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INSTALLATION AND MAINTENANCE MANUAL FOR ELECTRIC FIRE PUMP CONTROLLERS MODEL GFX

ViZi TOUCH

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Introduction 1

Electric fire pump controllers are designed to start an electric motor driven fire pump. It can either start the fire pump manually through the local start pushbutton or automatically through the sensing of a pressure drop in the sprinkler system. The fire pump controller is supplied with a pressure transducer. The fire pump can be stopped manually with the local stop pushbutton or automatically after the expiration of a field programmable timer. In both cases, stopping is only allowed if all starting causes have disappeared.

Types of Electric Fire Pump Controllers

FIRE PUMP CATALOG NUMBER

MODEL No. EXAMPLE: GFA - 208 / 160KW / 3 / 60
Model Prefix: GFA
Voltage: 208 V
HP/KW Rating: 215Hp / 160KW
Phase: 3
Frequency: 60 Hz

ACROSS-THE-LINE STARTER

MODEL GFA:
This model is intended to be used where the local utility or the capacity of the power source permits across-the-line starting.
Full voltage is applied to the motor as soon as the controller receives a start command.

REDUCED VOLTAGE STARTERS

These models are intended to be used where the local utility or the capacity of the power source does not permit full voltage starting.
In all the reduced voltage models, the manual “EMERGENCY RUN” device will initiate across-the-line starting.

MODEL GFR: AUTOTRANSFORMER STARTER
This model does not require a multi-connection motor. It only requires 3 conductors between the controller and the motor.
Upon a start command, an autotransformer is utilized to supply reduced voltage to the motor. After a time delay, the autotransformer is shunted out and the motor is connected to full voltage by a closed transition switching sequence.

MODEL GFS: SOLID STATE STARTER
This model does not require a multi-connection motor. It only requires 3 conductors between the controller and the motor.
Upon a start command, a solid-state starter is utilized to supply a step less ramp-up voltage to the motor until the motor reaches its full speed. At that time, a fully horsepower rated by-pass contactor is energized connecting the motor directly to full voltage and eliminating all heat loss within the solid-state starter.
This controller also features a soft motor stopping mode and a hard stop mode. For a hard stop, hold the stop pushbutton until the motor stop.

MODEL GFW: WYE-DELTA CLOSED TRANSITION STARTER
This model requires a multi-connection motor and 6 conductors between the controller and the motor.
Upon a start command, the motor is connected to the line in the wye connection. After a time delay, the motor is reconnected to the line in the Delta configuration applying full voltage to the motor windings by a closed transition switching sequence.

The power source does not « see » any open circuit during the transition from wye to delta. During the transition from Wye to Delta, a resistor bank is connected in the starting circuit and allows to keep the motor coils energized. An 80 second delay is then triggered and prevent the motor from stoping. This delay allows the resistors to cool down and will only be triggered if the transition occur. An emergency stop can still be perform by pulling the disconnecting mean handle.

MODEL GFY: WYE-DELTA OPEN TRANSITION STARTER
This type of starter requires a multi-connection motor and 6 conductors between the controller and the motor.
Upon a start command, the motor is connected to the line in the Wye connection. After a time delay, the motor is reconnected to the line in the Delta configuration applying full voltage to the motor windings. This controller is of the open transition type. The motor is disconnected from the line during the transition from start (wye) to run (delta) mode.

Methods of Starting/Stopping

The controllers are available as combination automatic / non-automatic with provision for manual or automatic shutdown (an automatic shutdown is only possible after an automatic start).

METHODS OF STARTING

AUTOMATIC START
The controller will start automatically on low pressure detection by the pressure sensor when the pressure drops below the cut-in threshold.

MANUAL START
The motor can be started by pressing the START push button, regardless of the system pressure.

REMOTE MANUAL START
The motor can be started from a remote location by momentarily closing a contact of a manual push button.

REMOTE AUTOMATIC START, DELUGE VALVE START
The motor can be started from a remote location by momentarily opening a contact connected to an automatic device.

EMERGENCY START
The motor can be started manually by using the emergency handle. This handle can be maintained in a closed position.

Important: to avoid damaging the contactor, it is recommended to start the motor in this manner:
1) Shutdown the main power by using the main disconnect means,
2) Pull the emergency handle and lock it in closed position,
3) Turn the power back on by using the main disconnect means.

SEQUENTIAL START
In case of a multiple pump application, it may be necessary to delay the automatic (pressure drop) starting of each motor to prevent simultaneous starting of all motors.

TEST START
The motor can be started manually by pressing the run test button.

METHODS OF STOPPING

MANUAL STOP
Manual stop is done by pressing the priority STOP push button. Note that pressing the stop push button will prevent the motor from restarting as long as the button is pressed, plus a two second delay.

AUTOMATIC STOP

Automatic stop is possible only after an automatic start and this function has been activated. When this function is enabled, the motor is automatically stopped 10 minutes after the restoration of the pressure (above the cut-out threshold) given that no other run cause is present.

EMERGENCY STOP

The emergency stop is always possible in any starting condition and is done by using the main disconnecting means located on the door.

Installation 2

The GFx electric fire pump controller is intended to be installed in accordance with the Standard of the National Fire Protection Association for the Installation of Centrifugal Fire Pumps, NFPA n°20-2013 (Centrifugal Fire Pumps) and

in USA National Electrical Code NFPA 70
in Canada Canadian Electrical Code, Part 1
others * Local Electrical Codes *

*Only American and Canadian applicable codes have been considered during the design of the controllers and the selection of components.

Location

The controller shall be located as close as practical to the engine/motor it controls and shall be within sight of the engine/motor. The controller shall be located or protected such that it will not be damaged by water escaping from pump or pump connections. Current carrying parts of the controller shall be not less than 12 in. (305 mm) above the floor level.

Working clearances around controller shall comply with NFPA 70, National Electrical Code, Article 110 or C22.1, Canadian Electrical Code, Article 26.302 or other local codes.

The controller is suitable for use in locations subject to a moderate degree of moisture, such as a damp basement. The pump room ambient temperature shall be between 39°F (4°C) and 104°F (40°C) (If a temperature option is included, see the rating label for maximum temperature).

The standard controller enclosure is rated IP55. It is the installer's responsibility to insure that either the standard enclosure meets the ambient conditions or that an enclosure with an appropriate rating has been provided. Controllers must be installed inside a building and they are not designed for outside environment. The paint color may change if the controller is exposed to ultraviolet rays for a long period of time.

Mounting

The fire pump controller shall be mounted in a substantial manner on a single incombustible supporting structure. Wall mounted controllers shall be attached to the structure or wall using all four (4) mounting ears provided on the controller with hardware designed to support the weight of the controller at a height not less than 12 in. (305 mm) above floor level. Floor mounted controllers shall be attached to the floor using all holes provided on the mounting feet with hardware designed to support the weight of the controller. The mounting feet provide the necessary 12 in. (305 mm) clearance for current carrying parts.

Storage

If the controller is not installed and energized immediately, Tornatech recommend following the instructions from the chapter 3 of the NEMA ICS 15 standard.

Wiring and Connections

Water Connections

The controller must be connected to the pipe system according to the latest edition of NFPA20 and also to a drain pipe. The water connections are on the left side of the controller. The connection to the system pressure is a Male ½ NPT. If a drain is present, the connection to the drain is a tapered connection for plastic tubing.

Electrical Wiring

The electrical wiring between the power source and the fire pump controller shall meet the latest edition of NFPA 20, NFPA 70 National Electrical Code Article 695 or C22.1 Canadian Electrical Code, Section 32-200 or other local codes. Electrical wiring shall be typically sized to carry at least 125% of the full load current (FLC or FLA) of the fire pump motor.

Electrical Connections

A licensed electrician must supervise the electrical connections. The dimension drawings show the area suitable for incoming power and motor connections. No other location shall be used. Only watertight hub fittings shall be used when entering the cabinet to preserve the IP rating of the cabinet. The installer is responsible for adequate protection of the fire pump controller components against metallic debris or drilling chips. Failure to do so may cause injuries to personnel, damage the controller and subsequently void warranty.

Energy Consumption

Standby power: 10W

Sizing

Incoming power terminals on the controller are suitable to accept wire based on that selection with insulation not less than 60°C. (Refer to terminal diagram for terminal sizes.)
The electrical wiring between the fire pump controller and the pump motor shall be in rigid, intermediate, or liquid tight flexible metal conduit or Type MI cable and meet the requirements of NFPA 70 National Electrical Code or C22.1 Canadian Electrical Code or other local codes.
The number of conductors required varies depending on the model of starter:
3-wires plus ground sized at 125% of full load current for models GFA, GFR.
6-wires plus ground sized at 125% of 58% of the motor full load current for: GFY and GFW models.

Incoming Power Connections

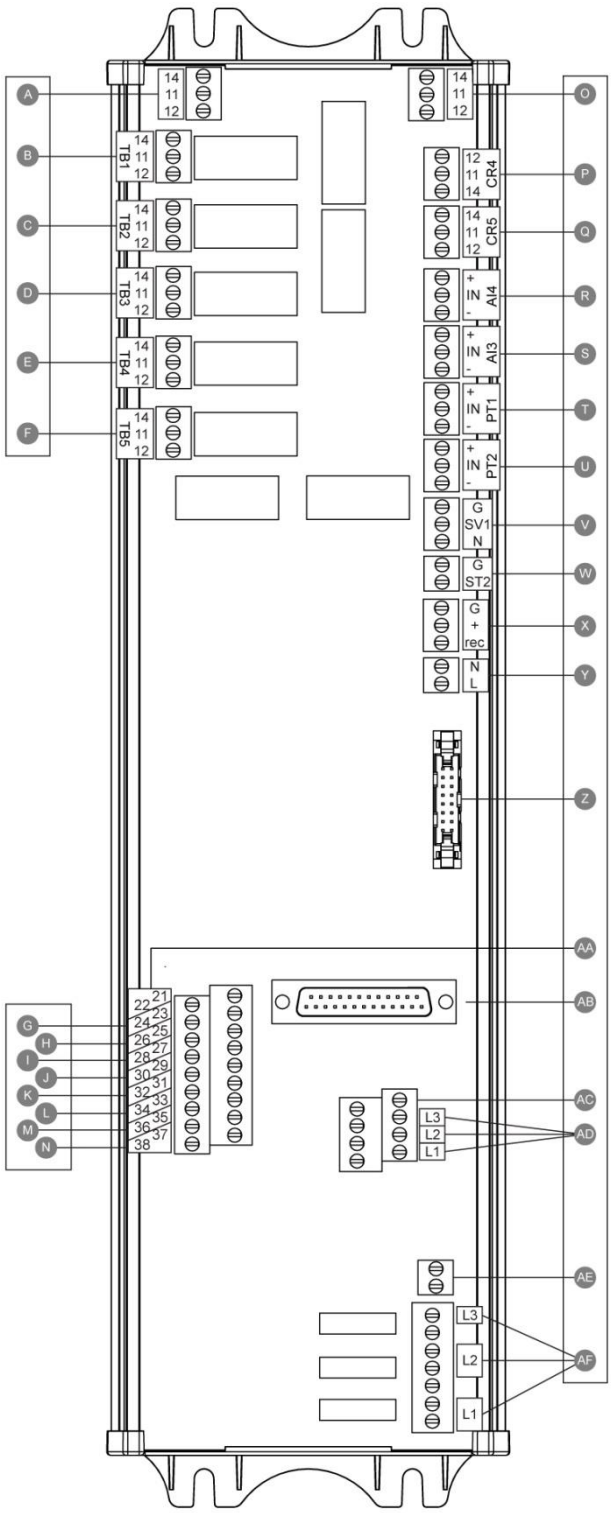
Incoming normal power is to be connected to terminals located on the disconnecting means IS.
- For 3 phases motor: identified L1-L2 and L3.
- For single phase motor: identified L1 and L3

Motor Connections

Motor wires shall be connected to terminals identified by:
- T1-T2 and T3 located on main contactor (1M) for models GFA, GFR.
- T1-T2 and T3 located on contactor (1M) and T6-T4 and T5 located on contactor (2M) for models GFY and GFW.

It is the responsibility of the installer to obtain connection information on the motor and to assure that the motor is connected as per motor manufacturer recommendations. Failure to do so may cause injuries to personnel, damage the motor and/or the controller and subsequently void warranty on both items.

