Instruction Sheet

Advantage VFD Controller Card

302-064

SUPERSEDES: January 1, 2012

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Plant ID No. 001-4008

Advantage VFD Controller Card

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1.0 IMPORTANT INFORMATION

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result** in death, serious injury or equipment damage.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result** in death, serious injury or equipment damage.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result** in injury or equipment damage.

PLEASE NOTE

Electrical equipment should be serviced only by qualified personnel. No responsibility is assumed by Taco for any consequence arising out of the use of this material. This document is not intended as an instruction manual for untrained persons.

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1.1 Before You Begin

Read and understand these instructions before performing any procedure on this drive.

⚠ DANGER

HAZARDOUS VOLTAGE

- Read and understand the installation manual before installing or operating the Altivar 61 drive. Installation, adjustment, repair and maintenance must be performed by qualified personnel.
- The user is responsible for compliance with all international and national electrical standards in force concerning protective grounding of all equipment.
- Many parts of this variable speed drive, including the printed circuit boards, operate at the line voltage. **DO NOT TOUCH.** Use only electrically insulated tools.
- **DO NOT** touch unshielded components or terminal strip screw connections with voltage present.
- **DO NOT** short across terminals PA and PC or across the DC bus capacitors.
- Install and close all the covers before applying power or starting and stopping the drive.
- Before servicing the variable speed drive:
  - Disconnect all power.
  - Place a **DO NOT TURN ON** label on the variable speed drive disconnect.
  - Lock the disconnect in the open position.
- Disconnect all power including external control power that may be present before servicing the drive. **WAIT 15 MINUTES** to allow the DC bus capacitors to discharge. Then follow the DC bus voltage measurement procedure given in the installation manual to verify that the DC voltage is less than 45 VDC. The drive LEDs are not accurate indicators of the absence of DC bus voltage.

Failure to follow these instructions will result in death or serious injury.

⚠ CAUTION

DAMAGED EQUIPMENT

- **Do not install or operate any drive that appears damaged.**

Failure to follow this instruction can result in equipment damage.

1.2 Documentation Structure

Installation manual

This manual describes:

- Assembly
- How to connect the drive

Programming manual

This manual describes:

- The functions
- The parameters
- How to use the drive display terminal (integrated display terminal and graphic display terminal)

Communication parameters manual

This manual describes:

- The drive parameters with specific information (addresses, formats, etc) for use via a bus or communication network
- The operating modes specific to communication (state chart)
- The interaction between communication and local control

Modbus, BacNET, Apogee FLN P1 manual, DeviceNet, Metasys N2

These manuals describe:

- Connection to the bus or network
- Configuration of the communication-specific parameters via the integrated display terminal or the graphic display terminal
- Diagnostics
- Software setup
- The communication services specific to the protocol

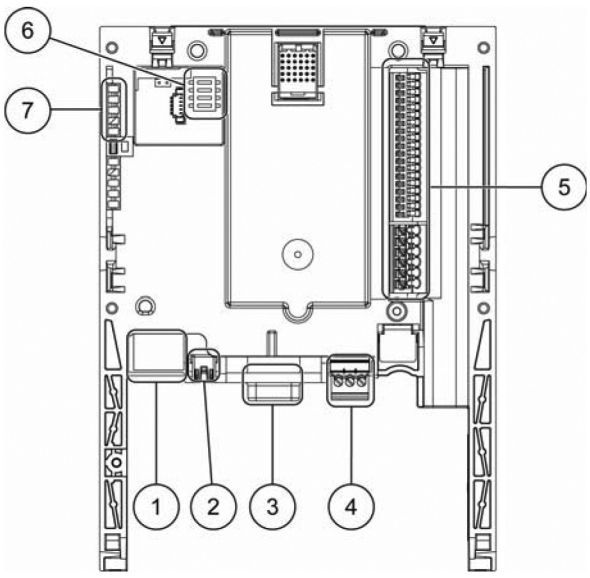
Advantage VFD Controller Card manual

This manual describes:

- Commissioning and functionality of controller system

1.3 Description

Parts Description Diagram



Parts Description Keys

1 - Ethernet port used for programming with SoMachine and for Modbus TCP communication.

2 - Mini-USB B port used for programming with SoMachine.

3 - 9-pin male SUB-D connector for connection to the CANopen bus.

4 - Connector with removable screw terminals, 3 contacts intervals of 3.81 mm (0.15 in.) for the 24 VDC power supply.

5 - 10 logic inputs, 6 logic outputs, 2 analog inputs, 2 analog outputs and 5 commons.

6 - Block of 4 configuration switches.

7 - 5 LEDs comprising:
- 1 LED G/Y **ETH** (Ethernet Activity)
- 1 LED G/R **NS** (Network Status)
- 1 LED G/R **MS** (Module Status)
- 1 LED G/R **CAN** (CANopen)
- 1 LED G/R **USER** programmable from the customer

1.4 Hardware Setup

Description of Terminals

TERMINAL	FUNCTION
24 V	Power supply for the Advantage VFD Controller Card, logic outputs and analog outputs. The Advantage VFD Controller Card should preferably be turned on before the drive. However, the Advantage VFD Controller Card must without fail be turned on no more than 2 seconds after the drive is turned on. Failure to follow this instruction locks the drive in card fault mode ILF). This fault cannot be reset and the only way to acknowledge it is to turn off the drive. Catalog number for a Telemecanique power supply (24 VDC, 2 A): ABL7 RE 24 02
COM	Common ground and electrical 0 V of the Advantage VFD Controller Card power supply, logic inputs (LI••), outputs (LO••), analog inputs (AI••) and analog outputs (AO••). This ground and electrical 0 V are common with the drive ground and electrical 0 V.
LI51 to LI60	24 VDC logic inputs
LO51 to LO56	24 VDC logic outputs
AI51 to AI52	0 ... 20 mA analog inputs
AO51 and AO52	0 ... 20 mA analog outputs

1.5 Characteristics

ELECTRICAL CHARACTERISTICS			
Power	Voltage	V	24 VDC (minimum 19, maximum 30)
Current Consumption	Maximum	A	2
	No Load	mA	80
	Using logic output	mA	200 maximum (see Note 1)
Analog Inputs (see Note 1)	AI51, AI52		2 current analog inputs 0 - 20mA, impedance 250 лъ Resolution: 10 bits Accuracy: ±1% for a temperature variation of 60°C Linearity: ±0.2% of the maximum value Common point for all the card I/O (see Note 2)
Analog Outputs	AO51, AO52		2 current analog outputs 0 - 20mA, impedence 500 лъ Resolution: 10 bits Accuracy: ±1% for a temperature variation of 60°C Linearity: ±0.2% of the maximum value Common point for all the card I/O (see Note 2)
Logic Inputs (see Note 2)	LI51 . . . LI60		10 logic inputs, 2 of which can be used for 2 counters or 4 of which can be used for 2 incremental encoders Impedence 4.4 клъ Maximum voltage: 30 VDC Switching thresholds: State 0 if ≤ 5 V or logic input not wired State 1 if ≥ 11 V Common point for all the card I/O (see Note 2)
Logic Outputs	LO51 . . . LO66		Six 24 VDC logic outputs, positive logic open collector type (source), compatible with level 1 PLC, standard IEC 65A-68 Maximum switching voltage: 30 V Maximum current: 200 mA Common point for all the card I/O (see Note 2)
I/O Connection	Type of contact		Screw, at intervals of 3.81 mm
	Maximum wire	mm2	1.5 (AWG 16)
	Tightening torque	Nm	0.25
Lithium Battery	Life		12 years (approximate)

Note 1: If the power consumption table does not exceed 200mA, this card can be powered by the drive. Otherwise, an external 24 VDC power supply must be used.

Note 2: This common point is also the drive 0 V (COM).

Note 3: When the controller card is installed, the analog inputs may be configured for 4-20mA in screens **[<EXPANSION>] ~ [CONFIG] ~ [CI_AI51 Type**] and **[<EXPANSION>] ~ [CONFIG] ~ [CI_AI52 Type]**. Please See **"[1.14 - WATER SOLUT.] ~ [<EXPANSION>] ~ [CONFIG] ~"** (see Section 2.9.13, page 26).

1.6 Data Backup Battery

The Advantage VFD Controller Card has a non-volatile RAM (NVRAM) which is needed to store variables. A lithium battery is mounted on this nonvolatile RAM to avoid this data being lost when the card is turned off.

2.0 PUMP CONTROL SYSTEM

2.1 Introduction

This program provides a fully featured control algorithm for a pumping system comprising of up to four variable speed pumps. Provisions also exist for a dedicated standby Jockey pump.

Each pump is controlled via ATV61 (or 71) with a Pre-Programmed Altivar-IMC card fitted. The four pump drives are connected via a CANopen network.

The drive with the ATV-IMC card attached is in control of the system operation. This is known as the base load (all) Duty pump. The Duty pump will determine how many pumps need to be operating for the present demand and will operate the Duty pump at a variable speed to make up the demand requirement.

The control algorithm provides a PID function for the Duty pump speed reference. The system duty set point can be entered into the Pump Controller Display Unit. The pressure or temperature feedback is connected to one of the Analog Inputs. In the case of delta-T and delta-P systems, the set point is set on the screen of the display unit and the feedback signals are wired as noted in the system wiring diagram.

Under normal operating conditions, the control algorithm will respond to an increase in demand by initially increasing the speed of the Duty pump. If the Duty pump is unable to fulfill the demand and has already reached full capacity, the control algorithm will switch in one of the External pumps. The Duty pump will then reduce in speed as it shares with the External pump to take up the demand.

The control algorithm will respond to a decrease in demand by initially decreasing the speed of the Duty pump. If the demand decreases further the control algorithm will switch out one of the External pumps. The Duty pump will then increase in speed to take up the demand.

2.2 Operational Modes

There are three modes of operation for the Pump Controller:

2.2.1 Protected Manual Mode is selected by closing digital input IMC_LI51. When in Protected Manual mode the Pump Controller will run at the manual speed reference. All pump related protection algorithms are active and may stop the pump (e.g. Hi Pressure, Cycling, etc).

2.2.2 Override Manual Mode is selected by closing digital input IMC_LI52. When in Override Manual mode the Pump Controller will run at the manual speed reference, but no pump related control functions are active. It is the operator's responsibility to ensure the pump and installation are not operated outside of the normal operating conditions. Typically, the Override Manual function would be used to test motor rotation without the pump protection interfering.

The status will display **PRO MAN (Pmm)** while in Protected Manual Mode and **OVER MAN (Omm)** while in Override Manual mode.

2.2.3 Auto Mode is selected by closing digital input IMC_LI57. When in Auto Mode the following applies:

The Start and Stop commands and the speed reference are generated within the pump's control algorithm. When the pump is not pumping and not in sleep mode the status will display **RDY (RDY)**.

2.3 Operational Features

The following features are available in the Pump Controller:

2.3.1 Duty Sharing

This pump control software is configured so that the Duty Pump will treat the other VSD's as External pumps in a lead pump configuration.

The External pumps will respond to the Duty pump start signal and will then match the speed of the Duty pump. The External Pump "ramp up to speed time" can be adjusted to suit the application.

The control algorithm will respond to an increase in demand by initially increasing the speed of the Duty pump. If the Duty pump is unable to fulfill the demand and has already reached full capacity, the control algorithm will switch in one of the External pumps.

If Duty Sharing is disabled, under increasing demand conditions, the External pumps will be turned on in numerically increasing order, based on CAN network addressing. Under decreasing demand conditions, the External pumps will be turned off in numerically decreasing order. This means External pump 1 always turns on first and off last. However, an External pump that is in an error condition (as detected via CANopen) will be skipped.

If Duty Sharing is enabled, then the External pumps will be selected based on their Run Time counters.

Under increasing demand the External pumps will be selected in order of the lowest Run Time counters. Under decreasing demand, the External pumps are progressively switched off in order of the highest Run Time counters. This means the least used External pump always turns on first and turns off last. However, an External pump that is faulted (via the digital input) will be skipped.

2.3.2 General Fault Segregation

The Pump Controller will respond to a fault condition in one of three ways, depending on the nature of the fault.

1. Drive or motor fault – This is a standard fault and the relevant drive manual should be consulted for further information. If a drive fault does occur however, the system will switch off all external pumps and ramp the Duty pump down before stopping.

2. Resettable System Fault – This is a pump system related fault that is expected to be cleared if the pump (system) shuts down temporarily. Depending on setup, a high pressure detected on the pressure feedback (analog input) or a loss of feedback signal, a pump cavitation condition, or a Flow Switch activation while at high speed will all result in the pump tripping. A relevant fault message will be displayed and pushing key F1 (help) will result in further fault help messaging. If configured for such the system will automatically reset a certain amount of times for each individual fault.

3. Non-Resettable System Fault - This is a pump system fault that is considered too serious to allow the pump to continue

operating. Cycling of the pump (starting too often), activation of the Low Water digital input, or the minimum pressure detection will all result in the pump (system) tripping and remaining off until reset. A relevant fault message will be displayed and pushing key F1 (help) will result in further fault help messaging.

2.3.3 Signal Loss Detection (Fault Tolerant Control)

If a loss of a feedback signal is detected, the system will automatically revert to a preset speed of ¾ of the high speed setting. Loss of signal is characterised by a 0 V or 0mA feedback value and applies to delta-T, delta-P and pressure feedback signals and does not apply to flow feedback signals. The function remains active as long as the system is in run mode.

2.3.4 External Pump Control – increasing demand (staging)

The Duty pump will respond to an increase in demand by initially increasing speed. If the demand is too great for the Duty pump to fulfill, the Duty pump will start an External pump.

A **high demand** condition can be detected by either:

- High Duty pump speed
- High Duty pump speed + delay
- Increasing system error (system error = setpoint – feedback)
- Increasing system error + delay
- High Duty pump speed and increasing system error
- High Duty pump speed and increasing system error + delay

This allows the response mode to be setup to suit the system requirements. By default, the “system error + delay” method is used to make a stage/destage decision.

2.3.5 External Pump Control – decreasing demand (destaging)

The Lead pump will respond to a decrease in demand by initially decreasing speed. If the demand is too low for the number of pumps running, the Lead pump will stop an External pump.

A **low demand** condition can be detected by either:

- Low Lead pump speed
- Low Lead pump speed + delay
- Decreasing (or negative) system error (over pressure)
- Decreasing system error + delay
- Low Lead pump speed and decreasing system error
- Low Lead pump speed and decreasing system error + delay

This allows the response mode to be setup to suit the system requirements.

In some instances, a decreasing demand condition may be required to turn the Lead pump off while one or more External Speed pumps are still running. Due to the flexibility of the Lead pump system, it is possible to configure the Lead pump to turn off due to the No Demand permissive while the External pumps continue to run.

2.3.6 No Demand Operation

During a period of decreasing demand, the control algorithm will turn off the External pumps and the Lead pump speed will decrease. When a No Demand condition is detected, the Lead pump will continue running but revert to the low speed as set up by the user.

A **no demand** condition can be detected by any combination of:

- Low Lead pump speed
- Low Lead pump current
- Low flow rate (flow meter)
- Low flow rate (flow switch)

2.3.7 PID Bypass Speeds

During pump switching, better performance may be achieved if the **PID** is bypassed, rather than relying on the PID response alone to adjust the pump speed to accommodate for the increased or decreased flow capacity. There are two bypass speeds available.

1. Stage Bypass – When the Lead pump requests an External pump to start, the Stage Bypass Speed is used to decrease the Lead pump speed to accommodate for the increased flow capacity of the additional pump.

2. Destage Bypass – When the Lead pump requests an External pump to stop, the Destage Bypass Speed is used to increase the Lead pump speed to accommodate for the decreased flow capacity.

The Lead pump’s status will display **BYP** while any of the Bypass speeds are active.

2.3.8 Setpoint Ramp

On initial starting or after a period of no demand, the feedback pressure may be below the setpoint pressure. To avoid the effects of the resultant feedback error on the PID, the Setpoint Ramp algorithm overrides the pressure setpoint and applies a derived setpoint to the PID controller. The derived setpoint commences at the present feedback pressure (resulting in no error being applied to the PID controller) and ramps up to the desired setpoint. The rate at which the setpoint ramp occurs is adjustable.

The setpoint ramp is considered complete if the system error reduces to 0, (system error = setpoint - feedback) i.e. the system has successfully started and the feedback pressure has risen to the setpoint pressure.

The Lead pump’s status screen will indicate **RAMP** during a Setpoint Ramp.

2.3.9 Pulse Flow Meter Input

The Pump Controller will accept direct connection from a pulse emitter type flow meter. This pulse signal is directly converted into a flow rate within the Pump Control software.

The pump Controller will also accept a flow signal via the analog inputs if required.

2.3.10 Flow Limiting

When the flow must be restricted to a particular level, the Flow Limit algorithm may be used. If the flow reaches the Flow Limit, the motor speed is ramped down. Once the flow is below the Flow Limit, the motor speed is held at its present value (or allowed to decrease if required). The Flow Limit algorithm will release the motor speed once the flow has dropped below the Flow Limit Reset. The rate at which the motor speed is ramped down is adjustable.

While the Flow Limit is active, the status will display **QLT**.

2.3.11 Pipe Fill

On initial start up, it is possible that there is minimal or no fluid in the downstream pipe. To avoid the effects of the

resultant feedback error on the PID, the Pipe Fill algorithm may override the PID when the Lead pump starts. The Lead pump will run at a preset speed until the system pressure increases to indicate the presence of fluid in the pipe.

The Lead pump's status will display **FILL** while the Pipe Fill is active.

