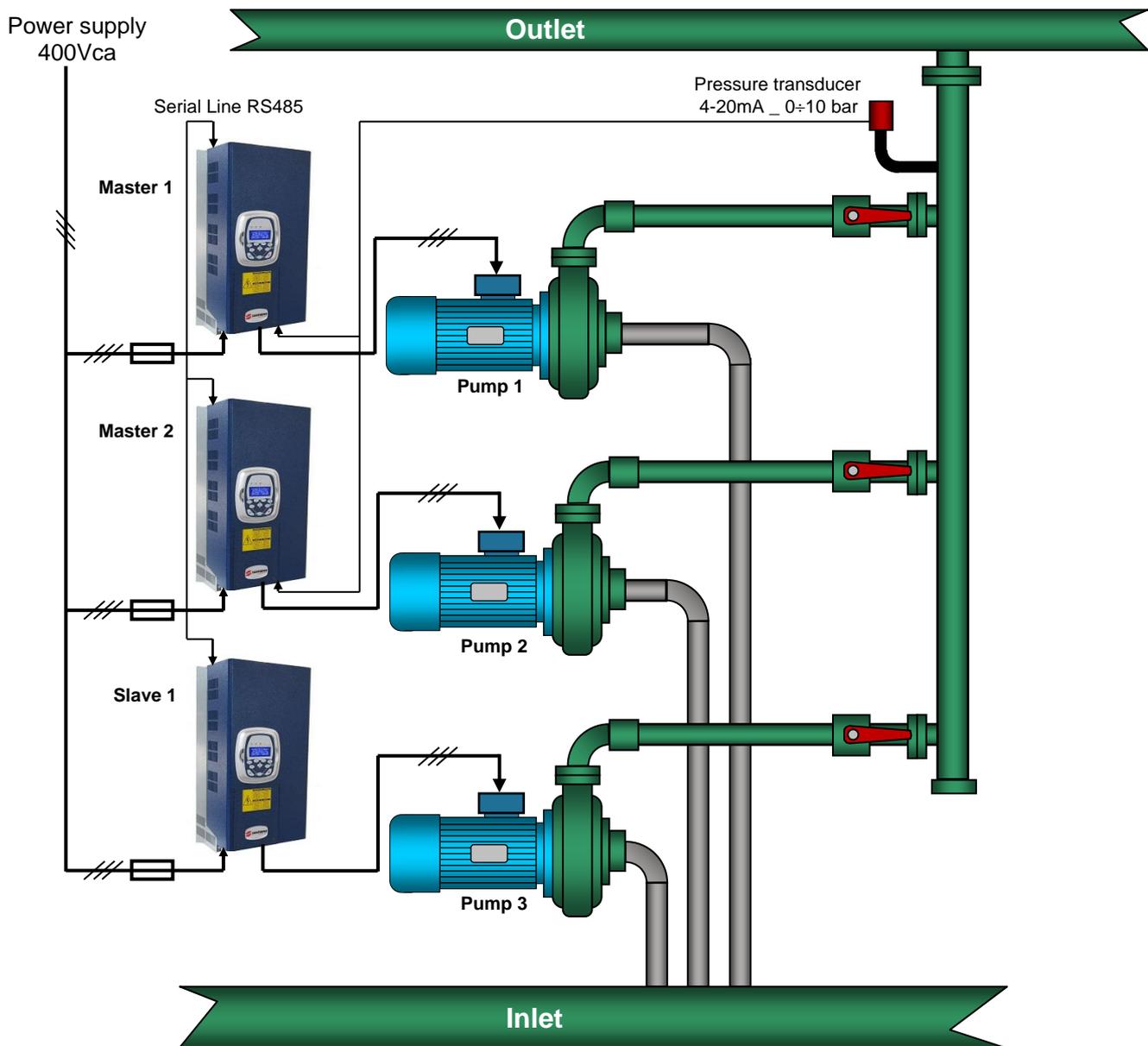