Terminal Strip Descriptions



Alarm output terminals (SPDT Relay, 11:Common, 12:Normally Closed, 14:Normally Open):

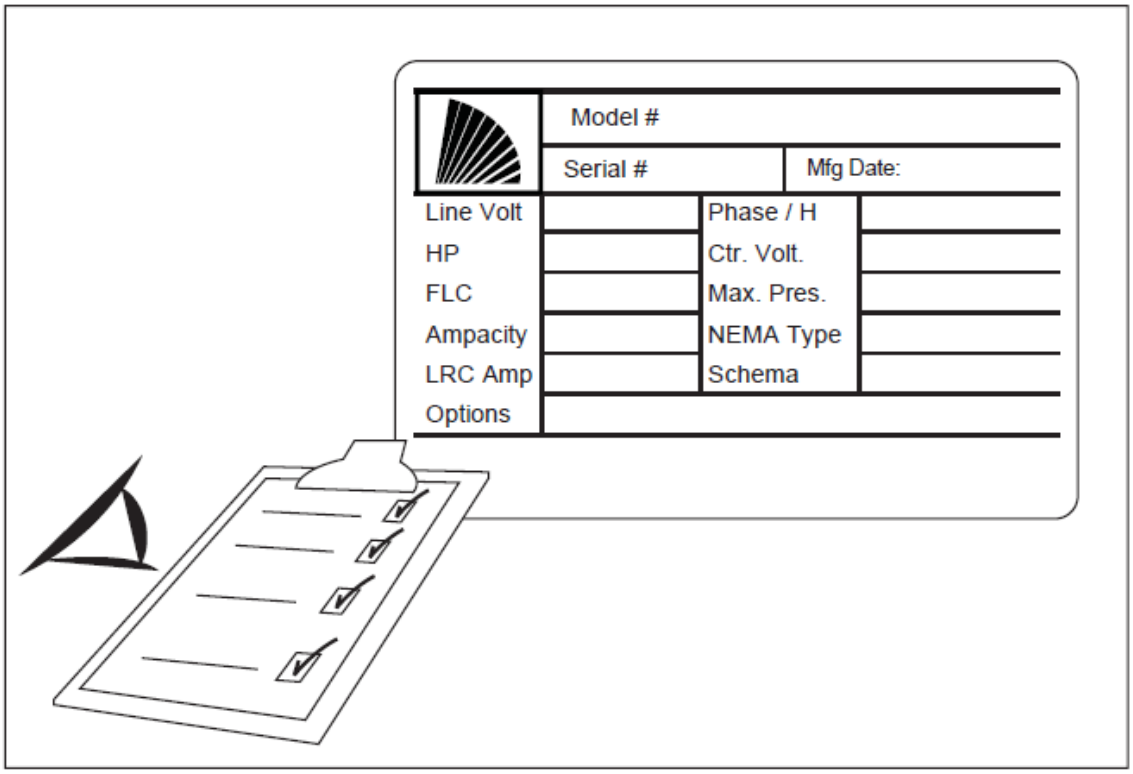
A: Motor Run
B: Power Available (Failsafe relay)
C: Phase Reversal
D: Pump Room Alarm
E: Motor Trouble
F: Factory Reserved

Field input terminal (Dry Contact Only: Voltage Free):

G: Remote Manual Start (NO)
H: Lockout (NO)
I: Remote Automatic Start (NC)
J: Deluge Valve (NC)
K: Factory Reserved 3 (NO)
L: Flow/Zone Start/Stop (NO)
M: Factory Reserved 2 (NO)
N: Factory Reserved 1 (NO)

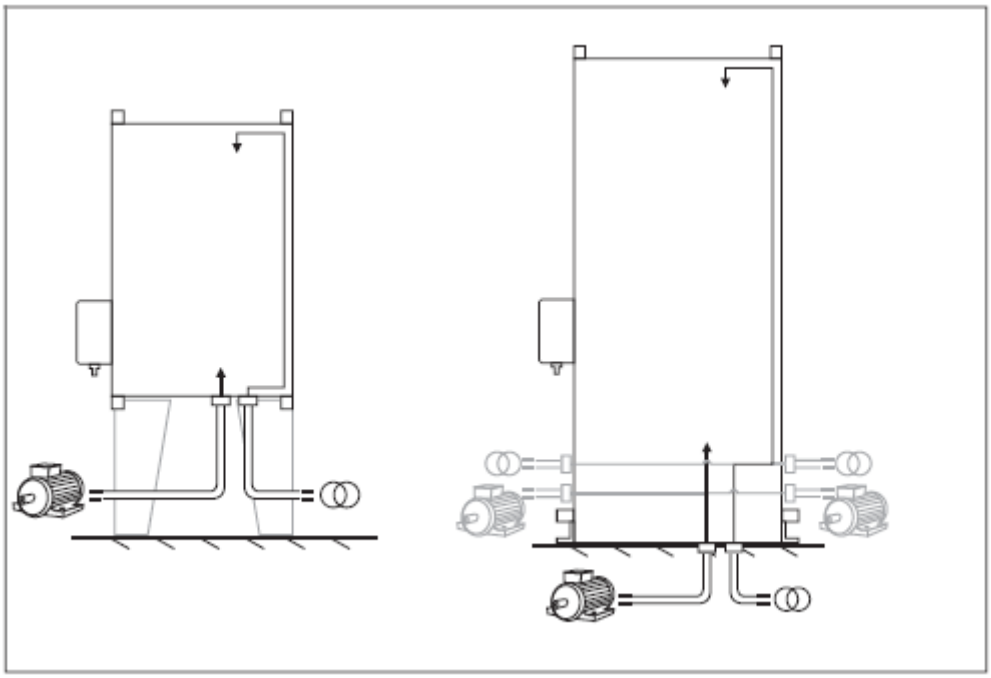
Factory IO:

O: Motor Run auxiliary contact
P: Main Coil power relay
Q: Delay Coil power relay
R: Water Level/Suction Pressure sensor
S: Spare Temperature/Flow sensor
T: PT1 Discharge Pressure sensor
U: PT2 Discharge Pressure sensor (redundant opt. only)
V: Test Solenoid Valve
W: Shunt Trip
X: Factory Reserved
Y: 24VAC input power
Z: CANBUS to IO cards
AA: Emergency Handle limit switch
AB: CANBUS to ViZiTouch
AC: Ground Fault
AD: Input Current sensing
AE: Ground
AF: Input Voltage sensing

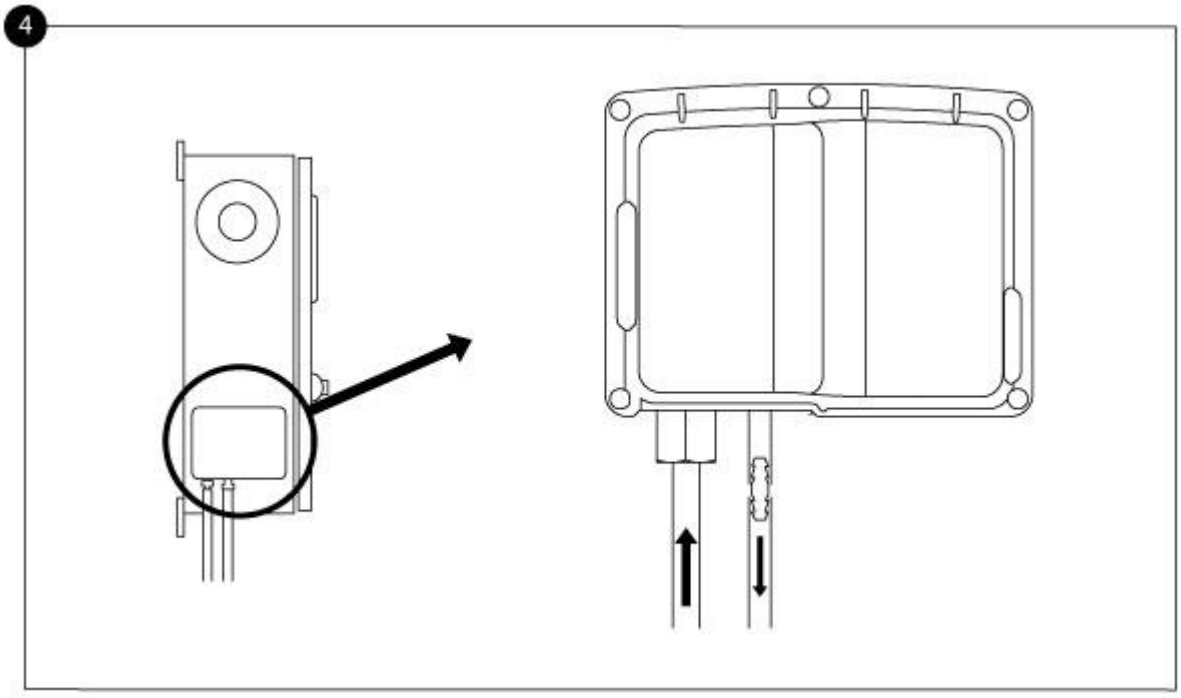


The rating label is the most important label. It must be read carefully to ensure the compatibility between the controller and the installation.

Verify that the controller is installed securely on the wall, or optionally on the mounting stand.



Make sure to drill holes for the motor and power connections and run the cables inside the panel, all in accordance with the specifications in order to minimize interference with other equipment.

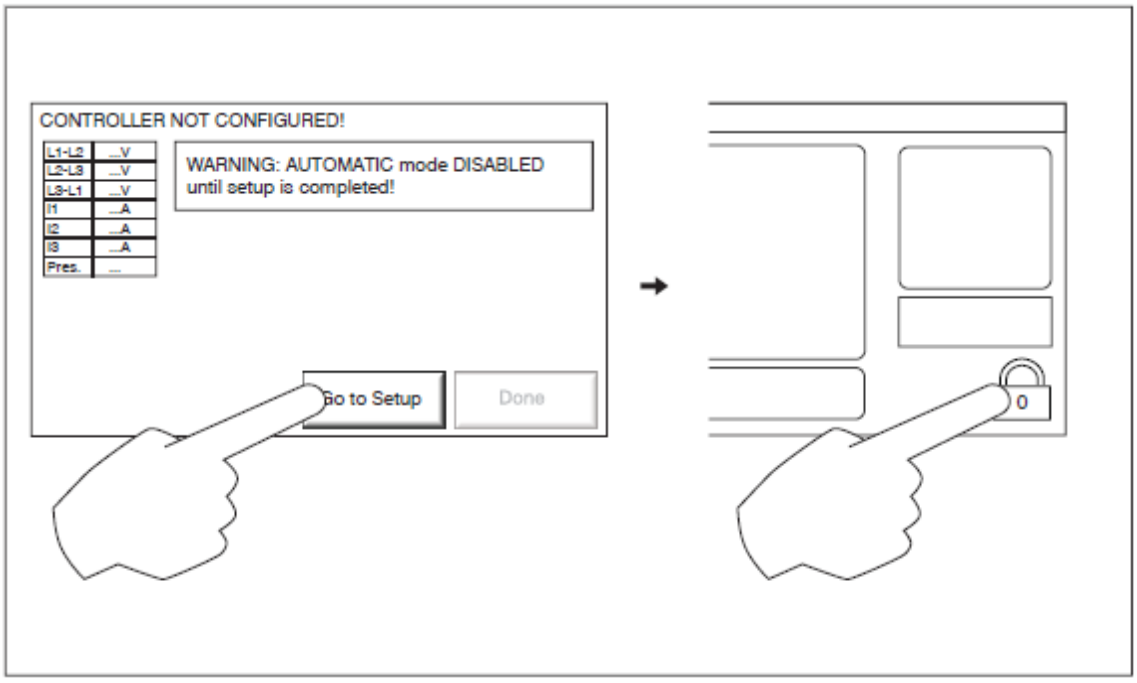


Verify and/or install the proper water connections for the water input and the drain. They must be securely installed and tightened. Refer to the silkscreen markings on the plastic cover.

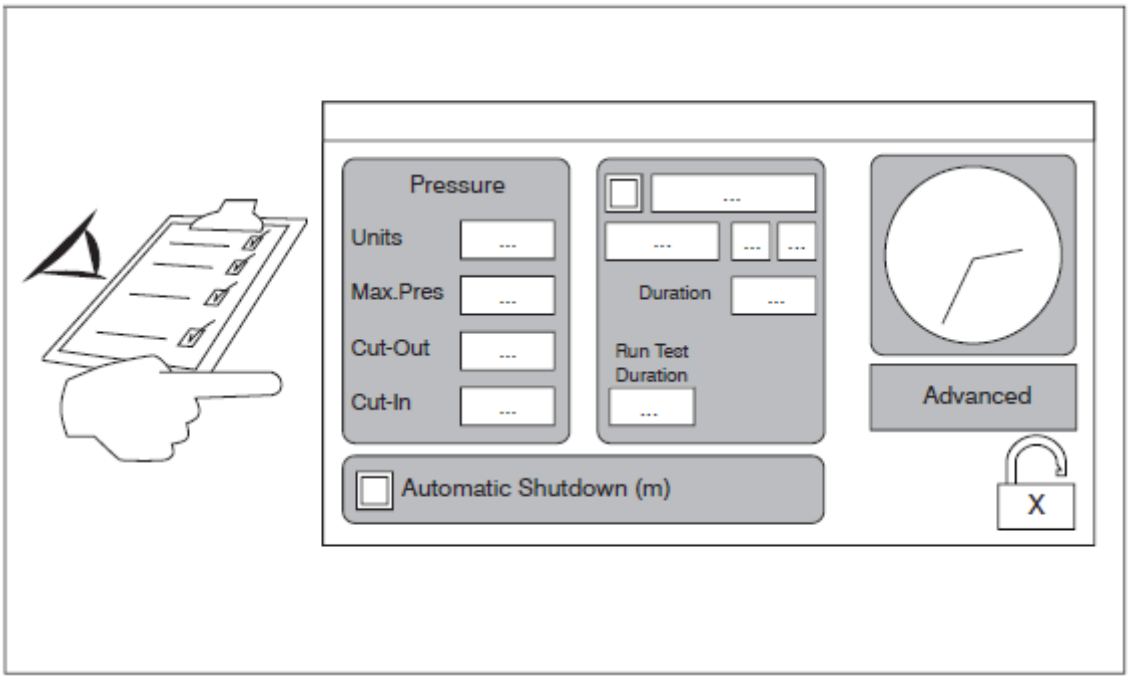
Connect the input power and the motor on their respective terminals. Secure with the appropriate torque as indicated on the torque label and verify all connections. Secure the door in closed position then put the circuit breaker disconnecting means in ON position. Verify the readings on the controller main screen.

Verify the motor rotation to ensure that the pump is turning in the right direction. The START and STOP push buttons can be used to toggle the motor ON/OFF.

