



Pressure transducer for IT control



Integrated Technologic® with Sensorless Control (ITSC) & Integrated Technologic (IT) Control

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1 Introduction and Safety

1.1 Introduction

Purpose of this manual

The purpose of this manual is to provide necessary information for:

- Installation
- Operation
- Maintenance



CAUTION:

Read this manual carefully before installing and using the product. Improper use of the product can cause personal injury and damage to property, and may void the warranty.

NOTICE:

Save this manual for future reference, and keep it readily available at the location of the unit.

1.2 Safety



WARNING:

- The operator must be aware of safety precautions to prevent physical injury.
- Operating, installing, or maintaining the unit in any way that is not covered in this manual could cause death, serious personal injury, or damage to the equipment. This includes any modification to the equipment or use of parts not provided by Xylem. If there is a question regarding the intended use of the equipment, please contact a Xylem representative before proceeding.
- Do not change the service application without the approval of an authorized Xylem representative.



CAUTION:

You must observe the instructions contained in this manual. Failure to do so could result in physical injury, damage, or delays.

1.2.1 Safety message levels

About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

- Personal accidents and health problems
- Damage to the product
- Product malfunction

Definitions

Safety message level	Indication
 DANGER:	A hazardous situation which, if not avoided, will result in death or serious injury

Safety message level	Indication
 WARNING:	A hazardous situation which, if not avoided, could result in death or serious injury
 CAUTION:	A hazardous situation which, if not avoided, could result in minor or moderate injury
 Electrical Hazard:	The possibility of electrical risks if instructions are not followed in a proper manner
NOTICE:	• A potential situation which, if not avoided, could result in undesirable conditions • A practice not related to personal injury

1.3 User safety

General safety rules

These safety rules apply:

- Always keep the work area clean.
- Pay attention to the risks presented by gas and vapors in the work area.
- Avoid all electrical dangers. Pay attention to the risks of electric shock or arc flash hazards.
- Always bear in mind the risk of drowning, electrical accidents, and burn injuries.

Safety equipment

Use safety equipment according to the company regulations. Use this safety equipment within the work area:

- Hard hat
- Safety goggles, preferably with side shields
- Protective shoes
- Protective gloves
- Gas mask
- Hearing protection
- First-aid kit
- Safety devices

NOTICE:

Never operate a unit unless safety devices are installed. Also see specific information about safety devices in other chapters of this manual.

Electrical connections

Electrical connections must be made by certified electricians in compliance with all international, national, state, and local regulations. For more information about requirements, see sections dealing specifically with electrical connections.

Precautions before work

Observe these safety precautions before you work with the product or are in connection with the product:

- Provide a suitable barrier around the work area, for example, a guard rail.
- Make sure that all safety guards are in place and secure.
- Make sure that you have a clear path of retreat.
- Make sure that the product cannot roll or fall over and injure people or damage property.
- Make sure that the lifting equipment is in good condition.
- Use a lifting harness, a safety line, and a breathing device as required.
- Allow all system and pump components to cool before you handle them.
- Make sure that the product has been thoroughly cleaned.
- Disconnect and lock out power before you service the pump.
- Check the explosion risk before you weld or use electric hand tools.

Precautions during work

Observe these safety precautions when you work with the product or are in connection with the product:

- Never work alone.
- Always wear protective clothing and hand protection.
- Stay clear of suspended loads.
- Always lift the product by its lifting device.
- Beware of the risk of a sudden start if the product is used with an automatic level control.
- Beware of the starting jerk, which can be powerful.
- Rinse the components in water after you disassemble the pump.
- Do not exceed the maximum working pressure of the pump.
- Do not open any vent or drain valve or remove any plugs while the system is pressurized. Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.
- Never operate a pump without a properly installed coupling guard.

Wash the skin and eyes

Follow these procedures for chemicals or hazardous fluids that have come into contact with your eyes or your skin:

Condition	Action
Chemicals or hazardous fluids in eyes	1. Hold your eyelids apart forcibly with your fingers. 2. Rinse the eyes with eyewash or running water for at least 15 minutes. 3. Seek medical attention.
Chemicals or hazardous fluids on skin	1. Remove contaminated clothing. 2. Wash the skin with soap and water for at least 1 minute. 3. Seek medical attention, if necessary.

1.4 Protecting the environment

Emissions and waste disposal

Observe the local regulations and codes regarding:

- Reporting of emissions to the appropriate authorities
- Sorting, recycling and disposal of solid or liquid waste
- Clean-up of spills

Exceptional sites



CAUTION: Radiation Hazard

Do NOT send the product to Xylem if it has been exposed to nuclear radiation, unless Xylem has been informed and appropriate actions have been agreed upon.

Recycling guidelines

Always follow local laws and regulations regarding recycling.

2 Transportation and Storage

2.1 Inspect the delivery

2.1.1 Inspect the package

1. Inspect the package for damaged or missing items upon delivery.
2. Note any damaged or missing items on the receipt and freight bill.
3. File a claim with the shipping company if anything is out of order.
If the product has been picked up at a distributor, make a claim directly to the distributor.

2.1.2 Inspect the unit

1. Remove packing materials from the product.
Dispose of all packing materials in accordance with local regulations.
2. Inspect the product to determine if any parts have been damaged or are missing.
3. If applicable, unfasten the product by removing any screws, bolts, or straps.
For your personal safety, be careful when you handle nails and straps.
4. Contact the local sales representative if there is any issue.

2.2 System lifting



WARNING:

Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points. Lifting devices such as eyebolts, slings, and spreaders must be rated, selected, and used for the entire load being lifted.



WARNING: Crush Hazard

1) Always lift the unit by its designated lifting points. 2) Use suitable lifting equipment and ensure that the product is properly harnessed. 3) Wear personal protective equipment. 4) Stay clear of cables and suspended loads.

2.3 Transportation guidelines

Precautions



DANGER: Crush Hazard

Moving parts can entangle or crush. Always disconnect and lock out power before servicing to prevent unexpected startup. Failure to do so could result in death or serious injury.

2.4 Storage guidelines

Storage location

The product must be stored in a covered and dry location free from heat, dirt, and vibrations.

NOTICE:

Protect the product against humidity, heat sources, and mechanical damage.

NOTICE:

Do not place heavy weights on the packed product.

3 Product Description

3.1 ITSC System description

The Integrated Technologic Sensorless Pump Controller is a variable frequency drive that has been configured for both sensorless and sensed pump control applications. The controller utilizes four different setups to allow the user to easily setup the controller for 4 different applications.

Set-up 1	Delta P or pressure control with wired transducer. The controller setpoint is preconfigured at 15 psi. The analog input AI53 is configured for a 40 psi Delta P transducer.
Set-up 2	Flow control with wired flow transducer. The controller setpoint is preconfigured at 150 GPM. The analog input AI54 is configured for a 4000 GPM flow transducer.
Set-up 3	Sensorless pressure control. The controller setpoint is preconfigured at the factory based on the order request.
Set-up 4	Sensorless flow control. The controller setpoint is preconfigured at the factory based on the order request.

- Per the factory default settings, the ITSC integrated active set-up is Setup 3. Refer to the ITSC Setup and Commissioning section in this manual for details on changing to Setup 4 for sensorless flow control, or setup 1 for wire Delta P or pressure transducer, or setup 2 for wire flow transducer.

3.2 IT System description

The Integrated Technologic Wired Transducer Pump Controller is a variable frequency drive that has been configured for sensed pump control applications only. The controller utilizes two different setups to allow the user to easily setup the controller for 2 different applications.

Set-up 1	Delta P or pressure control with wired transducer. The controller setpoint is preconfigured at 15 psi. The analog input AI53 is configured for a 40 psi Delta P transducer.
Set-up 2	Flow control with wired flow transducer. The controller setpoint is preconfigured at 150 GPM. The analog input AI54 is configured for a 4000 GPM flow transducer.

- Per the factory default settings, the IT integrated active set-up is Setup 1. Refer to the IT Setup and Commissioning section in this manual for details on changing set-ups to change to Setup 2 for wire flow transducer.

Enclosure rating



WARNING:

The enclosure rating of the controller must be maintained by using the appropriate wire or conduit connectors and installing the controller in the appropriate environment. Failure to use the appropriate connectors or to install in the appropriate environment may create a dangerous condition and will void the warranty.

- The standard enclosure rating for the controller is IP55 (NEMA12).
- The controller is intended for indoor use only.
- Ensure the installation environment complies with the controller rating.
- Make sure all cable glands and unused holes for glands are properly sealed and the cover is properly installed.
- Ensure that the system is installed in an environment that complies with the motor ingress protection rating. Refer to the motor IOM manual for details.

Ambient temperature



WARNING:

The ambient temperature rating of the controller must be maintained by installing the controller in the appropriate environment. Failure to operate the controller in the appropriate environment may create a dangerous condition and will void the warranty.

- To ensure proper cooling of the controller, there must be adequate space above and below the controller chassis. Refer to the Technologic Pump Controller IOM for details.
- The controller can be operated with full load output current at maximum ambient temperature up to the maximum altitude of 1000 m above sea level. For altitudes above 1000 m, the maximum output current and/or maximum ambient temperature must be derated. Refer to the Technologic Pump Controller IOM for details. Contact the factory for installation above 2000 m.

Maximum Temperature	Minimum Temperature
113°F (45°C)	32°F (0°C)
The output current rating is derated 2% for every degree above 113°F (45°C).	The controller will operate with reduced performance down to 14°F (-10°C)
At 122°F (50°C), the maximum output current rating of the controller will be reduced by 10%.	

4 Electrical Installation

4.1 Preinstallation

Precautions



Electrical Hazard:

- Branch circuit protection required. Provide branch circuit protection in accordance with the National Electrical Code.
 - Motor control equipment and electronic controls are connected to hazardous line voltages. Extreme care should be taken to protect against electrical hazard.
 - Proper protective grounding of the equipment must be established. Ground currents are higher than 3 mA.
 - A dedicated ground wire is required.
-

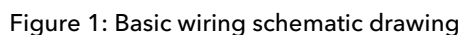


WARNING:

- Rotating shafts and electrical equipment can be hazardous. It is strongly recommended that all electrical work conform to all National and Local regulations. Installation, Start-up, and Maintenance should be performed only by qualified personnel.
 - Wear safety glasses whenever working on electric control or rotating equipment.
-

NOTICE:

Make all power connections with minimum 75°C rated copper wiring for installations in North America.



Electrical Hazard:

- Replacement fuses must be of the same continuous rating, fuse type and have the same maximum interrupting rating as the fuse being replaced.
- Before replacing a blown fuse or resetting a circuit breaker, the source of the fault causing the fuse to blow must be found and remedied.
- Before connecting the input power wiring or fusing, ensure all input disconnects or breakers are set and locked to the off position.

For operator's safety, it is important to ground drive properly. Failure to ground drive properly could result in death or serious injury.

NOTICE:

It is the responsibility of the user or certified electrical installer to ensure correct grounding (earthing) of the equipment in accordance with national and local electrical codes and standards.

Requirements:

- Follow all local and national codes for proper electrical equipment grounding (earthing).
 - Proper protective grounding of the equipment must be established. Ground currents are higher than 3 mA.
 - A dedicated ground wire is required.
 - Do not use conduit as a replacement for a ground wire.
 - Do not ground one controller to another in a “daisy chain” fashion. Each controller must have a dedicated ground connection.
 - A high strand count ground wire is preferred for dissipating high frequency electrical noise.
 - Keep the ground wire connections as short as possible.
1. Ensure that the input power source for the controller is locked in the off position.
 2. Connect metalized conduit to the controller.
 3. Route the power wiring through the conduit.
 4. Input power connections:
 - Single-phase drive: Connect the input power wires to terminals labeled L1, L2 on the input side of the disconnect and $\perp$ (Ground).

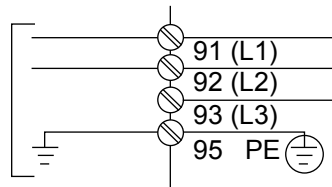


Figure 2: Power input wiring for single-phase drive

- Three-phase drive: Connect the input power wires to terminals labeled L1, L2, L3 on the input side of the disconnect and $\perp$ (Ground).

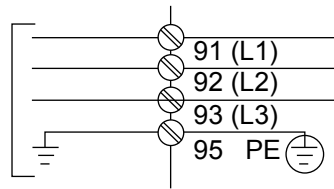


Figure 3: Power input wiring for three-phase drive

Refer to the Technologic Pump Controller IOM for details on wire sizing and routing.

4.3 Control terminal connections

Connecting to the control terminals

1. To connect control wiring to the control terminals, do the following:
 - a. Strip the control wire back 9-10mm (0.35-0.40 in)
 - b. Insert a screwdriver (2.5-3.5 mm) in the rectangular hole in between two circular holes and push it down.
 - c. Insert the cable in the adjacent circular hole.
 - d. Remove the screwdriver. The wire is now mounted to the terminal.
2. To remove the wire from the terminal:

- Insert a screwdriver (2.5–3.5 mm) in the rectangular hole and push it down.
- Pull out the cable.