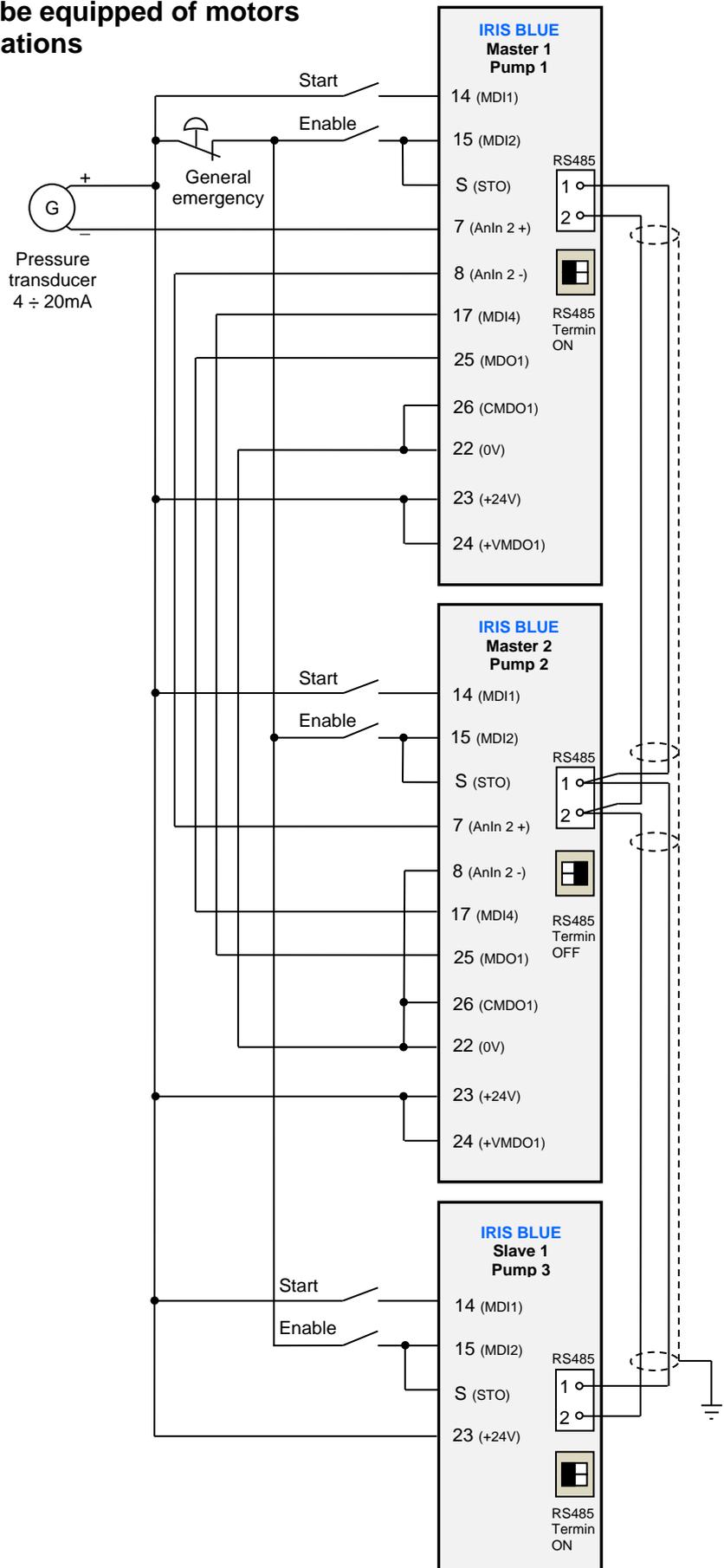# IRIS BLUE Multi-motor
– R02