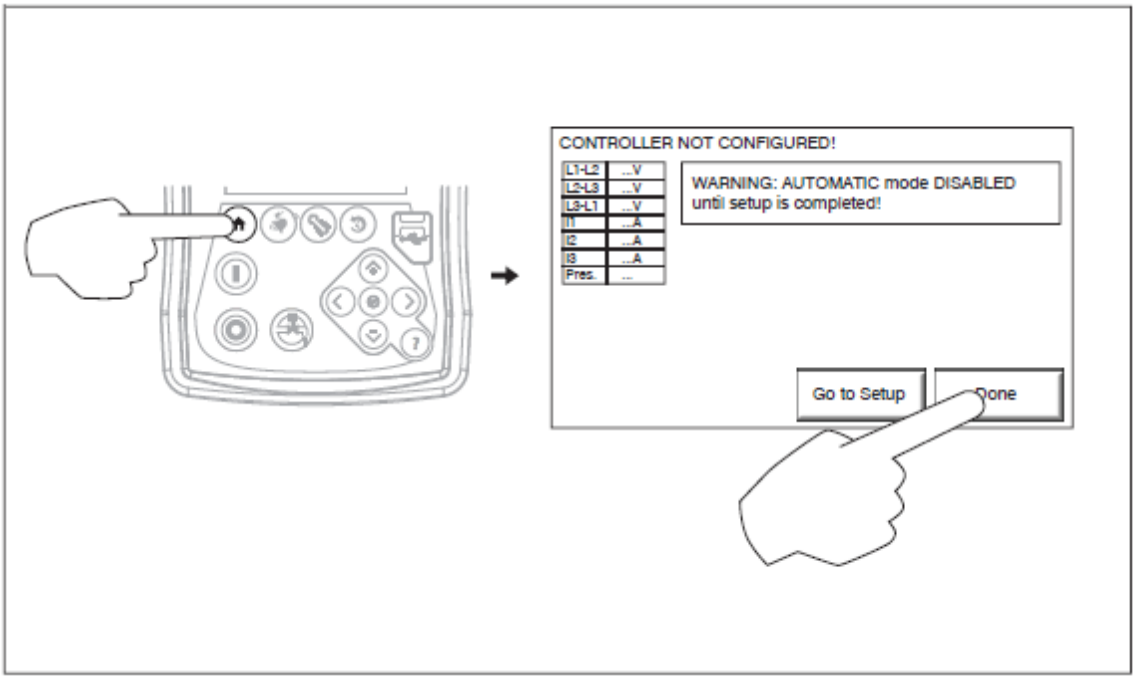
WARNING!
On a Wye-Delta closed transition starter, if the transition from Wye to Delta occurs (after 5 to 8 seconds depending on the motor HP), the manual stop push button will be disabled for 80 seconds. To stop the engine before the end of the 80 second delay, use the disconnecting mean handle.



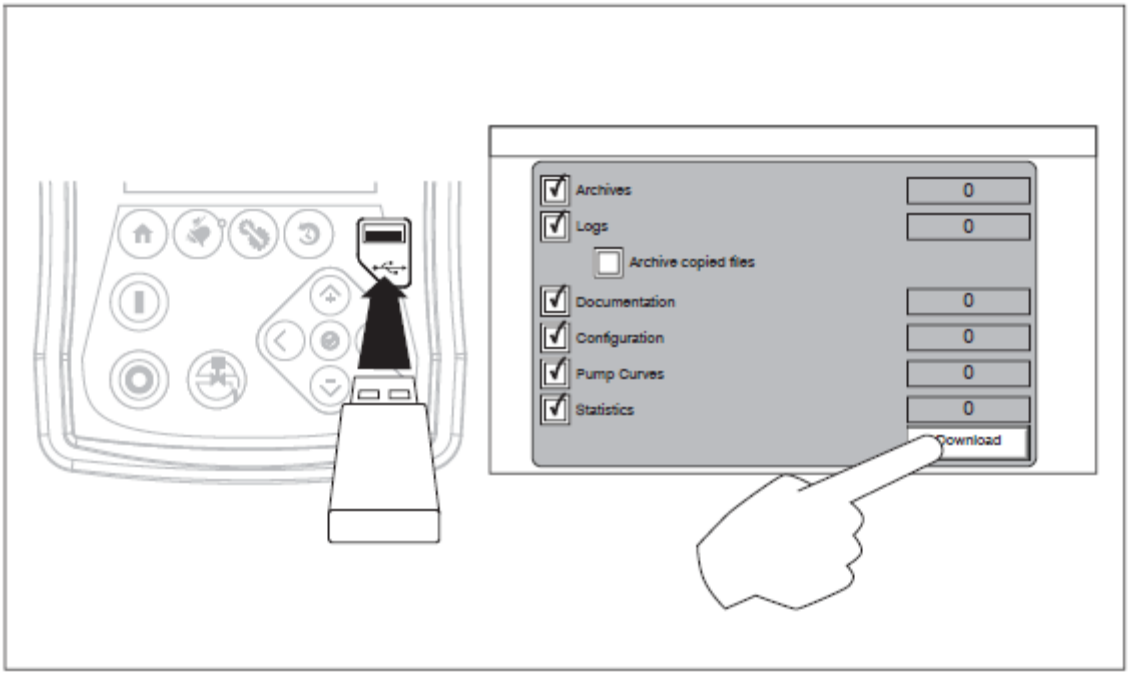
The "First Setup" page replaces the Homepage until the "First Setup" is done. Proceed to the setup page and press the lock to enter your authorization code.



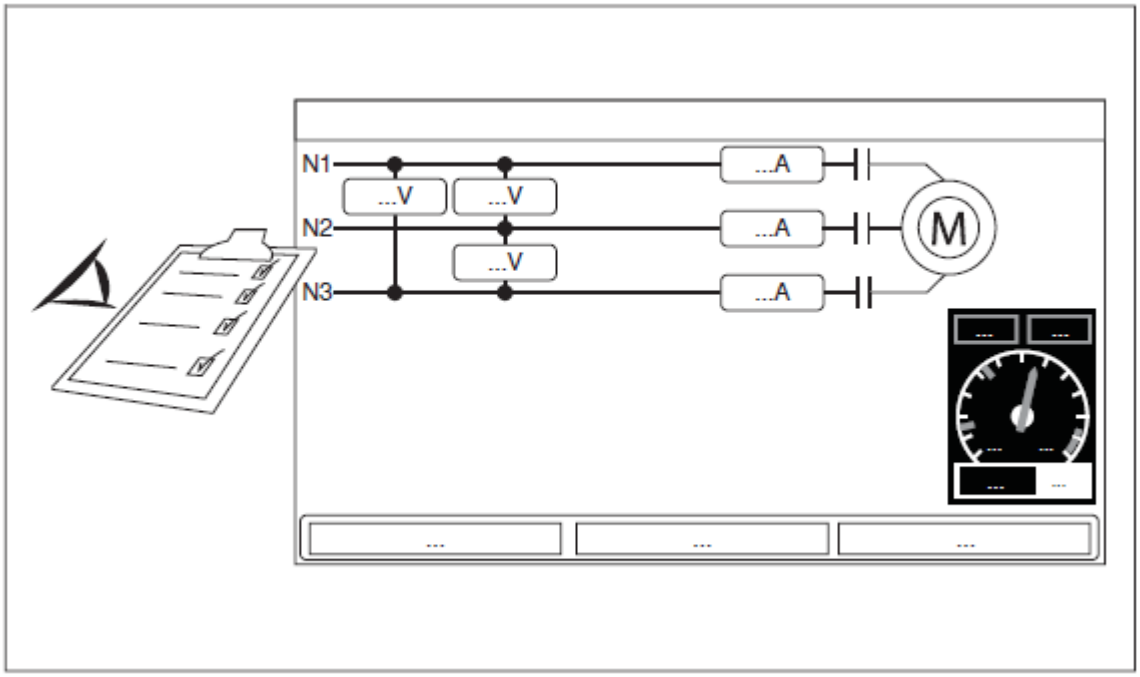
Select the controller pressure units, cut-in and cut-out. Verify that all other parameters on the setup page are correct.



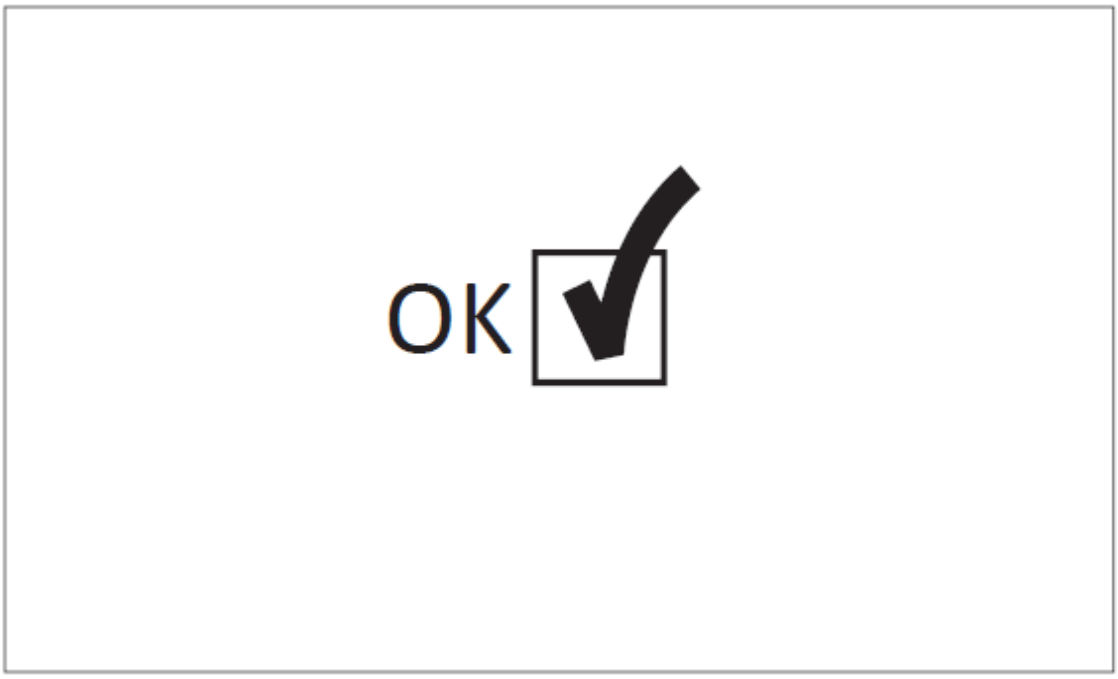
When satisfied with the controller settings, press the “Home” button on the membrane, then acknowledge the changes by pressing the "Done" button. If the "Done" button is unavailable, ensure that a sufficient authorization code has been entered and that at least all three voltages are valid.



Proceed with the download step to save the report.



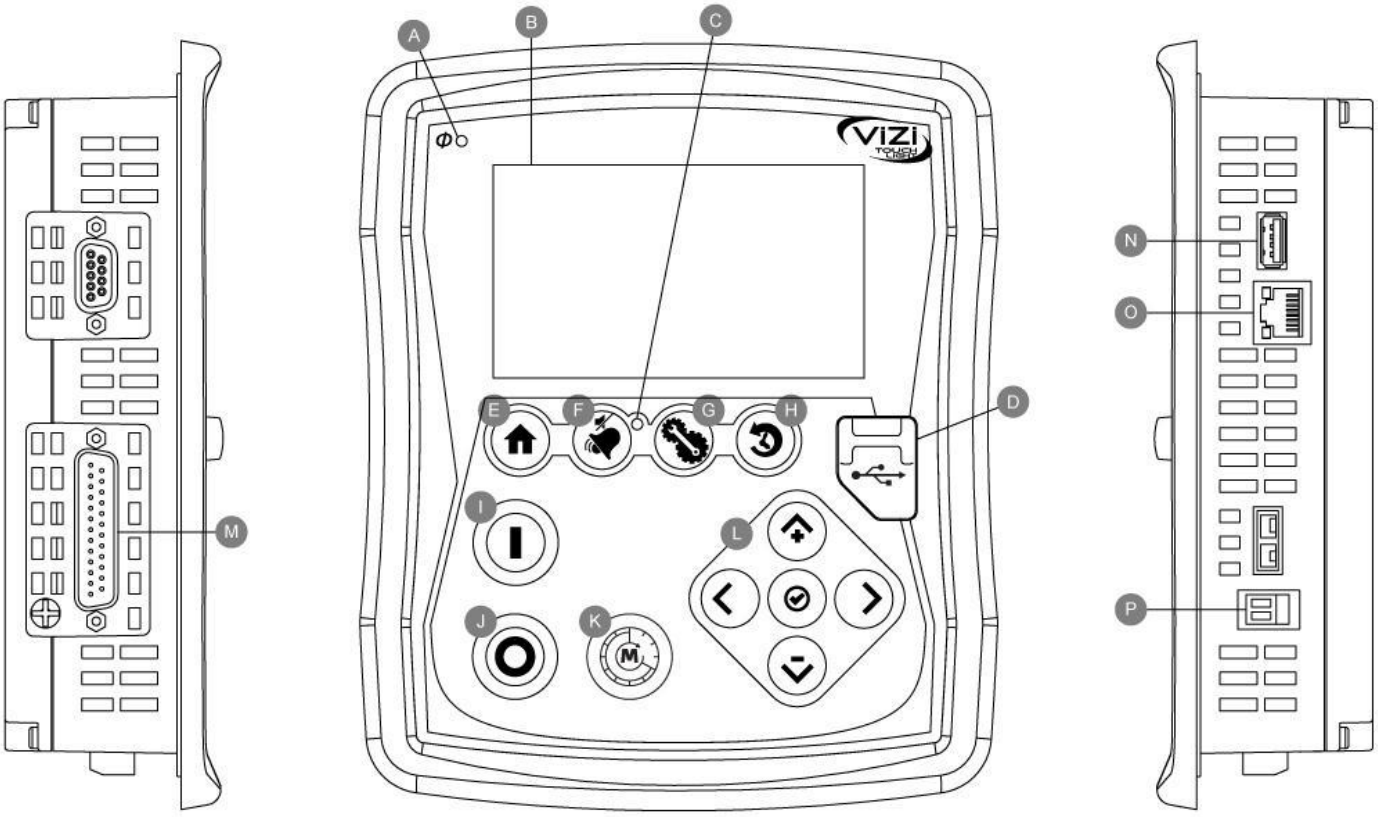
Once the configuration is done, click on the “Home” membrane button. The “First Setup” page will be displayed



The “First Start up” is now completed. The controller is fully installed and configured.