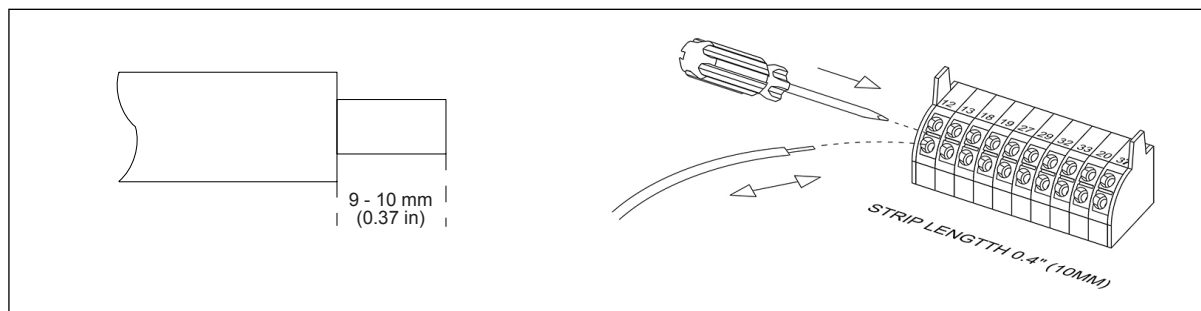


Figure 4: Connecting and disconnecting control wiring

Analog input configuration

If an analog input is used, the analog input configuration switches must be set properly. To set the configuration switches, remove the local control panel and set the appropriate switch as required.

- To configure the analog input as a voltage input, set the configuration switch to U (set to the left position).
- Switch A53 is used to configure analog input 53.
- Switch A54 is used to configure analog input 54.

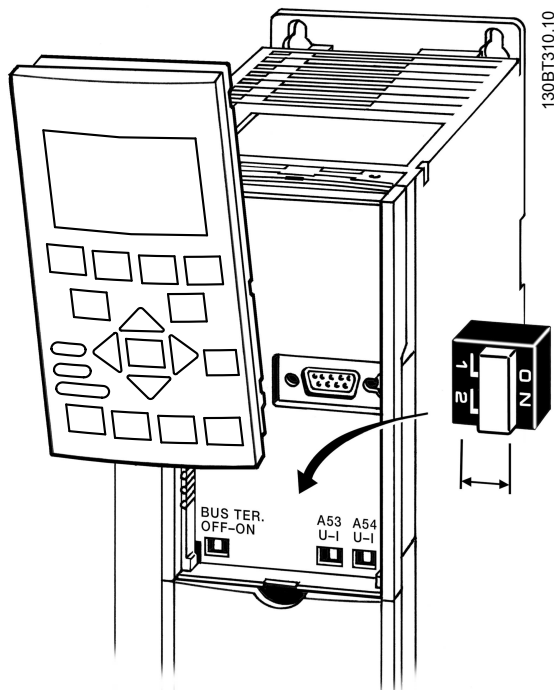


Figure 5: Configuration switch location



WARNING:

Some option cards available for the unit may cover these switches and must be removed to change switch settings. Always remove power to the unit before removing option cards.

4.4 Control terminal configurations

Table 1: Control terminal descriptions

	Terminal number	Parameter	Default setting	Description
Relay Outputs	01, 02, 03	5-40 Relay1	[160] No Alarm	Form C Relay Output. Usable for AC or DC voltages and either resistive or inductive loads. Refer to the relay wiring section for relay contact current and voltage ratings.
	04, 05, 06	5-40 Relay2	[5] Running	
Digital I/O	12, 13	-	+24 V DC	24 V DC supply voltage. Maximum output current is 200 mA total for all 24 V loads. Useable for digital inputs and external transducers.
	18	5-10	[8] Start	Start/Stop digital input signal for the drive. Connect input to 24 V to start. Open the input to stop.
	19	5-11	[0] No Operation	Unused digital input
	27	5-12	[0] No Operation	Unused digital input
	29	5-13	[0] No Operation	Unused digital input
	32	5-14	[0] No Operation	Unused digital input
	33	5-15	[0] No Operation	Unused digital input
	20	-	Common	Common for digital inputs and reference for 24 V supply
Analog I/O	39	-	AO Common	Common for analog output
	42	6-50	4-20mA Motor Freq	Analog output. Default setting is 4-20mA signal (500 Ω max) based on motor speed
	50	-	+10 V DC	10 V DC analog supply voltage. 15mA maximum.
	53	6-1	[0] No Operation	Analog input 53.
	54	6-2	[0] No Operation	Analog input 54.
	55	-	AI Common	Common for analog input
Common	61	-	Shield Connection	Integrated RC filter for cable shield. ONLY for connecting the shield when experiencing EMC problems.
	68	8-3	+	RS485 Interface +
	69	8-3	-	RS485 Interface -

Refer to the Technologic Controller IOM for details on control terminal wiring.

4.5 Common terminal wiring configurations

Relay wiring

Each controller has two programmable form C relay outputs. The relay terminals are located in various locations on the controller depending on the frame size.

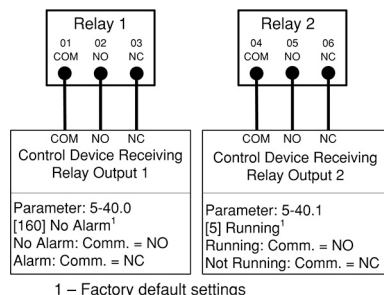


Figure 6: Relay terminal wiring

Table 2: Relay terminal ratings

Programmable relay outputs	2
Relay 01 Terminal number	1-3 (break), 1-2 (make)
Maximum terminal load (AC-1) ¹ on 1-3 (NC), 1-2 (NO) (Resistive load)	240 V AC, 2A
Maximum terminal load (AC-15) ¹ (Inductive load @ $\cos\phi$ 0.4)	240 V AC, 0.2A
Maximum terminal load (DC-1) ¹ on 1-2 (NO), 1-3 (NC) (Resistive load)	60 V DC, 1A
Maximum terminal load (DC-13) ¹ (Inductive load)	24 V DC, 0.1A
Relay 02 Terminal number	4-6 (break), 4-5 (make)
Maximum terminal load (AC-2) ¹ on 4-5 (NO) (resistive load) ^{2,3}	400 V AC, 2A
Maximum terminal load (AC-15) ¹ (Inductive load @ $\cos\phi$ 0.4)	240 V AC, 0.2A
Maximum terminal load (DC-1) ¹ on 4-5 (NO) (Resistive load)	80 V DC, 2A
Maximum terminal load (DC-13) ¹ on 4-5 (NO) (Inductive load)	24 V DC, 0.1A
Maximum terminal load (AC-1) ¹ on 4-6 (NC) (Resistive load)	240 V AC, 2A
Maximum terminal load (AC-15) ¹ on 4-6 (NC) (Inductive load @ $\cos\phi$ 0.4)	240 V AC, 0.2A
Maximum terminal load (DC-1) ¹ on 4-6 (NC) (Resistive load)	50 V DC, 2A
Maximum terminal load (DC-13) ¹ on 4-6 (NC) (Inductive load)	24 V DC, 0.1A
Minimum terminal load on 1-3 (NC), 1-2 (NO), 4-6 (NC), 4-5 (NO)	24 V DC 10mA, 24 V AC 20mA
Environment according to EN 60664-1	overvoltage category III/pollution degree 2

Factory default setup

This configuration utilizes the controller factory default settings for I/O.

ITSC factory default settings

- Configured for Set-up 3: Sensorless pressure control with no external transducer installed. There are no parameters that need to be adjusted to use this configuration.
- Set-up 4: Sensorless flow control, also uses these default settings for I/O.

IT factory default settings

- Configured for Set-up 1: Delta P or pressure control with wired transducer. Parameters 6-15 Terminal 53 High Ref./Feedback. Value and 20-14 Maximum Reference/Feedb. that need to be matched up with the maximum range of the Delta P or pressure transducer to use this configuration.
- Setup 2: flow control with wired transducer. Parameters 6-25 Terminal 54 High Ref./Feedback. Value and 20-14 Maximum Reference/Feedb. that need to be matched up with the maximum range of the flow transducer to use this configuration.

Set-ups are changed by adjusting parameter 0-10 Active Set-up. Refer to the Commissioning section in this manual for details on changing set-ups.

NOTICE:

The factory default settings are configured to require a start signal wired to DI18 as shown below.

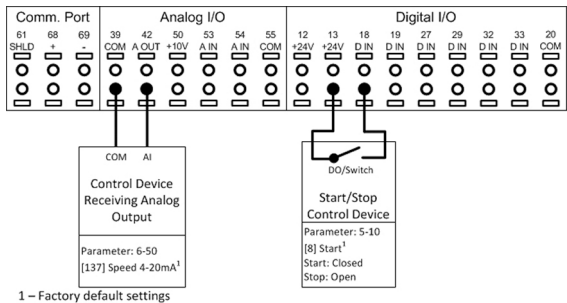


Figure 7: Analog output terminal connections when using factory defaults

Adding an external interlock

This setup adds an external interlock signal to the factory default configuration. An external interlock can be used in applications that operate at extreme temperatures and/or pressures to turn off the controller and issue an alarm during an abnormal system condition. The external interlock signal is connected to digital input 27 on the controller. This input can be controlled by an external device such as a suction pressure switch, an over pressure switch, temperature switch, a differential pressure switch, etc. When the input is disconnected from the 24V supply, an alarm is issued and the controller stops the motor. The controller will attempt to automatically restart if the Reset Mode [14-20] and Automatic Restart Time [14-21] are set to allow automatic restarting. To prevent an automatic restart set the reset mode [14-20] to Manual reset.

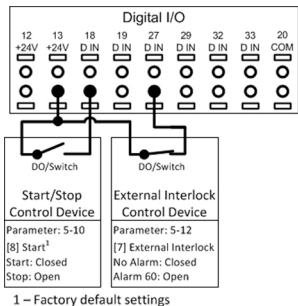


Figure 8: Terminal connections for external interlock

Table 3: Parameter settings for using an external interlock

Parameter number	Description	Set to
5-12	Terminal 27 Digital Input	External Interlock
14-20	Reset Mode	Set to the desired number of automatic resets. If a fault occurs more than this, setting a manual reset is required. Set to Manual Reset if no resets are allowed. Default setting is: Automatic reset x 3.
14-21	Automatic Restart Time	This is the time between when an alarm/warning is issued and when the controller attempts the next restart. Default setting is 30 seconds.

Adding transducer feedback

This configuration adds a transducer for closed loop control or for external monitoring. Use Set-up 1 for pressure control using a wired pressure transducer and Set-up 2 for flow control using a wired flow transducer. Refer to the Commissioning section in this manual for detail on changing set-ups.

NOTICE:

Be sure to properly set the analog input configuration switches prior to using the analog input.

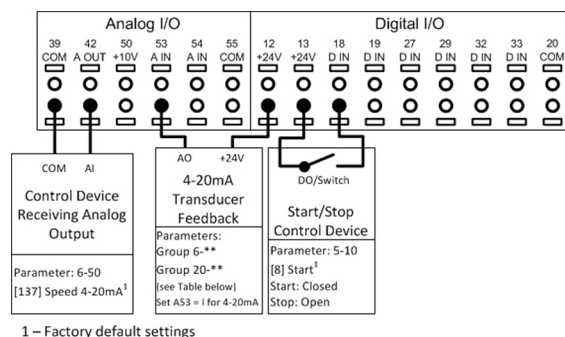


Figure 9: Terminal connections for 4-20mA wired sensor

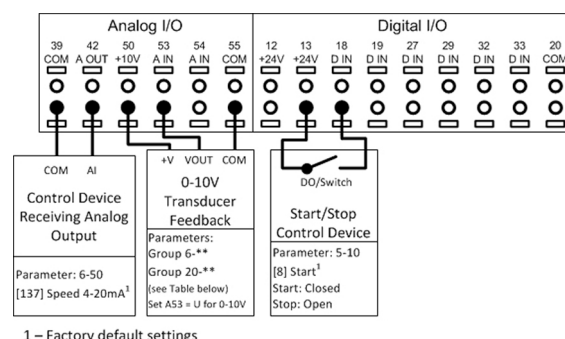


Figure 10: Terminal connections for 0-10V wired sensor

In order to set up the controller for closed loop control based on the feedback from an external transducer, set the following parameters:

Table 4: Parameter settings for using a wired sensor for feedback

Parameter number	Description	Set to
0-10	Active Set-up	For wired pressure transducer select Set-up 1. For wired flow transducer select Set-up 2.
6-14*	Terminal 53 Low Ref./Feedb. Value	Minimum transducer feedback value. For example, for a 0-40 psi DP transducer, set to 0.
6-15*	Terminal 53 High Ref./Feed. Value	Maximum transducer feedback value. For example, for a 0-40 psi DP transducer, set to 40.
6-17*	Terminal 53 Live Zero	Enabled
20-00	Feedback 1 Source	Analog Input 53*
20-12	Reference/Feedback	Select as appropriate for application. For example, set to psi when using a pressure transducer.

