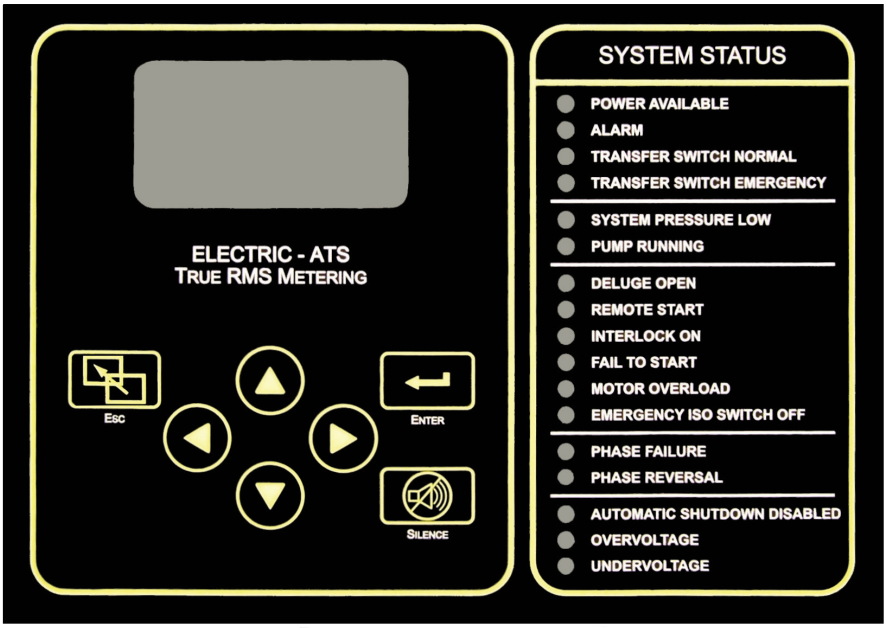
Installation & Operation Instructions

Mark IIXG Electric Fire Pump Controllers



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Publication NS1000-3100-50
ECN281259

California Proposition 65 Warning

WARNING: This product can expose you to chemicals including DINP, which is known to the State of California to cause cancer, and DIDP which is known to the State of California to cause birth defects or other reproductive harm.

WARNING: This product can expose you to chemicals including lead and lead compounds, which are know to the State of California to cause cancer and birth defects or other reproductive harm.

For more information go to: www.P65Warnings.ca.gov

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Publication GF100-85

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DANGER

RISK OF ELECTROCUTION

Personal injury or death could occur.
Ensure all power is disconnected before installing or servicing this equipment.

DANGER
DO NOT ATTEMPT TO INSTALL OR PERFORM MAINTENANCE ON EQUIPMENT WHILE IT IS ENERGIZED! DEATH, PERSONAL INJURY, OR SUBSTANTIAL PROPERTY DAMAGE MAY RESULT FROM CONTACT WITH ENERGIZED EQUIPMENT. ALWAYS VERIFY THAT NO VOLTAGE IS PRESENT BEFORE PROCEEDING, AND ALWAYS FOLLOW GENERALLY ACCEPTED SAFETY PROCEDURES. CONTROLLER "ON-OFF" SWITCH MUST BE IN THE EXTREME "OFF" POSITION TO OPEN THE ENCLOSURE DOOR. FIRETROL BRAND PRODUCTS CANNOT BE LIABLE FOR ANY MISAPPLICATION OR INCORRECT INSTALLATION OF ITS PRODUCTS.

INTRODUCTION

Firetrol® combined automatic and manual fire pump controllers are intended for starting electric motor driven fire pumps. This manual covers the following controllers:

FTA750 - Limited Service Controllers (Full Voltage Starting)
FTA1000 - Full Voltage Starting
FTA1250 - Part Winding Reduced Current Starting (Closed Circuit Transition)
FTA1300 - Wye-Delta Reduced Voltage Starting (Open Circuit Transition)
FTA1350 - Wye-Delta Reduced Voltage Starting (Closed Circuit Transition)
FTA1500 - Primary Resistance Reduced Voltage Starting (Closed Circuit Transition)
FTA1800 - Autotransformer Reduced Voltage Starting (Closed Circuit Transition)
FTA1930 - Digital Soft Starting
FTA2000 - High Voltage Starting
FTA2400 - Primary Reactor Reduced High Voltage Starting

Firetrol fire pump controllers are listed, approved or certified by the following approving authorities: Underwriters' Laboratories, Inc., Underwriters' Laboratories of Canada, Canadian Standards Association, New York Board of Standards and Appeals and Factory Mutual (Except FTA750 Limited Service Controllers). They are built to meet or exceed the requirements of the approving authorities listed above as well as NEMA and the latest editions of NFPA 20 and NFPA 70.

These instructions are intended to assist in the understanding of the installation and operation of these controllers. Read the instructions thoroughly prior to connecting or operating the controller. If there are any unanswered questions, please contact the local Firetrol representative or factory service department.

MOUNTING CONTROLLER

NOTE—Consult the appropriate job plans to determine the controller mounting location. Tools and materials (all mounting) required:

1. Assortment of common hand tools of the type used to service electromechanical equipment.
2. Drill for drilling wall/floor anchor holes.
3. Hole (conduit) punch.
4. Hand level.
5. Tape measure.
6. Four anchors with bolts and washers, per enclosure - if wall mount.
7. Mounting hardware for floor / wall mount.

Wall Mount— (Optional - If Ordered)

Procedure—

1. Locate bottom mounting brackets and hardware.
2. Inspect for damage.
3. Gently lay the controller on its back, using protection so the paint is not damaged. It is best to lay the controller in a location that is out of the way from actual mounting location.
4. Remove existing floor mounting legs if supplied. Attach each bracket to the bottom of the enclosure using the supplied hardware . Tighten nuts securely.

Note—Refer to the controller dimension drawing for necessary mounting dimensions.

The controller is wall mounted by using at least four (4) wall anchors, 2 or more anchors for the top ears and 2 or more anchors for the bottom mounting brackets (depending on enclosure size). The ears and brackets are dimensionally on the same center-line for ease in mounting.

5. Using either the dimension print or by measuring the distance between the center lines of the lower bracket slots, transcribe this dimension onto the wall. Note: The bottom edge of the enclosure should be a minimum of 12” (305 mm.) from the floor in case flooding of the pump room occurs.
6. Drill and put anchors into the wall for the lower bracket slot mounts.
7. Mark on the wall, the location of the holes in the upper mounting ears.
8. Drill and put anchors into wall for the upper mounts.
9. Install bolts and washers in lower anchors, leaving a gap between the washer and wall.
10. Lift the controller and place the bottom mounting slots down onto the lower anchor bolts. Do not tighten bolts.
11. Align holes in upper mounting ears and install bolts and washers in anchors.
12. Shim anchors as necessary to ensure rear of enclosure is vertically level and enclosure is not stressed. Tighten all anchor bolts.
13. Check to be sure enclosure door opens and closes freely and that enclosure is level.

FLOOR/BASE PLATE MOUNT

MOUNTING LEGS

PROCEDURE- (If not pre installed)

1. If legs were supplied, unpack the legs and mounting hardware.
2. Inspect legs for damage.
3. Securely lift controller or lay it on it’s back being careful not to damage painted surface.

4. Attach each leg to the bottom of the enclosure using the nuts, bolts, and washers provided for each leg. Tighten bolts securely.
5. After legs are securely attached, stand the controller up on its legs for floor mounting. Each leg has three holes on the bottom for anchoring to the floor or base plate.

NOTE—Consult the appropriate job plans to determine the controller mounting location. Refer to the controller dimension print for necessary mounting dimensions.

The controller is floor/base plate mounted by using the three pre-drilled holes in each leg. The holes are dimensionally on the same line for ease of mounting.

1. Using either the dimension print or by measuring the distance between the center lines of the holes on one leg, transcribe these dimensions onto floor/base plate.
2. Drill three holes in the floor/base plate for anchoring the leg.
3. Mark the location of the holes for the opposite leg and drill three more holes.
4. Secure the controller to the floor/base plate with bolts and washers and tighten.
5. Check to be sure the enclosure door opens freely and that the enclosure is level.

MAKING ELECTRICAL CONNECTIONS

Important Precautions—

Prior to making any field connections:

1. Open door of enclosure and inspect internal components and wiring for any signs of frayed or loose wires or other visible damage.
2. Verify that the controller information is what is required on the project:
   - Firetrol catalog number
   - Motor voltage and horsepower
   - Incoming line voltage and frequency
   - Maximum system pressure
3. Project electrical contractor must supply all necessary wiring for field connections in accordance with the National Electrical Code, local electrical code and any other authority having jurisdiction.
4. Refer to the appropriate field connection drawing for wiring information.

Procedure—

All field connections, remote alarm functions and AC wiring are brought into the enclosure through the top, bottom, or side conduit entrances as indicated on the dimension drawing.

1. Use a hole (conduit) punch, not a torch nor a drill, and punch a hole in the enclosure for the size conduit being used.
2. Install necessary conduit.
3. Pull all wires necessary for field connections, remote alarm functions, AC power and all other optional features. Allow enough excess wire inside the enclosure to make up connections to the appropriate line, load and control terminal block points. Be sure to consult the appropriate field connection diagram included with the manual. For proper wire sizing, refer to the National Electrical Code, NFPA 70.
4. Make all field connections to the remote alarm functions and any other optional features. Connect motor to controller load terminals. Do not connect AC power.

5. Verify AC line voltage, phase and frequency with the controller data plate on the enclosure door prior to connecting.
6. Check to see that all connections are both correctly wired (in accordance with the field connection diagram) and tight.
7. Close the enclosure door.

MAKING SYSTEM PRESSURE CONNECTIONS

The controller requires one (1) "System Pressure" connection from the system piping to the enclosure. The connection fitting, 1/2" FNPT, is provided on the bottom, external side of the enclosure for this purpose. The "Test Drain" connection, located next to the "System Pressure" connection, should be piped to a vented drain or to waste. The "Test Drain" is used only briefly during the weekly test cycle.

Note—Test drain line must be free flowing. Do not use any valves or plugs on this line.

Refer to NFPA 20 for correct field piping procedure of sensing line between the pumping system and the controller.

GENERAL PRE-START UP OPERATION

1. Controllers are shipped with the EMERGENCY RUN handle in the latched position. Before placing the controller in service, turn the EMERGENCY RUN handle and release to unlatch.
2. Check the controller for bolts, nuts and electrical connections which may have loosened during shipment.
3. If a remote start push-button is used, connect the wires to terminals as shown on field connection diagram.
4. If a deluge valve is used, remove the factory installed jumper from terminals as shown on field connection diagram. Connect wires from the normally closed contact on the deluge valve to terminals.
5. If a FTA200 remote alarm panel is used, connect like numbered terminals in the remote alarm panel to terminals in the fire pump controller. Terminals H and N must be connected if a FTA200 alarm panel is used.
6. If a FTA200 remote alarm panel is used, connect a reliable, separate, supervisory 120 volt power supply to terminals L1 and L2 in the alarm panel.

GENERAL START UP OPERATION

General operating procedures are indicated on the data plate fastened to the front of the controller enclosure door.

Voltage Check—

1. Energize the incoming power feeder.
2. Observe the Mark IIXG screen. Confirm that the displayed voltage and frequency matches the voltage stamped on the data plate.

At this time, it is necessary to prepare the controller for normal operation. See setup instructions for the Mark IIXG. After the Mark IIXG has been configured, return to this section.

Phase Rotation

If the Mark IIXG is reporting a phase reversal, see instructions in “Setting/Motor & Power/ Phase Sequence”.

To simulate a phase reversal for testing purposes, push and hold the phase reversal push-button located on the right hand side of the Mark IIXG with the door open (see photo on right). The phases will be reversed internal to the Mark IIXG and a phase reversal alarm will be initiated. The alarm will clear when the button is released.

MOTOR ROTATION

Confirm direction of motor rotation as follows:

FTA750, 1000, 1500, 1800, 2000, 2400 CONTROLLERS

1. On FTA2000, 2400 controller, place “Normal-Off-Test” switch in the Normal position.
2. Close enclosure door.
3. Momentarily close the isolating switch/circuit breaker handle, i.e. move up to the ON position and then back to OFF.
4. The pump motor should rotate immediately if system pressure is low. If system pressure is not low, press the manual START push-button and immediately press the manual STOP push-button.
5. Observe direction of motor rotation.
6. If rotation is incorrect, confirm that the isolating switch/circuit breaker is in the OFF position, open enclosure door and reverse any two of the motor leads (T1, T2, T3) on the load side of contactor 1M. For example, T1 and T2, T1 and T3 or T2 and T3.
7. Retest for proper rotation following steps 1 through 4.

FTA1250 CONTROLLERS

1. Close enclosure door.
2. Momentarily close the isolating switch/circuit breaker handle, i.e. move up to the ON position and then back to OFF.
3. The pump motor should rotate immediately if system pressure is low. If system pressure is not low, press the manual START push-button and immediately press the manual STOP push-button.
4. Observe direction of motor rotation.
5. If rotation is incorrect, confirm that the isolating switch/circuit breaker is in the OFF position, open enclosure door and reverse any two of the corresponding motor leads (T1, T2, T3, T7, T8, T9) on the load side of both contactors 1M and 2M. For example reverse T1 and T2 on contactor 1M and T7 and T8 on contactor 2M; or T1 and T3 on contactor 1M and T7 and T9 on contactor 2M; or T2 and T3 on contactor 1M and T8 and T9 on contactor 2M.
6. Retest for proper rotation following steps 1 through 4.

FTA1300, 1350 CONTROLLERS

1. Close enclosure door.
2. Momentarily close the isolating switch/circuit breaker handle, i.e. move up to the ON position and then back to OFF.

3. The pump motor should rotate immediately if system pressure is low. If system pressure is not low, press the manual START push-button and immediately press the manual STOP push-button.
4. Observe direction of motor rotation.
5. If rotation is incorrect, confirm that the isolating switch/circuit breaker is in the OFF position, open enclosure door and reverse any two of the corresponding motor leads (T1, T2, T3, T6/T12, T4/T10, T5/T11) on the load side of both contactors 1M and 2M. For example, reverse T1 and T2 on contactor 1M and T6/T12 and T4/T10 on contactor 2M; or T1 and T3 on contactor 1M and T6/T12 and T5/T11 on contactor 2M; or T2 and T3 on contactor 1M and T4/T10 and T5/T11 on contactor 2M.
6. Retest for proper rotation following steps 1 through 4.

FTA1930 Controllers

1. Close enclosure door.
2. Momentarily close the isolating switch/circuit breaker handle, i.e. move up to the ON position and then back to OFF.
3. The pump motor should rotate immediately if system pressure is low. If system pressure is not low, press the manual START push-button and immediately press the manual STOP push-button.
4. Observe direction of motor rotation.
5. If rotation is incorrect, confirm that the isolating switch/circuit breaker is in the OFF position, open enclosure door and reverse any two of the motor leads (T1, T2, T3) on the load side of contactor 1M. For example, T1 and T2, T1 and T3 or T2 and T3.
6. Retest for proper rotation following steps 1 through 4

FTA900, 975 POWER TRANSFER SWITCH

1. Confirm motor rotation from the normal power source for the controller as outlined above.
2. Open both the controller isolating disconnect switch/circuit breaker and the transfer switch isolating disconnect switch by moving the operating handles to the OFF position.
3. Refer to the Automatic Transfer Switch Operator's Manual. Manually transfer the switch to the emergency power source.
4. Start the generator set at the generator control panel.
5. With the generator running at stable voltage and frequency momentarily close the power transfer switch isolating disconnect switch. The pump motor should rotate immediately if system pressure is low. If system pressure is not low, press the manual START push-button and immediately press the manual STOP push-button.
6. Observe motor rotation. Confirm that the isolating switch is in the OFF position. Shutdown generator set.
7. If rotation is incorrect, reverse any two of the line leads at the power transfer switch isolating disconnect switch (L1, L2, L3). For example, L1 and L2, or L2 and L3, or L1 and L3.
8. Retest for proper rotation following steps 1 through 6.

FTA950, 976 POWER TRANSFER SWITCH

1. Confirm motor rotation from the normal power source for the controller as outlined above.
2. Open both the controller and transfer switch isolating disconnect/circuit breakers by moving the operating handles to the OFF position.
3. Refer to the Automatic Transfer Switch Operator's Manual. Manually transfer the switch to the emergency power source.
4. Momentarily close the power transfer switch isolating disconnect switch/circuit breaker. The pump motor should rotate immediately if system pressure is low. If system pressure is not low, press the manual START push-button and immediately press the manual STOP push-button.
5. Observe motor rotation.
6. If rotation is incorrect, confirm that the isolating disconnect switch/circuit breakers are in the OFF position. Request the utility company to disconnect the second utility incoming power at the source, then reverse any two of the line leads at the power transfer switch isolating disconnect switch (L1, L2, L3). For example, L1 and L2, L1 and L3, or L2 and L3.
7. Retest for proper rotation following steps 1 through 5 above.

INITIAL START-UP OPERATION

1. Place circuit breaker in ON position. The pump may start immediately if system pressure is low. The PUMP RUNNING and LOW PRESSURE LED's will be lit.
2. If the Mark IIXG is configured for automatic shutdown (AUTOMATIC STOP enabled), the pump motor will continue to run for the period of time set in the MIN RUN (or OFF DELAY) screen and then stop automatically, providing the STOP pressure setting has been reached. Both the system pressure and MIN RUN (or OFF DELAY) time remaining will be shown on the display. Depressing the STOP push-button during the running period will stop the motor as long as the button is held in. However, the motor will restart when the button is released if system pressure is below the stop setting.
3. If the controller is configured for manual shutdown (AUTOMATIC STOP disabled), the pump
   will continue to run until the STOP push-button is depressed.
4. To stop the motor otherwise, press and hold the STOP push-button and place the CIRCUIT BREAKER DISCONNECTING MEANS handle in the OFF position.

FOR MANUAL START

1. Follow the initial start-up instructions. The isolating switch/circuit breaker should be closed, the POWER AVAILABLE LED should be illuminated and system pressure normal, i.e. higher than the programmed START PRESSURE setting.
2. Press the START push-button. The pump motor should start and continue to run. It will not
   stop automatically. The running period timer and pressure switch have no control over this manual operation.
3. To stop, press the STOP push-button.
4. Starting from a remote START push-button (if used) functions in the same way as the local START push-button.
5. If the pump motor restarts, system pressure is below the START PRESSURE setting.

FOR EMERGENCY RUN START

1. Put the circuit breaker/isolating switch in the "off" position.
2. Push and lock the EMERGENCY RUN handle. Place the circuit breaker/isolating switch handle in the "on" position. The motor will start and continue to run until both of the following conditions have been satisfied:
   a. The EMERGENCY RUN handle has been turned to "unlock" position and released.
   b. The STOP push-button is pushed.
3. To stop the motor with the handle locked in the "run" position, place the circuit breaker handle in the OFF position, then turn the EMERGENCY RUN handle and release.
4. Return the circuit breaker operator to the ON position.
5. If the pump restarts, system pressure is below the START PRESSURE setting.

ABBREVIATED STARTING SEQUENCE

FTA750, FTA1000, 2000 FULL VOLTAGE CONTROLLER

1. Follow all of the initial start-up instructions.
2. The motor will start and run at full line voltage.

FTA1250 PART WINDING CONTROLLERS

1. Follow all of the initial start-up instructions.
2. MOTOR ACCELERATION timer is factory set for 2 seconds and may be field adjusted if necessary. (See Mark IIXG Programming for details).

CAUTION: DO NOT EXCEED FOUR (4) SECONDS MAXIMUM OR MOTOR MANUFACTURER'S LIMITS.

3. Contactor 1M connects 1/2 of motor windings during starting cycle. The motor may not reach full speed until the MOTOR ACCELERATION timer has timed out and both contactors 1M and 2M are energized.

FTA1300-1350 WYE-DELTA CONTROLLERS

1. Follow all of the initial start-up instructions.
2. MOTOR ACCELERATION timer is factory set for 2 seconds and may be field adjusted if necessary. (See Mark IIXG Programming for details).

CAUTION: DO NOT EXCEED THIS TIMER SETTING WITHOUT CONSULTING YOUR FIRETROL REPRESENTATIVE.

3. a. FTA1300 - Contactors 1M and 1S connect the motor in the WYE configuration. The motor may not reach full speed until the MOTOR ACCELERATION timer has timed out, deenergizing 1S and energizing 2M, connecting the motor in the DELTA configuration.
   b. FTA1350 - Contactors 1M and 1S connect the motor in the WYE configuration. The motor may not reach full speed until the MOTOR ACCELERATION timer has timed out, energizing 2S and connecting the resistor bank, then energizing 2M and connecting the motor in the DELTA configuration. 2S contacts deenergize contactor 1S.

CAUTION: A minimum run timer setting of less than 3 minutes can cause overheating of the resistors in FTA1350 and FTA1500 controllers. The resultant overheating may damage the controller.

FTA1500 PRIMARY RESISTANCE CONTROLLERS

1. Follow all of the initial start-up instructions.
2. MOTOR ACCELERATION timer is factory set for 2 seconds and may be field adjusted if necessary. (See Mark IIXG Programming for details).

CAUTION: DO NOT EXCEED FOUR (4) SECONDS MAXIMUM.

3. Contactor 1S connects the motor in series with the resistor bank. The motor may not reach full speed until the MOTOR ACCELERATION timer has timed out and contactor 1M is energized.

FTA1800, 2400 AUTOTRANSFORMER CONTROLLERS

1. Follow all of the initial start-up instructions.
2. MOTOR ACCELERATION timer is factory set for 2 seconds and may be field adjusted if necessary. (See Mark IIXG Programming for details).

CAUTION: DO NOT EXCEED THIS TIMER SETTING WITHOUT CONSULTING YOUR FIRETROL REPRESENTATIVE.

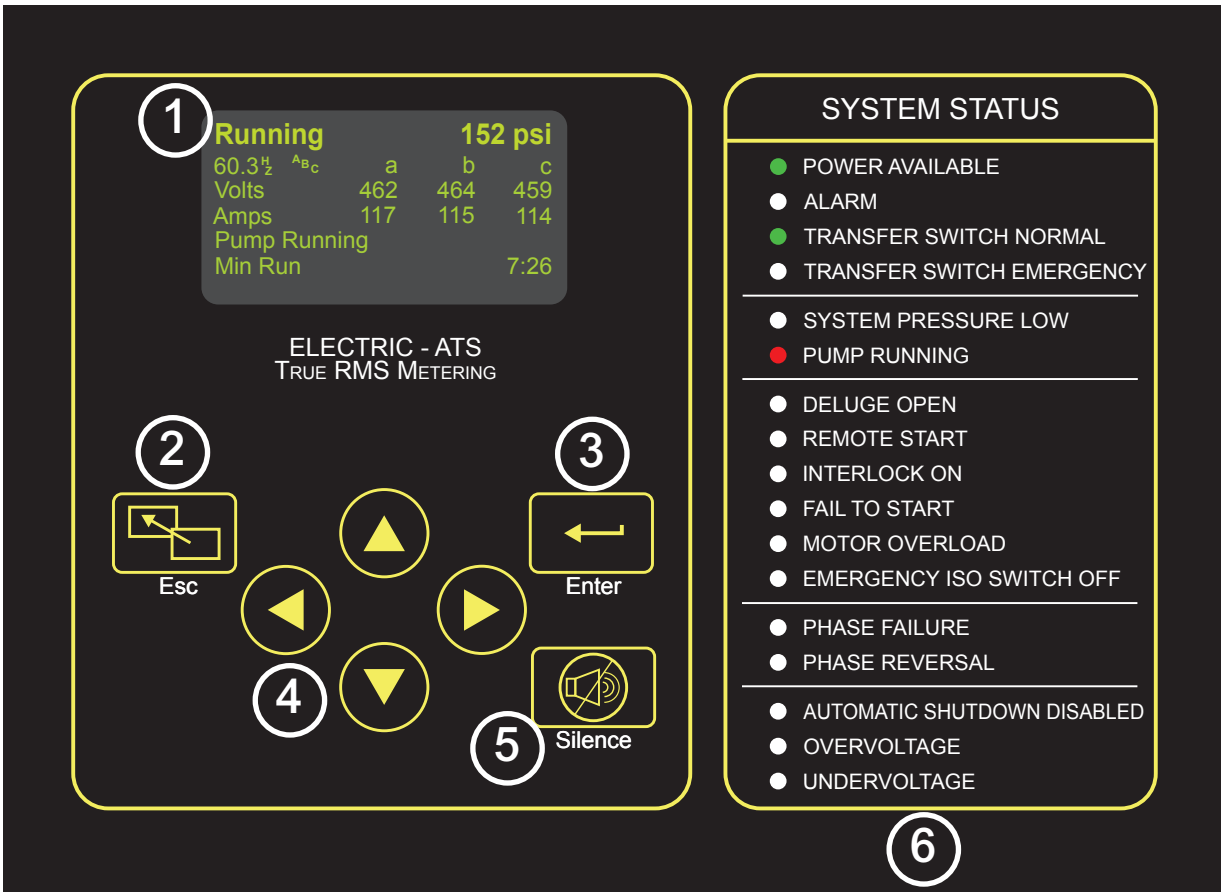
3. Contactor 1S and 2S close and connect the motor to the autotransformer/primary reactor during the starting cycle. The motor may not reach full speed until the MOTOR ACCELERATION timer has timed out, deenergizing contactor 1S and energizing contactor 1M, connecting the motor to full line voltage.

FTA1930 SOLID STATE STARTING CONTROLLERS

1. Follow the initial start-up instructions.
2. Motor will start at reduced voltage on soft start contactor 1MS.
3. When soft start contactor 1MS reaches full voltage, contactor 1M closes, bypassing 1MS.

CAUTION: Acceptance testing of each controller shall be for a minimum of six (6) automatic and six (6) manual starts at a minimum run time of five (5) minutes per NFPA 20 to insure resistor cooling between starts. Motor manufacturer's data must be consulted for maximum number of starts per hour and other starting conditions.

Mark IIXG User Interface and Display



1 **Informational Display**
Control Status and System Pressure
Frequency, Phase Rotation & Phases
Line Voltage/Phase
Motor Current/Phase
Active Alarms - Primary Status Notification
Date-Time or Active Timer
Secondary Status Notification

2 **ESC Button**
Used to go backwards through menu screens

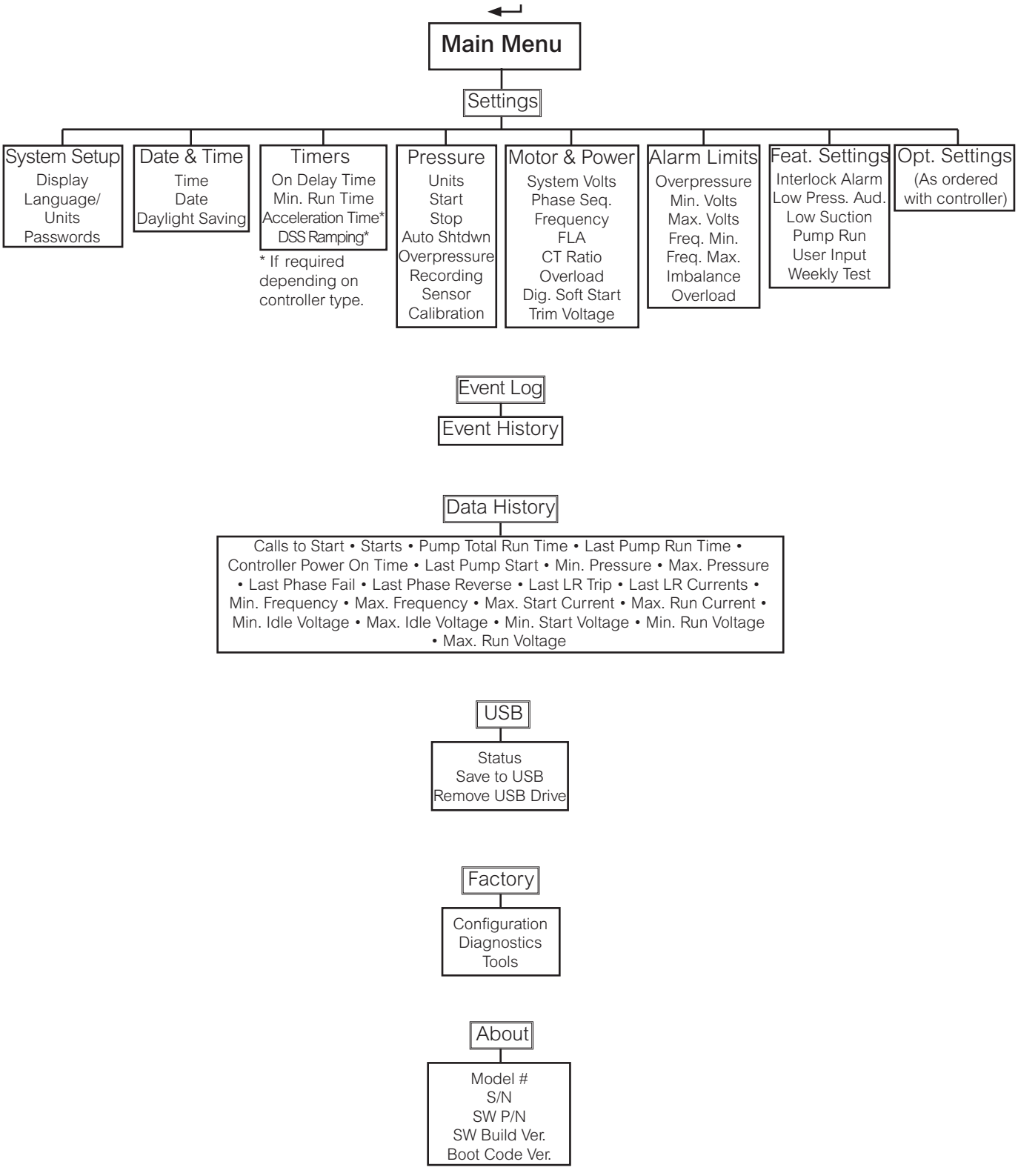
3 **Enter Button**
Used to go forwards through menu screens and save user defined settings

4 **Directional Arrows**
Used to go up and down in menu screens and change user defined values

5 **Silence Alarm Button**
Used to silence audible alarm

6 **System Status LED's**
Provide visual indication of important system information

Mark IIXG User Menu Structure



Programming Notes

The Firetrol Mark IIXG is multi-level password protected. User programmable functions are protected by a Level 1 password.

LEVEL 1 PASSWORD
2 - 1 - 1 - 2

1 Indicates the level of password required to modify a setting.

Note: Many menu settings feature an "enable/disable" option. These options are indicated by a "✓" for enabled or a "X" for disabled. In many cases this can also be interpreted as "✓" for yes or a "X" for no.

WARNING

RISK OF PROPERY LOSS, DEATH OR INJURY

Incorrect or inappropriate controller settings could render the fire protection system inoperable. Only qualified and knowledgeable personnel should operate this equipment.

Mark IIXG User Menu Settings

Note: Many menu settings feature an “enable/disable” option. These options are indicated by a "✓" for enabled or a “x” for disabled.

🔒1 Indicates the level of password required to modify setting.

System Setup - Display

↵ SETTINGS ↵ SYSTEM SETUP ↵ DISPLAY ↵ **BRIGHTNESS** ↵ 🔒1

Use ▲ and ▼ arrows to set desired display brightness. Press ↵ to confirm.

↵ SETTINGS ↵ SYSTEM SETUP ↵ DISPLAY ↵ ▼ **CONTRAST** ↵ 🔒1

Use ▲ and ▼ arrows to set desired display contrast. Press ↵ to confirm.

↵ SETTINGS ↵ SYSTEM SETUP ↵ DISPLAY ↵ ▼ **INVERT** ↵ 🔒1

Use ▲ or ▼ arrows to enable/disable inverted display (bright background with dark letters). Press ↵ to confirm.

↵ SETTINGS ↵ SYSTEM SETUP ↵ DISPLAY ↵ ▼ **KEYBOARD** ↵ 🔒1

Use ▲ or ▼ arrows to set the amount of time of keyboard inactivity before the display returns to the main screen. Press ↵ to confirm.

System Setup - Language & Units

↵ SETTINGS ↵ SYSTEM SETUP ↵ ▼ LANGUAGE & UNITS ↵ **LANGUAGE** ↵ 🔒1

Use ▲ and ▼ arrows to select preferred display language. Press ↵ to confirm.

↵ SETTINGS ↵ SYSTEM SETUP ↵ ▼ LANGUAGE & UNITS ↵ ▼ **PRESSURE** ↵ 🔒1

Use ▲ and ▼ arrows to select preferred pressure unit display (psi, bar kPa). Press ↵ to confirm.

System Setup - Passwords

↵ SETTINGS ↵ SYSTEM SETUP ↵ ▼ PASSWORDS ↵ **LEVEL 1** ↵ 🔒1

Use ▲▼◀▶ arrows to set preferred password for level 1 access. Press ↵ to confirm.

↵ SETTINGS ↵ SYSTEM SETUP ↵ ▼ PASSWORDS ↵ ▼ **LEVEL 2** ↵ 🔒2

Use ▲▼◀▶ arrows to set preferred password for level 2 access. Press ↵ to confirm.

NOTE: A higher level can change a lower level password (level 2 can change level 1). If passwords are changed from factory default and forgotten, charges my be incurred to reset the passwords.

Settings - Date & Time

↵ SETTINGS ▼ DATE & TIME ↵ **TIME** ↵ 🔒1

Use ▲▼◀▶ arrows to set current local time (24 hr format). Press ↵ to confirm.

↵ SETTINGS ▼ DATE & TIME ↵ ▼ **DATE** ↵ 🔒1

Use ▲▼◀▶ arrows to set current date (YYYY-MM-DD). The day of week will automatically update as required. Press ↵ to confirm.

↵ SETTINGS ▼ DATE & TIME ↵ ▼ **DATE FORMAT** ↵ 🔒1

Use ▲▼ arrows to set current date format (YYYY-MM-DD, DD-MM-YYYY, MM-DD-YYYY).
Press ↵ to confirm.

↵ SETTINGS ⓥ DATE & TIME ↵ ⓥ **DAYLIGHT SAVING** ↵ 🔒1

Use ⓐⓥ arrows to enable or disable automatic Daylight Saving time adjustments. Press ↵ to confirm.

ⓥ (**+/-**) ↵ Use ⓐⓥ arrows to set number of minutes to adjust for at the beginning or end of Daylight Saving time. Press ↵ to confirm.

ⓥ (**DST +**) "Begin" - **HOUR** ↵ Use ⓐⓥ arrows to set the hour of day that Daylight Saving time begins. Press ↵ to confirm.

ⓥ (**DST +**) "Begin" - **DAY** ↵ Use ⓐⓥ arrows to set the day of the month that Daylight Saving time begins. Press ↵ to confirm.

ⓥ (**DST +**) "Begin" - **MONTH** ↵ Use ⓐⓥ arrows to set the month of the year that Daylight Saving time begins. Press ↵ to confirm.

(Example: Hour=2:00, Day=2nd Sun, Month=Mar means Daylight Saving time would begin at 2:00a.m. on the 2nd Sunday in March)

ⓥ (**DST -**) "End" - **HOUR** ↵ Use ⓐⓥ arrows to set the hour of day that Daylight Saving time ends. Press ↵ to confirm.

ⓥ (**DST -**) "End" - **DAY** ↵ Use ⓐⓥ arrows to set the day of the month that Daylight Saving time ends. Press ↵ to confirm.

ⓥ (**DST -**) "End" - **MONTH** ↵ Use ⓐⓥ arrows to set the month of the year that Daylight Saving time ends. Press ↵ to confirm.

(Example: Hour=2:00, Day=1st Sun, Month=Nov means Daylight Saving time would end at 2:00a.m. on the 1st Sunday in November)

Timers

↵ SETTINGS ↵ ⓥ TIMERS ↵ **ON DELAY** ↵ 🔒1

Use ⓐⓥⓛⓡ arrows to set preferred on delay time. Press ↵ to confirm.

Note: On Delay (also known as sequential start) time, delays the starting of the motor when an automatic call to start is received.

↵ SETTINGS ↵ ⓥ TIMERS ↵ ⓥ **MIN RUN/OFF DELAY** ↵ 🔒1

Use ⓐⓥ arrows to set timer mode to Minimum Run or Off Delay. Press ⓡ key and use ⓐⓥⓛⓡ keys to set desired time. Press ↵ to confirm.

Note: Minimum Run time will begin when motor starts, Off Delay time will begin when system pressure has been restored to Stop pressure setting.

↵ SETTINGS ↵ ⓥ TIMERS ↵ ⓥ **ACCELERATION** ↵ 🔒2

Use ⓐⓥ arrows to set motor acceleration time. Press ↵ to confirm.

Note: Motor acceleration time is the time allotted for the motor to reach full speed during reduced voltage starting. The factory default should not be changed unless directed to by qualified service technician. Improper setting may cause damage to the controller and/or motor. (Acceleration setting only available on reduced voltage starting controllers FTA1250, 1300, 1350, 1500, 1800).

↵ SETTINGS ↵ ⓥ TIMERS ↵ ⓥ **SS BYPASS** ↵ 🔒2

Use ⓐⓥ arrows to set Soft Starter Bypass time. Press ↵ to confirm.

Note: The soft start bypass timer will energize the motor using a bypass (across-the-line) contactor if an up to speed signal is not given by the soft starter within the set time. This setting used only on soft start controllers (FTA1900, 1930)

Pressure

↵ SETTINGS ↵ ⓥ PRESSURE ↵ **UNITS** ↵ 🔒1

Use ⓐⓥ arrows to set preferred pressure unit system (psi, bar, kPa). Press ↵ to confirm.

↵ SETTINGS ↵ ⓥ PRESSURE ↵ ⓥ **START** ↵ 🔒1

Use ⓐⓥ arrows to set desired pump start pressure. Press ↵ to confirm.

