Zenith® Pumps ZVD Vector Drive

Installation
And Operation
Manual

AC Vector Motor
Speed Controller

Zenith® Pumps

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1. ZVD Description

1.1 Introduction

This manual contains easy to follow information and procedures required to complete the initial installation, wiring, and startup operation for the ZVD AC Vector Drive. Be sure to observe all WARNINGS, CAUTIONS, and NOTES prior to proceeding with a particular task.

Note: The standard ZVD Vector Drive is prepackaged in a NEMA 12 control cabinet. The controller is mounted and all internal cabinet wiring is complete. The unit is programmed according to customer specifications. All that is required of the customer is to make field wiring connections. The customer should become familiar with this manual, particularly with regard to input/output selections and wiring techniques to avoid electromagnetic interference (EMI) noise pickup, damage to equipment, and personal injury.

1.2 General Information

1.2.1 The standard ZVD AC Vector Motor Drive and Speed Control consists of an AC vector drive, mounted in a NEMA 12 control cabinet. The drive is mounted on the sub-panel and pre-wired to a terminal strip for customer terminations. The keypad from the drive has been relocated to the cabinet door via a connector cable. A Pulse Generator card has been installed in the drive to provide closed loop feedback.

1.2.2 The standard ZVD Vector Drive is available in four 230 VAC, 3 phase models (1, 2, 3, and 5 HP) and in four 460 VAC, 3 phase models (1, 2, 3, and 5 HP). The control cabinet size varies, depending on the horsepower rating of the drive. See the chart on page E-1 for cabinet sizes.

1.2.3 A standalone NEMA 1 version of the ZVD Vector Drive(s) is also available with the Pulse Generator card installed. The standalone ZVD is not supplied with a cable for use in remotely locating the keypad. The cable must be ordered separately. Consult the factory for details.

1.2.4 For 380 VAC input voltage, use the corresponding 460 VAC drive version. If full load at 380 VAC is required, use the next higher power drive and motor (e.g., if operating conditions require 1 HP and the input voltage is 380 VAC, specify a 2 HP drive and motor).

1.2.5 In Vector mode, the ZVD Vector Drive provides a closed loop accuracy of 0.1% of base speed under constant load. Closed loop feedback must be provided by a 120 PPR (minimum) Hall Effect feedback sensor or encoder.

1.2.6 A vector (inverter) duty AC motor is required. Constant torque turndown of the motor is 100:1.

1.2.7 The ZVD Vector Drive meets UL, CUL (CSA), and the CE low voltage directive. With the optional EMI filter, the drive also meets the CE EMI requirements.

1.2.8 In the event the motor drive assembly has to be located in a hazardous location, an optional intrinsically safe barrier is available to install in the ZVD Vector Drive cabinet to limit sensor current to safe levels.

1.2.9 Appendix A contains a list of ZVD Vector Drive options and auxiliary equipment by part number.

Table 1-1. ZVD Standard Specifications

Rated Input Voltage:	230 VAC: 180 – 264 VAC, 3 Phase			
HP Rating:	1 HP	2 HP	3 HP	5 HP
Rated Input Current:	5.7A	7.6A	14.0A	20.6A
Rated Output Current:	5.0A	7.0A	11.0A	17.0A
Rated Input Voltage:	460 VAC: 342 – 528 VAC, 3 Phase			
HP Rating:	1 HP	2 HP	3 HP	5 HP
Rated Input Current:	3.2A	4.3A	5.9A	11.2A
Rated Output Current:	2.7A	4.2A	5.5A	8.5A
Rated Input Frequency:	47 to 63 Hz			
Rated Output Voltage:	Proportional to Input Voltage			
Rated Output Frequency:	0.1 to 400 Hz			
Environment:	Ambient Temp: -10° C to 50° C Storage: - 20° C to 60° C			
Relative Humidity:	90 %, Non-condensing Vibration: 1 G to 20 Hz, 0.6 G above 20 Hz			
Cooling:	Natural, air cooled			
NEMA Ratings:	Standalone: NEMA 1 Keypad: NEMA 4 Enclosure: NEMA 12			
Classifications:	UL, CUL (CSA), CE (with optional EMI filter)			
Closed Loop Accuracy:	0.1% Base Speed, Constant Load			
Turndown:	100:1 Constant Torque, Vector Mode			
Tuning:	PID, Auto Detection of Motor in Vector Mode			
Password Protection:	Yes			
Fault Detection:	Self-test, Over-voltage, Over-current, Under-voltage, Overload, Overheating, External Fault, Electronic Thermal,Ground Fault			
Analog:	Input: 0 – 10 VDC or 4 – 20 mA Output: 0 – 10 VDC			
Setpoints:	User Defined Keypad, 0.01 Hz Resolution Analog, 0.1 Hz Resolution			
Control Inputs:	Five Standard Digital Inputs Six Multi-function Digital Inputs One Counter Input (250 Hz max) Feedback Sensor (with PG card installed)			
Control Outputs:	Three Open Collector Multi-function Outputs One Form C Relay Multi-function Output Retransmission of Feedback Frequency			
PLC Function:	15 Step Function (Speed, Time, Direction)			
Keypad Controls:	Fwd, Rev, Stop, Jog, Program, Monitor			
Serial Communications:	RS-485, Modbus Protocol			
Options:	Certified EMI filter to meet CE requirements Intrinsically Safe Barrier			