2.3.12 Multiple Acceleration and Deceleration Rates

The system uses different rates depending on status. One rate of acceleration and one of deceleration can be configured for times when the speed is below minimum (LSP). This is used to meet pump manufacturer specifications for pumps that require a minimum speed for pump cooling. There are also rates used when the system is under PID control that allows optimum performance. A third deceleration rate is used when the flow limit algorithm is active and a fourth when a fault condition is present.

2.3.13 Automatic Turn-On Turn-Off (Set Time Pumping)

The pump system can be configured to run automatically based on time. The system can be allowed to start at a user specified time and also turn off at a user specified time. This allows for such things as nighttime irrigation.

2.3.14 Pressure Display in Engineering Units

The pressure feedback signal can be displayed as a percentage value, or in the following engineering units:

- psi
- ft.hd
- m.hd
- Bar
- kPa

2.3.15 System Shutdown Options

The lead pump stop type can be selected as either ramp stop or free wheel stop. If a fault condition is present and ramp stop is chosen the system will ramp down at the rate set as the fault ramp and then trip displaying the relevant fault message. If the fault is Resettable the system may restart after a time delay if so configured.

When the Lead pump turns off under No Demand conditions, the destage mode selected will determine the response of the External pumps at this time. If the Lead pump speed is a condition of destaging, then the External pumps will sequentially shutdown at intervals of the destage delay. If the Lead pump speed is not a requirement for destaging, the External pumps will remain running until a decreasing demand causes an over-pressure condition.

2.3.16 Minimum Pressure (High Flow) Protection

If enabled the system will trip if a minimum pressure can't be met when the lead pump is running at a speed greater than that set. If minimum pressure (possible burst pipe) is sensed, the system will stop and trip displaying **MIN PRESS**. *This fault will not auto reset.*

2.3.17 Cavitation Protection

The Lead pump has a Cavitation protection algorithm. Cavitation is detected by high pump speed and low motor current. When cavitation is detected, the system will stop and trip displaying **CAVITATION**. If so configured the system will auto reset.

2.3.18 Low Level Lockout (Low Water) Protection

If enabled the system is unable to start until CI_LI60 is active. If CI_LI60 becomes inactive for longer than a user selectable time and the system is running the drive will trip and display **LOW LEVEL.**

If CI_LI60 is inactive and a start command is given the drive will remain off with the system status displaying **(LOW LEVEL) (LLEV)** periodically.

2.3.19 Cycling Protection

The Cycle Protection is designed to protect against the condition where the system fails to maintain pressure in the READY state and the Lead pump immediately restarts (i.e. a faulty NRV). A start is considered to have occurred every time the pump accelerates from zero speed, and the Cycle counter is incremented on each start.

If cycling is sensed the system will stop and trip displaying **CYCLING**. *This fault will not auto reset*.

2.3.20 Inlet Protection

This feature requires a pressure transducer to be installed on the suction side of the lead pump as well as one on the discharge. The applied setpoint is reduced when the suction pressure falls.

2.3.21 Drive Parameterization (Auto-Commissioning)

This feature is used to set up the motor parameters on all drives in the system (up to 4 drives) from the master drive. The motor parameters replicate the setup on the master drive.

2.3.22 High Temperature

This feature can be used to protect a Pump from over-temperature. A Digital input is used to trip the drive if this feature is used.

2.3.23 Delta-T

The Delta-T function sets the drive up to monitor two Taco iWorx Type III curve thermistors and calculates the differential temperature between these two temperature probes. The differential temperature is used as a feedback reference for the speed regulation PID loop in the controller.The function can be set up for hot or cold water systems.

2.3.24 Delta-P

The Delta-P function sets the drive up to monitor up to a 3 zone differential pressure system. The function determines the zone with the highest demand based on a pre-determined setpoint for each zone. It then regulates speed and staging/destaging based on the requirements of the most critical zone.

2.3.25 Delta-P Flow Reject

The Delta-P function incorporates provisions to enhance the efficiency of a system with the usage of flow meters. By configuring the flow value for a single pump system in the Delta-P menu, the system will destage all other pumps in operation if the flow value drops below the flow capabilities of a single pump. This destaging provision operates in addition to the standard destage function which may be based on feedback error.

2.3.26 Sleep Function

The Taco Pump Card is capable of invoking a sleep mode based on operation below a user defined speed for a user defined period of time. Upon invocation of the sleep mode, the system will stop running and the status would display SLEEP. The system will resume operation when the system feedback goes below a user defined value.

By default, the system sleep setpoint is automatically set to the low speed of the drive and as such the sleep function is not activated.

2.4 System I/O Configuration

The Inputs / Outputs configuration can be changed to allow more flexibility in the system.

The I/O maps are configured as follows.

2.4.1 I/O Map

INPUTS	DESCRIPTION
DIGITAL INPUTS	
IMC_LI51	Protected Manual Mode
IMC_LI52	Override Manual Mode
IMC_LI53	Low Flow Switch (N/C = Healthy)
IMC_LI54	
IMC_LI55	
IMC_LI56	
IMC_LI57	Auto Enable
IMC_LI58	Fault Reset
IMC_LI59	Pulse Flow Switch
IMC_LI60	Low Level Lockout (N/C = Healthy
Drive_LI1	
Drive_LI2	Alternate Reference/Setpoint
Drive_LI4	
Drive_LI5	
Drive_LI6	
ANALOG INPUTS	
IMC_AI51	User Configurable for Level, Flow or Pressure (Current Only)
IMC_AI52	User Configurable for Level, Flow or Pressure (Current Only)
Drive_AI1	User Configurable for Level, Flow, Pressure or Temperature (Voltage Only)
Drive_AI2	User Configurable for Level, Flow, Pressure or Temperature (Current & Voltage)

OUTPUTS	DESCRIPTION
DIGITAL OUTPUTS	
IMC_LO51	
IMC_LO52	
IMC_LO53	
IMC_LO54	System Run
IMC_LO55	System Fault
IMC_LO56	Jockey Pump Run
Drive_Relay1	
Drive_Relay2	
ANALOG OUTPUTS	
IMC_AO51	Not Used by Pump Program.
IMC_AO52	Not Used by Pump Program.
Drive_AO1	Not used by Pump Program. See Drive Manual for configuration.

2.4.2 CANopen Configuration

2.4.2.1 CANopen Wiring

See CANopen wiring schematic in Section 4, Figure 8.

2.4.2.2 CANopen Setup

To setup the CANopen communications, each drive must be configured to the correct CANopen Node Address. When the drive is first powered up go to the following screens:

1. Select menu **1.9 COMMUNICATION**
2. Select **CANopen**
3. Set **CANopen address** to 1 for the duty/master drive and 2, 3 and 4 respectively for the other drives in that order and **CANopen bitrate** to 125kbps
4. Repeat for all drives being configured and then cycle the power to the drives.

Next, configure the **Command Ref.1 Channel** as follows:

1. Select menu **1.6 COMMAND**.
2. Select **REF.1 CHANNEL**.
3. Set **REF.1 CHANNEL** to **PLC Card** for the duty/master VFD (drive 1).
4. Set **REF.1 CHANNEL** to **CANopen** for drives 2, 3 and 4.

2.5 Electrical Schematics

All the I/O connections to the lead pump system are as shown in Section 4, Figures 5, 6 and 7.

Figure 5 is for Delta-T systems with two Type 3 Taco iWorx PTC's.

Figure 6 is for Delta-P systems with feedback from up to 3 differential pressure transmitters.

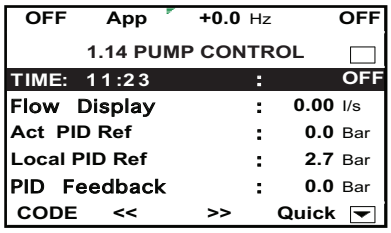
Figure 7 is for E-Flex drives.

2.6 Lead Pump Screen Navigation

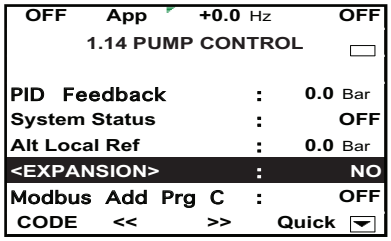
To begin configuring the pump controller the user must navigate to the custom screens. This is done in the following way:

Select **1.14 PUMP CONTROL** and press enter.

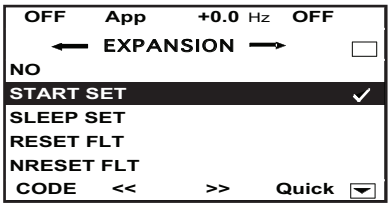
The user will now see the following screen.



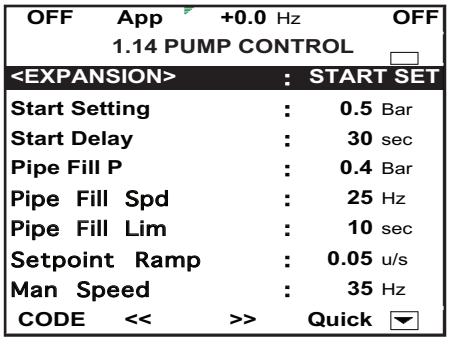
To begin configuring the pump controller, scroll down to **<EXPANSION>** and press enter.



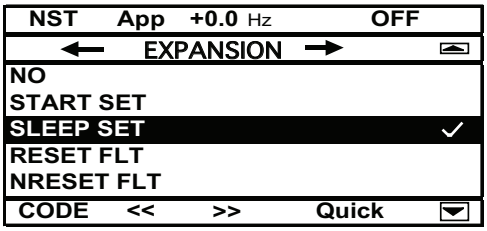
Then select **START SET**.



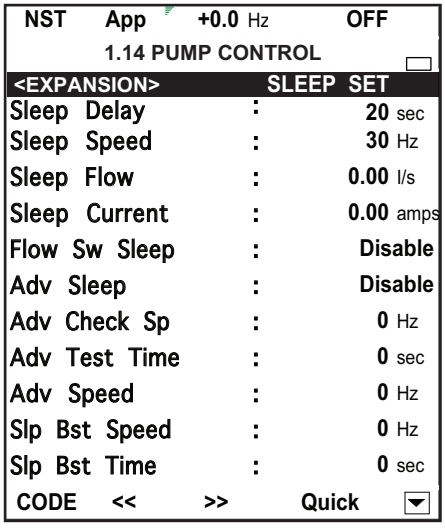
The following screens are now displayed.



Once the start settings have been modified, scroll back to



<EXPANSION> press enter and then select S**LEEP SET**.



The following screens are now displayed.

The same procedure should be followed to configure the variables for the desired functions.

2.7 Pre-Configuration

To ensure correct operation certain standard drive parameters have been pre-configured to suit the lead pump controller. These parameters are preset every time the power is cycled. They are:

- Fr1 [Ref.1 channel] = [Prog.Card] = (APP) = 170
- PSt [Stop Key priority] = [No] (nO) = 0
- CHCF [Profile] = [Separate] (SEP): Reference and command, separate = 1
- CCS [Cmd switching] = [C411] (C411): Internal Bit C411, active = 235
- CD1 [Cmd channel 1] = [Prog.card] (APP): Controller Inside Card = 31
- CD2 [Cmd channel 2] = [Terminals] (tEr): Terminals = 1
- PIF [PID feedback ass.] = [No] (nO): Function inactive = 0
- nSt [Freewheel stop ass.] = [No] (nO): Not assigned = 0

WARNING: The above parameters should not be modified and will be reinitialized to the above values on cycling of drive power.

2.7.1 T/K Mode

The ATV 61 drive sets Function Key F4 (on the drive HMI) to operate the T/K mode on the drive. This mode puts the drive into a fully manual control mode. This means that the drive can be started and stopped from the HMI and there is no control or protection coming from the Controller Card program.

WARNING: This function should be used with caution by experienced operators only.

To disable the T/K Mode functionality, go to Menu **1.6 COMMAND** and set F4 key assignment: from **T/K** to **No**.

2.8 Standard Pump Screens

The first seven screens under **1.14 PUMP CONTROL** are always visible. These screens are used to indicate setpoints, feedback, and system status and to set local PID Setpoints.

Time: XX.YY Status: (indicates the run time and the actual status of the system)

XX.YY is the current time as available from the real time clock. The clock can be adjusted in the last screen available in **1.14 PUMP CONTROL**.

Status indicates the current status of the pump system; refer to the table in the last section of this manual.

Flow Display: (Actual Flow)

This screen indicates the flow as measured by the flow meter. The screen will read 0.00 in case the system doesn't utilize a flow meter.

Act PID Ref: (Actual PID Reference)

This screen indicates the reference currently being presented to the PID controller.

Local PID Ref: (Local PID Reference)

Default	:=	0.0
Minimum	:=	0
Maximum	:=	PID Max Ref
Unit	:=	%, kPa, bar, psi

This screen sets the local reference, which can be activated in screen **1.14 PUMP CONTROL ~ <EXPANSION> ~PID~PID Reference**.

PID Feedback: (PID Feedback)

This screen indicates the PID Feedback as measured by the feedback pressure meter.

System Status: (Actual status of the system)

Status indicates the current status of the pump system; refer to the table in the last section of this manual.

Alt Local Ref: (Alternative Local PID Reference)

Default	:=	0.0
Minimum	:=	0
Maximum	:=	PID Max Ref
Unit	:=	%, kPa, bar, psi

This screen sets the local reference, which can be activated in screen **1.14 PUMP CONTROL ~ <EXPANSION> ~PID~Alt Reference.**

2.9 Parameter Description

2.9.1 <EXPANSION> START SET

Start Press: (Start Pressure)

Default	:=	3200.0
Minimum	:=	Pipe Fill P
Maximum	:=	PID Max Ref
Unit	:=	%, kPa, bar, psi

On a rising edge from CI_LI57 (auto run) the system will enter the ready state. If after the Start Delay, **<EXPANSION> ~ START SET ~ Start Delay**, the feedback pressure is below the start pressure, the drive will start and invoke the pipe fill function.

Alternatively the drive will start with no delay if the system has been in auto and entered the sleep condition and the feedback pressure has fallen below the start pressure. Under these conditions the pipe fill function is not invoked.

This parameter is set to to 3200.0 units (psi/bar/kPa) by default. If sleep function is enabled, this value has to be reduced below the setpoint value to enable the system to re-start.

Start Delay: (Start Delay)

Default	:=	30
Minimum	:=	0
Maximum	:=	999
Unit	:=	sec

On a rising edge from CI_LI57 (auto run) the system will enter the ready state. If after the Start Delay the feedback pressure is below the start pressure, the drive will start.

The Start Delay is only active on a new start unless the Priming Pump is activated. This means the Start Delay is active on each start.

Pipe Fill P: (Pipe Fill Pressure)

Default	:=	0.4
Minimum	:=	0
Maximum	:=	Start Press
Unit	:=	%, kPa, bar, psi

The Pipe Fill function is used to ensure a minimum amount of backpressure is present before allowing the system to enter PID control. This is to prevent any integral wind-up of the PID controller. If the pipe fill function is not desired then set this parameter to zero.

If however the pipe fill function is required the system will enter pipe fill when the drive performs a new start. The pipe fill function is only re-initialized after a rising edge on CI_LI57 (auto run) or a system / drive fault.

When the drive first starts the system will enter pipe fill and display **PIPE FILL (FILL)** as the system status. The system will remain in pipe fill until either the feedback pressure is greater than the value entered for this parameter or the system has been in pipe fill for longer than the time entered in screen **<EXPANSION> ~ START SET ~ Pipe Fill Lim.** If either of these conditions are met the system will enter setpoint ramp.

Pipe Fill Spd: (Pipe Fill Speed)

Default	:=	25
Minimum	:=	LSP
Maximum	:=	HSP
Unit	:=	Hz

When in pipe fill mode the drive will run at this speed or at drive minimum speed (LSP) if that is greater.

Pipe Fill Lim: (Pipe Fill Limit)

Default	:=	10
Minimum	:=	0
Maximum	:=	32767
Unit	:=	sec

If the system has been in pipe fill mode for longer than the time entered in this screen it will enter setpoint ramp mode regardless of the feedback pressure.

This parameter is useful to protect the system from remaining in pipe fill when a large demand is present and the system will never get the feedback pressure to a value greater than the value entered in **<EXPANSION> ~ START SET ~ Pipe Fill P**.

Setpoint Ramp: (Setpoint Ramp)

Default	:=	0.05
Minimum	:=	0.01
Maximum	:=	327.67
Unit	:=	un/s (units per second)

Setpoint ramp is used to prevent integral wind-up of the PID controller during a start sequence. If the selected setpoint is applied directly to the PID controller when the feedback pressure is low, the large error will cause the PID to make large motor speed adjustments to overcome this error. This can result in pressure spikes and water hammer. By ramping the setpoint up at a rate the system can effectively manage, this problem is overcome. The ramp rate is selected in (user selected) units per second.

Assuming the system has left pipe fill mode and the feedback at this point is 2.0 bar then if the selected setpoint is 4.0 bar and the ramp rate set is 0.2 units/sec then the setpoint will take 10 seconds to ramp up to 4.0 bar.

During setpoint ramp the system status will display **SET RAMP (RAMP)**. This will remain displayed until the applied setpoint has reached the selected setpoint and the pressure feedback is greater than or equal to the selected setpoint.

Please note that the system will stage external pumps if staging permissives are met.

Man Speed: (Manual Speed)

Default	:=	35
Minimum	:=	LSP
Maximum	:=	HSP
Unit	:=	Hz

CI_LI51	:=	Protected Manual Mode
CI_LI52	:=	Override Manual Mode
CI_LI57	:=	Auto Run

The three pump modes are mutually exclusive so if any more than one of the above inputs is true the system is locked out and the status display will show **LOCK OUT (LOCK)**.

If however:

CI_LI51 only is true the status display will show **PRO MAN (Pmm)** and the speed reference will be that set in this screen. All system safeties are still valid in this mode, high pressure etc.