↵ SETTINGS ↵ ⓥ PRESSURE ↵ ⓥ **STOP** ↵ 🔒1

Use ⓐⓥ arrows to set desired pump stop pressure. Press ↵ to confirm.

Note: Pump stop pressure must be set below the pump "churn" pressure (including minimum suction pressure), otherwise the pump will run continuously once started.

↵ SETTINGS ↵ ⓥ PRESSURE ↵ ⓥ **AUTOMATIC SHUTDOWN DISABLED** ↵ 🔒1

Use ⓐⓥ arrows to enable or disable the automatic shutdown disabled feature. Press ↵ to confirm.

Note: Enabling this feature makes the controller "manual stop only".

↵ SETTINGS ↵ ⓥ PRESSURE ↵ ⓥ **OVERPRESSURE ALARM** ↵ 🔒1

Use ⓐⓥ arrows to enable or disable the overpressure alarm feature. Press ↵ to confirm.

ⓥ Limit ↵ Use ⓐⓥ arrows to set the pressure limit for the overpressure alarm. Press ↵ to confirm.

↵ SETTINGS ↵ ⓥ PRESSURE ↵ ⓥ **RECORDING - DELTA** ↵ 🔒1

Use ⓐⓥ arrows to set pressure delta recording limit. Press ↵ to confirm.

Note: Pressure will be recorded whenever pressure changes by more than set limit.

ⓥ **HOURLY** ↵ Use ⓐⓥ arrows to enable or disable hourly pressure recording. Press ↵ to confirm.

Note: Pressure will be recorded every hour, on the hour.

↵ SETTINGS ↵ ⓥ PRESSURE ↵ ⓥ **SENSOR**

The maximum operating pressure of the installed pressure sensor (transducer) is shown. This value cannot be modified from this location.

↵ SETTINGS ↵ ⓥ PRESSURE ↵ ⓥ **CALIBRATION - SET TO ZERO** ↵ 🔒2

Note: Before proceeding, place jumper wire between field terminals #1 & 10 to prevent starting of the motor. A calibrated pressure gauge will be required to correctly adjust the settings.

Remove/relieve system pressure from the controller sensing line. If gauge shows 0 psi, no adjustments are required; otherwise set zero calibration to same value as displayed on pressure gauge. (Example: With system pressure removed the gauge reads 3 psi, set zero calibration value to 3).

Use ⓐⓥ arrows to set zero calibration value. Press ↵ to confirm.

Using calibrated gauge, restore pressure to controller sensing line. Adjust span setting to match the value shown on the gauge.

ⓥ **SET TO SPAN** ↵ Use ⓐⓥ arrows to set span calibration value. Press ↵ to confirm.

Note: Remove interlock jumper wire when calibration is complete.

↵ SETTINGS ↵ ⓥ PRESSURE ↵ ⓥ **RESET TO DEFAULT** ↵ 🔒2

Use ⓐⓥ arrows to enable the reset (pressure) to default option. Press ↵ to confirm. All user calibration settings will be reset to factory defaults and reset setting will revert back to disabled.

Motor & Power

↵ SETTINGS ↵ ⓥ MOTOR & POWER ↵ **SYS VOLTS**

System voltage is shown. This is factory setting and can only be modified by a qualified service technician. This setting is set in Factory/Configuration menu.

↵ SETTINGS ↵ ⓥ MOTOR & POWER ↵ ⓥ **PHASE SEQUENCE** ↵ 🔒1

Use ⓐⓥ to select required phase sequence (1~, abc, cba). Press ↵ to confirm.

Note: This setting is used to clear a false phase reversal alarm. On 3-phase systems, once proper motor rotation is confirmed, if phase reversal alarm is present, change this setting to clear the alarm. (If set to abc, change to cba or vise-versa). Single phase mode (1~) is only used for demo purposes or on rare limited service applications.

↵ SETTINGS ↵ ⓥ MOTOR & POWER ↵ ⓥ **FREQUENCY** ↵ 🔒3

Use ⓐⓥ to select required frequency (50 or 60 hz.). Press ↵ to confirm.

Note: This is a factory setting and can only be modified by a qualified service technician.

↵ SETTINGS ↵ ⓥ MOTOR & POWER ↵ ⓥ **FULL LOAD** ↵ 🔒3

Use ⓐⓥ to set the Full Load Amps of the motor being used. Press ↵ to confirm.

Note: This is a factory setting and can only be modified by a qualified service technician.

↵ SETTINGS ↵ ⓥ MOTOR & POWER ↵ ⓥ **CT RATIO** ↵ 🔒3

Use ⓐⓥ to set the value of the CT's being used. Press ↵ to confirm.

Note: This is a factory setting and can only be modified by a qualified service technician.

↵ SETTINGS ↵ ⓥ MOTOR & POWER ↵ ⓥ **OVERLOAD** ↵ 🔒1

Use ⓐⓥ to set the amp value at which the motor overload alarm will activate. Press ↵ to confirm.

Note: Default setting is 150% of motor FLA.

↵ SETTINGS ↵ ⓥ MOTOR & POWER ↵ ⓥ **DIGITAL SOFT START** ↵ **MOTOR FLA**

The programmed motor FLA value is displayed. This setting cannot be changed from this location.

ⓥ **INIT CURRENT** ↵ 🔒3

Use ⓐⓥ to set the Initial Starting Current (100-250% FLA). Press ↵ to confirm.

ⓥ **MAX CURRENT** ↵ 🔒3

Use ⓐⓥ to set the Maximum Starting Current (250-600% FLA). Press ↵ to confirm.

ⓥ **ACCEL RAMP** ↵ 🔒3

Use ⓐⓥ to set the Acceleration Ramp time (2 - 7 sec.). Press ↵ to confirm. This is the time allowed for the soft starter to ramp from the initial starting current to the maximum starting current.

ⓥ**UTS TIMER**

Value is shown for the UTS (Up To Speed) Timer. This timer determines how long to wait for the soft starter to reach full speed before a fault is indicated.

ⓥ **DECEL BEGIN LEVEL** ↵ 🔒3

Use ⓐⓥ to set the Deceleration Begin Level (70-95% FLA). Press ↵ to confirm. The starter will reduce current to set level at the beginning of the deceleration ramp.

ⓥ **DECEL PAUSE LEVEL** ↵ 🔒3

Use ⓐⓥ to set the Deceleration Pause Level (32-60% FLA). Press ↵ to confirm. The starter will reduce current to set level at the beginning of the pause cycle (sincerity test).

ⓥ **DECEL PAUSE TIME** ↵ 🔒3

Use ⓐⓥ to set the Deceleration Pause Time (2 - 7 sec.). Press ↵ to confirm. The starter will pause and hold for set time to ensure no starting causes are present.

ⓥ **DECEL END LEVEL**

Soft starter will decel to 25% motor FLA before disconnecting power from the motor. This setting cannot be changed.

ⓥ **DECEL TIME** ↵ 🔒3

Use ⓐⓥ to set the Deceleration Ramp Time (2 - 7 sec.). Press ↵ to confirm. This is the time of the deceleration ramp from begin level to end level (not including the decel pause time).

ⓥ **PHASE ROTATION**

Controller phase rotation is shown. This setting cannot be changed from this location.

ⓥ**TIMEOUT ENABLED**

This is a read only setting that is transmitted to the digital soft starter.

ⓥ **TIMEOUT**

This is a read only setting that is transmitted to the digital soft starter.

NO CURRENT AT RUN
This is a read only setting that is transmitted to the digital soft starter.

CT RATIO
This is a read only setting that is transmitted to the digital soft starter.

TX
This is a value representing communications sent to the digital soft starter.

RX
This is a value representing communications received from the digital soft starter.

ERROR
This is a value representing communication errors between the Mark IIXG and the digital soft starter.

← SETTINGS ← ▼ MOTOR & POWER ← ▼ **TRIM VOLTAGE** ← 🔒2
Use ▲▼ to adjust the displayed voltage for each phase in the Mark IIXG. Press ← to confirm. Adjustment can be made in 0.1% increments to more closely match actual voltage. These discrepancies are due to tolerances in the potential transformers used for the voltage conversions.
Note: This setting only available on high voltage controllers, 2300 - 7200 Volts (FTA2000, FTA2400).

Alarm Limits

← SETTINGS ← ▼ ALARM LIMITS ← **OVERPRESSURE ALARM**

ENABLED ← 🔒1
Use ▲▼ arrows to enable or disable the Overpressure Alarm. Press ← to confirm.

▼ **LIMIT** ← 🔒1
Use ▲▼ arrows to set the pressure limit for the Overpressure Alarm. Press ← to confirm.

← SETTINGS ← ▼ ALARM LIMITS ← ▼ **VOLT MIN** 🔒1
Use ▲▼ arrows to set the voltage limit for the Undervoltage Alarm. Press ← to confirm.
Note: The maximum and default setting is approximately -15% of nominal voltage.

▼ **ENABLED** ← 🔒1
Use ▲▼ arrows to enable or disable the Undervoltage Alarm. Press ← to confirm.

← SETTINGS ← ▼ ALARM LIMITS ← ▼ **VOLT MAX** 🔒1
Use ▲▼ arrows to set the voltage limit for the Overvoltage Alarm. Press ← to confirm.
Note: The maximum and default setting is approximately +10% of nominal voltage.

▼ **ENABLED** ← 🔒1
Use ▲▼ arrows to enable or disable the Overvoltage Alarm. Press ← to confirm.

← SETTINGS ← ▼ ALARM LIMITS ← ▼ **FREQ MIN** 🔒1
Use ▲▼ arrows to set the frequency limit for the Under frequency Alarm. Press ← to confirm.

▼ **ENABLED** ← 🔒1
Use ▲▼ arrows to enable or disable the Under frequency Alarm. Press ← to confirm.

← SETTINGS ← ▼ ALARM LIMITS ← ▼ **FREQ MAX** 🔒1
Use ▲▼ arrows to set the frequency limit for the Over frequency Alarm. Press ← to confirm.

▼ **ENABLED** ← 🔒1
Use ▲▼ arrows to enable or disable the Over frequency Alarm. Press ← to confirm.

← SETTINGS ← ▼ ALARM LIMITS ← ▼ **IMBALANCE** 🔒1
Use ▲▼ arrows to set the percentage of deviance between phases for the Phase Imbalance alarm.
Press ← to confirm.

← SETTINGS ← ▼ ALARM LIMITS ← ▼ **OVERLOAD** 🔒1
Use ▲▼ arrows to set the motor amps for the Motor Overload alarm (FLA - 150% FLA).
Press ← to confirm.

Feature Settings

↵ SETTINGS ↵ ⓥ FEATURE SETTINGS ↵ ⓥ **INTERLOCK ALARM** ↵ 🔒1
Use ⓐⓥ arrows enable or disable the alarm for Interlock On. Press ↵ to confirm.

↵ SETTINGS ↵ ⓥ FEATURE SETTINGS ↵ ⓥ **LOW PRESSURE AUD** ↵ 🔒1
Use ⓐⓥ arrows enable or disable the audible alarm for Low System Pressure. Press ↵ to confirm.

↵ SETTINGS ↵ ⓥ FEATURE SETTINGS ↵ ⓥ **LOW SUCTION** ↵

ENABLE ↵ 🔒1
Use ⓐⓥ arrows to enable or disable the Low Suction Alarm. Press ↵ to confirm.

ⓥ **AUDIBLE** ↵ 🔒1
Use ⓐⓥ arrows to enable or disable the Low Suction Alarm. Press ↵ to confirm.

ⓥ **COMMON ALARM** ↵ 🔒1
Use ⓐⓥ arrows to enable or disable the common alarm output for the Low Suction Alarm. Press ↵ to confirm.

↵ SETTINGS ↵ ⓥ FEATURE SETTINGS ↵ ⓥ **PUMP RUN ALARM** ↵

ⓥ **AUDIBLE** ↵ 🔒1
Use ⓐⓥ arrows to enable or disable the Pump Run Alarm. Press ↵ to confirm.

ⓥ **COMMON ALARM** ↵ 🔒1
Use ⓐⓥ arrows to enable or disable the common alarm output for the Pump Run Alarm. Press ↵ to confirm.

↵ SETTINGS ↵ ⓥ FEATURE SETTINGS ↵ **USER INPUT**

↵ **ENABLE** 🔒1
Use ⓐⓥ arrows to enable or disable the user defined alarm. Press ↵ to confirm.

ⓥ ↵ **ON DELAY** 🔒1
Use ⓐⓥ arrows to select an on delay time before the alarm is acknowledged (0-99 seconds).
Press ↵ to confirm.

ⓥ ↵ **AUDIBLE** 🔒1
Use ⓐⓥ arrows to select if the user input activates the audible alarm. Press ↵ to confirm.

ⓥ ↵ **COMMON ALARM** 🔒1
Use ⓐⓥ arrows to select if the user input activates the common alarm output. Press ↵ to confirm.

ⓥ ↵ **ON MESSAGE TEXT** 🔒1
Use ⓐⓥⓛⓡ arrows to program the message that is displayed and recorded when the user defined alarm is activated. Press ↵ to confirm.

ⓥ ↵ **OFF MESSAGE TEXT** 🔒1
Use ⓐⓥⓛⓡ arrows to program the message that is displayed and recorded when the user defined alarm is deactivated. Press ↵ to confirm.

↵ SETTINGS ↵ ⓥ FEATURE SETTINGS ↵ **WEEKLY TEST SETUP**

↵ **ENABLE** 🔒1
Use ⓐⓥ arrows to disable or define the frequency of the Weekly Test feature (Disabled, Every Week, Every 2 Weeks, ...Every 5 Weeks). Press ↵ to confirm.

ⓥ ↵ **ON** 🔒1
Use ⓐⓥ arrows to choose the day of the week that the Weekly Test is performed. Press ↵ to confirm.

ⓥ ↵ **AT** 🔒1
Use ⓐⓥⓛⓡ arrows to choose the time of day that the Weekly Test is performed. Press ↵ to confirm.

ⓥ ↵ **FOR** 🔒1
Use ⓐⓥ arrows to choose the duration (motor run time) of the Weekly Test. Press ↵ to confirm.

▼ ↵ NOW IN WEEK 🔒1

Use ▲▼ arrows to choose current time frame in reference to the Weekly Test schedule. Press ↵ to confirm. (Example: If test is programmed for every 2 weeks on Sunday and today were Friday then - If testing is desired to start this week, then every other week thereafter, we would now be in week 2 of 2 - If testing is desired to start on the following Sunday, not the coming Sunday, then we would now be in week 1 of 2).

Option Settings

↵ SETTINGS ↵ ▼ OPTION SETTINGS ↵

NOTE: The list of available options and the settings associated with them will vary with each controller. Below are the most common user defined settings that may appear.

↵ DELAY 🔒1

Use ▲▼ arrows to set the "on" delay time for selected option. Press ↵ to confirm.

↵ AUDIBLE 🔒1

Use ▲▼ arrows to enable or disable the audible alarm for selected option. Press ↵ to confirm.

▼ ↵ COMMON ALARM 🔒1

Use ▲▼ arrows to enable or disable the common alarm output for selected option.
Press ↵ to confirm.

Event Log

↵ ▼ EVENT LOG ↵

The Event Log is a record of events (pressure recording, alarms, starts, etc...) that are stored in the memory of the Mark IIXG. The last 3000 events are kept in this memory. The events are stored in the order that they occur, with the most recent being "first" (the last event that occurred will be event #1). The following keys are used to browse through the event log:

▶ Move forward through the events one at a time (1 - 2 - 3....etc)

◀ Move backward through the events one at a time (55 - 54 - 53....etc)

▲ Move forward through the events ten at a time (60 - 70 - 80....etc)

▼ Move backward through the events ten at a time (91 - 81 - 71....etc)

Pressing and holding of the arrow keys will allow the scrolling to move faster.

Data History

↵ ▼ DATA HISTORY ↵

The Data History is a record of important data and events that are kept throughout the life of the controller.

Use ▲▼ arrows to scroll through the information stored in the Data History log. The available information is: Numbers of calls to start • Number of actual starts • Pump total run time • Pump last run time • Total controller power on time • Last pump start time/date • Minimum system pressure • Maximum system pressure • Last phase failure • Last phase reversal • Last locked rotor trip • Last locked rotor currents • Frequency minimum • Frequency maximum • Maximum starting currents • Maximum run currents • Minimum voltage/phase while idle (not running) • Maximum voltage/phase while idle (not running) • Minimum voltage/phase during start • Minimum voltage/phase during run • Maximum voltage/phase during run

USB

↵ ▼ USB ↵

↵ SAVE TO USB 🔒1

Use ▲▼ arrows to enable or disable the Save to USB function. Press ↵ to confirm.
The following is saved to the USB flash drive: Event Log, Data History, Controller Information and all user defined settings (pressure settings, timer settings, alarm settings....etc.). The saved file is a text file named the same as the controller serial number (87654321.txt) and can be viewed using most word processing software.
Note: Use of a flash drive larger than 1GB may result in excessively long read/write operations. If a flash drive larger than 1GB must be used, create a 1GB or less partition on that drive.

▼ ↵ **REMOVE DRIVE** 🔒1
Use ▲▼ arrows to enable or disable the Remove Drive feature. Press ↵ to confirm.
Much like a computer, the Remove Drive feature ensures file closure prior to removing the USB flash drive from the Mark IIXG. Use of this feature helps prevent file corruption.

NOTE: The Mark IIXG also features an automatic daily save function. Every day at midnight (0:00) the events for that day are written to a file on the USB flash drive. This file is also a text file (.txt) and is named for the month, in the current year folder under Firetrol (x:\Firetrol\2009\Sept.txt).

MOTORSCOPE

↵ ▼ **MOTORSCOPE** ↵
Information is displayed for the following:
Startup Time
Sampling Rate
Voltage Min.
Current Max.
VOLTAGE GRAPH ↵
A graphical display of the controller voltage is shown representing the first 10 seconds of the last motor start.
▼ **CURRENT GRAPH** ↵
A graphical display of the motor current is shown representing the first 10 seconds of the last motor start.

Configuration - Model

↵ ▼ FACTORY ↵ CONFIGURATION ↵ **MODEL** ↵
SERIAL NUMBER ↵ 🔒3
Use ▲▼◀▶ arrows to enter the controller serial number. Press ↵ to confirm.
NOTE: This is a factory set parameter and under normal circumstances would never be changed.

▼ **MODEL** ↵ 🔒3
Use ▲▼ arrows to select required model number. Press ↵ to confirm.
NOTE: This is a factory set parameter and under normal circumstances would never be changed.

▼ **HP (HORSEPOWER)** ↵ 🔒3
Use ▲▼ arrows to select required motor horsepower. Press ↵ to confirm.
NOTE: This is a factory set parameter and under normal circumstances would never be changed.

▼ **VOLTAGE** 🔒3 ↵
Use ▲▼ arrows to select required voltage. Press ↵ to confirm.
NOTE: This is a factory set parameter and under normal circumstances would never be changed.

▼ **FULL LOAD** ↵ 🔒3
Use ▲▼ arrows to set the full load amps (FLA) of the motor. Press ↵ to confirm.
NOTE: This is a factory set parameter and under normal circumstances would never be changed.

▼ **CT RATIO** ↵ 🔒3
Use ▲▼ arrows to set required CT ratio for the controller. Press ↵ to confirm.
NOTE: This is a factory set parameter and under normal circumstances would never be changed.

▼ **FREQUENCY** ↵ 🔒3
Use ▲▼ arrows to select required frequency (hertz) for the supplied power. Press ↵ to confirm.
NOTE: This is a factory set parameter and under normal circumstances would never be changed.

▼ **PHASE SEQUENCE** ↵ 🔒1
Use ▲▼ to select required phase sequence (1~, abc, cba). Press ↵ to confirm.

PRESSURE SENSOR 3

Use ▲▼ to enable or disable the use of a pressure sensor (transducer). Press ↵ to confirm.
NOTE: This is a factory set parameter and under normal circumstances would never be changed.

AUTOSTART NC 3

Use ▲▼ to enable or disable the use of a Normally Closed contact for the autostart input. Press ↵ to confirm.

USER INPUT NUMBER 3

Use ▲▼ to select input used for user defined option. Press ↵ to confirm.

LOW SUCTION 3

Use ▲▼ to set the input for low suction pressure option. Press ↵ to confirm.

SCREEN SAVER 1

Use ▲▼ arrows to enable or disable the screen saver function. Press ↵ to confirm.
NOTE: The display screen is designed to automatically dim 5 minutes after returning to the home screen and without any activity. The screen will "wake up" or return to set brightness on a key press or any event that would cause a message to appear on the screen. This feature is designed to prolong the life of the display. It is not recommended that this function be disabled.

Configuration - Options

↵ ▼ FACTORY ↵ CONFIGURATION ↵ ▼ **OPTIONS** ↵ 3

This is area where ordered options are added by the factory. Any user defined parameters for these options would appear in the SETTING/OPTION SETTINGS menu.

Configuration - ADC Calibration

↵ ▼ FACTORY ↵ CONFIGURATION ↵ ▼ **ADC CALIBRATION** ↵ 4

This area displays the values of the Analog to Digital Converter calibrations. This calibration is done by the manufacturer. Any changes to these settings would have to be made by the factory.

Diagnostics

↵ ▼ FACTORY ↵ ▼ **DIAGNOSTICS** ↵

RAW INPUT: ANALOG ↵

Input values are shown. This information is for factory level troubleshooting purposes.

▼ **RAW INPUT: DISCRETE** ↵

Input values are shown. This information is for factory level troubleshooting purposes.

▼ **RAW INPUT: KEYS** ↵

Input values are shown. This information is for factory level troubleshooting purposes.

▼ **RAW OUTPUT: DISCRETE** ↵

Output values are shown. This information is for factory level troubleshooting purposes.

▼ **MARK IIXG STARTS**

Displays the total number of times the Mark IIXG has been booted.

▼ **LAMP TEST** ↵ 1

Use ▲▼ arrows to enable the lamp test. Press ↵ to begin test. All System Status LED's should illuminate. ↵ Use ▲▼ arrows to disable the lamp test. Press ↵ to end test. System Status LED's should turn off and return to normal indications.

▼ AUDIBLE TEST ↵ 🔒1

Use ▲▼ arrows to enable the audible test. Press ↵ to begin test. The audible alarm should sound. ↵ Use ▲▼ arrows to disable the audible test. Press ↵ to end test. The audible alarm will turn off.

▼ USB TEST ↵ 🔒1

Use ▲▼ arrows to enable the USB test. Press ↵ to begin test. A small test file is written to the USB flash drive then read back from the drive. If the write/read is successful, the test is passed. After completion of the test the setting will automatically return to disabled.

▼ PHASE FAIL ↵ 🔒2

Use ▲▼ arrows to enable the phase failure test. Press ↵ to begin test. The phase failure should be indicated. ↵ Use ▲▼ arrows to disable the phase failure test. Press ↵ to end test. The phase failure should clear.

▼ PHASE REVERSE ↵ 🔒2

Use ▲▼ arrows to enable the phase reversal test. Press ↵ to begin test. The phase reversal should be indicated. ↵ Use ▲▼ arrows to disable the phase reversal test. Press ↵ to end test. The phase reversal should clear.

▼ SHUNT 1 ↵ 🔒2

Use ▲▼ arrows to enable the shunt trip #1 test. Press ↵ to begin test. The normal (fire pump) circuit breaker should trip. Note: If the controller is supplied with a power transfer switch, the generator should start and transfer to the emergency power source.

↵ Use ▲▼ arrows to disable the shunt trip #1 test. Press ↵ to end test. Reset the fire pump circuit breaker. Note: If power transfer switch supplied and now in the emergency position, the generator will continue to run for 30 minutes before transferring back to normal power. To transfer back to normal power sooner, use the retransfer selector switch on the power transfer switch.

▼ SHUNT 2 ↵ 🔒2

Use ▲▼ arrows to enable the shunt trip #2 test. Press ↵ to begin test. The emergency (transfer switch) circuit breaker (if supplied) should trip. Note: If the transfer switch is in the normal position, the circuit breaker will trip and that is all. If the transfer switch is in the emergency position, the circuit breaker will trip and the transfer switch will transfer to the normal position if normal power is available.

↵ Use ▲▼ arrows to disable the shunt trip #2 test. Press ↵ to end test. Reset the transfer switch circuit breaker.

▼ FLAGS

These flags are a part of a manufacturer level testing tool.

Tools

↵ ▼ FACTORY ↵ **▼TOOLS** ↵

↵ CLEAR DATA HISTORY 🔒3

Use ▲▼ arrows to enable this option. Press ↵ to confirm. Data History will be cleared and option will automatically revert back to disabled.
NOTE: Once cleared, this data cannot be recovered.

↵ CLEAR EVENT LOG 🔒3

Use ▲▼ arrows to enable this option. Press ↵ to confirm. The Event Log will be cleared and option will automatically revert back to disabled.
NOTE: Once cleared, this data cannot be recovered.

↵ RESET TO DEFAULTS 🔒3

Use ▲▼ arrows to enable this option. Press ↵ to confirm. The Mark IIXG will be reset to "out of the box" default settings.
NOTE: All user and factory configuration settings will be lost.

↵ FIRMWARE UPDATE 🔒3 ↵

This is a tool for installing firmware updates. Updates are installed from a USB flash drive. On screen instructions will guide the process. Installing firmware usually takes just a few minutes, however, the controller is out of service during this time.

About

↵ ⓥ ABOUT ↵

Information is shown for: Model Number, Serial Number, Software (Part Number, Build Number, Date), and Boot Code
(Part Number, Version Information and Checksum Information).

FTA3100 Series
Setup and Operating Instructions

FTA3100 Series VFD Controllers for
Variable Speed Pressure Limiting

Mark II
Mark II XG

Instruction Manual NS3100-50N
Addendum to Mark II NS1000 Series Instruction Manuals

DAS 7-31-15 Rev N ECN 272561

Table of Contents

A. Overview

The Mark II FTA3100 provides a variable frequency drive (VFD) rated for variable torque in a PID process control loop to control the speed of a centrifugal pump for the purpose of limiting the pump discharge pressure in a fire protection system. The PID closed-loop controller, resident in the Control Techniques VFD, receives its set point from the Mark II and its feedback from a pressure transducer measuring the system pressure and the output of the check valve. The set point is the desired pressure limit for the system expressed in psi (or bar), and is entered into the Mark II as PRESSURE SET POINT with the start and stop pressure settings. The output of the PID is connected to the speed input of the drive which controls the speed of the AC induction motor driving the pump to maintain the system pressure at the set point. The role of the PID loop is to maintain the total system pressure at the set point regardless of any variations in pressure such as suction pressure, etc. The PID pressure limiting control is active in both automatic and non-automatic (or manual) modes. (Refer to block diagram Figures 2, 3, 4)

The FTA3100 series also incorporates a BYPASS of the VFD should the VFD become inoperable. The bypass path constitutes all of the characteristics of a non-variable speed, fire pump controller as provided in a fully rated, full-service controller. Upon failure of the VFD, the Mark II will bypass and isolate the VFD and operate the pump at rated speed. Firetrol full-service bypass configurations are as follows:

Table 1

FTA Model	Normal VFD Mode	Bypass Mode Motor Starting Method
3100	VFD	Across-the-line FTA1000
3110	VFD	Autotransformer FTA1800
3120	VFD	Soft Starter FTA1900
3130	VFD	Digital Soft Starter FTA1930

VFD Sizing for HP and Voltage

Control Techniques Drives used in FTA3100 series fire pump controllers are sized to provide full-load, motor-rated output current at controller-rated horsepower and voltage at a service factor of 1.0 in accordance with NFPA20-2010, paragraph 9.5.2.2 (2). Motors must also be marked suitable for inverter duty in accordance with NFPA20-2010, paragraph 9.5.1.4.

Spare Fuses

The Control Techniques Drives used in FTA3100 series fire pump controllers are protected by a set of high-speed Class J fuses designed specifically for protecting electronic devices in drives and softstarters. A set of three spare fuses is shipped with every controller and stored inside the VFD compartment.

Mark II Control

The role of the Mark II as the overall fire pump control device is to respond automatically to a low pressure condition with a CALL-TO-START and to operate and monitor the performance of the VFD. The Mark II monitors and controls the operation of VFD via 1) the RS485 serial modbus communications link and 2) the discrete digital I/O lines to the control terminals of the drive (see Figure 1). The VFD is entirely configured via the Mark II through this serial communications link precluding the need to operate the VFD via its keypad.

Should the Mark II detect a failure in the drive, it bypasses and isolates the VFD through the line and load isolation contactors (3M and 2M), and runs the pump in bypass mode at motor rated full-speed using the

starting configuration in Table 1 above. The operator may choose to manually operate the drive in BYPASS mode or NORMAL VFD mode. Operation in BYPASS mode produces both an audible local alarm and a remote alarm for annunciation of an abnormal condition in the controller.

VFD Parameters Downloaded from Mark II in NORMAL Mode

The Mark II communicates with the drive using MODBUS RTU over RS485 in the Normal mode when the drive is active. This serial communications protocol is a master-slave system with a half-duplex message exchange system. The Mark II is the master, and the drive is the slave. The device address of the VFD in the modbus network must be set to 001.

Parameters downloaded into the drive are of two types: 1) settings available to the operator and 2) settings hidden from the operator. The list of the operator screen settings is shown below. Any change made to any of these screen parameters is downloaded immediately into the VFD upon ENTER.

Settings hidden from the operator include drive initialization parameters and sincerity commands. These parameters are normally loaded into the drive at the factory, but may be loaded into the drive by the operator using the LOAD ALL VFD SETTINGS screen in the System Set Up menu of the Mark II. Since, all VFD settings in the **Mark II XG** (operator and hidden) are automatically loaded into the VFD upon 1) power up in Normal mode and/or 2) waking up in the Normal mode, the need for the LOAD ALL VFD SETTINGS screen in the XG is eliminated. A complete list of all drive parameters may be found in Section L, Drives Parameter Mapping.

The Mark II incorporates a parameter read-back routine for detecting modbus communication errors and will display and log the message, "VFD Failure Comm Err" if an error is detected (VFD Comm Fault in the Mark II XG). To correct the error, double-check that 1) the VFD is energized in NORMAL mode and 2) the modbus cables are securely connected at the VFD and at the Mark II. The VFD Failure Comm Err message may be cleared by pressing the MANUAL/STOP RESET pushbutton.

VFD Settings Available to the Operator

Parameter	***Range***	***Default***	***Mark II Control***
Motor rated voltage	VFD Specific	Mark II Voltage	Mark II and XG
*Motor rated frequency (Hz)	50 or 60	Mark II Freq	Mark II and XG
*Motor rated current (FLA)	VFD Specific	Mark II FLA	Mark II and XG
*Motor rated speed (rpm)	900 – 3600	1750	Mark II and XG
*Max Continuous VFD Current	VFD Specific	Factory Set	Mark II and XG
*Pressure Set Point (PID) (psi)	Stop + 5 to 600	100	Mark II and XG
*Pgain (PID)	0.0 – 4.0	1.0	Mark II and XG
*Igain (PID)	0.0 – 4.0	0.5	Mark II and XG
*Acceleration Rate (sec)	5 - 60	5	Mark II and XG
*Deceleration Rate (sec)	5 - 60	10	Mark II and XG
*Pause Time (sec)	5 - 60	5	XG only
*VFD Sleep or Unattended Timer (min)	0 - 30	30	XG only
*Shutdown Boot Timer (sec)	0 - 30	10	XG only

VFD Diagnostics			
Keypad Mode	On or Off	Off	Mark II and XG
Terminal—No PID	On or Off	Off	Mark II and XG
Terminal--PID	On or Off	Off	Mark II and XG

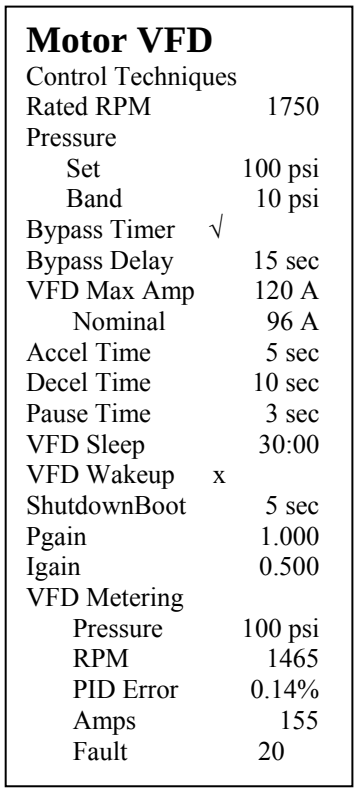
* Screens available to the operator with level 2 password or higher

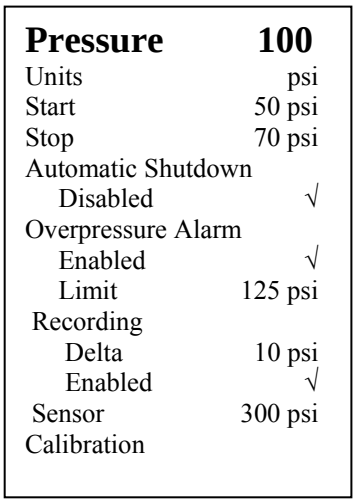
Mark II VFD Pressure Limiting PID Screens (Pressure Settings Menu)

The organization of the PID screens for the VFD configuration in the Mark II are as follows:

Screen (Password Level)	***Operating Mode in NORMAL***
Pressure Set Point (2)	Automatic and Manual
Stop Pressure (1)	Automatic
Start Pressure (1)	Automatic
SetPress BypassTimer (2)	Automatic and Manual
SetPress Bypass Band (2)	Automatic and Manual
Pgain Igain (2)	Automatic and Manual
Accel Decel (2)	Automatic and Manual

Mark II XG VFD Pressure Start and Pressure Limiting PID Screens





Pressure Set Point is the desired pressure limit or set point for the PID control algorithm which is operating the pump in both automatic and manual modes. Pressure Set Point may range from a maximum of 600 psi to a minimum of 5 psi above Stop Pressure.

Stop Pressure sets the point at which system pressure is satisfied for automatic shutdown after automatic start. The stop pressure set point is ignored in manual operation and in automatic operation if the Manual Stop feature is enabled (Automatic Shutdown Disabled in Mark II XG). Stop pressure may range from a maximum of 600 psi to a minimum of 1 psi above Start Pressure.

Start Pressure (Mark II Only) sets the point at which system pressure becomes ***low pressure***, generating an automatic call-to-start. Start pressure may range from a maximum of Stop Pressure -1 psi to 0 psi. Start pressure may also be set to ***Off-Show Pressure*** and ***Off-Hide Pressure***. ***Off-Show Pressure*** prohibits the controller from responding to an automatic low pressure condition but still shows pressure on the display. ***Off-Hide Pressure*** prohibits the controller from responding to an automatic low pressure condition and hides pressure from the display. A low pressure condition will always generate an automatic call-to-start unless 1) the Shutdown Interlock is installed 2) Emergency Stop is engaged, 3) Manual Stop is held depressed, or 3) start pressure is set to ***Off-Show Pressure*** or ***Off-Hide Pressure***.

Start Pressure (Mark II XG) sets the point at which system pressure becomes ***low pressure***, generating an automatic call-to-start. Start pressure may range from a maximum of Stop Pressure -1 psi to 0 psi. A low pressure condition will always generate an automatic call-to-start unless 1) the Shutdown Interlock is installed, 2) Emergency Stop is engaged, or 3) Manual Stop is held depressed.

Automatic Shutdown Disabled (Mark II XG) or Manual Stop Only (Mark II) requires the operator to manually stop the controller from an automatic call to start, i.e. the controller cannot automatically stop from an automatic start. All Firetrol controllers are shipped with Automatic Shutdown disabled to meet FM requirements. Automatic Shutdown Disabled ignores the Stop Pressure setting. However, since the Stop Pressure setting is above the Start Pressure and below the Set Pressure, it may need to be adjusted if either of these two settings is adjusted even if the controller is set for Automatic Shutdown Disabled.

SetPress BypassTimer sets the time required for the controller to reach the Pressure Set Point and remain within the band below the Pressure Set Point as defined by the SetPress Bypass Band screen below. Default is 15 seconds per NFPA20. If system pressure falls outside of the SetPress Bypass band for more than 15 seconds, the controller will go into VFD Failure, shutdown and isolate the VFD, and switch to BYPASS operation. See Figure 5

SetPress Bypass Band sets the pressure band or PID operating window relative to the Pressure Set Point for which the SetPress Bypass timer is applied. The band may be adjusted from 2 psi below Pressure Set Point to as much as the Start Pressure below Pressure Set Point. Factory default is 2 psi. See Figure 5

For a minimum SetPress Bypass Band of 2 psi at a Pressure Set Point of 150 psi, the PID control loop would need to keep system pressure between 148 and 150 psi in accordance with the setting of the SetPress BypassTimer to avoid a VFD Failure and transfer to BYPASS. A Start Pressure setting of 50 psi would permit a maximum SetPress Bypass Band of 100 psi (150-50).

PGain sets the proportional gain of the PID control loop (see Figure 4a). Proportional control determines the difference (or Error) between the Pressure Set Point and the System pressure and then applies appropriate proportional changes to the output of the PID loop to eliminate the error in pressure, i.e. the drive adjusts the speed of the pump to adjust the system pressure. PGain ranges from 0.0 to 4.0 in steps of 0.1. The default is set at 1.0.

A high gain results in a large response to a small error creating a very sensitive system. Setting the proportional gain too high may cause the system to become unstable. On the other hand a small gain results in a small response to a large error and a less sensitive system. A less sensitive system may not respond sufficiently to pressure disturbances in the system.

IGain sets the integral gain of the PID control loop. Integral control examines the offset of System pressure from Pressure Set Point over time and corrects it when necessary. IGain ranges from 0.0 to 4.0 in steps of 0.1. The default is set at 0.5. Integral gain eliminates steady state error and forces system pressure to the Pressure Set Point quicker than proportional control alone. However, the use of higher integral gains can lead to instability.

Note: A fast PID loop tuning usually overshoots slightly to reach the setpoint more quickly; however, some systems cannot accept overshoot, in which case a "critically damped" tuning is required, which will require a *P* setting significantly less than half that of the *P* setting causing oscillation.

