BoosterpaQ®
Grundfos CR-Booster Systems
60 Hz

Installation and operating instructions

Factory settings are documented in this manual. Please leave these instructions with the BoosterpaQ for future reference.

For technical support, call your supplier or contact Grundfos Pumps Corporation at 913 227 3400 (USA).

Model: _____

Part Number: _____

PFU 2000 Eprom P/N: _____

PMU 2000 Eprom P/N: _____

Serial Number: _____

Production Date: _____

Your BoosterpaQ was factory assembled and tested with the factory set control parameters listed at the beginning of one of the following sections as marked.

☐ Standard PFU 2000 System Controller
(See pages 6 and 7 for Installation and Start-up)

☐ Standard PMU 2000 System Controller
(See pages 6 and 8 for Installation and Start-up)

_____
Name

_____
Date

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SAFETY WARNING

Before beginning installation procedures, these Installation and Operating Instructions should be studied carefully. Installation and operation must be in accordance with the National Electrical Code and local regulations and accepted codes of good practice.

SHOCK HAZARD

A faulty motor or wiring can cause electrical shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the pump and system electrical panel to the power supply's grounding terminal is required for safe installation and operation (see "Electrical Connection," page 6).

In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.

Application

Grundfos BoosterpaQ systems are designed for transfer and boosting of clean water in commercial buildings, commercial landscape, industrial, and municipal applications. The BoosterpaQ range consists of three main groups: S, F, and E. The main groups are divided into subgroups as shown in the next column on this page.

Related Documents

For some BoosterpaQs, detailed information can be found in the following related documents:

- Wiring Diagram
- Bill of Materials
- CR Pump Installation and Operating Instructions
- CRE Pump Installation and Operating Instructions
- Variable Frequency Drive Installation and Operating Instructions
- BoosterpaQ Product Guide

BoosterpaQ System Types

System Type	System Function
ME	All pumps are fitted with variable frequency driven motors. All pumps in operation are speed-controlled (same speed) and are full-size.
MEH	Two half-size pumps are fitted with variable frequency driven motors (same speed if both pumps are operating). Full-size pumps are mains operated (on/off). The variable speed pump(s) always start first.
MES	One pump is fitted with a variable frequency drive motor. The other pumps are start/stop operated (on/off). All pumps are full-size pumps. The variable speed pump(s) always start first.
MF	All pumps are full-size pumps. One pump is operated via a variable frequency drive. The other pumps are start/stop operated (on/off). All pumps will be controlled by the variable frequency drive in rotation. The variable speed pump(s) always start first.
MFH	Two pumps are half-size pumps. The other pumps are full-size pumps. The two half-size pumps are controlled by a variable frequency drive in rotation, and the full-size pumps are start/stop operated (on/off) and alternated. The variable speed pump(s) always start first.
MS	All pumps are equal size and are start/stop operated (on/off).
MSH	One half-size pump. The other pumps are full-size pumps. All pumps are start/stop (on/off).

Construction

Grundfos BoosterpaQ systems consist of 1-8 pumps with all necessary fittings and a Grundfos Control 2000 mounted on a common base frame, ready for installation. The Control 2000 has its own base for large BoosterpaQs. In most cases a diaphragm tank must be included in the installation.

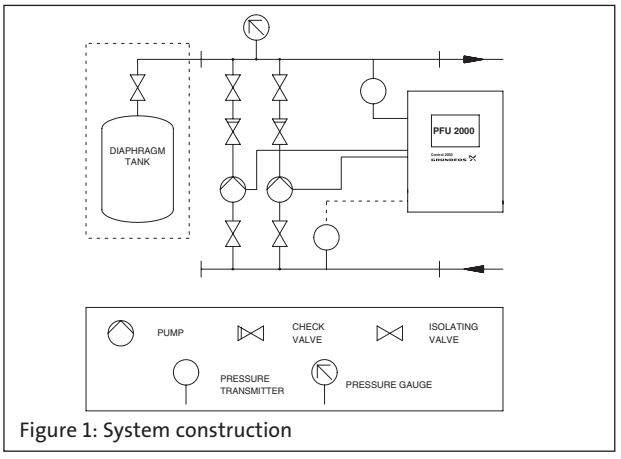
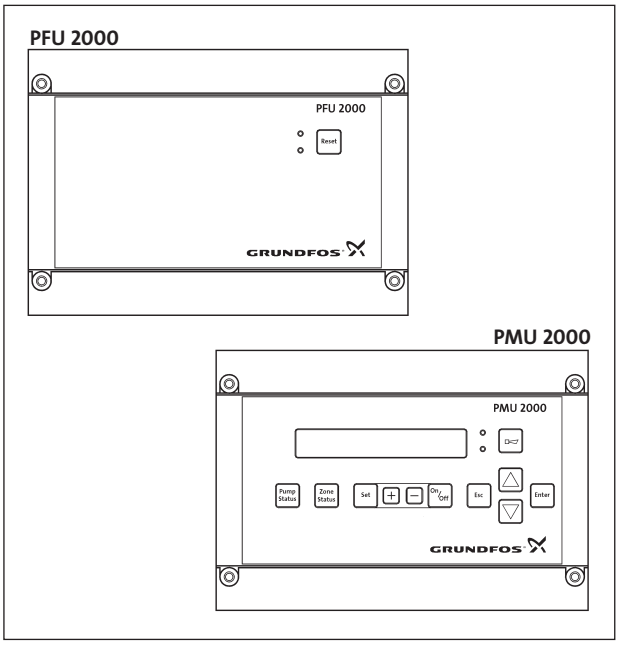


Figure 1: System construction

BoosterpaQ Control Modes

BoosterpaQs always include the Grundfos PFU 2000 Controller, but a PMU 2000 can be added. The optional PMU 2000 provides additional functions and detailed system information via a LCD (Liquid Crystal Display).

If the BoosterpaQ includes the PFU 2000 only, its faceplate will be located on the control panel door (see below). If the BoosterpaQ includes the optional PMU 2000, the PMU 2000 replaces the PFU 2000 faceplate (see below).



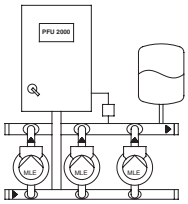
BoosterpaQs offer the following functions:

- Closed-loop control
- Automatic shut-off at zero flow
- Automatic cascade control of pumps
- Automatic pump rotation to equalize operation time among the pumps; and with PMU 2000, selectable pump priority, minimum pump operation, and selectable pump sequencing
- Manual operation of each pump
- Possibility of various analog set-point influences:
  – friction loss compensation (flow-dependent set-point control with or without flow measurement), PMU 2000 only
  – external set-point adjustment
- Possibility of various digital remote-control functions:
  – system on/off
  – reduced capacity during emergency power situations (PMU 2000)
  – alternative set-points (PMU 2000)
  – switching off individual pumps
- Pump and system monitoring functions:
  – minimum and maximum limits of actual value (high and low system pressure)
  – pre-pressure (out of water or low inlet pressure)
  – motor protection
  – BUS communication (GeniBUS Protocol)
- LCD Display and indication functions:
  – 2 x 24 character LCD display (PMU 2000)
  – green indicator light for operating indications and red indicator light for fault indications
  – potential-free relay contacts for operation and fault
- Multiple set-points (PMU 2000)
- Grundfos BUS communication (GeniBUS Protocol)

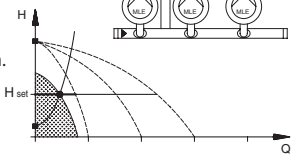
Product Description

Grundfos BoosterpaQ ME

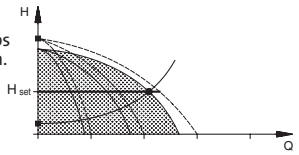
Example:
Three pumps of equal size with MLE motors and a diaphragm tank.



One pump in operation.



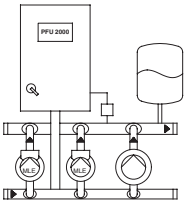
Three pumps in operation.



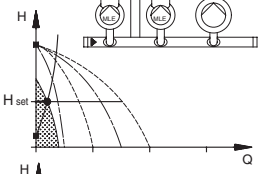
Grundfos BoosterpaQ ME maintains a constant pressure through continuous variable adjustment of the speed of the pumps. The system performance is adjusted to the demand through cutting in/out the required number of pumps and through parallel speed control of the pumps in operation. Pump rotation is automatic and depends on load, time and fault.

Grundfos BoosterpaQ MEH

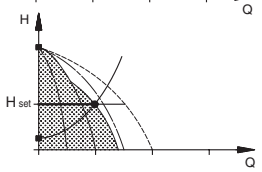
Example:
Two half-size pumps with MLE motors, one mains-operated full-size pump and a diaphragm tank.



One half-size pump with MLE motor in operation.



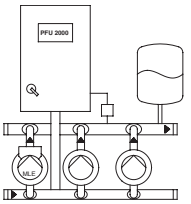
One full-size pump and one half-size pump with MLE motors in operation.



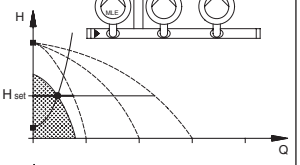
Grundfos BoosterpaQ MEH maintains a constant pressure through continuous variable and parallel adjustment of the speed of the two half-size pumps, while the full-size pump is mains-operated. The half-size pumps always start first. If the pressure cannot be maintained by one half-size pump, the second half-size pump and/or the full-size pump will be cut in. Pump rotation is automatic and depends on load, time and fault.

Grundfos BoosterpaQ MES

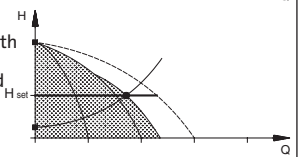
Example:
One pump with MLE motor, two mains-operated pumps and a diaphragm tank. All pumps are of equal size.



One pump with MLE motor in operation.



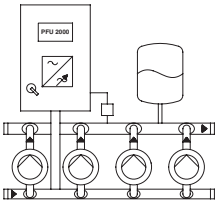
One pump with MLE motor in operation and two pumps on mains-operation.



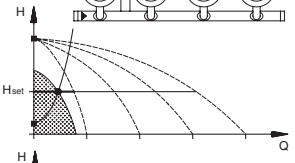
Grundfos BoosterpaQ MES maintains a constant pressure through continuous variable adjustment of the speed of one pump. The other pumps are cut in/out on mains operation according to demand thus achieving a performance corresponding to consumption. The pump with MLE motor will always start first. Rotation among the pumps on mains operation is automatic and depends on load, time and fault.

Grundfos BoosterpaQ MF

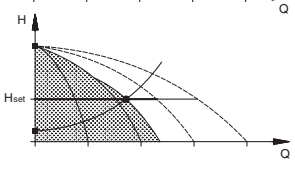
Example:
Four pumps and a diaphragm tank. All pumps are of equal size.



One pump in operation via variable frequency drive.



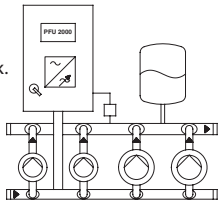
One pump in operation via variable frequency drive and two pumps on mains operation.



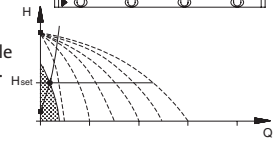
Grundfos BoosterpaQ MF maintains a constant pressure through continuous variable adjustment of the speed of one pump. The other pumps are mains-operated (on/off) according to the demand thus achieving a system size corresponding to the consumption. The pump controlled by the variable frequency drive will always start first. Pump rotation is automatic and depends on load, time and fault. All pumps are controlled by the variable frequency drive in rotation.

Grundfos BoosterpaQ MFH

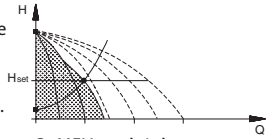
Example:
Two half-size pumps, two full-size pumps, and a diaphragm tank.



One half-size pump in operation via variable frequency drive.



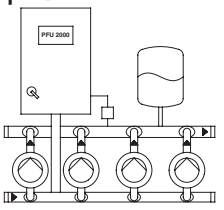
One full-size pump in operation via variable frequency drive and one full-size pump on mains operation.



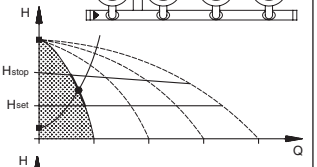
Grundfos BoosterpaQ MFH maintains a constant pressure through continuous variable adjustment of the speed of the one half-size pump. The rest of the pumps are mains-operated. A half-size pump controlled by the variable frequency drive will always start first. If the pressure cannot be maintained by one half-size pump, the second half-size pump and/or the full-size pump will be cut in on mains-operation. Rotation between the half-size pumps is automatic and depends on load, time and fault. The full-size pumps on mains power are automatically rotated among themselves.

Grundfos BoosterpaQ MS

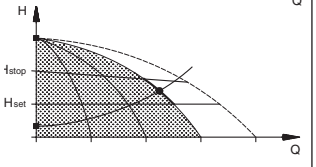
Example:
Four pumps and a diaphragm tank. All pumps are of equal size.



One pump in operation.



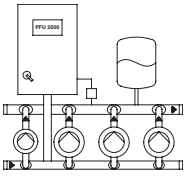
Three pumps in operation.



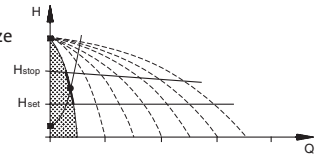
Grundfos BoosterpaQ MS maintains a pressure range by cutting in/out the required number of pumps. The operating range of the pumps will lie between the lines Hset and Hstop (cut-out pressure). The cut-out pressure cannot be set but is calculated automatically. Rotation among the pumps is automatic and depends on load, time, and fault.

Grundfos BoosterpaQ MSH

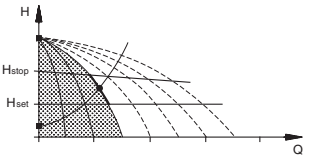
Example:
One half-size pump, three full-size pumps and a diaphragm tank.



Example:
One half-size pump in operation.



Example:
One half-size pump and one full-size pump in operation.



Grundfos BoosterpaQ MSH maintains a pressure range by cutting in/out the half-size pump and the full-size pumps. The half-size pump will always start first. The half-size pump will be cut out again when a full-size pump is cut in. The operating range of the pumps will lie between the lines Hset and Hstop (cut-out pressure). The cut-out pressure cannot be set but is calculated automatically. Rotation among the full-size pumps is automatic and depends on load, time and fault.