2. ZVD Installation and Wiring

2.1 Installation

The ZVD AC vector drive is sold in a NEMA 12 control cabinet and is intended to be part of a Zenith Products Division fluid handling solution. For customers who desire to mount the drive in their own cabinet, the ZVD is also sold as a standalone NEMA 1 drive.

2.1.1 NEMA 1 Standalone

If purchased as a NEMA 1 standalone drive, the location and installation of the ZVD should adhere to the following constraints:

2.1.1.1 Do not mount the ZVD drive near heat-radiating elements or in direct sunlight.

2.1.1.2 Do not install the ZVD drive in a place subjected to high temperature, high humidity, excessive vibration, corrosive gasses or liquids, or airborne dust or metallic particles.

2.1.1.3 Mount the ZVD drive vertically and do not restrict the air flow to the heat sink fins.

2.1.1.4 Allow sufficient space around the unit for heat dissipation. Approximately 6 inches should be allowed above and below the drive and 2 inches on each side.

2.1.2 NEMA 12

If purchased as a drive in a NEMA 12 cabinet, the location and installation of the ZVD should adhere to the following constraints:

2.1.2.1 Do not mount the NEMA 12 ZVD drive near heat-radiating elements or in direct sunlight.

2.1.2.2 Do not install the NEMA 12 ZVD drive in a place subjected to high temperature, high humidity, excessive vibration, corrosive gasses or liquids, or water spray.

2.1.2.3 Mount the NEMA 12 ZVD drive vertically, allowing a minimum of 6 inches above and below the control panel and 2 inches behind the panel for air flow and convection cooling.

2.2 Wiring

The ZVD drive will arrive with all internal wiring of the NEMA 12 cabinet complete, for most customer requirements. The customer will be required to wire to the terminal strip mounted inside the cabinet. If the customer desires to use some available functions of the ZVD that are considered non-routine, the customer may have to wire to the ZVD, itself. If the ZVD drive is ordered as a NEMA 1 standalone drive, the customer is required to make all connections to the drive.

2.2.1 General

CAUTION: TO PREVENT PERSONNEL ELECTROCUTION OR DAMAGE TO THE EQUIPMENT, MAKE SURE ALL POWER TO THE ZVD IS REMOVED BEFORE MAKING ANY WIRING CONNECTIONS OR CHANGES.

Wiring practices must conform to applicable local electric codes and the National Electric Code (NEC). If installed in a country outside the USA, wiring practices should conform to the electric codes of the country the ZVD is installed in.

2.2.1.1 Input power to the control cabinet must be supplied through an appropriately sized circuit breaker or fused disconnect that is within easy reach of the cabinet.

2.2.1.2 The control cabinet ground must be a single point termination and be at a resistance of less than 1 ohm with relation to true earth. All grounds within the control cabinet must be connected to the single point ground termination.

2.2.1.3 High voltage wiring (> 50 V) must be run in separate conduit from low voltage (<50 V) or signal wiring. If run parallel to each other, high voltage wiring should be separated from low voltage and signal wiring by 12 inches or as much as physically possible. If they must cross each other, they should cross perpendicularly.

2.2.1.4 Shielded cable should be used for signal wiring to prevent electrical noise contamination. The shield should be terminated at the ZVD only. (NOTE: Terminating the shield at both ends causes ground loops and defeats the purpose of using shielded cable).

2.2.1.5 Low voltage wiring making long runs outside a control cabinet should use shielded cable also. Shield termination should be at the end of the cable connected to the equipment requiring the most noise protection. (NOTE: In some cases, this may be the PC or PLC, rather than the ZVD).

2.2.2 NEMA 12

Wiring connections for the NEMA 12 enclosure are shown on page E-3.

NOTE: The NEMA 12 enclosure is not provided with any pre-punched conduit holes. The customer is required to punch holes in the enclosure to facilitate field wire entrance. The customer should ensure that the entrance holes and conduit conform to local wiring codes.