Effects of *increasing* parameters				
Parameter	**Rise Time**	**Overshoot**	**Settling Time**	**S.S. Error**
K_p	Decrease	Increase	Small Change	Decrease
K_i	Decrease	Increase	Increase	Eliminate

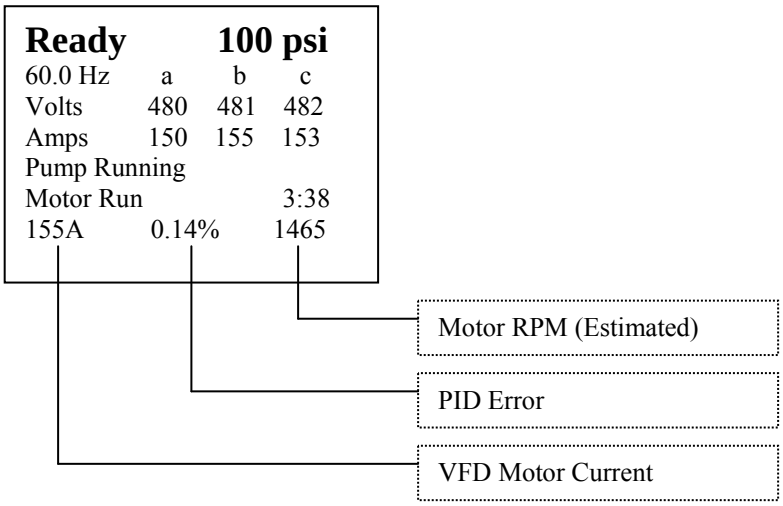
Accel adjusts the acceleration rate or ramp up time of the motor. Range is 5-60 seconds. Default is 5 seconds.

Decel adjusts the deceleration rate or ramp down time of the motor. Range is 5-60 seconds. Default is 10 seconds.

Run-time PID Monitoring Screens in Mark II METER Mode

Screen	***Operating Mode in NORMAL***
PID FDBK PSI: 100 Est Motor RPM: 1465	PID feedback pressure Estimated motor speed
PID Error %: ±0.14 VFD Motor Amps: 155	Difference between Set Pressure and feedback pressure Motor Amps measured by VFD

Run-time PID Monitoring in the Mark II XG



Note: PID Feedback pressure may be monitored on the Motor VFD screen under VFD Metering in the Mark II XG.

Motor I^2t Protection (*It.AC* trip)

The Control Techniques VFD provides a motor output current overload timer in the form of an I^2t software accumulator which will trip the drive (*It.AC*) upon timing out. The accumulation of I^2t represents the rise in temperature of the motor and is presented at Pr 4.19 as a percentage. Thus, if the accumulator should reach 100%, the drive will trip to protect the motor. On the other hand, should the overload fall away to less than 95% during the run, the accumulator is reset. See Section 8.4 in the Control Techniques Manual for additional details.

An *It.AC* trip is an unwanted trip and can become a nuisance especially if motor/pump is operated in its service factor (SF=1.15) to obtain the 150% flow point on the pump for the acceptance test. For this reason, care must be taken to size the fire pump controller HP and Voltage rating for operating the motor at a service factor of 1.0, i.e. the traditional 1.15 service factor is not permitted. Upsizing the motor and possibly the pump is the only alternative in handling the increase in HP and motor current required to get the 150% load point.

B. Modes of Operation

Normal Mode (VFD Mode)
Normal mode is the standard NFPA20 operating mode for a UL listed variable speed pressure limiting fire pump controller. Operation in Normal Mode brings all of the PID control features of the VFD controller into play to limit the pressure in the system by limiting the speed of the motor and pump. The PID loop is active in both automatic and manual modes (Local Start and Stop) of operation in Normal mode.

Bypass Mode
Bypass mode is required by NFPA20 as a back-up for Normal Mode should the drive fail to operate. **Bypass Mode permits the motor and pump to operate at full-speed, i.e. there is no pressure limiting control.** An alarm relay is provided to indicate bypass mode.

C. Front Panel Controls and Indicators

NORMAL/BYPASS Selector Switch Operation with Motor Stopped
Permits the operator to select between Normal mode and Bypass mode of operation. Switching to Bypass with Drive Ready and the motor stopped de-energizes the drive and prepares the controller for bypass operation. Switching to Normal generates a System Initialization (or reset) in preparation for operating the drive.

NORMAL/BYPASS Selector Switch Operation with Motor Running
Switching between Normal and Bypass modes while the motor is running can damage the drive. It is important to 1) stop the motor with the drive in Normal mode before switching into Bypass, and 2) stop the motor in Bypass before switching into Normal mode. But, if the operator does switch from Normal to Bypass with the motor running, the Mark II will soft stop the motor, de-energize the drive, dwell for a few seconds, and switch into Bypass whereupon it will respond to any calls-to-start. (Note: If the operator switches from Normal to Bypass with the motor running under the Mark II XG control, the XG ignores the switch until the operator presses Manual Stop or E-Stop to bring the motor to a halt, whereupon the XG switches the controller into Bypass mode).

If the operator switches from Bypass to Normal with the motor running, the Mark II stops the drive and performs a System Initialization (or reset). A System Initialization under these circumstances is extended in time to permit a spin down of the motor before operating it with the drive. **Note that starting a drive against a spinning motor may result in damage to the drive**. (Note: The Mark II XG provides a special "ShutdownBoot timer" which may be adjusted to cover the spin down of the motor under these circumstances).

Drive Ready Indicator Light
Indicates the VFD is powered up and healthy. This indicator is driven by a set of relay contacts in the drive. These contacts remain closed when power is applied to the drive, and the drive is healthy. These contacts are also continuously monitored by the Mark II to determine the status of the drive.

Bypass Active Light
Indicates the controller is operating in the bypass mode using one of the three configurations listed in Table 1 above. The controller can be placed in bypass mode 1) manually by the operator via the Normal/Bypass selector switch or 2) automatically by the Mark II if a VFD failure is encountered.

Manual Local Start Pushbutton
Soft starts the motor with the VFD in Normal mode and starts the motor in Bypass mode using one of the three starting methods listed in Table 1 above. If the unattended timer has expired de-energizing the drive, the start pushbutton cold starts the drive in Normal mode.

Manual Stop/Reset Pushbutton
Soft stops the motor with the VFD in Normal mode but does not remove power to the drive. Stops the motor in Bypass mode as permitted by one of the three starting methods listed in Table 1 above. Resets VFD Failure in Bypass mode to return to Normal Mode.

Emergency Stop Pushbutton
Soft stops the motor with VFD in Normal mode. Removes power from and isolates the drive. Stops the motor in Bypass mode as permitted by one of the three starting methods listed in Table 1 above. Emergency Stop also generates an audible alarm.

Emergency Run Bar
Engaging the emergency run bar in Normal mode de-energizes the line isolation and load isolation contactors in the power train of the drive and energizes bypass contactor 1M. Note that 1M and 2M are electrically and mechanically interlocked.

D. General Notes on Operation

Unattended Timer
If the Mark II VFD controller is unattended for 30 minutes in Normal mode after operating the motor, the controller goes to sleep in Normal mode by de-energizing the VFD line and load isolation contactors. This state remains the normal standby mode for the controller which remains asleep until awakened by a call-to-start.

Pressure Sincerity Check During Drive Deceleration
The Mark II conducts a pressure sincerity check during the deceleration of the drive from a soft stop command. Upon a command to soft stop the drive, the Mark II ramps the drive down to one-half the rated speed of the motor for a **Pause** period of 10 seconds (programmable from 0-10 seconds in the Mark II XG).

If system pressure remains above the STOP pressure during this sincerity check (not Low Pressure), then system pressure is considered stable, indicating there is no longer a demand for flow, and the Mark II soft stops the drive.

If system pressure falls below the START Pressure during the sincerity check, a low pressure condition is present, and the Mark II responds by ramping the pump back up to PRESSURE SET POINT until it receives another command to soft stop the drive.

E. Manual Operation

Obtaining Proper Pump Rotation with standard ABC incoming phase sequence
3100 Series VFD and bypass drive trains, including the soft starter bypass if so equipped, are shipped from the factory wired for industry standard ABC right-hand incoming phase rotation on L1, L2, and L3. To check the phase sequence of the incoming lines, press the METER key on the Mark II and navigate down to the Frequency and Phase Sequence screen.

Since the drive spins the motor in one and only one direction regardless of incoming phase rotation, proper motor rotation in the ABC system can only be obtained by 1) bumping the motor in NORMAL VFD mode to check rotation and 2) switching any two of the three incoming motor leads T1, T2, and T3 at the output of bypass contactor 1M to achieve proper rotation. **Note that the bypass contactor must always match the rotation of the motor as dictated by the drive.** As a precaution, after obtaining proper motor rotation in Normal, switch to Bypass Mode and bump the motor to check for proper rotation in Bypass before running the motor and pump at full speed.

Obtaining Proper Pump Rotation with CBA incoming phase sequence
If the incoming phase sequence is CBA, incoming lines L1, L2, and L3, must be switched to obtain the standard ABC right-hand phase rotation required by the controller. **Do not attempt to reverse any of the internal wiring of the controller in an effort to obtain ABC rotation.**

Manual Operation, Normal VFD Mode Start and Stop Pushbuttons
The pump may be operated manually via the local START and STOP pushbuttons. If the drive is ready, the Mark II will soft start the motor upon the operation of the START pushbutton which will ramp the pump up to the speed required to maintain PRESSURE SET POINT under PID control The Mark II handles the soft start command to the drive using the RUN FORWARD input in a 2-wire connection between terminals 22 and 26.

Pressure Set Point is maintained until the operator presses STOP, whereupon the Mark II performs a SINCERITY CHECK on system pressure for a pause period of 10 seconds. If system pressure remains above the STOP pressure during this sincerity check (not Low Pressure), then system pressure is considered stable, indicating there is no longer a demand for flow, and the Mark II soft stops the drive.

If system pressure falls below the START Pressure during the sincerity check, a low pressure condition has developed which the Mark II recognizes as an automatic call-to-start. The Mark II responds to the call-to-start by ramping the pump back up to PRESSURE SET POINT. The Mark II will continue operating the controller in AUTOMATIC until system pressure stabilizes indicating there is no longer a demand for flow.

F. Automatic Operation

Automatic Operation, Normal VFD Mode Low Pressure Call-to-Start with Automatic Stop
The pump is started automatically from a low pressure condition created when system pressure falls below the START pressure setting entered into the Mark II. If the VFD is Ready, the Mark II will soft start the drive, ramping the pump up to the speed required to maintain PRESSURE SET POINT under PID control.

The Mark II handles the soft start command to the drive using the RUN FORWARD input in a 2-wire connection between terminals 22 and 26.

Pressure Set Point is maintained until the Min Run time of 10 minutes expires whereupon the Mark II performs a SINCERITY CHECK on system pressure for a period of 5-10 seconds. If system pressure remains above the STOP pressure during this sincerity check (not Low Pressure), then system pressure is considered stable, indicating there is no longer a demand for flow, and the Mark II soft stops the drive.

If system pressure falls below the START Pressure during the sincerity check, a low pressure condition remains. The Mark II responds to the low pressure condition by 1) ramping the pump back up to PRESSURE SET POINT and 2) resetting the Min Run timer for another run of 10 minutes. This automatic cycle is continued until system pressure stabilizes indicating there is no longer a demand for flow.

Automatic Operation, Normal VFD Mode Low Pressure Call-to-Start with Manual Stop
The pump is started automatically from a low pressure condition created when system pressure falls below the START pressure setting entered into the Mark II. If the VFD is Ready, the Mark II will soft start the drive, ramping the pump up to the speed required to maintain PRESSURE SET POINT under PID control. The Mark II handles the soft start command to the drive using the RUN FORWARD input in a 2-wire connection between terminals 22 and 26.

Pressure Set Point is maintained until the operator presses STOP, whereupon the Mark II performs a SINCERITY CHECK on system pressure for a pause period of 10 seconds. If system pressure remains above the STOP pressure during this sincerity check (not Low Pressure), then system pressure is considered stable, indicating there is no longer a demand for flow, and the Mark II soft stops the drive.

If system pressure falls below the START Pressure during the sincerity check, a low pressure condition remains. The Mark II responds to the low pressure condition by 1) ramping the pump back up to PRESSURE SET POINT and 2) resetting the Min Run timer for another run of 10 minutes.

G. Bypass Operation

Bypass Due to a VFD failure
Should the Mark II detect a failure in the drive, it bypasses and isolates the drive through the line and load isolation contactors and runs the pump in Bypass mode. Once the drive is bypassed, the controller runs the pump at rated speed until the operator presses Manual Stop. An alarm relay is provided for indicating VFD failure.

The following conditions cause a VFD bypass:

1. **VFD Failure DrvCStrt** indicates that the drive has failed to power up within 5 seconds of a call to start. (**VFD not Ready** in the Mark II XG)
2. **VFD Failure XXX** indicates that the drive has tripped and the Mark II has been able to retrieve a valid trip code XXX.
3. **VFD Failure DriveErr** indicates that the drive has tripped, but the Mark II has been unable to retrieve a valid trip code.
4. Drive Motor Current Fail to Start (**VFD Failure MTR Curr**) in the first 12 seconds of motor starting. (**VFD Fail to Start in the Mark II XG**)

5. Failure to obtain and sustain the pressure Set Point within the SetPress Bypass Band for the period of time defined by the SetPress Bypass Timer when the motor is running (**VFD Failure Pressure).** Band and Timer defaults are 2 psi and 15 seconds respectively. See Figure 5.
6. Operation of the **Emergency Run** bar.

Mark II VFD Failures to Bypass
VFD Failure DrvCStrt
VFD Failure DriveErr
VFD Failure xxx (where xxx = drive error number 001-999)
VFD Failure Pressure
VFD Failure MTR Curr
Emergency Run

Note: A VFD Comm Error does not result in bypass operation.

The "VFD Failure xxx" message in the Mark II carries a three digit trip code ranging from 001 to 999 for identifying the trip (or error) posted by the Mark II as retrieved from the Control Techniques Drive. Trip numbers 001 - 499 are obtained from the drive's VFD serial communications look-up table which defines the nature of the trip as reported internally in the drive. Trip codes 500 – 999 are reserved for the Allen-Bradley drive.

Mark II XG VFD Failure Codes	**Code**
VFD Failure Pressure Code	300
VFD Failure to Start (motor current < 20%)	301
VFD Drive Not Ready	302
VFD Warm Start TimeOut	303
VFD Cold Start TimeOut	304
VFD Communication Error	305

Note: A VFD Comm Error does not result in bypass operation.

The "VFD Failure xxx" message in the **Mark II XG** may also carry a three digit trip code ranging from 1 to 232 for identifying the trip (or error) posted by the **Mark II XG** retrieved from the Control Techniques Drive over serial modbus. See Table 15-2 Serial Communications Look-up Table in the Appendix of this manual to identify the trip.

Note: Once the mark II detects a drive failure from monitoring the fault output of the drive, it must retrieve the trip code from the drive's trip history over modbus before shutting down the drive and going to bypass.

Return to Normal Mode from Bypass Due to a VFD failure

It is necessary to first press STOP/RESET in Bypass to clear the VFD failure message and alarm relay before switching back to Normal mode. When switching back to Normal mode under these conditions, the Mark II is reset, displaying "System Initialization" for 30 seconds during which all operations are inhibited. This lock-out period insures that the motor has come to rest in Bypass before re-energizing the drive in Normal mode.

H. Alarms and Event Logging

Over Pressure Alarm

An over pressure event will be captured and displayed as an alarm message on the Mark II if system pressure is equal to or greater than the value entered into the Overpressure Alarm screen in the Alarm Limits menu. This alarm is visible and audible and non-latching. The alarm may be reset by pressing the Manual Stop/Reset pushbutton. The alarm may be silenced by the Alarm Silence key on the Mark II. NFPA20 requires that the Overpressure alarm be set to 115% of the Pressure Set Point. (The Overpressure Alarm in the Mark II XG is located in the Pressure Settings menu).

Capturing Events in the FTA3100

The following events shall be captured in the event log and recorded on the flash drive.

3100 Event Table	Code
VFD Bypass Active	
VFD Failure xxx (where xxx = drive error number 001-999)	
VFD Failure Pressure	300
VFD Failure MTR Curr	301
VFD Drive Not Ready	302
VFD Warm Start TimeOut	303
VFD Cold Start TimeOut	304
VFD Comm Err	305
Overpressure	
Emergency Run	
Emergency Stop	

I. VFD Screen Settings Saved to Flash Drive

All VFD operator screens are included in the Settings section of the flash drive SaveDisk file.

J. Thermal Management

Due to the large amount of heat dissipated by VFD's and their line reactors operating at full-load conditions, the FTA3100 series controllers are equipped with thermal management packages for maintaining the temperature inside the enclosures within the safe operating ranges of the VFD's and other control electronics at the maximum rated ambient temperature of the controller, which is normally 40ºC. Thermal management packages for the FTA3100 UL listed series controllers may be fan cooling for NEMA Type 2 enclosures and closed-loop air conditioners for all other NEMA environment ratings. UL/FM listed FTA3100 series controllers must be NEMA 12 minimum and cooled by air-to-air heat exchangers. A thermostatically-controlled fan circuit is used to operate the cooling device whenever the VFD is energized and will continue operating the device after the VFD is shutdown until the temperature inside the enclosure falls below the setting of the thermostat.

Caution: All thermal management packages require some periodic maintenance. Please refer to the Instruction Manual accompanying the controller for detailed procedures.

Fan Cooling (UL Only)

The cooling fan package used in the FTA3100 series consists of a single-phase fan motor, washable intake air filter, plenum, finger guard, and grill plus an exhaust grill and filter. The thermostatically-controlled fan circuit operates the fan motor whenever the VFD is energized (3M contactor) and will continue operating the fan after the VFD is shutdown until the temperature inside the enclosure falls below the setting of the thermostat.

AC Cooling (UL only)

The AC cooling package used in the FTA3100 series is a closed-loop air conditioner consisting of an evaporator and a condenser. The thermostatically-controlled air conditioner circuit operates the compressor whenever the VFD is energized (3M contactor) and will continue operating the compressor after the VFD is shutdown until the temperature inside the enclosure falls below the setting of the thermostat. The air conditioner control circuit incorporates a minimum run timer (ACR) to prevent any short-cycling of the compressor.

Air-to-air Heat Exchanger Cooling (UL and FM)

An air-to-air heat exchanger is required in FM approved FTA3100 series VFD controllers. A thermostatically-controlled circuit is used to operate the fan in the heat exchanger whenever the VFD is energized (3M contactor) and will continue operating the fan after the VFD is shutdown until the temperature inside the enclosure falls below the setting of the thermostat.

K. VFD Diagnostics Defined—Normal Mode Only (Mark II Only)

VFD Mode, DIAGNOSTICS

The following three modes of operation are available in Diagnostics for troubleshooting the drive in NORMAL mode. All three diagnostic modes prevent the controller from switching into Bypass from a VFD failure thus permitting the operator to troubleshoot the drive free of interruption. All three diagnostic modes are displayed on the Mark II to alert the operator and are subject to an unattended timer of 30 minutes which if expires, shall return the controller to Normal mode.

Keypad Mode

Allows the service technician to operate the drive and run the motor independently of the Mark II using the local keypad on the VFD. VFD Failure and transfer into Bypass Mode are inhibited from operation in this mode. The operator is also locked out of any automatic operations or manual operations with the Local Start pushbutton in Keypad mode. The Emergency Stop pushbutton remains operable to shutdown and isolate theVFD.

Caution: Operation of the VFD in Diagnostics Keypad Mode via the VFD's keypad permits the operator to run the motor at full-speed which can produce full system pressure.

Terminal---NO PID Mode
Permits manual operation of the drive to full-speed using the Local Start and Stop pushbuttons. VFD Failure and transfer into Bypass Mode are inhibited from operation in this mode. Full-speed is expressed in hertz and is preset to 50 or 60Hz as determined by the system frequency setting in the System Setup Menu.

> **Caution: Operation of the VFD in Diagnostics Terminal---No PID Mode will produce full-speed at the motor which can produce full system pressure.**

Terminal---PID Mode
Permits manual PID operation of the drive to the Pressure Set Point using the Local Start and Stop pushbuttons. VFD Failure and transfer into Bypass Mode are inhibited from operation in this mode.

> **Caution: Operation of the VFD in Diagnostics Terminal---PID Mode could produce full-speed at the motor which can produce full system pressure if the PID feedback transducer is disconnected.**

VFD Diagnostics OFF
To exit VFD diagnostics, turn VFD Diagnostics OFF. Drive diagnostics may also be terminated by 1) power off/on reset or 2) unattended timer expiration.

L. Running VFD Diagnostics in Normal Mode—Motor Isolated (Mark II Only)

> **Caution: When troubleshooting the drive in Normal mode, it is recommended that the wire(s) on one side of the coil of the Bypass Contactor (1M) and the VFD Contactor (2M) be lifted to isolate the drive from the motor and the bypass power train in order to prevent any inadvertent operation of the motor. If it is necessary to lift two wires to open the coil (coil terminal is being used as a "tie" point), be sure to use a wire nut to maintain connection between the two wires. Please note that all contactor coils in the fire pump controller are operated at line voltage.**

Note: Since access to the VFD Diagnostic screens may only be acquired in Normal mode with the VFD de-energized to avoid nuisance bypassing due to the drive fault under investigation, the controller must first be placed in Emergency Stop mode before entering Normal mode.

1. Push in the red mushroom-head Emergency Stop pushbutton to maintain the controller in Emergency Stop.
2. Remove power from the controller via the main disconnect and follow the above instructions for disabling 1M and 2M.
3. Switch the controller into NORMAL mode.
4. Install the Interlock On jumper to avoid an automatic start if necessary.
5. Place the main disconnect in the ON position to apply power to the controller.
6. The audible alarm will be energized and remain energized as long as the controller remains in Emergency Stop.

7. Pull out the Emergency Stop pushbutton to release Emergency Stop and press the Silence Alarm key to silence the audible alarm.
8. Press the Menu key on the Mark II to advance to Diagnostics. Down-arrow to the VFD Diagnostics screen and select among the three diagnostic modes described above in Section K by pressing ENTER key. Note that the "KEYPAD" mode is the safest diagnostic mode for a beginner to use since pressing the Local Start pushbutton in step 10 energizes the drive in this mode but does not call for the drive to run the motor.
9. Press the HOME key to view the "Drive in Diagnostics" message.
10. Press the Local Start pushbutton to engage the Drive Isolation Contactor (3M) and energize the drive.
11. Operation in VFD Diagnostics mode permits the technician to troubleshoot the drive by maintaining power to the drive and preventing the drive from going into the BYPASS mode. The controller will remain in Normal mode until VFD Diagnostics are turned OFF.
12. Follow the instructions above under VFD Diagnostics OFF to return to full controller operation.
13. If it appears that the drive is operating properly disconnected from the motor and bypass power, the wiring to one or both of the contactor coils may be restored to continue troubleshooting the drive in diagnostics with the motor connected. Please note that a) power should always be removed from the controller before removing or restoring line voltage control wiring, and b) removing power from the controller automatically resets the Mark II VFD Diagnostics.
14. Repeat the procedure above to re-enter VFD Diagnostics and run the drive with 2M and/or 1M connected.

Running VFD Diagnostics in Normal Mode—Motor Connected (Mark II Only)

Note: Since access to the VFD Diagnostic screens may only be acquired in Normal mode with the VFD de-energized to avoid nuisance bypassing due to the drive fault under investigation, the controller must first be placed in Emergency Stop mode before entering Normal mode.

1. Push in the red mushroom-head Emergency Stop pushbutton to maintain the controller in Emergency Stop.
2. Make sure that the Interlock is installed or pressure is satisfied to avoid any automatic starts.
3. Switch the controller into BYPASS mode, then
4. Switch the controller back into NORMAL mode to place the Mark II in Normal with the VFD de-energized.
5. Make the appropriate selections in the diagnostic screens. Again, please note that the "KEYPAD" mode is the safest diagnostic mode to use since pressing the Local Start pushbutton in step 7 energizes the drive in this mode but does not call for the drive to run the motor.
6. Pull out the Emergency Stop pushbutton to release Emergency Stop.
7. Press Local Start to energize the VFD.
8. Operation in VFD Diagnostics mode permits the technician to troubleshoot the drive by maintaining power to the drive and preventing the drive from going into the BYPASS mode. The controller will remain in Normal mode until VFD Diagnostics are turned OFF.
9. Follow the instructions above under VFD Diagnostics OFF to return to full controller operation.

Running VFD Diagnostics in Normal Mode—Motor Isolated (Mark II XG Only)

Caution: When troubleshooting the drive in Normal mode, it is recommended that the wire(s) on one side of the coil of the Bypass Contactor (1M) and the VFD Contactor (2M) be lifted to isolate the drive from the motor and the bypass power train in order to prevent any inadvertent operation of the motor. If it is necessary to lift two wires to open the coil (coil terminal is being used as a "tie" point), be sure to use a wire nut to maintain connection between the two wires. Please note that all contactor coils in the fire pump controller are operated at line voltage.

Note: Since access to the VFD Diagnostic screens may only be acquired in Normal mode with the VFD de-energized to avoid nuisance bypassing due to the drive fault under investigation, the controller must first be placed in Emergency Stop mode before entering Normal mode.

1. Push in the red mushroom-head Emergency Stop pushbutton to maintain the controller in Emergency Stop.
2. Remove power from the controller via the main disconnect and follow the above instructions for disabling 1M and 2M.
3. Switch the controller into NORMAL mode.
4. Install the Interlock On jumper to avoid an automatic start if necessary.
5. Place the main disconnect in the ON position to apply power to the controller.
6. The audible alarm will be energized and remain energized as long as the controller remains in Emergency Stop.
7. Pull out the Emergency Stop pushbutton to release Emergency Stop. The VFD should be sleeping.
8. Go to Main Menu/Factory/Diagnostics/VFD******and select Terminal PID as your initial diagnostic mode.
9. While in still Diagnostics, enable VFD WAKEUP to wake up the drive.
10. Go back into VFD Diagnostics and select among the three diagnostic modes of your choice as described above in Section K.
11. Press ESC to view the "VFD Diagnostics" message on the home screen.
12. Operation in VFD Diagnostics mode permits the technician to troubleshoot the drive by maintaining power to the drive and preventing the drive from going into the BYPASS mode. The controller will remain in Normal mode until VFD Diagnostics are turned OFF or power to the controller is cycled.
13. Follow the instructions above under VFD Diagnostics OFF to return to full controller operation.
14. If it appears that the drive is operating properly disconnected from the motor and bypass power, the wiring to one or both of the contactor coils may be restored to continue troubleshooting the drive in diagnostics with the motor connected. Please note that a) power should always be removed from the controller before removing or restoring line voltage control wiring, and b) removing power from the controller automatically resets the Mark II XG VFD Diagnostics.
15. Repeat the procedure above to re-enter VFD Diagnostics and run the drive with 2M and/or 1M connected.

Running VFD Diagnostics in Normal Mode—Motor Connected (Mark II XG Only)

Note: Since access to the VFD Diagnostic screens may only be acquired in Normal mode with the VFD de-energized to avoid nuisance bypassing due to the drive fault under investigation, the controller must first be placed in Emergency Stop mode before entering Normal mode.

16. Push in the red mushroom-head Emergency Stop pushbutton to maintain the controller in Emergency Stop. The audible alarm will sound.
17. Make sure that the Interlock is installed or pressure is satisfied to avoid any automatic starts.
18. Switch the controller into BYPASS mode and press Manual Stop/Reset, then
19. Switch the controller back into NORMAL mode to reset the Mark II XG and place controller in Normal with the VFD de-energized.
20. Release the E-Stop pushbutton. VFD should be sleeping and alarm should be silenced.
21. Go to Main Menu/Factory/Diagnostics/VFD******and select Terminal PID as your initial diagnostic mode.
22. While in still Diagnostics, enable VFD WAKEUP to wake up the drive.
23. Go back into VFD Diagnostics and select among the three diagnostic modes of your choice as described above in section K.
24. Press ESC to view the "VFD Diagnostics" message on the home screen.
25. Operation in VFD Diagnostics mode permits the technician to troubleshoot the drive by maintaining power to the drive and preventing the drive from going into the BYPASS mode. The controller will remain in Normal mode until VFD Diagnostics are turned OFF.
26. Follow the instructions above under VFD Diagnostics OFF to return to full controller operation.

Running VFD Diagnostics from a VFD Failure to Bypass (Mark II XG Only)

1. Press Manual/Stop Reset to clear the VFD failure and follow steps 16 through 26 above.

FTA3100 I/O Assignments

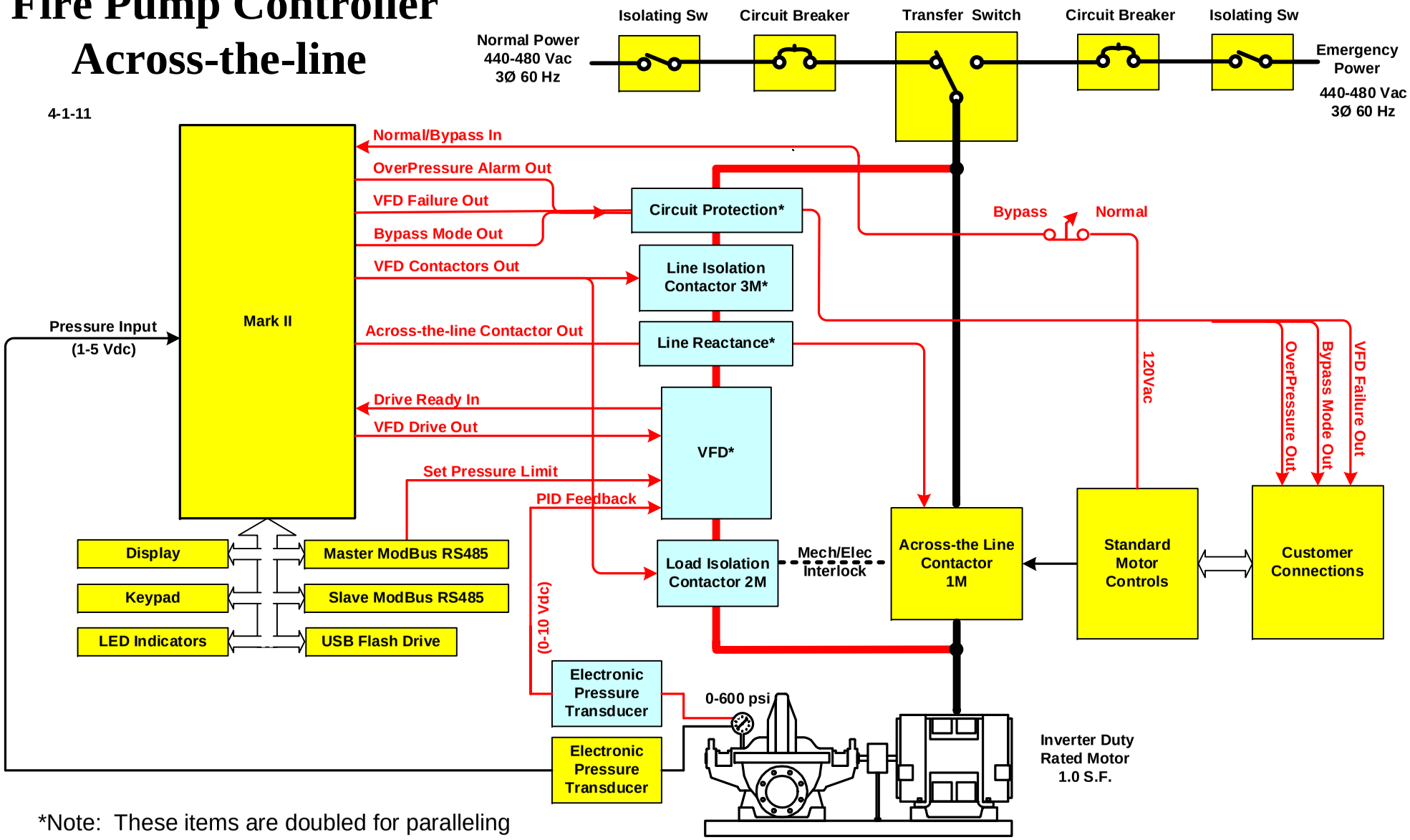
CONTROL TECHNIQUES DRIVE

FTA3100 Signal	Description	Mark II I/O	Drive Terminal	Mark II I/O Reassignments	Signal	Pin
Drive/Bypass Selector Switch	Selects Drive or Bypass Operation. Input is true for Drive mode.	I		User Input 7	In7	J3-6
Drive Ready	Signal from drive indicating drive is ready. Input is true for drive ready.	I	41 & 42	User Input 8	In8	J3-5
Emergency Stop	Shuts drive down and isolates in unattended mode	I		User Input 6	In6	J3-7
Bypass Motor Run 1CR	Motor Run 1CR	O		Motor Run #1 (1CR)	ACout1	J4-1
Bypass Motor Run 6CR	Motor Run 6CR	O		Motor Run #2 (6CR)	ACout2	J4-2
Drive Contactors Energized	Operates drive line and load isolation contactors	O		User Out 5 (3CR)	ACout9	J4-9
Soft Start Drive	Soft starts drive	O	26 & 22	User Out 6 (2CR)	ACout10	J4-10
Drive Failure*	Drive Failure	O		User Out 7	ACout11	J4-11
Bypass Mode*	Bypass Mode	O		User Out 8	ACout12	J4-12
Overpressure Alarm*	Overpressure Alarm Relay	O		User Out 3	ACout 7	J4-7

*Event messages displayed on Mark II

Figure 1

Mark II VFD Electric Fire Pump Controller Across-the-line



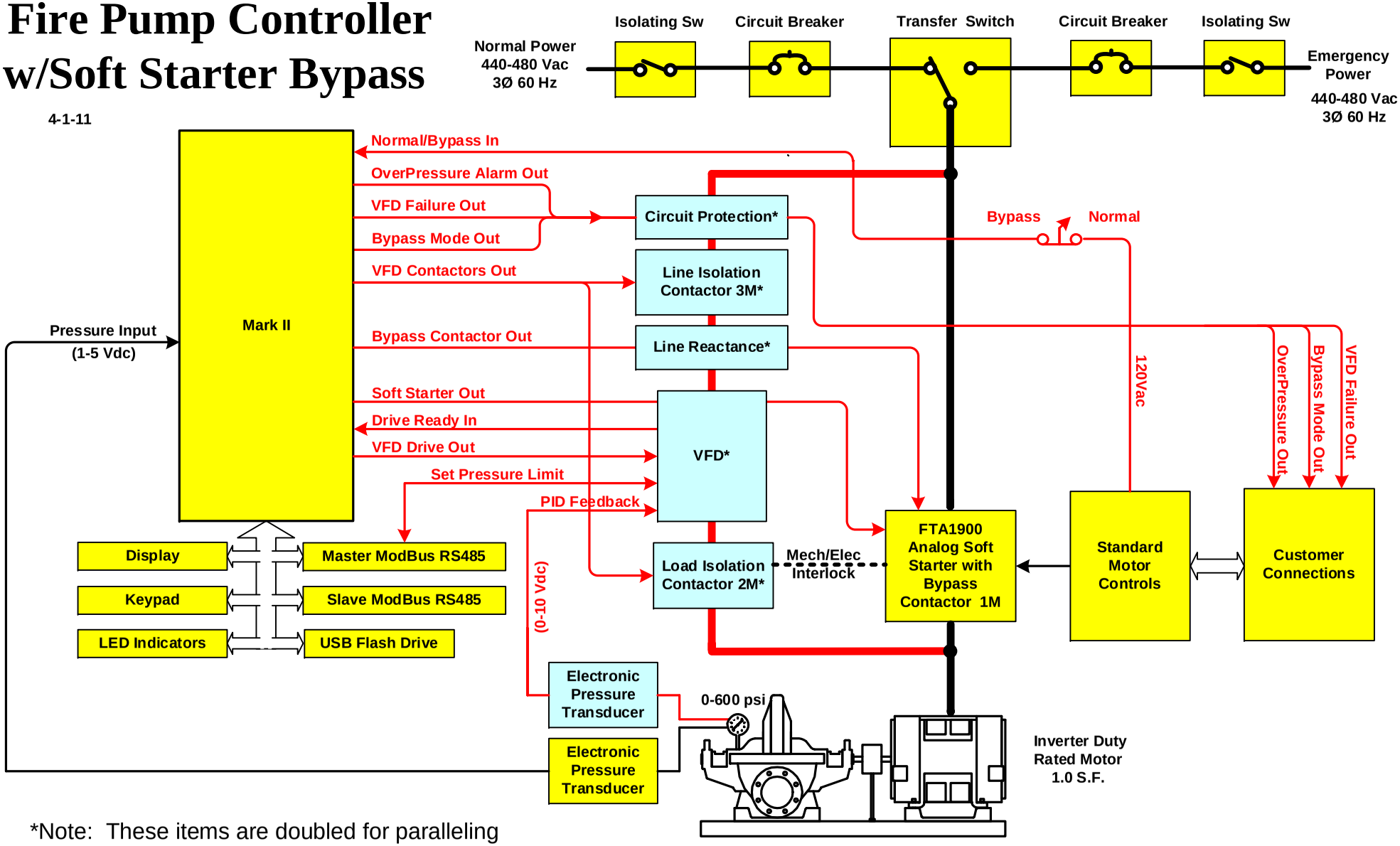
*Note: These items are doubled for paralleling drives in controllers rated at 250Hp and greater.