Installation

Upon its arrival, check your BoosterpaQ system for shipping damage and confirm that you have received the correct system prior to installation.

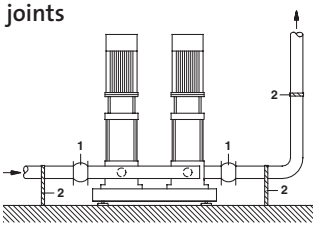
Location

BoosterpaQ systems must be installed in a well-ventilated area. When a BoosterpaQ is installed outdoors, it must be protected from rain, cold, heat, and direct sunlight to operate within the product humidity and temperature limits. The BoosterpaQ should be placed with a 3-foot clearance in front and on the two sides for ease of service.

Hydraulic installation

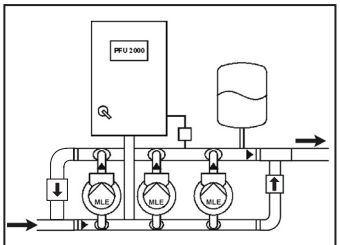
Arrows on the pump base show the direction of flow of water through the pump. The pipes connected to the BoosterpaQ must be of adequate size. To avoid resonance, expansion joints may be connected to the discharge and suction pipes (see drawing at right).

Installation with expansion joints



1. Expansion joint
2. Pipe hanger/support

The system pipes are connected to the manifolds of the BoosterpaQ. Either end of the manifolds can be used as long as the pipe does not pass in front of the control panel (check building codes). Apply approved sealing compound to the unused end of each manifold and fit the screw cap. For manifolds with flanges, blind flanges with gaskets are included.



Installation with bypass check valve

If the suction pressure periodically exceeds the discharge pressure, installing a bypass check valve (see drawing above) minimizes flow through the pumps when the system shuts down.

If the discharge pressure could reach pressures above the plumbing maximum rating due to VFD failure or other system causes, a pressure relief device must be installed. Another option is to install a pressure sustaining valve to return discharged fluid back to the suction manifold. Grundfos offers this option.

BoosterpaQ hardware should be checked for tightness prior to startup to avoid leaks due to transportation vibration. When a BoosterpaQ is installed in a densely populated building or the first user on the line is close to the BoosterpaQ, it is advisable to fit pipe hanger/supports on the suction and discharge pipes to prevent vibration being transmitted through the pipe work (see drawing at left with pipe hanger/support).

The BoosterpaQ should be positioned on a flat, level, solid surface; for example, a concrete floor or foundation. If the BoosterpaQ is not fitted with vibration dampers, it must be bolted to the floor or foundation. The pipes must be fastened securely to ensure that they cannot move or be twisted.

Expansion joints, pipe hangers and vibration dampers shown in the illustration at left are **not included** with the BoosterpaQ.

Install a diaphragm tank as specified in the “Technical Information” section.

Electrical connection

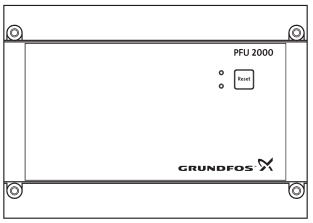
The connection of the electrical supply, transmitters and external monitoring equipment must be carried out by an authorized electrician in accordance with the NEC, local regulations and the BoosterpaQ wiring diagram.

Ensure that the Control 2000 and the pumps are suitable for the electricity supply on which they will be used (see Technical Data). Please read the wiring diagram carefully. According to the NEC, if the motors cannot be seen from the control panel, they must be fitted with a disconnect switch.

Any BoosterpaQ that utilizes a variable frequency drive (ME, MEH, MF, MFH, MES) should be connected to an electrical supply that all phase lines are electrically symmetrical with respect to ground. A “four wire wye” electrical supply is recommended. If a variable frequency drive is connected to a delta transformer, the drive may not operate correctly and may not provide optimum performance (excessive faults, erratic behavior, or complete failure). Ask your power company or electrician to determine what type of electrical supply is present. Generator supplied power must meet public utility power quality standards.

PFU 2000 Startup

PFU 2000



1. Have a qualified person check for proper power supply and plumbing connections. Make sure the main power is off.
2. Check that the air pressure in the diaphragm tank is 0.7 times the required discharge pressure set-point (0.9 times for MS and MSH systems). System pressure must not be applied to the tank connection during the tank pre-charge process. If water is supplied to the tank from the system, close the tank valve during the pressurizing process.
3. Prime the system as follows.

   Suction Pressure System (pumps are flooded at least as high as the highest part of the pumps)

   a. Close all discharge manifold pump isolation valves and open all inlet manifold pump isolation valves.

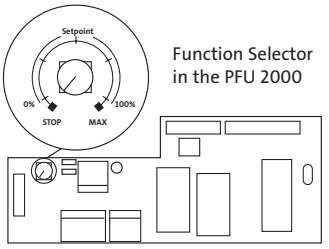
   b. Open the vent plug on top of each pump. It is a small hex head screw in a large vent plug. Air and water will escape from the pump through a small hole in the large vent plug. When the air is out and water is flowing steadily, tighten the small hex head screw on the vent plug to stop the flow.

   Suction Lift System (the water source is below the pumps or does not flood the pumps to the highest point on the pumps)

   a. Close all discharge manifold pump isolation valves and open all inlet manifold pump isolation valves.

   b. For suction lift applications, a foot valve must be placed on the inlet piping at the water source (tank, etc.). If there is a fill point above the highest point of the pumps, you may fill the system from this point. If there is no fill point above the highest point of the pumps, remove the large vent plug on each pump. Fill each pump until the water is up to the vent plug, then replace the vent plugs.
4. Check the inlet manifold pressure gauge. The inlet pressure must be at least 5% of the maximum pressure transducer rating (if a transducer is used). If another type of dry run protection is used, ensure that sufficient suction pressure is available for safe operation of the pumps.
5. Ensure all circuit breakers are in the **"on"** position. The control panel door must be open at this time.
6. If an isolation valve has been installed on the discharge manifold, close it. If not installed, make sure the discharge pump isolation valves are closed. Switch on main power (the pumps may start at this time).
7. Turn the Function Selector (small knob on the PFU Controller) on the PFU 2000 to **"Max"** (see drawing at right) (full clockwise rotation).

   If the pumps did not start in Step 6, they will start after approximately 15 seconds.



Function Selector in the PFU 2000

8. Vent the system by opening the vent plug on each pump (as in Step 3). Venting with the pumps running ensures all air is removed from the suction. **Do not run the system with the discharge manifold pump isolation valves closed for more than five minutes to prevent overheating of the pump liquid.**
9. Once the pumps have been fully vented, turn the PFU 2000 Function Selector to **"Stop"** (full counter-clockwise). As the pumps stop, check the pump rotation. If the area is dark, a flashlight may be required, or remove a coupling guard on each pump for better visibility. Disconnect main power when removing coupling guards. **Do not touch the couplings while the pumps are turning as injury may result.** Replace all coupling guards after the rotation check. **Disconnect main power when removing and replacing coupling guards (or open service disconnect switches if this option was supplied).** If the rotation is incorrect on any 3 phase pumps, switch any 2 of the 3 power main wires supplied to the control panel (L1, L2, L3).
10. Open the discharge manifold isolation valve and the isolation valves for each pump. Turn the PFU 2000 Function Selector clockwise approximately 50% of full rotation, allow the system to come up to speed, then slowly adjust the Function Selector until the system maintains the desired set-point pressure as read on the discharge pressure gauge.

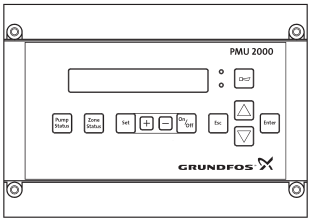
    NOTE: If you are filling an empty piping system, do not allow the pumps to run with the valves wide open as cavitation may occur.

    NOTE: If the set-point is changed, readjust the diaphragm tank precharge pressure to 0.7 times the new fluid pressure setting (0.9 times for MS and MSH systems). Check the diaphragm tank air pressure while no fluid pressure is applied to the tank (see Step 4).

    Your BoosterpaQ is now ready for operation.

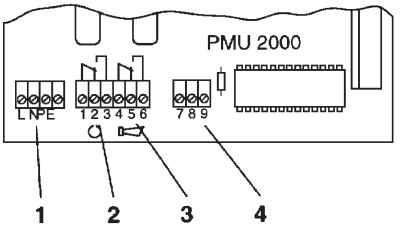
PMU 2000 Startup

PMU 2000



1. Have a qualified person check for proper power supply and plumbing connections. Make sure the main power is off.

2. Remove the PMU 2000 BUS plug (see drawing at right). Drawing shows view of the back of the PMU 2000, which is mounted on the control cabinet door. Leave the panel door open until after Step 13.



1. Electricity Supply
2. Operating Signal Output
3. Fault Signal Output
4. BUS (connection plug)

3. Check that the air pressure in the diaphragm tank is 0.7 times the required discharge pressure set-point (0.9 times for MS and MSH systems). System pressure must not be applied to the tank connection during the tank pre-charge process. If water is supplied to the tank from the system, close the tank valve during the pressurizing process.

4. Prime the system as follows.

   Suction Pressure System (pumps are flooded at least as high as the highest part of the pumps)

   a. Close all discharge manifold pump isolation valves and open all inlet manifold pump isolation valves.

   b. Open the vent plug on top of each pump. It is a small hex head screw in a large vent plug. Air and water will escape from the pump through a small hole in the large vent plug. When the air is out and water is flowing steadily, tighten the small hex head screw on the vent plug to stop the flow.

   Suction Lift System (the water source is below the pumps or does not flood the pumps to the highest point on the pumps)

   a. Close all discharge manifold pump isolation valves and open all inlet manifold pump isolation valves.

   b. For suction lift applications, a foot valve must be placed on the inlet piping at the water source (tank, etc.). If there is a fill point above the highest point of the pumps, you may fill the system from this point. If there is no fill point above the highest point of the pumps, remove the large vent plug on each pump. Fill each pump until the water is up to the vent plug, then replace the vent plugs.

5. Check the inlet manifold pressure gauge. There should be positive pressure on the gauge (at least 5 - 10 psig if a transducer is used). If another type of dry run protection is used, ensure that sufficient suction pressure is available for safe operation of the pumps.

6. Ensure all circuit breakers are in the **"on"** position.

7. Make sure the discharge manifold pump isolation valves are closed. Switch on main power. **CAUTION: The pumps may start at this time.**

8. Turn the Function Selector on the PFU 2000 to **"Max."** (see drawing with Step 7 on previous page) (full clockwise rotation). If the pumps did not start in Step 7, they will start after approximately 15 seconds.

9. Vent the system by opening the vent plug on each pump (as in Step 4). Venting with the pumps running ensures all air is removed from the suction. Do not run the system with the discharge manifold pump isolation valves closed more than five minutes to prevent overheating of the pump liquid.

10. Turn the PFU 2000 Function Selector to **"Stop"** (full counter-clockwise). As the pumps stop, check the pump rotation. If the area is dark, a flashlight may be required, or remove a coupling guard on each pump for better visibility. Disconnect the main power when removing coupling guards. **Do not touch the couplings while the pumps are turning as injury may result. Replace all coupling guards after the rotation check. Disconnect main power when removing and replacing coupling guards (or open service disconnect switches if this option was supplied).** If the rotation is incorrect on any 3 phase pumps, switch any 2 of the 3 power main wires supplied to the control panel (L1, L2, L3). If that doesn't correct the rotation, call your Grundfos representative.

11. Open the discharge manifold isolation valves for each pump. Turn the PFU 2000 Function Selector clockwise approximately 50% of full rotation, allow the system to come up to speed, then slowly adjust the Function Selector until system maintains the desired set-point pressure as read on the discharge pressure gauge. This is done for two reasons. If the PMU 2000 (following set-up steps) should fail or get damaged, the PFU 2000 will automatically operate the system. Also, if the Function Selector is left in the **"Stop"** or **"Max."** positions, the PFU 2000 will not allow the PMU 2000 to control the system. If there is a power outage, the PFU will control the system for approximately 30 seconds before the PMU settings are engaged. Therefore it is important that the PFU is set correctly.

    NOTE: If you are filling an empty piping system, do not allow the pumps to run with the valves wide open as cavitation may occur.

12. Turn off the main circuit breaker.

13. Replace the PMU 2000 plug which was removed in Step 2.

14. Turn on the main circuit breaker. **After approximately 15 seconds, the pumps will start.** If the system does not start, press the **"On/Off"** button on the PMU 2000 (see page 22 - 23). If the display reads **"Off,"** press **"+"** to set the Zone to **"On."** If the display already reads **"On,"** do NOT press **"+."** Instead, press **"Esc"** twice to return to the main menu. If the system still fails to start, the minimum inlet pressure may be set too low (only on systems WITH pre-pressure measuring, see pages 22 - 23). If your system does not start and is set up WITH pre-pressure measurement, press the **"Set"** button on the PMU 2000, then **"Enter,"** then press the down arrow repeatedly until you get to **"Zone Configuration,"** then press **"Enter,"** then press the "down arrow" repeatedly until you come to **"min. pre-pressure."** At this display, set the value below the available inlet pressure, then press **"Enter"** and **"Esc"** repeatedly until you return to the main menu, **"Status."**

15. After the system starts, the PMU 2000 will indicate a fault. This is normal. To reset the fault, press the **"Fault Indication"** button (see page 12). The LCD should read **"Alarm System Mains Drop."** Press the **"Enter"** button. This fault will clear.

16. There should be no more faults. If there are, you will need to review the Troubleshooting section beginning on this page. See page 12, section **"Fault Indication Menu"** for a fault indication reading guide.

17. If there are no more faults, press the **"Esc"** button twice to return to the main menu.

18. If your system is maintaining correct pressure, you are finished with the set-up. If your system pressure is incorrect, press the **"Set"** button on the PMU 2000 (see the graphic on pages 22-23), then press the **"Enter"** button on the PMU 2000. Next, press the **"+"** or **"-"** buttons on the PMU 2000 until the desired pressure in psi is indicated in the PMU 2000 LCD readout. Press **"Enter,"** then **"Esc"** twice.

