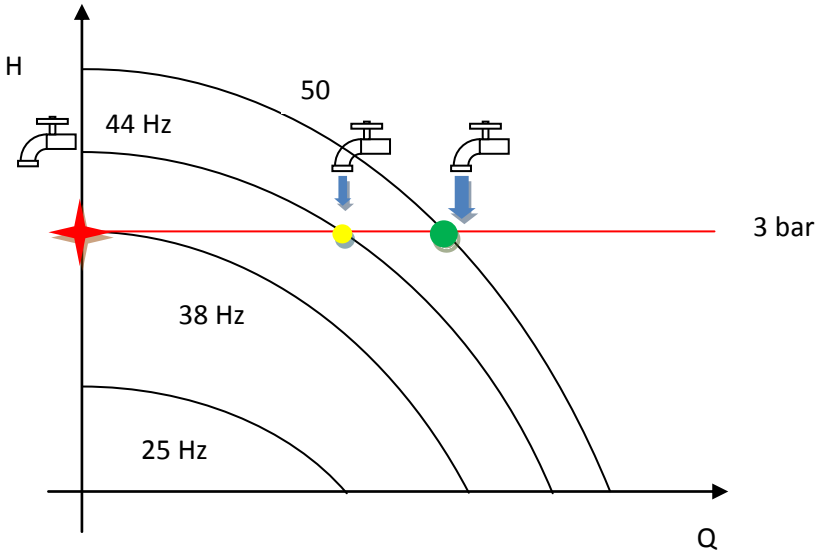
VASCO will stop the pump if the input voltage is lower than the set voltage for long time . By pressing START button is possible to run the pumps again.

5. Appendix

8.1 Minimum Stop Frequency on a costant pressure control.

Minimum stop frequency is the minimum frequency value that, by granting the pset , water delivery is nul.

Below scheme offers graphically the meaning of ”min. frequency” :



Progressively closing the delivery valve water reduces flow causing VASCO to reduce the pump speed by reducing the output frequency, to maintain constant the pressure (i.e. 3 bar).

Once the water flow stops (output completely closed), pump will run at minimum frequency to maintain the set pressure.

However, if water requirement stops, VASCO stops the pump to save energy costs. Pump will be stopped when min frequency is reached.

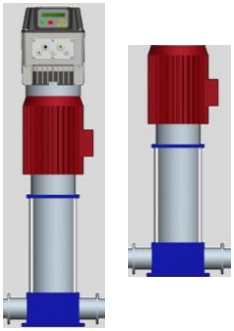
Once the pump is stopped at min. frequency value, set pressure is maintained in the system .

To maintain the pressure on the pump output line, it is necessary to install a small pressure tank ables to compensate possible water leakage and limiting the number of pump restarts.

It is important to pinpoint that at any set pressure corresponds to a single value of min. stop frequency.

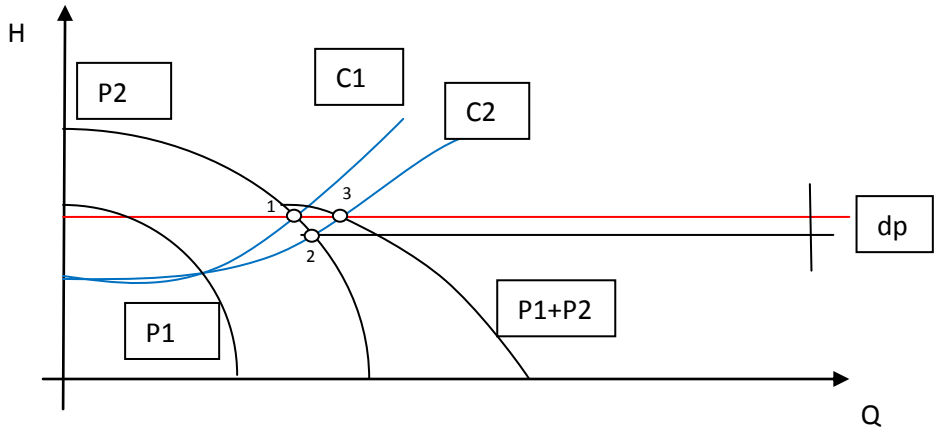
So, if the end user wants to change the set pressure, a new value of min. stop frequency should be detected.