FTA3100

Figure 2

Mark II VFD Electric Fire Pump Controller w/Soft Starter Bypass

4-1-11



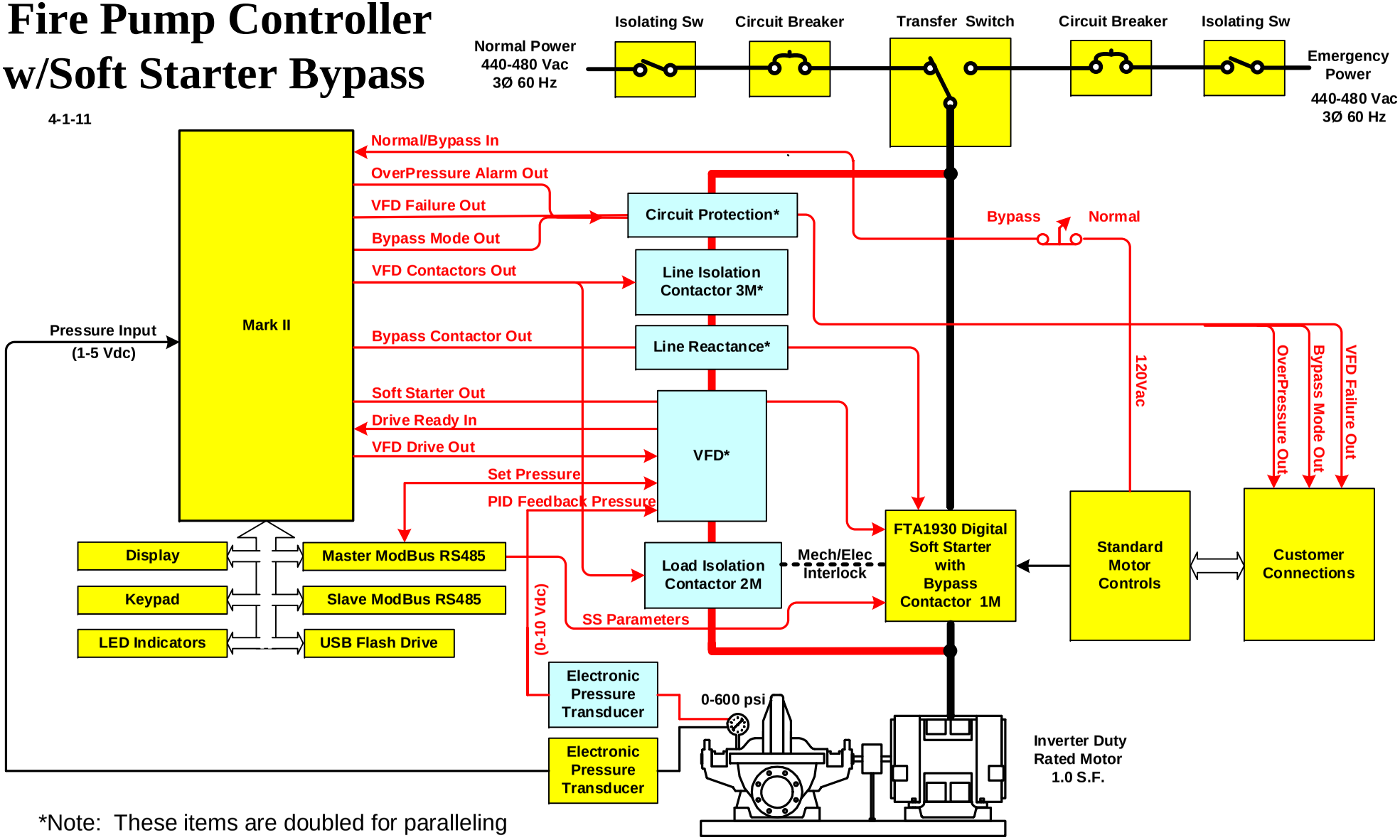
*Note: These items are doubled for paralleling drives in controllers rated at 250Hp and greater.

FTA3120

Figure 3

Mark II VFD Electric Fire Pump Controller w/Soft Starter Bypass

4-1-11



*Note: These items are doubled for paralleling drives in controllers rated at 250Hp and greater.

FTA3130

Figure 4

Mark II VFD PID Controller w/Control Techniques Drive

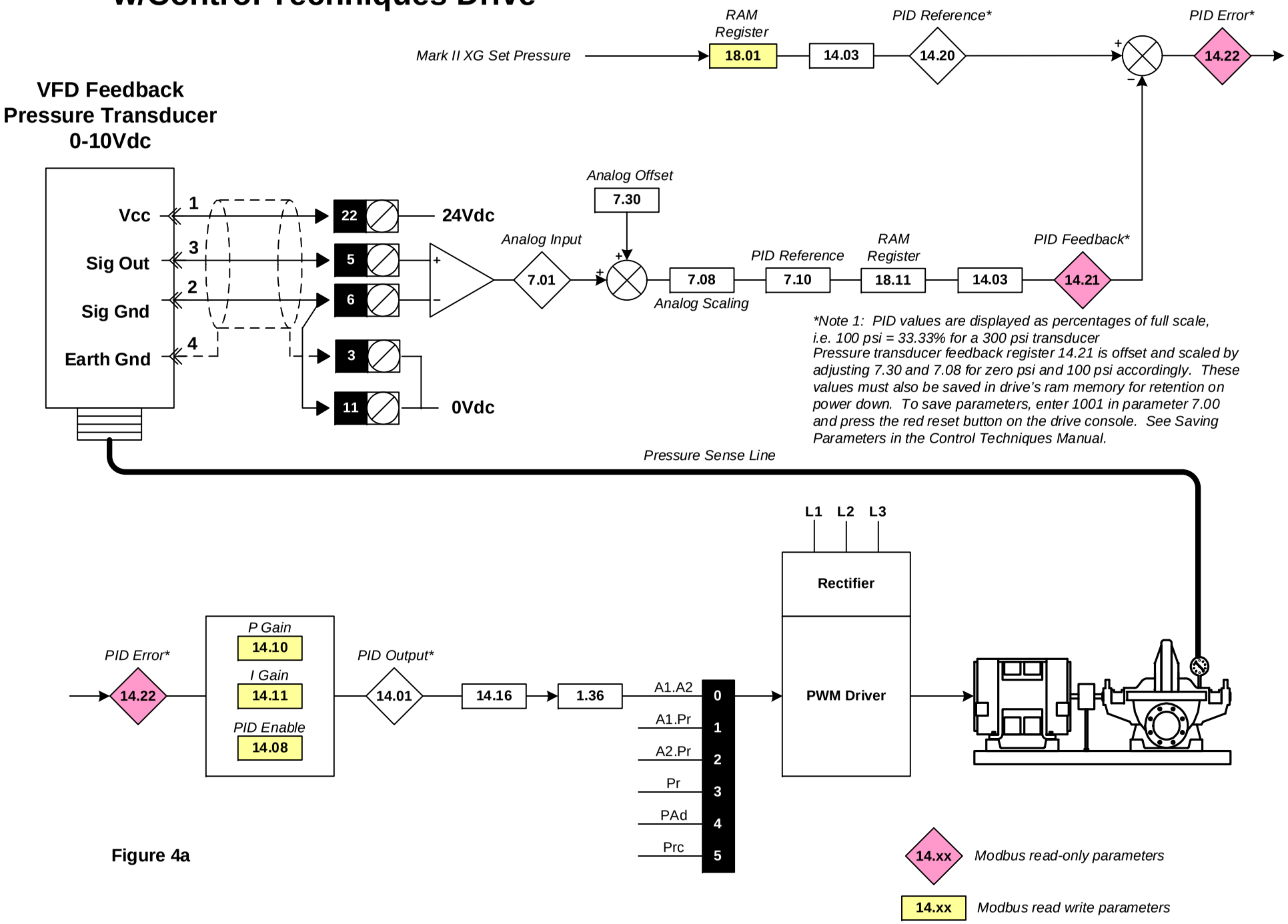


Figure 4a

VFD Failure to make the Pressure Set Point and Transfer to Bypass Operation

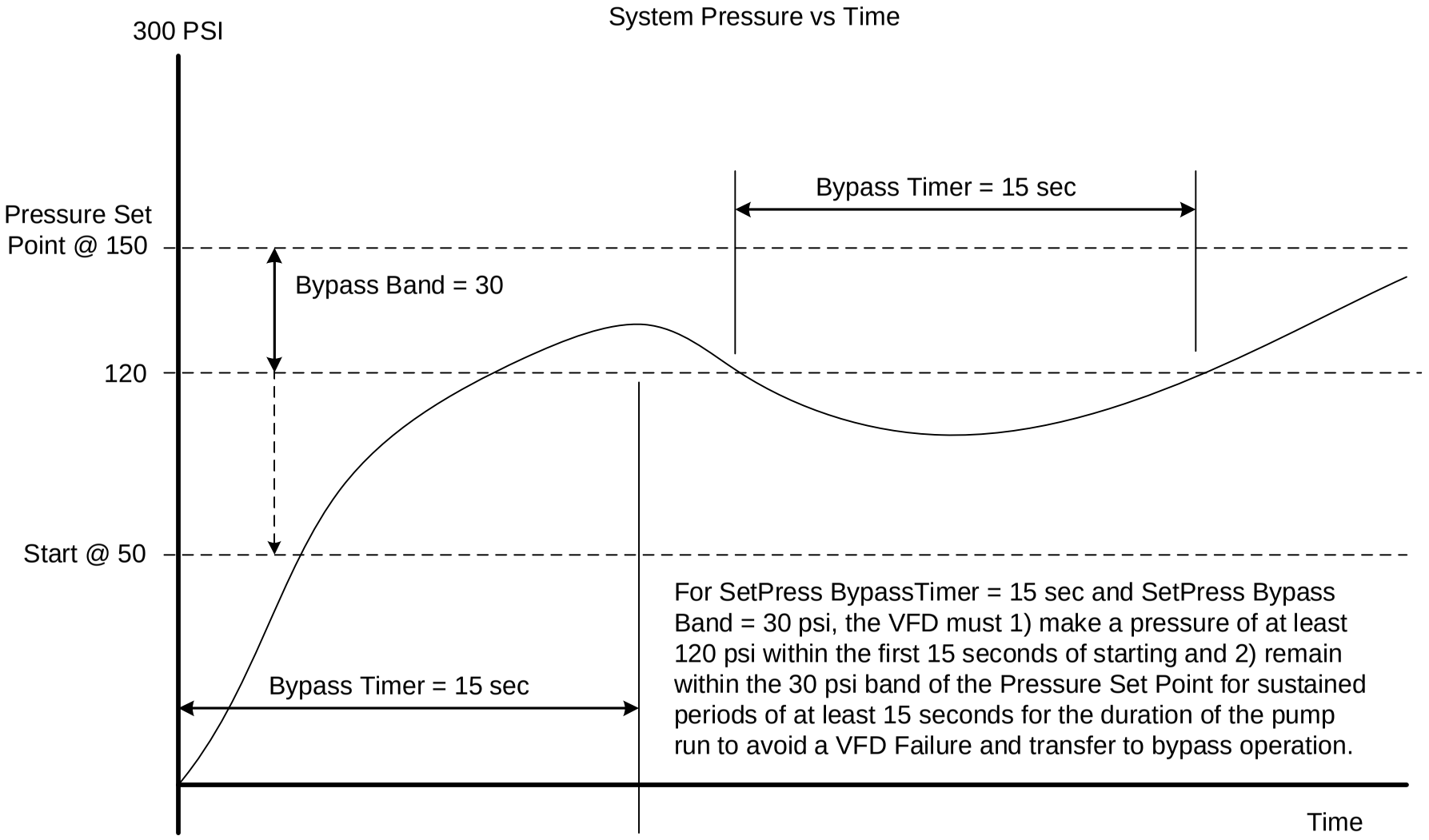


Figure 5

Typical VFD Pressure Limiting System Performance

1000 GPM @ 155 PSI
170 PSI Set Pressure

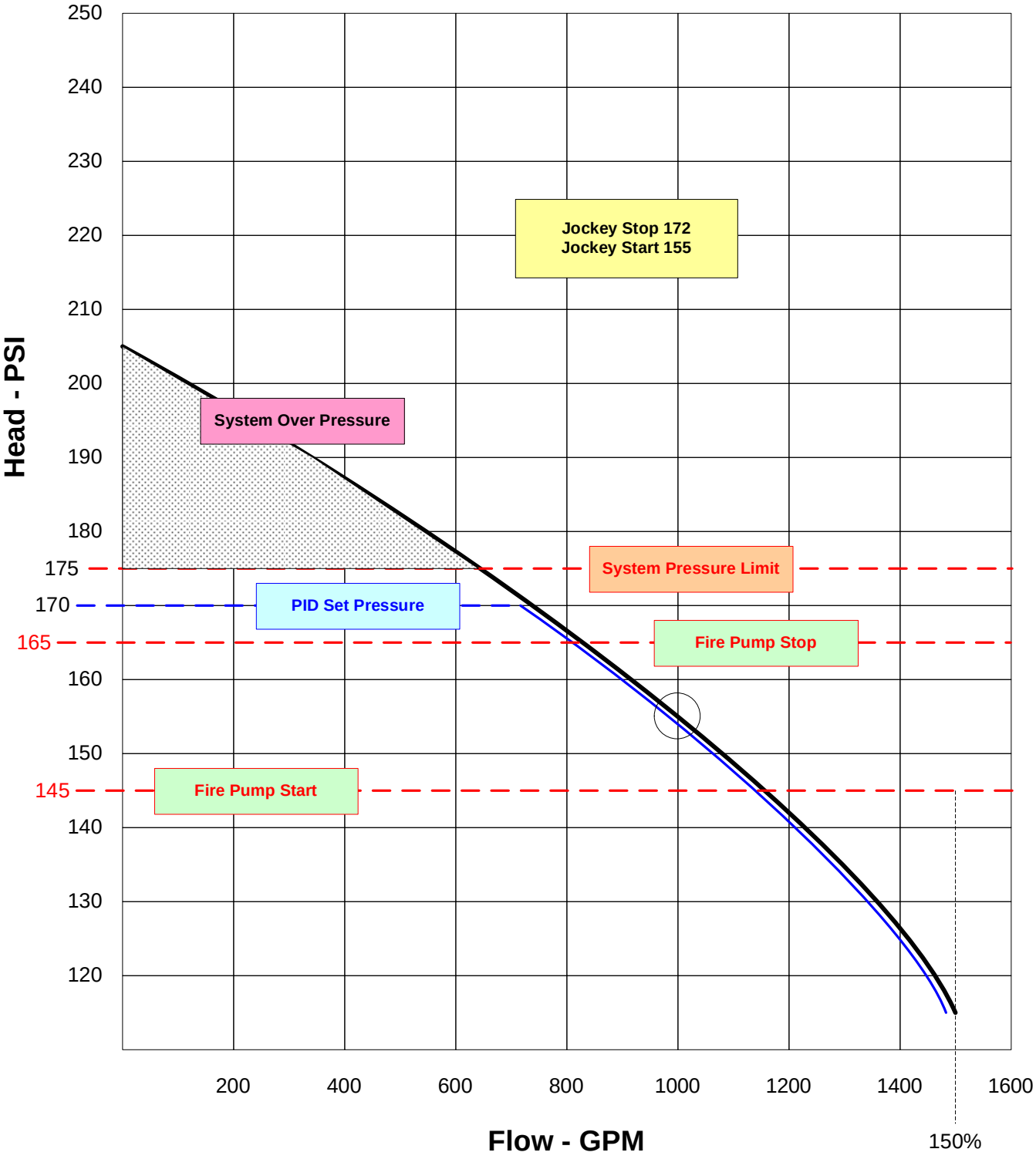
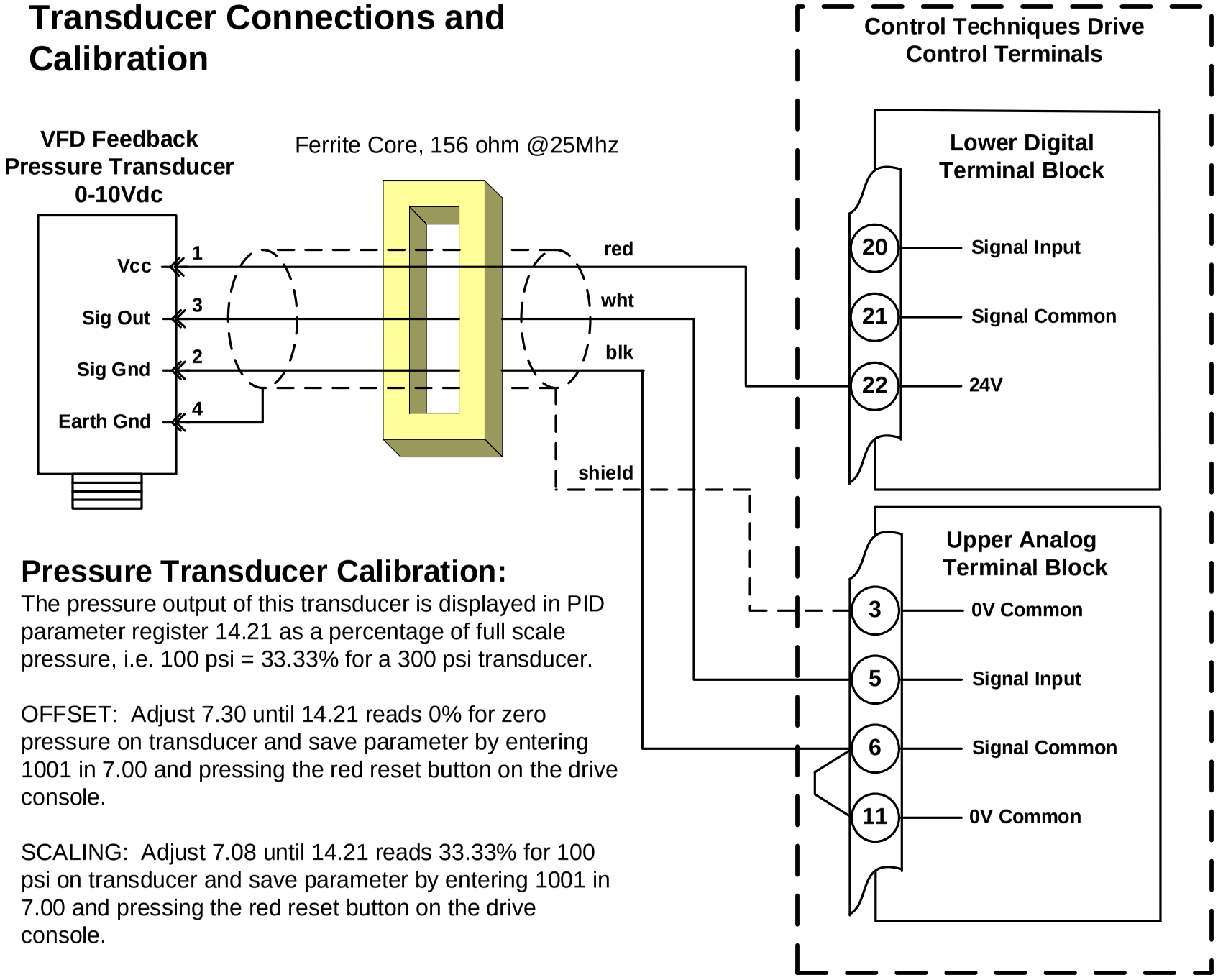


Figure 6

VFD Feedback Pressure Transducer Connections and Calibration



Pressure Transducer Calibration:

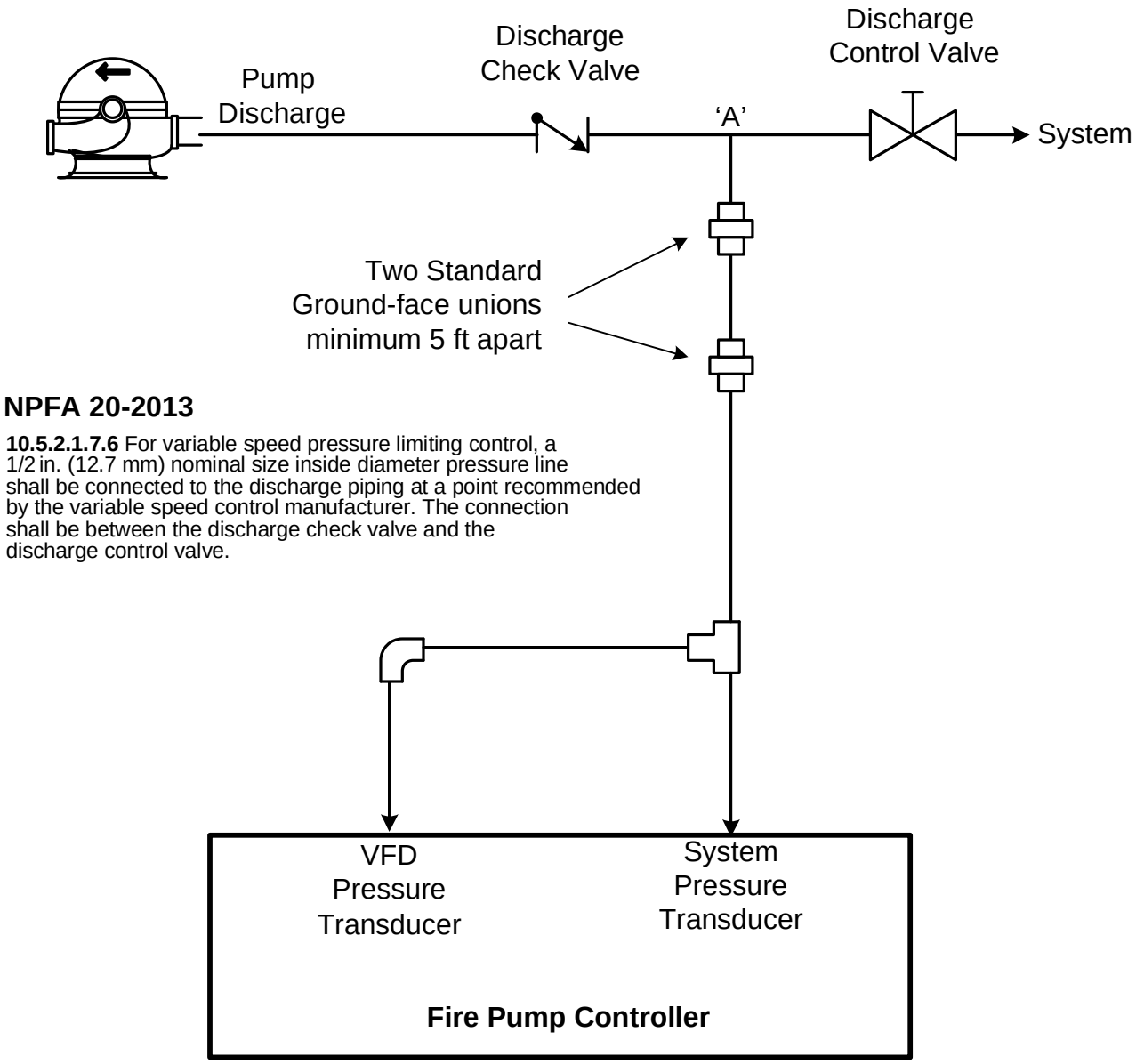
The pressure output of this transducer is displayed in PID parameter register 14.21 as a percentage of full scale pressure, i.e. 100 psi = 33.33% for a 300 psi transducer.

OFFSET: Adjust 7.30 until 14.21 reads 0% for zero pressure on transducer and save parameter by entering 1001 in 7.00 and pressing the red reset button on the drive console.

SCALING: Adjust 7.08 until 14.21 reads 33.33% for 100 psi on transducer and save parameter by entering 1001 in 7.00 and pressing the red reset button on the drive console.

Figure 7

Pressure Sensing Arrangement
FTA3100 Series VFD



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10.5.2.1.7.6 For variable speed pressure limiting control, a 1/2 in. (12.7 mm) nominal size inside diameter pressure line shall be connected to the discharge piping at a point recommended by the variable speed control manufacturer. The connection shall be between the discharge check valve and the discharge control valve.

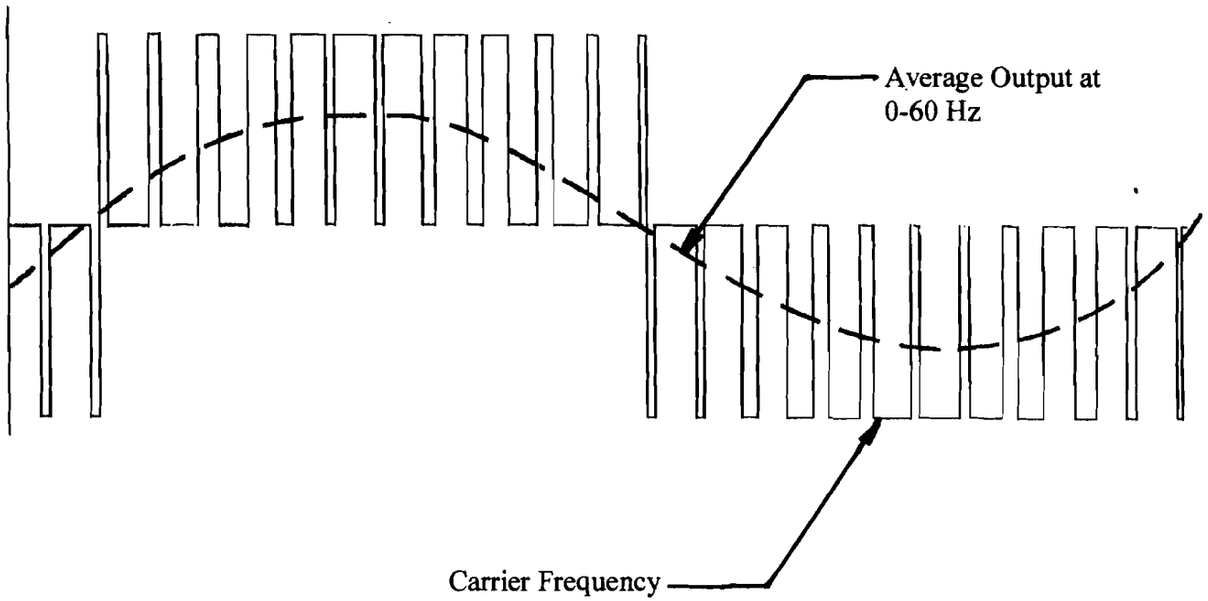
Note: For best VFD performance it is recommended that the sensing line connection to the discharge piping ('A') be made on a run of straight pipe, at a point where hydraulic turbulence is minimal, i.e. several pipe diameters away from the check valve and discharge control valve. Connections at or near tees or elbows should be avoided as well.

Figure 7a

Output Waveform

Control Techniques Unidrive SP Model SP6401

3 KHz Maximum PWM Switching Frequency (Carrier Frequency)
Open-loop vector mode with PID control for standard AC induction motors
125Hp, 380- 480Vac, 192 Amps



FTA3130 Soft Starter Fault Codes

The Benshaw MX2 Control Board will not accept a start command for the following "lockout" conditions which are displayed on both the MX2 and on the Mark II XG.

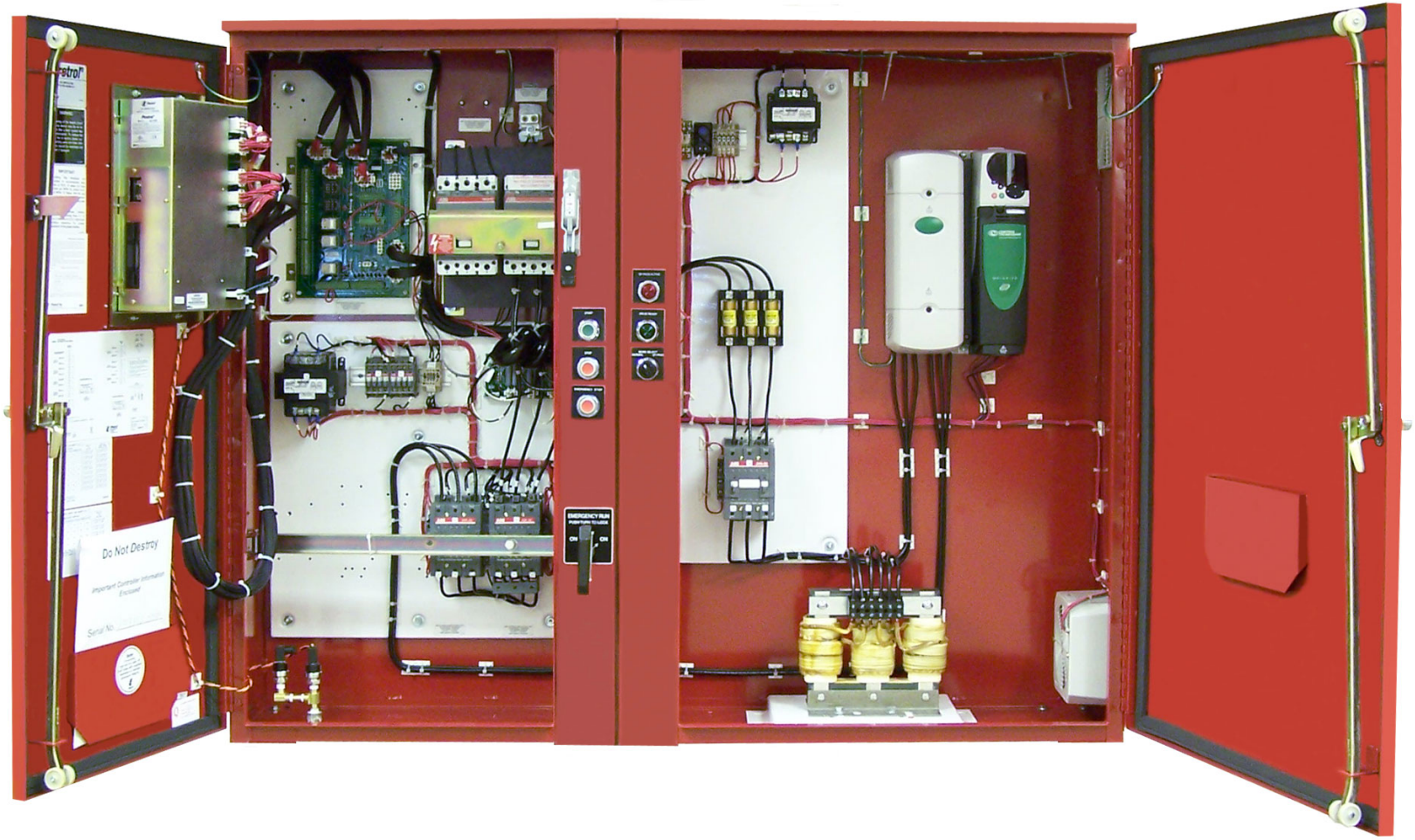
Mark II XG Display	Fault Lockout Status	Benshaw MX2 Display	Modbus Register
914	Interlock Input Present	"Lint"	Bit 13, Reg 40026
316	Loss of Control Power	"L CP"	Bit 7, Reg 40026
1520	Stack Over Temperature	"L Ot"	Bit 6, Reg 40026

The Benshaw MX2 will display the following alarms which are not displayed on the Mark II XG. These alarms are not considered to be "lockout" faults.

Mark II XG Display	Alarm Status	MX2 Display	Modbus Register
---	Phase Loss	"A27"	Bit 1, Reg 40025
---	No line	"noL"	Bit 2, Reg 40025
---	Stack Over Temperature	"A47"	Bit 10, Reg 40025

Figure 8a

FTA3120 using parallel drives for 300HP with Softstarter Bypass and Series 7000 Automatic Transfer Switch
Figure 9



FTA3100 75HP Single Drive with Across-the-line bypass
Figure 10

Mark II Electric Inputs

Input#	*Description*	*Pin*	*Gender*	*Signal*
1	User1	J3-12	M	ACin0
2	User2	J3-11	M	ACin1
3	User3	J3-10	M	ACin2
4	User4	J3-9	M	ACin3
5	User5	J3-8	M	ACin4
6	User6	J3-7	M	ACin5
7	User7	J3-6	M	ACin6
8	User8	J3-5	M	ACin7
9	CPU Tester Profile	J3-4	M	ACin8
10	Auto Start	J3-3	M	ACin9
11	Test Pushbutton	J3-2	M	ACin10
12	Cntrl Vac Present	J3-1	M	ACin11
13	Transfer Load Disconnect OP	J2-12	M	ACin12
14	Emergency Switch Off	J2-11	M	ACin13
15	Transfer to Emergency	J2-10	M	ACin14
16	Softstarter OverTemp	J2-9	M	ACin15
17	Softstarter Full Speed	J2-8	M	ACin16
18	Motor Accel	J2-7	M	ACin17
19	Deluge Open	J2-6	M	ACin18
20	Interlock	J2-5	M	ACin19
21	Manual Stop	J2-4	M	ACin20
22	Emergency Run	J2-3	M	ACin21
23	Remote Start	J2-2	M	ACin22
24	Local Start	J2-1	M	ACin23
	AC Input Return	J2-13	M	
	AC Input Return	J2-15	M	

FTA3100	Drive E-Stop
FTA3100	VFD Normal/Bypass Sw
FTA3100	Drive Ready

Figure 11

Mark II Electric Outputs									
Output#	***Description***		***Pin***	Gender	***Signal***				
1	Motor Run1 (1CR)		J4-1	F	ACout1				
2	Motor Run2 (6CR)		J4-2	F	ACout2				
3	Buzzer		J4-3	F	ACout3				
4	Alarm Relay		J4-4	F	ACout4				
5	User1		J4-5	F	ACout5				
6	User2		J4-6	F	ACout6				
7	User3		J4-7	F	ACout7	FTA3100	Over Pressure Alarm Relay		
8	User4		J4-8	F	ACout8				
9	User5		J4-9	F	ACout9	FTA3100	Drive Isolation Contactors		
10	User6		J4-10	F	ACout10	FTA3100	Drive Run		
11	User7		J4-11	F	ACout11	FTA3100	Drive Failure Alarm Relay		
12	User8		J4-12	F	ACout12	FTA3100	Bypass Active Alarm Relay		
13	Weekly Test Timer Solenoid		J5-3	M	ACout13				
14	Phase Reversal		J5-2	M	ACout14				
15	Phase Reversal		J5-4	M	ACout15NO				
15	Phase Reversal		J5-6	M	ACout15NC				
15	Phase Reversal		J5-5	M	ACout15COM				
16	Phase Failure		J5-9	M	ACout16NO				
16	Phase Failure		J5-8	M	ACout16NC				
	AC Common		J5-1	M					
	AC Common		J5-7	M					
ShuntTrip1			J6-1	M			**Figure 12**		
ShuntTrip1 Common			J6-2	M					
ShuntTrip2			J7-1	F					
ShuntTrip2 Common			J7-2	F					

N. Appendix

5 Getting Started

This chapter introduces the user interfaces, menu structure and security level of the drive.

5.1 Understanding the display

There are two keypads available for the Unidrive SP. The SM-Keypad has an LED display and the SM-Keypad Plus has an LCD display. Both keypads can be fitted to the drive but the SM-Keypad Plus can also be remotely mounted on an enclosure door.

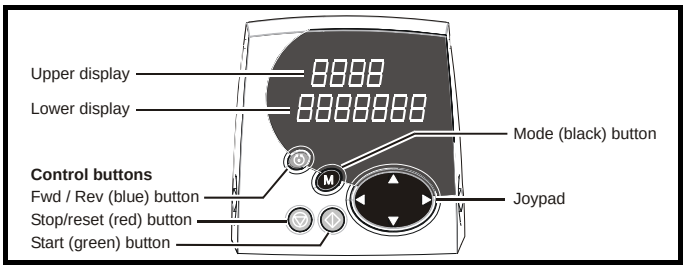
5.1.1 SM-Keypad (LED)

The display consists of two horizontal rows of 7 segment LED displays.

The upper display shows the drive status or the current menu and parameter number being viewed.

The lower display shows the parameter value or the specific trip type.

Figure 5-1 SM-Keypad



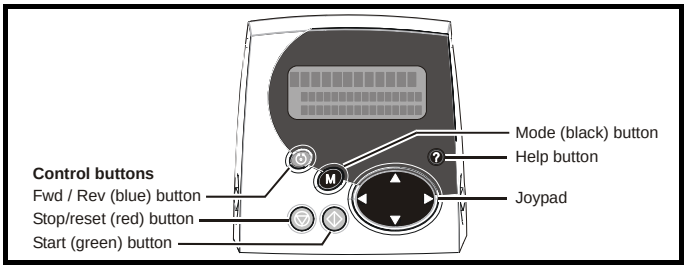
5.1.2 SM-Keypad Plus (LCD)

The display consists of three lines of text.

The top line shows the drive status or the current menu and parameter number being viewed on the left, and the parameter value or the specific trip type on the right.

The lower two lines show the parameter name or the help text.

Figure 5-2 SM-Keypad Plus



NOTE The red stop button is also used to reset the drive.

Both the SM-Keypad and the SM-Keypad Plus can indicate when a SMARTCARD access is taking place or when the second motor map is active (menu 21). These are indicated on the displays as follows.