Main Features 3

The ViZiTouch



A: Power Available LED: Indicates that power is available.
B: Touch Screen: 4.3 inches color touch screen LCD.
C: Alarm LED: Indicates if an alarm is active.
D: Front USB Connector: USB Device connector used for files download, software update, service reports.
E: Home button: Used to navigate to the Home page.
F: Alarm button: Used to navigate to the Alarm page. It also allows the user to silence the alarm bell, hence the small "no speaker" symbol.
G: Config button: Used to navigate to the Configuration page.
H : History button: Used to navigate to the History page.
I: Start button: Used to manually start the motor.
J: Stop button: Used to stop the motor.
K: Run Test button: Used to start the manual run test. Be aware that water will flow through the drain with models equipped with a solenoid valve.
L: Contextual navigation pad: Used to facilitate the navigation on specific pages. A small icon representing the contextual navigation pad will appear at the bottom right corner of a page if the pad is active. By clicking on the small pad icon, a menu explaining the specific functions of the arrows will appear. For example, it is possible to switch between the graphical or the table mode on the logs page, as well as navigate through the tables or the help pages.
M: CAN bus connector to IO cards
N: USB 2.0 connector
O: Ethernet connector
P: Alarm Bell connector

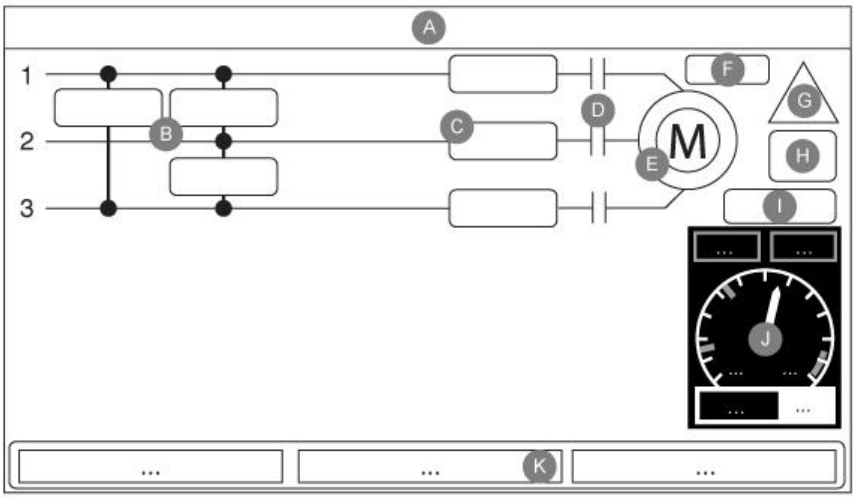
Warning
After 2 years of service, the Vizitouch battery may become less efficient and could lose the time after a shutdown.

First Setup

The First Setup must be done prior to using the controller. Completing the First Setup is the only way to access the homepage and enable the automatic mode of the controller.

Home 4

Home (Membrane button) **Home**



The home page displays all controller statuses and important values of the controller. All voltages, currents, pressure, motor state and status, as well as all timers and motor starting sequences.

The entire background will become red if an alarm becomes active. This feature will help the user identify a problem even from a significant distance away from the controller.

A: Navigation bar which contains general information about:
- The language (the language may be changed by pressing on it)
- The page title
- The alarm banner (warning and alarm messages may be shown)
- The date and time (adjustable in the Configuration page)

B: Voltages. Each box represents an individual phase voltage between the two adjacent lines.

C: Current. Each box represents an individual phase current between the two adjacent lines.

D: The motor contactors are represented here. An animation shows the contactor opened or closed depending on the signal sent to the main coil.

E: The electric motor. It will be grey if the engine is stopped, green if a “Motor Run” signal is detected and red if a “Fail to start” occurred. Pressing on the engine will redirect the user to the “Last Service Statistics” page, which monitors all relevant statistics concerning the controller since the last service.

F: Timers. Sequential start timer (on-delay) will start counting upon a pressure drop. The motor will only start if the pressure is still below the start point after the expiration of this timer. The minimum run period timer (off –delay) for automatic shutdown will start counting once the stop pressure is reached. The pump will stop at the expiration of this timer if the pressure is still above the stop pressure. If a periodic test has been programmed, the remaining time will be displayed. If a manual run test has been energized, the remaining time will be displayed.

G: The alarm/warning notification.
Warning indicator: Exclamation mark in a yellow round icon. If no alarm is in ACTIVE condition on the controller and at least one warning is ACTIVE or OCCURRED, the warning indicator will be present.

Alarm indicator: Exclamation mark in a red triangle icon. As soon as at least one alarm is ACTIVE or OCCURRED, the alarm indicator will be flashing.

H: The motor configuration symbol shows how the motor is wired to the contactor(s). This symbol is used to show if the motor is in a starting configuration (Wye wiring, for example) or in a permanent running configuration (i.e. delta wiring)

Permanent delta motor connection.

Temporary wye motor connection.

Temporary auto-transformer motor connection.

Temporary solid state starter motor connection.

I: Representation of the motor starting or stopping cause. A green capsule will indicate the reason why the motor is running. Possible choices are:

EMERGENCY: Manual motor starting activated by the emergency handle.

MANUAL: Manual motor starting activated by the START push button.

REMOTE MANUAL: Manual motor starting activated by a remote start contact.

DELUGE: Automatic motor starting activated by a deluge valve.

AUTO: Automatic motor starting activated by pressure drop

REMOTE AUTO: Automatic motor starting activated by remote equipment

MANUAL TEST: Automatic motor starting activated by the run test push button.

A red capsule will indicate the reason why the motor is not running despite the fact that a request is being made. Possible choices are:

LOCK ROTOR CURRENT: A lock rotor current alarm has not been cleared on the alarms page and prevents the motor from starting.

LOCKED: An interlock signal is preventing the motor from running.

J: The discharge pressure gauge. It allows for a precise reading of the actual system pressure. The red box on the upper left corner of the gauge indicates the value of the Cut-In set point and the green box on the upper right corner represents the Cut-Out set point. These values will also be represented by a red and green line on the gauge, allowing a quick comparison between the actual pressure and the set points. At the bottom of the gauge, a digital indicator shows the actual discharge pressure represented also by the needle of the gauge. To the right of the digital pressure indicator, the actual pressure unit is shown. Finally, the maximum allowable pressure is also indicated on the gauge and will scale the gauge accordingly.

K: Displays three statuses that describe the primary configuration of the controller: Pressure actuated or Non-pressure Actuated, Automatic Controller or Non-automatic, Manual or Automatic Shutdown.

Screen Saver

After 5 minutes of inactivity on the ViZiTouch, the screen will dim it's brightness to 25%. After 10 minutes of inactivity on the ViziTouch, the “Black Screen” screen saver will activate. Its goal is to expand the lifetime of the LCD screen. The screen saver will be instantly deactivated if the engine is running or if an alarm is activated. To manually deactivate it, simply touch the screen or any membrane button. After deactivation, the screen saver will always redirect to the “Home” page. It will also log off any user by resetting the security level to 0 and save any new modifications to the settings.

Alarms 5

Alarms (Membrane button) **Alarms**

Displays the list of currently active and occurred alarms. An alarm is called ACTIVE when its triggering condition is still valid. An alarm is called OCCURRED when its triggering condition has been active, but is no longer true. Alarms representing serious concerns are colored RED. Alarms representing simple warnings are colored YELLOW. To silence the bell press the ALARM button or it will silence itself after the expiration of a factory set timer. Pressing on the RESET button will reset OCCURRED alarms only. Alarms ending with ** are available on transfer switch models only.

The table displays system events:
- Date and Time: Date and time stamp of the alarm in the YYYY.MM.DD format
- Message: Alarm message
- State: OCCURRED or ACTIVE
- Color Code:
    - Red: The event is an alarm
    - Yellow: The event is a warning

Complete list of alarms :
- Normal Phase Reversal: Activates when the phase order on the normal power does not match the correct value of the controller. Each time a service is acknowledged on the ViZiTouch, the controller synchronises the correct phase order to the one detected on the normal power.

- Phase Loss N1: This alarm is activated if the first phase of the normal power connection does not meet the qualification criteria.

- Phase Loss N2: Activates if the second phase of the normal power connection does not meet the qualification criterions.

- Phase Loss N3: Activates if the third phase of the normal power connection does not meet the qualification criterions.

- Loss of power: Activates when a complete loss of normal power is detected.

- Lock Rotor Current: Activates when a lock rotor condition has been detected on the normal power. Note that the motor will not be permitted to start on the normal power as long as this alarm has not been reset from the alarms page.

- Fail to start: Activates if there is and under-current draw of two phases when the motor should be running. A 20 seconds factory set delay is used to give the motor enough time to start before signalling this alarm.

- Undercurrent: Activates when current is under 30% of FLA and motor has been running for 15 seconds.

- Overcurrent: Activates when current is above 120% of FLA.

- Under voltage: Activates when normal power voltage is below 80% of nominal voltage.

- Over voltage: Activates when normal power voltage is above 120% of nominal voltage.

- Phase Unbalanced: Activates when there is a difference of more than 30% of nominal voltage between the normal power voltage readings.

- Ground Fault: Activates when the ground fault input current is above the factory set value after a factory set delay.

- PT Fault Detected: If an optional dual pressure sensor is installed, it will be activated if the two pressure transducers show different readings. Further investigation is advised to determine what caused the different readings. Note that the controller will always choose the lowest pressure reading to determine the actual system pressure.

- Overpressure: Activates if the analog readout of the discharge pressure goes higher than the overpressure set point in the discharge pressure sensor page.

- Underpressure: Activates if the analog readout of the discharge pressure goes lower than the “Under Pressure” set point in the discharge pressure sensor page.

- Water Reservoir Low: Activates if the “Water Reservoir Low” contact input is triggered or if the analog readout of the water reservoir is enabled and is lower than the water reservoir low set point in the “Water Level” sensor page.

- Water Reservoir Empty: Activates if an external contact triggers the optional “Water Reservoir Empty” input.

- High Water Level: Activates if the optional “High Water Level” contact input is triggered or if the analog readout of the water level is enabled and goes higher than the “High Water Level” set point in the “Water Level” sensor page.

- Main Relief Valve Open: Activates if an external contact triggers the optional “Main Relief Valve Open” input.

- Io_expX-inX alarm: Activates if the specific expansion programmable input on the specific expansion board is activated and triggered.

- High Motor Temperature: Activates when the optional high motor temperature contact is activated.

- High Motor Vibration: Activates when the optional high motor vibration contact is activated.

- Control Voltage Not Healthy: Activates when the 24VAC power input to the IO cards is below the acceptable functional range.

- Motor Trouble: Activates when a motor related alarm condition is present (overcurrent, undercurrent, fail to start or ground fault).

- Pump Room Alarm: Activates when a pump room related alarm condition is present (overvoltage, undervoltage, phase unbalanced).

- Flow Meter On: Activates when the optional flow meter input is activated.

- IO Electric Communication Error: Activates if no communication with the electric IO card could be established for 15 seconds. This alarm is critical and triggers the bell. If this alarm persists for more than 1 minute, the controller will reboot to try to fix the problem.

- IO Expansion Communication Error: Activates if no communication with the Expansion IO card could be established for 15 seconds.

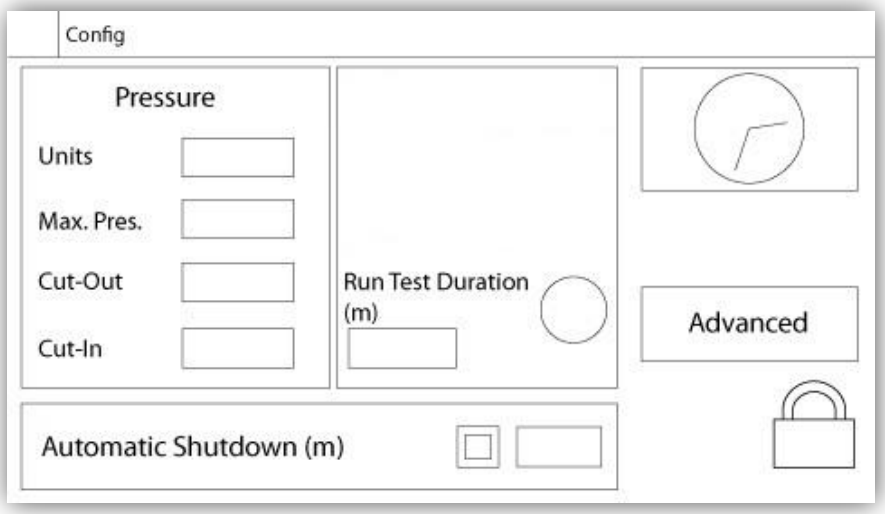
- Communication System Failure: Activates when the communication task has stopped responding. This alarm condition is critical and the controller will reboot to try to fix the problem.

- File System Failure: Activates when a file system error was detected. This alarm condition is critical and the controller will reboot to try to fix the problem.

- Pump on demand: Activates when the pressure is below the cut-in set-point on an automatic pressure actuated controller.

Configuration 6

Config (Membrane button) **Config**



Setup all basic configuration parameters.

The main configuration page provides a quick means of changing the most common settings. The padlock icon indicates the current authorization level. A locked padlock indicates that only basic settings can be changed. Press on the padlock to enter an authorization code to unlock additional settings. An unlocked padlock showing an authorization number indicates that some settings are unlocked. Press on the padlock again when you have concluded your operation.

Access Level 0:

-The “Advanced” button activates the advanced configuration pages.

- Date and Time adjustment are accessed by pressing the clock. Refer to the “Date and Time” page for more information.