3. ZVD Program Requirements

3.1 General

The ZVD program codes are arranged in groups. A program code is designated by its group number, followed by a dash, and then its individual number within that group. For example, the code 05 – 03 indicates it is the third code in the fifth group. For a full discussion on groups and codes, consult the full code listing.

3.2 Accessing Program Codes

3.2.1 To access the program codes, press the PROG/DATA key. The display shows a number on the left. This is the group number. To go to another group, use the UP and DOWN arrows.

3.2.2 When the desired group is in the display, press the PROG/DATA key again. A code number shows up on the right side of the display. Scroll to the correct code using the UP and DOWN arrows.

3.2.3 When the desired group and code are in the display, press the PROG/DATA key a third time. The display now shows the value in that code. To change the value, use the UP and DOWN arrows. If the number in the display is larger than one digit, the other digits may be accessed using the LEFT arrow.

3.2.4 Once the desired value has been entered in the code, press the PROG/DATA key a fourth time. The display will show “End”, which means that the change has been accepted. If it shows “Err”, the code cannot be changed at this time. The reason may be that the drive is in a “RUN” condition and the code cannot be changed until it is stopped. Some codes are “READ ONLY”, which means that they cannot be changed under any conditions, such as codes 00 - 00 and 00 – 01.

3.3 Standard Program Code Changes

NOTE: The default program in the ZVD is sufficient for normal pump operation except for a few codes, listed below. Changing the codes below should meet the needs of most users. If other functions are desired from the ZVD, consult the full code listing.

Code 00 – 03 (Startup Display Selection) = 2 (User Defined Units, U)

Code 00 – 04 (Multi-function Display) = 11 (encoder RPM)

Code 00 – 05 (User Defined Coefficient) = _____ (Maximum User Defined Units/Code 01 – 00 (60.OO Hz))

NOTE: See Appendix B for examples

Code 00 – 09 (Operating Mode) = 3 (Vector with Feedback)
Choices: Volts/Hertz without Feedback (0), Volts/Hertz with Feedback (1), Vector without Feedback (2), or Vector with Feedback (3)

Code 01 – 09 (Acceleration Rate in Seconds) = _____ (Default is 10.0)

Code 01 – 10 (Deceleration Rate in Seconds) = _____ (Default is 10.0)

Code 02 – 00 (Source of Frequency Command) = _____ (Default is 0 (Keypad))
Choices: Keypad (0), Analog 0 – 10VDC (1), Analog 4 – 20 mA (2), or RS-485 (4)

Code 02 – 01 (Source of Operation Command) = _____ (Default is 0 (Keypad))
Choices: Keypad (0), External with keypad stop (1), or RS-485 with keypad stop (3)

3.3 Standard Program Code Changes (continued)

Code 02 – 02 (Stop Method) = _____ (Default is 0 (Ramp Stop))
Choices: Ramp Stop (0) or Fast Stop (1)

Code 02 – 03 (Carrier Frequency) = 12 (KHz)

NOTE: EMI and heat generation are directly affected by carrier frequency. Acoustical noise is inversely affected by carrier frequency. If the motor is located in a space in which acoustical noise is not bothersome, set Code 02 – 03 to 2 KHz.

Code 02 – 04 (Reverse Operation) = 1 (Disable Reverse)

Code 02 – 05 (Operation Control Modes) = _____ (Default is 0 (Fwd/Stop))
Choices: One Contact Start/Stop (0) or Two Contacts Start and Stop (2)

Code 03 – 00 (Multi-function Output Terminal (Relay Output)) = _____ (Default is 8 (Fault Indication))
Choices: No function (0), AC drive operational (1), Maximum output frequency attained (2), Zero speed (3), Over-torque detection (4), Base-block (B.B.) indication (5), Low voltage indication (6), Fault indication (8), Desired frequency attained (9), PLC program running (10), PLC program step completed (11), PLC program completed (12), PLC program paused (13), Terminal count value attained (14), Preliminary count value attained (15), Heatsink overheat warning (19), AC drive ready (20), or Emergency stop indication (21).