	SM-Keypad	SM-Keypad Plus
SMARTCARD access taking place	The decimal point after the fourth digit in the upper display will flash.	The symbol 'CC' will appear in the lower left hand corner of the display
Second motor map active	The decimal point after the third digit in the upper display will flash.	The symbol 'Mot2' will appear in the lower left hand corner of the display

5.2 Keypad operation

5.2.1 Control buttons

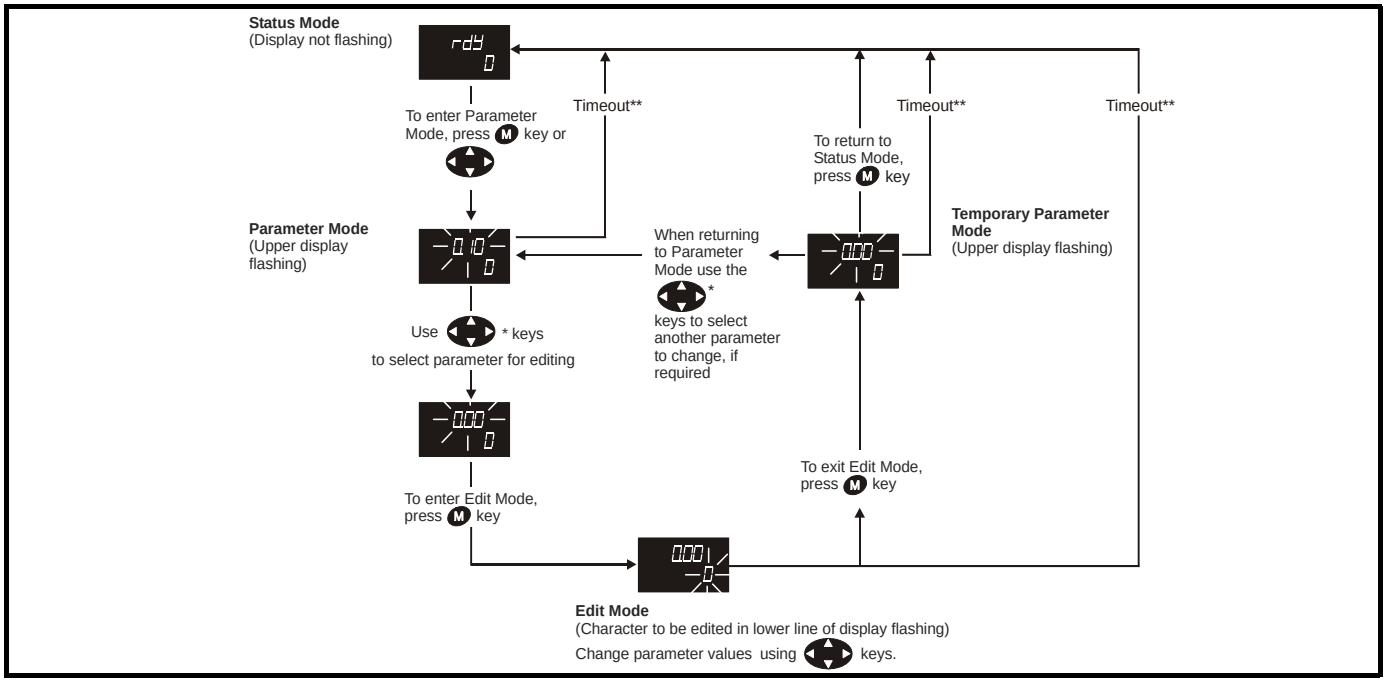
The keypad consists of:

1. Joypad - used to navigate the parameter structure and change parameter values.
2. Mode button - used to change between the display modes – parameter view, parameter edit, status.
3. Three control buttons - used to control the drive if keypad mode is selected.
4. Help button (SM-Keypad Plus only) - displays text briefly describing the selected parameter.

The Help button toggles between other display modes and parameter help mode. The up and down functions on the joypad scroll the help text to allow the whole string to be viewed. The right and left functions on the joypad have no function when help text is being viewed.

The display examples in this section show the SM-Keypad 7 segment LED display. The examples are the same for the SM-Keypad Plus except that the information displayed on the lower row on the SM-Keypad is displayed on the right hand side of the top row on the SM-Keypad Plus.

Figure 5-3 Display modes



* can only be used to move between menus if L2 access has been enabled (Pr **0.49**). Refer to section 5.9 on page 106.
Timeout defined by Pr **11.41 (default value = 240s).

Figure 5-4 Mode examples

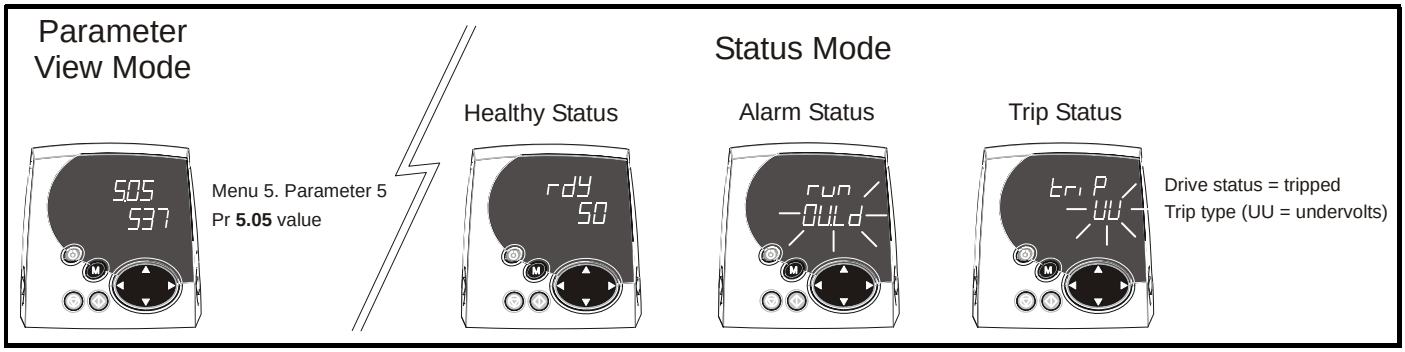
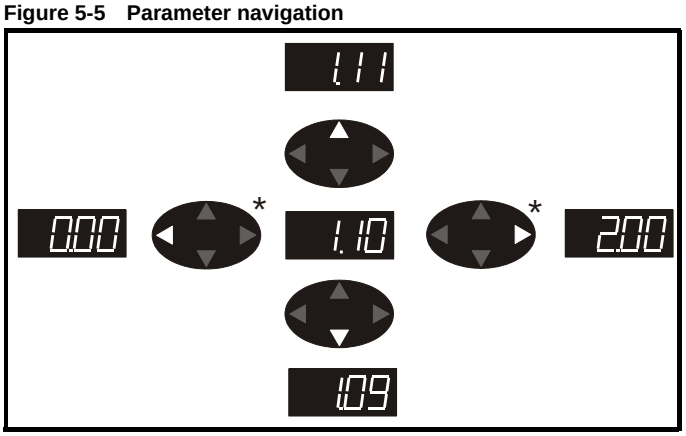


Figure 5-5 Parameter navigation



* can only be used to move between menus if L2 access has been enabled (Pr **0.49**). Refer to section 5.9 *Parameter access level and security* on page 106.

The menus and parameters roll over in both directions.

i.e. if the last parameter is displayed, a further press will cause the display to rollover and show the first parameter.

When changing between menus the drive remembers which parameter was last viewed in a particular menu and thus displays that parameter.

WARNING

Do not change parameter values without careful consideration; incorrect values may cause damage or a safety hazard.

NOTE

When changing the values of parameters, make a note of the new values in case they need to be entered again.

NOTE

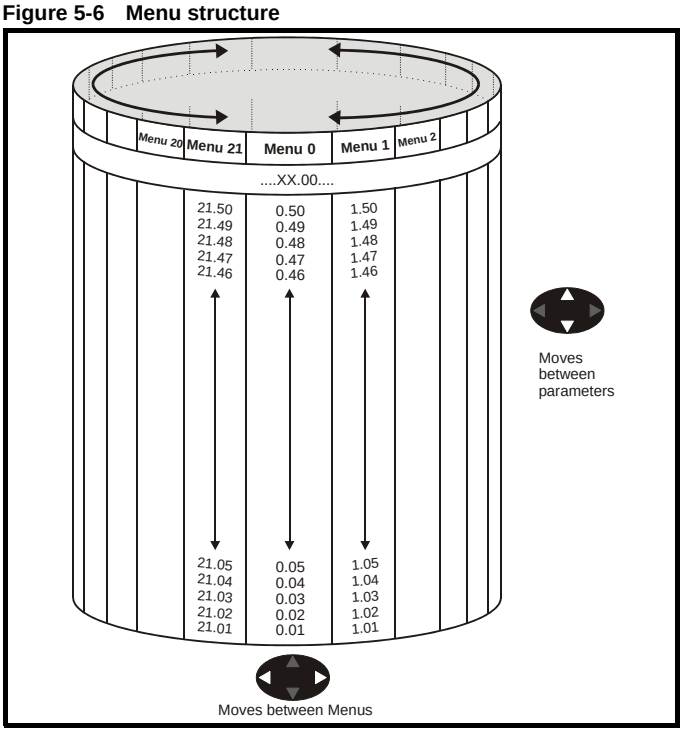
For new parameter-values to apply after the AC supply to the drive is interrupted, new values must be saved. Refer to section 5.7 *Saving parameters* on page 106.

5.3 Menu structure

The drive parameter structure consists of menus and parameters.

The drive initially powers up so that only menu 0 can be viewed. The up and down arrow buttons are used to navigate between parameters and once level 2 access (L2) has been enabled (see Pr **0.49**) the left and right buttons are used to navigate between menus. For further information, refer to section 5.9 *Parameter access level and security* on page 106.

Figure 5-6 Menu structure

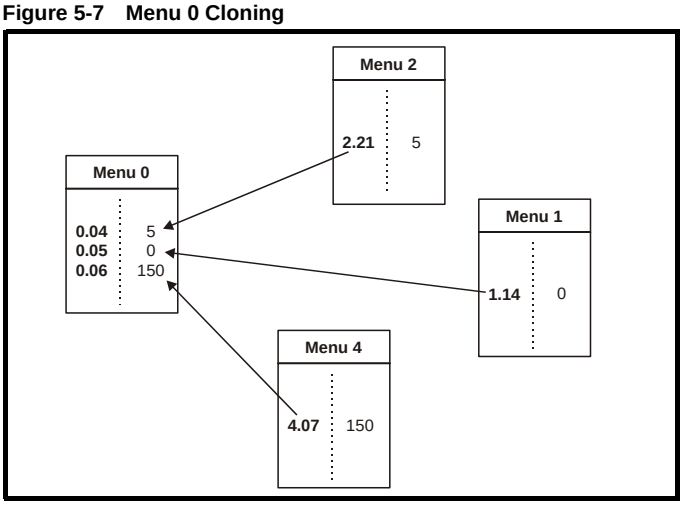


5.4 Menu 0

Menu 0 is used to bring together various commonly used parameters for basic easy set up of the drive.
Appropriate parameters are cloned from the advanced menus into menu 0 and thus exist in both locations.

For further information, refer to Chapter 6 *Basic parameters (Menu 0)* on page 109.

Figure 5-7 Menu 0 Cloning



5.5 Advanced menus

The advanced menus consist of groups or parameters appropriate to a specific function or feature of the drive. Menus 0 to 22 can be viewed on both keypads. Menus 40 and 41 are specific to the SM-Keypad Plus (LCD). Menus 70 to 91 can be viewed with an SM-Keypad Plus (LCD) only when an SM-Applications is fitted.

Menu	Description	LED	LCD
0	Commonly used basic set up parameters for quick / easy programming	✓	✓
1	Frequency / speed reference	✓	✓
2	Ramps	✓	✓
3	Slave frequency, speed feedback and speed control	✓	✓
4	Torque and current control	✓	✓
5	Motor control	✓	✓
6	Sequencer and clock	✓	✓
7	Analogue I/O	✓	✓
8	Digital I/O	✓	✓
9	Programmable logic, motorised pot and binary sum	✓	✓
10	Status and trips	✓	✓
11	General drive set-up	✓	✓
12	Threshold detectors and variable selectors	✓	✓
13	Position control	✓	✓
14	User PID controller	✓	✓
15, 16, 17	Solutions Module set-up	✓	✓
18	Application menu 1	✓	✓
19	Application menu 2	✓	✓
20	Application menu 3	✓	✓
21	Second motor parameters	✓	✓
22	Additional Menu 0 set-up	✓	✓
40	Keypad configuration menu	X	✓
41	User filter menu	X	✓
70	PLC registers	X	✓
71	PLC registers	X	✓
72	PLC registers	X	✓
73	PLC registers	X	✓
74	PLC registers	X	✓
75	PLC registers	X	✓
85	Timer function parameters	X	✓
86	Digital I/O parameters	X	✓
88	Status parameters	X	✓
90	General parameters	X	✓
91	Fast access parameters	X	✓

5.6 Changing the operating mode

Changing the operating mode returns all parameters to their default value, including the motor parameters. (Pr **0.49** *Security status* and Pr **0.34** *User security code* are not affected by this procedure.)

Procedure

Use the following procedure only if a different operating mode is required:

1. Ensure the drive is not enabled, i.e. terminal 31 is open or Pr **6.15** is Off (0)
2. Enter either of the following values in Pr **0.00**, as appropriate:
   1253 (Europe, 50Hz AC supply frequency)
   1254 (USA, 60Hz AC supply frequency)
3. Change the setting of Pr **0.48** as follows:

0.48 setting		Operating mode
	1	Open-loop
	2	Closed-loop Vector
	3	Closed-loop Servo
	4	Regen (See the *Unidrive SP Regen Installation Guide* for more information about operating in this mode)

The figures in the second column apply when serial communications are used.

4. Either:

- Press the red reset button
- Toggle the reset digital input
- Carry out a drive reset through serial communications by setting Pr **10.38** to 100 (ensure that Pr. **xx.00** returns to 0).

5.7 Saving parameters

When changing a parameter in Menu 0, the new value is saved when pressing the M Mode button to return to parameter view mode from parameter edit mode.

If parameters have been changed in the advanced menus, then the change will not be saved automatically. A save function must be carried out.

Procedure

Enter 1000* in Pr. **xx.00**

Either:

- Press the red reset button
- Toggle the reset digital input
- Carry out a drive reset through serial communications by setting Pr **10.38** to 100 (ensure that Pr. **xx.00** returns to 0).

*If the drive is in the under voltage trip state or is being supplied from a low voltage DC supply, a value of 1001 must be entered into Pr **xx.00** to perform a save function.

5.8 Restoring parameter defaults

Restoring parameter defaults by this method saves the default values in the drive's memory. (Pr **0.49** and Pr **0.34** are not affected by this procedure.)

Procedure

1. Ensure the drive is not enabled, i.e. terminal 31 is open or Pr **6.15** is Off (0)
2. Enter 1233 (EUR 50Hz settings) or 1244 (USA 60Hz settings) in Pr **xx.00**.
3. Either:

- Press the red reset button
- Toggle the reset digital input
- Carry out a drive reset through serial communications by setting Pr **10.38** to 100 (ensure that Pr. **xx.00** returns to 0).

5.9 Parameter access level and security

The parameter access level determines whether the user has access to menu 0 only or to all the advanced menus (menus 1 to 21) in addition to menu 0.

The User Security determines whether the access to the user is read only or read write.

Both the User Security and Parameter Access Level can operate independently of each other as shown in the table below:

Parameter Access Level	User Security	Menu 0 status	Advanced menus status
L1	Open	RW	Not visible
L1	Closed	RO	Not visible
L2	Open	RW	RW
L2	Closed	RO	RO

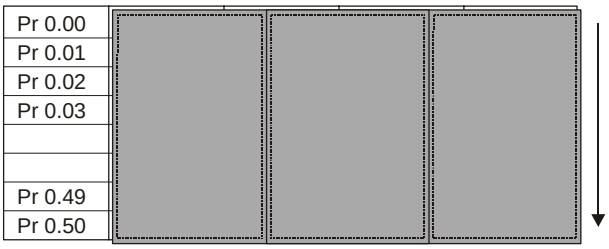
RW = Read / write access RO = Read only access

The default settings of the drive are Parameter Access Level L1 and user Security Open, i.e. read / write access to Menu 0 with the advanced menus not visible.

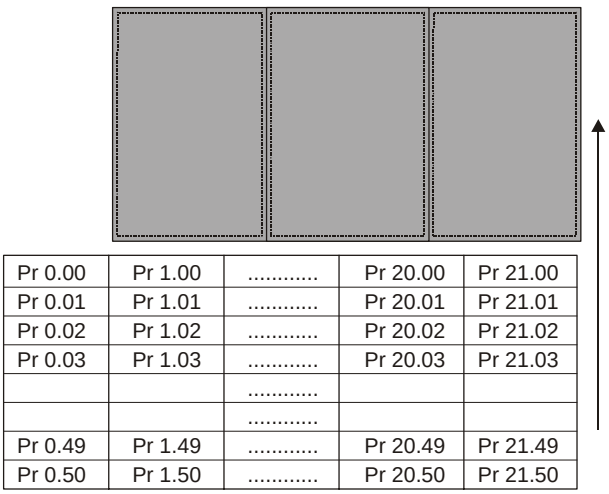
5.9.1 Access Level

The access level is set in Pr **0.49** and allows or prevents access to the advanced menu parameters.

L1 access selected - Menu 0 only visible



L2 access selected - All parameters visible



Pr 0.00	Pr 1.00	.....	Pr 20.00	Pr 21.00
Pr 0.01	Pr 1.01	.....	Pr 20.01	Pr 21.01
Pr 0.02	Pr 1.02	.....	Pr 20.02	Pr 21.02
Pr 0.03	Pr 1.03	.....	Pr 20.03	Pr 21.03
		.....		
		.....		
Pr 0.49	Pr 1.49	.....	Pr 20.49	Pr 21.49
Pr 0.50	Pr 1.50	.....	Pr 20.50	Pr 21.50

5.9.2 Changing the Access Level

The Access Level is determined by the setting of Pr **0.49** as follows:

String	Value	Effect
L1	0	Access to menu 0 only
L2	1	Access to all menus (menu 0 to menu 21)

The Access Level can be changed through the keypad even if the User Security has been set.

6 Basic parameters (Menu 0)

Menu 0 is used to bring together various commonly used parameters for basic easy set up of the drive. All the parameters in menu 0 appear in other menus in the drive (denoted by {…}).

Menus 11 and 22 can be used to change most of the parameters in menu 0. Menu 0 can also contain up to 59 parameters by setting up menu 22.

6.1 Single line descriptions

Parameter			Range(⇳)			Default(⇨)			Type					
			OL	VT	SV	OL	VT	SV						
0.00	**xx.00**	{**x.00**}	0 to 32,767			0			RW	Uni				
0.01	Minimum reference clamp	{**1.07**}	±3,000.0Hz	±SPEED_LIMIT_MAX Hz/rpm		0.0			RW	Bi			PT	US
0.02	Maximum reference clamp	{**1.06**}	0 to 3,000.0Hz	SPEED_LIMIT_MAX Hz/rpm		EUR> 50.0 USA> 60.0	EUR> 1,500.0 USA> 1800.0	3,000.0	RW	Uni				US
0.03	Acceleration rate	{**2.11**}	0.0 to 3,200.0 s/100Hz	0.000 to 3,200.000 s/1,000rpm		5.0	2.000	0.200	RW	Uni				US
0.04	Deceleration rate	{**2.21**}	0.0 to 3,200.0 s/100Hz	0.000 to 3,200.000 s/1,000rpm		10.0	2.000	0.200	RW	Uni				US
0.05	Reference select	{**1.14**}	A1.A2 (0), A1.Pr (1), A2.Pr (2), Pr (3), PAd (4), Prc (5)			A1.A2 (0)			RW	Txt		NC		US
0.06	Current limit	{**4.07**}	0 to Current_limit_max %			165.0	175.0		RW	Uni		RA		US
0.07	OL> Voltage mode select	{**5.14**}	Ur_S (0), Ur (1), Fd (2), Ur_Auto (3), Ur_I (4), SrE (5)			Ur_I (4)			RW	Txt				US
	CL> Speed controller P gain	{**3.10**}		0.0000 to 6.5535 1/rad s^{-1}			0.0100		RW	Uni				US
0.08	OL> Voltage boost	{**5.15**}	0.0 to 25.0% of motor rated voltage			Size 1 to 3: 3.0 Size 4 & 5: 2.0 Size 6: 1.0			RW	Uni				US
	CL> Speed controller I gain	{**3.11**}		0.00 to 655.35 1/rad			1.00		RW	Uni				US
0.09	OL> Dynamic V/F	{**5.13**}	OFF (0) or On (1)			0			RW	Bit				US
	CL> Speed controller D gain	{**3.12**}		0.00000 to 0.65535 (s)			0.00000		RW	Uni				US
0.10	OL> Estimated motor speed	{**5.04**}	±180,000 rpm						RO	Bi	FI	NC	PT	
	CL> Motor speed	{**3.02**}		±Speed_max rpm					RO	Bi	FI	NC	PT	
0.11	OL & VT> Drive output frequency	{**5.01**}	±Speed_freq_max Hz						RO	Bi	FI	NC	PT	
	SV> Drive encoder position	{**3.29**}			0 to 65,535 $1/2^{16}$ths of a revolution				RO	Uni	FI	NC	PT	
0.12	Total motor current	{**4.01**}	0 to Drive_current_max A						RO	Uni	FI	NC	PT	
0.13	OL & VT> Motor active current	{**4.02**}	±Drive_current_max A						RO	Bi	FI	NC	PT	
	SV> Analogue input 1 offset trim	{**7.07**}			±10.000 %			0.000	RW	Bi				US
0.14	Torque mode selector	{**4.11**}	0 to 1	0 to 4		Speed control mode (0)			RW	Uni				US
0.15	Ramp mode select	{**2.04**}	FASt (0) Std (1) Std.hV (2)	FASt (0) Std (1)		Std (1)			RW	Txt				US
0.16	OL> T28 and T29 auto-selection disable	{**8.39**}	OFF (0) or On (1)			0			RW	Bit				US
	CL> Ramp enable	{**2.02**}		OFF (0) or On (1)			On (1)		RW	Bit				US
0.17	OL> T29 digital input destination	{**8.26**}	Pr **0.00** to Pr **21.51**			Pr **6.31**			RW	Uni	DE		PT	US
	CL> Current demand filter time constant	{**4.12**}		0.0 to 25.0 ms			0.0		RW	Uni				US
0.18	Positive logic select	{**8.29**}	OFF (0) or On (1)			On (1)			RW	Bit			PT	US
0.19	Analogue input 2 mode	{**7.11**}	0-20 (0), 20-0 (1), 4-20tr (2), 20-4tr (3), 4-20 (4), 20-4 (5), VOLt (6)			VOLt (6)			RW	Txt				US
0.20	Analogue input 2 destination	{**7.14**}	Pr **0.00** to Pr **21.51**			Pr **1.37**			RW	Uni	DE		PT	US
0.21	Analogue input 3 mode	{**7.15**}	0-20 (0), 20-0 (1), 4-20tr (2), 20-4tr (3), 4-20 (4), 20-4 (5), VOLt (6), th.SC (7), th (8), th.diSp (9)			th (8)			RW	Txt			PT	US
0.22	Bipolar reference select	{**1.10**}	OFF (0) or On (1)			OFF (0)			RW	Bit				US
0.23	Jog reference	{**1.05**}	0 to 400.0 Hz	0 to 4000.0 rpm		0.0			RW	Uni				US
0.24	Pre-set reference 1	{**1.21**}	±Speed_limit_max rpm			0.0			RW	Bi				US
0.25	Pre-set reference 2	{**1.22**}	±Speed_limit_max rpm			0.0			RW	Bi				US
0.26	OL> Pre-set reference 3	{**1.23**}	±Speed_freq_ max Hz/rpm			0.0			RW	Bi				US
	CL> Overspeed threshold	{**3.08**}		0 to 40,000 rpm			0		RW	Uni				US
0.27	OL> Pre-set reference 4	{**1.24**}	±Speed_freq_ max Hz/rpm			0.0			RW	Bi				US
	CL> Drive encoder lines per revolution	{**3.34**}		0 to 50,000			1024	4096	RW	Uni				US
0.28	Keypad fwd/rev key enable	{**6.13**}	OFF (0) or On (1)			OFF (0)			RW	Bit				US

Parameter			Range(⇳)			Default(⇨)			Type					
			OL	VT	SV	OL	VT	SV						
0.29	SMARTCARD parameter data	{**11.36**}	0 to 999			0			RO	Uni		NC	PT	US
0.30	Parameter cloning	{**11.42**}	nonE (0), rEAd (1), Prog (2), AutO (3), boot (4)			nonE (0)			RW	Txt		NC		*
0.31	Drive rated voltage	{**11.33**}	200 (0), 400 (1), 575 (2), 690 (3) V						RO	Txt		NC	PT	
0.32	Drive rated current	{**11.32**}	0.00 to 9999.99A						RO	Uni		NC	PT	
0.33	OL> Catch a spinning motor	{**6.09**}	0 to 3			0			RW	Uni				US
	VT> Rated rpm autotune	{**5.16**}		0 to 2			0		RW	Uni				US
0.34	User security code	{**11.30**}	0 to 999			0			RW	Uni		NC	PT	PS
0.35	Serial comms mode	{**11.24**}	AnSI (0), rtu (1), Lcd (2)			rtU (1)			RW	Txt				US
0.36	Serial comms baud rate	{**11.25**}	300 (0), 600 (1), 1200 (2), 2400 (3), 4800 (4), 9600 (5), 19200 (6), 38400 (7), 57600 (8) Modbus RTU only, 115200 (9) Modbus RTU only			19200 (6)			RW	Txt				US
0.37	Serial comms address	{**11.23**}	0 to 247			1			RW	Uni				US
0.38	Current loop P gain	{**4.13**}	0 to 30,000			All voltage ratings: 20	200V drive: 75 400V drive: 150 575V drive: 180 690V drive: 215		RW	Uni				US
0.39	Current loop I gain	{**4.14**}	0 to 30,000			All voltage ratings 40	200V drive: 1000 400V drive: 2000 575V drive: 2400 690V drive: 3000		RW	Uni				US
0.40	Autotune	{**5.12**}	0 to 2	0 to 4	0 to 6	0			RW	Uni				
0.41	Maximum switching frequency	{**5.18**}	3 (0), 4 (1), 6 (2), 8 (3), 12 (4), 16 (5) kHz			3 (0)		6 (2)	RW	Txt		RA		US
0.42	No. of motor poles	{**5.11**}	0 to 60 (Auto to 120 pole)			0 (Auto)		6 POLE (3)	RW	Txt				US
0.43	OL & VT> Motor rated power factor	{**5.10**}	0.000 to 1.000			0.850			RW	Uni				US
	SV> Encoder phase angle	{**3.25**}			0.0 to 359.9°			0.0	RW	Uni				US
0.44	Motor rated voltage	{**5.09**}	0 to AC_voltage_set_max V			200V drive: 230 400V drive: EUR> 400, USA> 460 575V drive: 575 690V drive: 690			RW	Uni		RA		US
0.45	OL & VT> Motor rated full load speed (rpm)	{**5.08**}	0 to 180,000 rpm	0.00 to 40,000.00 rpm		EUR> 1,500 USA> 1,800	EUR> 1,450.00 USA> 1,770.00		RW	Uni				US
	SV> Motor thermal time constant	{**4.15**}			0.0 to 3000.0			20.0	RW	Uni				US
0.46	Motor rated current	{**5.07**}	0 to Rated_current_max A			Drive rated current [**11.32**]			RW	Uni		RA		US
0.47	Rated frequency	{**5.06**}	0 to 3,000.0 Hz	0 to 1,250.0 Hz		EUR> 50.0 USA> 60.0			RW	Uni				US
0.48	Operating mode selector	{**11.31**}	OPEn LP (1), CL VECt (2), SErVO (3), rEgEn (4)			OPEn LP (1)	CL VECt (2)	SErVO (3)	RW	Txt		NC	PT	
0.49	Security status	{**11.44**}	L1 (0), L2 (1), Loc (2)						RW	Txt			PT	US
0.50	Software version	{**11.29**}	1.00 to 99.99						RO	Uni		NC	PT	

* Modes 1 and 2 are not user saved, Modes 0, 3 and 4 are user saved

Key:

Coding	Attribute
OL	Open loop
CL	Closed loop vector and Servo
VT	Closed loop vector
SV	Servo
{X.XX}	Cloned advanced parameter
RW	Read/write: can be written by the user
RO	Read only: can only be read by the user
Bit	1 bit parameter: 'On' or 'OFF' on the display
Bi	Bipolar parameter
Uni	Unipolar parameter
Txt	Text: the parameter uses text strings instead of numbers.
FI	Filtered: some parameters which can have rapidly changing values are filtered when displayed on the drive keypad for easy viewing.
DE	Destination: This parameter selects the destination of an input or logic function.

Coding	Attribute
RA	Rating dependant: this parameter is likely to have different values and ranges with drives of different voltage and current ratings. This parameters is not transferred by SMARTCARDs when the rating of the destination drive is different from the source drive.
NC	Not cloned: not transferred to or from SMARTCARDs during cloning.
PT	Protected: cannot be used as a destination.
US	User save: parameter saved in drive EEPROM when the user initiates a parameter save.
PS	Power-down save: parameter automatically saved in drive EEPROM when the under volts (UV) trip occurs. With software version V01.08.00 and later, power-down save parameters are also saved in the drive when the user initiates a parameter save.

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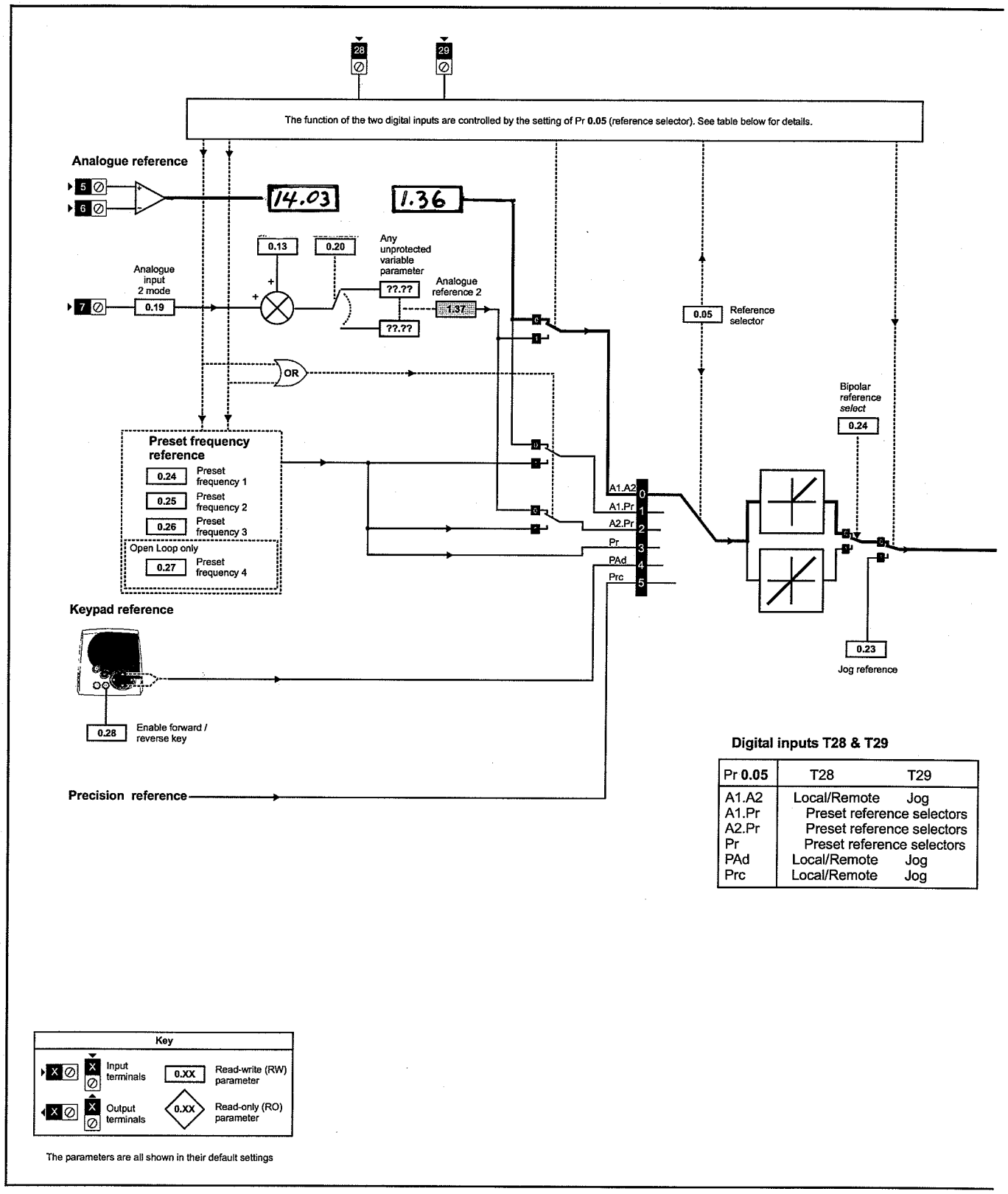
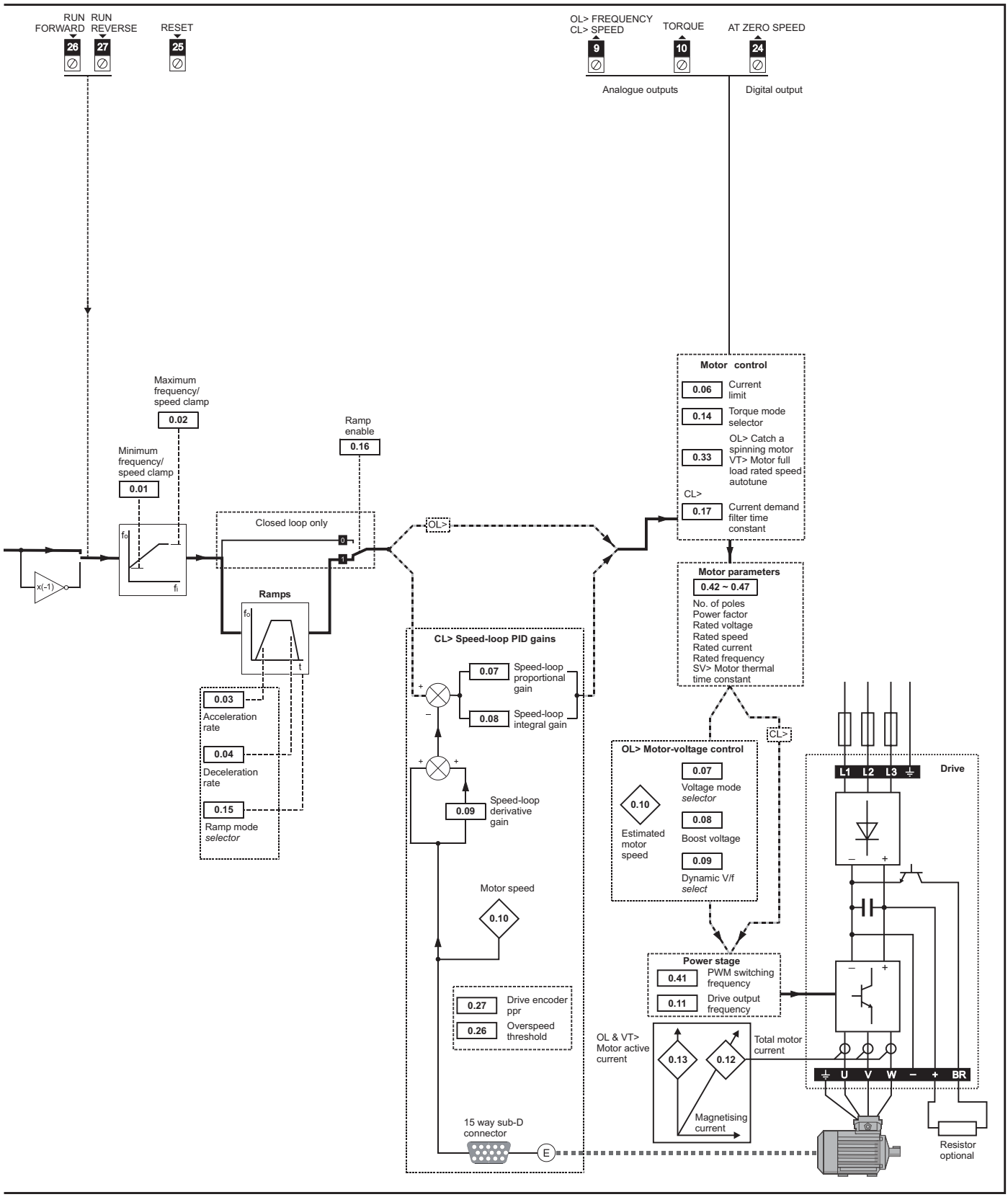
Figure 6-1 Menu 0 logic diagram



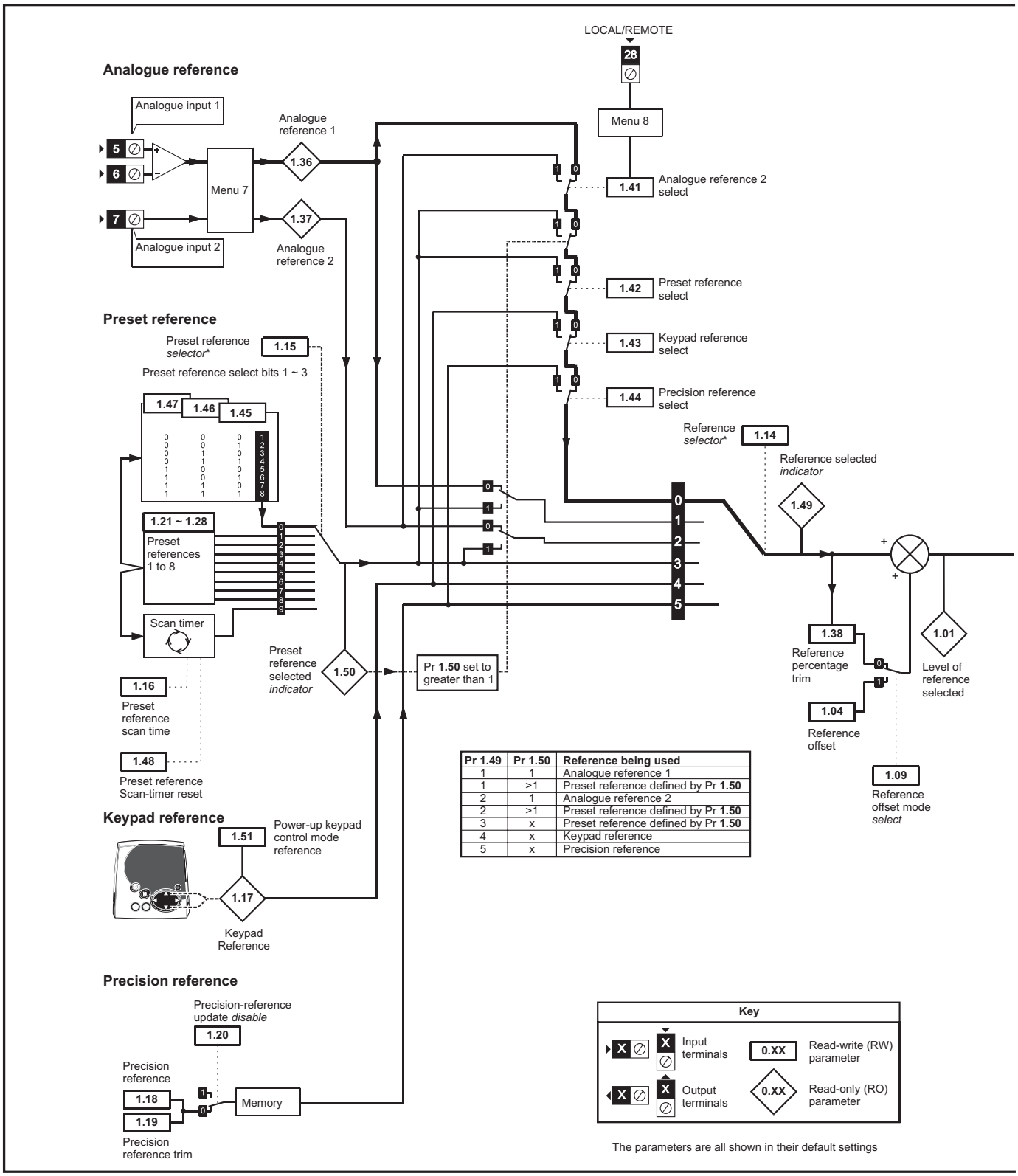
Digital inputs T28 & T29

Pr **0.05**	T28	T29
A1.A2	Local/Remote	Jog
A1.Pr	Preset reference selectors	
A2.Pr	Preset reference selectors	
Pr	Preset reference selectors	
PAd	Local/Remote	Jog
Prc	Local/Remote	Jog