CI_LI52 only is true the status display will show **OVER MAN (Omm**) and the speed reference will be that set in this screen. No system safeties are valid in this mode, high pressure etc is ignored.

Man Ref Selec: (Manual Speed Reference Selection)

Default	:=	Local
Range	:=	DRIVE_AI1, DRIVE_AI2, DRIVE_AI3, DRIVE_AI4, CI_AI51, CI_AI52 & LOCAL

The Manual Speed Reference can be selected from any of the available Analog Inputs or Local reference, see **Man Speed**.

2.9.2 <EXPANSION> SLEEP SET

Sleep Delay: (Sleep Delay)

Default	:=	20
Minimum	:=	0
Maximum	:=	3600
Unit	:=	sec

If the sleep function permissives are met the drive will switch off and enter the sleep state after this delay.

Sleep Speed: (Sleep Speed)

Default	:=	30
Minimum	:=	LSP
Maximum	:=	HSP
Unit	:=	Hz

If the drive speed falls below this value after the pipe fill function the sleep delay timer is started. During the sleep delay time the status will display **SLEEP FUN (SLFU)**. If the speed remains below this value for longer than the sleep delay time the drive will accelerate to the sleep boost speed for the sleep boost time and then stop and enter the sleep state. The status will now display **SLEEP (SLP).**

Sleep Flow: (Sleep Flow)

Default	:=	0.00
Minimum	:=	0
Maximum	:=	65535
Unit	:=	l/s, l/m, l/hr

If the flow falls below this value, after the pipe fill function, the sleep delay timer is started. During the sleep delay time the status will display **SLEEP FUN (SLFU)**. If the flow remains below this value for longer than the sleep delay time the drive will accelerate to the sleep boost speed for the sleep boost time and then stop and enter the sleep state. The status will now display **SLEEP (SLP)**.

Sleep Current: (Sleep Current)

Default	:=	0.0
Minimum	:=	0
Maximum	:=	2 * Drive rated current
Unit	:=	Amps

If the motor current falls below this value, after the pipe fill function, the sleep delay timer is started. During the sleep delay time the status will display **SLEEP FUN (SLFU)**. If the current remains below this value for longer than the sleep delay time the drive will accelerate to the sleep boost speed for the sleep boost time and then stop and enter the sleep state. The status will now display **SLEEP (SLP)**.

Flow Sw Sleep: (Flow Switch Sleep)

Default	:=	Disable
Range	:=	Disable or Enable

This parameter allows the user to select whether the flow switch (if installed) is used to instigate the sleep function. If enabled and input CI_LI53 is not active, after the pipe fill function, the sleep delay timer is started. During the sleep delay time the status will display **SLEEP FUN (SLFU)**. If input CI_LI53 remains inactive for longer than the sleep delay time the drive will accelerate to the sleep boost speed for the sleep boost time and then stop and enter the sleep state. The status will now display **SLEEP (SLP).**

Adv Sleep: (Advanced Sleep)

Default	:=	Disable
Range	:=	Disable or Enable

This parameter allows the user to select whether the advanced sleep function is used.

Adv Check Sp: (Advanced Check Speed)

Default	:=	0
Minimum	:=	LSP
Maximum	:=	HSP
Unit	:=	Hz

If a fall in demand doesn't cause either a significant fall in speed, or current, the advanced sleep function is used to periodically monitor the demand. This is typically required when the pump curve is particularly flat and a flow switch and/or meter is not installed.

If the drive speed is below the value entered here, for greater than the time entered in screen **<EXPANSION> ~ SLEEP SET ~ Adv Test Time**, the system will revert to the speed reference entered in screen **<EXPANSION> ~ SLEEP SET ~ Adv Speed**. While adjusting the speed to this new value the PID is disabled to prevent integral wind-up effects when leaving the advanced sleep function.

As soon as the **Adv Speed** is achieved the system reverts to PID control. There are two usual methods of checking for no demand; they are overspeed testing and under-speed testing.

In the case of overspeed testing the **Adv Speed** is set above the **Adv Check Sp** that will cause a negative error on the PID (setpoint-feedback) if no demand is present. This in turn will cause the system to begin reducing the motor speed. As there is no demand the PID error will remain and the motor speed will continue to be reduced until the minimum speed (LSP) is reached. When commissioned correctly this will cause the system to enter the sleep mode.

In the case of underspeed testing the **Adv Speed** is set below parameter **<EXPANSION> ~ SLEEP SET ~ Sleep Speed** which will cause no error on the PID (setpoint-feedback) if no demand is present. As there is no demand there will be no PID error and therefore the system will maintain motor speed below **Sleep Speed**. When commissioned correctly this will cause the system to enter the sleep mode.

Adv Test Time: (Advanced Test Time)

Default	:=	0
Minimum	:=	0
Maximum	:=	9999
Unit	:=	sec

The motor speed must be below Adv Speed for greater than the time entered in this screen before the advanced sleep function is activated.

Adv Speed: (Advanced Speed)

Default	:=	0
Minimum	:=	LSP
Maximum	:=	HSP
Unit	:=	Hz

If the advanced sleep function is active the system will revert to this speed reference.

Slp Bst Speed: (Sleep Boost Speed)

Default	:=	0
Minimum	:=	LSP
Maximum	:=	HSP
Unit	:=	Hz

Immediately prior to entering the sleep state the drive output frequency is set at the value entered in this screen for the time entered in screen **<EXPANSION> ~ SLEEP SET ~ Slp Bst Time**.

Slp Bst Time: (Sleep Boost Time)

Default	:=	0
Minimum	:=	0
Maximum	:=	32767
Unit	:=	Hz

Immediately prior to entering the sleep state the drive output frequency is set to Slp Bst Speed for the time entered in this screen.

2.9.3 <EXPANSION> RESET FLT

No Reset Att: (Number of Reset Attempts)

Default	:=	5
Minimum	:=	0
Maximum	:=	10
Unit	:=	NA

If any of the re-settable faults, cavitation or low flow have their auto reset functionality enabled, the number entered in this screen is the number of resets that will be performed for that particular fault. These attempts will be made at intervals set by parameter **<EXPANSION> ~ RESET FLT ~ Reset Pause.**

If the system trips more times than set in this screen within the time set in screen **<EXPANSION> ~ RESET FLT ~ Att Time** no reset will be performed and the system will need to be reset by activating the reset (digital input CI_LI58), toggling the auto run command (digital input CI_LI57) or pressing the stop reset button on the display. By resetting the system all fault counters are reset to zero. These fault counters are cumulative in that they are not reset to zero each time the **Decrement Dly** rolls over but have the individual counter decremented by one.

Decrement Dly: (Decrement Delay)

Default	:=	3600
Minimum	:=	0
Maximum	:=	9999
Unit	:=	sec

The faults high pressure, cavitation and low flow can be configured to have no consequence, to trip the system or to trip the system with auto-reset capability. If auto reset is selected in screens **<EXPANSION> ~ RESET FLT ~ Hi P Fault** or **<EXPANSION> ~ RESET FLT ~ Cavit Fault** or **<EXPANSION> ~ RESET FLT ~ Flow Fault** and the respective individual fault counter is below **No Reset Att** and that fault has caused the system to trip, then the system will reset after the delay set in screen **<EXPANSION> ~ RESET FLT ~ Reset Pause**. If however the respective fault counter is equal to No Reset Att, then no reset will be performed and the system will need to be reset by activating the reset (digital input CI_LI58), toggling the auto run command (digital input CI_LI57), pushing the keypad stop/reset button or by cycling the power to the drive / controller inside combination.

Reset Pause: (Reset Pause)

Default	:=	3600
Minimum	:=	0
Maximum	:=	9999
Unit	:=	sec

The three faults able to be reset, high pressure, cavitation and low flow, can be configured to have no consequence, to trip the system or to trip the system with auto-reset capability. If auto-reset is selected in screens **<EXPANSION> ~ RESET FLT ~ Hi P Fault** or **<EXPANSION> ~ RESET FLT ~ Cavit Fault** or **<EXPANSION> ~ RESET FLT ~ Flow Fault** and the respective individual fault counter is below **No Reset Att** and that fault has caused the system to trip, then the system will reset after the delay set in this screen. If however the respective fault counter is equal to **No Reset Att** then no reset will be performed and the system will need to be reset by activating the reset (digital input CI_LI58), toggling the auto run command (digital input CI_LI57), pushing the keypad stop/reset button or by cycling the power to the drive/controller inside combination.

Cavit Fault: (Cavitation Fault)

Default	:=	Enable
Range	:=	Disable, Enable or Aut Reset

This screen is used to select the desired response to a cavitation fault sensed by the motor current being less than **Cavit Current** while the motor speed is above **Cavit Speed** for longer than **Cavit Delay**.

If Disable is selected then no action is taken by the system if cavitation is detected.

If Enable is selected and cavitation is detected the system will trip and display **"CAVITATION"**. Pushing Function key F1 will show the fault screen relevant to the fault.

If Aut Reset is selected and cavitation is detected the system will trip and display **"CAVITATION"**. Pushing

Function key F1 will show the fault screen relevant to the fault. After the time delay **Reset Pause** the system will automatically reset as long as the respective individual fault counter is less than No Reset Att.

Cavit Current: (Cavitation Current)

Default	:=	0
Minimum	:=	0
Maximum	:=	2 * Drive rated current
Unit	:=	Amps

Cavitation is detected when the motor current is below the value entered in this screen while the motor speed is above Cavit Speed for longer than Cavit Delay.

Cavit Speed: (Cavitation Speed)

Default	:=	50
Minimum	:=	LSP
Maximum	:=	HSP
Unit	:=	Hz

Cavitation is detected when the motor speed is above the value entered in this screen while the motor current is below **Cavit Current** for longer than **Cavit Delay**.

Cavit Delay: (Cavitation Delay)

Default	:=	10
Minimum	:=	0
Maximum	:=	999
Unit	:=	sec

Cavitation is detected when the motor speed is above **Cavit Speed** while the motor current is below **Cavit Current** for longer than the value entered in this screen.

Flow Fault: (Flow Fault)

Default	:=	Enable
Range	:=	Disable, Enable or Aut Reset

This screen is used to select the desired response to a flow fault.

There are two ways the system detects a flow fault, either by sensing digital input CI_LI53 is inactive or by the flow feedback being below **Lo Flow Level**. The user selects which sensing mechanism to use in screen **<EXPANSION> ~ RESET FLT ~ Lo Flow Sel**.

Regardless of the sensing mechanism selected, low flow protection can be disabled during pipe fill.

This is done in screen **<EXPANSION> ~ RESET FLT ~ Fill Flow Pro** assuming **Fill Flow Pro** was set to **No** (no protection during pipe fill) and Flow Rate or Either was selected in screen **<EXPANSION> ~ RESET FLT ~ Lo Flow Sel.**

On completion of the Pipe Fill function and the low flow protection start delay, **Lo Flo Delay**, a low flow fault occurs if the flow feedback is below **Lo Flow Level** for longer than **Lo Flo Filter** and the motor speed is above **Lo Flo Speed**.

Alternatively, assuming **Fill Flow Pro** was set to **No** (no protection during pipe fill) and **Flow Sw** or **Either** was selected in screen **<EXPANSION> ~ RESET FLT ~ Lo Flow Sel,** on completion of the Pipe Fill function and the low flow protection start delay, **Lo Flo Delay**, a low flow fault occurs if digital input CI_LI53 is inactive for longer than **Lo Flo Filter** and the motor speed is above **Lo Flo Speed**.

If Disable is selected in this screen then no action is taken by the system if low flow is detected.

Alternatively if Enable is selected and a flow fault is generated due to flow feedback the system will trip and display **“FLOW RATE”**. If a flow fault is generated due to digital input CI_LI53 being inactive the system will trip and display “**NO FLOW”**. Pushing Function key F1 will show the fault screen relevant to the fault.

Alternatively if **Aut Reset** is selected and a flow fault is generated due to flow feedback the system will trip and display **“FLOW RATE”**. If a flow fault is generated due to digital input CI_LI53 being inactive the system will trip and display **“NO FLOW”**. Pushing Function key F1 will show the fault screen relevant to the fault. After the time delay **Reset Pause** the system will automatically reset as long as the respective individual fault counter is less than **No Reset Att**.

Lo Flow Sel: (Low Flow Selection)

Default	:=	Flow Sw
Range	:=	Flow Rate, Flow Sw or Either

This screen selects whether the flow feedback, the flow switch or both are used to trip the system under low flow conditions.

Lo Flo Level: (Low Flow Level)

Default	:=	0
Minimum	:=	0
Maximum	:=	327.67
Unit	:=	l/s, l/m, l/hr

If **Flow Rate** or **Rate** or **Sw** is selected in screen **Lo Flow Sel** then the flow rate must be below this level for a flow rate generated fault to occur.

Lo Flo Speed: (Low Flow Speed)

Default	:=	25
Minimum	:=	LSP
Maximum	:=	HSP
Unit	:=	Hz

The motor speed must be above the value entered in this screen for a flow fault to be generated.

Lo Flo Delay: (Low Flow Delay)

Default	:=	30
Minimum	:=	0
Maximum	:=	999
Unit	:=	sec

If low flow protection during Pipe Fill is enabled in screen Fill Flow Pro then as soon as the drive starts the Low Flow Delay is started. A flow fault can only occur after this delay has timed out.

Alternatively, if low flow protection during Pipe Fill is disabled in screen **Fill Flow Pro** then as soon as the Pipe Fill has finished the Low Flow Delay is started. A flow fault can only occur after this delay has timed out.

Lo Flo Filter: (Low Flow Filter)

Default	:=	2
Minimum	:=	0
Maximum	:=	999
Unit	:=	sec

After **Lo Flo Delay** the flow rate or flow switch permis-

sives must be met for greater than this time before the system will trip. This value is a de-bounce time to prevent nuisance faults.

Fill Flow Pro: (Fill Flow Protection)

Default	:=	NO
Range	:=	NO or YES

If this function is enabled (**YES** selected) the low flow protection is active during pipe fill. If disabled (**NO** selected) the low flow protection is only active after pipe fill has finished.

2.9.4 <EXPANSION> NRESET FLT

Cycle Time: (Cycle Time)

Default	:=	60
Minimum	:=	0
Maximum	:=	3600
Unit	:=	sec

If the drive transitions from the NST state to the Run state (drive starts), the cycle counter is incremented by one. If the Cycle Counter is greater than **<EXPANSION> ~ NRESET FLT ~ Cycle Count** the system will trip and require a reset via activation of CI_LI58, toggling the auto command (CI_LI57) or pushing the drive stop / reset button.

The cycle count is reset to zero each time the period set in this screen elapses.

Cycle Count: (Cycle count)

Default	:=	3
Minimum	:=	0
Maximum	:=	99
Unit	:=	Na

If the drive transitions from the NST state to the Run state (drive starts), the cycle counter is incremented by one. If the Cycle Counter is greater than **<EXPANSION> ~ NRESET FLT ~ Cycle Coun**t the system will trip and require a reset via activation of CI_LI58, toggling the auto command (CI_LI57) or pushing the drive stop / reset button.

Min Press Flt: (Minimum Pressure Fault)

Default	:=	Enable
Range	:=	Disable or Enable

If the drive is running and the system is not in Override Manual mode and the feedback pressure is less than **<EXPANSION> ~ NRESET FLT ~ Min Press Lev** for longer than **<EXPANSION> ~ NRESET FLT ~ Min Press Dly**, the system will trip and display **MIN PRESS**.

Min Press Lev: (Minimum Pressure Level)

Default	:=	0.0
Minimum	:=	0.0
Maximum	:=	3276.7
Unit	:=	%, kPa, bar, psi

If the drive is running and the system is not in Override Manual mode and the feedback pressure is less than **<EXPANSION> ~ NRESET FLT ~ Min Press Lev** for longer than **<EXPANSION> ~ NRESET FLT ~ Min Press Dly**, the system will trip and display **MIN PRESS**.

Min Press Dly: (Minimum Pressure Delay)

Default	:=	10
Minimum	:=	0
Maximum	:=	3600
Unit	:=	sec

If the drive is running and the system is not in Override Manual mode and the feedback pressure is less than **<EXPANSION> ~ NRESET FLT ~ Min Press Lev** for longer than **<EXPANSION> ~ NRESET FLT ~ Min Press Dly**, the system will trip and display **MIN PRESS**.

Low Lev: (Low Level)

Default	:=	Enable
Range	:=	Disable or Enable

If the drive is running and the system is not in Override Manual mode and digital input CI_LI60 is inactive for longer than **<EXPANSION> ~ NRESET FLT ~ Low Lev Dly** and this screen is set to **Enable**, the system will trip and display L**OW LEVEL**.

If CI_LI60 is inactive and a start command is given the drive will remain off with the system status displaying **LOW LEVEL (LLEV)** periodically.

Low Lev Dly: (Low Level Delay)

Default	:=	2
Minimum	:=	0
Maximum	:=	3600
Unit	:=	sec

If the drive is running and the system is not in Override Manual mode and digital input CI_LI60 is inactive for longer than the time entered in this screen and Low Lev is set to Enable, the system will trip and display **LOW LEVEL**.

Hi Temp: (High Temperature)

Default	:=	Enable
Range	:=	Disable or Enable

If the drive is running and the system is not in Override Manual mode and digital input DRIVE_LI4 is inactive for one second and this screen is set to Enable, the system will trip and display **HIGH TEMP**.

If DRIVE_LI4 is inactive and a start command is given, the drive will remain off with the system status displaying **HIGH TEMP (HI T)** periodically.