Parameter number	Description	Set to
20-13	Minimum Reference/Feedback	Minimum transducer feedback value. For example, for a 0-40 psi DP transducer, set to 0 psi.
20-14	Maximum Reference/Feedback	Maximum transducer feedback value. For example, for a 40 psi DP transducer, set to 40 psi.

* To use AI54, configure parameters 6-24, 6-25, 6-27 and set 20-00 to Analog Input 54. In order to set up the controller with a transducer that is used for external monitoring, rather than feedback to the controller, set the following parameters:

Table 5: Parameter settings for using a wired sensor for external monitoring

Parameter number	Description	Set to
0-24	Display Line 3 Large	Ext. 1 Feedback [Unit]
21-14	Ext. 1 Feedback Source	Analog Input 53*
21-10	Ext. 1 Ref./Feedback Unit	Select as appropriate for application. For example, set to psi when using a pressure transducer.
21-11	Ext. 1 Minimum Reference	Minimum transducer feedback value. For example, for a 0-40 psi DP transducer, set to 0 psi.
21-12	Ext. 1 Maximum Reference	Maximum transducer feedback value. For example, for a 40 psi DP transducer, set to 40 psi.
6-14*	Terminal 53 Low Ref./Feedb. Value	Minimum transducer feedback value. For example, for a 0-40 psi DP transducer, set to 0 psi.
6-15*	Terminal 53 High Ref./Feedb. Value	Maximum transducer feedback value. For example, for a 40 psi DP transducer, set to 40 psi.
6-17*	Terminal 53 Live Zero	Disabled

* To use AI 54, configure parameters 6-24, 6-25, 6-27 and set 21-14 to Analog Input 54.

Control from external PLC/BMS through Analog Input

The controller can be configured to accept either the process variable (e.g. actual pressure) or setpoint from an external control source such as a PLC or BMS controller through an analog input. The output from the external control device can be either a voltage or current output signal. Be sure to set the analog input configuration switches based on the type of output signal. When the process variable is supplied by the external controller, the wiring connections are the same as used with the connections for speed control from an external device through an analog input. When the setpoint or reference is supplied to the controller from the external device both a transducer and the external control device supplying the setpoint need to be connected to the controller. Refer to the wiring diagram below. The parameter settings for this configuration are shown below.

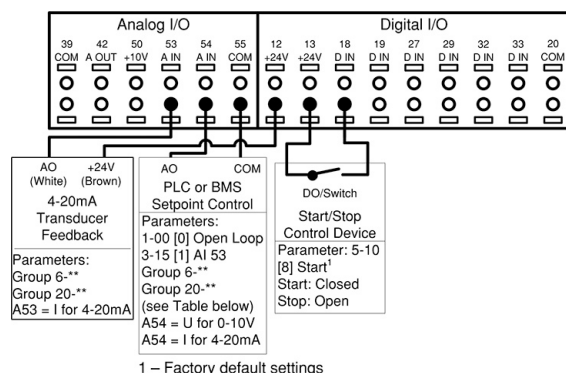


Figure 11: Connections for setpoint control through an external device

Table 6: Parameter settings for using an external control signal

Parameter Number	Parameter Description	For process variable from BMS/PLC*	For setpoint from BMS/PLC**	For speed reference from BMS/PLC***
1-00	Configuration Mode	Closed Loop	Closed Loop	Open Loop
3-15	Reference 1 Source	No Function	Analog Input 53*	Analog Input 53*
6-14	Terminal 53 Low Ref./ Feedb. Value	Minimum value of process variable. For example, for a 0-40 psi DP transducer, set to 0.	Minimum reference/ setpoint value. For example, for a 0-40 psi DP transducer, set to 0.	Minimum motor speed. For example, 0 RPM.
6-15	Terminal 53 High Ref./ Feedb. Value	Maximum value of process variable. For example, for a 40 psi DP transducer, set to 40.	Maximum reference/ setpoint value. For example, for a 40 psi DP transducer, set to 40.	Maximum motor speed. For example, 3450 RPM for 2 pole motor.
6-17	Terminal 53 Live Zero	Enabled	Enabled	Disabled
20-00	Feedback 1 Source	Analog Input 53	Select as appropriate for application. This can be any selection except the setting of parameter 3-15.	No Function
20-12	Reference/Feedback Unit	Select as appropriate for application. For example, set to psi when using pressure feedback.	Select as appropriate for application. For example, set to psi when using pressure reference.	NA
20-13	Minimum Reference/ Feedback	Minimum transducer feedback value. For example, for a 0-40 psi DP transducer, set to 0 psi.	Minimum reference/ setpoint value. For example, for a 0-40 psi DP transducer, set to 0 psi.	NA
20-14	Maximum Reference/ Feedback	Maximum transducer feedback value. For example, for a 40 psi DP transducer, set to 40 psi.	Maximum reference/ setpoint value. For example, for a 40 psi DP transducer, set to 40 psi.	NA

* To use AI 54, configure parameters 6-24, 6-25, 6-27 and set 20-00 to analog Input 54

** To use AI 54, configure parameters 6-24, 6-25, 6-27 and set 3-15 to analog Input 54

*** To use AI 54, set 3-15 to analog Input 54

Control from external PLC/BMS through communications port

A BMS or PLC can also be connected to the controller through the communications port. In this configuration the BMS or PLC can control the drive by overriding the setpoint. Control cables must be braided screened/shielded and the screen must be connected by means of a cable clamp at both ends to the metal cabinet of the controller. Be sure to terminate the bus connections by turning the BUS TER switch to the on position. The BUS

TER switch is located under the LCP as shown in [Figure 5: Configuration switch location](#) (page 13)

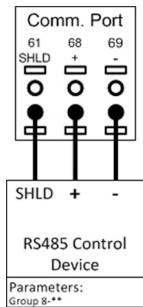


Figure 12: Terminal connections for external control source connected through comm. port

Table 7: Parameter settings for Modbus RTU and BACnet protocols

Parameter Number	Parameter Description	Protocol	
		Modbus RTU	BACnet
8-02	Control Source	FC Port	FC Port
8-30	Protocol	Modbus RTU	BACnet
8-31	Address	1	1
8-32	Baud Rate	19200	9600
8-33	Parity/Stop bit	Even Parity, 1 Stop bit	No Parity, 1 Stop bit
8-34	Estimated cycle time	0 ms	0 ms
8-35	Minimum Response Delay	10 ms	10 ms
8-36	Maximum Response Delay	5000 ms	5000 ms
8-37	Maximum Inter-Char Delay	0.86 ms	25 ms

The parameters above show an example of typical settings used for Modbus RTU or BACnet protocols. The parameters must be set according to the devices on the network. 8-32 Baud Rate and 8-33 Parity/Stop Bit should be set to match the other devices on the network. For detailed communication setup information for Modbus RTU, refer to the document number MG92B102 and MG11D202. The documents referenced above are available for download at www.danfoss.com.

4.6 Local control panel

The controller comes equipped with a local control panel (LCP). The panel allows the user to view the status of the controller, pump, and system without entering the parameter list. Consult the Technologic Pump Controller IOM for details on programming the controller. The default configuration is shown in the following figure.



Figure 13: Default configuration

1. Controller Status
2. Motor HP (Parameter 0-24)
3. Feedback / actual pressure (Parameter 0-20)
4. Pressure setpoint (Parameter 0-21)
5. Menu current (Parameter 0-22)
6. Motor frequency (Parameter 0-23)
7. Menu keys
8. Navigation keys and indicator LEDs
9. Operation keys

The parameters shown are the factory default settings. To display other values, modify parameters 0-20, 0-21, 0-22, 0-23, or 0-24.

4.7 Menu keys



Status Key	Pressing the [Status] key toggles between different status screens. There are 3 different status screens: 5 line readouts (default), 4 line readouts or Smart Logic Control. Use the [Status] key for selecting the mode of the LCP or for changing back to Display mode from either Quick Menu mode, Main Menu mode or the Alarm mode. The LCP display contrast can also be adjusted by pressing [Status] and the up or down arrow for a darker or brighter display.
Quick Menus Key	The [Quick Menus] key brings up a set of menus that allow easy access to some common parameters. The Quick Menu consists of My Personal Menu, Quick Set-up, Function Set-up, Changes Made and Loggings. My Personal Menu has been configured to contain some commonly used parameters in pumping applications.
Main Menu	The [Main Menu] key allows access to the complete parameter set. My Personal Menu provides the simplest and quickest access to the required parameters for most applications.
Alarm Log	The [Alarm Log] key allows access to the 5 latest alarms numbers A1-A5. To obtain details about an alarm, use the arrow keys to highlight the alarm number and press OK.

4.8 Navigation keys



Pressing the [Back] button reverts to the previous step or layer in the navigation structure.



Pressing the [Cancel] button will cancel the last change or command as long as the display has not been changed.

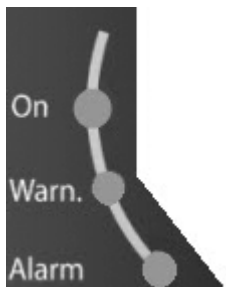


Pressing the [Info] button will display information about a command, parameter, or function in any display window. [Info] provides detailed information when needed. Exit the Info mode by pressing either [Info], [Back], or [Cancel].



The four navigation arrows are used to navigate between the different choices available in [Quick Menu], [Main Menu] and [Alarm Log]. Use these keys to move the cursor.

[OK] is used for choosing a parameter marked by the cursor and for enabling the change of a parameter.



If certain threshold values are exceeded, the Alarm and/or Warning (Warn.) LED will turn on. If an alarm or warning is active, a status or alarm text will appear on the control panel.

- Yellow Warn. LED: Indicates a warning is active
- Red Flashing Alarm LED: Indicates an alarm is active

The Green On LED is activated when the controller receives power.

- Green On LED: Control section is powered and working.

4.9 Operation keys



The [Hand on] key enables control of the drive via the LCP interface. Pressing [Hand on] also starts the motor and the speed can be manually adjusted using the arrow keys. The [Hand on] key can be enabled or disabled via parameter 0-40 [Hand on] key on LCP. If [Hand on] is active the drive can be stopped by:

- Start signal on DI 18
- The [Off] button
- Stop command from serial communication



Pressing the [Off] key will stop the motor. The [Off] key can be enabled or disabled via parameter 0-41 [Off] key on LCP. If no external stop function is selected and the [Off] key is disabled, the motor can only be stopped by disconnecting the mains supply.



Pressing the [Auto on] key enables the drive to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals and/or serial communication, the drive will start. This key can be enabled or disabled via 0-42 [Auto on] key on LCP.

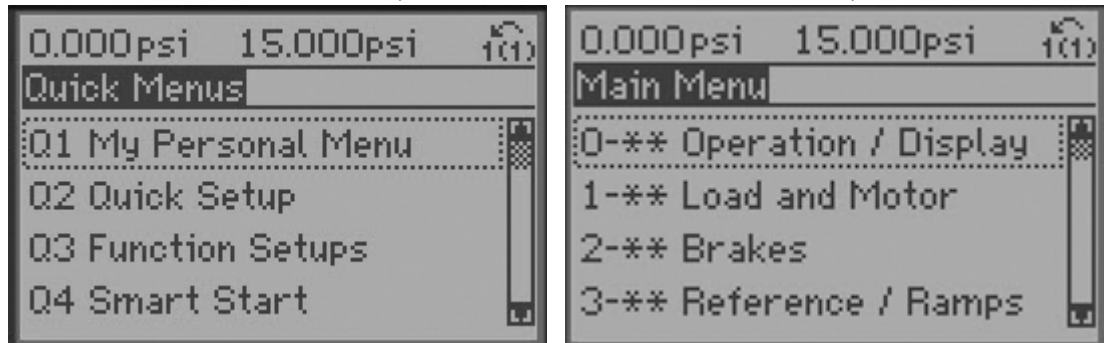


The [Reset] key is used for resetting the frequency converter after an alarm (trip). The key can be enabled or disabled via parameter 0-43 [Reset] key on LCP.

4.10 Programming the controller

The controller can be programmed by using either the Quick Menu mode or the Main Menu mode. The Main Menu mode allows access to all parameters. To view or modify a parameter in either the Main Menu or Quick Menu mode follow this procedure:

1. To enter the Quick Menu mode press  or to enter the Main Menu press .



2. Select the desired sub-menu in Quick Menus or parameter group in Main Menu by using the up and down arrows.
3. Press  to enter the selected menu in Quick Menus or the selected parameter group in Main Menu.
4. Once in the menu or parameter group use the up and down arrows to highlight the desired parameter. Press  to select the parameter and enable editing.
5. To edit the parameter use the up and down arrows to scroll through the parameter settings. For numeric values, use the left and right keys to select the position within the number. The highlighted area can be modified by using the up and down arrows.
6. Press  to accept the change or  to disregard the change.