Code 03 – 05 (Analog Output Signal) = _____ (Default is 0 (Analog frequency meter))
Choices: Analog frequency meter (0), Analog current meter (1), Output voltage (2), Output frequency (3), Motor output speed command (4), or Output power factor (5)

Code 04 – 04 (Multifunction Input MI1) = 20 (Emergency Stop)

Code 04 – 05 (Multifunction Input MI2) = _____ (Default is 0 (Disabled))
Choices: Disabled (0), Multi-step speed 1 (1), Multi-step speed 2 (2), Multi-step speed 3 (3), Multi-step speed 4 (4), External reset (5), Accel/Decel speed inhibit (6), Increase frequency (11), Decrease frequency (12), Counter reset (13), Run PLC program (14), Pause PLC program (15), Emergency stop (N.O.) (19), Emergency stop (N.C.) (20), or External start command (23)

Code 06 – 00 (Over-Voltage Stall Prevention) = 0 (Disabled)

Code 06 – 01 (Over-Current Stall Prevention During Acceleration) = 250 (%)

Code 06 – 02 (Over-Voltage Stall Prevention During Operation) = 250 (%)

Code 06 – 06 (Thermal Overload Relay) = 1 (Constant Torque Motor)

Code 06 – 07 (Thermal Characteristic) = 120 (Seconds)

Code 07 – 00 (Motor Rated Current) = _____ (Motor Rated Current / Drive Rated Current (in %))

NOTE: The setting of this parameter is very important, particularly when the motor HP is less than the maximum rating of the drive. This parameter protects the undersized motor from drawing too much current, and possibly being damaged. If the calculated value is less than 40 %, which is the default of Code 07 – 01, Code 07 – 01 must be set first.

Code 07 – 01 (Motor No-load Current) = _____ (Motor No-load Current / Drive Rated Current (in %))

3.3 Standard Program Code Changes (continued)

Code 07 – 02 (Torque Boost) = 0 (Code 00 - 09 = 2 or 3); = 8 (Code 00 – 09 = 0 or 1)

Code 07 – 04 (Number of Motor Poles) = 4 (Base Speed = 1800 RPM)

Code 07 – 05 (Motor Auto Detection) = 1, then press RUN (To Auto Detect Motor Resistance); = 0 (Normal)

Code 07 – 06 (Motor Line-to-line Resistance) = _____ (Auto Detect through or Measure Using an Ohmmeter)

Code 07 – 10 (Current Limit) = 100 (Software Version 3.12 or later)

Code 10 – 08 (Feedback Signal Detection Time) = 5 (Seconds)

Code 10 – 09 (Transmission Fault Treatment) = 1 (Alarm and RAMP to stop)

Code 10 – 10 (PG Pulse Range) = _____ (PPR of Feedback Sensor)

Code 10 – 11 (PG Input) = 1 (Single Phase Feedback)

Code 10 – 12 (Proportional Speed Control (P)) = 1.0 (Proportional Setting)

Code 10 – 13 (Integral Speed Control (I)) = .05 (Integral Setting)

Code 10 – 14 (Speed Control Output Frequency Limit) = 10.0 (Hz)

Code 10 – 15 (Feedback Display Factor (1800 rpm @ 60 Hz)) = _____
Choices: 120 PPR sensor (125), 60 PPR sensor (250), or 30 PPR sensor (500) (See Code 10 – 10)

NOTE: To reset all codes to factory defaults, set Code 00 – 02 = 10. Reprogram, as above.

4. ZVD Operation

NOTE: For all references to wiring, refer to Chapter 2. For all references to programming codes, refer to Chapter 3.

4.1 Local Keypad Operation

4.1.1 Entering Setpoint

4.1.1.1 Press the MODE key until the F or U is lit on the left side of the display.

4.1.1.2 If the F is lit, the setpoint will be entered in frequency. The frequency range is from 0.01 Hz to the value of Code 01-00, which for the standard setup is 60.00 Hz. A setting of 60.00 Hz means that the motor will turn at 1800 RPM.

4.1.1.3 If the U is lit, the setpoint will be entered in user-defined units. The unit is established by Code 00-05. The value in Code 00-05 represents 1.00 Hz, or 30 motor RPM.

4.1.2 Starting the ZVD

4.1.2.1 Press the RUN key. The motor will ramp up to set speed at the acceleration rate entered in Code 01-09.

4.1.2.2 The LED labeled RUN will be lit.

4.1.3 Stopping the ZVD

4.1.3.1 Press the STOP/RESET key. The motor will ramp down at the deceleration rate entered in Code 01-10.

4.1.3.2 The LED labeled RUN will flash during deceleration, and go off when stopped.

4.1.3.3 The LED labeled STOP will be lit.

4.1.4 Jogging the ZVD

4.1.4.1 To enable JOG, the drive must be in a stopped condition.

4.1.4.2 Press the JOG key. The motor will run at the frequency entered in Code 01–14 as long as the key is pressed. Releasing the JOG key will cause the motor to stop.