Example of Operation of a Multi-Motor Hydraulic System with Automatic PID Pressure Control - R02   05/10/2017
SW version: IB4.13x

Warning: The system must be equipped of motors of equal power and specifications

Wiring diagram
With passive two-wire transducer
4 ÷ 20mA and set-point via keypad

Pressure
transducer
4 ÷ 20mA

General
emergency

Start
Enable

IRIS BLUE
Master 1
Pump 1

14 (MDI1)
15 (MDI2)
S (STO)
7 (AnIn 2 +)
8 (AnIn 2 -)
17 (MDI4)
25 (MDO1)
26 (CMDO1)
22 (0V)
23 (+24V)
24 (+VMDO1)

RS485
1
2

RS485
Termin
ON

Start
Enable

IRIS BLUE
Master 2
Pump 2

14 (MDI1)
15 (MDI2)
S (STO)
7 (AnIn 2 +)
8 (AnIn 2 -)
17 (MDI4)
25 (MDO1)
26 (CMDO1)
22 (0V)
23 (+24V)
24 (+VMDO1)

RS485
1
2

RS485
Termin
OFF

Start
Enable

IRIS BLUE
Slave 1
Pump 3

14 (MDI1)
15 (MDI2)
S (STO)
23 (+24V)

RS485
1
2

RS485
Termin
ON

2

Preliminary programming of all the drives (Master1, Master2, Slave1)

To perform the following programming, the devices must be in their default programming condition.
If your device has been previously programmed, you will need to reset the internal programming to the factory parameter values (Restore Default).
In this application, the standard 9-poles serial is occupied by the series of Drives connected to the multi-motor system. Therefore, if you need to program through "Remote drive" software it is necessary to connect a suitable RJ45 adaptor instead of the keypad. Alternatively, you can use the keypad and set the parameters by following the instructions provided below.

Language setting through the keypad
The Drive is programmed by default with English as pre-set language, if you wish to choose a different one among the available ones, follow this procedure:
Select the Group "IDP", press "ENTER", then press "Arrow Up" and the text "PRODUCT" appears.
Press "ENTER" and "P263 Language → ENGLISH" appears.
Press "ENTER" and choose the desired language using the arrow keys "Up" or "Down", then confirm by pressing "ENTER".
Press the "MENU" key on the keypad twice to return to the main screen.

Programming the parameters of the "PAR" Group

Password and access level
P001 - Programming level   = Engineering   (max programming level)

** Before programming, disable all the drives removing "S" terminal.
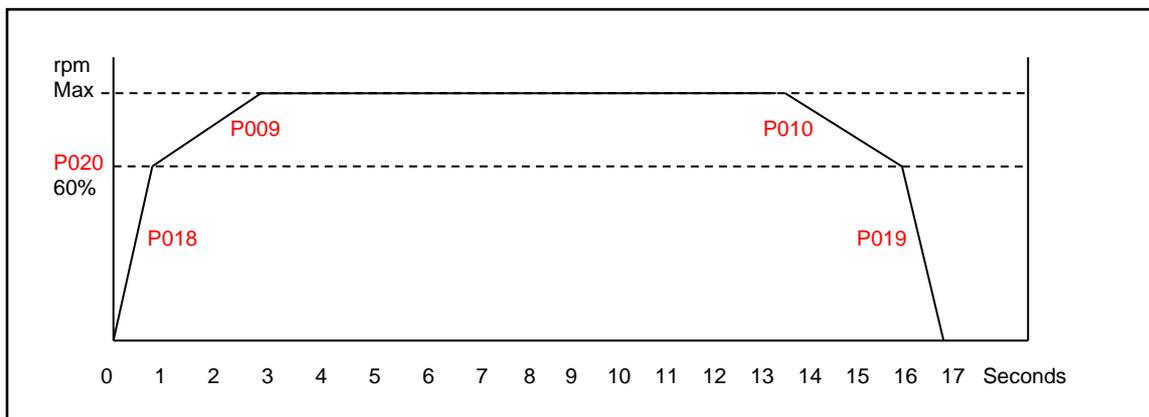
It's recommended to program all the drives in the order shown below starting from Slave 1, in order to avoid undesired alarms.