Quick Menu

The Quick Menu mode contains various submenus that allow quick and easy access to common parameters. There are six submenus under Quick Menus. The six submenus are shown in the following table.

Table 8: Quick Menus

Submenu	Submenu Group Name	Description
Q1	My Personal Menu	Contains parameters commonly used to configure pump applications
Q2	Quick setup	Contains parameters commonly used to configure the controller
Q3	Function setups	Provides quick access to parameters commonly required for HVAC applications
Q4	Smart Start	Prompts the user to set common parameters required to set up the controller
Q5	Changes Made	Shows the last 10 changed parameters, changes since factory defaults and input assignments
Q6	Loggings	Displays graph line readouts of the LCP parameters. To change displayed LCP parameters use parameters 0-20 to 0-24

My personal menu

My Personal Menu has been configured at the factory to contain 20 parameters that are commonly used in pumping applications. The parameters that are shown in My Personal Menu vary depending on which setup is active. Refer to the Setup and Commissioning section for details on My Personal Menu parameters.

NOTICE:

Quick Setup, Function Setups, and Smart Start submenus contain motor parameters. The motor parameters have been configured at the factory for the motor that has been shipped with the system. **Improperly configuring motor parameters may cause controller malfunction.**

Main Menu

The parameters in the Main Menu are grouped by category. Note that some groups are not visible unless the appropriate option card is installed. For a complete list and detailed description for each parameter refer to document number MG11CD02, available for download at www.danfoss.com. The parameter groups in the Main Menu are:

Table 9: Main menu parameter groups

Parameter Group	Name
0	Operation/Display
1	Load and Motor
2	Brakes
3	Reference/Ramps
4	Limits/Warnings
5	Digital In/Out
6	Analog In/Out
8	Comm. and Options
9	Profibus*
10	CAN Fieldbus*
11	LonWorks*
13	Smart Logic
14	Special Functions
15	Drive Information
16	Data Readouts
18	Info & Readouts
20	Drive Closed Loop
21	Ext. Closed Loop
22	Appl. Functions
23	Time-based Functions
24	Appl. Functions 2
25	Cascade controller
26	Analog I/O Option MCB 109*

* Appropriate option card must be installed

5 System Setup and Operation

5.1 Pre-start procedure



Electrical Hazard:

If input and output connections have been connected improperly, there is potential for high voltage on these terminals. If power leads for multiple motors are improperly run in same conduit, there is potential for leakage current to charge capacitors within the frequency converter, even when disconnected from mains input. For initial start up, make no assumptions about power components. Follow pre-start procedures. Failure to follow pre-start procedures could result in personal injury or damage to equipment.

1. Make sure the input power to unit is OFF and locked out per OSHA requirements. Do not rely on panel disconnect switches.

2.

Condition	Action
Single-phase drive	Use an AC voltmeter to verify that there is no voltage on input terminals L1 and L2, and from these terminals to ground, and output terminals T1, T2, and T3, phase-to-phase, and phase to ground for one phase power supply.
Three-phase drive	Use an AC voltmeter to verify that there is no voltage on input terminals L1, L2, and L3, phase-to-phase and phase-to-ground and output terminals T1, T2, and T3, phase-to-phase, and phase-to-ground for three phase power supply.

3. Use an ohmmeter to confirm continuity of the motor by measuring T1-T2, T2-T3, and T3-T1.

4.

Condition	Action
Single-phase drive	Use an ohmmeter to confirm open on input by measuring L1 and L2 for one phase power supply.
Three-phase drive	Use an ohmmeter to confirm open on input by measuring L1-L2, L2-L3, and L3-L1 for three phase power supply.

If an isolation transformer is between the power source and panel, continuity will be present. In this case, visually confirm that motor and power leads are not reversed.

5. Inspect the controller for loose connections on terminals.
6. Check for proper ground: controller to main building distribution ground, and to motor ground.
7. Confirm control connections are terminated per connection diagrams that are supplied with the equipment.
8. Check for external devices between drive and motor.
It is recommended that no devices be installed between the motor and drive.
9. Record motor nameplate data; hp, voltage, full load amps (FLA), and RPM. Ensure the nameplate data matches the drive ratings.
10. Confirm that incoming power matches drive label voltage and motor nameplate voltage.
11. For multiple winding motors, motors must be wired on run winding Delta, not Y-start winding.

**CAUTION:**

EQUIPMENT DAMAGE. If motor FLA (full load amperage) is greater than unit maximum amps, controller must be replaced with one of appropriate ratings. Do not attempt to run the unit. Failure to match FLA to the unit maximum amp rating may result in equipment damage.

12. Confirm that the motor FLA is equal to or less than the maximum controller output current. Some motors have higher than normal NEMA currents.

5.2 Pre-startup inspections

Item to Inspect	Description	Checked
Auxiliary equipment	- Look for auxiliary equipment, switches, disconnects, or input fuses/circuit breakers that may reside on input power side of the frequency converter or output side to motor. Ensure they are ready for full speed operation. - Check function and installation of any sensors used for feedback to the frequency converter. - Remove power factor correction caps on motor(s), if present.	
Cable routing	Ensure that input power, motor wiring and control wiring are separated or in three separate metallic conduits for high frequency noise isolation.	
Control wiring	- Check for broken or damaged wires and connections. - Check that control wiring is isolated from power and motor wiring for noise immunity. - Check the voltage source of the signals, if necessary. - The use of shielded cable or twisted pair is recommended. Ensure that the shield is terminated correctly.	
Cooling clearance	Measure that top and bottom clearance is adequate to ensure proper air flow for cooling.	
EMC considerations	Check for proper installation with regard to electromagnetic capability.	
Environmental conditions	- See equipment tech label for the maximum ambient operation temperature limits. - Humidity levels must be 5–95% non-condensing.	
Fusing and circuit breakers	- Check for proper fusing or circuit breakers. - Check that all fuses are inserted firmly and in operational condition and that all circuit breakers are in the open position.	
Grounding (earthing)	- The unit requires an earth wire (ground wire) from its chassis to the building ground (earth). - Check for good earth connections (ground connections) that are tight and free of oxidation. - grounding (earthing) to conduit or mounting the back panel to a metal surface is not a suitable ground (earth).	
Input and output power wiring	- Check for loose connections. - Check that motor and mains are in separate conduit or separated screened cables.	
Panel interior	Inspect that the unit interior is free of dirt, metal chips, moisture, and corrosion.	
Switches	Ensure that all switch and disconnect settings are in the proper positions.	
Vibration	- Check that the unit is mounted solidly or that shock mounts are used, as necessary. - Check for an unusual amount of vibration.	

Checked by:

Date:

5.3 Start-up procedure

**Electrical Hazard:**

EQUIPMENT HAZARD. The drive contains dangerous voltages when connected to line voltage. Installation, start-up, and maintenance must be performed only by qualified personnel. Failure to perform installation, start-up and maintenance by qualified personnel only could result in death or serious injury.

1. Perform pre-start procedure.
2. Ensure that all operator devices are in the OFF position.
3. Keep the built-in disconnect switch in the OFF position. Apply voltage to the unit. **DO NOT operate drive now.**

4.

Condition	Action
Single-phase drive	Not applicable
Three-phase drive	Confirm input line voltage is balanced within 3% for three phase drive. If it is not, correct input voltage imbalance before proceeding. Repeat this procedure after voltage correction, when applicable.

5. Confirm that the wiring matches the installation diagram that is supplied with the unit.
6. Ensure control wiring matches the installation application.
7. Turn the built-in disconnect to the ON position.

5.4 ITSC Setup and commissioning



WARNING:

System commissioning must be performed by qualified personnel.

- Ensure that all piping connections are made before commissioning the drive.
- Follow all start-up procedures for the motor, pump, and controller as indicated in their respective manuals.
- Refer to the Technologic Pump Controller IOM for detailed information on controller programming and parameters.
- Some default parameters are configured specially for the Integrated Sensorless controller. The default parameters that are listed in the Technologic controller IOM may be different.
- The motor parameters have been configured at the factory for the motor provided with the Integrated Technologic Controller. **After an initialization, the motor parameters are required to be matched up with motor nameplate to avoid damaging the motor. Refer to the Technologic Pump Controller IOM for details on initialization.**

Sensorless operation

ITSC product has been equipped with sensorless control capability. This feature allows control of a process variable (pressure or flow) without the need of installing an external transducer. **Sensorless control is intended for use in closed loop systems such as hydronic circulating pump systems. Sensorless control is not intended for open loop systems.** The sensorless control method uses the relationship between head (pressure), flow, power and speed (frequency) to determine the appropriate speed for the pump that is required to maintain the process variable setpoint. Since these relationships change with the use of different pumps and motors, pump performance data for the pump used must be programmed in to the controller. This data has been pre-programmed in to the drive at the factory to give the most accurate control possible. The controller is pre-configured at the factory for sensorless pressure control (Set-up 3).

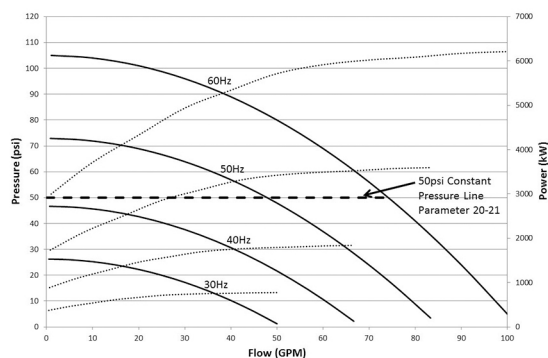


Figure 14: Pump performance and power curves

The solid lines in the diagram above show typical pump performance curves at various speeds. The dotted lines show the pump power curve at various speeds. The dashed line shows the setpoint of the process variable, in this case pressure. If a wired pressure transducer was used, the transducer would provide feedback to the pressure control loop. The pressure control loop would then calculate the speed required to maintain the setpoint during various flow conditions. In the case of sensorless pressure control, the drive calculates the pressure in the system based on the speed and power consumption of the pump and sends this value to the pressure control loop. The pressure control loop then calculates the speed command as with the wired transducer.

In either sensorless pressure or flow control mode the manipulated variable can be monitored or displayed by accessing parameter 18-50 Sensorless Readout [Unit]. In sensorless pressure control mode, the manipulated variable is flow (flow varies while the pressure setpoint is maintained). In sensorless flow control mode, the manipulated variable is pressure. The units for the manipulated variable are set in parameter 20-60 Sensorless Unit. For sensorless pressure control (Set-up 3) Sensorless Unit is set to GPM. For sensorless flow control (Set-up 4), Sensorless Unit is set to psi.

To change to sensorless flow control, change the active set-up to Set-up 4 by changing parameter 0-10 Active Set-up to Set-up 4.

Flow compensation

As flow in a pumping system increases, the system friction head losses will also increase. Friction head loss is higher in systems with increased pipe lengths or decreased pipe size. The impact of this head loss is that the pressure at different points in the system will vary depending on flow rate and the distance from the pump. The loss will be most significant in the zones farthest from the pump. The controller's internal flow compensation function is used to correct the effect of friction head loss in the system. The flow compensation function calculates a control curve based on pump and system parameters. The controller actively adjusts the setpoint along the control curve based on the speed of the pump. In a pump system, change in speed is proportional to a change in flow so the controller effectively adjusts the setpoint based on a change in speed. A change in pressure varies with the square of the change in speed or flow so a quadratic compensation factor is used to adjust the setpoint. This is the ideal compensation curve. When the controller is configured for sensorless pressure operation, the Square-linear curve approximation (Parameter 22-81) is automatically configured. Parameter 22-81 can be modified to adjust the control curve between a linear (0%) and quadratic (100%) response if a wired sensor is used for feedback. The diagram below illustrates this concept.

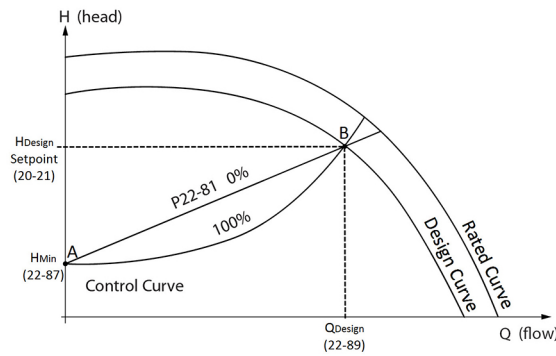


Figure 15: Flow compensation with sensorless control enabled

The flow compensation function requires some system parameters to be set in the controller to accurately model the control curve. Some parameters must be set based on the design of the system in order to properly configure this function. Set the parameters in the table below to properly configure the flow compensation function when the controller is configured for sensorless control.