2.9.5 <EXPANSION> SENSORS

Outlet TX Max: (Outlet Transducer Maximum)

Default	:=	10.0
Minimum	:=	0.1
Maximum	:=	3276.7

This screen is used to inform the system of the range of the transducer being used to measure outlet / discharge pressure. It is always assumed that the minimum is zero (i.e., a 0-10bar transducer would be selected rather than a 2-10 bar device). If the transducer used is 4-20mA and 0-10.0 bar then 10.0 should be entered in this screen, and bar should be selected as pressure unit.

Please note that if one of the Controller Inside analog inputs is used for outlet / discharge pressure, it must be correctly configured in screens **<EXPANSION> ~ CONFIG ~ CI_AI51 Type** or **<EXPANSION> ~ CONFIG ~ CI_AI52 Type** respectively.

If one of the drive analog inputs is used it must be configured to suit the device being used under **1.5 INPUTS/OUTPUTS CFG**.

Inlet TX Max: (Inlet Transducer Maximum)

Default	:=	10.0
Minimum	:=	0.1
Maximum	:=	3276.7

This screen is used to inform the system of the range of the transducer being used to measure inlet / suction pressure. It is always assumed that the minimum is zero (i,e., a 0-10bar transducer would be selected rather than a 2-10 bar device). If the transducer used is 4-20mA and 0-10.0 bar then 10.0 should be entered in this screen and bar should be selected as pressure unit.

Please note that if one of the Controller Inside analog inputs is used for inlet / suction pressure, it must be correctly configured in screens **<EXPANSION> ~ CONFIG ~ CI_AI51 Type** or **<EXPANSION> ~ CONFIG ~ CI_AI52 Type** respectively.

If one of the drive analog inputs is used it must be configured to suit the device being used under **1.5 INPUTS/OUTPUTS CFG**.

Press Units: (Pressure Units)

Default	:=	bar
Range	:=	%, kPa, bar, psi, l/s, l/m or l/h

This screen sets the unit displayed for all other screens that display or allow modification of a pressure value. The unit selected is for display purposes only and in no way affects any numerical values.

When changing the unit for display, the other screens in this sub-group **<EXPANSION> ~SENSORS ~** are not updated until another sub-group is selected and this one re-entered.

Flow Source: (Flow Source)

Default	:=	NONE
Range	:=	NONE, CI_LI59, DRIVE_AI1, DRIVE_AI2, DRIVE_AI3, DRIVE_AI4, CI_AI51, CI_AI52

This screen configures what type of transducer is used to measure flow. If a pulse flow meter is used, **CI_LI59** must be selected. If an analog meter is used, one of the listed analog sources should be selected. If no flow transducer is used, **NONE** should be selected.

Please note the following:

If one of the Controller Inside analog inputs is used, it must be correctly configured in screens **<EXPANSION> ~ CONFIG ~ CI_AI51 Type** or **<EXPANSION> ~ CONFIG ~ CI_AI52 Type** respectively.

If any of the analog sources are selected, the adjustable range is dependent on the flow unit that is selected in screen **<EXPANSION> ~ SENSORS ~ Flow Units**.

If **litres / s** is selected there will be two decimal places,

If **Litres / m** is selected there will be one decimal place,

If **Litres / h** is selected there will be no decimal places in the following screens:

Flow Display

<EXPANSION> ~ SLEEP SET ~ Sleep Flow
<EXPANSION> ~ RESET FLT ~ Lo Flow Level
<EXPANSION> ~ SENSORS ~ Flow AIN Tx
<EXPANSION> ~ FLOW LMT ~ Flow Limit
<EXPANSION> ~ FLOW LMT ~ Flo Lmt Reset
<EXPANSION> ~ FLOW COMP ~ Known Flow
<EXPANSION> ~ FLOW COMP ~ Known Flow

This equates to a maximum measured flow rate of 655.35 litres per second, 6553.5 litres per minute or 65535 litres per hour when an analog flow meter source is used.

If **CI_LI59** is selected the amount of decimal places for the above listed screens is based on the following:

If **<EXPANSION> ~ SENSORS ~ Volume** divided by **<EXPANSION> ~ SENSORS ~ Pulses/volume** is less than 0.1, then two decimal places are used.

If **<EXPANSION> ~ SENSORS ~ Volume** divided by **<EXPANSION> ~ SENSORS ~ Pulses/volume** is less than or equal to 1, one decimal place is used. Otherwise no decimal places are used.

Therefore a pulse flow transducer with 20 pulses per litre will cause two decimal places, a pulse flow transducer with 5 pulses per litre will cause one decimal place and a pulse flow transducer with 1 pulse per 10 litres will cause no decimal places.

T**he maximum frequency possible if CI_LI59 is used as pulse flow input is 5kHz.**

Flow AIN Tx: (Flow Transducer Analog Input Maximum)

Default	:=	0.00
Minimum	:=	0.00
Maximum	:=	65535

This screen is used to inform the system of the range of the transducer being used to measure flow if an analog transducer is used. This screen is redundant if CI_LI59 or NONE was selected in screen **<EXPANSION> ~SENSORS~ Flow Source**.

It is always assumed that the minimum is zero (i.e., a 0-10 bar transducer would be selected rather than a 2-10 bar device). If the transducer used is 0-20mA and 0-10000 litres/s, then 10000 should be entered in this screen and litres/s should be selected as flow unit.

Please note that if one of the Controller Inside analog inputs is used for inlet / suction pressure, then it must be correctly configured in screens **<EXPANSION> ~ CONFIG ~ CI_AI51 Type** or **<EXPANSION> ~ CONFIG ~ CI_AI52 Type** respectively.

If one of the drive analog inputs is used, it must be configured to suit the device being used under **1.5 INPUTS/OUTPUTS CFG**.

Pulses/volume: (Pulses per volume)

Default	:=	1.00
Minimum	:=	0.1
Maximum	:=	655.35
Unit	:=	pu/v

If a pulse flow transducer is used, this screen sets the amount of pulses expected per volume set in screen **<EXPANSION> ~ SENSORS ~ Volume**.

See also **<EXPANSION> ~ SENSORS ~ Flow Source** for a description of scaling effects.

Volume: (Volume)

Default	:=	1
Minimum	:=	1
Maximum	:=	65535
Unit	:=	pu/v

If a pulse flow transducer is used, this screen sets the volume expected per pulse set in screen **<EXPANSION> ~ SENSORS ~ Pulses/volume**.

See also **<EXPANSION> ~ SENSORS ~ Flow Source** for a description of scaling effects.

Flow Units: (Flow Units)

Default	:=	l/s
Range	:=	%, kPa, bar, psi, l/s, l/m or l/h

This screen sets the unit displayed for all other screens that display or allow modification of a flow rate.

See also **<EXPANSION> ~ SENSORS ~ Flow Source** for a description of scaling effects.

Flow Filter: (Flow Filter)

Default	:=	0
Minimum	:=	0
Maximum	:=	65535
Unit	:=	sec

If a pulse flow transducer is used, this screen sets the filter time base. If the signal is of a reasonably high frequency, some instability may be present. This filter is used to dampen the rate of change of the derived flow rate.

WARNING: If the value entered is too high, long delays may be present between a change of flow and any desired evasive action taking place.

CAN Flow dp: (CAN Flow Decimal Places)

Default	:=	0
Minimum	:=	0
Maximum	:=	2
Unit	:=	d.p

This screen is used to scale the input flow from the CAN network. O to 2 decimal places can be selected. This screen is only used if **CAN** is selected as the flow source.

2.9.6 <EXPANSION> FLOW LMT

Activate Lim: (Activate Limit)

Default	:=	Disable
Range	:=	Disable or Enable

This parameter enables or disables the flow limit function of the pump controller.

If flow limiting is enabled and the measured flow increases to a level greater than **<EXPANSION> ~ FLOW LIMIT ~ Flow Limit,** the controller immediately ceases PID control and begins to decelerate the motor at the flow limit rate set in screen **<EXPANSION> ~ FLOW LIMIT ~ Flow Lmt Ramp**. The motor will continue to decelerate until such time as the measured flow is below Flow Limit. At this time the current motor speed is maintained. The system will remain in flow limit until such time as the measured flow is less than **<EXPANSION> ~ FLOW LIMIT ~ Flow Lmt Reset** when the system again reverts to PID control.

Flow Limit: (Flow Limit)

Default	:=	0.0
Minimum	:=	Flo Lmt Reset
Maximum	:=	32767
Unit	:=	%, kPa, bar, psi, l/s, l/m or l/h

If the flow limit function is enabled, flow limiting action is initiated when the measured flow increases to a level greater than that entered in this screen.

Flo Lmt Reset: (Flow Limit Reset)

Default	:=	0.0
Minimum	:=	0.0
Maximum	:=	Flow Limit
Unit	:=	%, kPa, bar, psi, l/s, l/m or l/h

If the flow limit function is enabled, flow limiting action is terminated when the measured flow decreases to a level less than that entered in this screen.

Flow Lmt Ramp: (Flow Limit Ramp)

Default	:=	10.0
Minimum	:=	0.0
Maximum	:=	999.9
Unit	:=	sec

If the flow limit function is enabled, this is the rate at which the motor will be decelerated when the measured flow is above Flow Lmt.

2.9.7 <EXPANSION> PID

PID Reference: (PID Reference)

Default	:=	Local
Range	:=	DRIVE_AI1, DRIVE_AI2, DRIVE_AI3, DRIVE_AI4, CI_AI51, CI_AI52 or LOCAL

This parameter is used to select the reference for the pump controller PID.

Please note that if one of the Controller Inside analog inputs is used for PID Reference, it must be correctly configured in screens **<EXPANSION> ~ CONFIG ~ CI_AI51 Type** or **<EXPANSION> ~ CONFIG ~ CI_AI52 Type** respectively.

If one of the drive analog inputs is used, it must be configured to suit the device being used under **1.5 INPUTS/OUTPUTS CFG**.

PID Max Ref: (PID Maximum Reference)

Default	:=	3200.0
Minimum	:=	0.0
Maximum	:=	3276.7
Unit	:=	%, kPa, bar, psi

This parameter sets the maximum setpoint that can ever be applied to the pump controller PID. This can be used to prevent inadvertent operator error during adjustment of the PID setpoint.

PID Feedback: (PID Feedback)

Default	:=	DRIVE_AI2
Range	:=	DRIVE_AI1, DRIVE_AI2, DRIVE_AI3, DRIVE_AI4, CI_AI51, CI_AI52 or CAN

This parameter is used to select the Feedback for the pump controller PID.

Please note that if one of the Controller Inside analog inputs is used for PID Feedback, it must be correctly configured in screens **<EXPANSION> ~ CONFIG ~ CI_AI51 Type** or **<EXPANSION> ~ CONFIG ~ CI_AI52 Type** respectively.

If flow is to be used as the PID feedback, please ensure that the flow transducer details have been entered correctly in the **<EXPANSION> ~ SENSORS** screens prior to operation.

If one of the drive analog inputs is used it must be configured to suit the device being used under **1.5 INPUTS/OUTPUTS CFG**.

PID Gain: (PID Gain)

Default	:=	+1.40
Minimum	:=	-100.00
Maximum	:=	+100.00
Unit	:=	x

This parameter sets proportional gain of the custom PID controller.

PID Integral: (PID Integral)

Default	:=	2.00
Minimum	:=	0.00
Maximum	:=	100.00
Unit	:=	sec

This parameter sets integral gain of the custom PID controller.

PID Deriv: (PID Derivative)

Default	:=	0.00
Minimum	:=	0.00
Maximum	:=	100.00
Unit	:=	sec

This parameter sets derivative gain of the custom PID controller and is not typically altered.

PID Accel: (PID Acceleration)

Default	:=	5.0
Minimum	:=	0.0
Maximum	:=	999.9
Unit	:=	sec

This parameter sets the minimum time required for the PID controller to accelerate the motor from zero speed to motor rated frequency (FrS) when in PID control. This rate is used whenever the actual motor speed (rFr) is above the motor low speed (LSP) and PID control is active (i.e., not flow limiting and no fault conditions and not stopping).

PID Decel: (PID Deceleration)

Default	:=	5.0
Minimum	:=	0.0
Maximum	:=	999.9
Unit	:=	sec

This parameter sets the minimum time required for the PID controller to decelerate the motor from motor rated frequency (FrS) to zero speed when in PID control. This rate is used whenever the actual motor speed (rFr) is above the motor low speed (LSP) and PID control is active (i.e., not flow limiting and no fault conditions and not stopping).

Strt Acc Rate: (Starting Acceleration Rate)

Default	:=	3.0
Minimum	:=	0.0
Maximum	:=	999.9
Unit	:=	sec

This parameter sets the time required for the system to accelerate the motor from zero speed to motor rated frequency (FrS). This rate is used whenever the actual motor speed (rFr) is below the motor low speed (LSP) setting and no fault conditions are present.

Stp Dec Rate: (Stopping Deceleration Rate)

Default	:=	3.0
Minimum	:=	0.0
Maximum	:=	999.9
Unit	:=	sec

This parameter sets the time required for the system to decelerate from motor rated frequency (FrS) to zero speed. This rate is used whenever a stop command is present.

Alt Reference: (Alternative Reference)

Default	:=	Local
Range	:=	DRIVE_AI1, DRIVE_AI2, DRIVE_AI3, DRIVE_AI4, CI_AI51, CI_AI52 or LOCAL

This parameter is used to select the alternative reference for the pump controller PID. This reference becomes active when drive digital input two (DRIVE_LI2) is active.

See Figure 1.

2.9.8 <EXPANSION> STAGE

The Multi VSD can be used to stage up to 3 additional pumps. This means the additional pumps must be connected to the host drive controller card via CANopen.

Number of EXT: (Number of External Pumps)

Default	:=	0
Minimum	:=	0
Maximum	:=	3

This parameter sets the number of auxiliary pumps that are installed.

Note: The number of drives as configured in this parameter is not related to the number of drives as set up in the **<AUTO-COMM>** expansion menu.

Duty Sharing: (Duty Sharing)

Default	:=	Enable
Range	:=	ON or OFF

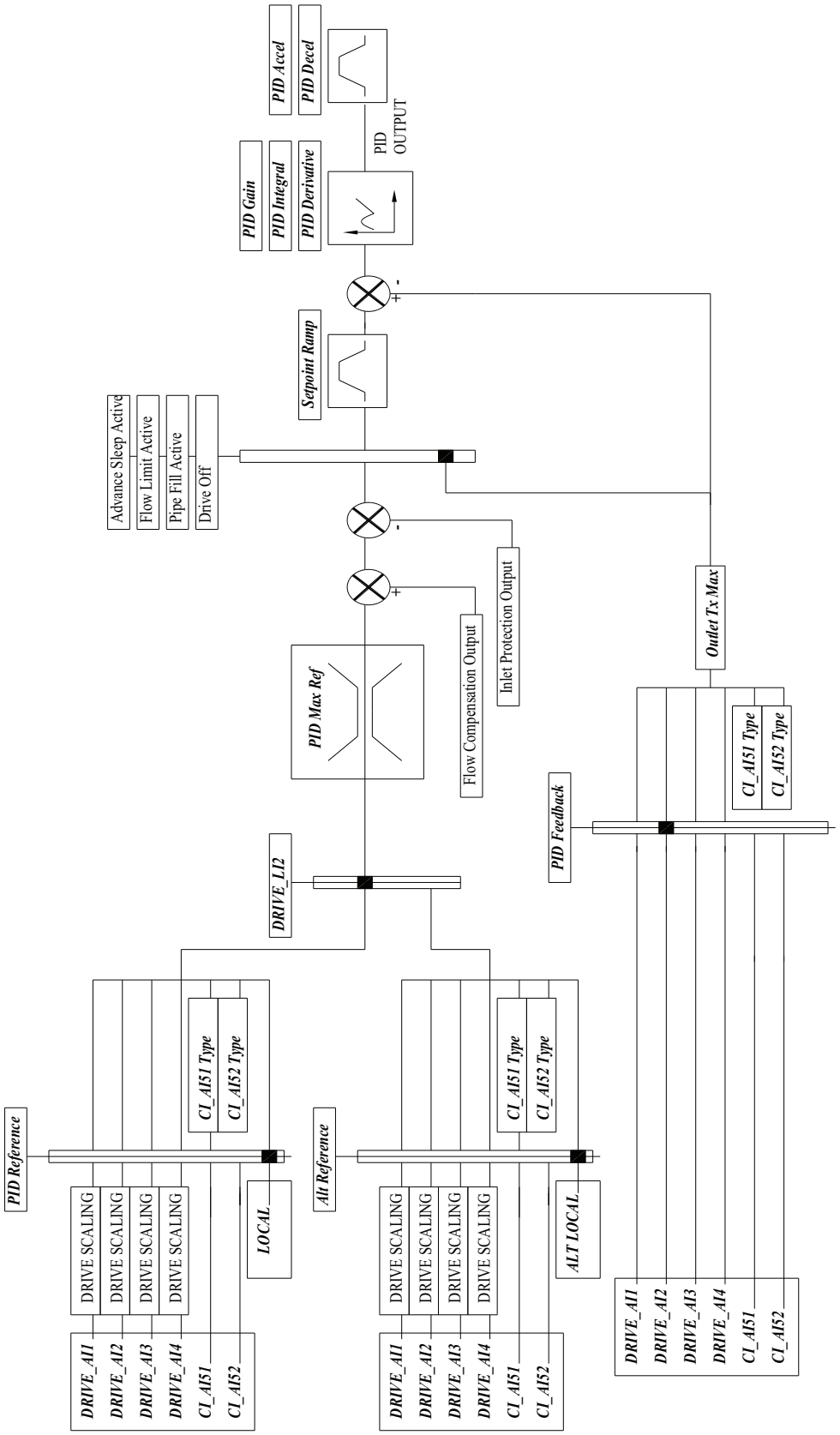
If duty sharing is enabled and an auxiliary pump is required, the pump with the least amount of run hours will always be started first. If an auxiliary pump is required to be destaged, the pump with the most run hours will always be stopped first. If duty sharing is disabled, the pumps will be started and stopped numerically (i.e., 1 on then 2 on then 3 on 3 off then 2 off then 1 off).