4.1.4.3 The LED labeled JOG will be lit while the JOG key is pressed.

4.1.5 Changing Motor Rotation

4.1.5.1 Rotation direction is indicated by the LED labeled FWD or REV being lit. NOTE: Code 02 – 04 enables or disables Reverse (Normally disabled).

4.1.5.2 If Reverse is enabled, to change rotation, press the MODE key until the direction is shown on the display. Using the UP or DOWN arrow, change motor direction.

4.1.6 Monitoring ZVD Operation

4.1.6.1 Press the MODE key until the H is lit on the left side of the display.

4.1.6.2 If the motor is running, the display will show the output to the motor in Hz.

4.1.6.2.1 Pressing the LEFT arrow scrolls through a series of parameters reflecting drive performance. These include output current, output voltage, output power, DC BUS voltage, power factor angle, torque ratio, counter value, and PLC time.

4.1 Local Keypad Operation (continued)

4.1.6.3 Press the MODE key until no LED's are lit on the left side of the display. This is the multi-function display and will indicate the parameter selected by Code 00 – 04.

4.1.6.3.1 If the action indicated in paragraph 4.1.6.2.1 has been performed, the display will show the last parameter viewed. Calling up Code 00 – 04 will reflect this new parameter. NOTE: To view encoder RPM, Code 00 – 04 must be set back to 11.

4.1.7 Faults

4.1.7.1 Should a fault occur, the ZVD will stop and display the fault designation. See the Troubleshooting section for fault designations.

4.1.7.2 Once the fault has been cleared, press the STOP/RESET key to clear the display and return to a ready condition.

4.2 Remote Operation

4.2.1 Setpoint

4.2.1.1 Select the method of supplying remote setpoint using Code 02–00.

4.2.1.2 For the method chosen above, wire according to page E-3.

4.2.1.3 Input the setpoint command.

4.2.2 Operation Command Control (Run/Stop)

4.2.2.1 Select the method of operation command control using Code 02–01.

4.2.2.2 If the method of control is using external contacts, select one contact or two contact using Code 02 – 05.

4.2.2.3 For the method of control chosen, wire according to page E-3.

4.2.2.4 Provide the method of operation command control chosen.

4.2.3 Remote Monitoring ZVD Operation

4.2.3.1 Analog Output, 0 – 10 VDC.

4.2.3.1.1 Select the parameter to be monitored using Code 03 – 05.

4.2.3.1.2 Wire the analog output circuit according to page E-3.

5. ZVD Troubleshooting and Fault Information

The ZVD motor drive has a comprehensive fault diagnostic system that includes several different alarms and fault messages. Once a fault is detected, the corresponding protective functions will be activated to shut down the drive output. Below are the fault descriptions for a fault shown on the digital keypad display. The four most recent faults can be read on the digital keypad display (codes 06-08 through 06-11.

NOTE: After faults occur, press RESET to begin using the drive again.

Fault Name	Fault Descriptions	Corrective Actions
oc	The AC drive detects an abnormal increase in current.	1. Check whether the motors horsepower corresponds to the AC drive output power. 2. Check the wiring connections between the AC drive and motor for possible short circuits. 3. Increase the Acceleration time. 4. Check for possible excessive loading conditions at the motor. 5. If there are any abnormal conditions when operating the AC drive after short-circuit being removed, it should be sent back to manufacturer.
occ	IGBT protection	
ou	The AC drive detects that the DC bus voltage has exceeded its maximum allowable value.	1. Check whether the input voltage falls within the rated AC drive input voltage. 2. Check for possible voltage transients. 3. Bus over-voltage may also be caused by motor regeneration. Either increase the decel time or add an optional braking resistor. 4. Check whether the required braking power is within the specified limits.
oH	The AC drive temperature sensor detects excessive heat.	1. Ensure that the ambient temperature falls within the specified temperature range. 2. Make sure that the ventilation holes are not obstructed. 3. Remove any foreign objects on the heatsinks and check for possible dirty heat sink fins. 4. Provide enough spacing for adequate ventilation.
Lu	The AC drive detects that the DC bus voltage has fallen below its minimum value.	1. Check whether the input voltage falls within the rated AC drive's input voltage.