8.2 Run/Stop of DOL pumps on constant pressure control.



Two pumps are connected in parallel and one pump (pump 1, P1) is run by a inverter while the second (pump 2, P2) is directely connected to the main power ("Direct On Line" connection). Start/Run of the second pumps are made by the exit digital contact 1 (even a third pump can be controlled by the second digital contact 2)

	**VASCO relais driving the DOL pumps are relais with no voltage contacts and normally opened. Max voltage to the contacts is 250 V, max current 5 A.**

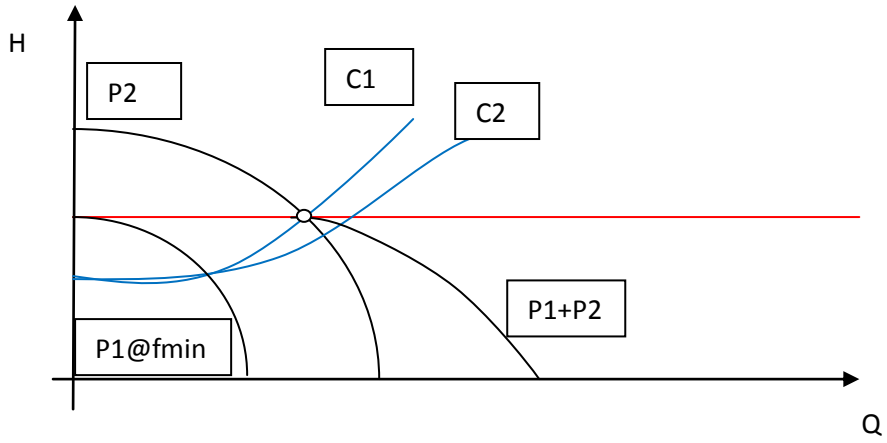


If pump 1 (P1) is already running to grant the desired set pressure (red line) , an additional water request change the system curve from C1 to C2 ; being P1 at maximum speed, it is not possible to maintain the set pressure by increasing the speed so the system pressure will drop till reaching the new working point 2.

If pressure at the point 2 is (pset – delta pressione start), VASCO will run the DOL by closing the exit digital contact 1. DOL pump will run at its nominal speed while the pump1 , to reach point 3 , will drop it speed equivalent to P1 pattern.

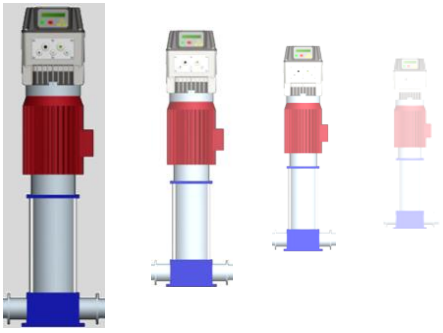
If water demands will decrease coming back to the system curve C1, always maintaining constant pressure in the system, pump 1 will reach a frequency equivalent to the minimum frequency to maintain the set

pressure ; once the minimum frequency is reached by pump1, DOL pump will be switched off and pump 1 will increase the speed till granting the pset in the system



	**If two pumps are connected in parallel, the first driven by VASCO and the second with a DOL connection , it is necessary, during the initial setting procedure makes sure that the value "delta pressure restart" will be sufficiently high to grant the first pump, once the DOL pump is switched on, to reach a frequency higher than its minimum frequency value .** **To do so, switch on/off cycles are excluded avoiding damages to DOL pump.**