Parameter set **<EXPANSION> ~ SAVED TIM ~** shows the saved run time hours for all pumps.

Stage Mode: (Stage Mode)

Default	:=	Sp+Pr+Dly
Range	:=	Sp+Pr+Dly, Sp+Pr, Sp+Dly, Sp Only, Pr+Dly, Pr Only

Figure 1: PID Schematic



This parameter sets the permissives that will be needed before an auxiliary pump is started.

Sp+Pr+Dly - If this is selected, an auxiliary pump will not be staged until the lead pump speed is greater than **<EXPANSION> ~ STAGE ~ Stage Speed**, the system error (setpoint – feedback) is greater than **<EXPANSION> ~ STAGE ~ Stage Error** and these two permissive have been true for longer than **<EXPANSION> ~ STAGE ~ Stage Delay**.

Sp+Pr - If this is selected, an auxiliary pump will not be staged until the lead pump speed is greater than **<EXPANSION> ~ STAGE ~ Stage Speed** and the system error (setpoint – feedback) is greater than **<EXPANSION> ~ STAGE ~ Stage Error**.

Sp+Dly - If this is selected, an auxiliary pump will not be staged until the lead pump speed is greater than **<EXPANSION> ~ STAGE ~ Stage Speed** for longer than **<EXPANSION> ~ STAGE ~ Stage Delay**.

Sp Only - If this is selected, an auxiliary pump will not be staged until the lead pump speed is greater than **<EXPANSION> ~ STAGE ~ Stage Speed**.

Pr+Dly - If this is selected, an auxiliary pump will not be staged until the system error (setpoint – feedback) is greater than **<EXPANSION> ~ STAGE ~ Stage Error** for longer than **<EXPANSION> ~ STAGE ~ Stage Delay**.

Pr Only - If this is selected, an auxiliary pump will not be staged until the system error (setpoint – feedback) is greater than **<EXPANSION> ~ STAGE ~ Stage Error**.

See Figure 2.

Stage Speed: (Stage Speed)

Default	:=	50
Minimum	:=	Stg Byp Spd
Maximum	:=	HSP
Unit	:=	Hz

This parameter sets the minimum speed of the lead pump before an auxiliary pump is started if **Speed** is one of the stage permissives selected in screen **<EXPANSION> ~ STAGE ~ Stage Mode**.

See Figure 2.

Stage Error: (Stage Error)

Default	:=	0.0
Minimum	:=	0.0
Maximum	:=	3276.7
Unit	:=	%, kPa, bar, psi

This parameter sets the required system error (setpoint – feedback) before an auxiliary pump is started if **Error** is one of the stage permissives selected in screen **<EXPANSION> ~ STAGE ~ Stage Mode**.

See Figure 2.

Stage Delay: (Stage Delay)

Default	:=	5
Minimum	:=	1
Maximum	:=	3600
Unit	:=	sec

This parameter sets the required delay after a selected permissive has been met before an auxiliary pump is started if **Delay** is one of the stage permissives selected in screen **<EXPANSION> ~ STAGE ~ Stage Mode**.

See Figure 2.

Stg Byp Spd: (Stage Bypass Speed)

Default	:=	50
Minimum	:=	LSP
Maximum	:=	Stage Speed
Unit	:=	Hz

Immediately prior to staging an auxiliary pump the lead pump will decelerate to the speed entered in this screen and will remain at this speed for the time entered in screen **<EXPANSION> ~ STAGE ~ Stg Byp Time**. After this time the system reverts back to PID control.

See Figure 2.

Stg Byp Time: (Stage Bypass Time)

Default	:=	5
Minimum	:=	1
Maximum	:=	3600
Unit	:=	sec

Immediately prior to staging an auxiliary pump the lead pump will decelerate to the speed entered in screen **<EXPANSION> ~ STAGE ~ Stg Byp Spd** and will remain at this speed for the time entered in this screen. After this time the system reverts back to PID control.

See Figure 2.

Stage Offset: (Stage Offset)

Default	:=	0
Minimum	:=	0
Maximum	:=	Stage Speed- Stg Byp Spd
Unit	:=	Hz

Immediately prior to staging an auxiliary pump the lead pump will decelerate to the speed entered in screen **<EXPANSION> ~ STAGE ~ Stg Byp Spd**. On commencement of deceleration, the auxiliary pump is not necessarily staged immediately. If desired, the system can wait until the lead pump has slowed to **Stg Byp Spd +** the value entered in this screen.

This setting is typically used when the external pumps are soft starter controlled.

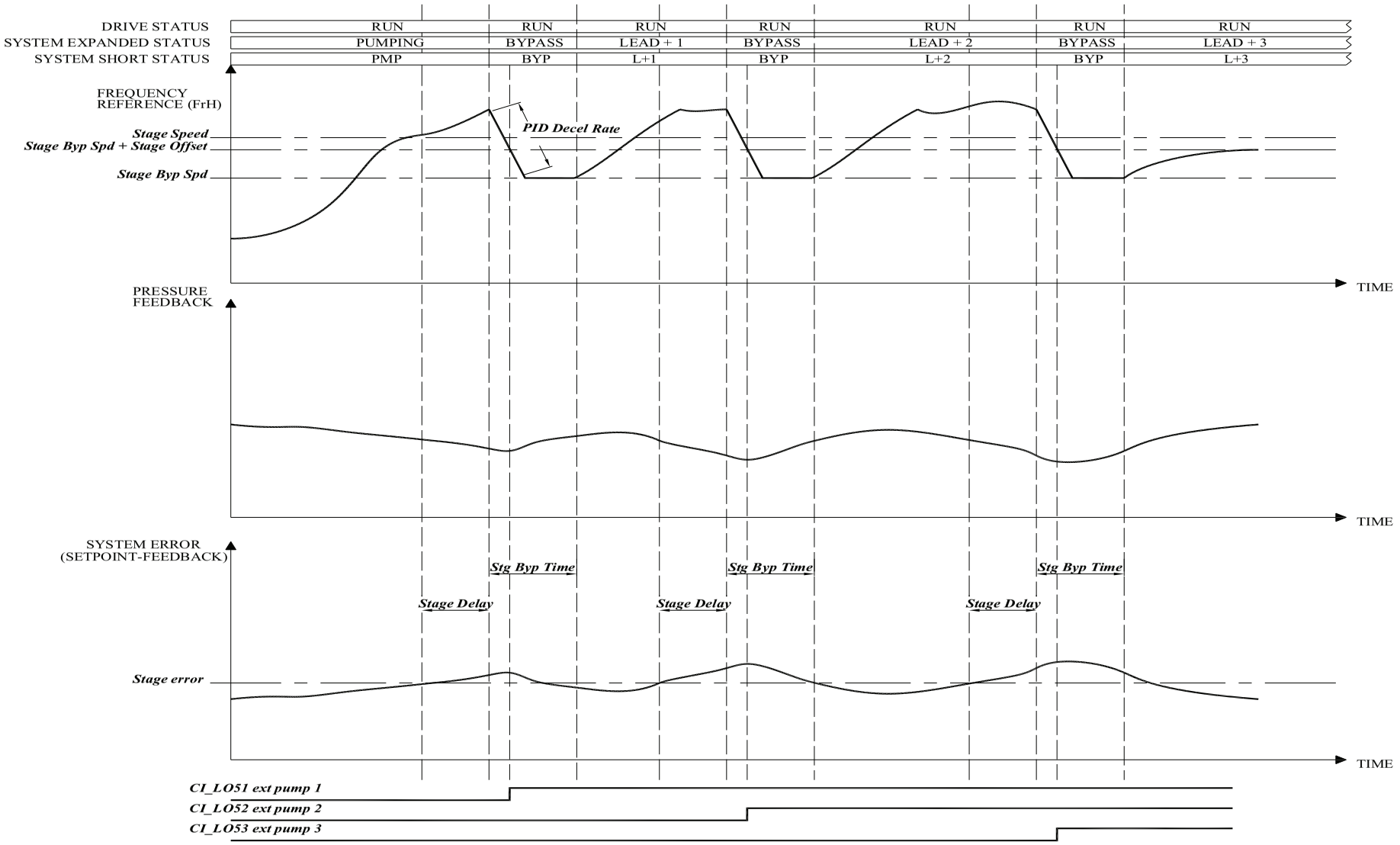
See Figure 2.

2.9.9 <EXPANSION> DESTAGE

Destage Mode: (Destage Mode)

Default	:=	Sp+Pr+Dly
Range	:=	Sp+Pr+Dly, Sp+Pr, Sp+Dly, Sp Only, Pr+Dly, Pr Only

Figure 2: Stage



This parameter sets the permissives that will be needed before an auxiliary pump is stopped.

Sp+Pr+Dly - If this is selected, an auxiliary pump will not be destaged until the lead pump speed is less than **<EXPANSION> ~ DESTAGE ~ Destage Speed**, the system error (setpoint – feedback) is less than **<EXPANSION> ~ DESTAGE ~ Destage Error** and these two permissive have been true for longer than **<EXPANSION> ~ DESTAGE ~ Destage Delay**.

Sp+Pr - If this is selected, an auxiliary pump will not be destaged until the lead pump speed is less than **<EXPANSION> ~ DESTAGE ~ Destage Speed** and the system error (set-point – feedback) is less than **<EXPANSION> ~ DESTAGE ~ Destage Error**.

Sp+Dly - If this is selected, an auxiliary pump will not be destaged until the lead pump speed is less than **<EXPANSION> ~ DESTAGE ~ Destage Speed** for longer than **<EXPANSION> ~ DESTAGE ~ Destage Delay**.

Sp Only - If this is selected, an auxiliary pump will not be destaged until the lead pump speed is less than **<EXPANSION> ~ DESTAGE ~ Destage Speed**.

Pr+Dly - If this is selected, an auxiliary pump will not be destaged until the system error (setpoint – feedback) is less than **<EXPANSION> ~ DESTAGE ~ Destage Error** for longer than **<EXPANSION> ~ DESTAGE ~ Destage Delay**.

Pr Only - If this is selected, an auxiliary pump will not be destaged until the system error (setpoint – feedback) is less than **<EXPANSION> ~ DESTAGE ~ Destage Error**.

See Figure 3.

Destage Speed: Destage Speed)

Default	:=	40
Minimum	:=	LSP
Maximum	:=	Dstge Byp Sp
Unit	:=	Hz

This parameter sets the maximum speed of the lead pump before an auxiliary pump is stopped if **Speed** is one of the destage permissives selected in screen **<EXPANSION> ~ DESTAGE ~ Destage Mode**.

See Figure 3.

Destage Error: (Destage Error)

Default	:=	0.0
Minimum	:=	-3276.7
Maximum	:=	0
Unit	:=	%, kPa, bar, psi

This parameter sets the required system error (setpoint – feedback) before an auxiliary pump is stopped if **Error** is one of the destage permissives selected in screen **<EXPANSION> ~ DESTAGE ~ Destage Mode**.

See Figure 3.

Destage Delay: (Destage Delay)

Default	:=	1
Minimum	:=	1
Maximum	:=	3600
Unit	:=	sec

This parameter sets the required delay, after all selected permissives have been met, before an auxiliary pump is stopped if **Delay** is one of the destage permissives selected in screen **<EXPANSION> ~ DESTAGE ~ Destage Mode**.

See Figure 3.

Dstge Byp Sp: (Destage Bypass Speed)

Default	:=	40
Minimum	:=	Destage Speed
Maximum	:=	HSP
Unit	:=	Hz

Immediately prior to destaging an auxiliary pump the lead pump will accelerate to the speed entered in this screen and will remain at this speed for the time entered in screen **<EXPANSION> ~ DESTAGE ~ Dstg Byp Time**. After this time the system reverts back to PID control.

See Figure 3.

Dstg Byp Time: (Destage Bypass Time)

Default	:=	5
Minimum	:=	1
Maximum	:=	3600
Unit	:=	sec

Immediately prior to destaging an auxiliary pump the lead pump will accelerate to the speed entered in screen **<EXPANSION> ~ DESTAGE ~ Dstg Byp Sp** and will remain at this speed for the time entered in this screen. After this time the system reverts back to PID control.

See Figure 3.

Dstg Offset: (Destage Offset)

Default	:=	0
Minimum	:=	0
Maximum	:=	250
Unit	:=	Hz

Immediately prior to destaging an auxiliary pump, the lead pump will accelerate to the speed entered in screen **<EXPANSION> ~ DESTAGE ~ Dstge Byp Sp**. On commencement of acceleration the auxiliary pump is not necessarily destaged immediately. If desired, the system can wait until the lead pump speed has risen to **Dstge Byp Sp** minus the value entered in this screen.

See Figure 3.

2.9.10 <EXPANSION> RUN TIMES

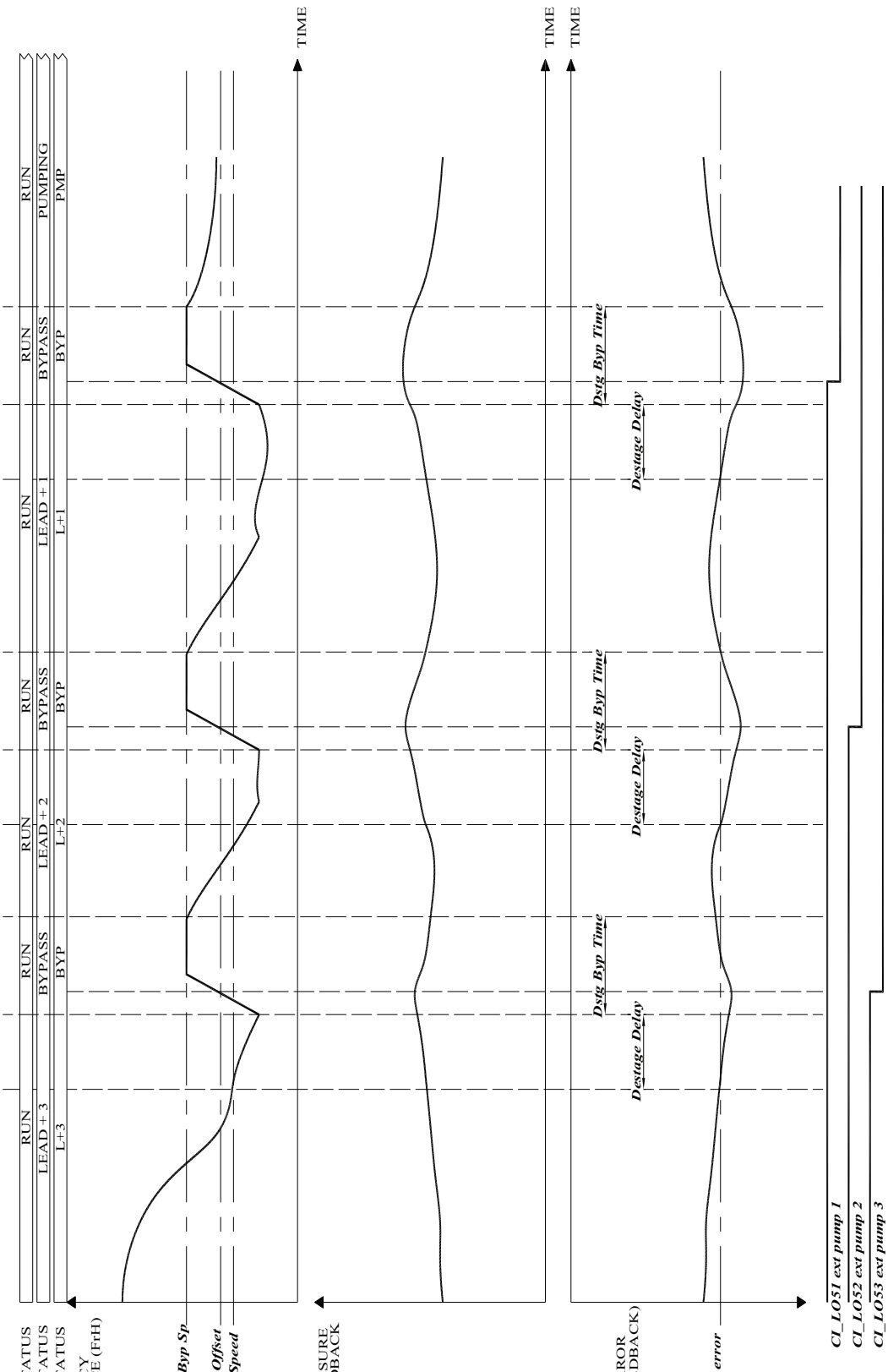
Timed Pumping: (Timed Pumping)

Default	:=	Disable
Range	:=	Disable or Enable

This parameter enables or disables the Run Times function of the pump controller.

If enabled the system will only run during the times set in the following screens. If disabled the system will run whenever start permissives are met.

Figure 3: Destage



If the following values are entered in the following screens:

<EXPANSION> ~ RUN TIMES ~ Start Hours = 19
<EXPANSION> ~ RUN TIMES ~ Start Mins = 0
<EXPANSION> ~ RUN TIMES ~ Stop Hours = 8
<EXPANSION> ~ RUN TIMES ~ Stop Mins = 0

the system will only run between 19:00 hours (7pm) and 08:00 hours (8am). At all other times the system will be off.

Start Hours: (Start Hours)

Default	:=	0
Minimum	:=	0
Maximum	:=	23
Unit	:=	hours

This screen sets the start hours.