RUN FORWARD
26
RUN REVERSE
27
RESET
25
OL> FREQUENCY
CL> SPEED
9
TORQUE
10
AT ZERO SPEED
24
Analogue outputs
Digital output
Motor control
0.06 Current limit
0.14 Torque mode selector
0.33 OL> Catch a spinning motor VT> Motor full load rated speed autotune
CL>
0.17 Current demand filter time constant
Maximum frequency/ speed clamp
0.02
Minimum frequency/ speed clamp
0.01
Ramp enable
0.16
Closed loop only
OL>
Ramps
0.03 Acceleration rate
0.04 Deceleration rate
0.15 Ramp mode selector
Motor parameters
0.42 ~ 0.47
No. of poles
Power factor
Rated voltage
Rated speed
Rated current
Rated frequency
SV> Motor thermal time constant
CL> Speed-loop PID gains
0.07 Speed-loop proportional gain
0.08 Speed-loop integral gain
0.09 Speed-loop derivative gain
Motor speed
0.10
0.27 Drive encoder ppr
0.26 Overspeed threshold
15 way sub-D connector
OL> Motor-voltage control
0.07 Voltage mode selector
0.08 Boost voltage
0.09 Dynamic V/f select
0.10 Estimated motor speed
Power stage
0.41 PWM switching frequency
0.11 Drive output frequency
OL & VT> Motor active current
0.13
0.12
Total motor current
Magnetising current
Drive
L1 L2 L3
U V W BR
Resistor optional

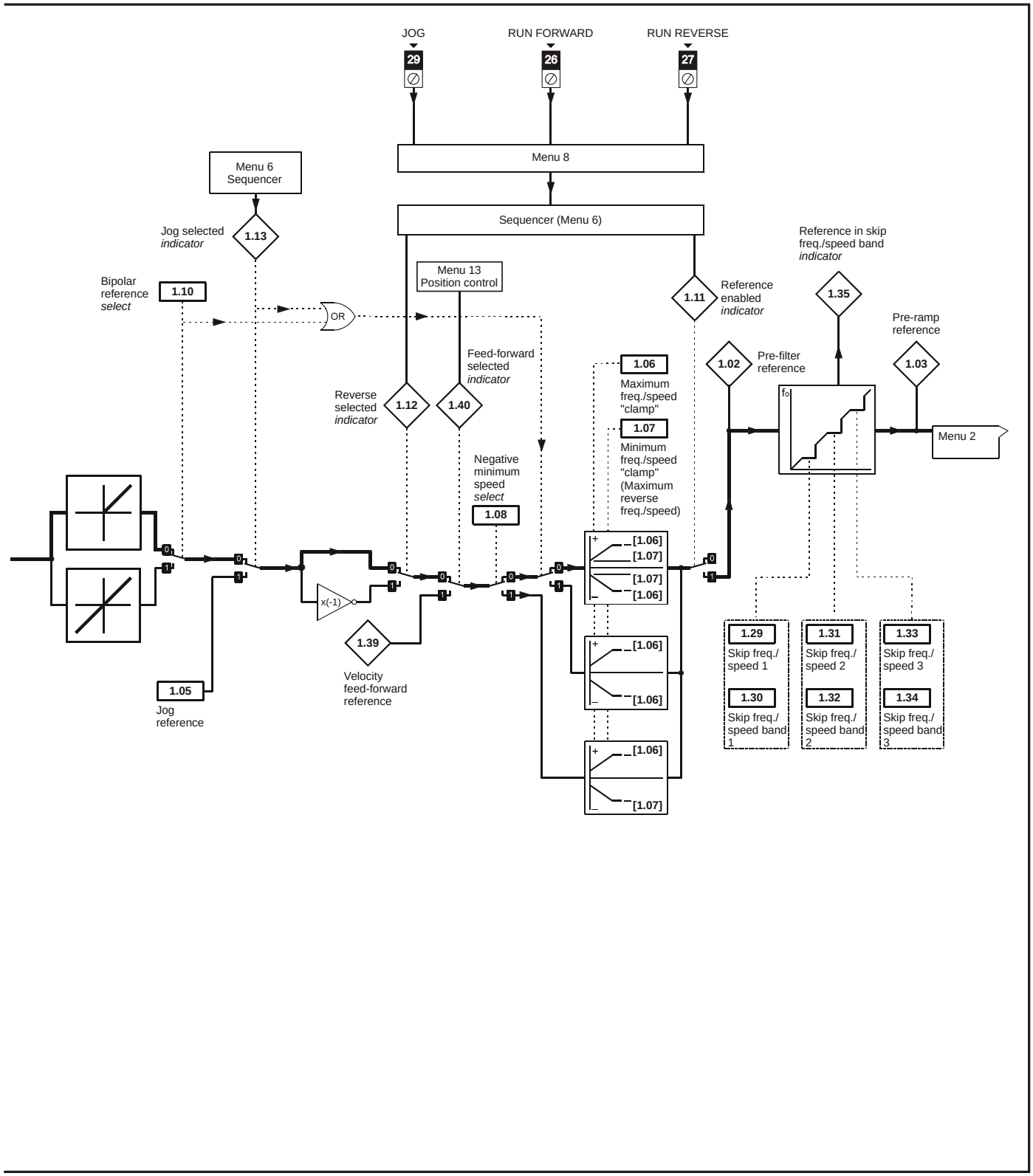
11.1 Menu 1: Frequency / speed reference

Figure 11-1 Menu 1 logic diagram



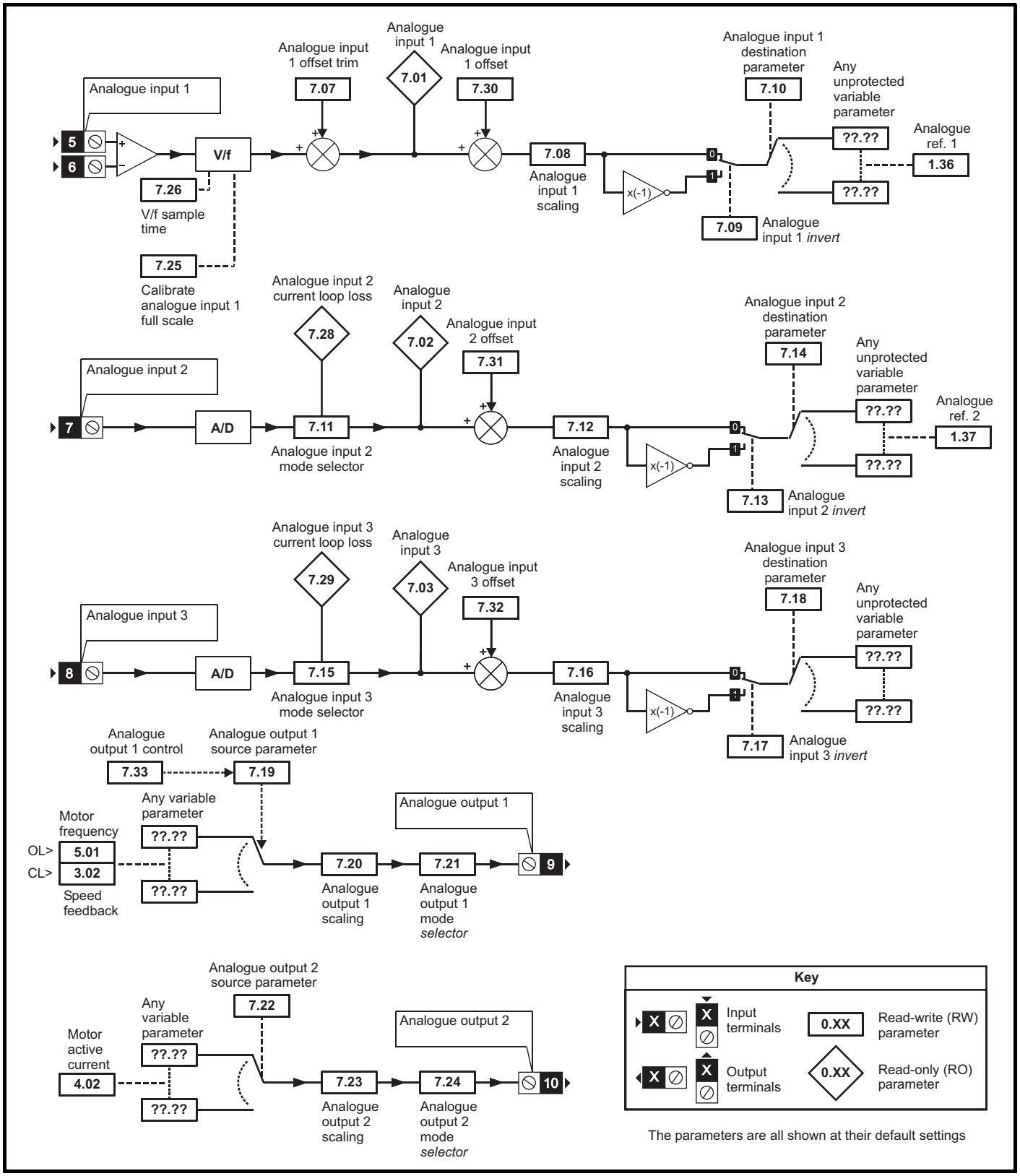
Pr 1.49	Pr 1.50	Reference being used
1	1	Analogue reference 1
1	>1	Preset reference defined by Pr **1.50**
2	1	Analogue reference 2
2	>1	Preset reference defined by Pr **1.50**
3	x	Preset reference defined by Pr **1.50**
4	x	Keypad reference
5	x	Precision reference

*For more information, refer to section 11.21.1 *Reference modes* on page 248.


JOG
RUN FORWARD
RUN REVERSE
29
26
27
Menu 8
Menu 6 Sequencer
Sequencer (Menu 6)
Jog selected indicator
1.13
Menu 13 Position control
Reference in skip freq./speed band indicator
Bipolar reference select
1.10
OR
1.11
Reference enabled indicator
1.35
Pre-ramp reference
1.03
1.02
Pre-filter reference
Feed-forward selected indicator
1.06
Maximum freq./speed "clamp"
Reverse selected indicator
1.12
1.40
1.07
Minimum freq./speed "clamp" (Maximum reverse freq./speed)
Menu 2
Negative minimum speed select
1.08
[1.06]
[1.07]
x(-1)
1.39
Velocity feed-forward reference
1.05
Jog reference
1.29
Skip freq./ speed 1
1.30
Skip freq./ speed band 1
1.31
Skip freq./ speed 2
1.32
Skip freq./ speed band 2
1.33
Skip freq./ speed 3
1.34
Skip freq./ speed band 3

11.7 Menu 7: Analogue I/O

Figure 11-11 Menu 7 logic diagram



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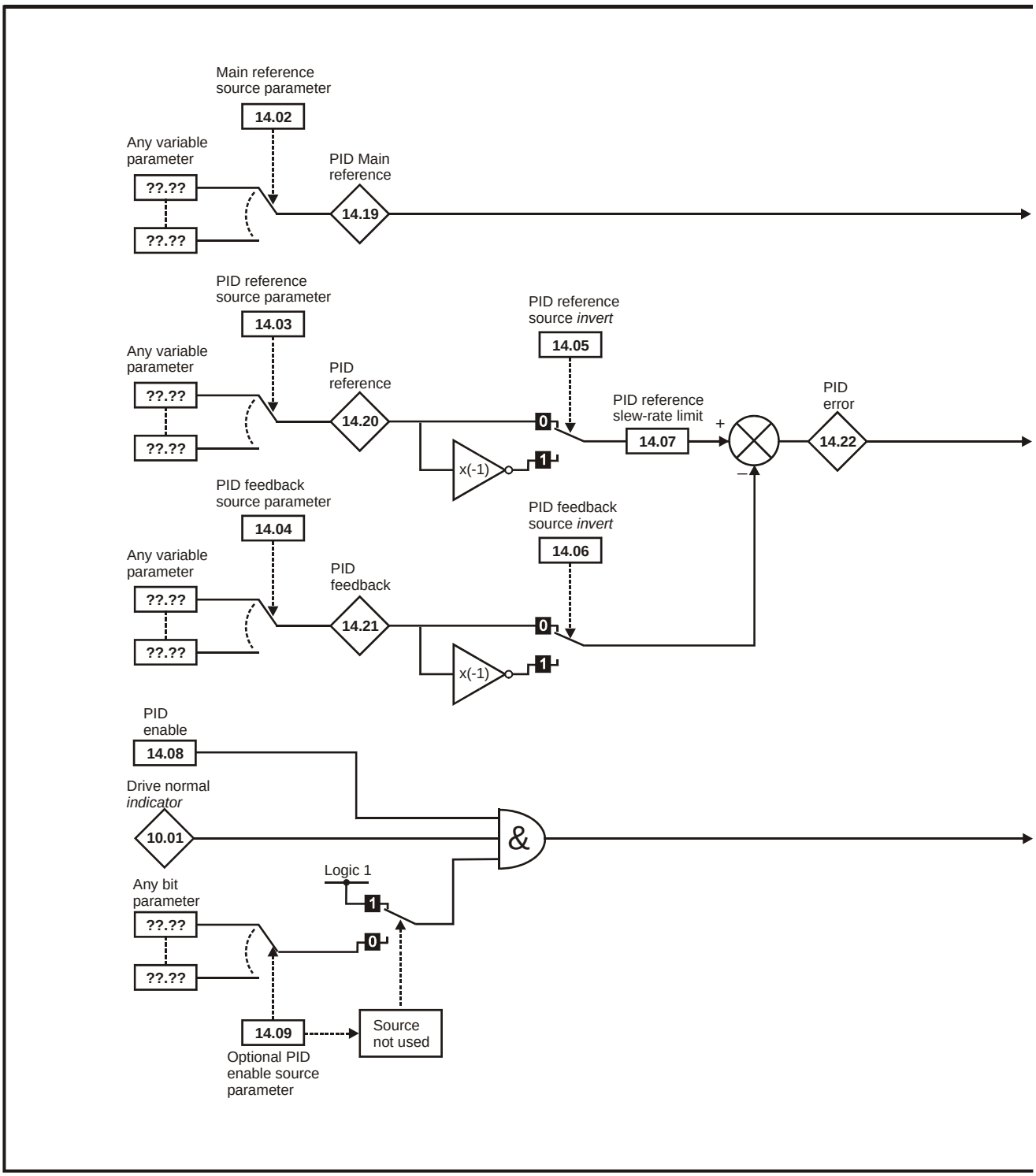
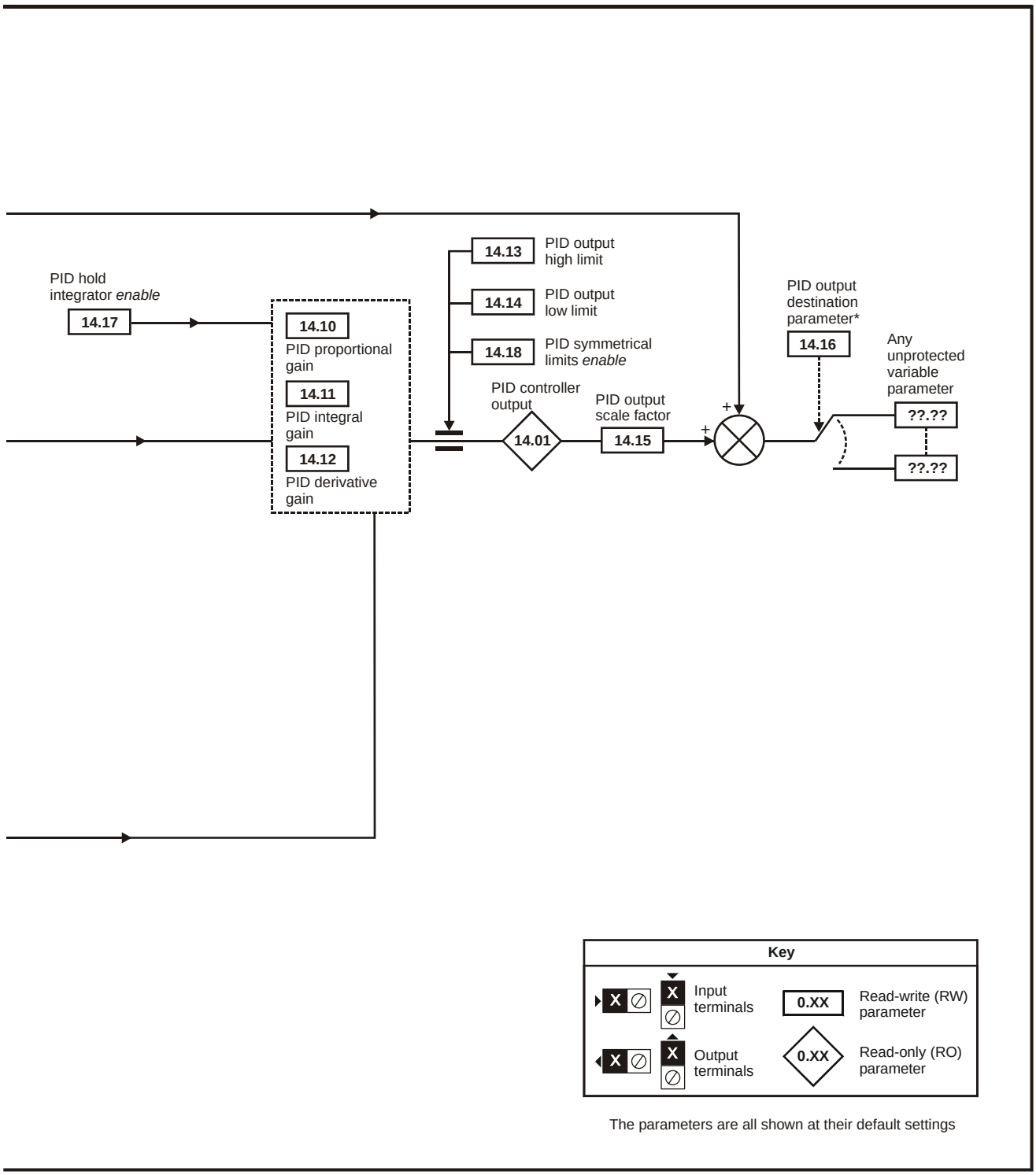
11.14 Menu 14: User PID controller

Figure 11-22 Menu 14 Logic diagram





The parameters are all shown at their default settings

*The PID controller is only enabled if Pr **14.16** is set to a non Pr **xx.00** and unprotected destination parameter.

Parameter			Range(⇳)		Default(⇨)			Type					
			OL	CL	OL	VT	SV						
5.01	Output frequency	{**0.11**}	±SPEED_FREQ_MAX Hz	±1,250.0 Hz				RO	Bi	FI	NC	PT	
5.02	Output voltage		0 to AC_voltage_max V					RO	Uni	FI	NC	PT	
5.03	Output power		±Power_max kW					RO	Bi	FI	NC	PT	
5.04	Motor rpm	{**0.10**}	±180,000 rpm					RO	Bi	FI	NC	PT	
5.05	D.C bus voltage		0 to +DC_voltage_max V					RO	Uni	FI	NC	PT	
5.06	Rated frequency	{**0.47**}	0 to 3,000 Hz	VT> 0 to 1,250.0 Hz	EUR> 50.0, USA> 60.0			RW	Uni				US
5.07	Motor rated current	{**0.46**}	0 to Rated_current_max A		Drive rated current [**11.32**]			RW	Uni		RA		US
5.08	Rated load rpm / rated speed	{**0.45**}	0 to 180,000 rpm	0.00 to 40,000.00 rpm	EUR> 1,500 USA> 1,800	EUR> 1,450.00 USA> 1,770.00	3,000.00	RW	Uni				US
5.09	Rated voltage	{**0.44**}	0 to AC_VOLTAGE_SET_MAX V		200V drive: 230 400V drive: EUR> 400 USA> 460 575V drive: 575 690V drive: 690			RW	Uni		RA		US
5.10	Rated power factor	{**0.43**}	OL & VT> 0.000 to 1.000		0.850			RW	Uni		RA		US
5.11	Number of motor poles	{**0.42**}	Auto to 120 Pole (0 to 60)		Auto (0)		6 POLE (3)	RW	Txt				US
5.12	Autotune	{**0.40**}	0 to 2	VT> 0 to 4 SV> 0 to 6	0			RW	Uni		NC		
5.13	Dynamic V/F / flux optimise select	{**0.09**}	OFF (0) or On (1)	VT> OFF (0) or On (1)	OFF (0)			RW	Bit				US
5.14	Voltage mode select	{**0.07**}	Ur_S (0), Ur (1), Fd (2), Ur_Auto (3), Ur_I (4), SrE (5)		Ur_I (4)			RW	Txt				US
	Action on enable			SV> nonE (0), Ph EnL (1), Ph Init (2)			nonE(0)	RW	Txt				US
5.15	Low frequency voltage boost	{**0.08**}	0.0 to 25.0 % of motor rated voltage		3.0	1.0		RW	Uni				US
5.16	Rated rpm autotune	{**0.33**}		VT> 0 to 2		0		RW	Uni				US
5.17	Stator resistance		Size 1 to 5: 0.000 to 65.000 Ω Size 6: 0.000 to 65.000 x 10 mΩ		0.0			RW	Uni		RA		US
5.18	Maximum switching frequency	{**0.41**}	3 (0), 4 (1), 6 (2), 8 (3), 12 (4), 16 (5) kHz		3 (0)		6 (2)	RW	Txt		RA		US
5.19	High stability space vector modulation		OFF (0) or On (1)		OFF (0)			RW	Bit				US
5.20	Quasi-square enable		OFF (0) or On (1)		OFF (0)			RW	Bit				US
5.21	Field gain reduction			OFF (0) or On (1)		OFF (0)		RW	Bit				US
5.22	High speed servo mode enable			SV> OFF (0) or On (1)			0	RW	Bit				US
5.23	Voltage offset		0.0 to 25.0 V		0.0			RW	Uni		RA		US
5.24	Transient inductance (σL_s)		0.000 to 500.000 mH		0.000			RW	Uni		RA		US
5.25	Stator inductance (L_s)			VT> 0.00 to 5,000.00 mH		0.00		RW	Uni		RA		US
5.26	High dynamic performance enable			OFF (0) or On (1)		OFF (0)		RW	Bit				US
5.27	Enable slip compensation		OFF (0) or On (1)		On (1)			RW	Bit				US
5.28	Field weakening compensation disable			VT> OFF (0) or On (1)		OFF (0)		RW	Bit				US
5.29	Motor saturation breakpoint 1			VT> 0 to 100% of rated flux		50		RW	Uni				US
5.30	Motor saturation breakpoint 2			VT> 0 to 100% of rated flux		75		RW	Uni				US
5.31	Voltage controller gain		0 to 30		1			RW	Uni				US
5.32	Motor torque per amp, K_t			VT> 0.00 to 500.00 N m A^{-1}				RO	Uni				US
				SV> 0.00 to 500.00 N m A^{-1}			1.60	RW	Uni				US
5.33	Motor volts per 1,000 rpm, K_e			SV> 0 to 10,000 V			98	RW	Uni				US
5.35	Disable auto switching frequency change		OFF (0) or On (1)		OFF (0)			RW	Bit				US
5.36	Motor pole pitch		0 to 655.35 mm		0.00			RW	Uni				US
5.37	Actual switching frequency		3 (0), 4 (1), 6 (2), 8 (3), 12 (4), 16 (5), 6 rEd (6), 12 rEd (7)					RO	Txt		NC	PT	
5.38	Minimal movement phasing test angle			SV> 0.0 to 25.5°			5.0	RW	Uni				US
5.39	Minimal movement phasing test pulse length			SV> 0 to 3			0	RW	Uni				US
5.40	Spin start boost		0.0 to 10.0	VT> 0.0 to 10.0	1.0			RW	Uni				US

RW	Read / Write	RO	Read only	Uni	Unipolar	Bi	Bi-polar	Bit	Bit parameter	Txt	Text string		
FI	Filtered	DE	Destination	NC	Not cloned	RA	Rating dependent	PT	Protected	US	User save	PS	Power down save

Parameter		Range(⇳)		Default(⇨)			Type					
		OL	CL	OL	VT	SV						
6.01	Stop mode	COASt (0), rP (1), rP.dcl (2), dcl (3), td.dcl (4), diSAbLE (5)	COASt (0), rP (1), no.rP (2)	rP (1)		no.rP (2)	RW	Txt				US
6.03	Mains loss mode	diS (0), StoP (1), ridE.th (2)		diS (0)			RW	Txt				US
6.04	Start / stop logic select	0 to 4		4			RW	Uni				US
6.06	Injection braking level	0 to 150.0%		100.0%			RW	Uni		RA		US
6.07	Injection braking time	0.0 to 25.0s		1.0			RW	Uni				US
6.08	Hold zero speed	OFF (0) or On (1)		OFF (0)		On (1)	RW	Bit				US
6.09	Catch a spinning motor {**0.33**}	0 to 3	0 to 1	0	1		RW	Uni				US
6.12	Enable stop key	OFF (0) or On (1)		OFF (0)			RW	Bit				US
6.13	Enable forward / reverse key {**0.28**}	OFF (0) or On (1)		OFF (0)			RW	Bit				US
6.15	Drive enable	OFF (0) or On (1)		On (1)			RW	Bit				US
6.16	Electricity cost per kWh	0.0 to 600.0 currency units per kWh		0			RW	Uni				US
6.17	Reset energy meter	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
6.18	Time between filter changes	0 to 30,000 hrs		0			RW	Uni				US
6.19	Filter change required / change done	OFF (0) or On (1)		OFF (0)			RW	Bit			PT	
6.20	Powered-up time: years.days	0 to 9.364 years.days					RW	Uni		NC	PT	
6.21	Powered-up time: hours.minutes	0 to 23.59 hours.minutes					RW	Uni		NC	PT	
6.22	Run time: years.days	0 to 9.364 years.days					RO	Uni		NC	PT	PS
6.23	Run time: hours.minutes	0 to 23.59 hours.minutes					RO	Uni		NC	PT	PS
6.24	Energy meter: MWh	±999.9 MWh					RO	Bi		NC	PT	PS
6.25	Energy meter: kWh	±99.99 kWh					RO	Bi		NC	PT	PS
6.26	Running cost	±32,000					RO	Bi		NC	PT	
6.27	Time before filter change due	0 to 30,000 hrs					RO	Uni		NC	PT	PS
6.28	Select clock for trip log time sampling	OFF (0) or On (1)		OFF (0)			RW	Bit				US
6.29	Hardware enable	OFF (0) or On (1)					RO	Bit		NC	PT	
6.30	Sequencing bit: Run forward	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
6.31	Sequencing bit: Jog forward	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
6.32	Sequencing bit: Run reverse	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
6.33	Sequencing bit: Forward / reverse	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
6.34	Sequencing bit: Run	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
6.35	Forward limit switch	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
6.36	Reverse limit switch	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
6.37	Sequencing bit: Jog reverse	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
6.39	Sequencing bit: Not stop	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
6.40	Enable sequencer latching	OFF (0) or On (1)		OFF (0)			RW	Bit				US
6.41	Drive event flags	0 to 65,535		0			RW	Uni		NC		
6.42	Control word	0 to 32,767		0			RW	Uni		NC		
6.43	Control word enable	OFF (0) or On (1)		OFF (0)			RW	Bit				US
6.44	Active supply	OFF (0) or On (1)					RO	Bit		NC	PT	
6.45	Force cooling fan to run at full speed	OFF (0) or On (1)		OFF (0)			RW	Bit				US
6.46	Normal low voltage supply	Size 1: 48V, Size 2 and 3: 48V to 72V		48			RW	Uni			PT	US
6.47	Disable mains/phase loss detection from input rectifier	OFF (0) or On (1)		OFF (0)			RW	Bit				US
6.48	Mains loss ride through detection level	0 to DC_VOLTAGE_SET_MAX V		200V drive: 205, 400V drive: 410, 575V drive: 540, 690V drive: 540			RW	Uni		RA		US
6.49	Disable multi-module drive module number storing on trip	OFF (0) or On (1)		OFF (0)			RW	Bit				US
6.50	Drive comms state	drv (0), SLot 1(1), SLot 2 (2), SLot 3 (3)					RO	Txt		NC	PT	
6.51	External rectifier not active	OFF (0) or On (1)		OFF (0)			RW	Bit				

RW	Read / Write	RO	Read only	Uni	Unipolar	Bi	Bi-polar	Bit	Bit parameter	Txt	Text string		
FI	Filtered	DE	Destination	NC	Not cloned	RA	Rating dependent	PT	Protected	US	User save	PS	Power down save

*For more information, refer to section 11.21.5 *Stop modes* on page 251.

**For more information, refer to section 11.21.6 *Mains loss modes* on page 252.

***For more information, refer to section 11.21.7 *Start / stop logic modes* on page 253.

****For more information, refer to section 11.21.8 *Catch a spinning motor* on page 254.

Parameter			Range(⇳)		Default(⇨)			Type					
			OL	CL	OL	VT	SV						
7.01	T5/6 analogue input 1 level		±100.00 %					RO	Bi		NC	PT	
7.02	T7 analogue input 2 level		±100.0 %					RO	Bi		NC	PT	
7.03	T8 analogue input 3 level		±100.0 %					RO	Bi		NC	PT	
7.04	Power circuit temperature 1		-128 to 127 °C					RO	Bi		NC	PT	
7.05	Power circuit temperature 2		-128 to 127 °C					RO	Bi		NC	PT	
7.06	Control board temperature		-128 to 127 °C					RO	Bi		NC	PT	
7.07	T5/6 analogue input 1 offset trim	{**0.13**}	±10.000 %		0.000			RW	Bi				US
7.08	T5/6 analogue input 1 scaling		0 to 4.000		1.000			RW	Uni				US
7.09	T5/6 analogue input 1 invert		OFF (0) or On (1)		OFF (0)			RW	Bit				US
7.10	T5/6 analogue input 1 destination		Pr **0.00** to **21.51**		Pr **1.36**			RW	Uni	DE		PT	US
7.11	T7 analogue input 2 mode	{**0.19**}	0-20 (0), 20-0 (1), 4-20.tr (2), 20-4.tr (3), 4-20 (4), 20-4 (5), VOLt (6)		VOLt (6)			RW	Txt				US
7.12	T7 analogue input 2 scaling		0 to 4.000		1.000			RW	Uni				US
7.13	T7 analogue input 2 invert		OFF (0) or On (1)		OFF (0)			RW	Bit				US
7.14	T7 analogue input 2 destination	{**0.20**}	Pr **0.00** to **21.51**		Pr **1.37**			RW	Uni	DE		PT	US
7.15	T8 analogue input 3 mode	{**0.21**}	0-20 (0), 20-0 (1), 4-20.tr (2), 20-4.tr (3), 4-20 (4), 20-4 (5), VOLt (6), th.SC (7), the (8), th.diSP (9)		VOLt (6)			RW	Txt				US
7.16	T8 analogue input 3 scaling		0 to 4.000		1.000			RW	Uni				US
7.17	T8 analogue input 3 invert		OFF (0) or On (1)		OFF (0)			RW	Bit				US
7.18	T8 analogue input 3 destination		Pr **0.00** to **21.51**		Pr **0.00**			RW	Uni	DE		PT	US
7.19	T9 analogue output 1 source		Pr **0.00** to **21.51**		Pr **5.01**	Pr **3.02**		RW	Uni			PT	US
7.20	T9 analogue output 1 scaling		0.000 to 4.000		1.000			RW	Uni				US
7.21	T9 analogue output 1 mode		VOLt (0), 0-20 (1), 4-20 (2), H.SPd (3)		VOLt (0)			RW	Txt				US
7.22	T10 analogue output 2 source		Pr **0.00** to **21.51**		Pr **4.02**			RW	Uni			PT	US
7.23	T10 analogue output 2 scaling		0.000 to 4.000		1.000			RW	Uni				US
7.24	T10 analogue output 2 mode		VOLt (0), 0-20 (1), 4-20 (2), H.SPd (3)		VOLt (0)			RW	Txt				US
7.25	Calibrate T5/6 analogue input 1 full scale		OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
7.26	T5/6 analogue input 1 sample time		0 to 8.0 ms		4.0			RW	Uni				US
7.28	T7 analogue input 2 current loop loss		OFF (0) or On (1)					RO	Bit		NC	PT	
7.29	T8 analogue input 3 current loop loss		OFF (0) or On (1)					RO	Bit		NC	PT	
7.30	T5/6 analogue input 1 offset		±100.00 %		0.00			RW	Bi				US
7.31	T7 analogue input 2 offset		±100.0 %		0.0			RW	Bi				US
7.32	T8 analogue input 3 offset		±100.0 %		0.0			RW	Bi				US
7.33	T9 analogue output 1 control		Fr (0), Ld (1), AdV (2)		AdV (2)			RW	Txt				US
7.34	IGBT junction temperature		±200 °C					RO	Bi		NC	PT	
7.35	Drive thermal protection accumulator		0 to 100.0 %					RO	Uni		NC	PT	
7.36	Power circuit temperature 3		-128 to 127 °C					RO	Bi		NC	PT	

RW	Read / Write	RO	Read only	Uni	Unipolar	Bi	Bi-polar	Bit	Bit parameter	Txt	Text string		
FI	Filtered	DE	Destination	NC	Not cloned	RA	Rating dependent	PT	Protected	US	User save	PS	Power down save

11.10 Menu 10: Status and trips

Parameter		Range(⇳)		Default(⇨)			Type					
		OL	CL	OL	VT	SV						
10.01	Drive healthy	OFF (0) or On (1)					RO	Bit		NC	PT	
10.02	Drive active	OFF (0) or On (1)					RO	Bit		NC	PT	
10.03	Zero speed	OFF (0) or On (1)					RO	Bit		NC	PT	
10.04	Running at or below minimum speed	OFF (0) or On (1)					RO	Bit		NC	PT	
10.05	Below set speed	OFF (0) or On (1)					RO	Bit		NC	PT	
10.06	At speed	OFF (0) or On (1)					RO	Bit		NC	PT	
10.07	Above set speed	OFF (0) or On (1)					RO	Bit		NC	PT	
10.08	Load reached	OFF (0) or On (1)					RO	Bit		NC	PT	
10.09	Drive output is at current limit	OFF (0) or On (1)					RO	Bit		NC	PT	
10.10	Regenerating	OFF (0) or On (1)					RO	Bit		NC	PT	
10.11	Braking IGBT active	OFF (0) or On (1)					RO	Bit		NC	PT	
10.12	Braking resistor alarm	OFF (0) or On (1)					RO	Bit		NC	PT	
10.13	Direction commanded	OFF (0) or On (1) [0 = FWD, 1 = REV]					RO	Bit		NC	PT	
10.14	Direction running	OFF (0) or On (1) [0 = FWD, 1 = REV]					RO	Bit		NC	PT	
10.15	Mains loss	OFF (0) or On (1)					RO	Bit		NC	PT	
10.16	Under voltage active	OFF (0) or On (1)					RO	Bit		NC	PT	
10.17	Overload alarm	OFF (0) or On (1)					RO	Bit		NC	PT	
10.18	Drive over temperature alarm	OFF (0) or On (1)					RO	Bit		NC	PT	
10.19	Drive warning	OFF (0) or On (1)					RO	Bit		NC	PT	
10.20	Trip 0	0 to 230*					RO	Txt		NC	PT	PS
10.21	Trip 1	0 to 230*					RO	Txt		NC	PT	PS
10.22	Trip 2	0 to 230*					RO	Txt		NC	PT	PS
10.23	Trip 3	0 to 230*					RO	Txt		NC	PT	PS
10.24	Trip 4	0 to 230*					RO	Txt		NC	PT	PS
10.25	Trip 5	0 to 230*					RO	Txt		NC	PT	PS
10.26	Trip 6	0 to 230*					RO	Txt		NC	PT	PS
10.27	Trip 7	0 to 230*					RO	Txt		NC	PT	PS
10.28	Trip 8	0 to 230*					RO	Txt		NC	PT	PS
10.29	Trip 9	0 to 230*					RO	Txt		NC	PT	PS
10.30	Full power braking time	0.00 to 400.00 s		See Table 11-7			RW	Uni				US
10.31	Full power braking period	0.0 to 1500.0 s		See Table 11-7			RW	Uni				US
10.32	External trip	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
10.33	Drive reset	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
10.34	No. of auto-reset attempts	0 to 5		0			RW	Uni				US
10.35	Auto-reset delay	0.0 to 25.0 s		1.0			RW	Uni				US
10.36	Hold drive healthy until last attempt	OFF (0) or On (1)		OFF (0)			RW	Bit				US
10.37	Action on trip detection	0 to 3		0			RW	Uni				US
10.38	User trip	0 to 255		0			RW	Uni		NC		
10.39	Braking energy overload accumulator	0.0 to 100.0 %					RO	Uni		NC	PT	
10.40	Status word	0 to 32,767					RO	Uni		NC	PT	
10.41	Trip 0 time: years.days	0.000 to 9.365 years.days					RO	Uni		NC	PT	PS
10.42	Module number for trip 0, or, Trip 0 time: hours.minutes	00.00 to 23.59 hours.minutes					RO	Uni		NC	PT	PS
10.43	Module number for trip 1, or, Trip 1 time	0 to 600.00 hours.minutes					RO	Uni		NC	PT	PS
10.44	Module number for trip 2, or, Trip 2 time	0 to 600.00 hours.minutes					RO	Uni		NC	PT	PS
10.45	Module number for trip 3, or, Trip 3 time	0 to 600.00 hours.minutes					RO	Uni		NC	PT	PS
10.46	Module number for trip 4, or, Trip 4 time	0 to 600.00 hours.minutes					RO	Uni		NC	PT	PS
10.47	Module number for trip 5, or, Trip 5 time	0 to 600.00 hours.minutes					RO	Uni		NC	PT	PS
10.48	Module number for trip 6, or, Trip 6 time	0 to 600.00 hours.minutes					RO	Uni		NC	PT	PS
10.49	Module number for trip 7, or, Trip 7 time	0 to 600.00 hours.minutes					RO	Uni		NC	PT	PS
10.50	Module number for trip 8, or, Trip 8 time	0 to 600.00 hours.minutes					RO	Uni		NC	PT	PS
10.51	Module number for trip 9, or, Trip 9 time	0 to 600.00 hours.minutes					RO	Uni		NC	PT	PS

RW	Read / Write	RO	Read only	Uni	Unipolar	Bi	Bi-polar	Bit	Bit parameter	Txt	Text string		
FI	Filtered	DE	Destination	NC	Not cloned	RA	Rating dependent	PT	Protected	US	User save	PS	Power down save

*The value given for the range is that obtained via serial communication. For the text string displayed on the drive, see Chapter 13 *Diagnostics* on page 275.