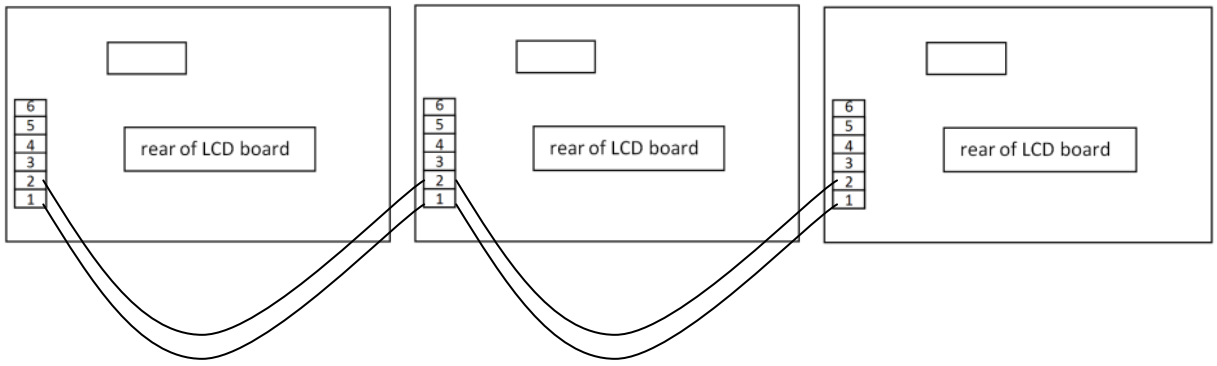
8.3 COMBO function on constant pressure control



In the menu “installer parameter” is possible to set ON the COMBO function. By this function installer can connect up to 8 pumps in parallel, each controlled by a VASCO, in order to maintain constant pressure even with high delivery changes. The working concept is the same described in “Run/Stop of DOL pumps on costant pressure control” with the difference that each pump is controlled by a VASCO.

RS 485 connecting

VASCOs communicate by RS 485 using a private NASTEC protocol.
Each VASCO of the pumping group must be connected with a 2 wire cable using plug 1,2 in rear of LCD board.



Programming for COMBO function:

1. **Addressing**

Once that RS485 cable connection is made is possible to proceed with software programming.
In the installer parameters menù of each VASCO must be setted ON the COMBO voice.

Then is possible to set the address in each VASCO. The **VASCO with address 00 will be the master. In a group there must be only a master**. It will be the one to which will be connected the pressure sensor and the one that will be the responsible of group working.
The other VASCOs are called slave with address 01, 02, 03, …, 07. Remember: never give to two VASCOs the same address otherwise the communication will be broken.

2. **Pressure sensor**

In a system of more VASCOs connected together for COMBO working, is possible to use only 1 pressure connected to the master (address 00). The value of pressure will be communicate to slaves by RS 485.
To prevent stopping of system due to a pressure sensor fault, is possible to connect a second pressure sensor (of the same type of pressure 1) to the master in the analogic input 2.
It' s also possible to connect a pressure sensor to each VASCOs.
Anyway, remember to do the offset of pressure sensors in the VASCO they're connected with.

3. **Alternance**

In order to have the same use of each pump of the group, is possible to set ON the ALTERNANCE parameter in the master. In this way the master will reorganize the starting priority of the pumps checking the life of each of them.

4. **In case of alarm or failure**

Each VASCO controls its pump. If a failure happens in a VASCO of the group, it will be stopped and automatically its working will be passed to another VASCO of the group.

	**Every time user accesses in menu display in master unit, communication between VASCOs is broken. In order to recovery communication (after exiting from "menu display" in master unit or, in general, every time communication is broken), user must press STOP button in "initial display STATUS" showing NO COMMUNICATION. This operation must be done in each VASCO of the group.** **Setting of minimum stop frequency must be done in each VASCO of the group.**