Programming Slave 1

"PAR" Group

Ramps
P009 - Acceleration ramp 1   = 3.00 s (Motor acceleration ramp)
P010 - Deceleration ramp 1   = 3.00 s (Motor deceleration ramp)
P018 - Initial acceleration time   = 1.00 s (Acceleration up to 60% of speed)
P019 - Final deceleration time   = 1.00 s (Deceleration below 60% of speed)
P020 - Initial/Final speed threshold of the ramp   = 60%   (Speed threshold for ramp change)

If the plant is at risk of mechanic shock in the pipe lines (water hammer), the ramp time P010 must be extended as much as necessary to reduce or eliminate the shock.

Display/Keypad

P265-First page = Measurements (page displayed at start-up)

Programming the parameters of the "CF" Group

Motor configuration (Pump 3)

C013 - Type of V curve on F	= Quadratic	(Energy saving curve)
C016 - Motor rated speed	= ….. rpm	(Enter the rpm value as on nameplate)
C017 - Motor rated power	= ….. kW	(Enter the motor power value as on nameplate)
C018 - Motor rated current	= ….. A	(Enter the motor current value as on nameplate)
C019 - Motor rated voltage	= ….. V	(Enter the motor voltage value as on nameplate)
C028 - Motor min revolutions per minute	= ….. rpm	

- Enter the minimum desired rpm value for the specific characteristics of the installed pump corresponding to the Pressure/flow operation point of the plant.

C029 - Motor max revolutions per minute = …..rpm (Enter the desired max speed)

Thermal protection

C265 - Thermal protection mode for Motor = No derating

Control method

C140 - Selection of control source no. 1 = Serial Line
C143 - Selection of Reference source 1 = Serial Line
C144 - Selection of Reference source 2 = Disabled (It disables the secondary reference input)

Serial lines

R001 - Drive ModBus address line 0 = 3

Now keep pushing "Reset" on the keypad to restart the drive with the new configuration and the new serial address.

Programming Master 2

"PAR" Group
Display/Keypad

P265 - First page = Keypad (page displayed at start-up)
P267 - PID unit of measure = bar (unit of measure selected by the user)

The following parameters represent the values that can be displayed directly on the keypad upon start-up

**P268d - Measure n 3 on Keypad page	= M024: PID Fbk	(Third line displayed on "Measurements page")
**P268e - Measure n 4 on Keypad page	= M023: PID Ref	(Fourth line displayed on "Measurements page")

**Parameters that can only be edited using the keypad.

Ramps

P009 - Acceleration ramp 1	= 3.00 s	(Motor acceleration ramp)
P010 - Deceleration ramp 1	= 3.00 s	(Motor deceleration ramp)
P018 - Initial acceleration time	= 1.00 s	(Acceleration up to 60% of speed)
P019 - Final deceleration time	= 1.00 s	(Deceleration below 60% of speed)
P020 - Initial/Final speed threshold of the ramp	= 60%	(Speed threshold for ramp change)

The same values set for "Slave 1" are recommended.

Programming the parameters of the "CF" Group
Serial lines

R001 - Drive ModBus address line 0 = 2

Now keep pushing "Reset" on the keypad to restart the drive with the new configuration and the new serial address.

Motor configuration

C013 - Type of V curve on F	= Quadratic	(Energy saving curve)
C016 - Motor rated speed	= ….. rpm	(Enter the motor rpm value as on nameplate)
C017 - Motor rated power	= ….. kW	(Enter the motor power value as on nameplate)
C018 - Motor rated current	= ….. A	(Enter the motor current value as on nameplate)
C019 - Motor rated voltage	= ….. V	(Enter the motor voltage value as on nameplate)
C028 - Motor min revolutions per minute	= ….. rpm	

- Enter the minimum desired rpm value for the specific characteristics of the installed pump corresponding to the Pressure/flow operation point of the plant.