19. When your system is operating properly, reduce the system demand to 0 gpm by closing the system discharge valve. Your BoosterpaQ will slow down and stop within one to three minutes. If it does not do so, check the Troubleshooting section. If the system functions properly, reopen discharge valve.

20. The BoosterpaQ should now be running. If not, recheck Steps 18-19 and/or the Troubleshooting section beginning on page 9. The system pressure should build to the set-point pressure which you entered in Display 200 and remain there as flow demand rises and falls.

21. If your BoosterpaQ does not start, press the PMU 2000 panel alarm button which looks like an alarm horn and is next to the LED lights. If there are any fault indications, press the **"Enter"** button repeatedly until all faults clear. If all faults clear, press **"Esc"** until the **"Status"** screen appears (Display 100). The system should start and maintain the set-point pressure. If it still is not operating properly, recheck Steps 18-19 or review the next section (Common Startup Problems).

Troubleshooting — Common Startup Problems

Before working with pumps, terminal boxes or controllers, the electricity supply must be switched off.

Most start-up problems occur for the following reasons:

1. Incorrect voltage or supply configuration — the system will not start and lights may not illuminate. Alarms may appear on variable frequency drives.

2. Wires and cables loosened during rough shipment — this can cause faults and erratic operation. The lights on the PFU 2000 or PMU 2000 panel and the lights on or inside the motor terminal boxes may indicate everything is operating properly, even when it is not, if certain connections are loose. Most loose connections will indicate a fault or cause erratic system operation. Check to make sure all wires and cables are well connected. DO NOT move wires to other terminals or remove wires even if it appears that they don't match the electrical schematic. Every BoosterpaQ is factory tested and proper operation is verified with the wires connected as you receive them. Call your Grundfos distributor or the Grundfos factory if you believe you have discovered incorrect wiring or documentation.

3. PMU 2000 LCD Display Settings are different than the factory listed settings in this Installation and Operating Manual — check them against the factory settings (only applies if a PMU 2000 is installed). To check or change the PMU 2000 settings, refer to the "PMU 2000 LCD Display Overview," (pages 22 - 23). To find out which way your system is set up, check the factory settings list on page 12. Step through each menu of the PMU 2000, but DO NOT make changes without carefully checking the factory settings. If the settings in the PMU 2000 are different than the values recorded under PMU 2000 factory setting, change them to match the factory settings. If you believe the factory settings are incorrect, check the explanations in the section beginning on page 24, "PMU 2000 Display Notes," to see if the settings still seem incorrect. If you still feel they are incorrect, please call your Grundfos distributor or the Grundfos factory.

4. Inlet pressure is too low or no water is present at the inlet manifold — check the inlet pressure gauge. The pressure must be at least 5% of the maximum pressure transducer rating (if a transducer is used), higher than **"min. pre-pressure"**-Display 231 (if PMU 2000 installed), higher than the setting of the inlet pressure switch (if used), or the level control switch must be closed (if used). A closed valve(s) leading to the inlet manifold could be the problem.

5. MLE motor (or Baldor SmartMotor) tripped on fault — if an MLE motor trips on overload, allow 15 seconds to reset itself. If motor does not reset, check motor settings.

6. Tank pre-charge pressure is too low or too high — when the system drops to low flow demand, the BoosterpaQ will stop at a pressure slightly higher than the set-point. It will restart when the pressure drops again below the set-point. If the system stops and starts frequently the tank pre-pressure may be too low or too high. Stop the system, close the valve to the tank, bleed the tank, and check the pre-charge air pressure. It must be 0.7 times the set-point of the system (0.9 times for MS and MSH systems). If the system continues to stop and start frequently, consider a larger size tank.
7. Suction and discharge piping reversed.
8. Pump, manifold, or system piping is plugged with debris.
9. Pumps rotate clockwise (must be counter-clockwise looking from the top). On 3 phase systems, switch any 2 of the 3 power mains wires supplied to the control panel. Do NOT switch other wires until this has been tried.
10. Voltage monitor is triggered. Check voltage (loss of phase, large imbalance).
11. PFU 2000 DIP Switch Settings are different than the factory listed settings in this Installation and Operating Manual — check them against the factory settings on page 12 depending or whether your system has only a PFU 2000 or a PMU 2000. Call your Grundfos distributor or the Grundfos factory if you believe you have discovered incorrect settings.

Operating and fault indications

The two indicator lights (LED) on the front cover of PFU 2000/PMU 2000 indicate pump operation (green) and/or fault (red). Two external indicator lights (LED) can be connected instead of the two indicator lights (LED) on the front cover (see page 38, Terminals 7 and 8). The function of the indicator lights (LED) and the operating and fault signal outputs are listed in the table below.

INDICATOR LIGHTS		OUTPUTS PFU 2000		OUTPUTS PMU 2000		
Fault (red)	**Operation (green)**	**Fault**	**Operation**	**Fault**	**Operation**	**Description**
Off	Off					Electricity supply switched off or supply failure.
Off	Permanently on					At least one pump in each zone is in operation.
Off	Flashing					All pumps in at least one zone have been stopped: • via external on/off switch or • via function selector in PFU 2000 (pos. STOP), • via PFU 2000/PMU 2000.
Permanently on	Off					At least one pump is stopped due to fault.
Permanently on	Permanently on					At least one pump is or has been stopped due to fault. At least one pump in each zone is in operation.
Permanently on	Flashing					All pumps in at least one zone have been stopped: • via external on/off switch or via function selector in PFU 2000 • via PFU 2000/PMU 2000. At least one pump is or has been stopped due to fault.

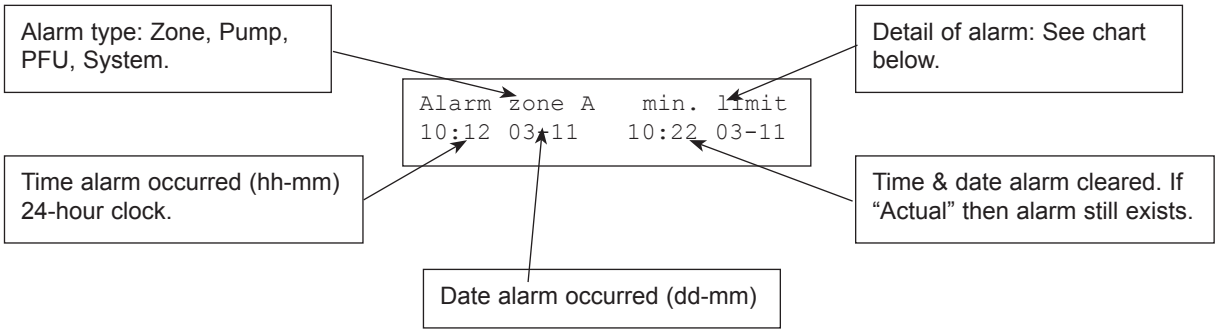
Troubleshooting/Fault-finding chart

Fault	Cause	Remedy
1. Motor does not run when started.	a) Electricity supply disconnected or loose wires.	Connect the electricity supply. Check for loose wires. **DO NOT** over tighten terminal screws.
	b) Automatic circuit breakers cut out.	Correct the fault and cut in the automatic circuit breakers.
	c) Motor protection activated.	Correct the fault and reactivate the motor protection.
	d) Fuse in the PFU 2000 defective.	Replace the fuse.
	e) Motor defective.	Repair/replace the motor.
2. Motor starts, but stops immediately afterwards.	a) Fault in pressure transmitter.	Check transmitter/wiring. If necessary replace the pressure transmitter. Transmitters with 0-20 mA or 4-20 mA output signals are monitored by the PFU 2000.
	b) Dry running or no pre-pressure. The operating pressure is not reached.	Check the supply of water to the pump. When the pressure has been reestablished, the pump will restart after 15 seconds and the fault indication will remain.
3. Unstable water delivery from BoosterpaQ MS (applies only to very low consumption)	a) Pre-pressure too low.	Check the suction pipe and possible suction strainer.
	b) On/Off band set too low	Increase On/Off band
	c) Suction pipe/pumps partly blocked by impurities.	Clean the suction pipe/pumps.
	d) Pumps suck air.	Check the suction pipe for leakages.
	e) Pressure transmitter defective.	Replace the transmitter.
	f) Max. Limit set too low.	Increase Max. limit.
4. Pumps are running, but deliver no water or reduced output	a) Suction pipe/pumps blocked by impurities.	Clean the suction pipe/pumps.
	b) Check valve blocked in closed position.	Clean the check valve. The check valve must move freely.
	c) Suction pipe leaky.	Check the suction pipe for leakages.
	d) Air in suction pipe/pumps.	Vent the pumps. Check the suction pipe for leakages.
	e) Motors running with the wrong direction of rotation.	Change the direction of rotation.
5. Leakages from the shaft seal	a) Shaft seal defective.	Replace the shaft seal.
	b) Height adjustment of pump shaft is inaccurate.	Readjust the shaft height.
6. Noise	a) The pumps are cavitating.	Clean the suction pipe/pumps and possibly the suction strainer.
	b) The pumps do not rotate freely (frictional resistance) due to inaccurate height adjustment of the pump shaft.	Readjust the shaft height.
7. Very frequent starts and stops	a) Wrong diaphragm tank precharge pressure.	Check the diaphragm tank precharge pressure.
	b) Incorrect voltage.	Check voltage during motor operation.
	c) PMU settings other than factory.	Review documentation and restore PMU to original factory settings.
8. System only runs at max. or **"Off"** (no regulation)	a) Fault in transmitter or signal.	Check wire connections. Ensure bare wire, NOT insulation, is compressed in termination fitting. If connection is good replace pressure transmitter.

PMU fault indication menu

Press the  button on the PMU to see the following faults.

The PMU will keep the last 10 faults in memory.



PMU alarm examples

PMU alarm display	Condition	Possible remedy
Alarm System mains drop 10:12 03-11 11:43 29-10	There was a power failure to the system.	This is normal during shipping as there was a power failure to the system. Simply reset the alarm.
Alarm Zone A max. limit 10:12 03-11 Actual	High System Pressure on discharge. Possible VFD failure or max. limit set too low.	Solve VFD problem. Adjust max. limit to higher value (may be too close to set-point (system pressure).
Alarm Zone A min. limit 10:12 03-11 Actual	Low System Pressure on discharge. Possible pipe breakage in system or pipes are not yet filled.	Repair piping. Adjust Min. Limit to a lower value as it may be set too high (too close to system pressure).
Alarm Zone A Watershort 10:12 03-11 Actual	Low Suction Pressure. Check suction conditions.	If inlet is pressurized, lower min. pre-pressure. If flooded suction or suction lift, ensure water is in suction piping.
Alarm Zone A speed cont. 10:12 03-11 10:16 03-11	Speed Control (Variable Frequency Drive) Fault.	Check VFD fault log.
Alarm Zone A sensor AI1 10:12 03-11 Actual	Sensor fault on Analog Input 1 (discharge pressure transducer)	Check transducer connections (may just be loose wire). Check transducer. Replace if necessary.
Alarm Zone A sensor AI2 10:12 03-11 Actual	Sensor fault on Analog Input 2 (normally suction pressure transducer).	Check transducer connections (may just be loose wire). Check transducer. Replace if necessary.
Alarm Zone A sensor AI3 10:12 03-11 Actual	Sensor fault on Analog Input 3 (normally external set-point).	Check external set-point source. Check connection (may be loose or not connected at all).
Alarm pump: 1 fault 10:12 03-11 Actual	Fault on pump number 1.	If pump is on/off pump (constant speed), check manual motor protector (breaker). If pump is MLE or Baldor Smartmotor, check motor fault log or consult motor Installation & Operating Instructions. Check voltage monitor relay.
Alarm PFU 123 15:12 03-11 Actual	There is a communication error between the PMU and the PFU that is connected to pumps 1, 2 and 3.	Check BUS (RS485) connection between PMU and PFU. Check power supply to PFU and/ or PMU. Check fuse in PFU.

Faults, general

Fault conditions in the system are indicated by:

- Red indicator light (LED) on PFU or PMU
- Red indicator light(s) (LED) on control panel door
- PFU 2000 fault signal relay (if connected to alarm or light)
- PMU 2000 fault signal relay (if connected to alarm or light)
- PMU 2000 LCD display

In the PMU 2000, if installed, the last 10 **"Fault"** indications are stored and sorted by time, occurrence and correction. If more than 10 faults occur, the current faults and the latest reset faults will be kept in the fault memory. **"Warnings"** remain stored until they are reset on the PMU 2000. This does not apply to the faults exceeding 10.

Manual resetting (restarting of PFU 2000)

A manual reset followed by an immediate restart is accomplished in **one** of the following ways:

- Press the **"Reset"** button on the PFU 2000
- Turn the function selector in the PFU 2000 to STOP, then adjust back to the original settings
- Reset the fault indication(s) which caused the stop by pressing **"Enter"** while in the **"Fault Indication Menu"** of the PMU 2000 until all faults are reset

The PFU 2000 can be manually reset every fifth second.

Automatic resetting (restarting of PFU 2000)

When a fault has been corrected, the system will attempt to restart automatically at the following intervals:

- 1st time after 15 seconds
- 2nd time after five minutes
- 3rd - 4th time at 30 minute intervals
- 5th - ? time once every 24 hours until the fault has been corrected

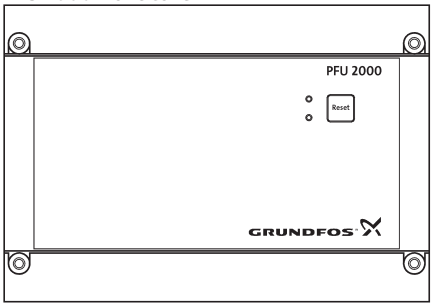
Your BoosterpaQ will not restart automatically until the fault has been corrected. Each fault condition, except for faults which do not shut down operation, increases the restarting count attempts stored in memory. The number of stored restarting attempts is reduced to zero by manual resetting, allowing an immediate restarting attempt.

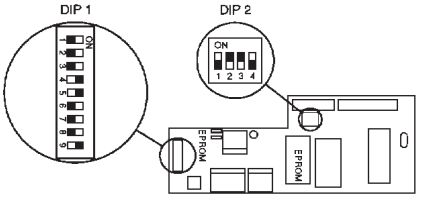
If not manually reset, the number of stored restarting attempts will be reduced by one every three hours after the alarm disappears. After a certain time without faults, an automatic restarting attempt will be made 15 seconds after the fault has been corrected **("1st time mode")**.