Start Mins: (Start Minutes)

Default	:=	0
Minimum	:=	0
Maximum	:=	59
Unit	:=	Minutes

This screen sets the start minutes.

Stop Hours: (Stop Hours)

Default	:=	0
Minimum	:=	0
Maximum	:=	23
Unit	:=	hours

This screen sets the stop hours.

Stop Mins: (Stop Minutes)

Default	:=	0
Minimum	:=	0
Maximum	:=	59
Unit	:=	Minutes

This screen sets the stop minutes.

2.9.11 <EXPANSION> AUTO-COMM

Auto-Commission: (Auto-Commission Trigger)

Default	:=	Disable
Range	:=	Disable or Enable

This parameter enables or disables the Auto-Commissioning function of the pump controller.

The Auto-Commissioning function replicates the motor parameters of the master drive on the slave drives in a multi-drive system (up to 3 slave drives).

The parameters replicated are:

Standard motor frequency (IEC/NEMA)
Motor rated power
Motor rated voltage
Motor rated speed
Motor rated frequency
Motor rated current

Upon triggering the enable command, the function sets up the parameters on the slave drives via the CANopen network and returns an onscreen status update of the operation. The operation may take up to 10 seconds to complete before an onscreen update is displayed below the **VFD Qty**. parameter.

This function requires that the slave drives have addresses 2, 3 and 4 on the CANopen network. As such, before this function can be triggered, the communication parameters have to be set up on the slave drives.

The CAN communication parameters to be set up on all drives are as follows:

CANopen address: Address 1 on master with subsequent additional drives to be addressed sequentially 2,3, and 4.(e.g. if **VFD Qty**. is set to 3, the slave drives have to be set to address 2 and 3).

CANopen bit rate: 125 kbps

Note: This function must only be enabled when the system is not in **RUN** mode.

VFD Qty (tot.): Total number of drives (including master)

Default	:=	1
Range	:=	1-4

This parameter is used to configure the number of drives to be parameterized over the network.

Note: The number of drives as configured in this parameter is not related to the number of drives the controller will attempt to control. The number of drives controlled by the system is configured in **<EXPANSION> ~ Stage ~ Number of EXT.**

2.9.12 <EXPANSION> SAVED TIME

Lead Time: (Lead Time)

Default	:=	0
Minimum	:=	0
Maximum	:=	65535
Unit	:=	hours or minutes

This screen displays the hours the lead pump has been running since it was last reset. When displayed this parameter may be overwritten to reset back to zero or any number desired. If **minutes** is selected in screen **<EXPANSION> ~ SAVED TIME ~ Time Base** the value is incremented every minute that the lead pump is running.

Please note that when displayed, this parameter is not updated.

Ext1 Time: (External Pump One Time)

Default	:=	0
Minimum	:=	0
Maximum	:=	65535
Unit	:=	hours or minutes

This screen displays the hours external pump one has been running since it was last reset. When displayed, this parameter may be overwritten to reset back to zero or any number desired. If **minutes** is selected in screen **<EXPANSION> ~ SAVED TIME ~ Time Base,** the value is incremented every minute that external pump one is running.

Please note that when displayed, this parameter is not updated.

Ext2 Time: (External Pump Two Time)

Default	:=	0
Minimum	:=	0
Maximum	:=	65535
Unit	:=	hours or minutes

This screen displays the hours external pump two has been running since it was last reset. When displayed, this parameter may be overwritten to reset back to zero or any number desired. If **minutes** is selected in screen **<EXPAN-**

SION> ~ SAVED TIME ~ Time Base, the value is incremented every minute that external pump two is running.

Please note that when displayed, this parameter is not updated.

Ext3 Time: (External Pump Three Time)

Default	:=	0
Minimum	:=	0
Maximum	:=	65535
Unit	:=	hours or minutes

This screen displays the hours external pump three has been running since it was last reset. When displayed, this parameter may be overwritten to reset back to zero or any number desired. If **minutes** is selected in screen **<EXPANSION> ~ SAVED TIME ~ Time Base,** the value is incremented every minute that external pump three is running.

Please note that when displayed, this parameter is not updated.

Time Base: (Time Base)

Default	:=	Hours
Range	:=	Hours or Minutes

For commissioning purposes, the user can select to have the pump runtime hours increment on a per minute basis. This parameter should always be reset to hours at the completion of commissioning.

2.9.13 <EXPANSION> CONFIG

CI_AI51 Type: (Controller Inside Analog Input 51)

Default	:=	4-20mA
Range	:=	4-20mA or 0-20mA

This parameter allows the user to select the type of transducer being installed.

CI_AI52 Type: (Controller Inside Analog Input 52)

Default	:=	4-20mA
Range	:=	4-20mA or 0-20mA

This parameter allows the user to select the type of transducer being installed.

Stop Type: (Drive Stop Type Configuration)

Default	:=	Ramp
Range	:=	Wheel (Freewheel), Ramp

Fault Ramp: (Fault Ramp)

Default	:=	3.0
Minimum	:=	0.0
Maximum	:=	999.9
Unit	:=	sec

This parameter sets the ramp rate to be used when a fault occurs.

Fault Hist: (Fault History)

Default	:=	0
Minimum	:=	0
Maximum	:=	8888

This parameter shows a history of application faults in a numerical format. A maximum of four digits will be displayed with the left most digit giving the code for the oldest application fault and the right hand digit giving the code for the most recent application fault. The fault codes are as follows:

1. Flow switch fault.
2. Flow rate fault
3. Analog high pressure fault
4. Cavitation fault
5. Cycle fault
6. Minimum pressure fault
7. Low level fault
8. Digital high pressure fault
9. High Temperature

If this screen displays 3622, then the last two faults were flow rate, the fault immediately prior to these was a minimum pressure fault and the oldest recorded fault was an analog high pressure fault. The value in this screen is not write protected so may be reset to zero.

Version: (Controller Program Version)

Default	:=	2010

This parameter displays the version of controller program currently in use.

Remote / Networ: (Remote Network Selection)

Default	:=	No
Range	:=	No, Yes

This parameter enables/disables the remote connection. If enabled, the system can be called to run via a communication network.

2.9.14 <EXPANSION> DELTA-T

Delta-T Sys. =: (Delta-T System Enable)

Default	:=	Disable
Range	:=	Disable, Enable

This parameter allows the user to enable the Delta-T system control. The Delta-T system allows for Type 3 Taco iWorx PTC input connections across 24Vdc and AI1 and AI2. The analog input signals are converted into temperature values and a differential calculated between these two signals. The resulting differential value is used as feedback. In this mode, the local setpoint on the main **Mult.Pump** menu screen is used as the reference desired differential temperature setpoint.

The Delta-T setting also converts all feedback and setpoint units to °C or °F based on the **< Set in deg.C>** setting below.

Note: In delta-T mode, flow compensation and pressure based error detection functions (minimum pressure detection and inlet protection) are disabled. High pressure detection can still be utilized however only with a logic input from a pressure switch. Analog high pressure detection is disabled.

Hot/Cold =: (Hot/Cold Water System Selection)

Default	:=	COLD
Range	:=	COLD, HOT

The configuration of a HOT/COLD water system determines the method of calculation of the temperature differential.

COLD water systems:
ΔT = AI2 probe temperature – AI1 probe temperature

HOT water systems:
ΔT = AI1 probe temperature – AI2 probe temperature

Set in deg.C =: (Selection of temperature display between °C and °F)

Default	:=	No (°C setting)
Range	:=	No (°C setting), Yes (°F setting)

2.9.15 <EXPANSION> DELTA-P

Delta-P Sys.: (Delta-P System Enable)

Default	:=	Disable
Range	:=	Disable, Enable

This parameter allows the user to enable the Delta-P system control. The Delta-P system control allows for the connection of up to three 4-20mA pressure differential transmitters on AI2, AI51 and AI52. The analog input signals are converted into a differential pressure value. The value with the highest difference from the setpoint is selected as the reference for the system speed regulation. In this mode, the zone setpoint chosen as the reference is displayed on the main **Mult.Pump** menu screen as **<Local Setpoin>**.

In the Delta-T mode, if a flow sensor is used, it has to be wired to AI1 and provide a 0-10V feedback. The flow sensor has to be set up by **1.14 PUMP CONTROL <EXPANSION> ~ SENSORS ~ Flow source** and selecting **<DRIVE_AI1>.**

The Delta-T setting also converts all feedback and setpoint units to °C or °F based on the **< Set in deg.C>** setting below.

Note: In delta-P mode, flow compensation and pressure based error detection functions (minimum pressure detection and inlet protection) are disabled. High pressure detection can still be utilized, however, only with a logic input from a pressure switch. Analog high pressure detection is disabled.

No.Of Zones =: (Number of Zones)

Default	:=	1
Range	:=	1-3

The number of zones determines the selection of feedback as a system reference. If only 1 zone is present, feedback is taken from AI2. Each additional zone is to be wired in to AI51 and AI52 in that order.

Lo.Flow.Threshold =: (Low Flow Threshold for Lag Reject Function)

Default	: =	0.00
Range	: =	0.0 - 3276.0

Zone1 Set Pt. =: (Zone 1 Setpoint)

Zone2 Set Pt. =: (Zone 2 Setpoint)

Zone3 Set Pt. =: (Zone 3 Setpoint)

2.10 Configuration Record

The following tables can be used to record drive parameters that may be unique to each pump setup. The following only covers basic settings in the drive and should not be used as a conclusive Drive Commissioning Sheet. For detailed settings, the user must consult the relevant ATV 61/71 Programming Manual.

PARAMETER	RECORD 1	RECORD 2
Rated Motor Power	Kw	Kw
Rated Motor Volt	Volt	Volt
Rated Motor Current	Amp	Amp
Rated Motor Frequency	Hz	Hz
Rated Motor Speed	rpm	rpm
Motor Control Type		
Output Phase Rotation		
Current Limitation	Amp	Amp
Max. Frequency	Hz	Hz
Low Speed	Hz	Hz
High Speed	Hz	Hz
RV Inhibit		

AI1 CONFIGURATION		
AI1 Type	Voltage	Voltage
AI1 Min. Value	Volt	Volt
AI1 Max. Value	Volt	Volt
AI1 Filter	Sec	Sec

AI2 CONFIGURATION		
AI2 Type	Cur/Volt	Cur/Volt
AI2 Min. Value	mA/V	mA/V
AI2 Max. Value	mA/V	mA/V
AI2 Filter	mA/V	mA/V
AI2 Range	%	%

The values given in the Example column of this document are for a system comprising two multi-pump VSD's. The system pipe work is rated for a maximum of 6 bar and the desired constant pressure is 4 bar. The system IO is as follows:

CONTROLLER INSIDE	
DIGITAL	
CI_LI51	Protected Manual Mode
CI_LI52	Override Manual Mode
CI_LI53	Low Flow Switch
CI_LI54	
CI_LI55	
CI_LI56	
CI_LI57	Auto Enable
CI_LI58	
CI_LI59	
CI_LI60	Low level Lockout
CI_LO51	
CI_LO52	
CI_LO53	
CI_LO54	
CI_LO55	
CI_LO56	

ATV61	
DRIVE_LI1	
DRIVE_LI2	
DRIVE_LI3	High Pressure
DRIVE_LI4	
DRIVE_LI5	
DRIVE_LI6	
ANALOG	
DRIVE_AI2	Pressure Feedback 4-20 mA 0-1 Bar
DRIVE_RO1	System Fault
DRIVE_RO2	System Run

2.11 Commissioning Guide

This commissioning guide assumes the user has at least a basic understanding of the ATV drive HMI structure. This guide is a general listing of procedures only. Equipment and personnel safety should be carefully considered prior to undertaking any of the following steps.

2.11.1 Power Verification

STEP 1: Verify the input voltage to the panel or the drive.

STEP 2: Ensure that the VFD properly matches the input voltage.

STEP 3: Ensure all motor and power wiring is correct. Ensure there is no possibility Controller Inside inputs, CI_LI51 (Protected Manual Mode), CI_LI52 (Override Manual Mode) or CI_LI57 (Auto Run) can be active when the power is applied to the system. This can be done by removing the wiring from the respective CI terminals or ensuring the relevant switches are in the off position. This is required to protect against the lead pump running unexpectedly.

2.11.2 Motor/VFD Verification

STEP 1: Ensure drive is properly wired to motor and power to drive.

STEP 2: Power on the three phase supply to the drive.

STEP 3: Ensure drive has proper motor nameplate information.

STEP 4: Ensure motor and drive function properly.

STEP 5: Press the Run key on the display to check motor/pump direction. This should be done in consultation with the mechanical installation engineers.

Please note that no system safeties are operational at this stage.

2.11.3 Save Parameters

Save parameters in drive menu 3.0.

2.11.4 Power Off

Power off the three phase supply to the drive.

2.11.5 Install the Controller Card

Refer to the Altivar ATV-IMC Drive Controller instruction sheet (VW3A52150).

2.11.6 Install Analog Input Control Wires

Follow schematic in Section 2.5.

2.11.7 Install Jumpers

Follow schematic in Section 2.5.

For E-Flex drives, see instructions in Section 3.0.

2.11.8 Power On

Switch on the three phase supply to the drive.

2.11.9 Change Drive Parameters

STEP 1: Go to **1.4 MOTOR CONTROL** and enter all motor details including the minimum and maximum motor speeds. These limits may be specified by either the system or the pump manufacturer.

STEP 2: Go to **1.4 MOTOR CONTROL ~ Motor control type** and select **V/F 2pts**.

STEP 3: Go to **1.3 SETTINGS**. Set the low speed to 20 Hz and set the high speed to desired value (i.e. 50 Hz or 60 Hz).

STEP 4: The pump system status can be displayed on the display top most line.

STEP 5: Go to **2 ACCESS LEVEL** and select **Expert**.

STEP 6: Go to **6.1 PARAM. BAR SELECT** and untick **Motor curren**t and tick **Local/Remote**.

This same method can be used during the commissioning process to modify the variables you may wish to view at different times. During initial steps the motor speed and system status is most relevant but motor current is needed when setting cavitation levels for instance.

STEP 7: Go to **1.6 COMMAND ~ F4 key assignment** and select **T/K**.

Press the F4 button so the top line of the display has **RDY** and **HMI** displayed as below:

RDY HMI +0.0 Hz LOC

STEP 8: Press the F4 button so the top line of the display is as below:

NST APP +0.0 Hz REM

For E-Flex drives, follow parameter change steps in Section 3.0.

2.11.10 Set Up and Test Control Signals

STEP 1: Go to 1**.5 INPUTS / OUTPUTS CFG ~ AI1 CONFIGURATION** and **AI2 CONFIGURATION** and configure these two analog channels to suit any devices you may have connected to them.

For Delta-T Configuration (Temperature Probes), AI2 should be set for voltage.

For Delta-P Configuration (Differential Pressure Transmitter), AI2 should be set to current.

STEP 2: For two additional zones of differential pressure (2 additional differential pressure transmitters), go to **1.14 PUMP CONTROL <EXPANSION> ~ CONFIG ~ CI_AI51 Type** and **CI_AI52 Type** and configure these two analog channels to 4-20 mA (or V depending on the devices you may have connected to them). If either of these channels is not used it can be ignored.

STEP 3: Go To **1.2 MONITORING ~ I/O MAP ~ LOGIC INPUT MAP** and **ANALOG INPUTS IMAGE** and check that all Drive IO functions correctly.

STEP 4: Go To **1.2 MONITORING ~ CONTROLLER INSIDE I/O MAP ~ INSIDE CARD LI MAP** and **CONTROLLER INSIDE AI MAP** and check that all Controller Inside IO functions correctly.

2.11.11 Set up Communications

The CAN cables can now be connected to the drives.

To setup the **CANopen** communications, each drive must be configured to the correct **CANopen Node Address**. When the drive is first powered up, go to the following screens:

1. Select menu **1.9 COMMUNICATION**.
2. Select **CANopen**.

3. Set **CANopen Address** to 1 for the duty/master drive and 2, 3 and 4 respectively for the other drives in that order and **CANopen bitrate** to 125kbps.
4. Repeat for all drives being configured and then cycle the power to the drives.

Next, configure the **Command Ref.1 Channel** as follows:

1. Select menu **1.6 COMMAND**.
2. Select **REF.1 CHANNEL**.
3. Set **REF.1 CHANNEL** to **PLC Card** for the duty/master VFD (drive 1).
4. Set **REF.1 CHANNEL** to **CANopen** for drives 2, 3 and 4.

The drive power may need cycling for the CAN Node address to initialize.

Select F4 for all drives until drives 2, 3 and 4 display **CAN** in the upper left corner of the user interface. The duty/master drive displays **APP** in the upper left corner of the user interface.

2.11.12 Set Control Parameters

2.11.12.1 Set Delta-P Mode

STEP 1: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ SENSORS** and set **'Fdbk.Unit'** to the desired units.

STEP 2: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ SENSORS** and set **'Outlet Tx Max'** to the maximum pressure differential value (in pressure units) expected from the pressure differential transmitter (e.g. if 4-20mA signal is expected to provide pressure differential feedback between 0-400psi, set this parameter to 400).

STEP 3: Check that the **'Start Setp.'** parameter in the **1.14 PUMP CONTROL ~ <EXPANSION> ~ START SET** menu is set to a value that is high enough to start the system (i.e., if the system feedback is above this value on initial startup, the system will not start). When Delta-P is enabled, the **'Start Setp.'** parameter is set to be equivalent to the **'Outlet Tx Max'** parameter set in Step 4 above.

STEP 4: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ DELTA-P** and set **'Delta-P Syste'** and select **Enable**.

STEP 5: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ DELTA-P** and set **'No. of Zones'** and the corresponding setpoint desired for each zone. If a flow meter is used, the flow reject threshold is set by the **'Lo.Flow.Thres'** parameter.