Access Level 1:

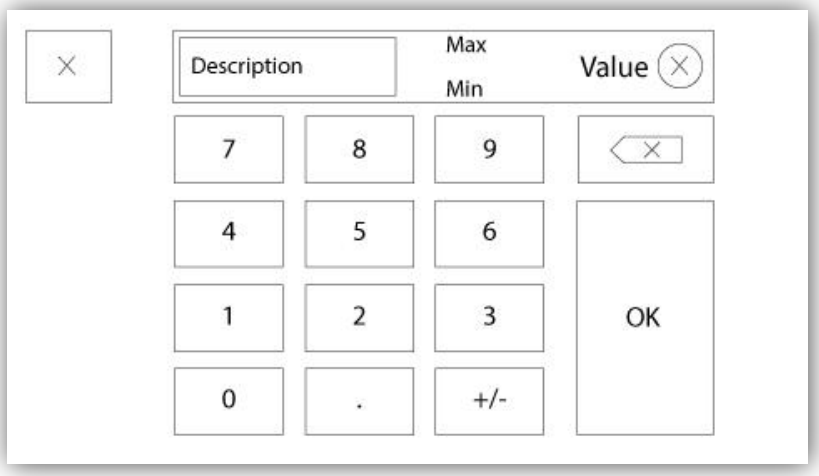
Inside the left box, the main pressure parameters can be set.
- Adjustment of the pressure reading “Unit of measure”: PSI, kPa, bar, FoH, mH20
- Maximum pressure of system (between the Cut-Out value and 9999)
- Cut-Out adjustment (between the Cut-Out value and the Maximum Pressure value). It should be set before setting the Cut-In
- Cut-In adjustment (between 0 and the Cut-Out value)

Inside the middle box, the parameters linked to the different tests can be set.

The next set of parameters is the periodic test schedule which consists of three editable fields. The first field is the day of the week and the time, in hours and minutes. Simply press the appropriate button to set these values accordingly. The next editable field located just below is the periodic test duration in minutes. The last section of the middle box is the duration of the manual “Run Test”, labelled with the “Run Test” icon button as seen on the membrane. Press the button to modify the value of the manual "Run Test" duration.

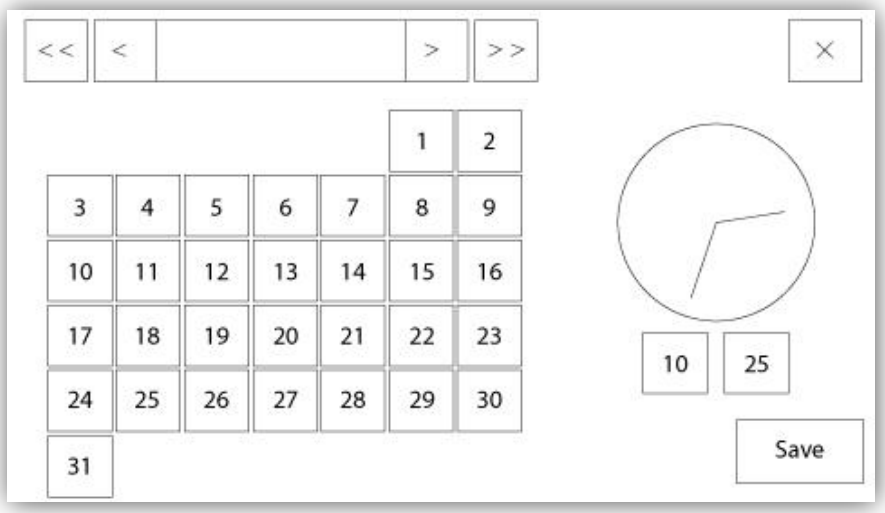
Inside the lower box, the Automatic Shutdown may be activated and the duration of the “Run Period Timer” is shown. To edit the “Run Period Timer”, refer to the “Timers” page in the advanced configuration pages.

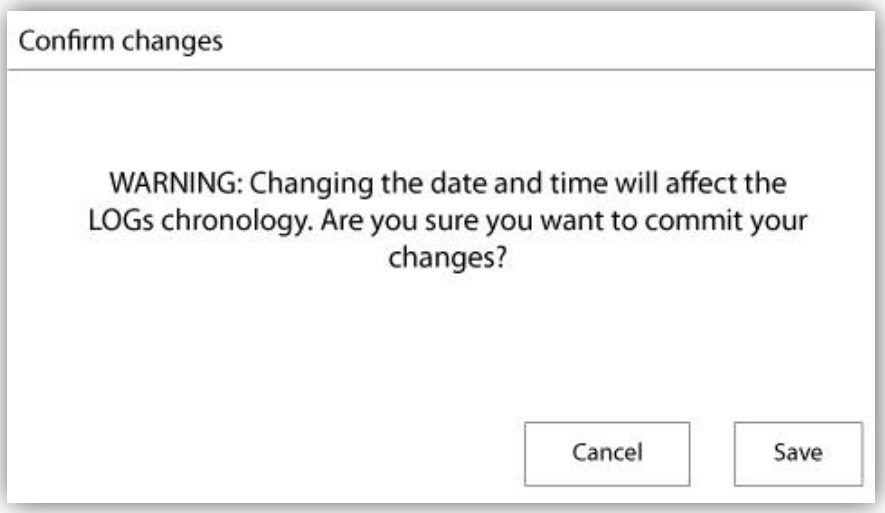
NumPad Page



The NumPad is activated every time the user clicks on a white square box representing a number that can be set. On top of the NumPad, the current parameter is shown. The text will flash red if the value entered is invalid and the OK button will be black, indicating that the value is out of range. The MIN and MAX show the range of values accepted for that particular parameter. The “X” button allows the user to cancel editing the value. The back arrow erases the last entered number and the “CA” button clears the whole text field. Simply click the “OK” button once the value is set.

Date and Time Page





The Date and Time can be configured by selecting the current month and year by pressing the arrow buttons on each side of the “Month-Year” display and selecting the day of the month by selecting the actual day. The time is set by pressing the two square boxes under the clock; the left sets the hours and the right sets the minutes. Press the Save button to commit the changes. A dialog box will appear to confirm the change “Date and Time”. The user may cancel the changes by pressing the “Cancel” button. Please note that changing the date and time will have an effect on the logs chronology.

User Login Page / KeyPad Page

User Login KeyPad:
This page allows the user to log into a higher security level by entering a password. If the password is valid the text field will turn green and if it is invalid, the text field will turn red. A "X" button appears in the text field as soon as a character is entered, allowing for a quick erase of the written password.

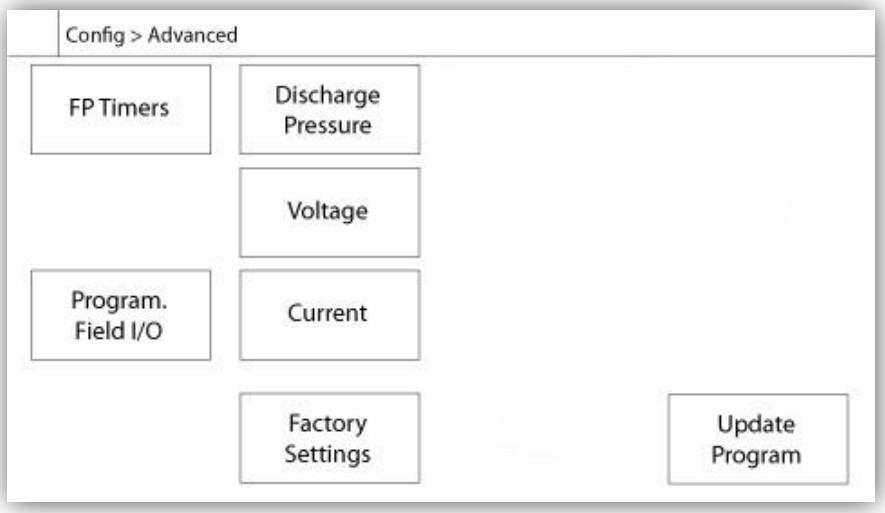
If the password is invalid for a consecutive number of times, the user will be redirected to the "Service Dealer" page, allowing the user to communicate with the appropriate Service Dealer.

If the password is valid, the "Configuration" page will reload and the access security level will be shown inside the lock. To log off, click on the lock and the user security level will return to "0"

Other KeyPads:
The KeyPad is activated every time the user clicks on a grey rectangle box with white text representing a text that can be set. The "X" button allows the user to cancel editing the value. The back arrow erases the last entered

character and the "CA" button clears the whole text field. Simply click the "OK" button once the value is set. This type of text field is mostly used to generate a digital text indication for a custom alarm input.

Advanced Configuration Page **Config > Advanced**



This page is the portal to all the advanced configuration parameters of the ViZiTouch.

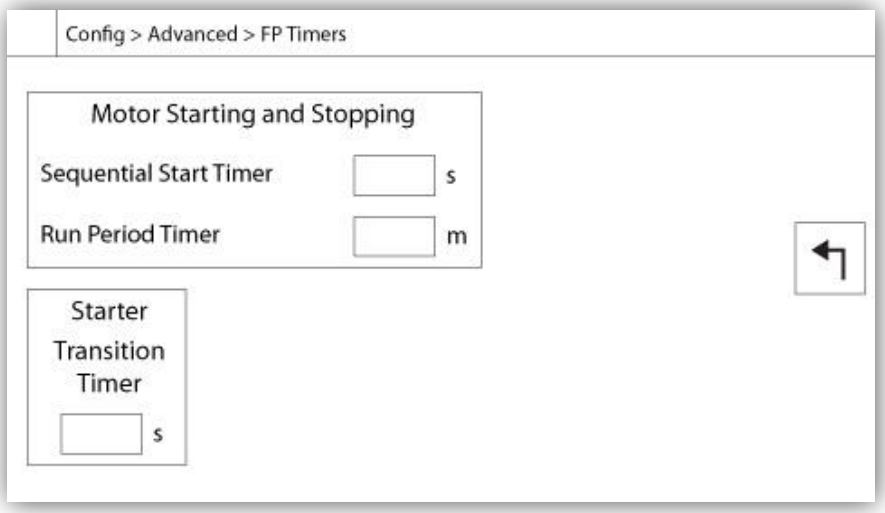
All timers, sensors, factory settings, software update, service dealer and debug pages may be accessed simply by clicking on the appropriate buttons.

Since two of the analog inputs are using the same physical connector, only one of these can be installed at once. These analog inputs are shown in the grey box surrounded by a black dotted line. Each time one of these sensors is installed, the other will turn orange, preventing the dual installation of these sensors.

All buttons are set to security "Level 0" except "Update Program" which is set at "Level 1" security.

Details of the Advanced Configuration Page

Timers Page **Config > Advanced > Timers1-2**



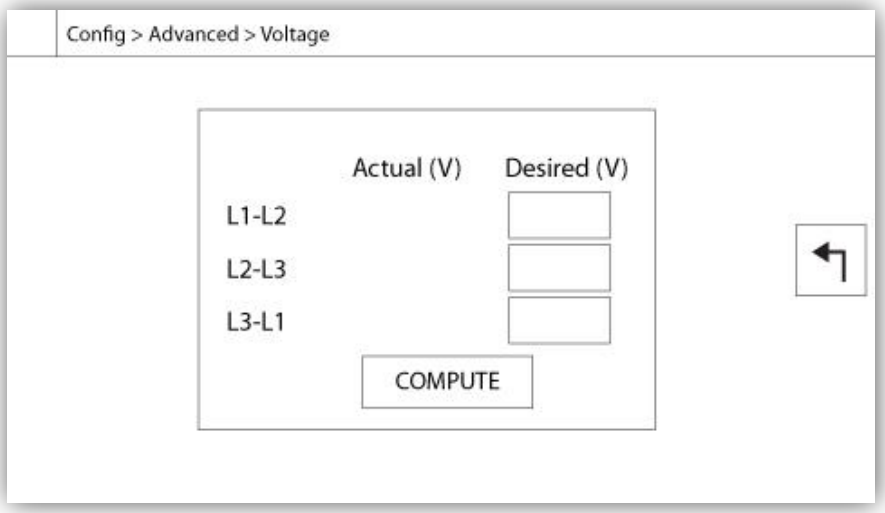
Most common timers can be configured here. Note that any timer set to 0 will remove the delay in the decision process.

Access level 1:

- Motor starting and stopping:
The sequential start timer set-point, in seconds, will delay an automatic motor starting.
The run period timer, in minutes, will delay the stopping of the motor when the automatic run cause of an automatic stop configured controller has returned to normal and that no other run causes are present.

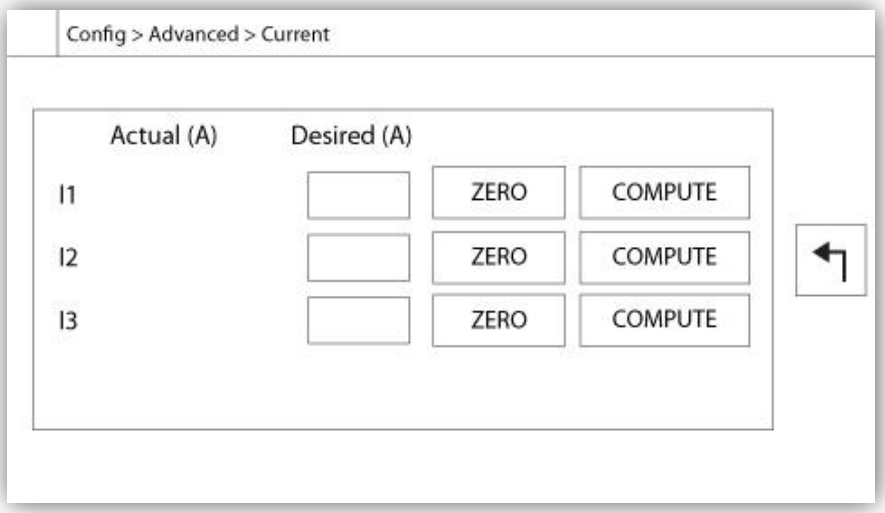
Access level 2:
- Transition Timer: Will set the time for which a motor is in the temporary starting wiring configuration. When this timer expires, the motor will be wired in delta.