Factory settings with standard PFU 2000 System Controller (PMU 2000 NOT installed)

The following entries are the factory settings for the BoosterpaQ with the serial number which is listed on page 2 of this manual (if “Standard PFU 2000 System Controller” was marked). The factory settings cover most standard booster applications. Please contact your Grundfos representative if you believe the settings should be changed to match your application or the system is not operating properly.

PFU 2000 front cover





PFU 2000: Example only - check factory settings

❑ **WITH Pre-pressure Measuring**
(has a pressure transducer on the inlet manifold)

❑ **WITHOUT Pre-pressure Measuring**
(pressure switch or level switch on the inlet manifold)

PFU 2000 #1
(for systems with 1 to 4 pumps)

DIP/Switch #1

	OFF	ON
1		
2		
3		
4		
5		
6		
7		
8		
9		

DIP/Switch #2

ON				
OFF				
	1	2	3	4

"X" indicates that each switch was slid to that position for this BoosterpaQ at the factory.

PFU 2000 #2
(for systems with 5 or more pumps)

DIP/Switch #1

	OFF	ON
1		
2		
3		
4		
5		
6		
7		
8		
9		

☐ Installed
☐ Not installed

DIP/Switch #2

ON				
OFF				
	1	2	3	4

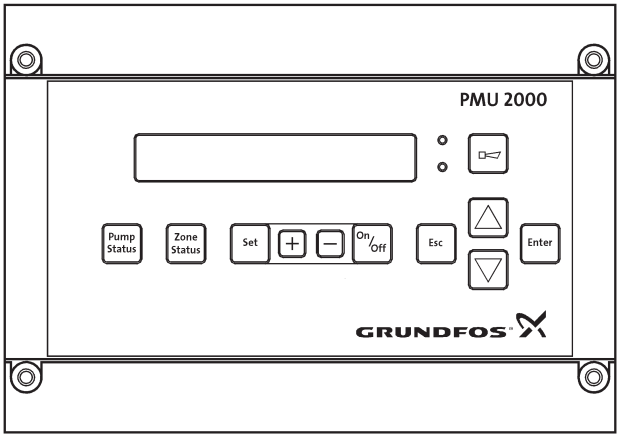
"X" indicates that each switch was slid to that position for this BoosterpaQ at the factory.

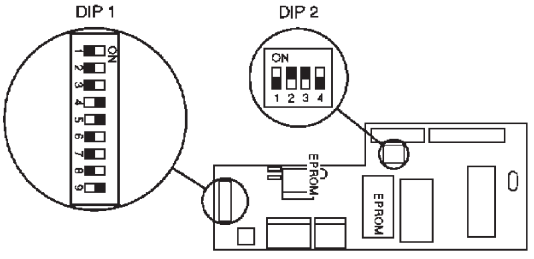
See PFU 2000 Dip Switch Configuration, page 34.

With Optional PMU 2000 System Controller Installed

The following entries are the factory settings for the BoosterpaQ with the serial number which is listed on page 2 of this manual (if "Optional" PMU 2000 system controller" was marked). The factory settings cover most standard booster applications. Please contact your Grundfos representative if you believe the settings should be changed to match your application or the system is not operating properly. PMU 2000, Display 200 may require adjustment (see Step 18).

PMU 2000 front cover

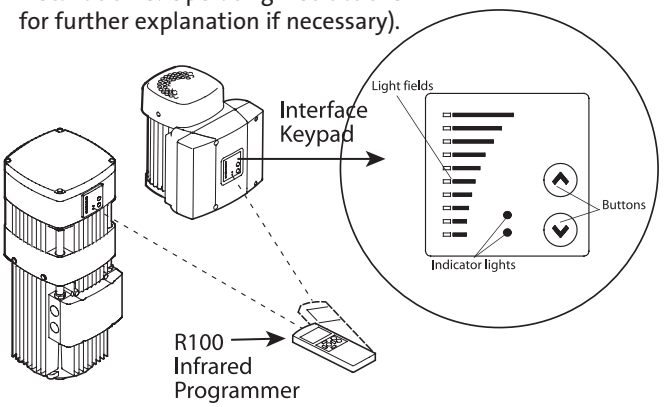




PFU 2000 DIP Switch Locations: Example only - check factory settings

R100 factory settings

If the MLE motors have an R100 Interface Keypad (shown) the following are the mandatory settings: (See CRE Installation & Operating Instructions for further explanation if necessary).



DISPLAY	SETTINGS
Set Point	100% (Not "Max.")
Operating Mode	Normal
Control Mode	Uncontrolled
External Set Point	0-10 V
Signal Relay	Ready
Buttons on Motor	Not Active
Stop Function	Not Active
Operations Range	min. 12% max 100%

PFU 2000 #1
(for systems with 1 to 4 pumps)

DIP #1

	OFF	ON
1		
2		
3		
4		
5		
6		
7		
8		
9		

DIP #2

ON				
OFF				
	1	2	3	4

"X" indicates that each switch was slid to that position for this BoosterpaQ at the factory.

PFU 2000 #2
(for systems with 5 or more pumps)

DIP #1

	OFF	ON
1		
2		
3		
4		
5		
6		
7		
8		
9		

☐ Installed
☐ Not installed

DIP #2

ON				
OFF				
	1	2	3	4

"X" indicates that each switch was slid to that position for this BoosterpaQ at the factory.

PMU factory settings

101	All Pumps Set to ❑ Zone A ❑ Other ( )
104	Alarm Suppression ❑ On ❑ Off
105	Pump Communication ❑ On ❑ Off
111	Configuration Pre-Setting ❑ 8 With Pre-Pressure Monitoring ❑ Other ( )
200	Set-point Max _____
201	Clock Program - See Below
202	Set-point Influence ❑ On ❑ Off
202	Set-point Influence ____%
204	System Time _____ seconds
205	Min Sequence _____seconds
206	Medium Sequence* _____seconds
207	On/Off Band _____
208	Pump Change ❑ On ❑ Off
209	Pump Change Time _____
212	Zone Name _____
213	Measuring Unit _____
214	Control Function ❑ Normal ❑ Inverse
219	Discharge Pressure Transducer (See Next Page)
216	Pre-Pressure Measuring ❑ On ❑ Off
220	Suction Pressure Transducer (See Next Page)
217	External Influence ❑ Off ❑ Ext. (See Below)
222	Input 4 ❑ Off ❑ Remote On/Off ❑ Reduced Op. ❑ Fire Fight
235	Hydraulic ❑ Parallel ❑ Series
226	Standby Pumps _____
227	Pump Priority (See Next Page)
228	Max. Limit (Discharge) _____
229	Min. Limit (Discharge) _____
230	Min. Limit Operation ❑ On ❑ Off
231	Min. Pre-Pressure _____
232	Maximum Pump Head (See Next Page)
300	Zone ❑ On ❑ Off ❑ Local ❑ Max

*Service Code Entry required

201 clock program

Daily	
Time	Set-point

Sa-Su	
Time	Set-point

M-F	
Time	Set-point

219 discharge sensor

❑ 4-20mA ❑ Other (_____)

❑ _____ to _____PSI ❑ Other (_____)

220 suction sensor

❑ 4-20mA ❑ Other (_____)

❑ _____to _____PSI ❑ Other (_____)

227 pump priority			
Pump 1		Pump 4	
Pump 2		Pump 5	
Pump 3		Pump 6	

227 pump maximum head			
Pump 1		Pump 4	
Pump 2		Pump 5	
Pump 3		Pump 6	

Danfoss VLT 2800 Factory Settings

			Field changes	
Parameter	**Description**	**Factory setting**	**New value**	**Date**
002	Local/Remote Operation	0		
003	Local Reference	Default		
101	Torque Characteristics	2		
102	Motor Power, kW			
103	Motor Voltage			
104	Motor Frequency, Hz			
105	Motor Current, SFA			
106	Rated Motor Speed, RPM			
107	Automatic Motor Adaptation	2		
128	Thermal Motor Protection	4		
204	Minimum Reference			
205	Maximum Reference			
206	Ramp Type	2		
207	Ramp Up Time			
208	Ramp Down Time			
214	Reference Function	2		
215	Preset Reference	100		
302	Digital Input	7		
304	Digital Input	0		
305	Digital Input	24		
323	Relay Output	1		
406	Automatic Restart Time	10		
411	Switching Frequency	4500		
018	Lock for Data Change	1		

Additional settings

Danfoss VLT 8000 Factory Settings

		Factory Setting		Field Changes	
Item Number	**Parameter**	**Value**	**Value #**	**New Value**	**Date**
1	001 Language	English	0		
2	102 Motor Power				
3	103 Motor Voltage				
4	104 Motor Frequency				
5	105 Motor Current				
6	106 Motor Speed				
7	201 Minimum Freq.				
8	202 Maximum Freq.				
9	206 Ramp Up Time				
10	207 Ramp Down Time				
11	323 Relay 1 Function	Ready Signal	1		
12	326 Relay 2 Function	Running	3		

Additional Settings

Danfoss VLT 8000 Factory Settings (continued)

Extended Menu Programming

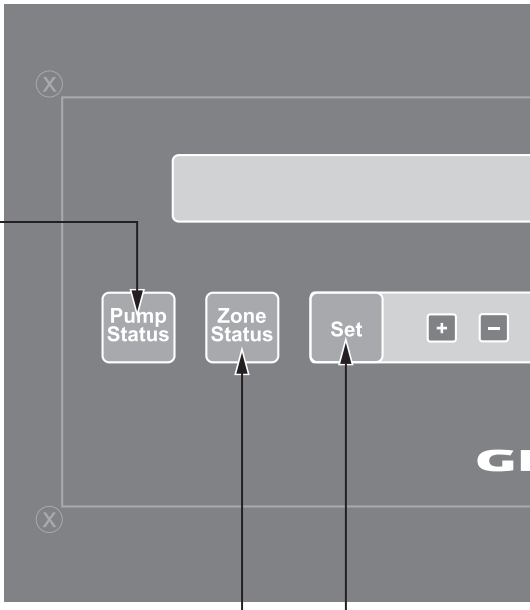
		Factory Setting		Field Changes	
Item Number	Parameter	Value	Value #	New Value	Date
Level 0	007 Large Readout		3		
	008 Small Display Readout		16		
	009 Small Display Readout		5		
	010 Small Display Readout		6		
Level 1	101 Torque Characteristics	VT Low	2		
	112 Motor Preheater	Disable	0		
	117 Motor Thermal Protection	ETR Trip 1	4		
Level 2	208 Automatic ramp-down	Disable	0		
	210 Reference Type	External/Preset	2		
	211 Preset Reference 1	100%			
Level 3	302 Pin 18	Start	1		
	303 Pin 19	Reverse and Start	2		
	305 Pin 29	Preset Ref. On	6		
	308 Pin 53	Reference	1		
	309 Term. 53, Min. Scaling	0.0V			
	310 Term. 53, Max. Scaling	10V			
	325 Relay 01, Off Delay	2 sec			
Level 4	400 Reset Function	Automatic Reset x 10	6		
	401 Automatic Restart time	5 sec			
	407 Switching Frequency	4500			
	408 Interference Reduction Method	Fixed Switching Freq.	0		
Level 0	016 Lock for data change	Locked	1		

Baldor SmartMotor Settings

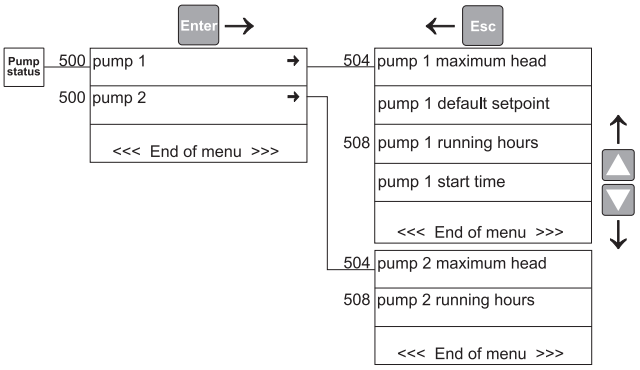
		Factory Setting	Field Changes	
Section	**Parameter**	**Value**	**New Value**	**Date**
Level 2 Blocks				
Output Limits	Min Output Freq.	12 Hz		
Output Limits	Max Output	60 Hz		
Output Limits	PK Current Limit			
Output Limits	PWM Frequency	6 kHz		
Miscellaneous	Restat Aut/Man	Auto		
Motor Data	Motor voltage			
Motor Data	Motor Rated Amps			
Level 1 Blocks				
Preset Speed	Preset Speed #1			
Accel	Accel #1			
Decel Rate	Decel #1			
Output	Opto Output #1	Ready		
Input	Operating Mode	#1 2 Wire / 7 Spd		
Input	ANA CMD Select	0 - 10 V		
V/Hz and Boost	V/Hz Profile	67% Sqr Law		
Additional Settings				

PMU 2000 LCD display overview WITH pre-pressure measuring

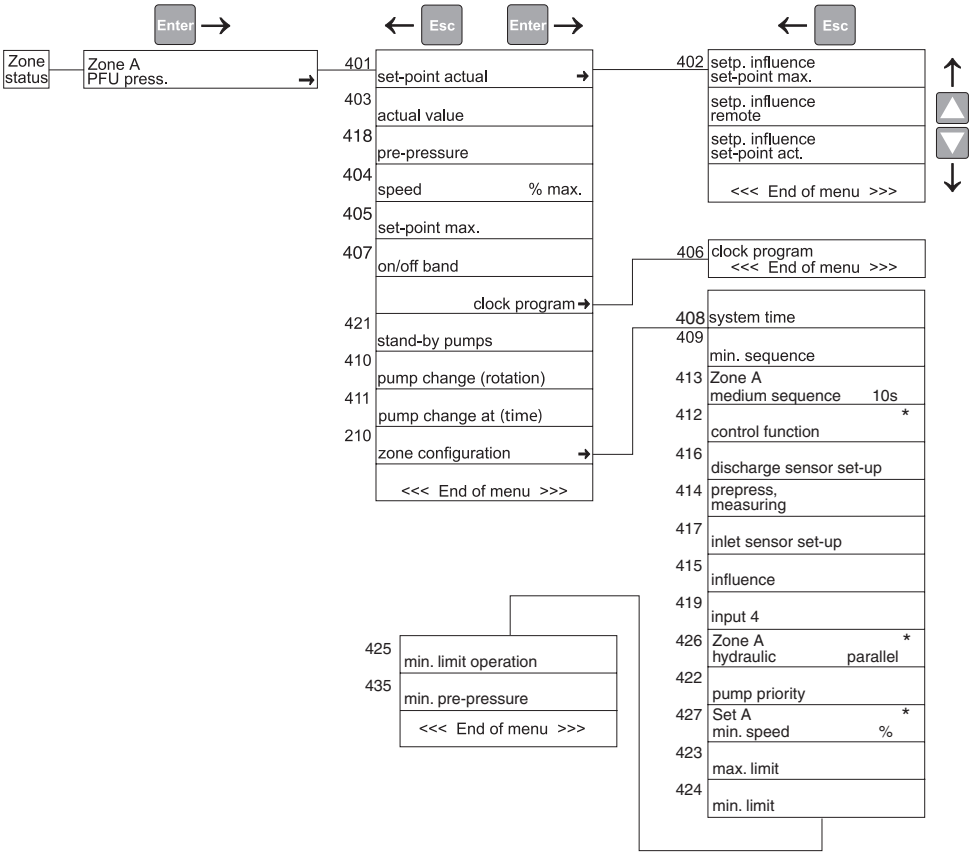
The following PMU 2000 LCD Display Overview illustrates the LCD Menus and Displays for the Optional PMU 2000. To return to Display 100, repeatedly press “Esc.” Refer to page 24 for “PMU 2000 LCD Display Notes.”