STEP 6: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ STAGE** and set the number of external drives.

STEP 7: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ STAGE** and set **'Stage Error'** and **'Stage Delay'** to desired values.

STEP 8: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ DESTAGE** and set **'Destage Error'** and **'Destage Delay'** to desired values.

NOTE: **'Destage Error'** is a negative value.

STEP 9: Go to **1.2 MONITORING ~ I/O MAP ~ ANALOG INPUTS IMAGE** and ensure AI2 is reading mA. If AI2 is not reading **mA**, go to **1.2 INPUTS / OUTPUTS CFG ~ AI2 CONFIGURATION** and set **'AI2 Type'** to **Current**.

STEP 10: When input LI57 is triggered high (switch closed), the system will begin running.

2.11.12.2 Set Delta-T Mode

STEP 1: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ DELTA-T** and select between **HOT/COLD** water system.

STEP 2: Enable the Delta-T system with the first parameter on this expansion menu.

STEP 3: Set the desired temperature differential setpoint value to be maintained on the **1.14 PUMP CONTROL** main menu, **'Local Setpoin'** field. The current temperature differential value is noted below this parameter in the **'Feedback Meas.'** field.

STEP 4: When input LI57 is triggered high (switch closed), the system will begin running.

STEP 5: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ STAGE** and set the number of external drives.

STEP 6: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ STAGE** and set **'Stage Error'** and **'Stage Delay'** to desired values.

STEP 7: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ DESTAGE** and set **'Destage Error'** and **'Destage Delay'** to desired values.

STEP 8: Go to **1.2 MONITORING ~ I/O MAP ~ ANALOG INPUTS IMAGE** and ensure AI2 is reading **Volts**. If AI2 is not reading **Volts**, go to **1.5 INPUTS / OUTPUTS CFG ~ AI2 CONFIGURATION** and set **'AI2 Type'** to **Voltage**.

STEP 9: When input LI57 is triggered high (switch closed), the system will begin running.

2.11.12.3 Pressure Booster Mode

STEP 1: Ensure that Delta-P and Delta-T modes are disabled in their respective expansion menus.

STEP 2: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ PID** and set **'PID Feedback'** to the input channel of the feedback signal. Also, set the **'PID Max Ref.'** parameter to the maximum allowable PID setpoint value (in pressure units) (e.g. if the pressure feedback is 0-400 psi but the PID setpoint is to be limited to 300 psi, set this parameter to 300). To set the PID setpoint on the drive display, set the **'PID Reference'** parameter to LOCAL.

STEP 3: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ SENSORS** and set **'Outlet Tx Max'** to the maximum pressure value (in pressure units) expected from the pressure transmitter (e.g. if 4-20mA signal is expected to provide pressure differential feedback between 0-400psi, set this parameter to 400).

STEP 4: Check that the **'Start Setp.'** parameter in the **1.14 PUMP CONTROL ~ <EXPANSION> ~ START SET** menu is set to a value that is high enough to start the system (i.e. if the system feedback is above this value on initial startup, the system will not start).

STEP 5: Set the desired system setpoint to be maintained on the **1.14 PUMP CONTROL** main menu, **'Local Setpoin'** field. The current system pressure feedback value is noted below this parameter in the **'Feedback Meas.'** field.

STEP 6: When input LI57 is triggered high (switch closed), the system will begin running.

2.11.13 Activate/Test Drive

2.11.14 Additional Settings

STEP 1: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ SENSORS** and set the relevant values for your system. If a parameter is not understood, consult the relevant section earlier in this manual. Configure only the functions you require and disable those not necessary.

STEP 2: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ START SET** and set the relevant values for your system. If a parameter is not understood, consult the relevant section earlier in this manual. Configure only the functions you require and disable those not necessary.

STEP 3: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ SLEEP SET** and set the relevant values for your system. If a parameter is not understood, consult the relevant section earlier in this manual. Configure only the functions you require and disable those not necessary.

STEP 4: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ RESET FLT** and set the relevant values for your system. If a parameter is not understood, consult the relevant section earlier in this manual. Configure only the functions you require and disable those not necessary.

STEP 5: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ NRESET FL** and set the relevant values for your system. If a parameter is not understood, consult the relevant section earlier in this manual. Configure only the functions you require and disable those not necessary.

Note: High Temperature Monitoring is enabled as default.

STEP 6: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ FLOW LMT** and set the relevant values for your system. If a parameter is not understood, consult the relevant section earlier in this manual. Configure only the functions you require and disable those not necessary.

STEP 7: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ PID** and set the relevant values for your system. If a parameter is not understood, consult the relevant section earlier in this manual. Configure only the functions you require and disable those not necessary.

STEP 8: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ STAGE** and set the relevant values for your system. If a parameter is not understood, consult the relevant section earlier in this manual. Configure only the functions you require and disable those not necessary.

STEP 9: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ DESTAGE** and set the relevant values for your system. If a parameter is not understood, consult the relevant section earlier in this manual. Configure only the functions you require and disable those not necessary.

STEP 10: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ RUN TIMES** and set the relevant values for your system. If a parameter is not understood, consult the relevant section earlier in this manual. Configure only the functions you require and disable those not necessary.

STEP 11: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ FLOW COMP** and set the relevant values for your system. If a parameter is not understood, consult the relevant section earlier in this manual. Configure only the functions you require and disable those not necessary.

STEP 12: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ INLET PRO** and set the relevant values for your system. If a parameter is not understood, consult the relevant section earlier in this manual. Configure only the functions you require and disable those not necessary.

STEP 13: (Optional) Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ AUTO-COMM**. If all pumps are identical, this function can be used to parameterize the motor parameters of all drives from the main drive.

STEP 14: Go to **1.14 PUMP CONTROL ~ <EXPANSION> ~ SAVED TIM** and set the relevant values for your system. This sub-group is largely read only but you may wish to temporarily change the timebase to minutes, to aid in commissioning, if multiple external pumps are used. Please remember to return the timebase to hours on completion of commissioning.

STEP 15: Go to 1.14 PUMP CONTROL ~ <EXPANSION> ~ CONFIG and set the relevant values for your system. If a parameter is not understood, consult the relevant section earlier in this manual. Configure only the functions you require and disable those not necessary.

The system can now be run in automatic and operation observed. Some system reliant tuning will need to be performed, especially to the PID gains, fault levels and delays, sleep permissives etc. These are system reliant and tuning will only be achieved by monitoring and adjusting relevant parameters based on observations made.

2.12 Remote Communication

Remote communications with the controller are available for the purpose of two functions.:

- Status Monitoring – Modbus Register 6449
- RUN/STOP monitoring – Modbus Register 6450

The description of the status values on register 6449 are provided in the following section (System Status Overview). The value written to the RUN/STOP register is not retained after a power cycle. As such, the RUN/STOP command will have to be rewritten to register 6450 by the remote controller after a power cycle.

2.13 System Status Overview

STATUS	VALUE	DESCRIPTION
OFF	1	System Off
'READY'	2	System is ready to start
'AUTO STOP'	3	
'JOCKEY ON'	4	Jockey Pump is Running
'STOPPING'	5	
'PIPE FILL'	6	The Pipe fill feature is active
'SET RAMP'	7	The Pump is in Setpoint Ramp Mode
'PUMPING'	8	The Duty Pump is Pumping
'MAIN+1'	9	The Duty Pump and one Slave is pumping
'MAIN+ 2'	10	The Duty Pump and two Slaves are pumping
'MAIN+ 3'	11	The Duty Pump and three Slaves are pumping
'Q LIMIT'	12	The Flow Limit Feature is active
'SLEEP'	13	The system has gone to sleep (Standby)
'BYPASS'	14	The PID is bypassed while the Staging or Destaging
'MANUAL'	15	
'WAITING'	16	
'LOCK OUT'	17	The system is locked out
'PRO MAN'	18	Protected Manual Mode is selected
'OVER MAN'	19	Override Manual Mode is selected
'SLEEP FUN'	20	
'NIGHT DAY'	21	
'LOW FLOW'	22	
'CAVITATE'	23	
'HI PRESS'	24	
'INLET CMP'	25	
'ANTI JAM'	26	
'EXT FLT' *	27	One of the external pump drives cannot be detected loss of signal alarm
'LOW LEVEL'	28	
'SLEEP BST'	29	The system is in Sleep Boost Mode
'ADV SLEEP'	30	
'NOVAR+1'	31	The Duty Pump has stopped and one pump is still running
'NOVAR+2'	32	The Duty Pump has stopped and two pumps are still running
'NOVAR+3'	33	The Duty Pump has stopped and three pumps are still running

* When the system displays **EXT FLT** intermittently, this could be due to one of the two following reasons:

- If the system is configured with more than one external pump in the **Stage** menu, and the drive controlling that pump is no longer available on the communication network.
- If there is a loss of signal detected on one of the analog inputs used for feedback. In this case, the system will automatically revert to 75% of the full speed. For 60Hz, the system will be running at 45Hz.

3.0 USING THE TACO PUMP CARD WITH AN E-FLEX

3.1 Master Drive

3.1.1 Master Drive Wiring Modifications

STEP 1: Connect a jumper wire across terminals H22 and H32 (as noted on the conductor markings). These terminals are located on the contact blocks of the HOA switch. Refer to Figure 4.

STEP 2: To ensure that the controller card is in **'LOCK-OUT'** mode when the H-O-A switch is not in **'AUTO'** mode, wire a jumper from terminal C of the E-Flex to LI51 of the controller card.

STEP 3: To set the controller to run state, connect a jumper from terminal +24Vdc to LI57. Note: This is the RUN enable command of the controller and will allow the unit to run immediately upon power up if the H-O-A switch is set to **'AUTO'**.

STEP 4: If a BMS run relay is available, wire it across terminals 6 and 7. If no contact is present, a jumper can be wired across these two terminals. Note: This is a 120V circuit and will determine the operation of the unit in **'AUTO'** mode. In **'AUTO'** mode, the unit will start immediately if the contact between terminal 6 and 7 is closed. The START and STOP pushbuttons will not affect the operation of the system in **'AUTO'** mode.

3.1.2 Master Drive AFC Parameter Changes

Note: Before making the following parameter changes, set the H-O-A switch and AFC-OFF-Bypass switch to **OFF** position.

STEP 1: Go to menu **1.6 COMMAND** (DRIVE MENU > COMMAND).

Make the following changes:

- Profile Separate
- Cmd switching LI4
- Cmd channel 1 C.Insid.card
- Cmd channel 2 Terminals
- Ref 2 Switching LI4
- Ref 2 Channel HMI
- HMI Cmd Stop

STEP 2: Go to menu **1.14 PUMP CONTROL** (DRIVE MENU > PUMP CONTROL.

Make the following changes:

- Select Expansion > Config
- Scroll down to **'E Flex'** and set to **YES**.

STEP 3: Cycle power to the drive and controller and the new settings will take effect.

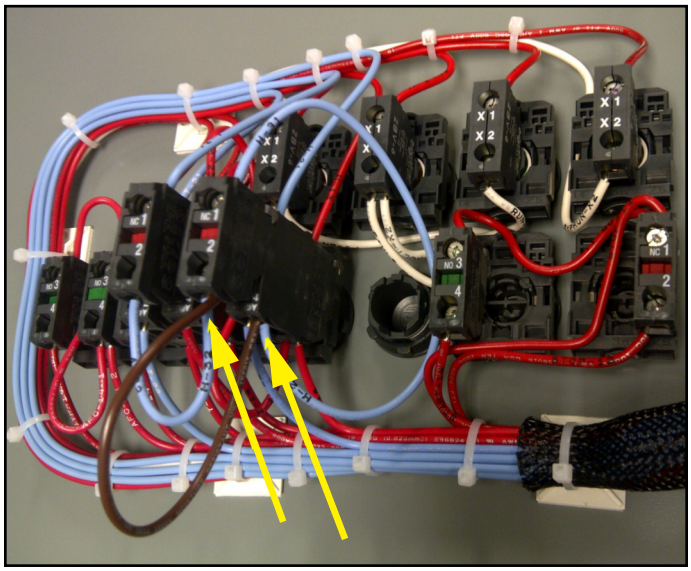


Figure 4

3.2 External/Slave Drive (Drives without a Controller Attached)

3.2.1 External/Slave Drive Wiring Modifications

STEP 1: Connect a jumper wire across terminals H22 and H32 (as noted on the conductor markings). These terminals are located on the contact blocks of the HOA switch. Refer to Figure 4.

3.2.2 External/Slave Drive AFC Parameter Changes

STEP 1: Go to menu **1.6 COMMAND** (DRIVE MENU > COMMAND).

Make the following changes:

- Ref 1 Channel CAN
- Profile Separate
- Cmd switching LI4
- Cmd channel 1 CAN
- Cmd channel 2 Terminals
- Ref 2 Switching LI4
- Ref 2 Channel HMI
- HMI Cmd Stop

STEP 2: Go to **1.8 Communication>CANopen** and set up CAN address for each additional drive in the configuration.

3.3 Description of Modes of Operation

MODE	AFC	OFF	BYPASS
HAND	Use Start - Stop buttons on E-Flex to run unit. Speed reference is set on drive keypad.	Unit turns OFF.	Use Start - Stop buttons on E-Flex to run unit, bypass-ing the AFC.
OFF	Unit turns OFF.	Unit turns OFF.	Unit turns OFF.
AUTO	Depending on controller state (LI57), unit immediately goes to RUN. Start - Stop on E-Flex has no effect.	Unit turns OFF.	Unit immediately goes to RUN. Start - Stop on E-Flex has no effect.

NOTES:

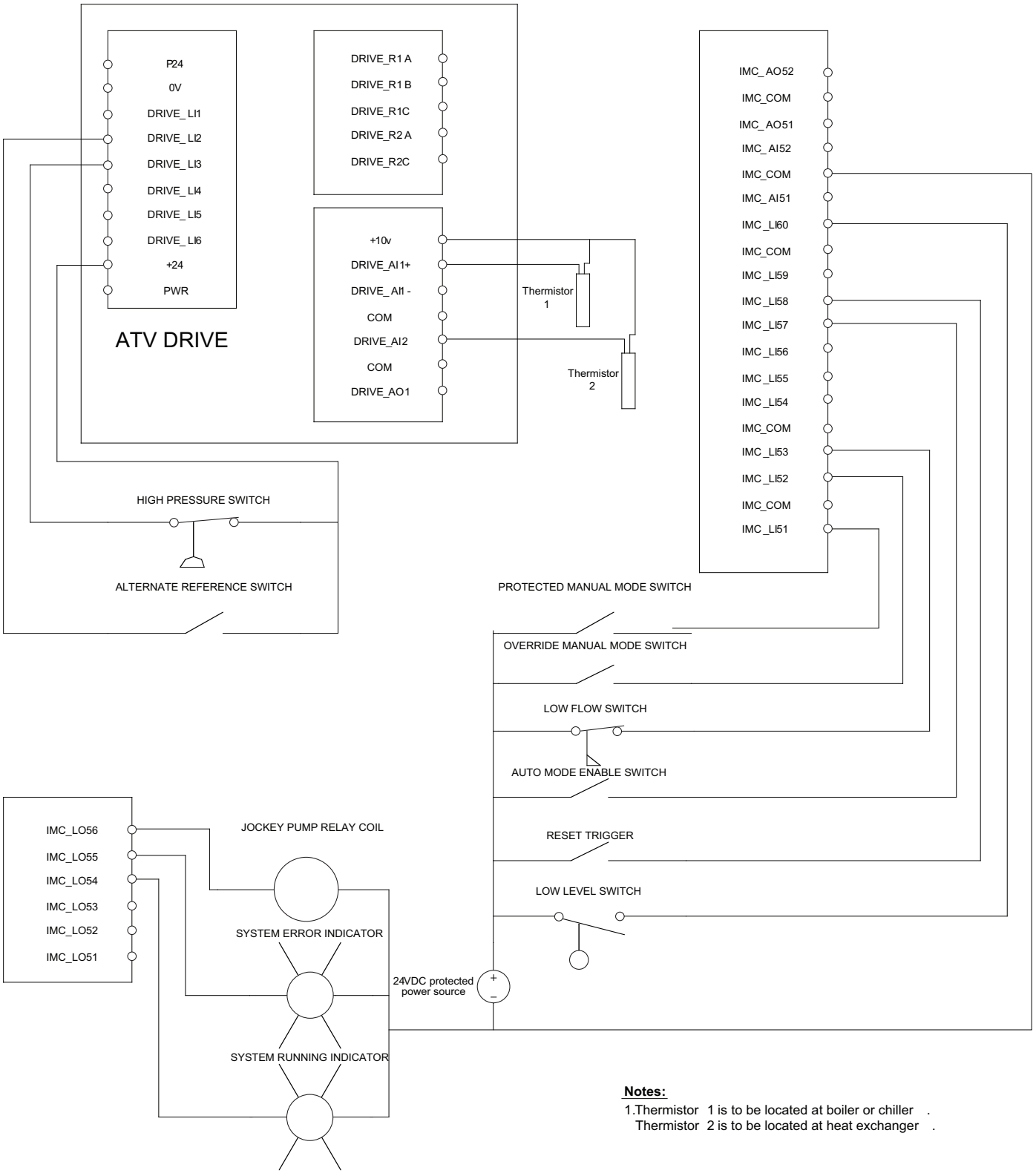
1. With the E Flex unit, LI3 is no longer the high pressure switch connection.
2. LI4 is used for reference switching.
3. LI2 is freewheel stop and not used for reference switching per non E-Flex configurations.

4a. In **'AUTO-AFC'** mode, the unit may be stopped by any of the following three steps:
- 4a.1 Switch the H-O-A or AFC-OFF-BYPASS to the OFF position.
- or 4a.2 Set LI57 to logic LOW.
- or 4a.3 Open the circuit between terminal 6 and 7 AND hit the STOP button on the keypad.