Table 10: Flow compensation parameters with sensorless control enabled

Parameter number	Description	Set to
22-80	Flow compensation	Enabled
22-81	Square-Linear-Curve approximation	Modify between 100% (square) and 0% (linear) per system requirements.
22-87	Pressure at no flow	System pressure at no flow and no flow speed. This is the minimum design head for the system.
22-89	Flow at design point	System flow at H_{Design} (pressure setpoint (20-21))

If the controller is configured to operate with a wired sensor or in sensorless flow control mode, additional parameters must be set to properly configure the flow compensation function because pump performance data is unknown by the controller. In a sensorless application the controller is preprogrammed with the pump performance data. This means that only 3 points (setpoint, pressure at no flow and flow at design point) are required to determine the control curve for a sensorless application. For a sensorless flow or wired sensor application the pump data is not known so additional parameters must be configured for proper operation of the flow compensation function. The parameters that are required to be configured will depend on whether the speed at the design point is known. If the speed at the design point is known, set Work Point Calculation (parameter 22-82) to disabled. Set the Speed at No Flow [Hz] and Pressure at No-Flow Speed (parameters 22-84 and 22-87 respectively), which correlate to point A on the diagram below. The intersection of the system setpoint and Speed at Design Point [Hz] (parameter 22-86) correlates with point B. With this information the controller can then calculate the control curve. Refer to the diagram below.

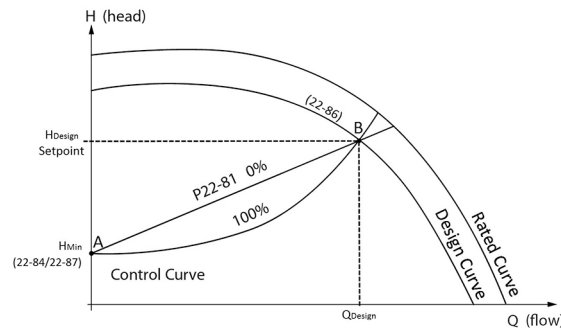


Figure 16: Flow compensation with sensorless control disabled and speed at system design working point is unknown

Table 11: Flow compensation parameters when speed at design point is known

Parameter number	Description	Set to
22-80	Flow compensation	Enabled
22-81	Square-Linear-Curve approximation	Modify between 100% (square) and 0% (linear) per system requirements.
22-82	Work point calculation	Disabled
22-84	Speed at no flow (Hz)	To find this point, close all valves in the system and run the pump at the minimum design head. The speed corresponding to the minimum head requirement at no flow will be entered here.
22-86	Speed at design point (Hz)	These points correspond to the speed required to maintain point B (design head (setpoint) and flow).
22-87	Pressure at no flow	System pressure at no flow and no flow speed. This is the minimum design head.

If the speed at the design point is unknown, the Work Point Calculation (parameter 22-82) must be enabled. With the Work Point Calculation enabled the controller will calculate the speed at the design point based on settings of some additional parameters correlating to the points shown on the diagram below. The first point determined is point A which is the minimum required head at minimum speed (parameters 22-84 and 22-87). Points C and D can be determined by consulting the pump performance curve. Point C is determined by extending the design setpoint line horizontally to intersect the rated curve which is the pump performance curve at rated speed (usually 50 or 60Hz). The flow at this point (Q_{Rated}) is set in parameter 22-90 Flow at Rated Speed. Point D is determined by extending the design flow point (Q_{Design}) vertically to intersect the rated speed curve. The head generated at this flow and speed is set at Pressure at Rated Speed (parameter 22-88). Knowing points A, C and D allow the controller to calculate point E along with the control curve which includes point B (speed, pressure and flow at design speed). Refer to the diagram below.

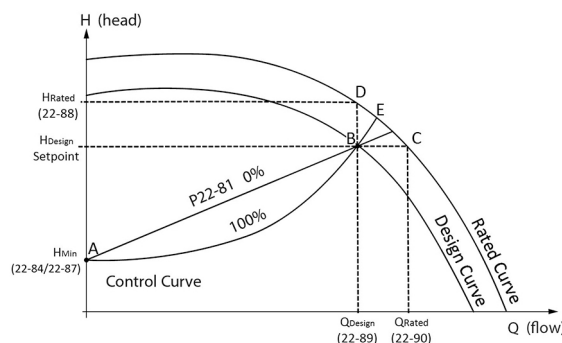


Figure 17: Flow compensation with sensorless control disabled and speed at system design working point is unknown

Table 12: Flow compensation parameters when speed at design point is unknown

Parameter number	Description	Set to
22-80	Flow compensation	Enabled
22-81	Square-Linear-Curve approximation	Modify between 100% (square) and 0% (linear) per system requirements.
22-82	Work point calculation	Enabled
22-84	Speed at no flow (Hz)	To find this point, close all valves in the system and run the pump at the minimum design head. The speed corresponding to the minimum head requirement at no flow will be entered here.
22-87	Pressure at no flow	System pressure at no flow and no flow speed. This is the minimum design head.
22-88	Pressure at rated speed	This point corresponds to the head developed at design flow and rated speed. This value can be defined using the pump performance curve.
22-89	Flow at design point	This point corresponds to the system design flow.
22-90	Flow at rated speed	This point corresponds to the flow at rated speed. This value can be defined using the pump performance curve.

Commissioning

NOTICE:

The factory default settings are configured to require a start signal to be wired to DI18.

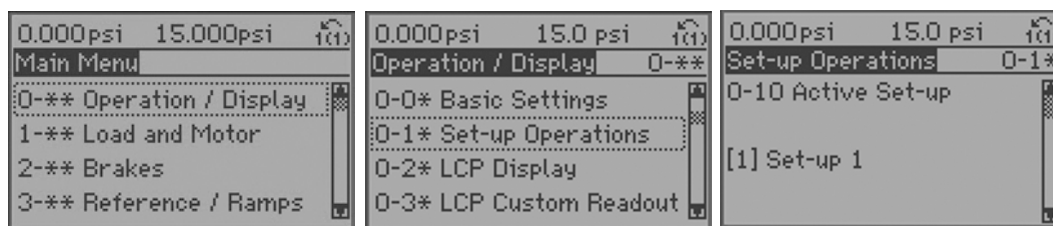
For fast and easy installation, the controller has been preprogrammed with 4 different set-ups. Each set-up is configured for a different application. The set-ups contain parameters that are preset for the given application.

Set-up 1	Default configured for Delta P or pressure control with a wired pressure transducer. The pressure transducer input is configured for a transducer with a maximum output at 40.0 psi. The setpoint is preset to 15psi. Connect transducer feedback to AI53. Be sure to properly set the analog input configuration switch A53 to match the sensor output type (I = 4-20mA output).
Set-up 2	Default configured for flow control with a wired flow transducer. The flow transducer input is configured for a transducer with a maximum output at 4000.0 GPM. The setpoint is preset to 150 GPM. Connect transducer feedback to AI54. Be sure to properly set the analog input configuration switch AI54 to match the sensor output type (U = 0-10V output).

Set-up 3	Default configured for pressure control using sensorless pressure control. No transducer connections are required. The setpoint has been preconfigured at the factory based on the order request. This is the default set-up.
Set-up 4	Default configured for flow control using sensorless flow control. No transducer connections are required. The setpoint has been preconfigured at the factory based on the order request.

The controller comes configured with Set-up 3 as the active set-up (sensorless pressure control). To select a different set-up:

1. From the status screen, press  to enter the parameter list.
2. Use the up and down arrows to scroll to 0-** Operation/Display and press .
3. Under Operation/Display use the up and down arrows to select 0-1* Set-up Operations and press .
4. Under 0-1* Set-up Operations select 0-10 Active Set-up by pressing .
5. Press  to enable editing of the parameter.
6. Change parameter 0-10 Active Set-up to the desired set-up using the up and down buttons.
7. Press  to save the changes.
8. Press  to return to the status screen.



To complete commissioning of the controller it is recommended to use My Personal Menu. My Personal Menu has been configured with parameters commonly used in pump applications. To access this menu press  and select My Personal Menu by pressing . Scroll through the My Personal Menu parameter list and adjust the parameters using the navigation keys. The following parameters have been added to My Personal Menu for quick access:

Table 13: My personal menu parameters for set-ups 1 and 2

		Setup 1	Setup 2	
		Delta P / Pressure Control Wired Pressure Transducer	Flow Control Wired Flow Transducer	
Parameter Number	Parameter Name	Default Value for Set-up 1	Default Value for Set-up 2	Parameter Description
20-21	Setpoint 1	15.0	150.0	Process setpoint. The controller will adjust speed to maintain this value.
20-00	Feedback 1 Source	Analog Input 53	Analog Input 54	Feedback source for the PID controller, transducer input source.
20-12	Reference/Feedback Unit	psi	GPM	Transducer feedback units
20-13	Min Reference/Feedb.	0.0	0.0	Minimum feedback value for the transducer.

		Setup 1	Setup 2	
		Delta P / Pressure Control Wired Pressure Transducer	Flow Control Wired Flow Transducer	
Parameter Number	Parameter Name	Default Value for Set-up 1	Default Value for Set-up 2	Parameter Description
20-14	Max Reference/Feedb.	40.0	4000.0	Maximum feedback value for the transducer.
3-41	Ramp 1 Ramp Up Time	10 s	10 s	Ramp up time (0 to full speed). Increasing this time will produce a slower ramp up.
3-42	Ramp 1 Ramp Down Time	10 s	10 s	Ramp down time (full speed to 0). Increasing this time will produce a slower ramp down.
20-93	PID Prop Gain	5	5	Proportional correction gain for PID controller. Increasing this value will produce a faster system response. CAUTION: Increasing this value too high can make the system unstable and produce severe oscillations.
20-94	PID Integration Time	3.3 s	3.3 s	Integration time for the PID controller. Increasing this value will produce a slower system response. CAUTION: Decreasing this value too low can make the system unstable and produce severe oscillations.
22-80	Flow Compensation	Disabled	Disabled	Enables or disables flow compensation (head loss compensation) function.
22-81	Square-Linear Curve Approx.	100%	100%	Adjusts shape of the flow compensation control curve.
22-84	Speed at No Flow [Hz]	0.0 Hz	0.0 Hz	Speed required to maintain the minimum head at no flow. Use this parameter when flow compensation is enabled. See figure 3, point A.
22-86	Speed at Design Point [Hz]	60.0 Hz	60.0 Hz	Speed required to maintain the design point. Use this parameter when flow compensation is enabled. See figure 3, point B.
22-87	Pressure at No Flow Speed	0.000	0.000	Pressure developed at no flow speed. Use this parameter when flow compensation is enabled. See figure 2, point A.

		Setup 1	Setup 2	
		Delta P / Pressure Control Wired Pressure Transducer	Flow Control Wired Flow Transducer	
Parameter Number	Parameter Name	Default Value for Set-up 1	Default Value for Set-up 2	Parameter Description
22-89	Flow at Design Point	NA	NA	System flow at the setpoint and rated speed. Use this parameter when flow compensation is enabled. See figure 2, point B.
5-10	Terminal 18 Digital Input	Start	Start	DI 18 function
5-11	Terminal 19 Digital Input	No operation		DI 19 function
5-12	Terminal 27 Digital Input	No operation		DI 27 function
6-50	Terminal 42 Output	Speed 4-20mA	Speed 4-20mA	Analog output function
5-40	Function Relay	Relay 1: No Alarm Relay 2: Running	Relay 1: No Alarm Relay 2: Running	Relay 1 and 2 function. See note below on how to program this parameter.

Table 14: My personal menu parameters for set-ups 3 and 4

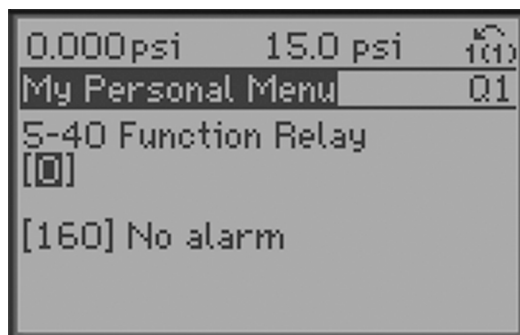
		Setup 3	Setup 4	
		Sensorless Pressure Control	Sensorless Flow Control	
Parameter Number	Parameter Name	Default Value for Set-up 3	Default Value for Set-up 4	Parameter Description
20-21	Setpoint 1	15.0	150.0	Process setpoint. The controller will adjust speed to maintain this value.
20-00	Feedback 1 Source	Sensorless Pressure	Sensorless Flow	Feedback source for the PID controller, transducer input source.
20-12	Reference/Feedback Unit	psi	GPM	Transducer feedback units
20-13	Min Reference/Feedb.	0.0	0.0	Minimum feedback value for the transducer.
20-14	Max Reference/Feedb.	200.0	4000.0	Maximum feedback value for the transducer.
3-41	Ramp 1 Ramp Up Time	10 s	10 s	Ramp up time (0 to full speed). Increasing this time will produce a slower ramp up.
3-42	Ramp 1 Ramp Down Time	10 s	10 s	Ramp down time (full speed to 0). Increasing this time will produce a slower ramp down.
20-93	PID Prop Gain	5	5	Proportional correction gain for PID controller. Increasing this value will produce a faster system response. CAUTION: Increasing this value too high can make the system unstable and produce severe oscillations.