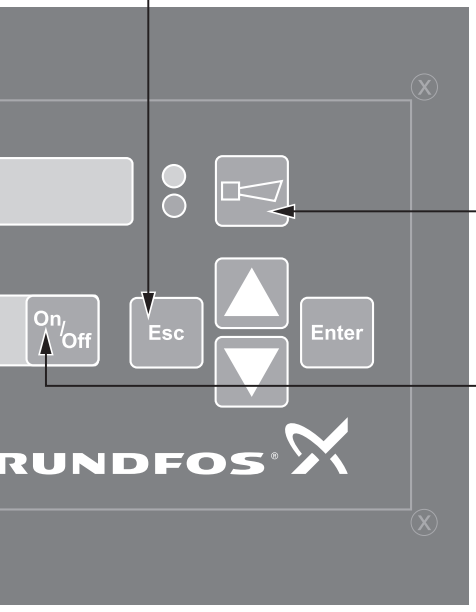


Pump status menu



Zone status menu





Basic menu

Enter →

100 Status 1.2.3.4 5 6 7 8 I I 0 A M - -

101 Configuration set to zone 12345678 AAAAA---

102 Configuration-Presetting →

103 Configuration Time/Date dd-mm-yy

Configuration autom. summertime * on

104 Configuration alarm suppression

105 Configuration pump comm. alarm

Configuration cust. entry code 000000

107 Configuration PCU →

106 Configuration PMU

108 Configuration PFU

<<< End of menu >>> *

← Esc

111 Zone A PFU 8 press.

Service Code Entry

Fault indication menu

600 Alarm 1

Alarm 2

On/off menu

On/Off

300 zone switched to

301 pump 1 switched to

301 pump 2 switched to

<<< End of menu >>>

Setting menu

Enter →

Set

Set A PFU press. 12345678 →

← Esc Enter →

200 setpoint max.

207 on/off band

213 measurement unit

clock program →

setp. influence →

212 zone name:

226 stand-by pumps

208 pump change (rotation)

209 pump change at (time)

210 zone configuration →

211 pump 1 * →

211 pump 2 * →

<<< End of menu >>>

← Esc

201 clock program

<<< End of menu >>>

202 setp. influence progressive infl

<<< End of menu >>>

204 system time

205 min. sequence

206 Set A medium sequence * 10s

214 control function

219 discharge sensor set-up

216 inlet prepress measuring

220 inlet sensor set-up

217 influence

222 input 4

235 Set A hydraulic * parallel

227 pump priority

223 Set A min. speed * 0%

228 max. limit

229 min. limit

230 min. limit operation

231 min. prepressure (inlet)

<<< End of menu >>>

232 pump 1 maximum head *

pump maximum flow * 100%

233 pump 1 running hours *

234 pump start time * 1.0s

<<< End of menu >>>

232 pump 2 maximum head *

233 pump 2 running hours *

234 pump start time * 1.0s

<<< End of menu >>>

Setting of control parameters

* Available only when service code is activated (Display 106).

Moves one display up in menu

Jumps one level backward and displays basic menu

Esc

Enter

— Jumps one level forward
— Stores settings
— Resets fault indications

Moves one display down in menu

PMU 2000 LCD display notes

The following PMU 2000 LCD Display Notes must be used in conjunction with the PMU 2000 Display Overview Diagrams ("Overview" in this section) on pages 22 - 23. The number at the beginning of each item is the display number shown on the Overview.

BASIC MENU

100 - Status Display
This is the first display which appears when the PMU 2000 is switched on. The display indicates:

- which pumps are connected to the PMU 2000,
- which pumps are running, switched off, or whether any of the pumps are in an alarm state.

Pressing **"Esc"** repeatedly from any location in any menu returns you to this display. If no button on the PMU 2000 is pressed within 15 minutes, it will automatically return to this display.

The PMU 2000 LCD Overview Display examples indicate the following (see pages 22 - 23):

- Pumps 1 and 2 are running **[I]**
- Pump 3 is not running **[O]**
- Pump 4 indicates a fault **[A]**. The fault is identified under "Fault Indication Menu" (Display 600)
- Pump 5 is set to **"Max"** RPM
- Pumps 6 and 7 are allocated to a zone [-] but they have not yet been connected to a PMU 2000, or the electricity supply to the pump was never switched on
- Pump 8 has not been allocated to any zone [ ]
- A decimal point (.) between two pump numbers indicate that these pumps have been connected to a PCU 2000. The display indicates that pumps 1,2,3, and 4 have been connected to a PCU 2000.

101 - Allocation to Zone
All pumps controlled by a PMU 2000 must be allocated to Zone "A." Numbers in the display not assigned to a pump must be set to **"-".** If "A" is not assigned to the pumps in the system (for example, if it is a two pump system, one and two should have an "A" below them), press **"+"** or **"-"** until the **"A"** appears under each installed pump. Press **"+"** or **"-"** to put a **[-]** under all other pump numbers. Press **"Enter"** to store each entry and advance to the next pump number.

102 - Presetting
The factory setting for Display 102 is listed in this manual. If a different presetting is shown, press **"Enter"** to jump to Display 111, use the **"UP"** and **"DOWN"** arrows to find the correct setting, press **"Enter,"** and then **"Esc"** to return to Display 102. See Display 111.

103 - Day, Time, and Date (Day, Month, Year)
This is where the day of the week, time, and date are set. Press **"+"** or **"-"** to set each character and press **"Enter"** to store and advance to the next character. The format is dd-mm-yy.

104 - Suppression of Alarm
The alarm output of the PMU 2000 will normally be active when the red indicator light is on. If alarm suppression is selected, the alarm output can be put out of operation for 15 minutes by pressing any key on the PMU 2000. If the fault has not been remedied within 15 minutes, the alarm will re-activate automatically.

[on] The alarm output will be suppressed for 15 minutes by pressing any of the keys on the PMU 2000

[off] The alarm output is active when the red indicator light is on

Press **"+"** or **"-"** to set, and "Enter" to store

105 - Pump Communication
In certain cases, it may be expedient to stop some of the pumps by switching off the electricity supply. This will normally cause a fault indication. If "off" is selected in "pump comm. alarm," the PMU 2000 will not indicate any communication faults.

[on] The PMU 2000 will indicate a communication fault

[off] The PMU 2000 will not indicate a communication fault

Press **"+"** or **"-"** to set, and **"Enter"** to store

106 - PMU Identification
The display indicates the software identification number of the specific PMU 2000. Please have this number available when contacting your distributor or Grundfos for service.

107 - PCU Identification
If a PCU 2000 is connected, this display indicates the software identification number of the PCU 2000 to which the pumps are connected. Please have this number available when contacting your distributor or Grundfos for service.

108 - PFU Identification
This display indicates the software identification number of the PFU 2000 (P/N on the PFU 2000 EPROM). Please have this number available when contacting your distributor or Grundfos for service. If this display does not come up, the BUS connection is faulty.

End of Menu
You are at the bottom of this menu (same for all menus). Press the **"UP"** arrow to move up through the menu, **"Esc"** repeatedly to go to Display 101, or one of the function buttons to go to that function (for example: **"Pump Status," "Zone Status,"** etc.).

111 - Presetting
See Display 102.

SETTING MENU ("SET BUTTON")
200 - Setting of Set-point Max.
This is the place where you will select the set-point of your system. The set-point is the pressure at which you want your system to operate regardless of flow demand. **If the factory set function parameters listed in this manual match your application needs, this will be the ONLY setting you will have to adjust when you install your BoosterpaQ. If the factory Display 200 setting (page 14) matches your required set-point and has not been changed, you may not need to make any PMU 2000 changes.**

The set-point max. can be reduced to **"set-point act."** through settings in the clock program (Display 201), or set-point influence (Display 202). For many BoosterpaQ applications, **"set-point max."** will be the same as **"set-point act."**. Only when a custom application setup is required will these two numbers be different (examples: more than one system pressure required throughout the day, friction loss compensation, etc.). These influences are set in other displays which are explained in this section. All "influences" reduce the **"set-point max."** down to the **"set-point act."** when they are activated. More than one "influence" can operate at the same time.

201 - Clock Program for Change of Set-point (multiple set-points). This is NOT where the clock is set. That is Display 102.
This is one of the "influences" mentioned in Display 200 which reduces **"set-point max."** If only one set-point is required, skip this display, or clear it if it has data in it.

Multiple set-points are required when the pressure demand throughout the day changes. Lowering the **"set-point max."** can provide better service and reduces energy usage when peak pressure is not required. For example, a multiple zone sprinkler application may be best served with multiple pressure settings. Setting the sprinklers and changing of the set-point to coincide accomplishes this. This feature can also be used to reduce the system pressure during off peak usage at factories and commercial buildings.

In the "clock program," each switching time is set separately. If three daily switching times are required, three displays must be set. It is possible to set a total of 10 switching times.

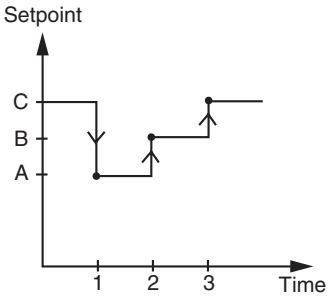
In the data field **[program]**, one of four different functions can be selected for time.

1 - **[insert]** A new switching time can be inserted. Switching times already set will remain unchanged.
2 - **[change]** The displayed switching time can be changed.
3 - **[delete]** The displayed switching time can be deleted
4 - **[copy]** Switching times from another zone are copied into the current zone and the existing clock program is deleted. This feature normally does not apply as the standard setup for BoosterpaQs is only for Zone A.

Possible settings for days:

1 - **[daily]** The same switching times apply to each day of the week.
2 - **[Mon, Tue, Wed, Thu, Fri, Sat, Sun]** Different switching times for each day.
3 - **[Mon, Fri]** The same switching times from Monday to Friday.
4 - **[Sa-Su]** The same switching times for Saturday and Sunday.

Hourly Settings: 0-23



Example:
Clock program with three switching times:
Switch to set-point A at time 1
Switch to set-point B at time 2
Switch to set-point C at time 3

Example for Setting the Clock Program
The owner requests the following set-points:

06:30 to 08:30	65 psi
08:31 to 10:30	55 psi
10:31 to 12:30	50 psi
Rest of day	55 psi

The first entry should look like the following:

```
Set A     clock  insert
Daily 06:30h->   65
```

Once you adjust the pressure to 65 psi and hit the Enter button, the time & pressure will disappear and you will see the following:

```
Set A     clock  _program
        :  h->
```

Simply press the "+" button and repeat the process until all of the times are entered. You can press the up/down arrows to view all of the clock settings. Once completed the clock settings should look like the following:

```
Set A     clock  insert
Daily 06:30h->   65
```

```
Set A     clock  insert
Daily 08:31h->    55
```

```
Set A     clock  insert
Daily 10:31h->    50
```

```
Set A     clock  insert
Daily 12:31h->    55
```

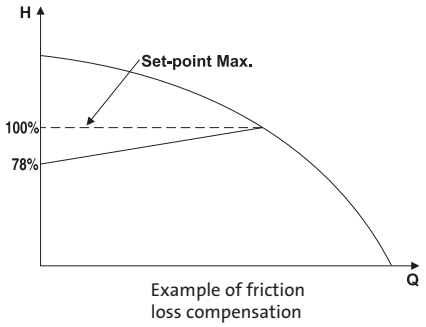
From 12:31 to the next time, the set-point will be 55 psi. The next time is at 6:30 am, which was the first entry.

202 - Set-point Influence

Several different displays may appear under **"setp. influence"** depending on the influence type selected.

[Progressive infl] "System Friction Compensation:"
"Progressive influences" is a system friction compensation factor which can provide a constant pressure at a downstream location as flow demand changes, regardless of pipe friction loss. For example, although the pressure at the sensor on the discharge manifold will remain constant as flow increases (when **"progressive infl."** is not selected), friction losses in the system piping will cause increasing pressure drops below the set-point at locations downstream from your BoosterpaQ. If you want to maintain stable pressure at a critical pressure point some distance from the sensor without moving the sensor (maybe you would have to bore through concrete or a mountain to do so), your BoosterpaQ can adjust the set-point to compensate for the system friction losses as flow increases. The pressure at the sensor will now follow the changing set-point and the system friction losses will drop this changing set-point output down to the desired set-point at the critical location. You must know your system friction characteristics (plot a system curve using standard tables). It can also be set by "trial and error."