4b. In **'BYPASS'** mode, the unit may be stopped by switching the H-O-A or AFC-OFF-BYPASS to the OFF position.

5. The STOP button on the AFC keypad or the E-Flex panel will not work in **'AUTO'** mode.

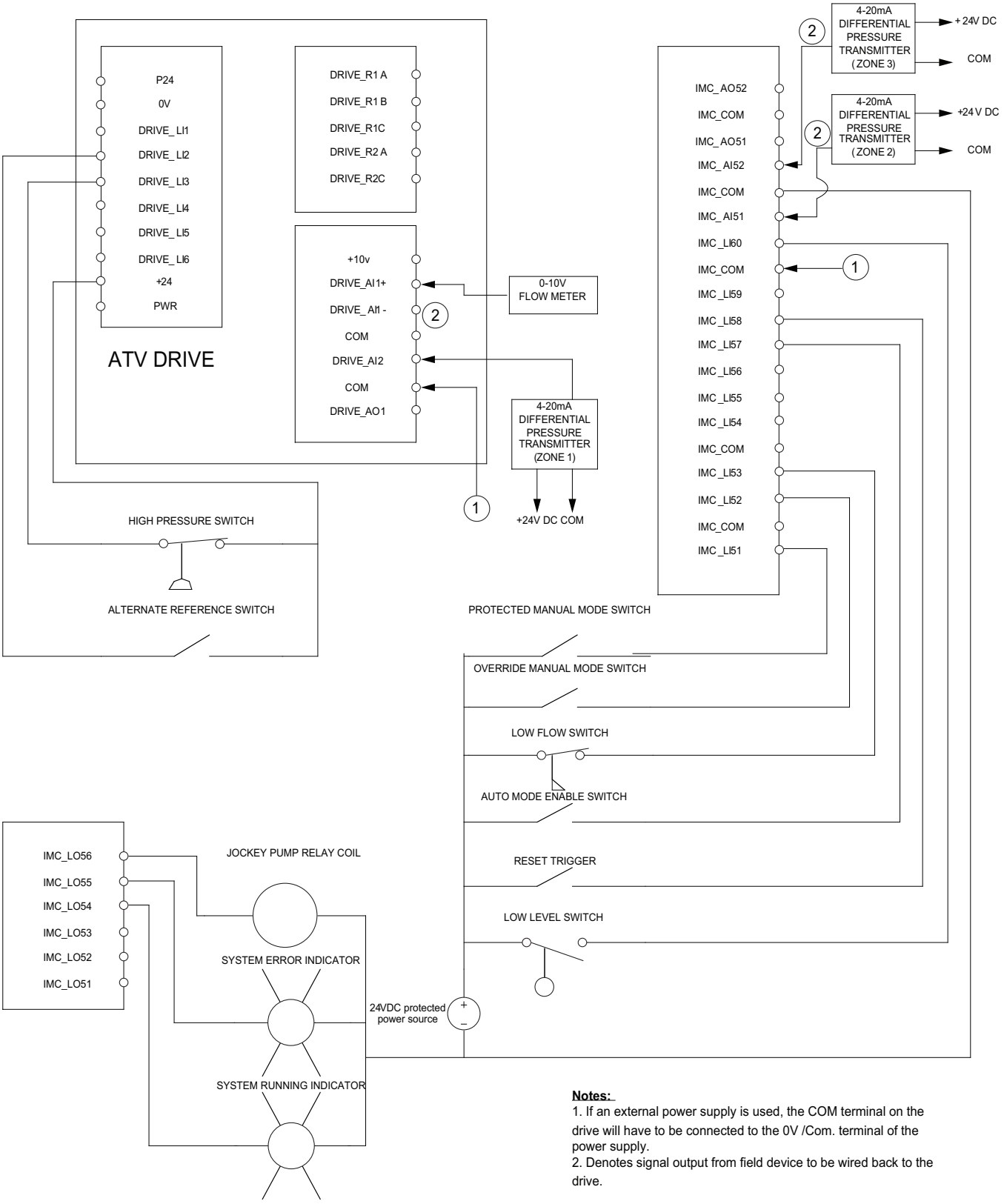
Figure 5: TACO Pump Card Delta-T System Wiring Diagram



Notes:

1.Thermistor 1 is to be located at boiler or chiller .
Thermistor 2 is to be located at heat exchanger .

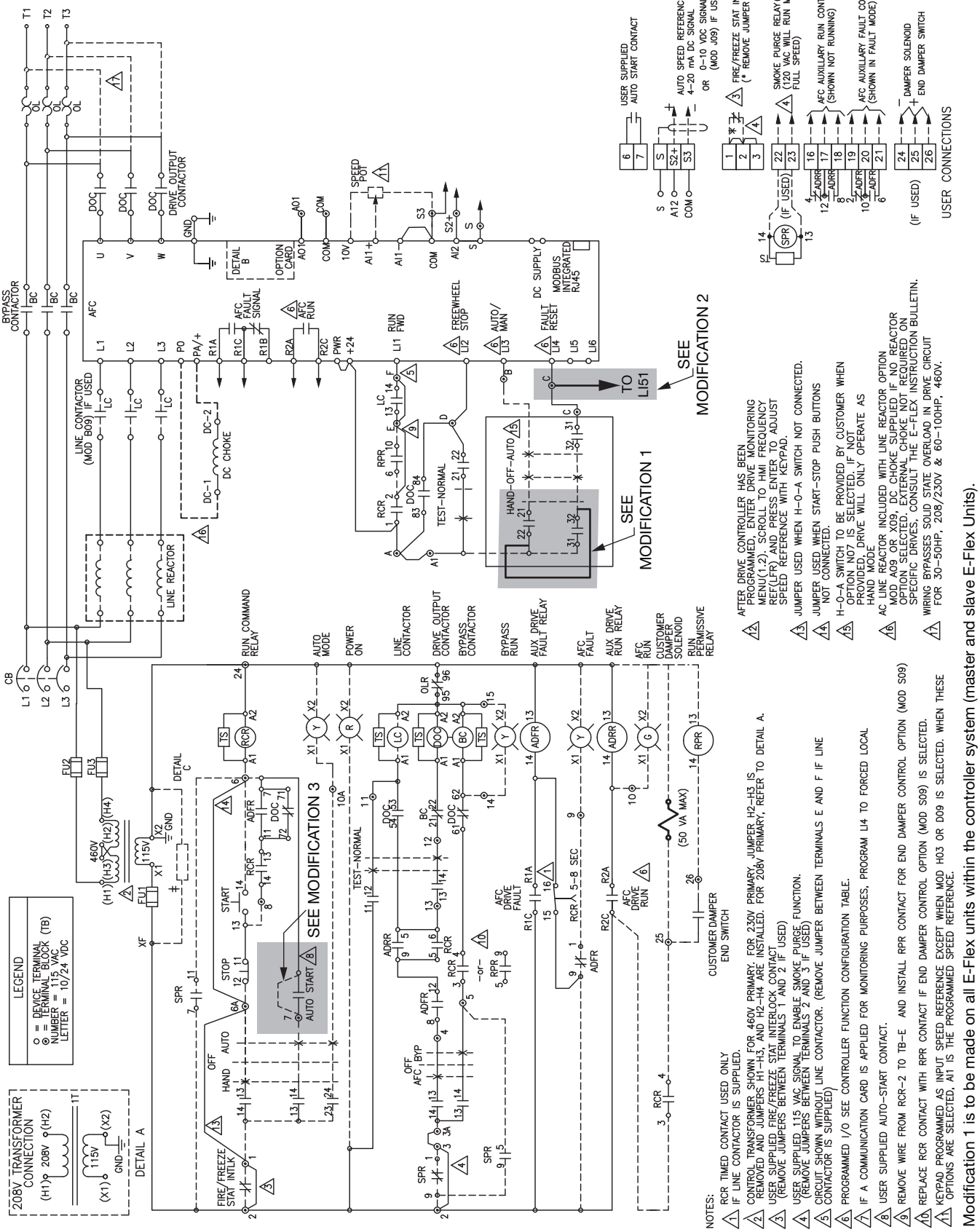
Figure 6: TACO Pump Card Delta-P System Wiring Diagram



Notes:

1. If an external power supply is used, the COM terminal on the drive will have to be connected to the 0V /Com. terminal of the power supply.
2. Denotes signal output from field device to be wired back to the drive.

Figure 7: TACO Pump Card E-Flex System Wiring Diagram



NOTES:

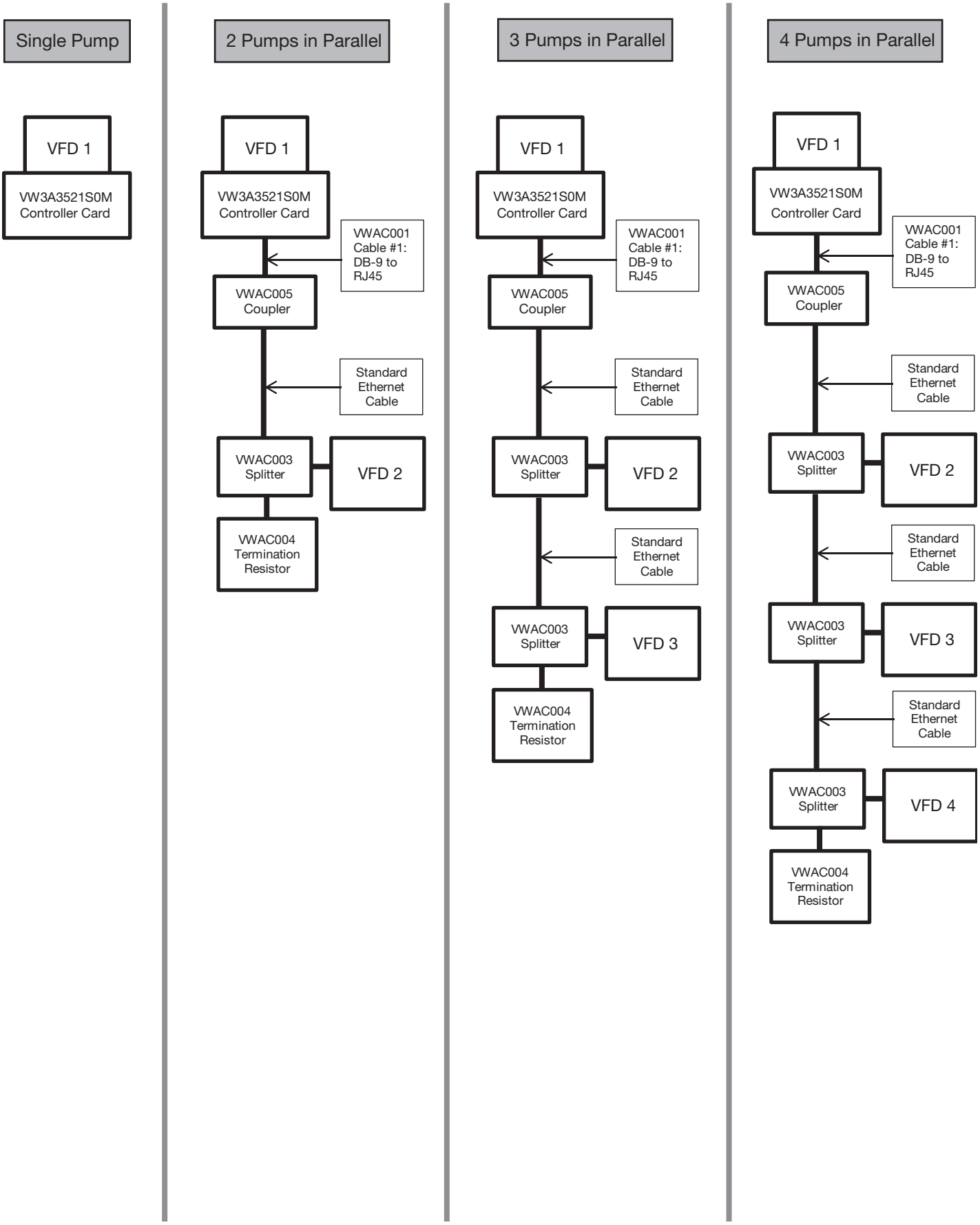
1. RCR TIMED CONTACT USED ONLY IF LINE CONTACTOR IS SUPPLIED.
2. CONTROL TRANSFORMER SHOWN FOR 460V PRIMARY. FOR 230V PRIMARY, JUMPER H2–H3 IS REMOVED AND JUMPERS H1–H3, AND H2–H4 ARE INSTALLED. FOR 208V PRIMARY, REFER TO DETAIL A.
3. USER SUPPLIED FIRE/FREEZE STAT INTERLOCK CONTACT (REMOVE JUMPERS BETWEEN TERMINALS 1 AND 2 IF USED)
4. USER SUPPLIED 115 VAC SIGNAL TO ENABLE SMOKE PURGE FUNCTION. (REMOVE JUMPERS BETWEEN TERMINALS 2 AND 3 IF USED)
5. CIRCUIT SHOWN WITHOUT LINE CONTACTOR. (REMOVE JUMPER BETWEEN TERMINALS E AND F IF LINE CONTACTOR IS SUPPLIED)
6. PROGRAMMED I/O SEE CONTROLLER FUNCTION CONFIGURATION TABLE.
7. IF A COMMUNICATION CARD IS APPLIED FOR MONITORING PURPOSES, PROGRAM LI4 TO FORCED LOCAL
8. USER SUPPLIED AUTO–START CONTACT.
9. REMOVE WIRE FROM RCR–2 TO TB–E AND INSTALL RPR CONTACT FOR END DAMPER CONTROL OPTION (MOD S09)
10. REPLACE RCR CONTACT WITH RPR CONTACT IF END DAMPER CONTROL OPTION (MOD S09) IS SELECTED.
11. KEYPAD PROGRAMMED AS INPUT SPEED REFERENCE EXCEPT WHEN MOD H03 OR D09 IS SELECTED. WHEN THESE OPTIONS ARE SELECTED, AI1 IS THE PROGRAMMED SPEED REFERENCE.
12. AFTER DRIVE CONTROLLER HAS BEEN PROGRAMMED, ENTER DRIVE MONITORING MENU(1.2). SCROLL TO HMI FREQUENCY REF(LFR) AND PRESS ENTER TO ADJUST SPEED REFERENCE WITH KEYPAD.
13. JUMPER USED WHEN H–O–A SWITCH NOT CONNECTED.
14. JUMPER USED WHEN START–STOP PUSH BUTTONS NOT CONNECTED.
15. H–O–A SWITCH TO BE PROVIDED BY CUSTOMER WHEN OPTION N07 IS SELECTED. IF NOT PROVIDED, DRIVE WILL ONLY OPERATE AS HAND MODE
16. AC LINE REACTOR INCLUDED WITH LINE REACTOR OPTION MOD A09 OR X09, DC CHOKE SUPPLIED IF NO REACTOR OPTION SELECTED. EXTERNAL CHOKE NOT REQUIRED ON SPECIFIC DRIVES, CONSULT THE E–FLEX INSTRUCTION BULLETIN.
17. WIRING BYPASSES SOLID STATE OVERLOAD IN DRIVE CIRCUIT FOR 30–50HP, 208/230V & 60–100HP, 460V.

Modification 1 is to be made on all E-Flex units within the controller system (master and slave E-Flex Units).

Modification 2 is to be made only on the master E-Flex unit.

Modification 3 is to be made on all E-Flex units within the controller system. If no building control system (BCS) connection is required and for all slave E-Flex drives, a jumper is to be placed across terminals 6 and 7. If a BCS is present, the RUN command from the BCS is to be wired only to the master E-Flex unit. NOTE: This is a 120 V circuit.

Figure 8: TACO Pump Card CANopen Wiring Diagram



Accessories List

NUMBER OF PUMPS IN PARALLEL	ITEMS NEEDED TO CONNECT THE DRIVES TO EACH OTHER		
	PART NUMBER	DESCRIPTION	QUANTITY
1	VW3A3521S0M	ADVANTAGE 61 VFD PUMP CONTROLLER CARD	1
2	VW3A3521S0M	ADVANTAGE 61 VFD PUMP CONTROLLER CARD	1
	VWAC001	Cable #1: DB-9 to RJ45 for CAN tap with term in DB-9	1
	—	Standard Ethernet Cable (length job dependent)	1
	VWAC003	Splitter: RJ45 DAISYCHAIN TAP with 0.3M DROP CABLE	1
	VWAC004	Termination Resistor RJ45	1
	VWAC005	Category 5E Shielded RJ45 (8 x 8) Keystone Feed-Thru Coupler	1
3	VW3A3521S0M	ADVANTAGE 61 VFD PUMP CONTROLLER CARD	1
	VWAC001	Cable #1: DB-9 to RJ45 for CAN tap with term in DB-9	1
	—	Standard Ethernet Cable (length job dependent)	2
	VWAC003	Splitter: RJ45 DAISYCHAIN TAP with 0.3M DROP CABLE	2
	VWAC004	Termination Resistor RJ45	1
	VWAC005	Category 5E Shielded RJ45 (8 x 8) Keystone Feed-Thru Coupler	1
4	VW3A3521S0M	ADVANTAGE 61 VFD PUMP CONTROLLER CARD	1
	VWAC001	Cable #1: DB-9 to RJ45 for CAN tap with term in DB-9	1
	—	Standard Ethernet Cable (length job dependent)	3
	VWAC003	Splitter: RJ45 DAISYCHAIN TAP with 0.3M DROP CABLE	3
	VWAC004	Termination Resistor RJ45	1
	VWAC005	Category 5E Shielded RJ45 (8 x 8) Keystone Feed-Thru Coupler	1

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