C029 - Motor max revolutions per minute = …..rpm   (Enter the desired max speed)

Control method

C144 - Reference 2 selection   = Disabled   (Disables the secondary input of speed reference)

Thermal protection

C265 - Thermal protection mode for Motor   = No derating

PID Configuration

C291 - PID operating mode   = Normal   (Enables PID control with opposite reaction with respect to the feedback)

**-Warning: Once C291 is modified, the Drive temporarily activates the alarm A067 "INPUT AIN2 <4mA!.
Do not reset the alarm**. Exit by pressing the "Menu" key twice and proceed with the programming ignoring the alarm condition ("Alarm" red light on).

C285 - Selection of reference 1 PID   = Keypad   (Source of PID reference)

Setting PID control and shutdown/automatic restart "Sleep"/"Wake Up" modes

The following group of parameters must be set according to the system specifications. The suggested programming reflects the typical requirements of a sample system.

"PAR" Group

PID parameters

P237 - Min PID output   = …. %   (It sets the min working speed as a percentage)
This value must be set as a percentage of C028 and C029.
*For example: if C028=2600 rpm and C029=3000 rpm calculate P237=(C028 * 100) /C029 = 86,6%.*

P237a - Wake-up mode for PID	= ERR >P237b	(Type of pump awakening based on error as %)
P237b - Wake-up level for PID	= +2.00%	(It establishes the error as a % that causes the pump to awaken)
P245 - Min reference accepted by PID	= ….	This is used if you need to limit the variation range of the minimum reference settable on the keypad, e.g. 30% (3 bar)
P246 - Max reference accepted by PID	= ….	This is used if you need to limit the variation range of the maximum reference settable on the keypad, e.g. 70% (7bar)
P255 - PID Disable Delay for low PIDout	= 60 s	(Delay time after which, if the PID output reaches the set limit in P237, the motor automatically stops. "Sleep Mode".)
P255a - Reference for PID disable	= 0%	
P255c - PID disable threshold with low ref.	= Enter the same value set in P237 plus 1%	
P255d - PID disable threshold with high ref.	= Enter the same value set in P237 plus 1%	
P257 - Gain for PID Measure Scaling	= 0,100	(Scale factor from the percentage PID value)

For example: with P257=0.1, an indication of 10.00 bar is obtained when the PID reference is 100%.

"CF" Group
Motor power

C600 - Number of motors	= 3	(Enter the number of motors the system is equipped with)
C601 - Motor 2 rated power	= … kW	(Pump 2 motor power)
C601 - Motor 3 rated power	= … kW	(Pump 3 motor power)
C605 - Slave motor type	= Variable Speed	(Type of the multi-motor control at variable speed)

Multi-motor digital inputs

C615 - Motor 2 digital input available   = Serial   (Type of control with Motor 2)
C616 - Motor 3 digital input available   = Serial   (Type of control with Motor 3)

- Warning: since the programming is not ended yet, the "W47 Serial TMout" warning will appear. Please ignore this warning and keep on programming. At the end it will be possible to reset all the warnings.

C623 - Slave mode digital input   = MDI4   (Input used to switch between master or
                                            Slave mode)

Master serial

C650 - Motor 2 drive type   = IRIS BLUE MMC (It defines the type of Drive applied to the first motor)
C651 - Motor 2 device address   = 1   (Serial address dedicated to communication
                                            with the Master 2 Drive)
C662 - Motor 3 drive type   = PENTA/IRIS   (It defines the type of Drive applied to the third motor)
C663 - Motor 3 device address   = 3   (Serial address dedicated to the communication with
                                            the Slave 1 Drive)
C667 - Motor 3 value for max reference = … rpm   (Maximum Slave 1 Drive speed reference -
                                            Motor 3, C029 if it is IRIS BLUE or Penta drive)

- If the "W47 Serial TMout" warning is still present, keep on pushing "RESET" on the keypad for 10 seconds and wait for the restart.