To activate progressive infl., set **"progressive infl." [on]** (Display 202). The pressure will rise at the manifold pressure sensor as flow increases. The flow is estimated according to PMU 2000 internal operating data without actual measurement of the flow, eliminating the high cost of a flow meter. **"Set-point act."** will increase linearly from the adjustable percentage at zero flow to 100% of **"set-point max."** at maximum flow. **"Maximum flow"** is the sum of the maximum flows of all the pumps in the zone, minus all standby pumps (see **"Standby Pumps,"** Display 226).



Example of friction loss compensation

To calculate what **"set-point max."** must be when **"progressive infl."** is active, calculate the system friction drop between the BoosterpaQ and the critical pressure point at maximum flow. Add this value to the desired set-point at the critical pressure point. This is **"set-point max."**. Now divide the desired set-point at the downstream critical point by the sum of the friction loss and the desired set-point and express the result as a percentage. To active **"progressive infl.,"** select **[on]** in Display 202 and advance to the next display (press **"Enter"**). Enter the percentage value you calculated. The setting range is 50% to 100%.

Example for Setting the Set-point Influence:

A system pressure (set-point max) of 90 psi is required at full flow. It has been determined that at low flow a system pressure of 70 psi will be sufficient.

First of all the progressive influence needs to be switched "on". Once this is done the PMU display should look like the following:

```
Set A    setp. influence
progressive infl   _on
```

Next press the down arrow and you will see the following screen: The first number (50 in this case) is the percentage of set-point max the discharge pressure will be at zero flow.

```
Set A   setp. influence
  progressive _ 50 -> 100%
```

In this example the desired pressure at zero flow is 70 psi which is 78% (70/90 = 0.78) of the set-point max. So the final entry should look like the following:

```
Set A   setp. influence
progressive _ 78 -> 100%
```

As flow increases the discharge pressure will progressively increase as the flow approaches 100% (all pumps on at 100%).

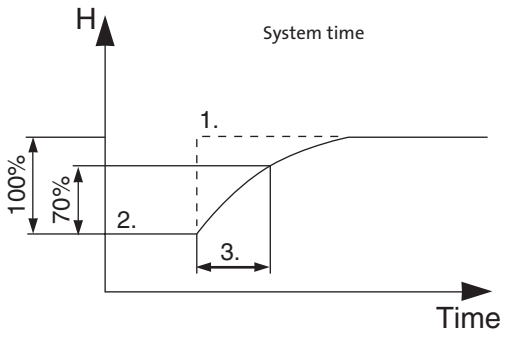
204 - System Time Constant (Reaction Time)
The time constant determines the reaction time of the system to changing demands and changed set-points. The time constant is defined as the time which passes between when an adjustment is made until the actual value has moved approximately 70% of the distance between the starting value and the new adjusted value. Entering the system time into the PMU 2000 allows it to adjust its reaction time to match the system characteristics, reducing the possibility of "overshoot" (actual pressure shooting past the desired point, high or low, because the pump system responds too quickly) and sluggish performance.

High value means a slow system; therefore slow reaction is required (for example: "temperature change")

Low value means a fast system; therefore, fast reaction is required (for example: pressure usually changes fast)

The selection range is 0.4 - 800 seconds. The normal range is 0.4 to 5.0 seconds (default = 2 seconds). The default value on BoosterpaQ systems is set low as most pressure systems are fairly fast. Calculating system time can be difficult for fast changing systems, so "trial and error" is usually applied and is acceptable. Slower systems can more easily be tested and measured, so calculation is possible. For example, if you have set up your BoosterpaQ for maintaining a set temperature, you can set the system time to 0.4, change the set-point, measure the time it takes to change the temperature from the starting point to the new set-point, and multiply by 0.7 to get the system time constant.

Notice that the temperature will most likely shoot past the new set-point because of the 0.4 setting, but now you will change the system time constant to 0.7 times the measured time and the system will not overshoot. See also Display 205.



205 - Min. Sequence (Min. Switching Time)
Another way of preventing hunting and overshoot in the system is to adjust the minimum time between switching individual pumps on/off (see Display 204).

The setting range is 2-300 seconds. The default value is ten seconds. The normal range is 5 - 30 seconds.

206 - Medium sequence
(Only available when service code is entered.)
This function is like a motor minimum run timer.
Normal range: 20 - 300 seconds (default = 20 seconds).
Lower settings = more motor on/off cycling, discharge pressure is less stable.
Higher settings = less motor on/off cycling, discharge pressure is more stable.
The medium sequence is automatically and temporarily set to one second when the discharge pressure reaches the average of the **set-point max** and **max limit**.
The max limit can be adjusted up and down to adjust the average to assist in the control of the BoosterpaQ. If the max limit fault is triggered when a pump is started "across the line," the max limit can be adjusted to a higher value to increase the average value.

207 - On/Off-Band
The on/off-band is the difference between the required discharge pressure (set-point) and the stop pressure. It can be set between 0 and the max. value of the pressure sensor range (read the pressure sensor range on the side of the pressure sensor). If the pressure sensor is in "bar," convert to psi by multiplying "bar" times 14.5 (for example: 10 bar = 145 psi).

In ME, MEH, MES, MF, and MFH systems, pump speed is continuously adjusted to maintain constant pressure. In MS and MSH systems, the pumps are started and stopped to maintain the pressure.

When the flow computed by the PMU 2000 is lower than Qmin, the discharge pressure increases to the upper limit of the on/off-band and then stops. The stop pressure is the selected set-point, plus the on/off-band. The system will start again when the pressure has dropped 5% below the set-point.

Approximately every 30 seconds or when the operating point changes (consumption changes), the PMU 2000 will estimate the flow by reducing the speed for a short while. The rate at which the pressure drops is used to compute the flow estimate.

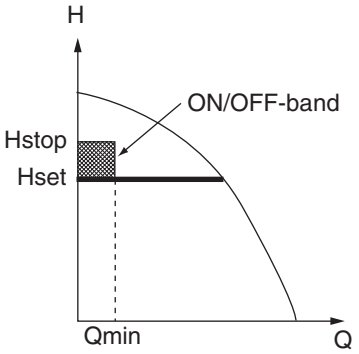
Systems without a PMU:
The default value for the on/off-band is 0.1 times the measuring range of the pressure sensor (for example: 10 bar or 145 psi, on/off-band default is 14.5 psi).

Drawing at right illustrates:

Set-point (full line)

On/off-band (hatched field)

Qmin computed by the PMU 2000 (dotted line)



208 - Pump Change (Rotation)
Pump rotation ensures evenly distributed running hours for all pumps. Pump rotation is accomplished by all Booster-paQs (PFU 2000 only and PMU 2000) by three methods: flow demand, time-dependent, fault dependent. Display 208 sets the time-dependent function to either **[on]** or **[off]**.

After each start or stop of a pump due to enough change in flow demand, the PMU 2000 rotates the pump starting order. If selected, time-dependent pump change occurs provided the starting order has not been changed for 24 hours due to a lack of sufficient flow change or if a fault has not occurred. Normally, flow demand will vary enough in a 24-hour period to eliminate a time-dependent pump change.

[on] Time-dependent pump change is active (see Display 209)

[off] Time-dependent pump change is inactive

209 - Time for Pump Change
This display sets the time-dependent pump rotation. It is not active unless display 208 has been set to **[on]**.

210 - Zone Operating Parameters
Press "Enter" to move to the available zone settings (204, 205, etc. See the PMU 2000 LCD Overview Illustrations).

211 - Pump Operating Parameters
To move from Pump 1 to Pump 2 (and higher pump numbers), press the **"DOWN"** arrow while in Menu 211. Press the **"UP"** arrow to move to lower pump numbers. Press **"Enter"** to move to available pump settings (232, 233) for each pump.

212 - Zone Name
For entry of a seven-character zone name (optional). Press **"Enter**" to advance to the next letter position, then **"+" or "-"** to select each character.

213 - Measuring Unit
If the pressure sensor(s) features a measuring unit different from the one set at the factory (default is psi), you can change the measuring unit in Display 213. The need for adjusting Display 213 normally occurs if the pressure sensor(s) are changed to a different value. The pressure sensor(s) may be changed, for example, due to a major change in inlet pressure or a change in the application requirements, such as increasing the pump stages to account for a need for higher pressure.

IMPORTANT NOTE: When the measuring unit is changed, all displays are automatically changed. However, the numerical values are not adjusted to reflect the change in units.

Example: If "bar" is changed to "psi," all displays will reflect "psi" automatically. But, a "bar" value of 1 (for example) set in a display will not automatically be changed to 14.5, the conversion to psi. You must adjust all menu values to reflect the new "psi" unit. Not doing so can cause symptoms which you may think are hardware related.
Example: You change **"bar"** to **"psi."** You change **"set-point max."** from 6 bar to 87 psi, but you do not change the **"max. limit"** value in Display 228, which was set to 10 bar. You turn the BoosterpaQ on and it tries to ramp up to 87 psi, the set-point. But when it passes through 10 psi it stops because the **"max. limit"** is still set to 10. It appears that the BoosterpaQ has a hardware problem, but it only needs to be set correctly. Be sure to check all values to reflect a unit change. Check Displays 200, 201, 207, 218, 219, 220, 221, 228, 229, 231, 232, 233.

The following measuring units can be selected:
Pressure or pressure with pre-pressure measuring: bar, mbar, psi, kPa

214 - Control Function
This display sets either direct or inverse reaction of the system to deviations from the set-point.

[normal] If the actual value; for example pressure, is lower than the set-point, the pump performance will be increased.

[invers] If the actual value is higher than the set-point, the pump performance is increased. This might be used in a typical temperature application. For example, in a cooling application when temperature goes above the set-point (positive temperature direction), the system speeds up to provide more cold water (positive speed direction).
The default is [normal].

216 - Pre-pressure Measuring

[on] Pre-pressure measuring is active

[off] Pre-pressure measuring is inactive

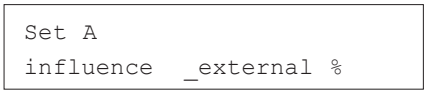
Pre-pressure measuring should be used if the system is running at a pre-pressure higher than 50% of the set-point and 10% of the pump max. pressure. Pre-pressure measuring, combined with a pressure transducer on the suction inlet, also provides low inlet pressure and dry run protection. Low inlet pressure and dry run protection is also available using a pressure switch or level control. However, these devices do not provide the analog pressure information to the PFU 2000 which is used to smooth performance when the above system characteristics are present. This setting must correspond to the menu.

217 - External Set-point Influence
External influence on the set-point is effected via the PFU 2000 analog/digital Input 3, Terminal 15.

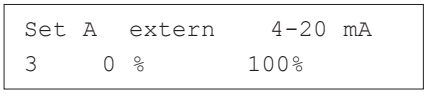
The most common use of this function is to have a remote set-point adjustment (like from an energy management system or building automation system).

Example: A building automation system is set up to control the set-point of the system from a control room. The signal from the control room will be 4-20mA.

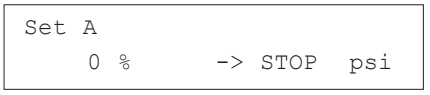
First, turn the external influence (217) to "external" and "%":



Then pressing the down button, adjust the analog input signal (AI 3) to 4-20 mA and the percentages to 0% and 100%.



Press the down arrow again and set up the next two windows according to the following:



[off] External influence on the set-point via the PFU 2000 is not possible
[extern] An external analog signal reduces the set-point maximum.

Other influences are available for applications other than pressure boosting. Please consult Grundfos if you want to use one of the other influences.

219 - Discharge Pressure Sensor Measuring Range, Input 1 (AI 1)
In this display, the pressure sensor signal type is selected and the minimum and maximum range of the sensor is entered. The following signal types are available:

- 0-10 V
- 0-20 mA
- 4-20 mA (default, installed at the factory)

PMU 2000 LCD display notes (continued)

220 - Suction Pressure Sensor Measuring Range, Input 2 (AI 2)
The suction pressure sensor signal output is recorded here. If a suction pressure sensor is not installed, a pressure switch or level switch is wired across different terminals than the pressure sensor and PFU 2000 DIP Switch 1, Contact 4 is set to "On." A pressure sensor, set to pre-pressure measurement is the factory default. The following output signal selections are available:

- 0-10 V
- 0-20 mA
- 4-20 mA (default, installed at the factory)

221 - Input 3, External Set-point Influence Signal Input (AI 3):
The external set-point influence signal type is recorded here.

- 0-10 V
- 0-20 mA
- 4-20 mA (default, installed at the factory)

222 - Input 4, Activate/Deactivate External Digital Signal
When a switch is closed across Terminals 16 and "—" on the PFU 2000 board, the Input 4 function selection is activated. The functions are:

[off] Closing the contacts causes no action. This is the factory default unless otherwise requested.

[remote] Remote control on/off. CLOSED contacts start the system.

[reduced op] When PFU 2000 Input 4 contact is CLOSED, the pumps which have NOT been set to reduced operation will be switched off. The effective set-point will be **"set-point max. 1,"** set in Display 225.

[fire fight] Note that **"fire fight"** does NOT imply that BoosterpaQ systems are certified as a fire pump system, as it is not. **"Fire fight"** is used to emphasize the necessity of overriding the water shortage monitoring function per operator discretion. When the PFU 2000 contact is CLOSED, "**set-point max. 1"** will be activated. At least one pump is started. Pre-pressure measuring is deactivated and this function is not influenced by any external signal nor by the clock program (multiple set-points, Display 201). The value required for **"set-point max. 1"** is set in Display 225.

[flowswitch] When low flow occurs, the flow switch contacts must open. As actual pressure exceeds the set-point, the system will shut down.

223 - Minimum Speed
Available when service code is entered. Consult factory.

224 - Number of Pumps on Reduced Operation
This display appears only if **"reduced op"** is selected under Input 4, Display 222. The number of pumps required to operate under **"reduced op"** is set in this display. The selection range is from 0 pumps to one pump less than the total number of pumps on the BoosterpaQ. The default value is 0, resulting in all pumps stopping when a switch is closed across PFU 2000 Terminals 14 and Y.

225 - Set-point Max.1
This display appears only if **"reduced op."** is selected under Input 4, Display 222. The value required for **"set-point max. 1"** is set in this display. The selection range is from STOP to **"set-point max."** set in Display 200.

226 - Stand-by Pumps
The number of stand-by pumps is set in this display. The range is from 0 pumps to one pump less than the total number of pumps on the BoosterpaQ. The default value is 0.