Table 11-7 Defaults for Pr 10.30 and Pr 10.31

Drive rating	Pr 10.30	Pr 10.31
200V, size 1 & 2	0.04	2.0
400V, size 1 & 2	0.02	2.0
All other ratings and frame sizes	0.00	

Parameter		Range(⇳)		Default(⇨)			Type					
		OL	CL	OL	VT	SV						
14.01	PID control output	±100.00 %					RO	Bi		NC	PT	
14.02	PID main reference source	Pr **0.00** to **21.51**		Pr **0.00**			RW	Uni			PT	US
14.03	PID reference source	Pr **0.00** to **21.51**		Pr **0.00**			RW	Uni			PT	US
14.04	PID feedback source	Pr **0.00** to **21.51**		Pr **0.00**			RW	Uni			PT	US
14.05	PID reference source invert	OFF (0) or On (1)		OFF (0)			RW	Bit				US
14.06	PID feedback source invert	OFF (0) or On (1)		OFF (0)			RW	Bit				US
14.07	PID reference slew-rate limit	0.0 to 3,200.0 s		0.0			RW	Uni				US
14.08	PID enable	OFF (0) or On (1)		OFF (0)			RW	Bit				US
14.09	PID optional enable source	Pr **0.00** to **21.51**		Pr **0.00**			RW	Uni			PT	US
14.10	PID proportional gain	0.000 to 4.000		1.000			RW	Uni				US
14.11	PID integral gain	0.000 to 4.000		0.500			RW	Uni				US
14.12	PID derivative gain	0.000 to 4.000		0.000			RW	Uni				US
14.13	PID upper limit	0.00 to 100.00 %		100.00			RW	Uni				US
14.14	PID lower limit	±100.00 %		-100.00			RW	Bi				US
14.15	PID output scaling factor	0.000 to 4.000		1.000			RW	Uni				US
14.16	PID output destination	Pr **0.00** to **21.51**		Pr **0.00**			RW	Uni	DE		PT	US
14.17	PID hold integrator enable	OFF (0) or On (1)		OFF (0)			RW	Bit		NC		
14.18	PID symmetrical limits enable	OFF (0) or On (1)		OFF (0)			RW	Bit				US
14.19	PID main reference	±100.00 %					RO	Bi		NC	PT	
14.20	PID reference	±100.00 %					RO	Bi		NC	PT	
14.21	PID feedback	±100.00 %					RO	Bi		NC	PT	
14.22	PID error	±100.00 %					RO	Bi		NC	PT	

RW	Read / Write	RO	Read only	Uni	Unipolar	Bi	Bi-polar	Bit	Bit parameter	Txt	Text string		
FI	Filtered	DE	Destination	NC	Not cloned	RA	Rating dependent	PT	Protected	US	User save	PS	Power down save

11.16 Menu 18: Application menu 1

Parameter		Range(⇳)		Default(⇨)			Type					
		OL	CL	OL	VT	SV						
18.01	Application menu 1 power-down saved integer	-32,768 to +32,767		0			RW	Bi		NC		PS
18.02 to 18.10	Application menu 1 read-only integer	-32,768 to +32,767		0			RO	Bi		NC		
18.11 to 18.30	Application menu 1 read-write integer	-32,768 to +32,767		0			RW	Bi				US
18.31 to 18.50	Application menu 1 read-write bit	OFF (0) or On (1)		0			RW	Bit				US

11.17 Menu 19: Application menu 2

Parameter		Range(⇳)		Default(⇨)			Type					
		OL	CL	OL	VT	SV						
19.01	Application menu 2 power-down saved integer	-32,768 to +32,767		0			RW	Bi		NC		PS
19.02 to 19.10	Application menu 2 read-only integer	-32,768 to +32,767		0			RO	Bi		NC		
19.11 to 19.30	Application menu 2 read-write integer	-32,768 to +32,767		0			RW	Bi				US
19.31 to 19.50	Application menu 2 read-write bit	OFF (0) or On (1)		0			RW	Bit				US

11.18 Menu 20: Application menu 3

Parameter		Range(⇳)		Default(⇨)			Type					
		OL	CL	OL	VT	SV						
20.01 to 20.20	Application menu 3 read-write integer	-32,768 to +32,767		0			RW	Bi		NC		
20.21 to 20.40	Application menu 3 read-write long integer	-2^{31} to $2^{31}-1$		0			RW	Bi		NC		

With software V01.07.00 and later, all menu 20 parameters are transferred to the SMARTCARD when a 4yyy transfer is performed. See section 9.2.1 *Writing to the SMARTCARD* on page 152 for more information.

RW	Read / Write	RO	Read only	Uni	Unipolar	Bi	Bi-polar	Bit	Bit parameter	Txt	Text string		
FI	Filtered	DE	Destination	NC	Not cloned	RA	Rating dependent	PT	Protected	US	User save	PS	Power down save

15 Diagnostics

The display on the drive gives various information about the status of the drive. These fall into three categories:

- Trip indications
- Alarm indications
- Status indications

WARNING

Users must not attempt to repair a drive if it is faulty, nor carry out fault diagnosis other than through the use of the diagnostic features described in this chapter.
If a drive is faulty, it must be returned to an authorized Control Techniques distributor for repair.

15.1 Trip indications

If the drive trips, the output of the drive is disabled so that the drive stops controlling the motor. The lower display indicates that a trip has occurred and the upper display shows the trip. If this is a multi-module drive and a power module has indicated a trip, then the upper display will alternate between the trip string and the module number.

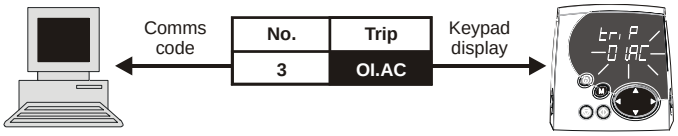
Trips are listed alphabetically in Table 15-1 based on the trip indication shown on the drive display. Refer to Figure 15-1.

If a display is not used, the drive LED Status indicator will flash if the drive has tripped. Refer to Figure 15-2.

The trip indication can be read in Pr **10.20** providing a trip number. Trip numbers are listed in numerical order in Table 15-2 so the trip indication can be cross referenced and then diagnosed using Table 15-1.

Example

1. Trip code 3 is read from Pr **10.20** via serial communications.
2. Checking Table 15-2 shows Trip 3 is an OI.AC trip.



3. Look up OI.AC in Table 15-1.
4. Perform checks detailed under *Diagnosis*.

Figure 15-1 Keypad status modes

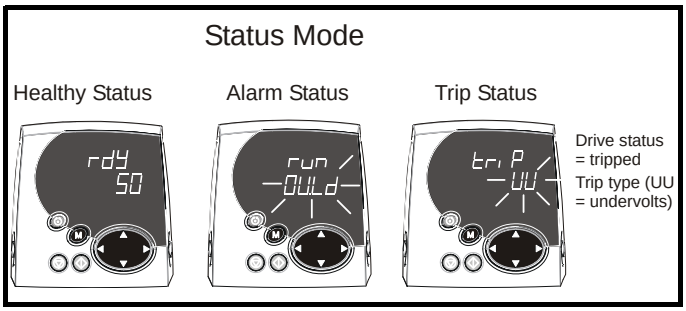
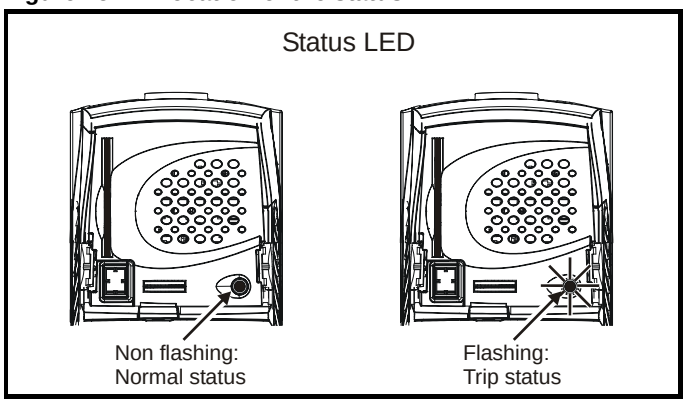


Figure 15-2 Location of the status LED



Trip	Diagnosis
OI.AC	**Instantaneous output over current detected: peak output current greater than 225%**
3	Acceleration / deceleration rate is too short. If seen during autotune reduce voltage boost Pr **5.15** Check for short circuit on output cabling Check integrity of motor insulation Check feedback device wiring Check feedback device mechanical coupling Check feedback signals are free from noise Is motor cable length within limits for that frame size? Reduce the values in speed loop gain parameters – Pr **3.10**, Pr **3.11** and Pr **3.12** (closed loop vector and servo modes only) Has offset measurement test been completed? (servo mode only) Reduce the values in current loop gain parameters - Pr **4.13** and Pr **4.14** (closed loop vector and servo modes only)

Table 15-1 Trip indications

Trip	Diagnosis
C.Acc	**SMARTCARD trip: SMARTCARD Read / Write fail**
185	Check SMARTCARD is fitted / located correctly Replace SMARTCARD
C.boot	**SMARTCARD trip: The menu 0 parameter modification cannot be saved to the SMARTCARD because the necessary file has not been created on the SMARTCARD**
177	A write to a menu 0 parameter has been initiated via the keypad with Pr **11.42** set to auto(3) or boot(4), but the necessary file on the SMARTCARD has not bee created Ensure that Pr **11.42** is correctly set and reset the drive to create the necessary file on the SMARTCARD Re-attempt the parameter write to the menu 0 parameter
C.bUSY	**SMARTCARD trip: SMARTCARD can not perform the required function as it is being accessed by a Solutions Module**
178	Wait for the Solutions Module to finish accessing the SMARTCARD and then re-attempt the required function
C.Chg	**SMARTCARD trip: Data location already contains data**
179	Erase data in data location Write data to an alternative data location
C.cPr	**SMARTCARD trip: The values stored in the drive and the values in the data block on the SMARTCARD are different**
188	Press the red reset button
C.dAt	**SMARTCARD trip: Data location specified does not contain any data**
183	Ensure data block number is correct
C.Err	**SMARTCARD trip: SMARTCARD data is corrupted**
182	Ensure the card is located correctly Erase data and retry Replace SMARTCARD
C.Full	**SMARTCARD trip: SMARTCARD full**
184	Delete a data block or use different SMARTCARD
cL2	**Analogue input 2 current loss (current mode)**
28	Check analogue input 2 (terminal 7) current signal is present (4-20mA, 20-4mA)
cL3	**Analogue input 3 current loss (current mode)**
29	Check analogue input 3 (terminal 8) current signal is present (4-20mA, 20-4mA)
CL.bit	**Trip initiated from the control word (Pr 6.42)**
35	Disable the control word by setting Pr **6.43** to 0 or check setting of Pr **6.42**
C.OPtn	**SMARTCARD trip: Solutions Modules fitted are different between source drive and destination drive**
180	Ensure correct Solutions Modules are fitted Ensure Solutions Modules are in the same Solutions Module slot Press the red reset button
C.rdo	**SMARTCARD trip: SMARTCARD has the Read Only bit set**
181	Enter 9777 in Pr **xx.00** to allow SMARTCARD Read / Write access Ensure card is not writing to data locations 500 to 999

<table>
<tr><th>Trip</th><th>Diagnosis</th></tr>
<tr><td>C.rtg</td><td>SMARTCARD trip: SMARTCARD attempting to change the destination drive ratings
No drive rating parameters have been transferred</td></tr>
<tr><td>186</td><td>Press the red reset button
Drive rating parameters are:
<table>
<tr><th>Parameter</th><th>Function</th></tr>
<tr><td>2.08</td><td>Standard ramp voltage</td></tr>
<tr><td>4.05/6/7, 21.27/8/9</td><td>Current limits</td></tr>
<tr><td>4.24</td><td>User current maximum scaling</td></tr>
<tr><td>5.07, 21.07</td><td>Motor rated current</td></tr>
<tr><td>5.09, 21.09</td><td>Motor rated voltage</td></tr>
<tr><td>5.10, 21.10</td><td>Rated power factor</td></tr>
<tr><td>5.17, 21.12</td><td>Stator resistance</td></tr>
<tr><td>5.18</td><td>Switching frequency</td></tr>
<tr><td>5.23, 21.13</td><td>Voltage offset</td></tr>
<tr><td>5.24, 21.14</td><td>Transient inductance</td></tr>
<tr><td>5.25, 21.24</td><td>Stator inductance</td></tr>
<tr><td>6.06</td><td>DC injection braking current</td></tr>
<tr><td>6.48</td><td>Mains loss ride through detection level</td></tr>
</table>
The above parameters will be set to their default values.</td></tr>
<tr><td>C.TyP</td><td>SMARTCARD trip: SMARTCARD parameter set not compatible with drive</td></tr>
<tr><td>187</td><td>Press the reset button
Ensure destination drive type is the same as the source parameter file drive type</td></tr>
<tr><td>dESt</td><td>Two or more parameters are writing to the same destination parameter</td></tr>
<tr><td>199</td><td>Set Pr xx.00 = 12001 check all visible parameters in the menus for duplication</td></tr>
<tr><td>EEF</td><td>EEPROM data corrupted - Drive mode becomes open loop and serial comms will timeout with remote keypad on the drive RS485 comms port.</td></tr>
<tr><td>31</td><td>This trip can only be cleared by loading default parameters and saving parameters</td></tr>
<tr><td>Enc1</td><td>Drive encoder trip: Encoder power supply overload</td></tr>
<tr><td>189</td><td>Check encoder power supply wiring and encoder current requirement
Maximum current = 200mA @ 15V, or 300mA @ 8V and 5V</td></tr>
<tr><td>Enc2</td><td>Drive encoder trip: Wire break (Drive encoder terminals 1 & 2, 3 & 4, 5 & 6)</td></tr>
<tr><td>190</td><td>Check cable continuity
Check wiring of feedback signals is correct
Check encoder power is set correctly
Replace feedback device
If wire break detection on the main drive encoder input is not required, set Pr 3.40 = 0 to disable the Enc2 trip</td></tr>
<tr><td>Enc3</td><td>Drive encoder trip: Phase offset incorrect whilst running</td></tr>
<tr><td>191</td><td>Check the encoder signal for noise
Check encoder shielding
Check the integrity of the encoder mechanical mounting
Repeat the offset measurement test</td></tr>
<tr><td>Enc4</td><td>Drive encoder trip: Feedback device comms failure</td></tr>
<tr><td>192</td><td>Ensure encoder power supply is correct
Ensure baud rate is correct
Check encoder wiring
Replace feedback device</td></tr>
<tr><td>Enc5</td><td>Drive encoder trip: Checksum or CRC error</td></tr>
<tr><td>193</td><td>Check the encoder signal for noise
Check the encoder cable shielding
With EnDat encoders, check the comms resolution and/or carry out the auto-configuration Pr 3.41</td></tr>
<tr><td>Enc6</td><td>Drive encoder trip: Encoder has indicated an error</td></tr>
<tr><td>194</td><td>Replace feedback device
With SSI encoders, check the wiring and encoder supply setting</td></tr>
</table>

Trip	Diagnosis
Enc7	**Drive encoder trip: Initialisation failed**
195	Re-set the drive Check the correct encoder type is entered into Pr **3.38** Check encoder wiring Check encoder power supply is set correctly Carry out the auto-configuration Pr **3.41** Replace feedback device
Enc8	**Drive encoder trip: Auto configuration on power up has been requested and failed**
196	Change the setting of Pr **3.41** to 0 and manually enter the drive encoder turns (Pr **3.33**) and the equivalent number of lines per revolution (Pr **3.34**) Check the comms resolution
Enc9	**Drive encoder trip: Position feedback selected is selected from a Solutions Module slot which does not have a speed / position feedback Solutions Module fitted**
197	Check setting of Pr **3.26** (or Pr **21.21** if the second motor parameters have been enabled)
Enc10	**Drive encoder trip: Servo mode phasing failure because encoder phase angle (Pr 3.25 or Pr 21.20) is incorrect**
198	Check the encoder wiring. Perform an autotune to measure the encoder phase angle or manually enter the correct phase angle into Pr **3.25** (or Pr **21.20**). Spurious Enc10 trips can be seen in very dynamic applications. This trip can be disabled by setting the overspeed threshold in Pr **3.08** to a value greater than zero. Caution should be used in setting the over speed threshold level as a value which is too large may mean that an encoder fault will not be detected.
Enc11	**Drive encoder trip: A failure has occurred during the alignment of the analogue signals of a SINCOS encoder with the digital count derived from the sine and cosine waveforms and the comms position (if applicable). This fault is usually due to noise on the sine and cosine signals.**
161	Check encoder cable shield. Examine sine and cosine signals for noise.
Enc12	**Drive encoder trip: Hiperface encoder - The encoder type could not be identified during auto-configuration**
162	Check encoder type can be auto-configured. Check encoder wiring. Enter parameters manually.
Enc13	**Drive encoder trip: EnDat encoder - The number of encoder turns read from the encoder during auto-configuration is not a power of 2**
163	Select a different type of encoder.
Enc14	**Drive encoder trip: EnDat encoder - The number of comms bits defining the encoder position within a turn read from the encoder during auto-configuration is too large.**
164	Select a different type of encoder. Faulty encoder.
Enc15	**Drive encoder trip: The number of periods per revolution calculated from encoder data during auto-configuration is either less than 2 or greater than 50,000.**
165	Linear motor pole pitch / encoder ppr set up is incorrect or out of parameter range i.e. Pr **5.36** = 0 or Pr **21.31** = 0. Faulty encoder.
Enc16	**Drive encoder trip: EnDat encoder - The number of comms bits per period for a linear encoder exceeds 255.**
166	Select a different type of encoder. Faulty encoder.
Enc17	**Drive encoder trip: The periods per revolution obtained during auto-configuration for a rotary SINCOS encoder is not a power of two.**
167	Select a different type of encoder. Faulty encoder.
ENP.Er	**Data error from electronic nameplate stored in selected position feedback device**
176	Replace feedback device
Et	**External trip from input on terminal 31**
6	Check terminal 31 signal Check value of Pr **10.32** Enter 12001 in Pr **xx.00** and check for parameter controlling Pr **10.32** Ensure Pr **10.32** or Pr **10.38** (=6) are not being controlled by serial comms
HF01	**Data processing error: CPU address error**
	Hardware fault - return drive to supplier

Trip	Diagnosis
HF02	**Data processing error: DMAC address error**
	Hardware fault - return drive to supplier
HF03	**Data processing error: Illegal instruction**
	Hardware fault - return drive to supplier
HF04	**Data processing error: Illegal slot instruction**
	Hardware fault - return drive to supplier
HF05	**Data processing error: Undefined exception**
	Hardware fault - return drive to supplier
HF06	**Data processing error: Reserved exception**
	Hardware fault - return drive to supplier
HF07	**Data processing error: Watchdog failure**
	Hardware fault - return drive to supplier
HF08	**Data processing error: Level 4 crash**
	Hardware fault - return drive to supplier
HF09	**Data processing error: Heap overflow**
	Hardware fault - return drive to supplier
HF10	**Data processing error: Router error**
	Hardware fault - return drive to supplier
HF11	**Data processing error: Access to EEPROM failed**
	Hardware fault - return drive to supplier
HF12	**Data processing error: Main program stack overflow**
	Hardware fault - return drive to supplier
HF13	**Data processing error: Software incompatible with hardware**
	Hardware or software fault - return drive to supplier
HF17	**Multi-module system thermistor short circuit**
217	Hardware fault - return drive to supplier
HF18	**Multi-module system interconnect cable error**
218	Hardware fault - return drive to supplier
HF19	**Temperature feedback multiplexing failure**
219	Hardware fault - return drive to supplier
HF20	**Power stage recognition: serial code error**
220	Hardware fault - return drive to supplier
HF21	**Power stage recognition: unrecognised frame size**
221	Hardware fault - return drive to supplier
HF22	**Power stage recognition: multi module frame size mismatch**
222	Hardware fault - return drive to supplier
HF23	**Power stage recognition: multi module voltage rating mismatch**
223	Hardware fault - return drive to supplier
HF24	**Power stage recognition: unrecognised drive size**
224	Hardware fault - return drive to supplier
HF25	**Current feedback offset error**
225	Hardware fault - return drive to supplier
HF26	**Soft start relay failed to close, soft start monitor failed or braking IGBT short circuit at power up**
226	Hardware fault - return drive to supplier
HF27	**Power stage thermistor 1 fault**
227	Hardware fault - return drive to supplier

Trip	Diagnosis
HF28	**Power stage thermistor 2 fault or internal fan fault (size 3 and larger)**
228	Hardware fault - return drive to supplier
HF29	**Control board thermistor fault**
229	Hardware fault - return drive to supplier
HF30	**DCCT wire break trip from power module**
230	Hardware fault - return drive to supplier
HF31	**Aux fan failure from power module**
231	Replace auxiliary fan
HF32	**Power stage - a module has not powered up in a multi-module parallel drive**
232	Check AC power supply
It.AC	**Output current overload timed out (I^2t) - accumulator value can be seen in Pr 4.19**
20	Ensure the load is not jammed / sticking Check the load on the motor has not changed If seen during an autotune in servo mode, ensure that the motor rated current Pr **0.46** (Pr **5.07**) or Pr **21.07** is ≤Heavy Duty current rating of the drive Tune the rated speed parameter (closed loop vector only) Check feedback device signal for noise Check the feedback device mechanical coupling
It.br	**Braking resistor overload timed out (I^2t) – accumulator value can be seen in Pr 10.39**
19	Ensure the values entered in Pr **10.30** and Pr **10.31** are correct Increase the power rating of the braking resistor and change Pr **10.30** and Pr **10.31** If an external thermal protection device is being used and the braking resistor software overload is not required, set Pr **10.30** or Pr **10.31** to 0 to disable the trip
L.SYnC	**Drive failed to synchronise to the supply voltage in Regen mode**
39	Refer to the *Diagnostics* chapter in the *Unidrive SP Regen Installation Guide*.
O.CtL	**Drive control board over temperature**
23	Check cubicle / drive fans are still functioning correctly Check cubicle ventilation paths Check cubicle door filters Check ambient temperature Reduce drive switching frequency
O.ht1	**Power device over temperature based on thermal model**
21	Reduce drive switching frequency Reduce duty cycle Decrease acceleration / deceleration rates Reduce motor load
O.ht2	**Heatsink over temperature**
22	Check cubicle / drive fans are still functioning correctly Check cubicle ventilation paths Check cubicle door filters Increase ventilation Decrease acceleration / deceleration rates Reduce drive switching frequency Reduce duty cycle Reduce motor load
Oht2.P	**Power module heatsink over temperature**
105	Check cubicle / drive fans are still functioning correctly Check cubicle ventilation paths Check cubicle door filters Increase ventilation Decrease acceleration / deceleration rates Reduce drive switching frequency Reduce duty cycle Reduce motor load

Trip	Diagnosis
O.ht3	**Drive over-temperature based on thermal model**
27	The drive will attempt to stop the motor before tripping. If the motor does not stop in 10s the drive trips immediately. Check cubicle / drive fans are still functioning correctly Check cubicle ventilation paths Check cubicle door filters Increase ventilation Decrease acceleration / deceleration rates Reduce duty cycle Reduce motor load
Oht4.P	**Power module rectifier over temperature or input snubber resistor over temperature (size 4 and above)**
102	Check for supply imbalance Check for supply disturbance such as notching from a DC drive Check cubicle / drive fans are still functioning correctly Check cubicle ventilation paths Check cubicle door filters Increase ventilation Decrease acceleration / deceleration rates Reduce drive switching frequency Reduce duty cycle Reduce motor load
OI.AC	**Instantaneous output over current detected: peak output current greater than 225%**
3	Acceleration /deceleration rate is too short. If seen during autotune reduce voltage boost Pr **5.15** Check for short circuit on output cabling Check integrity of motor insulation Check feedback device wiring Check feedback device mechanical coupling Check feedback signals are free from noise Is motor cable length within limits for that frame size? Reduce the values in speed loop gain parameters – Pr **3.10**, Pr **3.11** and Pr **3.12** (closed loop vector and servo modes only) Has offset measurement test been completed? (servo mode only) Reduce the values in current loop gain parameters - Pr **4.13** and Pr **4.14** (closed loop vector and servo modes only)
OIAC.P	**Power module over current detected from the module output currents**
104	Acceleration /deceleration rate is too short. If seen during autotune reduce voltage boost Pr **5.15** Check for short circuit on output cabling Check integrity of motor insulation Check feedback device wiring Check feedback device mechanical coupling Check feedback signals are free from noise Is motor cable length within limits for that frame size? Reduce the values in speed loop gain parameters – Pr **3.10**, Pr **3.11** and Pr **3.12** (closed loop vector and servo modes only) Has offset measurement test been completed? (servo mode only) Reduce the values in current loop gain parameters - Pr **4.13** and Pr **4.14** (closed loop vector and servo modes only)
OI.br	**Braking transistor over-current detected: short circuit protection for the braking transistor activated**
4	Check braking resistor wiring Check braking resistor value is greater than or equal to the minimum resistance value Check braking resistor insulation
OIbr.P	**Power module braking IGBT over current**
103	Check braking resistor wiring Check braking resistor value is greater than or equal to the minimum resistance value Check braking resistor insulation
OIdC.P	**Power module over current detected from IGBT on state voltage monitoring**
109	Vce IGBT protection activated. Check motor and cable insulation.
O.Ld1	**Digital output overload: total current drawn from 24V supply and digital outputs exceeds 200mA**
26	Check total load on digital outputs (terminals 24,25,26)and +24V rail (terminal 22)
O.SPd	**Motor speed has exceeded the over speed threshold**
7	Increase the over speed trip threshold in Pr **3.08** (closed loop modes only) Speed has exceeded 1.2 x Pr **1.06** or Pr **1.07** (open loop mode) Reduce the speed loop P gain (Pr **3.10**) to reduce the speed overshoot (closed loop modes only)

Trip	Diagnosis
OV	**DC bus voltage has exceeded the peak level or the maximum continuous level for 15 seconds**
2	Increase deceleration ramp (Pr **0.04**) Decrease braking resistor value (staying above the minimum value) Check nominal AC supply level Check for supply disturbances which could cause the DC bus to rise – voltage overshoot after supply recovery from a notch induced by DC drives. Check motor insulation **Drive voltage rating** **Peak voltage** **Maximum continuous voltage level (15s)** 400 830 815 690 1190 1175 If the drive is operating in low voltage DC mode the overvoltage trip level is 1.45 x Pr **6.46**.
OV.P	**Power module DC bus voltage has exceeded the peak level or the maximum continuous level for 15 seconds**
106	Increase deceleration ramp (Pr **0.04**) Decrease braking resistor value (staying above the minimum value) Check nominal AC supply level Check for supply disturbances which could cause the DC bus to rise – voltage overshoot after supply recovery from a notch induced by DC drives. Check motor insulation **Drive voltage rating** **Peak voltage** **Maximum continuous voltage level (15s)** 400 830 815 690 1190 1175 If the drive is operating in low voltage DC mode the overvoltage trip level is 1.45 x Pr **6.46**.
PAd	**Keypad has been removed when the drive is receiving the speed reference from the keypad**
34	Fit keypad and reset Change speed reference selector to select speed reference from another source
Ph	**AC voltage input phase loss or large supply imbalance detected**
32	Ensure all three phases are present and balanced Check input voltage levels are correct (at full load) **NOTE** Load level must be between 50 and 100% for the drive to trip under phase loss conditions. The drive will attempt to stop the motor before this trip is initiated.
Ph.P	**Power module phase loss detection**
107	Ensure all three phases are present and balanced Check input voltage levels are correct (at full load)
PS	**Internal power supply fault**
5	Remove any Solutions Modules and reset Check integrity of interface ribbon cables and connections (size 4,5,6 only) Hardware fault - return drive to supplier
PS.10V	**10V user power supply current greater than 10mA**
8	Check wiring to terminal 4 Reduce load on terminal 4
PS.24V	**24V internal power supply overload**
9	The total user load of the drive and Solutions Modules has exceeded the internal 24V power supply limit. The user load consists of the drive's digital outputs, the SM-I/O Plus digital outputs, the drive's main encoder supply and the SM-Universal Encoder Plus encoder supply. • Reduce load and reset • Provide an external 24V >50W power supply • Remove any Solutions Modules and reset
PS.P	**Power module power supply fail**
108	Remove any Solutions Modules and reset Check integrity of interface ribbon cables and connections (size 4,5,6 only) Hardware fault - return drive to supplier
PSAVE.Er	**Power down save parameters in the EEPROM are corrupt**
37	Indicates that the power was removed when power down save parameters were being saved. The drive will revert back to the power down parameter set that was last saved successfully. Perform a user save (Pr **xx.00** to 1000 or 1001 and reset the drive) or power down the drive normally to ensure this trip does or occur the next time the drive is powered up.
rS	**Failure to measure resistance during autotune or when starting in open loop vector mode 0 or 3**
33	Check motor power connection continuity

Trip	Diagnosis
SAVE.Er	**User save parameters in the EEPROM are corrupt**
36	Indicates that the power was removed when user parameters were being saved. The drive will revert back to the user parameter set that was last saved successfully. Perform a user save (Pr **xx.00** to 1000 or 1001 and reset the drive) to ensure this trip does or occur the next time the drive is powered up.
SCL	**Drive RS485 serial comms loss to remote keypad**
30	Refit the cable between the drive and keypad Check cable for damage Replace cable Replace keypad
SLX.dF	**Solutions Module slot X trip: Solutions Module type fitted in slot X changed**
204,209,214	Save parameters and reset

Trip	Diagnosis
SLX.Er	**Solutions Module slot X trip: Solutions Module in slot X has detected a fault**
202,207,212	**Feedback module category** Check value in Pr **15**/**16**/**17.50**. The following table lists the possible error codes for the SM-Universal Encoder Plus, SM-Encoder Plus and SM-Resolver. See the *Diagnostics* section in the relevant Solutions Module User Guide for more information.

Error code	Module	Trip Description	Diagnostic
0	All	No trip	No fault detected
1	SM-Universal Encoder Plus	Encoder power supply overload	Check encoder power supply wiring and encoder current requirement Maximum current = 200mA @ 15V, or 300mA @ 8V and 5V
	SM-Resolver	Excitation output short circuit	Check the excitation output wiring.
2	SM-Universal Encoder Plus & SM-Resolver	Wire break	Check cable continuity Check wiring of feedback signals is correct Check supply voltage or excitation output level Replace feedback device
3	SM-Universal Encoder Plus	Phase offset incorrect whilst running	Check the encoder signal for noise Check encoder shielding Check the integrity of the encoder mechanical mounting Repeat the offset measurement test
4	SM-Universal Encoder Plus	Feedback device communications failure	Ensure encoder power supply is correct Ensure baud rate is correct Check encoder wiring Replace feedback device
5	SM-Universal Encoder Plus	Checksum or CRC error	Check the encoder signal for noise Check the encoder cable shielding
6	SM-Universal Encoder Plus	Encoder has indicated an error	Replace encoder
7	SM-Universal Encoder Plus	Initialisation failed	Check the correct encoder type is entered into Pr **15**/**16**/**17.15** Check encoder wiring Check supply voltage level Replace feedback device
8	SM-Universal Encoder Plus	Auto configuration on power up has been requested and failed	Change the setting of Pr **15**/**16**/**17.18** and manually enter the number of turns (Pr **15**/**16**/**17.09**) and the equivalent number of lines per revolution (Pr **15**/**16**/**17.10**)
9	SM-Universal Encoder Plus	Motor thermistor trip	Check motor temperature Check thermistor continuity
10	SM-Universal Encoder Plus	Motor thermistor short circuit	Check motor thermistor wiring Replace motor / motor thermistor
11	SM-Universal Encoder Plus	Failure of the sincos analogue position alignment during encoder initialisation	Check encoder cable shield. Examine sine and cosine signals for noise.
	SM-Resolver	Poles not compatible with motor	Check that the correct number of resolver poles has been set in Pr **15**/**16**/**17.15**.
12	SM-Universal Encoder Plus	Encoder type could not be identified during auto-configuration	Check encoder type can be auto-configured. Check encoder wiring. Enter parameters manually.
13	SM-Universal Encoder Plus	Number of encoder turns read from the encoder during auto-configuration is not a power of 2	Select a different type of encoder.
14	SM-Universal Encoder Plus	Number of comms bits defining the encoder position within a turn read from the encoder during auto-configuration is too large.	Select a different type of encoder. Faulty encoder.
15	SM-Universal Encoder Plus	The number of periods per revolution calculated from encoder data during auto-configuration is either <2 or >50,000.	Linear motor pole pitch / encoder ppr set up is incorrect or out of parameter range i.e. Pr **5.36** = 0 or Pr **21.31** = 0. Faulty encoder.
16	SM-Universal Encoder Plus	The number of comms bits per period for a linear encoder exceeds 255.	Select a different type of encoder. Faulty encoder.
74	All	Solutions Module has overheated	Check ambient temperature Check cubicle ventilation

Trip	Diagnosis
SLX.Er	**Solutions Module slot X trip: Solutions Module in slot X has detected a fault**
202,207,212	**Automation (Applications) module category** Check value in Pr **15**/**16**/**17.50**. The following table lists the possible error codes for the SM-Applications and SM-Applications Lite. See the *Diagnostics* section in the relevant Solutions Module User Guide for more information.

Error Code	Trip Description
39	User program stack overflow
40	Unknown error - please contact supplier
41	Parameter does not exist
42	Attempt to write to a read-only parameter
43	Attempt to read from a write-only parameter
44	Parameter value out of range
45	Invalid synchronisation modes
46	Unused
47	Synchronisation lost with CTSync Master
48	RS485 not in user mode
49	Invalid RS485 configuration
50	Maths error - divide by zero or overflow
51	Array index out of range
52	Control word user trip
53	DPL program incompatible with target
54	DPL task overrun
55	Unused
56	Invalid timer unit configuration
57	Function block does not exist
58	Flash PLC Storage corrupt
59	Drive rejected application module as Sync master
60	CTNet hardware failure. Please contact your supplier
61	CTNet invalid configuration
62	CTNet invalid baud-rate
63	CTNet invalid node ID
64	Digital Output overload
65	Invalid function block parameter(s)
66	User heap too large
67	RAM file does not exist or a non-RAM file id has been specified
68	The RAM file specified is not associated to an array
69	Failed to update drive parameter database cache in Flash memory
70	User program downloaded while drive enabled
71	Failed to change drive mode
72	Invalid CTNet buffer operation
73	Fast parameter initialisation failure
74	Over-temperature
75	Hardware unavailable
76	Module type cannot be resolved. Module is not recognised.
77	Inter-option module comms error with module in slot 1
78	Inter-option module comms error with module in slot 2
79	Inter-option module comms error with module in slot 3
80	Inter-option module comms error with module unknown slot
81	APC internal error
82	Communcations to drive faulty

Trip	Diagnosis
SLX.Er	**Solutions Module slot X trip: Solutions Module in slot X has detected a fault**
202,207,212	**Automation (I/O Expansion) module category** Check value in Pr **15**/**16**/**17.50**. The following table lists the possible error codes for the SM-I/O Plus, SM-I/O Lite, SM-I/O Timer, SM-PELV and SM-I/O 120V modules. See the *Diagnostics* section in the relevant Solutions Module User Guide for more information.