Fault Name	Fault Descriptions	Corrective Actions
oL	1. The AC drive detects excessive drive output current. **Note:** The AC drive can withstand up to 150% of the rated current for a maximum of 60 seconds.	1. Check whether the motor is overloaded. 2. Reduce torque compensation setting as set in Pr.7-02. 3. Increase the AC drive's output capacity.
oL1	Internal electronic overload trip	1. Check for possible motor overload. 2. Check electronic thermal overload setting. 3. Increase motor capacity. 4. Reduce the current level so that the drive output current does not exceed the value set by the Motor Rated Current Pr.7-00.
oL2	Motor overload. Check the parameter settings (Pr.6-03 to Pr.6-05)	1. Reduce the motor load. 2. Adjust the over-torque detection setting to an appropriate setting (Pr.06-03 to Pr.06-05).
cE-	Communication Error	1. Check the connection between the AC drive and computer for loose wires. 2. Check if the communication protocol is properly set.
ocA	Over-current during acceleration: 1. Short-circuit at motor output. 2. Torque boost too high. 3. Acceleration time too short. 4. AC drive output capacity is too small.	1. Check for possible poor insulation at the output line. 2. Decrease the torque boost setting in Pr.7-02. 3. Increase the acceleration time. 4. Replace with the AC drive with one that has a higher output capacity (next HP size).
ocd	Over-current during deceleration: 1. Short-circuit at motor output. 2. Deceleration time too short. 3. AC drive output capacity is too small.	1. Check for possible poor insulation at the output line. 2. Increase the deceleration time. 3. Replace with the AC drive with one that has a higher output capacity (next HP size).
ocn	Over-current during steady state operation: 1. Short-circuit at motor output. 2. Sudden increase in motor loading. 3. AC drive output capacity is too small.	1. Check for possible poor insulation at the output line. 2. Check for possible motor stall. 3. Replace with the AC drive with one that has a higher output capacity (next HP size).

Fault Name	Fault Descriptions	Corrective Actions
EF	The external terminal EF-GND goes from OFF to ON.	1. When external terminal EF-GND is closed, the output will be turned off. (under N.O. E.F.) 2. Press RESET after fault has been cleared
EF1	Emergency stop. When the multifunction input terminals (MI1 to MI6) stop, AC drive stops any output.	Press RESET after fault has been cleared.
cF1	Internal memory IC can not be programmed.	1. Return to the factory. 2. Check the EEPROM on the control board.
cF2	Internal memory IC can not be read.	1. Return to the factory. 2. Reset drive to factory defaults.
cF3	Drive's internal circuitry abnormal.	Return to the factory.
HPF	Hardware protection failure	Return to the factory.
codE	Software protection failure	Return to the factory.
cFA	Auto accel/decel failure	1. Don't use the function of auto acceleration/deceleration.
GFF	Ground fault : The AC drive output is abnormal. When the output terminal is grounded (short circuit current is 50% more than the AC drive rated current), the AC drive power module may be damaged. The short circuit protection is provided for AC drive protection, not user protection.	Ground fault : 1. Check whether the IGBT power module is damaged. 2. Check for possible poor insulation at the output line.
bb	External Base Block. AC drive output is turned off.	1. When the external input terminal (B.B.) is active, the AC drive output will be turned off. 2. Disable this connection and the AC drive will begin to work again.
AnLEr PGErr	AnLEr: analog feedback error PGErr: PG feedback signal error	1. Check both parameter settings and wiring of Analog/PC (Pr. 10-00). 2. Check for possible fault between system reaction time and the feedback signal detection time (Pr. 10-08).

APPENDIX A: ZVD Part Numbers

Standalone Part Numbers (NEMA 1)

Description	Part Number
1 HP, 230 VAC, 3 Phase	68-16817-0108-0
2 HP, 230 VAC, 3 Phase	68-16817-0109-0
1 HP, 460 VAC, 3 Phase	68-16817-0110-0
2 HP, 460 VAC, 3 Phase	68-16817-0111-0
3 HP, 230 VAC, 3 Phase	68-16817-0114-0
3 HP, 460 VAC, 3 Phase	68-16817-0115-0
5 HP, 230 VAC, 3 Phase	68-16817-0116-0
5 HP, 460 VAC, 3 Phase	68-16817-0117-0

NEMA 12 Part Numbers

Description	Part Number
1 HP, 230 VAC, 3 Phase	64-16814-0693-1
2 HP, 230 VAC, 3 Phase	64-16814-0694-1
1 HP, 460 VAC, 3 Phase	64-16814-0695-1
2 HP, 460 VAC, 3 Phase	64-16814-0696-1
3 HP, 230 VAC, 3 Phase	64-16814-0699-1
3 HP, 460 VAC, 3 Phase	64-16814-0700-1
5 HP, 230 VAC, 3 Phase	64-16814-0702-1
5 HP, 460 VAC, 3 Phase	64-16814-0703-1