Example:
One stand-by pump in a 3-pump system has been selected. All three pumps will start/stop in full alternation depending on the performance required, but only two pumps can run simultaneously. This provides even run time for all pumps, but reserves one pump capacity.

227 - Pump Priority
The operating priority of the pumps is set in this display. The priority is from 1 (highest priority) to 8 (lowest priority).

When used: If you have a three pump system and one pump has a leaky seal or noisy motor bearing, you can set that individual pump to priority 2. The controller will not turn on this pump unless the other two pumps cannot keep up with demand or one of them has faulted.

228 - Max. Limit (High system pressure)
This display sets the maximum discharge pressure limit as measured by the discharge pressure sensor. If the pressure sensor is located downstream, the BoosterpaQ can produce the **"max. limit,"** plus the friction loss drop between the discharge and the pressure sensor before it will trip. This function is designed to help prevent damage due to over pressure, such as pipe breakage or damage to end use devices.

If **"max. limit"** is exceeded for more than 0.5 seconds, all pumps are switched off and a fault indication is produced. If the pressure drops below the **"max. limit"** for more than five seconds, the pumps will be switched on automatically. The fault reason will remain in the Fault Indication Menu until cleared or erased if 10 faults occur after it is recorded.

The range is from 0 to max. value of the discharge pressure sensor range.

229 - Min. Limit (Low system pressure)
This display sets the minimum discharge pressure limit as measured by the discharge pressure sensor. If the pressure sensor is located downstream, the BoosterpaQ must produce the friction drop head, plus the **"min. limit"** to avoid a trip.

This function can be used to check for a broken pipe. The system designer must confirm what the limit should be to indicate a broken pipe to avoid nuisance tripping. If a pipe has actually broken, the pressure won't rise and the system won't restart, preventing further water loss and possible water damage.

If the pressure at the sensor drops below the **"min. limit"** for more than five seconds and display 230 is set to **[off]**, all pumps will stop and a fault indication will be produced. If the pressure falls below **"min. limit"** and Display 230 is set to **[on]**, the pumps will not be switched off, but a fault indication will be produced and recorded in the Fault Indication Menu.

If the pressure rises above **"min. limit"** or more than five seconds, the fault indication will disappear and the pumps will be switched on automatically.

The set range is from 0 to the maximum value of the pressure sensor.

230 - Min. Limit Operation

[on] No pumps are switched off at **"min. limit"** operation, but a fault indication is produced.

[off] The pumps are switched off at **"min. limit operation"** and a fault indication is produced.

231 - Min. Pre-pressure (low suction pressure)
This display only appears if pre-pressure measuring is [on], Display 216.

This display sets the **"min. pre-pressure"** at which a fault indication is produced. If the inlet pressure falls below **"min. pre-pressure,"** all the pumps are switched off and a fault indication is produced. It protects against dry run and can be used to shut off the system if the inlet drops below local government low inlet pressure limits. When the pressure rises above the **"min."** pressure value, the fault resets and the system will run.

See PMU factory settings.

232 - Maximum Head
This display records the maximum pump head for each pump at 0 flow (shut-off) and 100% RPM. The PMU 2000 requires this information for smooth operation.

233 - Running Hours
This display changes the recorded running hours for each pump. If a pump is replaced or service is performed, the running hours can be set to 0 in order to keep a record of total running hours without having to log it.

234 - Pump Start Time
Only available when the service code is entered. Consult factory.

235 - Hydraulic
Sets the pumps to operate in series or parallel. BoosterpaQ pumps always operate in parallel. Only available when service code is entered.

START/STOP MENU

300 - Start/Stop of Zones
The top line indicates the specific zone (**"A"** is the default for BoosterpaQs), the zone name if entered, and its control parameter.

The bottom line selects whether the zone is active or switched off.

The zone has four settings:

[on] The pumps are started by the PMU 2000, depending on the required performance.

[off] The pumps in the zone are switched off.

[local] The pumps are not controlled by the PMU 2000, but by the PFU 2000.

[max.] All pumps which are set to **[on]** in display 301 are operated at maximum performance. All internal monitoring functions remain active. Any remote-controlled set-points, clock program (multiple set-points), and external start/stop inputs are not active.

301 - Start/Stop of Pumps
The top line indicates the specific pump and its operating condition (see the Pump Status Menu).

The bottom line is used to select whether the pump is active or switched off.

[on] The pump is started by the PMU 2000, depending on the required performance.

[off] The pump is switched off.

ZONE STATUS MENU

(Adjustments cannot be made here—for viewing only)
401 - Actual Set-point
This display indicates the actual set-point. If it is different than **"set-point max."** it may be due to the settings entered in other displays. These are called "influences." To see if there are any factors influencing the actual set-point, press "Enter" when in Display 401 to bring up Display 402.

If the operating pressure is lower than the set-point, before assuming a hardware problem, check this menu to determine if other factors may be lowering the set-point, resulting in a lower actual system pressure.
402 - Set-point Influence
This display indicates the set-point influences selected and the impact they will have on modifying **"set-point max."** to produce **"set-point act."** If more than one set-point influenced is entered, several underlying displays can be triggered (for example: 201, 202, 217, 222, 224, 225, and 226). Display 204, system time constant does not change the set-point, but if it is set much lower than it should be, sluggish action could incorrectly give an appearance that the set-point is too low or a hardware problem exists.

403 - Actual Value
This display indicates the actual discharge pressure.

404 - Speed
This display indicates the performance sum of all the operating pumps. Each pump is rated at 100% when running full speed. For example, in a three-pump system where all pumps are running at max. speed, Display 404 will indicate 300%.

In the same three-pump system with one pump running at max. speed, one pump frequency-controlled to 50%, and one pump stopped, Display 404 will indicate 150%.

405 - Set-point Max.
This display indicates the maximum set-point as set in Display 200.

406 - Clock Program (Multiple Set-points)
This display gives an overview of the switching times set in Display 201.

407 - On/Off Band
This display indicates the **"on/off band"** values set in Display 207.

408 - System Time Constant (Reaction Time)
This display indicates the system time constant set in Display 204.

409 - Minimum Switching Time
This display indicates the minimum switching time set in Display 205.

410 - Pump Change (Rotation)
This display indicates whether time-dependent change has been selected, Display 208.

[on] Time-dependent pump change is active.

[off] Time-dependent pump change is inactive.

After each pump stops, the PMU 2000 changes the starting order of the pumps regardless of the on/off status of this display.

411 - Time for Pump Change
This display indicates when time-dependent pump change is initiated after the system is started (Display 209).

[00:05] (5 minutes after midnight) is the default. Be sure to set the correct time in Display 103. Whatever the setting, time-dependent rotation occurs 24 hours after the initiation and occurs again every 24 hours thereafter unless demand change has caused pumps to start and stop or a fault occurs.

412 - Control Function
This display indicates the control function selected in Display 214.

[normal] If the actual value is smaller than the set-point, the pump performance is increased.

[invers] If the actual value is smaller than the set-point, the pump performance will be reduced.

413 - Medium Sequence
Timing function, only available when service code is entered.

414 - Pre-pressure Measuring
This display indicates the following as set in Display 216.

[on] Pre-pressure measuring is active.

[off] Pre-pressure measuring is inactive.

415 - External Set-point Influence
This display indicates the external influence selected in Display 217.

416 - Pressure Sensor Measuring Range, Input 1, Discharge Pressure
This display indicates the measuring unit of the discharge pressure sensor, Display 219.

417 - Pressure Sensor Measuring Range, Input 2, Inlet Pressure
This display indicates the measuring unit of the inlet pressure sensor, Display 220.

418 - Pre-Pressure Measuring
[on] or **[off]**. Corresponds to Display 216.

419 - Input 4
This display indicates the function of PMU 2000 digital Input 4, Display 222.

420 - Input 4 (Value)
This display indicates the values set in the following displays. Display 222 must be set to "reduced op." in order for Displays 224 and 225 to show.

[reduced op] Display 224 **[set-point max1]** Display 225

421 - Stand-by Pump
This display indicates the number of stand-by pumps, Display 226.
422 - Pump Priority
Indicates the operating priority of the pumps, Display 227.

423 - Max. Limit
Indicates the **"maximum limit,"** Display 228. If this limit is exceeded for 0.5 second, the pumps will stop and a fault is indicated. If the pressure drops below the **"maximum limit"** for more than five seconds, the system will restart automatically.

424 - Min. Limit
Indicates the discharge **"minimum limit,"** Display 229. If the discharge falls below this limit, a fault occurs.

If **[off]** is selected in Display 230, the pumps are switched off as well as a fault indicated.

425 - Min. Limit Operation
Indicates whether **"min. limit operation"** is active or inactive as selected in Display 230.

[on] No pumps are switched off if the value falls below the minimum limit, but a fault is indicated.

[off] The pumps are switched off when the value falls below the minimum limit, and a fault is indicated.

426 - Hydraulic
Sets the pumps to operate in series or parallel. Always set to parallel for BoosterpaQs. Only available when the service code is entered.

427 - Minimum Speed
Only available when the service code is entered.

435 - Min. Pre-pressure
Indicates the minimum pre-pressure fault value entered in Display 231 (Display 216 **[on]**).

PUMP STATUS MENU

500 - Examples of Pump Status
The top line indicates the pump number and zone (Zone **"A"** set as the factory default).

The bottom line indicates the current operating condition of the pump.

[I] The pump is running.

[O] The pump is stopped.

[A] There is a fault indication for the pump (see Fault Indication Menu, Display 600).

[M] The pump is set to max. speed.

[is running] The pump is controlled by the zone settings.

[cascade cont] The pump has been switched off due to a low performance requirement or the zone has been switched off via an external stop/stop switch.

[zone is off] The zone has been switch off from the PMU 2000 via the start/stop menu.

[remote off] The pump has been switched off via an external start/stop switch connected to the pump or PFU 2000.

[switched off] The pump has been switched off from the PMU 2000 via the start/stop menu.

[not availabl] No power supply to the pump or the pump has not been connected to the PMU 2000.

[fault] Other fault which has caused the pump to be switched off.

504 - Pump Maximum Head
Indicates the maximum head of the pump at maximum speed and 0 flow (shut-off at full RPM) set in Display 232.

508 - Pump Running Hours
Indicates the accumulated running hours of the pump. The hours can be changed in Display 233 after periodic maintenance or when a pump is replaced. Eliminates the need for a hard copy record.

FAULT INDICATION MENU

600 - Examples of Fault Indications
Examples of fault indications for the PFU 2000:

The top line indicates **[PFU]** and the pump numbers.

The bottom line indicates the time at which the fault occurred, when it disappeared or whether it still exists.

Under **"Alarm,"** the last 10 fault indications can be viewed, sorted by time of occurrence, the latest fault appearing first.

When the fault condition has been eliminated, reset the indication by pressing **"Enter."**

If "alarm suppression" was set to **[on]** in the Basic Menu, the alarm output will be suppressed for 15 minutes by pressing one of the buttons on the PMU 2000.

The cause of the fault can be:

No voltage supply to the PFU 2000

Defective communication cable between the PFU 2000 and the PMU 2000

Fault in the PFU 2000 or PMU 2000

[7 8] Fault in the PFU 2000 connected to pumps 7 and 8

[11:59] Time the fault occurred

[13-06] Date the fault occurred [dd-mm]

[13:20] Time the fault disappeared

[14-06] Date the fault disappeared [dd-mm]

[actual] The fault still exists

Maintenance

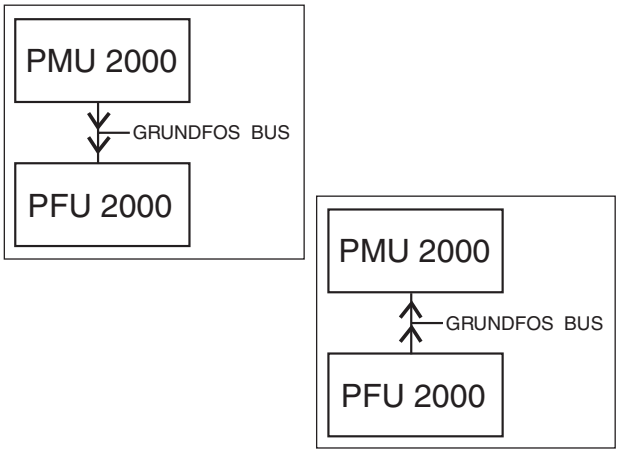
Care must be taken to ensure that escaping water does not cause injury to persons or damage to the motor or other components. In hot water installations, special attention should be paid to the risk of injury caused by scalding hot water. See also page 3, “Safety Warning” and “Shock Hazard.”

Pumps - Pump bearings and shaft seal are maintenance-free. If the pump is to be drained for a long period of inactivity, remove one of the coupling guards to inject a few drops of silicone oil on the shaft between the pump head and the coupling. This will prevent the shaft seal faces from sticking.

Motor Bearings - Motors which are not fitted with grease nipples are maintenance-free sealed bearings. Motors fitted with grease nipples should be lubricated according to the greasing instructions in the CR Pump Installation and Operating manual. In the case of seasonal operation (motor is idle for more than six months of the year), it is recommended to grease the motor when the pump is taken out of operation.

Frost Protection - Pumps which are not being used during periods of frost should be drained to avoid damage. Drain the pump by loosening the vent screw in the pump head and by removing the drain plug from the base. Do not tighten the vent screw. Replace the drain plug. Pressure transducers should also be removed to avoid damage. To restart operation, see **“Start-Up.”**

Control Panel - It must be kept clean and dry. Systems with cooling fans have filters that should be cleaned periodically. No other periodic maintenance is required.



Technical information

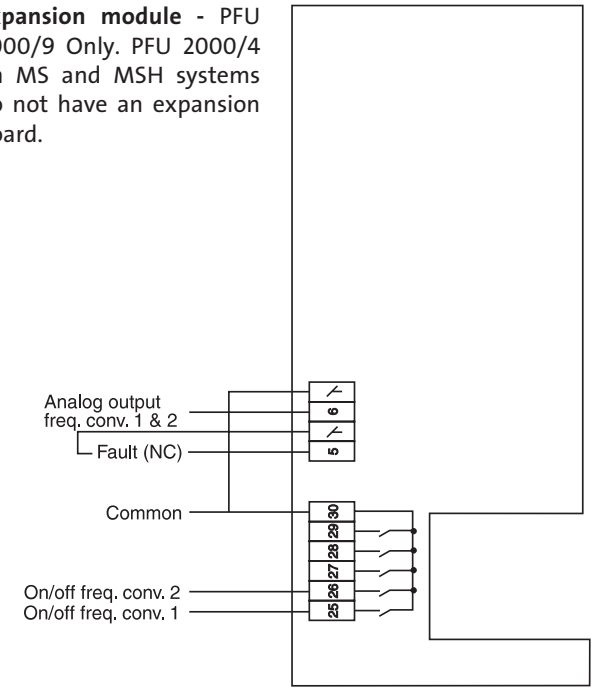
DIP Switch Setting for PFU 2000. See the factory settings sections of this manual.