		Setup 3	Setup 4	
		Sensorless Pressure Control	Sensorless Flow Control	
Parameter Number	Parameter Name	Default Value for Set-up 3	Default Value for Set-up 4	Parameter Description
20-94	PID Integration Time	3.3 s	3.3 s	Integration time for the PID controller. Increasing this value will produce a slower system response. CAUTION: Decreasing this value too low can make the system unstable and produce severe oscillations.
22-80	Flow Compensation	Enabled	Disabled	Enables or disables flow compensation (head loss compensation) function.
22-81	Square-Linear Curve Approx.	100%	100%	Adjusts shape of the flow compensation control curve.
22-84	Speed at No Flow [Hz]	NA	0.0 Hz	Speed required to maintain the minimum head at no flow. Use this parameter when flow compensation is enabled. See figure 3, point A.
22-86	Speed at Design Point [Hz]	NA	60.0 Hz	Speed required to maintain the design point. Use this parameter when flow compensation is enabled. See figure 3, point B.
22-87	Pressure at No Flow Speed	0.000	0.000	Pressure developed at no flow speed. Use this parameter when flow compensation is enabled. See figure 2, point A.
22-89	Flow at Design Point	0.000	NA	System flow at the setpoint and rated speed. Use this parameter when flow compensation is enabled. See figure 2, point B.
5-10	Terminal 18 Digital Input	Start	Start	DI 18 function
5-11	Terminal 19 Digital Input	No operation		DI 19 function
5-12	Terminal 27 Digital Input	No operation		DI 27 function
6-50	Terminal 42 Output	Speed 4-20mA	Speed 4-20mA	Analog output function
5-40	Function Relay	Relay 1: No Alarm Relay 2: Running	Relay 1: No Alarm Relay 2: Running	Relay 1 and 2 function. See note below on how to program this parameter.

Parameter 5-40, Function Relay, in My Personal Menu is an array parameter. This parameter can be programmed using the following procedure.

1. Enter My Personal Menu as previously described.
2. Use the up and down arrows to scroll to parameter 5-40 Function Relay.
3. Press  to enable editing.

4. Use the up and down arrows to select Relay 1 or Relay 2. Relay 1 is [0]. Relay 2 is [1].
5. Press  to save the selection and enable editing of the relay function.
6. Use the up and down arrows to select the desired relay function.
7. Press  to save the selection. This will also enable selection of Relay 1 or Relay 2. Repeat the steps above to change the function of the other relay.
8. To exit editing of the parameter press .



Once the parameters in My Personal Menu have been set, press  to start the controller and complete the commissioning of the controller.

5.5 IT Setup and commissioning



WARNING:

System commissioning must be performed by qualified personnel.

- Ensure that all piping connections are made before commissioning the drive.
- Follow all start-up procedures for the motor, pump, and controller as indicated in their respective manuals.
- Refer to the Technologic Pump Controller IOM for detailed information on controller programming and parameters.
- Some default parameters are configured specially for the Integrated Sensorless controller. The default parameters that are listed in the Technologic controller IOM may be different.
- The motor parameters have been configured at the factory for the motor provided with the Integrated Technologic Controller. **After an initialization, the motor parameters are required to be matched up with motor nameplate to avoid damaging the motor. Refer to the Technologic Pump Controller IOM for details on initialization.**

Commissioning

NOTICE:

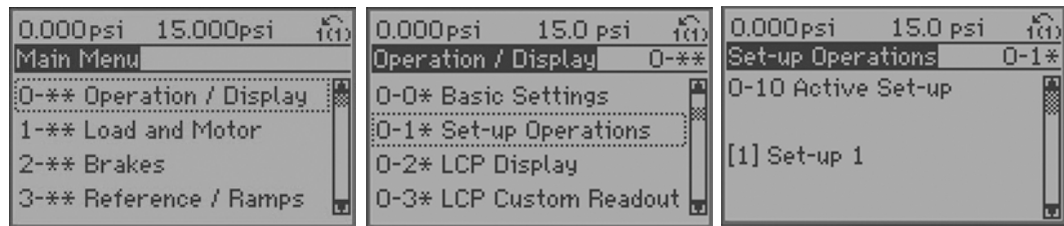
The factory default settings are configured to require a start signal to be wired to DI18.

For fast and easy installation, the controller has been preprogrammed with 4 different set-ups. Each set-up is configured for a different application. The set-ups contain parameters that are preset for the given application.

Set-up 1	Default configured for Delta P or pressure control with a wired pressure transducer. The pressure transducer input is configured for a transducer with a maximum output at 40.0 psi. The setpoint is preset to 15psi. Connect transducer feedback to AI53. Be sure to properly set the analog input configuration switch A53 to match the sensor output type (I = 4-20mA output).
Set-up 2	Default configured for flow control with a wired flow transducer. The flow transducer input is configured for a transducer with a maximum output at 4000.0 GPM. The setpoint is preset to 150 GPM. Connect transducer feedback to AI54. Be sure to properly set the analog input configuration switch AI54 to match the sensor output type (U = 0-10V output).

The controller comes configured with Set-up 1 as the active set-up (Delta P / Pressure control). To select a different set-up:

1. From the status screen, press  to enter the parameter list.
2. Use the up and down arrows to scroll to 0-** Operation/Display and press .
3. Under Operation/Display use the up and down arrows to select 0-1* Set-up Operations and press .
4. Under 0-1* Set-up Operations select 0-10 Active Set-up by pressing .
5. Press  to enable editing of the parameter.
6. Change parameter 0-10 Active Set-up to the desired set-up using the up and down buttons.
7. Press  to save the changes.
8. Press  to return to the status screen.



To complete commissioning of the controller it is recommended to use My Personal Menu. My Personal Menu has been configured with parameters commonly used in pump applications. To access this menu press  and select My Personal Menu by pressing . Scroll through the My Personal Menu parameter list and adjust the parameters using the navigation keys. The following parameters have been added to My Personal Menu for quick access:

Table 15: My personal menu parameters for set-ups 1 and 2

		Setup 1	Setup 2	
		Delta P / Pressure Control Wired Pressure Transducer	Flow Control Wired Flow Transducer	
Parameter Number	Parameter Name	Default Value for Set-up 1	Default Value for Set-up 2	Parameter Description
20-21	Setpoint 1	15.0	150.0	Process setpoint. The controller will adjust speed to maintain this value.
20-00	Feedback 1 Source	Analog Input 53	Analog Input 54	Feedback source for the PID controller, transducer input source.

		Setup 1	Setup 2	
		Delta P / Pressure Control Wired Pressure Transducer	Flow Control Wired Flow Transducer	
Parameter Number	Parameter Name	Default Value for Set-up 1	Default Value for Set-up 2	Parameter Description
20-12	Reference/Feedback Unit	psi	GPM	Transducer feedback units
20-13	Min Reference/Feedb.	0.0	0.0	Minimum feedback value for the transducer.
20-14	Max Reference/Feedb.	40.0	4000.0	Maximum feedback value for the transducer.
3-41	Ramp 1 Ramp Up Time	10 s	10 s	Ramp up time (0 to full speed). Increasing this time will produce a slower ramp up.
3-42	Ramp 1 Ramp Down Time	10 s	10 s	Ramp down time (full speed to 0). Increasing this time will produce a slower ramp down.
20-93	PID Prop Gain	5	5	Proportional correction gain for PID controller. Increasing this value will produce a faster system response. CAUTION: Increasing this value too high can make the system unstable and produce severe oscillations.
20-94	PID Integration Time	3.3 s	3.3 s	Integration time for the PID controller. Increasing this value will produce a slower system response. CAUTION: Decreasing this value too low can make the system unstable and produce severe oscillations.
22-80	Flow Compensation	Disabled	Disabled	Enables or disables flow compensation (head loss compensation) function.
22-81	Square-Linear Curve Approx.	100%	100%	Adjusts shape of the flow compensation control curve.
22-84	Speed at No Flow [Hz]	0.0 Hz	0.0 Hz	Speed required to maintain the minimum head at no flow. Use this parameter when flow compensation is enabled. See figure 3, point A.
22-86	Speed at Design Point [Hz]	60.0 Hz	60.0 Hz	Speed required to maintain the design point. Use this parameter when flow compensation is enabled. See figure 3, point B.
22-87	Pressure at No Flow Speed	0.000	0.000	Pressure developed at no flow speed. Use this parameter when flow compensation is enabled. See figure 2, point A.

		Setup 1	Setup 2	
		Delta P / Pressure Control Wired Pressure Transducer	Flow Control Wired Flow Transducer	
Parameter Number	Parameter Name	Default Value for Set-up 1	Default Value for Set-up 2	Parameter Description
5-10	Terminal 18 Digital Input	Start	Start	DI 18 function
5-11	Terminal 19 Digital Input	No operation		DI 19 function
5-12	Terminal 27 Digital Input	No operation		DI 27 function
6-50	Terminal 42 Output	Speed 4-20mA	Speed 4-20mA	Analog output function
5-40	Function Relay	Relay 1: No Alarm Relay 2: Running	Relay 1: No Alarm Relay 2: Running	Relay 1 and 2 function. See note below on how to program this parameter.

Parameter 5-40, Function Relay, in My Personal Menu is an array parameter. This parameter can be programmed using the following procedure.

1. Enter My Personal Menu as previously described.
2. Use the up and down arrows to scroll to parameter 5-40 Function Relay.
3. Press  to enable editing.
4. Use the up and down arrows to select Relay 1 or Relay 2. Relay 1 is [0]. Relay 2 is [1].
5. Press  to save the selection and enable editing of the relay function.
6. Use the up and down arrows to select the desired relay function.
7. Press  to save the selection. This will also enable selection of Relay 1 or Relay 2. Repeat the steps above to change the function of the other relay.
8. To exit editing of the parameter press .



Once the parameters in My Personal Menu have been set, press  to start the controller and complete the commissioning of the controller.

6 Troubleshooting

6.1 Troubleshooting menus

The controller has various menus which display information used to troubleshoot the controller.

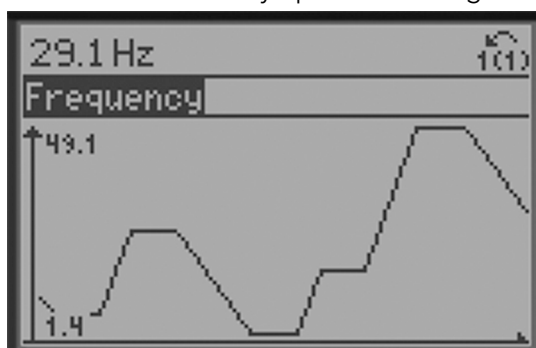
Changes Made

The Changes Made menu can be used to view changes made to parameters. To access the Changes Made menu press  and scroll to Changes Made. Press  to enter the menu.

Loggings

During troubleshooting the Loggings menu can be used to monitor the parameters shown on the LCP in graphical form. To access the Loggings menu press  and scroll to

Loggings. Use the arrow keys to select the desired parameter to monitor. Press  to view the parameter in graphical form. The graphical window scrolls right to left, present state is on the right and past state is on the left. The window shows 1 minute of logged data and continuously updates from right to left.



Data Log Settings

Parameter group 15 Drive Information contains parameters that allow monitoring present and past state of the controller. The controller has been configured to log 4 parameters in the event of an alarm condition these settings are found in the Data Log Settings, parameter group 15-1*. The following parameters will be logged: Feedback [Unit], Frequency, Inverter Thermal and Motor Current. The controller is set to take 50 samples of data prior to the alarm event. This data can be viewed by accessing the controller using the MCT 10 tool. Contact the factory for details.

6.2 Reset the frequency converter

Parameter group 15 Drive Information contains parameters that allow monitoring present and past state of the controller. The controller has been configured to log 4 parameters in the event of an alarm condition. The following parameters will be logged: Feedback [Unit], Frequency, Inverter Thermal and Motor Current. The controller is set to take 50 samples of data prior to the alarm event. The data can be viewed by accessing the Quick Menu mode

by pressing . Scroll to sub-menu Q6 Loggings and press .

A warning or alarm is signalled by the relevant LED on the front of the frequency converter and indicated by a code on the display.

A warning remains active until its cause is no longer present. Under certain circumstances operation of the motor may still be continued. Warning messages may be critical, but are not necessarily so.

In the event of an alarm, the frequency converter will have tripped. Alarms must be reset to restart operation once their cause has been rectified. This may be done in four ways:

1. By using the [RESET] control button on the LCP.
2. Via a digital input with the "Reset" function.
3. Via serial communication/optional fieldbus.
4. By resetting automatically using [Auto Reset] function.