Voltage Calibration **Config > Advanced > Voltage**

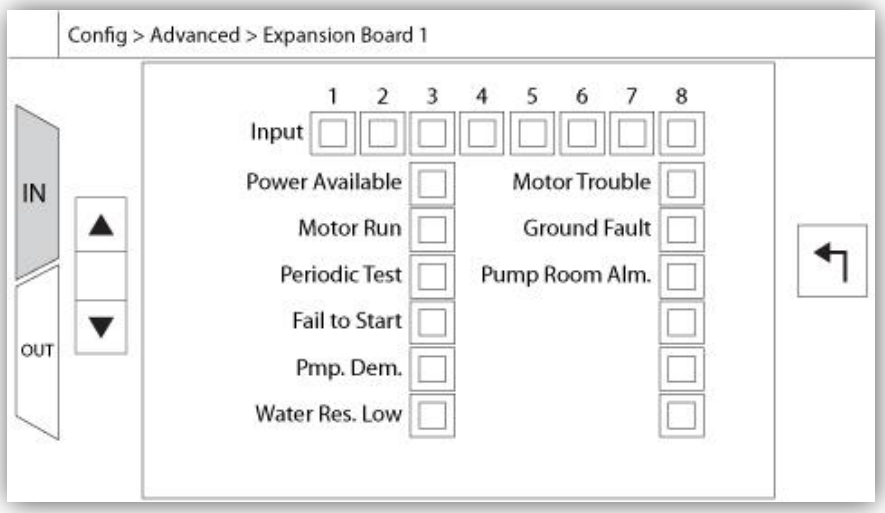


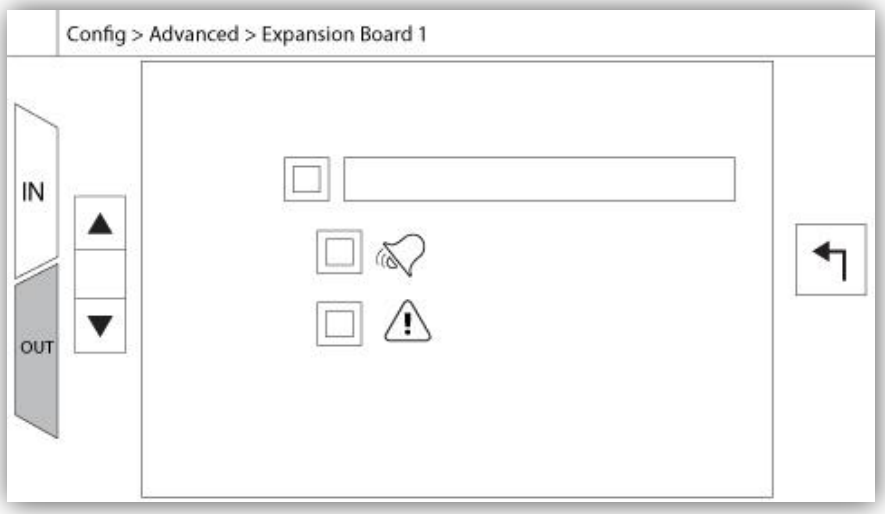
To calibrate the voltage sensing element of a power source, enter the 3 phase voltages as read on a calibrated meter then press compute. In the case of a transfer switch model, 3 additional voltages need to be calibrated the same way.

Current Calibration **Config > Advanced > Current**



To calibrate a particular current sensing element, enter the current value as read from a calibrated ammeter and then press COMPUTE. For best results, press the ZERO button when no current is flowing through the sensing element before calibrating.





This page allows the configuration of both programmable inputs and outputs available on an IO Expansion board. Two buttons located far right navigates between the input and output section of the page.

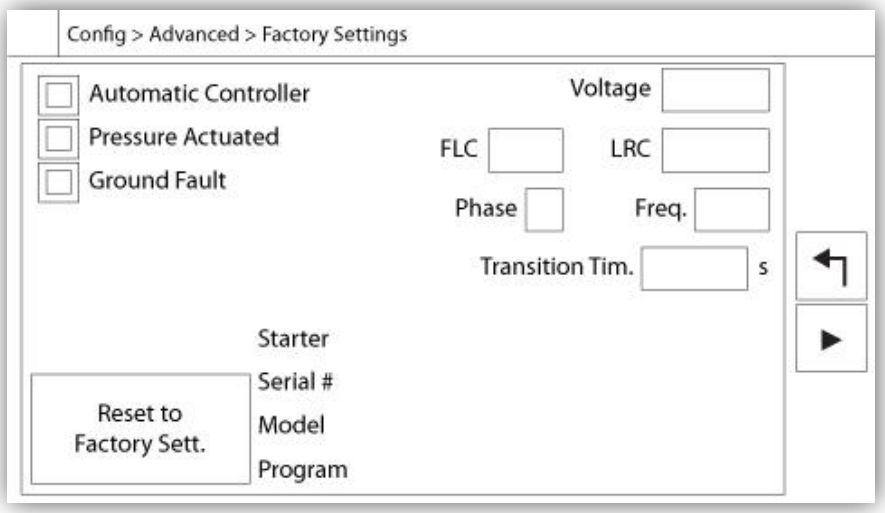
Input:
The input page has four elements: The NO/NC setting, the "Digital Text Indication" field, the "Alarm Bell Icon" and the "Alarm Icon". Each one can be Enabled or disabled. The first step is to click on the square button beside the text field to activate the management of the input signal. If the "Alarm Bell Icon" is Enabled, the input signal will trigger the Alarm Bell. If the "Alarm Icon" is Enabled, the input signal will be treated as an alarm, if not, as a warning. As on the output page, the buttons at the top allow for an easy navigation between all available inputs of the diesel board.

Output:
The configuration is performed by pressing on the square box located beside one of the signal needed. The box will swap between BLANK (none), a NO (normally open) and a NC (normally close) symbol, allowing the desired configuration to be obtained. On top of all outputs signals available, it is possible to link in the same way the expansion board inputs to the selected output in any combination. The final state of the output signal is a logical "OR" combination of all selected signal.

Update Program Page

This procedure is highly important and must be attempted with care. Please make sure to contact the factory prior to using the Update Software function.

Factory Settings **Config > Advanced > Factory Settings**



The factory settings are always pre-configured at the factory and set the main parameters of the controller. Most of the settings found on this page can only be changed by an authorized Tornatech employee and is protected by a level 8 password.

Automatic Controller – Non-Automatic Controller: An automatic controller will respond to automatic start requests, like a pressure transducer, a pressure switch, a deluge valve or a remote automatic start trigger. A non-automatic controller will only start the motor on manual requests.

Pressure Actuated – Non-Pressure Actuated: A pressure actuated controller has at least one pressure transducer installed and will monitor the system pressure at all time. In an automatic controller, the pressure drop will start the motor.

Enable/Disable – Ground Fault: The “Ground Fault” is a factory installed option that will enable or disable the Ground Fault Visual Indication.

“Reset to Factory Settings”: This button redirects to the “Reset to Factory Settings” page. This is a major operation

that must be used with care and only if the factory was contacted first. See the “Reset to Factory Settings” help for more details.

Voltage: Nominal voltage of the controller

FLC: Full load current rating of the motor.

LRC: Lock rotor current rating of the motor. Unless specified, this value is automatically set to six times the FLC.

Phase: Input power number of phases.

Frequency: Input power frequency.

Transition Timer: Will set the time for which a motor is in the temporary starting wiring configuration. When this timer expires, the motor will be wired in delta.

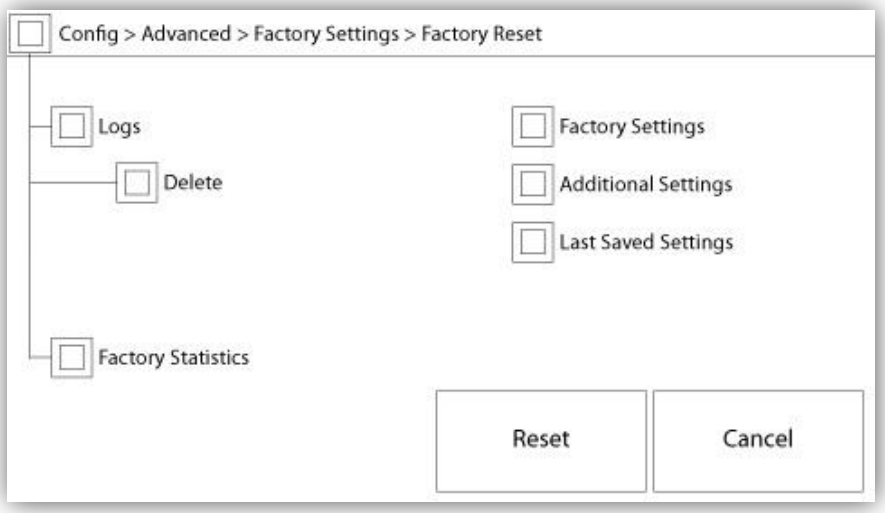
Starter: Motor starter configuration. This value is read-only.

Serial: Serial number of the controller. This value is read-only.

Model: Model number of the controller. This value is read-only.

Program: Program version of the ViZiTouch. This value is read-only.

Reset to Factory Settings Page



This page will reset the ViZiTouch to the original factory configuration, thus clearing all subsequent configurations performed during the life of the controller.

This procedure should only be used as a last attempt to bring back the controller to a usable state.

User “Level 2”:

The “RESET” button will be activated (will become blue) only if no square buttons from the left column are activated and the “Last Saved Settings” from the right column is not activated as well. A “Level 2” user can only reset the “Factory Settings” and/or the “Additional Settings” from the right column.

The “Factory Settings” reset will restore the controller to its original factory configuration and service state. This means that the first service will be undone, automatic mode settings, as well as the controller’s “Homepage” will be deactivated until “First Service” is completed again. Please refer to the “Quick Start-Up” guide for more information on how to perform the “First Start-Up” and how to complete the “Field Acceptance Test Report”.

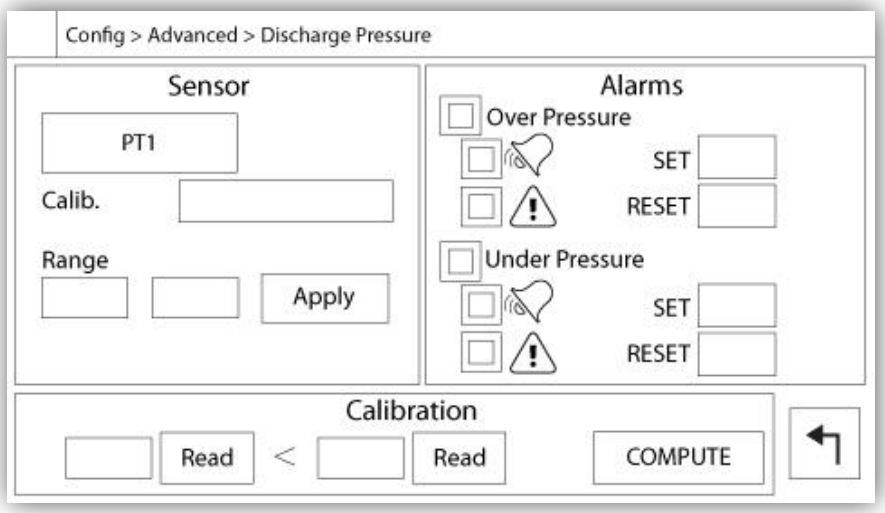
Please note that all logs, pump curves and statistics will not be reset.

The “Additional Settings” reset will update the controller with an additional configuration sent by the manufacturer. It does not perform a true “Factory Reset”. Its purpose is to allow an update of configuration variables that can only be updated by Tornatech Inc.

All other square buttons on this page are “Level 9” security and can only be used by certified Tornatech representatives, unless otherwise specified. The first square in the upper left corner performs the “Select all” function for these parameters.

The Sensors Pages

Important Notice!
Every analog sensor cable used for this controller should be shielded. The shield has to be grounded on the motor side. Not complying to these recommendations may affect the controller good functioning and void its warranty.



In the ViZiTouch, all sensors refer to analog input connectors on the I/O board. They all have similar settings and configuration.

The “Installed” selection (”Level 2” security): Install or uninstall this sensor from the ViZiTouch configuration.

Discharge Pressure: To set the pressure system unit, go the “Config” page. All pressure transducers share the same unit.
The “Source” button (4 choices): (“Level 2” security)
- None: No pressure transducer or pressure switch is installed.
- PT1 (factory standard): Only the AI1 terminal on the “T” terminal strip is Enabled.
- PT2: Only the AI2 terminal on the “T” terminal strip is Enabled.
- AUTO (factory installed option): AI1 and AI2 are installed and arranged for a redundancy system. The ViZiTouch will always consider the lowest of the two pressure values as the reference. Additional alarms, like “PT fault detected” become Enabled This alarm is triggered when the two transducers provides values that are different by more than a pre-set delta value. The ViZiTouch will never make a decision as to which transducer is faulty; it will only reveal that there is a problem with one of them. The service dealer should test both transducers to find out which one is faulty.

Suction Pressure: To set the pressure system unit, go the “Config” page. All pressure transducers share the same unit.
The “suction pressure” sensor shares the same analog input (AI4) as the water level sensor. Only one of them can be installed at all time. Prior to installing one of them, the other one must be uninstalled by visiting its own sensor page.

Flow: The “Flow” sensor shares the same analog input (AI3) as the spare temperature sensor. Only one of them can be installed at all time. Prior to installing one of them, the other one must be uninstalled by visiting its own sensor page.

The “Unit” button is located just right of the “Installed” selection. Click on it to select the appropriate “Flow” Unit, the factory pre-set unit is the GPM.

Flow Start:
- Enable/Disable the “Flow Start” condition by pressing the square button. If this alarm is Enabled, it will also start the engine by means of a “FLOW” request.
- Alarm Bell Icon: Activates the bell when a “Flow Start” occurs.
- Alarm Icon: If selected, the “Flow Start” event will be an alarm. If unselected, it will be a warning.
- Value: Flow value at which the “Flow Start” event will change state.
- Timer On: Timer used to buffer the activation of the “Flow Start” signal by the ViZiTouch.