NEMA 12 Part Numbers with EMI filter installed

Description	Part Number
1 HP, 230 VAC, 3 Phase	68-16814-0705-0
2 HP, 230 VAC, 3 Phase	68-16814-0706-0
3 HP, 230 VAC, 3 Phase	68-16814-0707-0
5 HP, 230 VAC, 3 Phase	68-16814-0708-0
1 HP, 460 VAC, 3 Phase	68-16814-0709-0
2 HP, 460 VAC, 3 Phase	68-16814-0710-0
3 HP, 460 VAC, 3 Phase	68-16814-0711-0
5 HP, 460 VAC, 3 Phase	68-16814-0712-0

Auxiliary Part Numbers

Description	Part Number
Pulse Generator Card	68-16818-0114-0
EMI Filter, 1 - 2 HP, 230/460 VAC	68-16818-0116-0
EMI Filter, 3 - 5 HP, 230 VAC	68-16818-0117-0
EMI Filter, 3 - 5 HP, 460 VAC	68-16818-0118-0
ZVD to Keypad Cable, 1 meter long	68-17507-0049-0
ZVD to Keypad Cable, 2 meters long	68-17507-0052-0
ZVD to Keypad Cable, 3 meters long	68-17507-0053-0
ZVD to Keypad Cable, 5 meters long	68-17507-0054-0
Intrinsically Safe Barrier	68-16509-0071-1

APPENDIX B: ZVD Program Code 00-05 Examples

Example (1): User Defined Units in Pump RPM

Given: Code 01 – 00 = 60 Hz

Motor RPM @ 60 Hz = 1800 RPM

Reducer Ratio = 21.420 : 1

Then: Pump RPM @ 60 Hz = 1800 / 21.420 = 84.03 RPM

Code 00 – 05 = Pump RPM / Code 01 – 00

Code 00 – 05 = 84.03 / 60 = 1.40

Example (2): User Defined Units in Pump RPM

Given: Code 01 – 00 = 60 Hz

Motor RPM @ 60 Hz = 1800 RPM

Reducer Ratio = 5.091 : 1

Then: Pump RPM @ 60 Hz = 1800 / 5.091 = 353.565 RPM

Code 00 – 05 = Pump RPM / Code 01 – 00

Code 00 – 05 = 353.565 / 60 = 5.89

Example (3): User Defined Units in Flow Rate (cc / minute)

Given: Code 01 – 00 = 60 Hz

Motor RPM @ 60 Hz = 1800 RPM

Reducer Ratio = 11.202 : 1

Pump Capacity = 2.4 cc / revolution

Then: Pump RPM @ 60 Hz = 1800 / 11.202 = 160.686 RPM

Pump Flow Rate @ 60 Hz = 160.686 RPM x 2.4 cc / Rev = 385.646 cc / minute

Code 00 – 05 = Pump Flow Rate / Code 01 – 00

Code 00 – 05 = 385.646 / 60 = 6.43

Example (4): User Defined Units in Flow Rate (gal / hour)

Given: Code 01 – 00 = 60 Hz

Motor RPM @ 60 Hz = 1800 RPM

Reducer Ratio = 11.238 : 1

Pump Capacity = 15.0 cc / revolution

Then: Pump RPM @ 60 Hz = 1800 / 11.238 = 160.171 RPM

Pump Flow Rate @ 60 Hz = 160.171 RPM x 15.0 cc / Rev = 2402.56 cc / minute

Pump Flow Rate in cc / hour @ 60 Hz = 2402.56 cc/m x 60 m/hr = 144,154 cc/hr

Pump Flow Rate gal/hr @ 60 Hz = 144,154 cc/hr x .0002642 gal/cc = 38.09 gal/hr

Code 00 – 05 = Pump Flow Rate / Code 01 – 00

Code 00 – 05 = 38.09 / 60 = 0.63

Example (5): User Defined Units in Flow Rate (gm / minute)

Given: Code 01 – 00 = 60 Hz

Motor RPM @ 60 Hz = 1800 RPM

Reducer Ratio = 22.585 : 1

Pump Capacity = 1.2 cc / revolution

Fluid Specific Gravity = 1.1 gm / cc

Then: Pump RPM @ 60 Hz = 1800 / 22.585 = 79.699 RPM

Pump Flow Rate @ 60 Hz = 79.699 RPM x 1.2 cc/Rev = 95.64 cc / minute

Pump Flow Rate in gm/min @ 60 Hz = 95.64 cc/m x 1.1 gm/cc = 105.2 gm/min

Code 00 – 05 = Pump Flow Rate in gm/min/Code 01 – 00

Code 00 – 05 = 105.2 / 60 = 1.75

Example (6): User Defined Units in Flow Rate (pounds / hour)