After a manual reset using the [RESET] control button on the LCP, the [AUTO ON] or [HAND ON] button must be pressed to restart the motor.

Trip-locked alarm

If an alarm cannot be reset, the reason may be that its cause has not been rectified, or the alarm is trip-locked (see also table on following page).

NOTICE:

Disconnect and lock out electrical power before installing or servicing the unit.

- Alarms that are trip-locked offer additional protection, means that the mains supply must be switched off before the alarm can be reset.
- After being switched back on, the frequency converter is no longer blocked and may be reset as described above once the cause has been rectified.
- Alarms that are not trip-locked can also be reset using the automatic reset function in 14-20 Reset Mode. Warning: Automatic wake-up is possible.)

If a warning and alarm is marked against a code in the table on the following page, this means that either a warning occurs before an alarm, or it can be specified whether it is a warning or an alarm that is to be displayed for a given fault. This is possible, for instance, in 1-90 Motor Thermal Protection. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash on the frequency converter. Once the problem has been rectified, only the alarm continues flashing.

Table 16: Alarm/Warning code list

Number	Description	Warning	Alarm/Trip	Alarm / Trip Lock	Parameter Reference
1	10 volts low	X			
2	Live zero error	(X)	(X)		6-01
3	No motor	(X)			1-80
4	Mains phase loss	(X)	(X)	(X)	14-12
5	DC link voltage high	X			
6	DC link voltage low	X			
7	DC over voltage	X	X		
8	DC under voltage	X	X		
9	Inverter overloaded	X	X		
10	Motor ETR over temperature	(X)	(X)		1-90
11	Motor thermistor over temperature	(X)	(X)		1-90
12	Torque limit	X	X		
13	Over current	X	X	X	
14	Earth fault	X	X	X	
15	Hardware mismatch		X	X	
16	Short circuit		X	X	
17	Control word timeout	(X)	(X)		8-04
18	Start failed		X		

Number	Description	Warning	Alarm/Trip	Alarm / Trip Lock	Parameter Reference
23	Internal fan fault	X			
24	External fan fault	X			14-53
25	Brake resistor short-circuited	X			
26	Brake resistor power limit	(X)	(X)		2-13
27	Brake chopper short-circuited	X	X		
28	Brake check	(X)	(X)		2-15
29	Drive over temperature	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	4-58
31	Motor phase V missing	(X)	(X)	(X)	4-58
32	Motor phase W missing	(X)	(X)	(X)	4-58
33	Inrush fault		X	X	
34	Fieldbus communication fault	X	X		
35	Out of frequency range	X	X		
36	Mains failure	X	X		
37	Phase imbalance (not applicable for single-phase drives)	X	X		
38	Internal fault		X	X	
39	Heatsink sensor		X	X	
40	Overload of digital output terminal 27	(X)			5-00, 5-01
41	Overload of digital output terminal 29	(X)			5-00, 5-02
42	Overload of digital output on X30/6	(X)			5-32
42	Overload of digital output on X30/7	(X)			5-33
46	Pwr. card supply		X	X	
47	24 V supply low	X	X	X	
48	1.8 V supply low		X	X	
49	Speed limit	X	(X)		1-86
50	AMA calibration failed		X		
51	AMA check Unom and Inom		X		
52	AMA low Inom		X		
53	AMA motor too big		X		
54	AMA motor too small		X		
55	AMA parameter out of range		X		
56	AMA interrupted by user		X		
57	AMA timeout		X		
58	AMA internal fault	X	X		
59	Current limit	X			

Number	Description	Warning	Alarm/Trip	Alarm / Trip Lock	Parameter Reference
60	External interlock	X			
62	Output frequency at maximum limit	X			
64	Voltage limit	X			
65	Control board over-temperature	X	X	X	
66	Heat sink temperature low	X			
67	Option configuration has changed		X		
69	Pwr. card temp		X	X	
70	Illegal FC configuration			X	
71	PTC 1 safe stop	X	X ¹⁾		
72	Dangerous failure			X ¹⁾	
73	Safe stop auto restart				
76	Power unit setup	X			
79	Illegal PS config		X	X	
80	Drive initialized to default value		X		
91	Analog input 54 wrong settings			X	
92	NoFlow	X	X		22-2*
93	Dry pump	X	X		22-2*
94	End of curve	X	X		22-5*
95	Broken belt	X	X		22-6*
96	Start delayed	X			22-7*
97	Stop delayed	X			22-7*
98	Clock fault	X			0-7*
201	Fire M was active				

6.3 Warnings and alarms

Warning/Alarm	Description	Cause	Remedy
1 – 10 V low	The control card voltage is below 10 V from terminal 50.	A short in a connected potentiometer or improper wiring of the potentiometer.	Remove the wiring from terminal 50. If the warning clears, the problem is with the customer wiring.
2 – Sensor Fault	This warning or alarm will only appear if programmed by the user in 6-01 Sensor FaultTimeout Function. The signal on one of the analog inputs is less than 50% of the minimum value that is programmed for that input.	Broken wiring or faulty device sending the signal.	Check the connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common. General Purpose I/O Option Card terminals 11 and 12 for signals, terminal 10 common. Analog I/O Option Card terminals 1, 3, 5 for signals, terminals 2, 4, 6 common. Check that the frequency converter programming and switch settings match the analog signal type. Perform Input Terminal Signal Test

Warning/Alarm	Description	Cause	Remedy
4 – Input phase loss	A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears for a fault in the input rectifier on the frequency converter. Options are programmed at [14-12] Function at Input Imbalance (not applicable for single-phase drives).		Check the supply voltage and supply currents to the frequency converter.
5 – DC link voltage high	The intermediate circuit voltage (DC) is higher than the high voltage warning limit.	The limit is dependent on the frequency converter voltage rating. The frequency converter is still active.	
6 – DC link voltage low	The intermediate circuit voltage (DC) is lower than the low voltage warning limit.	The limit is dependent on the frequency converter voltage rating. The frequency converter is still active.	
7 – DC overvoltage	If the intermediate circuit voltage exceeds the limit, the frequency converter trips after a time.		Connect a brake resistor Extend a ramp time Change the ramp type Activate functions in [2-10] Brake Function Increase [14-26] Trip Delay at Inverter Fault
8 – DC under voltage	If the intermediate circuit voltage (DC) drops below the under voltage limit, the frequency converter checks if a 24 VDC backup supply is connected.	If no 24 VDC backup supply is connected, the frequency converter trips after a fixed time delay. The time delay varies with unit size.	Check that the supply voltage matches the frequency converter voltage. Perform input voltage test Perform soft charge and rectifier circuit test.
9 – Inverter overloaded	The frequency converter is about to cut-out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection gives a warning at 98% and trips at 100% while giving an alarm. The frequency converter cannot be reset until the counter is below 90%.	The fault is that the frequency converter is overloaded by more than 100% for too long.	Compare the output current shown on the LCP with the frequency converter rated current. Compare the output current shown on the LCP with the measured motor current. Display the Thermal Drive Load on the LCP and
10 – Motor overload temperature	According to the electronic thermal protection (ETR), the motor is too hot. Select whether the frequency converter gives a warning or an alarm when the counter reaches 100% in 1-90 Motor Thermal Protection.	The fault occurs when the motor is overloaded by more than 100% for too long.	Check for motor overheating. Check if the motor is mechanically overloaded. Check that the motor current set in [1-24] Motor Current is correct.

Warning/Alarm	Description	Cause	Remedy
11 – Motor thermistor over temp	The thermistor might be disconnected. Select whether the frequency converter gives a warning or an alarm in 1-90 Motor Thermal Protection.		Check for motor overheating. Check if the motor is mechanically overloaded. When using terminal 53 or 54, check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply) and that the terminal switch for 53 or 54 is set for voltage. Check [1-93] Thermistor Source selects terminal 53 or 54. When using digital inputs 18 or 19, check that the thermistor is connected correctly between either terminal 18 or 19 (digital input PNP only) and terminal 50. Check [1-93] Thermistor Source selects terminal 18 or 19.
12 – Torque limit	The torque has exceeded the value in 4-16 Torque Limit Motor Mode or the value in 4-17 Torque Limit Generator Mode. 14-25 Trip Delay at Torque Limit can change this from a warning only condition to a warning followed by an alarm.		If the motor torque limit is exceeded during ramp up, extend the ramp up time. If the generator torque limit is exceeded during ramp down, extend the ramp down time. If torque limit occurs while running, possibly increase the torque limit. Be sure the system can operate safely at a higher torque. Check the application for excessive current draw on the motor.
13 – Over current	The inverter peak current limit (approx. 200% of the rated current) is exceeded. The warning lasts about 1.5 seconds, then the frequency converter trips and issues an alarm. This fault may be caused by shock loading or fast acceleration with high inertia loads. If extended mechanical brake control is selected, trip can be reset externally.		Remove power and check if the motor can be turned. Check that the motor size matches the frequency converter. Check parameters 1-20 through 1-25 for correct motor data.
14 – Ground/Earth fault	There is current from the output phases to ground, either in the cable between the frequency converter and the motor or in the motor itself.		Remove power to the frequency converter and repair the earth fault. Check for ground faults in the motor by measuring the resistance to ground of the motor leads and the motor megohmmeter.

Warning/Alarm	Description	Cause	Remedy
15 – Hardware mismatch	A fitted option is not operational with the present control board hardware or software.		Record the value of the following parameters and contact your Xylem supplier: • [15-40] FC Type • [15-41] Power Section • [15-42] Voltage • [15-43] Software Version • [15-45] Actual Typecode String • [15-49] SW ID Control Card • [15-50] SW ID Power Cord • [15-60] Option Mounted • [15-61] Option SW Version
16 – Short circuit	There is a short circuit in the motor or motor wiring.		Remove power to the frequency converter and repair the short circuit.
17 – Control word timeout	There is no communication to the frequency converter. The warning will only be active when [8-04] Control Timeout Function is NOT set to [0] OFF.	If [8-04] Control Timeout Function is set to Stop and Trip, a warning appears and the frequency converter ramps down until it stops then displays an alarm.	Check connections on the series communication cable. Increase [8-03] Control Timeout Time Check operation of the communication equipment Verify proper installation based on EMC requirements.
18 – Start failed	The speed has not been able to exceed [1-77] Compressor Start Max Speed [RPM] during start within the allowed time. (set in [1-79] Compressor Start Max Time to Trip).	This may be caused by a blocked motor.	
23 – Internal fan fault	The fan warning function checks if the fan is running. The fan warning can be disabled on [14-53] Fan Monitor.		Check for proper fan operation. Cycle power to the frequency converter and check that the fan operates briefly at startup. Check the sensors on the heatsink and control card.
24 – External fan fault	The fan warning function checks if the fan is running. The fan warning can be disabled on [14-53] Fan Monitor.		Check for proper fan operation. Cycle power to the frequency converter and check that the fan operates briefly at startup. Check the sensors on the heatsink and control card.
25 – Brake resistor short circuit	The brake resistor is monitored during operation. If a short circuit occurs, the brake function is disabled and the warning appears. The frequency converter is still operational but without the brake function.		Remove power to the frequency converter and replace the brake resistor (see [2-15] Brake Check).

Warning/Alarm	Description	Cause	Remedy
26 – Brake resistor power limit	The power transmitted to the brake resistor is calculated as a mean value over the last 120 seconds of run time. The calculation is based on the intermediate circuit voltage and the brake resistance value set in [2-16] brake Max. Current.	The warning is active when the dissipated braking is higher than 90% of the brake resistance power. If Trip [2] is selected in [2-13] Brake Power Monitoring, the frequency converter will trip when the dissipated braking power reaches 100%.	
27 – Brake chopper fault	The brake transistor is monitored during operation and if a short circuit occurs, the brake function is disabled and a warning is issued.	The frequency converter is still operational but, since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive.	Remove power to the frequency converter and remove the brake resistor.
28 – Brake check failed	The brake resistor is not connected or not working.		Check [2-15] Brake Check.
29 – Heatsink temp	The maximum temperature of the heatsink has been exceeded. The temperature fault will not reset until the temperature falls below the reset heatsink temperature. The trip and reset points are based on the frequency converter power size.		Check for the following conditions: • Ambient temperature too high. • Motor cable too long. • Incorrect airflow clearance above and below the frequency converter. • Blocked airflow around the frequency converter. • Damaged heatsink fan. • Dirty heatsink.
30 – Motor phase U missing	Motor phase U between the frequency converter and the motor is missing.		Remove power from the frequency converter and check motor phase U.
31 – Motor phase V missing	Motor phase V between the frequency converter and the motor is missing.		Remove power from the frequency converter and check motor phase V.
32 – Motor phase W missing	Motor phase W between the frequency converter and the motor is missing.		Remove power from the frequency converter and check motor phase W.
33 – Inrush fault	Too many power-ups have occurred within a short time period.		Let the unit cool to operating temperature.
34 – Fieldbus communication fault	Communication between the fieldbus and the communication option card is not operating.		
36 – Mains failure	This warning/alarm is only active if the supply voltage to the frequency converter is lost and 14-10 Mains Failure is NOT set to [0] No Function.		Check the fuses to the frequency converter and mains power supply to the unit.