Water Level: The “Water Level” sensor shares the same analog input (AI4) as the suction pressure sensor. Only one of them can be installed at all time. Prior to installing one of them, the other one must be uninstalled by visiting its own sensor page. The “Water Level” sensor has no unit, since it is monitoring the “Water Level” as a percentage.

Spare Temperature: The “Spare Temperature” sensor shares the same analog input (AI3) as the Flow sensor. Only one of them can be installed at all time. Prior to installing one of them, the other one must be uninstalled by visiting its own sensor page. The “Unit” button is located just right of the “Installed” selection. Click on it to select the appropriate “Spare Temperature” Unit, the factory pre-set unit is the Celsius.

Fuel Level (GPD Model Only): The “Fuel Level” sensor has no unit, since it is monitoring the “Fuel Level” as a percentage.

The Calibration method is the same for all sensors.

CALIBRATION:

The Calibration button: (“Level 2” security for the choice of calibration, but “Level 1” security for the calibration procedure itself.) There are 4 ways to calibrate every sensor:

- 0-10V: Theoretical calibration with 0-10V sensor. Simply enter a value in the system pressure unit for 0V and another value for 10V. Click on the “Apply” button to confirm the calibration. The resulting measured pressure is shown in the lower right corner of the “Sensor” box. Make sure the dipswitch package right below the “T” terminals is set to “0-10V” for that particular sensor (refer to the drawing). The switches are labelled and are each linked to one analog input, in this case “1 or 2”. *Important Note: A set of jumpers is also associated with each analog input. MAKE SURE THE CONTROLLER IS COMPLETELY POWERED OFF BEFORE MOVING A JUMPER. THIS INCLUDES REMOVING THE AC AND DC POWER. The jumper can be placed on “5Vdc”, “12Vdc” and “Vaux” and represents the powered DC value of the sensor. The factory pre-set position is “5Vdc”. If an installed sensor has a power value of “5Vdc”, then the “0-10V” theoretical calibration must be calculated accordingly. Please contact manufacturer for more information.

- 4-20mA: Theoretical calibration with 4-20mA sensor. Simply enter a value in the system pressure unit for 4mA and another value for 20mA. The procedure explained above also applies in this case.

-Field Calibration: This is the factory pre-set method and the only one that is an actual calibration. Selecting this calibration method will generate the Calibration box situated in the lowest part of the sensor page. It is very important that the same care is used when selecting the appropriate dipswitch setting and jumper position. Please refer to the “0-10V” section above.
1.Two actual points (low and high) are required.
2. Set the lowest point (usually 0).
3. Press the left read button.
4. Press the left rectangle text field and enter the value read on the external calibrated gauge.
5. Set a high point (usually the highest possible value will create the best calibration).
6. Press the right read button.

7. Press the right rectangle text field and enter the value read on the external calibrated gauge.
8. Press the calculate button to finish the calibration. If the settings are incorrect, the calculate button will remain red and if correct, the button will turn blue. The resulting measured value is shown in the lower right corner of the “Sensor” box.

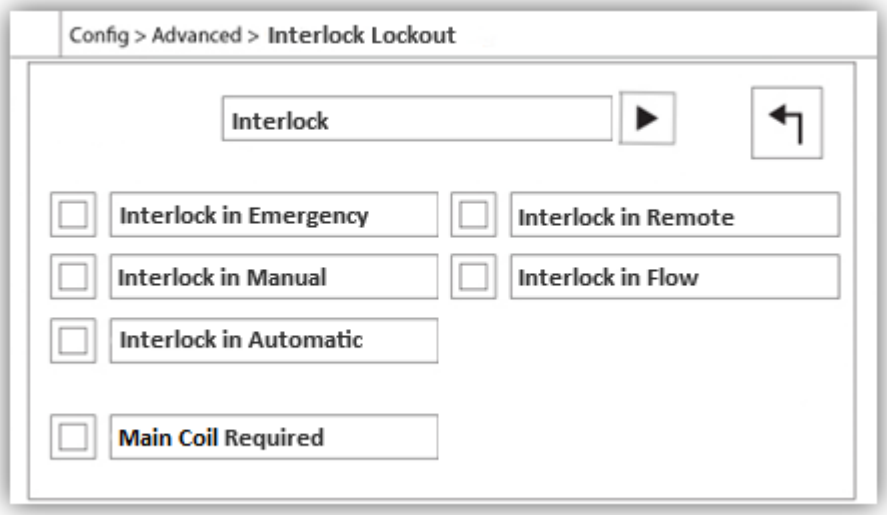
- On/Off: Use the input with a dry contact sensor, for example a float switch. The only parameter to set for this method is the NO/NC buttons, effectively selecting between a normally open and a normally close switch. Click on the “Apply” button to confirm the calibration.

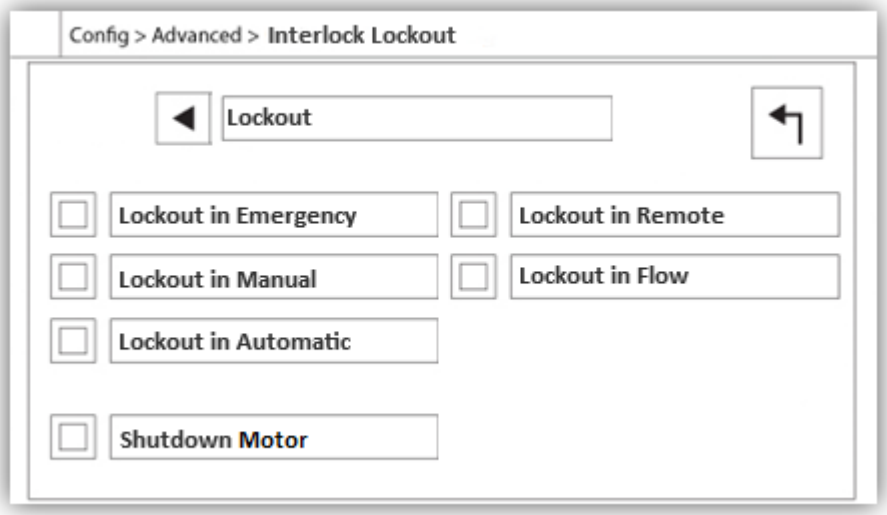
The Alarms Section: (“Level 1” security)

The “DRY” button can enable or disable the “Dry Contact Input” on the IO board. There are two modes when Enabled, either “Normally open, NO” or “Normally close, NC”. Each mode is represented by the standard NO/NC symbols.

- Enable/Disable the corresponding alarm/warning condition by pressing the square button.
- Alarm Bell Icon: Activates the bell when the condition occurs.
- Alarm Icon: If selected, the occurring condition will be an alarm. If unselected, it will be a simple warning.
- RESET: Value at which the condition will go from the “ACTIVE” state to the “OCCURRED” state.
- SET: Value at which the system will activate the corresponding condition.

Interlock Lockout **Config > Advanced > Interlock Lockout**





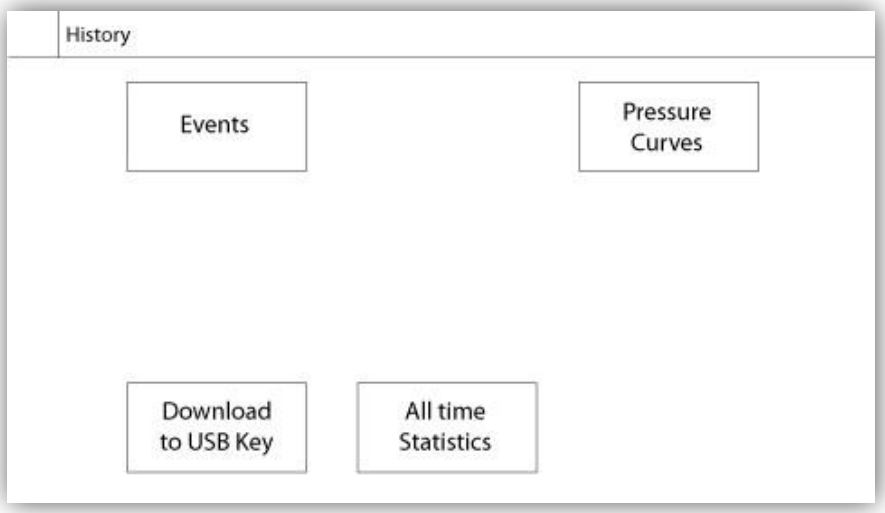
These pages allow to configure the Lockout input and the interlock output parameters. To be active, those options need to be assigned to an Input or an Output on the I/O board.

Lockout is an Input that disables the motor from starting.
- Enable in emergency: If checked, this option will prevent the electronic assistance on an Emergency start.
- Enable in manual mode: If checked, this option will prevent the Manual start.
- Enable in automatic mode: If checked, this option will prevent the Automatic start.
- Enable in remote manual mode: If checked, this option will prevent the Remote Manual start.
- Enable in "start/stop" mode: If checked, this option will prevent the "start/stop" mode.
- Shutdown Motor: If enabled, the lockout signal will also act as a shutdown and will stop the motor if it is running.

Interlock is an Output that prevents a second motor from starting.
- Enable in emergency: If checked, this option will activate the output "interlock" on an Emergency start.
- Enable in manual mode: If checked, this option will activate the output "interlock" on a Manual start.
- Enable in automatic: If checked, this option will activate the output "interlock" on a Automatic start.
- Enable in Remote Manual mode: If checked, this option will activate the output "interlock" on a Remote Manual start.
- Enable in "start/stop" mode: If checked, this option will activate the output "interlock" on a "start/stop" mode.
- Main Coil required: If enabled, the controller will wait to have the Main Coil signal active before activating the Interlock output.

History 7

History (Membrane button) **History**



Select a specific page within the History section. Everything related to the statistics, events, pressure, power logs and the download to USB is available within the History page.

-Events: This button leads to the “Events” page, which displays the most recent 500 events. Each event log contains the date and time of occurrence as well as a brief description of the event.

-Download to USB Device: This button leads to the “Download to USB Device” page, which allows the user to download information, including the user manual, drawings, logs, statistics and configuration.

-All Time Statistics: This button leads to the “All Time Statistics” page, which displays the date and time of the first power up, the date and time when the first start-up was completed and the total “On Time” of the controller. These statistics can never be reset.

-Pressure: This button leads to the “Pressure Curves” page, which displays all relevant pressure information.

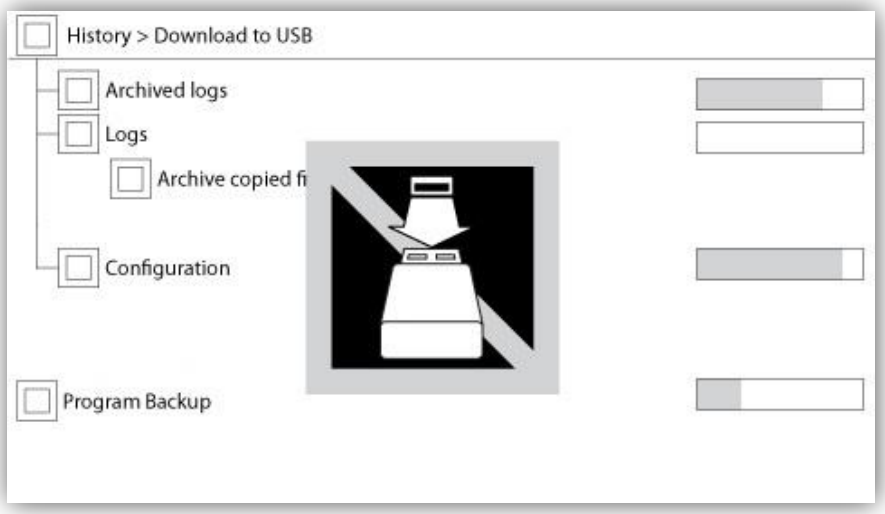
Details of the History Page

Events Page — History > Events Log

It shows the last 500 events which occurred in chronological order. The first column is the date, the second one is the time of occurrence and the third column is the “Event message”. To obtain a log that is older than 500 events, visit the “Download to USB Device” page and select “Events”. This method will generate a file containing all events logs in the ViZiTouch history.

The contextual navigation pad is implemented in this page. It allows quick navigations functions, like “previous page”, “next page”, “first page” and “last page”. As always, clicking on the Navigation Pad Icon in the lower right corner of the screen will pop-up the Navigation Pad functions specific for this page.

Download to USB Device — History > Download to USB



To download information from the ViZiTouch to a USB Device a user with at least a "level 1" password must be logged in. The first square beside the title is a "Select All" button. Pressing it will select all categories except "Archive copied files", which serves a separate purpose. The "Download to USB" button will execute the command. The entire right side is filled with different progress bars, to help monitor the current transfer. If a USB Device is not present or if there is an error, a message saying "Could not mount USB drive" will appear and any further action is cancelled. To try again, remove the device, re-insert and press the button once more.

-Archived logs: All logs files that were archived using the "Archive copied files" square button. The purpose of archiving files is to free up memory on the ViZiTouch by archiving older log files.

-Logs: All logs are currently available in the ViZiTouch memory. A "Comma Separated Values" or ".csv" file is created every day and is named accordingly. Most software in modern computers will be able to read and interpret these files. The log files contain the event logs, the pressure logs and the power logs.