"PAR" Group
Multi-Motor digital outputs

P630 - Output MDO1, selection of the relevant signal = D613: Master (Digital output that sets master
                                                          or slave status)

"CF" Group
Motor power

C606 - It disables the system if master is KO   = NO-MMC slave enable (It uses as Master the second
                                                     available motor)

"PAR" Group
Control range

P600 - Min operation power   = 85% (Value of speed generated by the system under which other pumps may be
                                      disengaged if P602 time is exceeded)
P601 - Max operation power   = 99% (Value of speed generated by the system above which other pumps may be
                                      engaged if P602 time is exceeded)

Programming Master 1

In case the two drives, Master 1 and 2, correspond to the same model, size, and software version, it is possible to use the keypad as a transfer method of the programming from Master 2 (already set) to Master 1, using the "TX/RX" (Upload/Download) key on the keypad.

At the end of the transferring procedure, the transferred program must be permanently stored, following these instructions:

Enter the EEPROM menu, "managing EEPROM operation", select "SAVE WORK" and confirm by pushing the "ENTER" key twice.

The programming of the Master 2 drive is the same as the one carried out for the Master 1, with two main differences concerning the following parameters:

C651 - Motor 2 device address   = 2 (Serial address dedicated to the communication with the Master 1 drive)

Serial lines

R001 - Drive ModBus address line 0   = 1

Warning: After setting R001, switch the Drive off and on again

Remember to change R001 and C651 as specified above and to switch the Drive supply off and on to activate the communication to the new address.

"PAR" Group

Display/Keypad

  P268d - Measure n 3 on Keypad page = M024: PID Fbk   (Enter the same value chosen for Master 2)
  P268e - Measure n 4 on Keypad page = M023: PID Ref   (Enter the same value chosen for Master 2)
  **Parameters that can only be edited using the keypad.

Theory of operation

The diagram in the previous pages shows a pressure control inside a manifold, with feedback from a 4–20mA, 0–10 bar probe.

The pressure set-point setting is done via the keypad. By changing the set-point it is possible to adjust the pressure from 0 up to the maximum transducer value, while keeping it constant according to the system needs.

In case the pressure settles at a value that exceeds the one set in the set-point, following a reduction in water demand, the drive will adjust the pump to a minimum speed (as set in parameter P237) and, in case the wake-up mode is enabled (P255), the pump will stop automatically, provided that this condition lasts longer than the time set in the relevant parameter.

When a higher consumption is restored, the pump will start again as soon as the error reaches the value set in P237b, recovering the pressure level and maintaining it constant by means of the internal PID controller.

In this example, 3 drives are used for the simultaneous control of 3 pumps that operate on the same piping. The whole system is managed by the master drive that smartly determines when and whether to switch on and off the remaining pumps and adjust their speed in order to always have a sufficient number of active pumps and meet the system's demand. Thus the following results are obtained: high energy saving, prompt reply to the system demands, alternate operation of the pumps to get an equal wear among them.

Each system can only have one active Master device, which in turn can control up to a maximum of 4 Slaves; however, in this example two drives "Master 1" and "Master 2" can become Master of the system by alternating automatically when the input status at terminal 17 becomes active.

The drive that is not Master becomes Slave and is controlled by the active Master, but in case the Master is disabled or switched off, it automatically carries on all the functions of the stopped drive, becoming itself a back-up Master unit without any interruptions to the service.

Note: don't forget to set the same PID reference on the keypad of both drives Master 1 and Master 2. In fact, if the reference is different, in case of automatic change of the Master mode, a different regulation could occur. For example, if the pressure is set on 2 bar on the first Master, it is necessary to set 2 bar also on the second master to avoid this problem.

Note:
The above-mentioned diagrams and parameter values represent a mere example of how the application can be used, and they may be modified according to the User requirements and the technical specifications of the system. Therefore, it is the installer's responsibility to ensure a correct implementation. Compliance with the current safety regulations and successful installation are responsibility of the installer; please refer to the application manual of the product.