8.4 Software scheme

INV: ON/OFF Mot: ON/OFF ps = XX.X pm = XX.X	INV: ON/OFF Mot: ON/OFF f = XXX.X [Hz]	INV:ON/OFF Mot:ON/OFF V = XXX [V] / I = XX.X [A]	INV:ON/OFF Mot. ON/OFF cosphi = X.XX	INV:ON/OFF Mot. ON/OFF STATUS:NORMAL/ALARM	MENU' ENT to access

no password: end user level password 1: installer level (default: 001) password 2: advanced level (default: 002)	**ENTER**	
	life inverter xxxxx h : xx m	
	life motor xxxxx h : xx m	
	XXXXXXXXXXXX XXXXXXX h : XX m	

MENU' user param.	MENU' Instal. param.	MENU' Adv. Param.	MENU' Retrieve Init. Set.	MENU' Change Init.Set.
ENTER	**ENTER** **password 1**	**ENTER** **password 2**	**ENTER** **password 1**	**ENTER** **password 2**
Working freq. f = XXX [Hz]	Control mode Constant Press/ Fixed Freq.	Rump up time t = XX [sec]	ENT to restore initial settings	Language italiano/english
Set pressure. p = XX.X [bar]	Max sensor press. 20mA = XX.X [bar]	Rump down time t = XX [sec]		Rated Motor Volt V = XXX [V]
Language Italiano / english	Offset press. sensor ENT per taratura	PWM f = XX.X [kHz]		Voltage Boost V = XX [%]
	Max System Pres. pmax = XX.X [bar]	Rated Motor Volt V = XXX [V]		Rated Motor Amp I = XX [A]
	Working freq. f = XXX [Hz]	Voltage Boost V = XX [%]		Rated Motor Freq. f = XXX [Hz]
	Dry run cosphi cosphi = X.XX	Rated Motor Amp I = XX [A]		Min. Motor Freq. f = XXX [Hz]
	Set pressure p = XX.X [bar]	Rated motor freq. f = XXX [Hz]		Rump up time t = XX [sec]
	Test Min. Stop freq. ENT to begin	Min. Motor freq. f = XXX [Hz]		Rump down time t = XX [sec]

	Press START and close discharge	AutoRestart ON/OFF		PWM f = XX.X [kHz]
	Tuning : START/STOP ----------	Change PASSWORD2 ENT		Control mode Constant Press/ Fixed Freq.
	min f = XXX [Hz] p = XX.X [bar]			Max Sensor Pres. 20mA = XX.X [bar]
	Set Min. Stop freq. fmin = XXX [Hz]			Offset sensor pres. ENT for tuning
	Stop delay t = XX [s]			Max System Pres. pmax = XX.X [bar]
	Delta start pressure p = XX.X [bar]			Working Freq. f = XXX [Hz]
	Ki XXX			TEST motor START/STOP
	Kp XXX			Rotation Sense NORMAL/REVERSE
	Pump DOL 1 ON/OFF			Dry Run Cosphi cosphi = X.XX
	Pump DOL 2 ON/OFF			Set Pressure p = XX.X [bar]
	Time start AUX pumps t = XX [s]			Test Min. Stop freq. ENT to begin
	Time stop AUX pumps t = XX [s]			Press START and close discharge
	Rotation Sense NORMAL/REVERSE			Tuning : START/STOP ----------
	Digital input 1 N.A. / N.C.			min f = XXX [Hz] p = XX.X [bar]
	Digital input 2 N.A. / N.C.			Set Min. Stop Freq. fmin = XXX [Hz]
	COMBO			Stop delay

	ON/OFF			t = XX [s]
	Address XX			Delta start pressure p = XX.X [bar]
	Alternance ON/OFF			INIT SETUP COMPLETED
	Change PASSWORD1 ENT			

DECLARATION OF CONFORMITY

VASCO 409 is an electronic device to be connected to other electrical equipment with which it is to form individual units. It must, therefore, that the putting into service of this unit (with all its subsidiary equipments) to be performed by qualified personnel.

The product conforms to the following regulations:

EN 55011 Class A
EN 61000
EN 60146
EN 50178
EN 60204-1

ing. Marco Nassuato
Operation Manager

NOTES