	DIP Switch												
	DIP 1									DIP 2			
Setting of On/Off Band	1	2	3	4	5	6	7	8	9	1	2	3	4
Very Small 7 psi		ON	ON										
Small 10 psi	ON	OFF											
Normal 15 psi	OFF	OFF											
Large 22 psi	OFF	ON											
Setting of system time, minimum switching sequence and medium switching sequence													
Quick System time 0.8 seconds Min. switching sequence 2 seconds Medium switching sequence 10 seconds			OFF			ON							
Normal System time 2 seconds Min. switching sequence 5 seconds Medium switching sequence 20 seconds			OFF			OFF							
Slow System time 10 seconds Min. switching sequence 10 seconds Medium switching sequence 120 seconds			ON			ON							
Very Slow System time 60 seconds Min. switching sequence 20 seconds Medium switching sequence 300 seconds			ON			OFF							
Pre-pressure/water shortage monitoring: Pre-pressure measuring (4-20 mA) - Water shortage monitoring (switch) (NC or NO)				OFF ON						ON OFF	OFF ON		
1. Without a PMU 2000 1.1 Operation on the basis of EPROM settings in the PFU 2000 1.2 Operation on the basis of data stored in the PFU 2000 RAM. 2. With a PMU 2000 2.1 Operation on the basis of current PMU 2000 data.					ON OFF OFF								
Discharge pressure: - 0-10V signal - 4-20 mA signal												OFF ON	
External set-point influence signal: - 0-10V signal - 4-20 mA signal													OFF ON
This PFU 2000 controls the last pump of the zone:							OFF						
This PFU 2000 does not control the last pump of the zone:							ON						
Number of pumps controlled: 1								OFF	OFF				
Number of pumps controlled: 2								OFF	ON				
Number of pumps controlled: 3								ON	OFF				
Number of pumps controlled: 4								ON	ON				

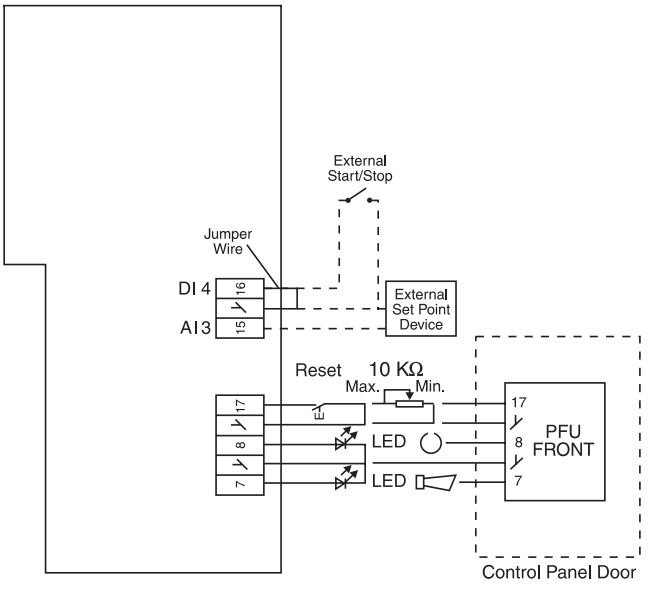
***If your BoosterpaQ has more than four pumps, there will be two PFU 2000 controllers.**

Technical information (continued)

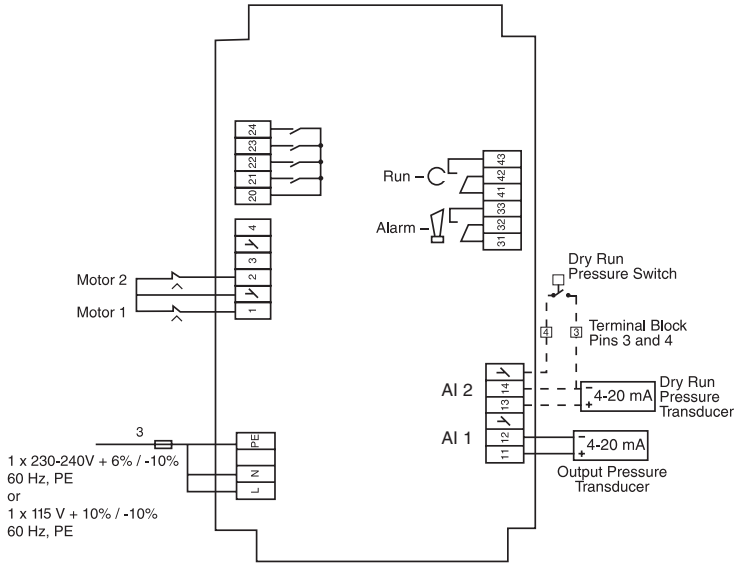
Expansion module - PFU 2000/9 Only. PFU 2000/4 on MS and MSH systems do not have an expansion board.



Expansion module - Control Board, PFU 2000/9 & PFU 2000/4



Expansion module - Control Board, PFU 2000/9 & PFU 2000/4



Technical information (continued)

Minimum inlet pressure

Calculation of the inlet pressure "H" is recommended when...

- the liquid temperature is high
- the flow is significantly higher than the rated flow
- water is drawn from depths
- water is drawn through long pipes
- inlet conditions are poor.

To avoid cavitation, make sure that there is a minimum pressure on the suction side of the pump. The maximum suction lift "H" in feet can be calculated as follows:

$H = p_b \times NPSHR - H_f - H_v - H_s$

p_b = Barometric pressure in feet absolute. (Barometric pressure can be set to 33.9 feet at seal level.) In closed systems, p_b indicates the system pressure in feet.

NPSHR = Net Positive Suction Head Required in feet. (To be read from the NPSHR curve at the highest flow the pump will be delivering.)

H_f = Friction loss in suction pipe in feet. (At the highest flow the pumps will be delivering.)

H_v = Vapor pressure in feet. (To be read from the vapor pressure scale. H_v depends on the liquid temperature

H_s = Safety margin = minimum 2.0 feet

If the "H" calculated is positive, the pump can operate at a suction lift of maximum "H" feet.

If the "H" calculated is negative, an inlet pressure of minimum "H" feet is required.

Diaphragm tank

Please install ASME tank when required. To maintain UL/cUL system approval, tanks attached to the BoosterpaQ manifolds must be ASME certified.

Recommended **minimum** diaphragm tank sizes are as follows:

Recommended Diaphragm Tank Size (gallons)

Pump Type	ME	MES	MF	MS
CR(E) 3	4.4	4.4	4.4	20
CR(E) 5	4.4	4.4	4.4	34
CR(E) 10	8.6	8.6	8.6	62
CR(E) 15	34	34	34	211
CR(E) 20	34	34	34	211
CR(E) 32	44	44	44	317
CR(E) 45	86	86	86	528
CR(E) 64	132	132	132	1056
CR90	-	-	132	1056

If your system has minor leaks or experiences low intermittent flows, a larger tank size may be required. These are minimum sizes. Installing larger sizes can result in smoother operation.

For MS systems the size of the diaphragm tank can also be calculated by means of the following formula:

$$V = \frac{Q \times 15 \times (14.5 + P_{set} + On/off_{band})}{n_{max} \times On/off_{band} \times k} \times \frac{1}{k}$$

V = Tank volume (gallons)
Q = Nominal flow for the smallest pump in the system (gpm)
On/off_{band} = Difference between set-point and stop pressure [psi]
p_{set} = Set-point [psi]
k = 0.9, constant for diaphragm tank pre-charge pressure
n_{max} = Max. number of starts/stops per hour.

Operating conditions

Liquid Temp.:	Maximum +176°F (+80°C) for standard systems. Call for higher temperatures.
Ambient Temp.:	32°F to +104°F (0°C to +40°C) Consult factory for higher temperatures. Operation above 131°F (55°C) is not allowed.
Operating Press.:	150 psi or 230 psi, as rated for the specific BoosterpaQ. **Do not** exceed the pressure rating of the tank.
Humidity:	95% maximum

Line impedance

It is recommended that the electricity supply have a line impedance of 1% - 2% (3% max. for 3x575V supply).

Total Harmonic Distortion

The Total Harmonic Distortion on the voltage should be no more than 5%.

Sound pressure level

For individual pump sound pressure values, call Grundfos. The sound pressure level for a number of pumps can be calculated as follows:

Lmax = Lpump + (n - 1) x 3

Lpump = Sound pressure level for one pump

Lmax. = Maximum sound pressure level

n = Number of pumps

Maximum inlet pressure

Discharge pressure must not exceed the tank, sensor and gauge ratings.

Pump			psi (bar)
CR, CRI, CRN 1s			
1s-2	→	1s-27	145 (10)
CR(E), CRI(E), CRN(E) 1			
1-2	→	1-25	145 (10)
1-27			218 (15)
CR(E), CRI(E), CRN(E) 3			
3-2	→	3-15	145 (10)
3-17	→	3-25	218 (15)
CR(E), CRI(E), CRN(E) 5			
5-2	→	5-9	145 (10)
5-10	→	5-24	218 (15)
CR(E), CRI(E), CRN(E) 10			
10-1	→	10-5	116 (8)
10-6	→	10-17	145 (10)
CR(E), CRI(E), CRN(E) 15			
15-1	→	15-2	116 (8)
15-3	→	15-12	145 (10)
CR(E), CRI(E), CRN(E) 20			
20-1			116 (8)
20-2	→	20-10	145 (10)
CR(E), CRN(E) 32			
32-1-1	→	32-2	58 (4)
32-3-2	→	32-6	145 (10)
32-7-2	→	32-11-2	218 (15)
CR(E), CRN(E) 45			
45-1-1	→	45-1	58 (4)
45-2-2	→	45-3	145 (10)
45-4-2	→	45-8-1	218 (15)
CR(E), CRN(E) 64			
64-1-1			58 (4)
64-1	→	64-2-1	145 (10)
64-2	→	64-5-2	218 (15)
CR(E), CRN(E) 90			
90-1-1	→	90-1	145 (10)
90-2-1	→	90-4-1	218 (15)

Technical information (continued)

Electrical data PFU and PMU

PFU Terminal Designation or Number	Function PFU 2000	Technical data
L, N, PE	Voltage supply for PFU 2000.	1 x 115V +/- 10%, 60 Hz, PE 1 x 230-240V + 6% / -10%, 60 Hz, PE
A, Y, B	Communication among the units in the Grundfos Pump Management System 2000	GRUNDFOS BUS, RS-485, GRUNDFOS BUS protocol
1-4	Analog/digital input for motor protection	PTC or thermal switch (NC)
5	Monitoring of variable frequency drive	NC contact
6	Analog control signal for variable frequency drive	DC 0-10V
7	Connection of external LED (fault)	Positive (anode), maximum 5 mA
8 11 and 13	Connection of external LED (operation) DC 24V supply for transmitter	Positive (anode), maximum 5 mA Maximum 70 mA
12	**ANALOG INPUT 1:** Actual value in the system	DC 0-10V 0-20 mA 4 - 20 mA
14	**ANALOG INPUT 2:** Input for pre-pressure Input signal can be inverted by means of the DIP1, Contact 4	DC 0-10V 0-20 mA 4-20 mA On/off contact (digital)
15	**ANALOG INPUT 3:** Signal for remote setting of set-point. Note: In systems without PMU 2000, only DC 0-10V can be used	DC 0-10V 0-20 mA 4-20 mA
16	**DIGITAL INPUT 4:** For remote on/off, flow	Maximum contact load: 12V / 12 mA switch, etc.
17	Connection of external reset button, for instance, in the front cover of the control cabinet, or external potentiometer for selecting the set-point	Maximum contact load: 12V / 12 mA
20 and 30	Contactor coil voltage	____
29	Variable frequency drive on/off	____
21, 22, 23, 24	On/off of motors 1, 2, 3, 4. Mains-operation	Maximum contact load: 250V / 8 A, AC1
25, 26, 27, 28	On/off of motors 1, 2, 3, 4. Variable frequency drive operation	Maximum contact load: 250V / 8 A, AC1
31 - 33	Fault signal relay	Potential-free contacts Maximum contact load: 250V / 0.5 A, AC1
41 - 43	Operating signal relay	Potential-free contacts. Maximum contact load: 250V / 0.5 A, AC1
Function PMU 2000		
L, N, PE	Voltage supply for PMU 2000	1 x 115V +/- 10%, 60 Hz, PE 1 x 230-240V + 6% / -10%, 60 Hz, PE
1, 2, 3	Operating signal relay	Potential-free contacts Maximum contact load: 250V / 1.0 A, AC1
4, 5, 6	Fault signal relay	Potential-free contacts Maximum contact load: 250V / 1.0 A, AC1
7, 8, 9	Communication among the units in the Grundfos Pump Management System 2000	GRUNDFOS BUS, RS-485, GRUNDFOS BUS protocol.
Mains supply		
Main Power Switch	Control 2000	See BoosterpaQ nameplate and electrical print for phase and voltage requirement.

LIMITED WARRANTY

Products manufactured by GRUNDFOS PUMPS CORPORATION (GRUNDFOS) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. GRUNDFOS' liability under this warranty shall be limited to repairing or replacing at GRUNDFOS' option, without charge, F.O.B. GRUNDFOS' factory or authorized service station, any product of GRUNDFOS' manufacture. GRUNDFOS will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by GRUNDFOS are subject to the warranty provided by the manufacturer of said products and not by GRUNDFOS' warranty. GRUNDFOS will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with GRUNDFOS' printed installation and operating instructions.

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BE > THINK > INNOVATE >

Being responsible is our foundation
Thinking ahead makes it possible
Innovation is the essence

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L-BP-TL-001	Rev. 1/05
PRINTED IN USA	

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