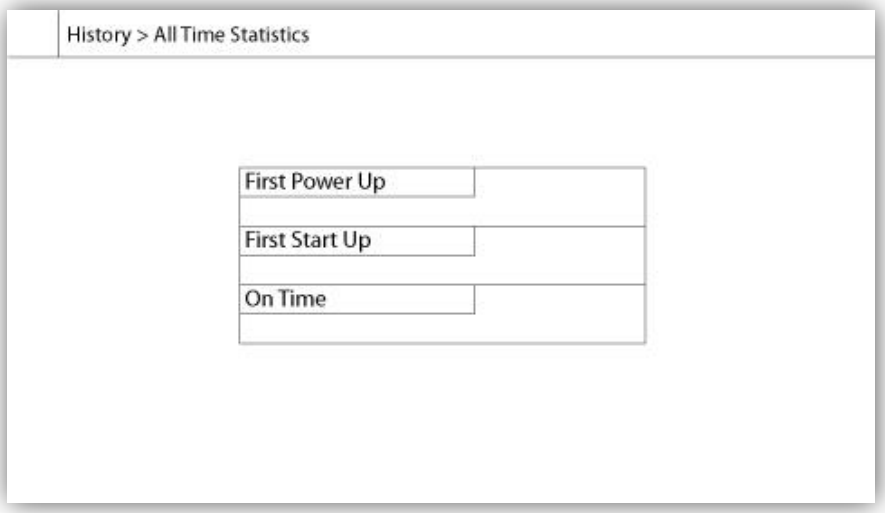
-Configuration: All configuration parameters contained in a ".txt" file, including but not limited to nominal values, serial number, calibration parameters.

Program Backup: A compressed and encrypted file, only readable by the ViZiTouch. This allows the user to copy a complete ViZiTouch to another one. IMPORTANT: The ViZiTouch is not in service while downloading the program backup.

The Statistics

All Time Statistics

History > All Time Statistics



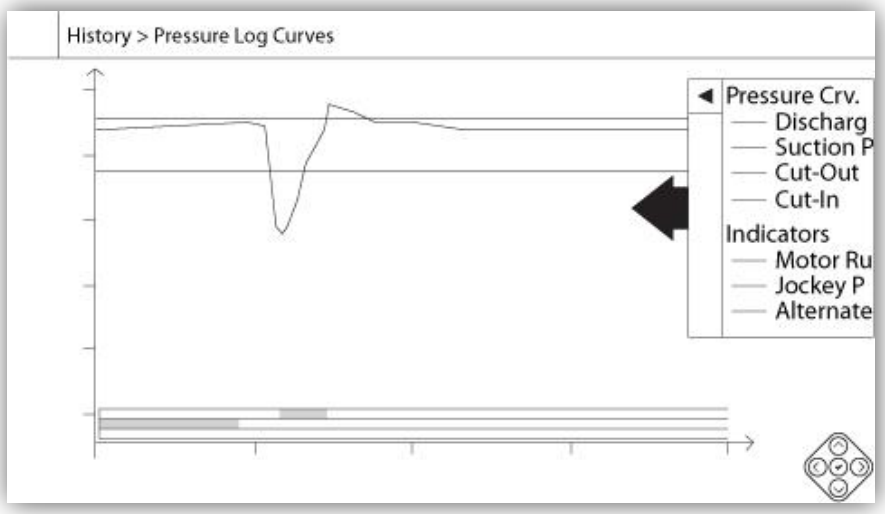
All statistics shown here are calculated since the controller's first start-up was done. All dates are in the YYYY.MM.DD format and all time references are in the HH:MM:SS format.

-First Power Up: Date and time of when the controller was first powered up.
-First Start Up: Date and time of when the controller's first start-up was completed.
-On Time: Total duration of controller powered on since the first power-up. In Day.Hour.Minutes.

Pressure Curves

Graphical Mode

History > Pressure Log Curves



The vertical axis represents the pressure in the actual unit selected. Its scale is dynamic and will resize depending on the highest recorded value. The horizontal axis represents time and period. The left part of the horizontal axis shows the beginning of the current scope and the right part shows the end of the scope. Located just right of the axis, the total scope time is shown. The contextual navigation pad is implemented in this page. It allows for quick navigation functions, like “Zoom in”, “Zoom out”, “Rewind”, “Forward” and “Textual Mode”. As always, clicking on the Navigation Pad Icon in the lower right corner of the screen will pop-up the Navigation Pad functions specific for this page. By pressing the right or left buttons on the navigation pad, the time will shift back or forth by a quarter of the current zoom setting, allowing a quick user-friendly navigation.

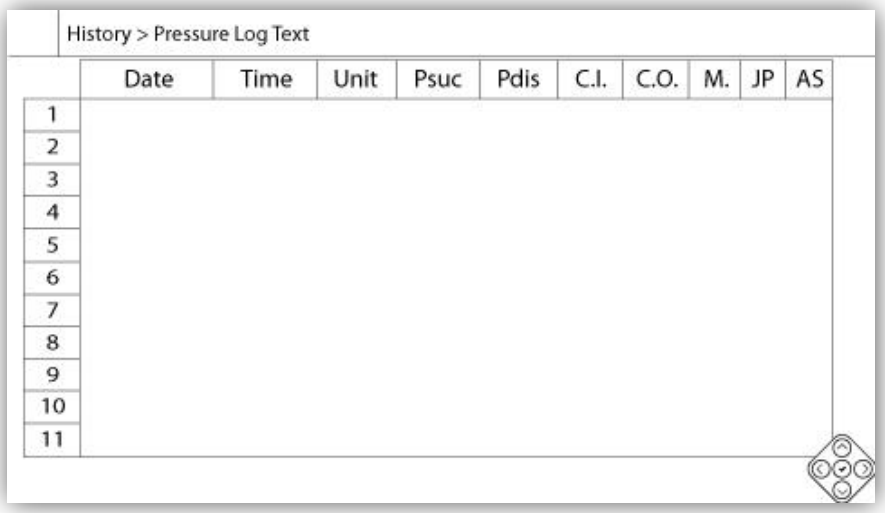
The grey vertical bar with a blue arrow, located at the far right of the screen, is the legend. Clicking on it will display

an accurate description of the different curves (Discharge pressure, Suction pressure when available, Cut-In and Cut-Out) with their respective colors.

Between the “0” pressure value and the horizontal axis, a short series of narrow horizontal zones are displayed. They are described in the “Indicators” section of the legend. These zones indicate when the motor was running, when a jockey pump was running and when the voltage reading is taken from the alternate side by shading small sections of the horizontal zone whenever the condition is occurring.

As indicated earlier, the “Textual Mode” is available by pressing the “Select” button on the navigation pad. This will represents the pressure logs in a table form, allowing for a more precise reading (see “Textual Mode” right below).

Textual Mode **History > Pressure Log Text**



The “Pressure Log text” shows a table with 10 rows. The total number of rows available is 500 and the logs are sorted in chronological order. To see more logs, please download all logs on a USB Device.

Description of the columns :
-Date: Date when the log was recorded
-Time: Time when the log was recorded
-Unit: Actual pressure unit when the log was recorded
-Suc.: Suction pressure value
-Dis.: Discharge pressure value
-C.I.: Cut-In value when the log was recorded
-C.O.: Cut-Out value when the log was recorded
-M.: The cell will become green if the motor was running for that specific pressure log.
-JP: The cell will become green if the jockey pump was running for that specific pressure log.
-AS: In the case of fire pump models built with an automatic transfer switch, the cell will become green if the logged phase voltages were read from the Alternate Side of the controller.

The contextual navigation pad is implemented in this page. It allows for quick navigation functions, like “Page Up”, “Page Down”, “First Page”, “Last Page” and “Graphical Mode”. As always, clicking on the Navigation Pad Icon in the lower right corner of the screen will pop-up the Navigation Pad functions specific for this page. By pressing these buttons, the displayed rows will shift, allowing a quick user-friendly navigation.

Technical Documents 8

Patents

Country	Title	Grant No
CA	Mechanical activator for contactor	2741881
US	Mechanical activator for contactor	US8399788B2
CA	Mechanical activator for electrical contactor	165512
CA	Mechanical activator for electrical contactor	165514
US	Mechanical activator for electrical contactor	D803794
US	Mechanical activator for electrical contactor	Patent pending
EP	Mechanical activator for electrical contactor	002955393-0001/2
AE	Mechanical activator for electrical contactor	Patent pending
AE	Mechanical activator for electrical contactor	Patent pending
CA	Fire pump digital operator	163254
US	Fire pump digital operator interface	D770313
AE	Fire pump digital operator interface	Patent pending
EP	Fire pump digital operator interface	002937250-0001
CA	System and method for detecting failure in a pressure sensor of a fire pump system	Patent pending
US	System and method for detecting failure of a pressure sensor in a fire pump system	Patent pending

Pre-Field Acceptance Test			
TORNATECH MODEL GFX ELECTRIC FIRE PUMP CONTROLLER PRE- FIELD ACCEPTANCE TEST CHECK LIST			
Note: This document should be an official indication of whether or not the installation and general condition of the equipment is adequate for a field acceptance test. This document should also aid the individual responsible for executing the field acceptance test to decide whether or not to carry out the field acceptance test of the equipment.			
Installation Check List:		**YES**	**NO**
1	Verify that the nameplate of the Fire Pump Controller corresponds with the AC voltage available.		
2	Visual inspection for any damage to the exterior of the Fire Pump Controller. Make sure the enclosure, alarm bell, selector switch, membrane and display are not damaged.		
3	Verify that the Fire Pump Controller has been installed within sight of the pump and engine or motor.		
4	Verify that the Fire Pump Controller has been installed not less than 12 inches from the floor of the mechanical room.		
5	Verify that all electrical connections to the Fire Pump Controller are done using liquid tight conduit and connectors.		
6	With the Fire Pump Controller door open, visually inspect for any drill chips, dirt or foreign objects in the bottom of the enclosure, loose wires, broken components and general proper electrician workmanship.		
7	Verify that the correct Normal Power AC voltage is supplied to the controller by taking a voltage reading at the incoming terminals of the isolating switch (IS).		
8	Verify that the motor leads are connected for the corresponding starting method.		
Initial Power-Up Check List:		**YES**	**NO**
1	Controller door must be closed and latched, with Disconnecting Means handle in the OFF position.		
2	Verify that the Emergency Start Handle is in the OFF position.		
3	Verify that the Normal Power voltage and hertz displayed on the digital screen are the same as measured in point 7 of the Installation Checklist above.		
4	Verify that there is no Phase Reversal Alarm.		
Note: A manual or automatic start must only be executed if the motor and the pump have been cleared to be started by their respective official service technicians.		**YES**	**NO**
1	Place the Disconnecting Means handle in the ON position.		
2	Push the START pushbutton. The motor will start.		
3	Verify the motor rotation: • If the motor rotation is correct, no adjustment is required. • To correct the motor rotation, change motor connection leads 1 and 3 (A and C) at the run contactor		
4	Verify any alarms that would appear on the digital display screen. Correct any alarm condition.		
5	Set the Cut-Out and Cut-In settings by following the ViZiTouch documentation. You need to be logged in to modify these settings. Verify the automatic start by dropping the system pressure below the Cut-In setting.		
6	Stop the motor by pressing the “STOP” membrane button. Note: the motor will only stop if the system pressure is above the cut-out setting.		

Tornatech Controller S/N: _____

Installation address: _____

_____

_____

Check list completed? _____Yes _____ No

Check list completed by: _____

Company: _____

Date: _____

Witnessed By: _____

Comments: _____

_____

_____

_____

_____

_____

Field Acceptance Test Report			
TORNATECH MODEL HFX ELECTRIC FIRE PUMP CONTROLLER FIELD ACCEPTANCE TEST REPORT			
Complete this first section if it was not completed during the Pre-Field Acceptance test			
Note: A manual or automatic start must only be executed if the motor and the pump have been cleared to be started by their respective official service technicians.		**YES**	**NO**
1	Place the Disconnecting Means handle in the ON position.		
2	Push the START pushbutton. The motor will start.		
3	Verify the motor rotation: • If the motor rotation is correct, no adjustment is required. • To correct the motor rotation, change motor connection leads 1 and 3 (A and C) at the run contactor		
4	Verify any alarms that would appear on the digital display screen. Correct any alarm condition.		
5	Set the Cut-Out and Cut-In settings by following the ViZiTouch documentation. You need to be logged in to modify these settings. Verify the automatic start by dropping the system pressure below the Cut-In setting.		
6	Stop the motor by pressing the “STOP” membrane button. Note: the motor will only stop if the system pressure is above the cut-out setting.		
Phase Reversal Verification		**YES**	**NO**
1	Verify or simulate phase reversal Overcurrent Protection Controller nameplate info Electric Motor nameplate info FLC: _____A FLC: _____A LRC: _____A LRC: _____A		
Motor Starts			
Normal Power		**YES**	**NO**
1	6 manual starts		
2	6 automatic starts		
3	6 Emergency Handle starts		
4	1 remote/deluge valve start		

Field Settings:
Cut-Out Pressure: _____ Cut-In Pressure: _____ Minimum run period timer activated? Yes: _____ Set at _____minutes. No: _____ Sequential Start Timer? Yes: _____ Set at _____seconds. No: _____

Alarm Contacts Connections:

Fire Pump Controller

Motor Run connected? _____Yes _____ No

Power Available connected? _____Yes _____ No

Phase Reversal connected? _____Yes _____ No

Other contacts supplied and connected? _____Yes _____ No

Tornatech Controller S/N: _____

Installation address: _____

_____

Field Acceptance Test completed? _____Yes _____ No

Field Acceptance completed by: _____

Company: _____

Date: _____

Witnessed By: _____

Company: _____

The undersigned witness has been made aware of the NFPA20 article 14.4 Periodic Inspection, Testing and Maintenance which stipulates that “Fire pumps shall be inspected tested and maintained in accordance with NFPA25 – Standard for the Inspection, Testing and Maintenance of Water Based Fire Protection Systems”

Comments: _____

_____

_____

_____

_____

Americas

Tornatech Inc. (Head Office) - Laval, Quebec, Canada
Tel.: + 1 514 334 0523
Toll free: + 1 800 363 8448

Europe

Tornatech Europe SPRL - Wavre, Belgium
Tel.: + 32 (0) 10 84 40 01

Middle East

Tornatech FZE - Dubai, United Arab Emirates
Tel.: + 971 (0) 4 887 0615

Asia

Tornatech Pte Ltd. - Singapore
Tel.: + 65 6795 8114
Tel.: + 65 6795 7823

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www.tornatech.com