Warning/Alarm	Description	Cause	Remedy
38 – Internal fault	When an internal fault occurs, a code number defined in the table below is displayed.		Cycle power to the frequency converter. Check that the option is properly installed. Check for loose or missing wiring. It may be necessary to contact your Xylem supplier or service department. Note the code number for further troubleshooting directions.
39 – Heatsink sensor	No feedback from the heatsink temperature sensor.	The signal from the IGBT Thermal sensor is not available on the power card. The problem could be on the power card, on the gate drive card, or the ribbon cable between the power card and gate drive card.	
40 – Overload of digital output terminal 27			Check the load connected to terminal 27 or remove short-circuit connection. Check [5-00] Digital I/O Mode and 5-01 Terminal 27 Mode.
41 – Overload of digital output terminal 29			Check the load connected to terminal 29 or remove short-circuit connection. Check [5-00] Digital I/O Mode and [5-02] Terminal 29 Mode.
42 – Overload of digital output on X30/6 or overload of digital output on X30/7			For X30/6, check the load connected to X30/6 or remove short-circuit connection. Check 5-32 Term X30/6 Digi Out (General Purpose I/O Option Card). For X30/7, check the load connected to X30/7 or remove short-circuit connection. Check 5-33 Term X30/7 Digi Out (General Purpose I/O Option Card).
45 – Ground fault 2	Ground (earth) fault on startup.		Check for proper grounding (earthing) and loose connections. Check for proper wire size. Check motor cables for short-circuits or leakage currents.
46 – Power card supply	The supply on the power card is out of range.	There are three power supplies generated by the switch mode power supply (SMPS) on the power card: 24 V, 5 V, +/- 18 V. When powered with 24 VDC with the 24VDC Backup Option Card option, only the 24 V and 5 V supplies are monitored. When powered with three-phase mains voltage, all three supplied are monitored.	Check for a defective power cord. Check for a defective control card. Check for a defective option card. If a 24 VDC power supply is used, verify proper supply power.
47 – 24 V supply low	The 24 V DC is measured on the control card.	The external 24 V DC backup power supply may be overloaded.	Contact your Xylem supplier.

Warning/Alarm	Description	Cause	Remedy
48 – 1.8 V supply low	The power supply is measured on the control card.	The 1.8 V DC supply used on the control card is outside of allowable limits.	Check for a defective control card. If an option card is present, check for an overvoltage condition.
49 – Speed limit	When the speed is not within the specified range in [4-11] Motor Speed Low Limit [RPM] and [4-13] Motor Speed High Limit [RPM], the frequency converter will show a warning.	When the speed is below the specified limit in [1-86] Trip Speed Low [RPM] (except when starting or stopping) the frequency converter will trip.	
50 – AMA calibration failed			Contact your Xylem supplier or Xylem Service Department.
51 – AMA check Unom and Inom	The settings for motor voltage, motor current, and motor power are wrong.		Check the settings in parameters 1-20 to 1-25.
52 – AMA low Inom	The motor current is too low.		Check the setting in [4-18] Current Limit.
53 – AMA motor too big	The motor is too big for the AMA to operate.		
54 – AMA motor too small	The motor is too small for the AMA to operate.		
55 – AMA Parameter out of range	The parameter values of the motor are outside of the acceptable range. AMA will not run.		
56 – AMA interrupted by the user	The AMA has been interrupted by the user.		
57 – AMA timeout			Try to restart AMA again. Repeated restarts may overheat the motor.
58 – AMA internal fault			Contact your Xylem supplier.
59 – Current limit	The current is higher than the value in [4-18] Current Limit.		Ensure that motor data in parameters 1-20 through 1-25 are set correctly. Possibly increase the current limit. Be sure that the system can operate safely at a higher limit.
60 – Pump Protect	A digital input signal is indicating a pump protection external to the controller is active.		
62 – Output frequency at maximum limit	The output frequency has reached the value set in [4-19] Max Output Frequency.		Check the application to determine the cause. Possibly increase the output frequency. Be sure the system can operate safely at a higher output frequency. The warning will clear when the output drops below the maximum limit.
65 – Control card over temperature	The cut-out temperature of the control card is 80°C.		Check that the ambient operating temperature is within limits. Check for clogged filters. Check fan operation. Check the control card.

Warning/Alarm	Description	Cause	Remedy
66 – Heatsink temperature low	The frequency converter is too cold to operate. This warning is based on the temperature sensor in the IGBT module.		Increase the ambient temperature of the unit. A trickle amount of current can be supplied to the frequency controller whenever the motor is stopped by setting [2-00] DC Hold/Preheat Current at 5% and [1-80] Function at Stop.
67 – Option module configuration has changed	One or more options have either been added or removed since the last power down.		Check that the configuration change is intentional and reset the frequency controller.
68 – Safe stop activated	Loss of the 24 VDC signal on terminal 37 has caused the frequency controller to trip.		To resume normal operation, apply 24 VDC to terminal 37 and reset the frequency controller.
69 – Power card temperature	The temperature sensor on the power card is either too hot or too cold.		Check that the ambient operating temperature is within limits. Check for clogged filters. Check fan operation. Check the power card.
70 – Illegal FC configuration	The control card and power card are incompatible.		Contact your supplier with the typecode of the unit from the
80 – Drive initialized to default value	Parameter settings are initialized to default settings after a manual reset.		Reset the unit to clear the alarm.
92 – No flow	A no-flow condition has been detected in the system.	[22-23] No-Flow Function is set for alarm.	Troubleshoot the system and reset the frequency converter after the fault has been cleared.
93 – No Water/Loss of Prime	A low power condition in the system with the frequency converter operating at high speed may indicate a the pump is out of water or has lost prime.	[22-26] No Water/Loss of Prime Function is set for alarm. The [22-39] No Water/Loss of Prime Limit is set too high.	Troubleshoot the system and reset the frequency converter after the fault has been cleared.
94 – Under Pressure	The system pressure is below the Under Pressure limit (Under Pressure Limit = Setpoint [22-25] Under Pressure Difference).	This may indicate leakage in the system. [22-50] Under Pressure Function is set for alarm.	Troubleshoot the system, and reset the frequency converter after the fault has been cleared.
95 – Broken belt	Torque is below the torque level set for no load, indicating a broken belt.	[22-60] Broken Belt Function is set for alarm.	Troubleshoot the system and reset the frequency converter after the fault has been cleared.
96 – Start delayed	Motor start has been delayed due to short-cycle protection.	[22-76] Interval between Starts is enabled.	Troubleshoot the system and reset the frequency converter after the fault has been cleared.
97 – Stop delayed	Stopping the motor has been delayed due to short cycle protection.	[22-76] Interval between Starts is enabled.	Troubleshoot the system and reset the frequency converter after the fault has been cleared.
98 – Clock fault	Time is not set or the RTC clock has failed.		Reset the clock in [0-70] Date and Time.
200 – Fire mode		This indicates the frequency controller is operating in fire mode.	Cycle power to the unit to remove the warning. See the fire mode data in the alarm log on the controller.
201 – Fire mode was active	This indicates the frequency controller had entered fire mode.		Cycle power to the unit to remove the warning. See the fire mode data in the alarm log on the controller.

Warning/Alarm	Description	Cause	Remedy
202 – Fire mode limits exceeded	While operating in fire mode one or more alarm conditions has been ignored which would normally trip the unit.	Operating in this condition voids unit warranty.	Cycle power to the unit to remove the warning. See the fire mode data in the alarm log on the controller.
203 – Missing motor	With a frequency converter operating multi-motors, an under-load condition was detected.	This could indicate a missing motor.	Inspect the system for proper operation.
204 – Locked rotor	With a frequency converter operating multi-motors, an overload condition was detected.	This could indicate a locked rotor.	Inspect the motor for proper operation.
250 – New spare part	A component in the frequency converter has been replaced.		Reset the frequency converter for normal operation.
251 – New typecode	A component in the frequency converter has been replaced and the typecode changed.		Reset the frequency converter for normal operation.

7 Product warranty

Commercial warranty

Warranty. For goods sold to commercial buyers, Seller warrants the goods sold to Buyer hereunder (with the exception of membranes, seals, gaskets, elastomer materials, coatings and other "wear parts" or consumables all of which are not warranted except as otherwise provided in the quotation or sales form) will be (i) be built in accordance with the specifications referred to in the quotation or sales form, if such specifications are expressly made a part of this Agreement, and (ii) free from defects in material and workmanship for a period of thirty-six (36) months from the date of installation or forty-two (42) months from the date of shipment (which date of shipment shall not be greater than after receipt of notice that the goods are ready to ship), whichever shall occur first, unless a longer period is specified in the product documentation (the "Warranty").

Except as otherwise required by law, Seller shall, at its option and at no cost to Buyer, either repair or replace any product which fails to conform with the Warranty provided Buyer gives written notice to Seller of any defects in material or workmanship within ten (10) days of the date when any defects or non-conformance are first manifest. Under either repair or replacement option, Seller shall not be obligated to remove or pay for the removal of the defective product or install or pay for the installation of the replaced or repaired product and Buyer shall be responsible for all other costs, including, but not limited to, service costs, shipping fees and expenses. Seller shall have sole discretion as to the method or means of repair or replacement. Buyer's failure to comply with Seller's repair or replacement directions shall terminate Seller's obligations under this Warranty and render the Warranty void. Any parts repaired or replaced under the Warranty are warranted only for the balance of the warranty period on the parts that were repaired or replaced. Seller shall have no warranty obligations to Buyer with respect to any product or parts of a product that have been: (a) repaired by third parties other than Seller or without Seller's written approval; (b) subject to misuse, misapplication, neglect, alteration, accident, or physical damage; (c) used in a manner contrary to Seller's instructions for installation, operation and maintenance; (d) damaged from ordinary wear and tear, corrosion, or chemical attack; (e) damaged due to abnormal conditions, vibration, failure to properly prime, or operation without flow; (f) damaged due to a defective power supply or improper electrical protection; or (g) damaged resulting from the use of accessory equipment not sold or approved by Seller. In any case of products not manufactured by Seller, there is no warranty from Seller; however, Seller will extend to Buyer any warranty received from Seller's supplier of such products.

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Limited consumer warranty

Warranty. For goods sold for personal, family or household purposes, Seller warrants the goods purchased hereunder (with the exception of membranes, seals, gaskets, elastomer

materials, coatings and other "wear parts" or consumables all of which are not warranted except as otherwise provided in the quotation or sales form) will be free from defects in material and workmanship for a period of thirty-six (36) months from the date of installation or forty-two (42) months from the product date code, whichever shall occur first, unless a longer period is provided by law or is specified in the product documentation (the "Warranty").

Except as otherwise required by law, Seller shall, at its option and at no cost to Buyer, either repair or replace any product which fails to conform with the Warranty provided Buyer gives written notice to Seller of any defects in material or workmanship within ten (10) days of the date when any defects or non-conformance are first manifest. Under either repair or replacement option, Seller shall not be obligated to remove or pay for the removal of the defective product or install or pay for the installation of the replaced or repaired product and Buyer shall be responsible for all other costs, including, but not limited to, service costs, shipping fees and expenses. Seller shall have sole discretion as to the method or means of repair or replacement. Buyer's failure to comply with Seller's repair or replacement directions shall terminate Seller's obligations under this Warranty and render this Warranty void. Any parts repaired or replaced under the Warranty are warranted only for the balance of the warranty period on the parts that were repaired or replaced. The Warranty is conditioned on Buyer giving written notice to Seller of any defects in material or workmanship of warranted goods within ten (10) days of the date when any defects are first manifest.

Seller shall have no warranty obligations to Buyer with respect to any product or parts of a product that have been: (a) repaired by third parties other than Seller or without Seller's written approval; (b) subject to misuse, misapplication, neglect, alteration, accident, or physical damage; (c) used in a manner contrary to Seller's instructions for installation, operation and maintenance; (d) damaged from ordinary wear and tear, corrosion, or chemical attack; (e) damaged due to abnormal conditions, vibration, failure to properly prime, or operation without flow; (f) damaged due to a defective power supply or improper electrical protection; or (g) damaged resulting from the use of accessory equipment not sold or approved by Seller. In any case of products not manufactured by Seller, there is no warranty from Seller; however, Seller will extend to Buyer any warranty received from Seller's supplier of such products.

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To make a warranty claim, check first with the dealer from whom you purchased the product or visit www.xyleminc.com for the name and location of the nearest dealer providing warranty service.

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- 1) The tissue in plants that brings water upward from the roots
- 2) A leading global water technology company

We're a global team unified in a common purpose: creating innovative solutions to meet our world's water needs. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. We move, treat, analyze, and return water to the environment, and we help people use water efficiently, in their homes, buildings, factories and farms. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise, backed by a legacy of innovation.

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