Error code	Module	Reason for fault
0	All	No errors
1	All	Digital output overload
2	SM-I/O Lite, SM-I/O Timer	Analogue input 1 current input too high (>22mA) or too low (<3mA)
	SM-PELV	Digital input overload
3	SM-PELV	Analogue input 1 current input too low (<3mA)
4	SM-PELV	User power supply absent
5	SM-I/O Timer	Real time clock communication error
74	All	Module over temperature

SLX.Er	**Solutions Module slot X trip: Solutions Module in slot X has detected a fault**
202,207,212	**Fieldbus module category** Check value in Pr **15**/**16**/**17.50**. The following table lists the possible error codes for the Fieldbus modules. See the *Diagnostics* section in the relevant Solutions Module User Guide for more information.

Error code	Module	Trip Description
0	All	No trip
52	SM-PROFIBUS-DP, SM-Interbus, SM-DeviceNet, SM-CANOpen	User control word trip
61	SM-PROFIBUS-DP, SM-Interbus, SM-DeviceNet, SM-CANOpen, SM-SERCOS	Configuration error
64	SM-DeviceNet	Expected packet rate timeout
65	SM-PROFIBUS-DP, SM-Interbus, SM-DeviceNet, SM-CANOpen, SM-SERCOS	Network loss
66	SM-PROFIBUS-DP	Critical link failure
	SM-CAN, SM-DeviceNet, SM-CANOpen	Bus off error
69	SM-CAN	No acknowledgement
70	All (except SM-Ethernet)	Flash transfer error
	SM-Ethernet	No valid menu data available for the module from the drive
74	All	Solutions module over temperature
75	SM-Ethernet	The drive is not responding
76	SM-Ethernet	The Modbus connection has timed out
80	All (except SM-SERCOS)	Inter-option communications error
81	All (except SM-SERCOS)	Communications error to slot 1
82	All (except SM-SERCOS)	Communications error to slot 2
83	All (except SM-SERCOS)	Communications error to slot 3
84	SM-Ethernet	Memory allocation error
85	SM-Ethernet	File system error
86	SM-Ethernet	Configuration file error
87	SM-Ethernet	Language file error
98	All	Internal watchdog error
99	All	Internal software error

<table>
<tr><th>Trip</th><th>Diagnosis</th></tr>
<tr><td>SLX.Er</td><td>Solutions Module slot X trip: Solutions Module in slot X has detected a fault</td></tr>
<tr><td>202,207,212</td><td>SLM module category
Check value in Pr 15/16/17.50. The following table lists the possible error codes for the SM-SLM. See the Diagnostics section in the SM-SLM User Guide for more information.
<table>
<tr><th>Error Code</th><th>Trip Description</th></tr>
<tr><td>0</td><td>No fault detected</td></tr>
<tr><td>1</td><td>Power supply overloaded</td></tr>
<tr><td>2</td><td>SLM version is too low</td></tr>
<tr><td>3</td><td>DriveLink error</td></tr>
<tr><td>4</td><td>Incorrect switching frequency selected</td></tr>
<tr><td>5</td><td>Feedback source selection incorrect</td></tr>
<tr><td>6</td><td>Encoder error</td></tr>
<tr><td>7</td><td>Motor object number of instances error</td></tr>
<tr><td>8</td><td>Motor object list version error</td></tr>
<tr><td>9</td><td>Performance object number of instances error</td></tr>
<tr><td>10</td><td>Parameter channel error</td></tr>
<tr><td>11</td><td>Drive operating mode incompatible</td></tr>
<tr><td>12</td><td>Error writing to the SLM EEPROM</td></tr>
<tr><td>13</td><td>Motor object type incorrect</td></tr>
<tr><td>14</td><td>Unidrive SP object error</td></tr>
<tr><td>15</td><td>Encoder object CRC error</td></tr>
<tr><td>16</td><td>Motor object CRC error</td></tr>
<tr><td>17</td><td>Performance object CRC error</td></tr>
<tr><td>18</td><td>Unidrive SP object CRC error</td></tr>
<tr><td>19</td><td>Sequencer timeout</td></tr>
<tr><td>74</td><td>Solutions module over temperature</td></tr>
</table></td></tr>
<tr><td>SLX.HF</td><td>Solutions Module slot X trip: Solutions Module X hardware fault</td></tr>
<tr><td>200,205,210</td><td>Ensure Solutions Module is fitted correctly
Return Solutions Module to supplier</td></tr>
<tr><td>SLX.nF</td><td>Solutions Module slot X trip: Solutions Module has been removed</td></tr>
<tr><td>203,208,213</td><td>Ensure Solutions Module is fitted correctly
Re-fit Solutions Module
Save parameters and reset drive</td></tr>
<tr><td>SL.rtd</td><td>Solutions Module trip: Drive mode has changed and Solutions Module parameter routing is now incorrect</td></tr>
<tr><td>215</td><td>Press reset.
If the trip persists, contact the supplier of the drive.</td></tr>
<tr><td>SLX.tO</td><td>Solutions Module slot X trip: Solutions Module watchdog timeout</td></tr>
<tr><td>201,206,211</td><td>Press reset.
If the trip persists, contact the supplier of the drive.</td></tr>
<tr><td>t010</td><td>User trip defined in 2nd processor Solutions Module code</td></tr>
<tr><td>10</td><td>SM-Applications program must be interrogated to find the cause of this trip</td></tr>
<tr><td>t038</td><td>User trip defined in 2nd processor Solutions Module code</td></tr>
<tr><td>38</td><td>SM-Applications program must be interrogated to find the cause of this trip</td></tr>
<tr><td>t040 to t089</td><td>User trip defined in 2nd processor Solutions Module code</td></tr>
<tr><td>40 to 89</td><td>SM-Applications program must be interrogated to find the cause of this trip</td></tr>
<tr><td>t099</td><td>User trip defined in 2nd processor Solutions Module code</td></tr>
<tr><td>99</td><td>SM-Applications program must be interrogated to find the cause of this trip</td></tr>
<tr><td>t101</td><td>User trip defined in 2nd processor Solutions Module code</td></tr>
<tr><td>101</td><td>SM-Applications program must be interrogated to find the cause of this trip</td></tr>
<tr><td>t111 to t160</td><td>User trip defined in 2nd processor Solutions Module code</td></tr>
<tr><td>111 to 160</td><td>SM-Applications program must be interrogated to find the cause of this trip</td></tr>
</table>

Trip	Diagnosis
t168 to t175	**User trip defined in 2nd processor Solutions Module code**
168 to 175	SM-Applications program must be interrogated to find the cause of this trip
t216	**User trip defined in 2nd processor Solutions Module code**
216	SM-Applications program must be interrogated to find the cause of this trip
th	**Motor thermistor trip**
24	Check motor temperature Check thermistor continuity Set Pr **7.15** = VOLt and reset the drive to disable this function
thS	**Motor thermistor short circuit**
25	Check motor thermistor wiring Replace motor / motor thermistor Set Pr **7.15** = VOLt and reset the drive to disable this function
tunE*	**Autotune stopped before completion**
18	The drive has tripped out during the autotune The red stop key has been pressed during the autotune The secure disable signal (terminal 31) was active during the autotune procedure
tunE1*	**The position feedback did not change or required speed could not be reached during the inertia test (see Pr 5.12)**
11	Ensure the motor is free to turn i.e. brake was released Check feedback device wiring is correct Check feedback parameters are set correctly Check encoder coupling to motor
tunE2*	**Position feedback direction incorrect or motor could not be stopped during the inertia test (see Pr 5.12)**
12	Check motor cable wiring is correct Check feedback device wiring is correct Swap any two motor phases (closed loop vector only)
tunE3*	**Drive encoder commutation signals connected incorrectly or measured inertia out of range (see Pr 5.12)**
13	Check motor cable wiring is correct Check feedback device U,V and W commutation signal wiring is correct
tunE4*	**Drive encoder U commutation signal fail during an autotune**
14	Check feedback device U phase commutation wires continuity Replace encoder
tunE5*	**Drive encoder V commutation signal fail during an autotune**
15	Check feedback device V phase commutation wires continuity Replace encoder
tunE6*	**Drive encoder W commutation signal fail during an autotune**
16	Check feedback device W phase commutation wires continuity Replace encoder
tunE7*	**Motor number of poles set incorrectly**
17	Check lines per revolution for feedback device Check the number of poles in Pr **5.11** is set correctly
Unid.P	**Power module unidentified trip**
110	Check all interconnecting cables between power modules Ensure cables are routed away from electrical noise sources
UP ACC	**Onboard PLC program: cannot access Onboard PLC program file on drive**
98	Disable drive - write access is not allowed when the drive is enabled Another source is already accessing Onboard PLC program - retry once other action is complete
UP div0	**Onboard PLC program attempted divide by zero**
90	Check program
UP OFL	**Onboard PLC program variables and function block calls using more than the allowed RAM space (stack overflow)**
95	Check program
UP ovr	**Onboard PLC program attempted out of range parameter write**
94	Check program
UP PAr	**Onboard PLC program attempted access to a non-existent parameter**
91	Check program

Trip	Diagnosis
UP ro	**Onboard PLC program attempted write to a read-only parameter**
92	Check program
UP So	**Onboard PLC program attempted read of a write-only parameter**
93	Check program
UP udF	**Onboard PLC program un-defined trip**
97	Check program
UP uSEr	**Onboard PLC program requested a trip**
96	Check program
UV	**DC bus under voltage threshold reached**
1	Check AC supply voltage level **Drive voltage rating (Vac)** — **Under voltage threshold (Vdc)** 200 — 175 400 — 350 575 & 690 — 435

*If a tunE through tunE 7 trip occurs, then after the drive is reset the drive cannot be made to run unless it is disabled via the Secure Disable input (terminal 31), drive enable parameter (Pr **6.15**) or the control word (Pr **6.42** and Pr **6.43**).

Table 15-2 Serial communications look-up table

No.	Trip	No.	Trip	No.	Trip
1	UV	40 to 89	t040 to t089	184	C.FULL
2	OV	90	UP div0	185	C.Acc
3	OI.AC	91	UP PAr	186	C.rtg
4	OI.br	92	UP ro	187	C.TyP
5	PS	93	UP So	188	C.cPr
6	Et	94	UP ovr	189	EnC1
7	O.SPd	95	UP OFL	190	EnC2
8	PS.10V	96	UP uSEr	191	EnC3
9	PS.24V	97	UP udF	192	EnC4
10	t010	98	UP ACC	193	EnC5
11	tunE1	99	t099	194	EnC6
12	tunE2	100		195	EnC7
13	tunE3	101	t101	196	EnC8
14	tunE4	102	Oht4.P	197	EnC9
15	tunE5	103	OIbr.P	198	EnC10
16	tunE6	104	OIAC.P	199	DESt
17	tunE7	105	Oht2.P	200	SL1.HF
18	tunE	106	OV.P	201	SL1.tO
19	It.br	107	PH.P	202	SL1.Er
20	It.AC	108	PS.P	203	SL1.nF
21	O.ht1	109	OldC.P	204	SL1.dF
22	O.ht2	110	Unid.P	205	SL2.HF
23	O.CtL	111 to 160	t111 to t160	206	SL2.tO
24	th	161	Enc11	207	SL2.Er
25	thS	162	Enc12	208	SL2.nF
26	O.Ld1	163	Enc13	209	SL2.dF
27	O.ht3	164	Enc14	210	SL3.HF
28	cL2	165	Enc15	211	SL3.tO
29	cL3	166	Enc16	212	SL3.Er
30	SCL	167	Enc17	213	SL3.nF
31	EEF	168 to 175	t168 to t175	214	SL3.dF
32	PH	176	EnP.Er	215	SL.rtd
33	rS	177	C.boot	216	t216
34	PAd	178	C.bUSY	217	HF17
35	CL.bit	179	C.Chg	218	HF18
36	SAVE.Er	180	C.OPtn	219	HF19
37	PSAVE.Er	181	C.RdO	220 to 232	HF20 to HF32
38	t038	182	C.Err		
39	L.SYnC	183	C.dAt		

Table 12-4 Maximum permissible continuous output current @ 50°C (122°F) ambient for wall mounted drives

Model	Normal Duty								Heavy Duty							
	Nominal rating		Maximum permissible continuous output current (A) for the following switching frequencies						Nominal rating		Maximum permissible continuous output current (A) for the following switching frequencies					
	kW	hp	3kHz	4kHz	6kHz	8kHz	12kHz	16kHz	kW	hp	3kHz	4kHz	6kHz	8kHz	12kHz	16kHz
SP1201	1.1	1.5	5.2						0.75	1.0	4.3					
SP1202	1.5	2.0	6.8						1.1	1.5	5.8					
SP1203	2.2	3.0	9.6					9.0	1.5	2.0	7.5					
SP1204	3.0	3.0	11.0			10.9	9.5	8.3	2.2	3.0	10.6				9.5	8.3
SP2201	4.0	5.0	15.5				13.5	11.5	3.0	3.0	12.6					11.4
SP2202	5.5	7.5	19.7	18.9	17.3	15.9	13.5	11.5	4.0	5.0	17.0			15.7	13.4	11.4
SP2203	7.5	10	19.5	18.6	17.2	15.8	13.4	11.5	5.5	7.5	19.2	18.4	17.0	15.7	13.3	11.4
SP3201	11	15	42.0				38.2		7.5	10	31.0					
SP3202	15	20	54.0		52.8	47.0	38.2		11	15	42.0				37.2	
SP4201	18.5	25	68.0						15	20	56.0					
SP4202	22	30	80.0						18.5	25	68.0					
SP4203	30	40	87.4						22	30	80.0					
SP1401	1.1	1.5	2.8						0.75	1.0	2.1					
SP1402	1.5	2.0	3.8						1.1	2.0	3.0					
SP1403	2.2	3.0	5.0					3.9	1.5	3.0	4.2					3.8
SP1404	3.0	5.0	6.9				5.1	3.9	2.2	3.0	5.8				4.8	3.7
SP1405	4.0	5.0	8.8		7.3	6.0	4.2	3.1	3.0	5.0	7.6		7.2	6.0	4.2	3.1
SP1406	5.5	7.5	10.1	9.0	7.3	6.0	4.2	3.1	4.0	5.0	9.5	9.0	7.2	6.0	4.2	3.1
SP2401	7.5	10	15.3	14.2	11.8	10.0	7.3	5.5	5.5	10	13.0		11.7	9.9	7.3	5.5
SP2402	11	15	15.7	14.2	11.8	10.0	7.3	5.5	7.5	10	15.5	14.1	11.7	9.9	7.3	5.5
SP2403	15	20	16.8	15.0	12.2	10.1	7.1		11	20	16.7	15.0	12.2	10.1	7.1	5.1
SP2404*	15	20	22.3	19.8	15.8	12.8	8.6	5.9	15	20	22.3	19.8	14.0	11.2	7.3	4.6
SP3401	18.5	25	35.0		33.5	28.5	21.5	16.9	15	25	32.0		30.7	26.1	19.7	15.4
SP3402	22	30	43.0	41.5	34.2	28.7	21.0	16.0	18.5	30	40.0		34.1	28.4	20.7	16.0
SP3403	30	40	46.0	41.5	34.2	28.7	21.0		22	30	46.0	41.5	33.6	28.3	20.8	
SP4401	37	50	68.0		66.8	54.9			30	50	60.0		46.7	38.3		
SP4402	45	60	83.0	81.6	66.5	52.3			37	60	68.2	58.6	46.0	37.7		
SP4403	55	75	86.5	86.2	71.3	59.3			45	75	86.5	74.7	60.1	49.8		
SP5401	75	100	138		105.9	87.4			55	100	112.7	96.4	74.5	59.9		
SP5402	90	125	141	140	112	92			75	125	140	123	99.0	82.0		
SP6401	110	150	191.5	190.1	147.6				90	150	180	157.9	121.5			
SP6402	132	200	198.4	180.6	138.1				110	150	190	157.9	116.2			
SP3501	3.0	3.0	5.4						2.2	2.0	4.1					
SP3502	4.0	5.0	6.1						3.0	3.0	5.4					
SP3503	5.5	7.5	8.4						4.0	5.0	6.1					
SP3504	7.5	10	11.0						5.5	7.5	9.5					
SP3505	11	15	16.0			14.7			7.5	10	12.0					
SP3506	15	20	22.0		17.8	14.7			11	15	18.0		16.8	13.9		
SP3507	18.5	25	24.6	22.0	17.8	14.7			15	20	22.0	20.4	16.7	13.9		
SP4601	18.5	25	22.0						15	20	19.0					
SP4602	22	30	27.0			24.7			18.5	25	22.0					
SP4603	30	40	36.0		30.7	24.7			22	30	27.0					
SP4604	37	50	43.0	39.6	30.7	24.7			30	40	36.0		30.7	24.7		
SP4605	45	60	45.6	39.5	30.7	24.7			37	50	43.0	39.6	30.7	24.7		
SP4606	55	75	51.9	44.9	34.7	27.7			45	60	51.9	44.9	34.7	27.7		
SP5601	75	100							55	75						
SP5602	90	125							75	100						
SP6601	110	150							90	125						
SP6602	132	175							110	150						

NOTE

For the definition of ambient temperature, see section 3.9 *Cubicle design and drive ambient temperature* on page 52.

*See **SP2404 Power and current ratings* on page 258.

Table 12-9 Losses @ 50°C (122°F) ambient for wall mounted drives

Model	Drive losses (W) taking into consideration any current derating for the given conditions															
	Normal Duty								Heavy Duty							
	Nominal rating		3kHz	4kHz	6kHz	8kHz	12kHz	16kHz	Nominal rating		3kHz	4kHz	6kHz	8kHz	12kHz	16kHz
	kW	hp							kW	hp						
SP1201	1.1	1.5	33	35	38	42	49	56	0.75	1	27	29	32	35	41	47
SP1202	1.5	2.0	45	47	51	56	64	73	1.1	1.5	38	40	43	47	55	62
SP1203	2.2	3.0	67	70	76	81	92	97	1.5	2.0	51	53	58	62	71	81
SP1204	3.0	3.0	78	82	89	97			2.2	3.0	75	78	86	94	97	
SP2201	4.0	5.0	155	161	173	186	190		3.0	3.0	133	139	150	160	182	190
SP2202	5.5	7.5	190						4.0	5.0	170	176	190			
SP2203	7.5	10	190						5.5	7.5	190					
SP3201	11	15	331	347	380	412	436		7.5	10	260	272	297	321	370	
SP3202	15	20	431	451	480	463	439		11	15	349	365	398	430	439	
SP4201	18.5	25	517	541	589	637			15	20	428	448	488	528		
SP4202	22	30	611	639	694	750			18.5	25	517	541	589	637		
SP4203	30	40	671	701	761	821			22	30	611	639	694	750		
SP1401	1.1	1.5	26	29	37	45	61	76	0.75	1.0	20	24	30	37	51	64
SP1402	1.5	2.0	34	38	48	57	76	95	1.1	2.0	27	31	39	48	64	80
SP1403	2.2	3.0	44	50	61	72	95	97	1.5	3.0	37	42	52	62	82	95
SP1404	3.0	5.0	62	69	83	97			2.2	3.0	52	58	70	83	92	
SP1405	4.0	5.0	83	94	97				3.0	5.0	72	82	97			
SP1406	5.5	7.5	97						4.0	5.0	91	97				
SP2401	7.5	10	186	190					5.5	10	164	178	190			
SP2402	11	15	190						7.5	10	190					
SP2403	15	20	190						11	20	190					
SP2404	15	20	245						15	20	245					229
SP3401	18.5	25	364	392	430	417	399	389	15	25	337	363	399	387	373	364
SP3402	22	30	437	455	435	418	399	388	18.5	30	411	443	435	417	396	388
SP3403	30	40	474	459	429	415	397		22	30	474	459	429	415	397	
SP4401	37	50	714	781	898	852			30	50	629	689	638	617		
SP4402	45	60	882	944	894	814			37	60	716	673	629	607		
SP4403	55	75	877	949	912	875			45	75	876	820	775	750		
SP5401	75	100	1471	1616	1462	1411			55	100	1186	1118	1047	1009		
SP5402	90	125	1500	1644	1543	1480			75	125	1500	1434	1366	1333		
SP6401	110	150	1942	2118	1939				90	150	1817	1747	1610			
SP6402	132	200	2068	2108	1997				110	150	1979	1851	1715			
SP3501	3.0	3.0	127	141	168	196			2.2	2.0	112	124	148	172		
SP3502	4.0	5.0	135	150	180	209			3.0	3.0	127	141	168	196		
SP3503	5.5	7.5	163	181	218	254			4.0	5.0	135	150	180	209		
SP3504	7.5	10	197	219	263	306			5.5	7.5	178	198	237	276		
SP3505	11	15	267	296	354	383			7.5	10	212	235	281	328		
SP3506	15	20	362	399	390	384			11	15	300	332	372	369		
SP3507	18.5	25	405	399	390	384			15	20	365	374	369			
SP4601	18.5	25	409	470	590	711			15	20	360	413	519	625		
SP4602	22	30	496	568	712	789			18.5	25	409	470	590	711		
SP4603	30	40	660	754	805	789			22	30	496	568	712	789		
SP4604	37	50	798	831	805	789			30	40	660	754	805	789		
SP4605	45	60	850	831	805	789			37	50	798	831	805	789		
SP4606	55	75	871	848	816	797			45	60	871	848	816	797		
SP5601	75	100							55	75						
SP5602	90	125							75	100						
SP6601	110	150							90	125						
SP6602	132	175							110	150						

Table 12-10 Losses @ 50°C (122°F) ambient for free standing cubicle drives

Model	Drive losses (W) taking into consideration any current derating for the given conditions														
	Normal Duty							Heavy Duty							
	Nominal rating		3kHz	4kHz	6kHz	8kHz	12kHz	16kHz	Nominal rating		3kHz	4kHz	6kHz	8kHz	12kHz	16kHz
	kW	hp							kW	hp						
SP8411	225	300							185	280						
SP8412	250	400							225	300						
SP8413	315	450							250	400						
SP8414	355	500							315	450						
SP9411	400	600							355	500						
SP9412	450	700							400	600						
SP9413	500	800							450	700						
SP9414	560	900							500	800						
SP9415	675	1000							560	900						

Table 12-11 Power losses from the front of the drive when through-panel mounted

Frame size	Power loss
1	≤50W
2	≤75W
3	≤100W
4	≤204W
5	≤347W
6	≤480W

12.1.3 Supply requirements

Voltage:

SPX20X 200V to 240V ±10%
SPX40X 380V to 480V ±10%
SPX50X 500V to 575V ±10%
SPX60X 500V to 690V ±10%

Number of phases: 3

Maximum supply imbalance: 2% negative phase sequence (equivalent to 3% voltage imbalance between phases).

Frequency range: 48 to 65 Hz

For UL compliance only, the maximum supply symmetrical fault current must be limited to 100kA

Unidrive SP size 6 heatsink fan supply requirements

Nominal voltage: 24V
Minimum voltage: 23.5V
Maximum voltage: 27V
Current drawn: 3.3A
Recommended power supply: 24V, 100W, 4.5A
Recommended fuse: 4A fast blow (I^2t less than $20A^2s$)

12.1.4 Line reactors

Input line reactors reduce the risk of damage to the drive resulting from poor phase balance or severe disturbances on the supply network.

Where line reactors are to be used, reactance values of approximately 2% are recommended. Higher values may be used if necessary, but may result in a loss of drive output (reduced torque at high speed) because of the voltage drop.

For all drive ratings, 2% line reactors permit drives to be used with a supply unbalance of up to 3.5% negative phase sequence (equivalent to 5% voltage imbalance between phases).

Severe disturbances may be caused by the following factors, for example:

- Power factor correction equipment connected close to the drive.
- Large DC drives having no or inadequate line reactors connected to the supply.
- Direct-on-line started motor(s) connected to the supply such that when any of these motors are started, the voltage dip exceeds 20%

Such disturbances may cause excessive peak currents to flow in the input power circuit of the drive. This may cause nuisance tripping, or in extreme cases, failure of the drive.

Drives of low power rating may also be susceptible to disturbance when connected to supplies with a high rated capacity.

Line reactors are particularly recommended for use with the following drive models when one of the above factors exists, or when the supply capacity exceeds 175kVA:

SP1201 SP1202 SP1203 SP1204
SP1401 SP1402 SP1403 SP1404

Model sizes SP1405 to SP4606 have an internal DC choke and SP5401 to SP6602 have internal AC line chokes, so they do not require AC line reactors except for cases of excessive phase unbalance or extreme supply conditions.

When required each drive must have its own reactor(s). Three individual reactors or a single three-phase reactor should be used.

Reactor current ratings

The current rating of the line reactors should be as follows:

Continuous current rating:
Not less than the continuous input current rating of the drive

Repetitive peak current rating:
Not less than twice the continuous input current rating of the drive

12.1.5 Motor requirements

No. of phases: 3

Maximum voltage:
Unidrive SP (200V): 240V
Unidrive SP (400V): 480V
Unidrive SP (575V): 575V
Unidrive SP (690V): 690V

12.1.6 Temperature, humidity and cooling method

Ambient temperature operating range:
0°C to 50°C (32°F to 122°F).
Output current derating must be applied at ambient temperatures >40°C (104°F).

Minimum temperature at power-up:
-15°C (5°F), the supply must be cycled when the drive has warmed up to 0°C (32°F).

Cooling method: Forced convection

Maximum humidity: 95% non-condensing at 40°C (104°F)

14 Technical Data

14.1 Drive

14.1.1 Power and current ratings (Derating for switching frequency and temperature)

For a full explanation of 'Normal Duty' and 'Heavy Duty' refer to section 3.1 *Ratings* on page 10.

Table 14-1 Maximum permissible continuous output current @ 40°C (104°F) ambient

Model	Normal Duty					Heavy Duty				
	Nominal rating		Maximum permissible continuous output current (A) for the following switching frequencies			Nominal rating		Maximum permissible continuous output current (A) for the following switching frequencies		
	kW	hp	3kHz	4kHz	6kHz	kW	hp	3kHz	4kHz	6kHz
SPMA1401	110	150	205		164.1	90	150	180	174.4	134.5
SPMA1402	132	200	236	210.4	157.7	110	150	210	174.8	129.7
SPMA1601	110	150	125			90	125	100		
SPMA1602	132	175	144			110	150	125		
SPMD1401	110	150	205	187	143	90	150	180	150	110
SPMD1402	132	175	248	225	172	110	150	210	175	128
SPMD1403	160	200	290	264	202	132	175	248	206	151
SPMD1404	185	300	335	305	233	160	200	290	241	177
SPMD1601	110	150	125			90	125	100		
SPMD1602	132	175	144			110	150	125		
SPMD1603	160	200	168			132	175	144		
SPMD1604	185	250	192			160	200	168		

NOTE

For the definition of ambient temperature, see section 5.7 *Cubicle design and drive ambient temperature* on page 42.

NOTE

An additional derating of 5% is required for parallel applications.

Table 14-2 Maximum permissible continuous output current @ 50°C (122°F) ambient

Model	Normal Duty					Heavy Duty				
	Nominal rating		Maximum permissible continuous output current (A) for the following switching frequencies			Nominal rating		Maximum permissible continuous output current (A) for the following switching frequencies		
	kW	hp	3kHz	4kHz	6kHz	kW	hp	3kHz	4kHz	6kHz
SPMA1401	110	150	191.5	190.1	147.6	90	150	180	157.9	121.5
SPMA1402	132	200	198.4	180.6	138.1	110	150	190	157.9	116.2
SPMA1601	110	150				90	125			
SPMA1602	132	175				110	150			
SPMD1401	110	150	172	157	120	90	150	163	135	100
SPMD1402	132	175	208	189	145	110	150	190	158	116
SPMD1403	160	200	244	222	170	132	175	224	186	137
SPMD1404	185	300	282	256	196	160	200	262	218	160
SPMD1601	110	150				90	125			
SPMD1602	132	175				110	150			
SPMD1603	160	200				132	175			
SPMD1604	185	250				160	200			

NOTE

For the definition of ambient temperature, see section 5.7 *Cubicle design and drive ambient temperature* on page 42.

NOTE

An additional derating of 5% is required for parallel applications.

14.1.2 Power dissipation

Table 14-3 Losses @ 40°C (104°F) ambient

Model	Drive losses (W) taking into consideration any current derating for the given conditions									
	Normal Duty					Heavy Duty				
	Nominal rating		3kHz	4kHz	6kHz	Nominal rating		3kHz	4kHz	6kHz
	kW	hp				kW	hp			
SPMA1401	110	150	2058	2259	2153	90	150	1817	1935	1772
SPMA1402	132	200	2477	2455	2255	110	150	2192	2042	1888
SPMA1601	110	150				90	125			
SPMA1602	132	175				110	150			
SPMD1401	110	150	2058	2259	2153	90	150	1817	1935	1772
SPMD1402	132	175	2477	2455	2255	110	150	2192	2042	1888
SPMD1403	160	200	2994	3286	3132	132	175	2631	2450	2265
SPMD1404	185	300	3462	3799	3621	160	200	3189	2970	2746
SPMD1601	90	125				75	100			
SPMD1602	110	150				90	125			
SPMD1603	132	175				110	150			
SPMD1604	160	200				132	175			

NOTE

For the definition of ambient temperature, see section 5.7 *Cubicle design and drive ambient temperature* on page 42.

Table 14-4 Losses @ 50°C (122°F) ambient

Model	Drive losses (W) taking into consideration any current derating for the given conditions									
	Normal Duty					Heavy Duty				
	Nominal rating		3kHz	4kHz	6kHz	Nominal rating		3kHz	4kHz	6kHz
	kW	hp				kW	hp			
SPMA1401	110	150	1942	2118	1939	90	150	1817	1747	1610
SPMA1402	132	200	2068	2108	1997	110	150	1979	1851	1715
SPMA1601	110	150				90	125			
SPMA1602	132	175				110	150			
SPMD1401	110	150	1942	2118	1939	90	150	1817	1747	1610
SPMD1402	132	175	2068	2108	1997	110	150	1979	1851	1715
SPMD1403	160	200	2500	2822	2774	132	175	2375	2221	2057
SPMD1404	185	300	2890	3262	3207	160	200	2879	2692	2494
SPMD1601	90	125				75	100			
SPMD1602	110	150				90	125			
SPMD1603	132	175				110	150			
SPMD1604	160	200				132	175			

Table 14-5 Unidrive SPMC/U losses @ 40°C (104°F) ambient

Model	Maximum Losses W
SPMU1401	442
SPMU1402	765
SPMU2402	1524
SPMC1401	525
SPMC1402	871
SPMC2402	1737
SPMU1601	481
SPMU2601	956
SPMC1601	503
SPMC2601	1001

Table 14-6 Power losses from the front of the drive when through-panel mounted

Model	Power loss
SPMA	≤480W
SPMD	≤300W
SPMC/U	≤50W

Table 14-7 Input inductor losses @ 40°C (104°F) ambient

Part number	Model	Maximum Losses W
4401-0181-00	INL401	375
4401-0182-00	INL402	545
4401-0183-00	INL601	233
4410-0184-00	INL602	309

Table 14-8 Output inductor losses @ 40°C (104°F) ambient

Part number	Model	Maximum Losses W
4401-0188-00	OTL411	71
4401-0189-00	OTL412	85
4401-0192-00	OTL413	83
4401-0186-00	OTL414	100

14.1.3 Supply requirements

Voltage:

SPMXX40X 380V to 480V ±10%
SPMXX60X 500V to 690V ±10%

Number of phases: 3

Maximum supply imbalance: 2% negative phase sequence (equivalent to 3% voltage imbalance between phases).

Frequency range: 48 to 62 Hz

For UL compliance only, the maximum supply symmetrical fault current must be limited to 100kA

Unidrive SPMA/D heatsink fan supply requirements

Nominal voltage:	24V
Minimum voltage:	23.5V
Maximum voltage:	27V
Current drawn:	3.3A
Recommended power supply:	24V, 100W, 4.5A
Recommended fuse:	4A fast blow (I^2t <$20A^2s$)

Unidrive SPMC/U external 24V supply requirements

Nominal voltage:	24V
Minimum voltage:	23V
Maximum voltage:	28V
Current drawn:	3A
Minimum start-up voltage:	18V
Recommended power supply:	24V, 100W, 4.5A
Recommended fuse:	4A fast blow (I^2t <$20A^2s$)

NOTE

If the Unidrive SPM power supply (CT part number 8510-0000) is used to supply the Unidrive SPMA/D or SPMC/U fusing is not required.

14.1.4 Unidrive SPM power supply

CT part number:	8510-0000
Current rating:	10A
Input voltage:	85 to 123 / 176 to 264Vac auto switching
Cable size:	0.5mm^2 (20AWG)
Fuse:	5A slow-burn from supply

14.1.5 Additional line reactors

Reactor current ratings

See section 6.2.3 *Supplies requiring additional line reactance* on page 51.

The current rating of the line reactors should be as follows:

Continuous current rating:

Not less than the continuous input current rating of the drive

Repetitive peak current rating:

Not less than twice the continuous input current rating of the drive

14.1.6 Motor requirements

No. of phases: 3

Maximum voltage:

Unidrive SPM (400V): 480V
Unidrive SPM (690V): 690V

14.1.7 Temperature, humidity and cooling method

Ambient temperature operating range:

0°C to 50°C (32°F to 122°F).

Output current derating must be applied at ambient temperatures >40°C (104°F).

Minimum temperature at power-up:

-15°C (5°F), the supply must be cycled when the drive has warmed up to 0°C (32°F).

Cooling method: Forced convection

Maximum humidity: 95% non-condensing at 40°C (104°F)

14.1.8 Storage

-40°C (-40°F) to +50°C (122°F) for long term storage, or to +70°C (158°F) for short term storage.

14.1.9 Altitude

Altitude range: 0 to 3,000m (9,900 ft), subject to the following conditions:

1,000m to 3,000m (3,300 ft to 9,900 ft) above sea level: de-rate the maximum output current from the specified figure by 1% per 100m (330 ft) above 1,000m (3,300 ft)

For example at 3,000m (9,900ft) the output current of the drive would have to be de-rated by 20%.

14.1.10 IP Rating (Ingress Protection)

The Unidrive SPM is rated to IP20 pollution degree 2 (dry, non-conductive contamination only) (NEMA 1). However, it is possible to configure the drive to achieve IP54 rating (NEMA 12) at the rear of the heatsink for through-panel mounting (some current derating is required).

The IP rating of a product is a measure of protection against ingress and contact to foreign bodies and water. It is stated as IP XX, where the two digits (XX) indicate the degree of protection provided as shown in Table 14-9.

Table 14-9 IP Rating degrees of protection

First digit		Second digit	
Protection against contact and ingress of foreign bodies		Protection against ingress of water	
0	No protection	0	No protection
1	Protection against large foreign bodies ϕ > 50mm (large area contact with the hand)	1	-
2	Protection against medium size foreign bodies ϕ > 12mm (finger)	2	-
3	Protection against small foreign bodies ϕ > 2.5mm (tools, wires)	3	Protection against spraywater (up to 60° from the vertical)
4	Protection against granular foreign bodies ϕ > 1mm (tools, wires)	4	Protection against splashwater (from all directions)
5	Protection against dust deposit, complete protection against accidental contact.	5	Protection against heavy splash water (from all directions, at high pressure)
6	Protection against dust ingress, complete protection against accidental contact.	6	Protection against deckwater (e.g. in heavy seas)
7	-	7	Protection against immersion
8	-	8	Protection against submersion

Table 14-10 NEMA enclosure ratings

NEMA rating	Description
Type 1	Enclosures are intended for indoor use, primarily to provide a degree of protection against contact with the enclosed equipment or locations where unusual service conditions do not exist.
Type 12	Enclosures are intended for indoor use, primarily to provide a degree of protection against dust, falling dirt and dripping non-corrosive liquids.

Param	Parameter	Setting Range	Units	Default
P1	Motor FLA	10 – 720	RMS Amps	65
P2	Initial Current	50 – 600	%FLA	100
P3	Maximum Current1	300 – 600	%FLA	600
P4	Accel Ramp Time	2 – 7	Seconds	5
P5	UTS / Stall Timer	1-210	Seconds	10
P6	Decel Begin Level	95 – 70	%	88
P7	Decel Pause Level	32 – 60	%	48
P8	Decel Pause Time	2 – 7	Seconds	5
P9	Decel End Level	25	%	25
P10	Decel Time	2 – 7	Seconds	5
P11	Miscellaneous Commands	0: None 1: Reset Run Time 2: Reset KWh/MWh 3: Enter Reflash mode 4 Store Parameters 5 Load Parameters 6: Factory Reset 7: Std. BIST 8: Powered BIST		0
P12	Modbus Address	1 – 2	-	2
P13	Communication Timeout	OFF, 1 – 120	Seconds	OFF
P14	Phase Order	InS Insensitive AbC ABC CbA CBA		AbC
P15	No Current at Run Fault Enable	EnA, DIS	-	EnA
P16	CT Ratio	72, 96, 144, 288, 864, 2640, 3900, 5760, 8000		288

Param	Parameter	Setting Range	Units	Default
P17	Meter	0: Status 1: Ave Current 2: L1 Current 3: L2 Current 4: L3 Current 5: Curr Imbal 6: Ground Fault 7: Ave Volts 8: L1-L2 Volts 9: L2-L3 Volts 10: L3-L1 Volts 11: Overload 12: Power Factor 13: Watts 14: VA 15: VARS 16: kW hours 17: MW hours 18: Phase Order 19: Line Freq 20: Analog Input 21: Analog Output 22: Run Days 23: Run Hours 24: Starts 25: TruTorque % 26: Power % 27: Peak Current During Last Start 28: Last Start Duration		0
P18	Software Part Number	Display Only		
P19	Passcode			Off
P20	Fault Log			

Comments:

Revised: 02/09/07 – wgb – Changed some defaults based on AK defaults. Removed a few parameters.
02/20/07 – wgb – Removed unused parameters. Revised some parameter ranges.

03/12/07 – wgb – Added two parameters for Modbus address and No Current at Run Fault enable.

03/26/07 – wgb – Changed Modbus address default to 2.

04/04/07 – wgb – Added Last Start Duration to meter options.