Given: Code 01 – 00 = 60 Hz

Motor RPM @ 60 Hz = 1800 RPM

Reducer Ratio = 5.057 : 1

Pump Capacity = 4.5 cc / revolution

Fluid Specific Gravity = 1.25 gm / cc

Then: Pump RPM @ 60 Hz = 1800 / 5.057 = 355.94 RPM

Pump Flow Rate @ 60 Hz = 355.94 RPM x 4.5 cc / Rev = 1601.7 cc / minute

Pump Flow Rate in gm/min @ 60 Hz = 1601.7 cc/m x 1.25 gm/cc = 2002 gm/min

Pump Flow Rate in lb/min @ 60 Hz = 2002 gm/m x .0022 lb/gm = 4.417 lb/min

Pump Flow Rate in lb/hr @ 60 Hz = 4.417 lb/min x 60 min/hr = 265.0 lb/hr

Code 00 – 05 = Pump Flow Rate in lb/hr/Code 01 – 00

Code 00 – 05 = 265.0 / 60 = 4.42

APPENDIX C: ZVD Program Codes

Gear Reducer: Size _____ Ratio _____

The below listed program codes have been changed from the ZVD default program codes. If the drive has been reset to factory default for any reason, these codes must be changed to the entry listed for the drive to operate as it did when first received

Code	Code Description	Entry
00-03	Startup Display Selection	_____
00-04	Multi-function Display	_____
00-05	User Defined Coefficient	_____
00–09	Operating Mode	_____
01–09	Acceleration Rate in Seconds	_____
01–10	Deceleration Rate in Seconds	_____
02–00	Source of Frequency Command	_____
02–01	Source of Operation Command	_____
02–02	Stop Method	_____
02–03	Carrier Frequency	_____
02–04	Reverse Operation	_____
02–05	Operation Control Modes	_____
03–00	Multi-function Output Terminal (Relay Output)	_____
03–05	Analog Output Signal	_____
04–04	Multifunction Input MI1	_____
04–05	Multifunction Input MI2	_____
06–00	Over-Voltage Stall Prevention	_____
06–01	Over-Current Stall Prevention During Acceleration	_____
06–02	Over-Voltage Stall Prevention During Operation	_____
06–06	Thermal Overload Relay	_____
06–07	Thermal Characteristic	_____
07–00	Motor Rated Current	_____
07–01	Motor No-load Current	_____
07–02	Torque Boost	_____
07–04	Number of Motor Poles	_____
07–06	Motor Line-to-line Resistance	_____
07–10	Current Limit	_____
10–08	Feedback Signal Detection Time	_____
10–09	Transmission Fault Treatment	_____
10–10	PG Pulse Range	_____
10–11	PG Input	_____
10–12	Proportional Speed Control (P)	_____
10–13	Integral Speed Control (I)	_____
10–14	Speed Control Output Frequency Limit	_____
10–15	Feedback Display = 1800 rpm @ 60 Hz	_____

NOTE: To reset all codes to factory defaults, set Code 00 – 02 = 10.

APPENDIX D: ZVD Summary of Default Program Codes

★ Can be set during operation

Group 0: User Parameters			
Parameters	**Explanation**	**Settings**	**Factory Default Setting**
0-00	Identity Code of Drive	Read-only	#
0-01	Rated Current Display	Read-only	##.#
0-02	Parameter Reset	d10: reset parameter to factory setting	0
0-03	Start-up Display of AC Drive ★	d0: F (setting frequency)	
		d1: H (actual frequency)	
		d2: u (user-defined unit)	
		d3: Multi Function Display	0
		d4: FWD/REV	
0-04	Content of Multi Function Display	d0: Display output current (A)	
		d1: Display Counter Value (C)	
		d2: Display Process Operation (1. tt)	
		d3: Display DC-BUS Voltage (U)	
		d4: Display output voltage (E)	0
		d5: Output power factor angle (n.)	
		d6: Display output power (kW)	
		d7: Display motor speed (r)	
		d8: Display estimated torque ratio (T)	
		d11: Display motor tachometer	
0-05	User-Defined Coefficient K ★	0.01 to 160.00	1.00
0-06	Software Version	Read-only	###
0-07	Password Input	0 to 65535	0
0-08	Password Setting	0 to 65535	0
0-09	Control Methods	d0: V/F control	
		d1: V/F Control + PG	0
		d2: Vector Control	
		d3: Vector Control + PG	

APPENDIX D: ZVD Summary of Default Program Codes

Group 1: Basic Parameters			
Parameters	**Explanation**	**Settings**	**Factory Default Setting**
01-00	Maximum Output Freq. (Fo,max)	50.0 to 400 Hz	60.0
01-01	Maximum Voltage Frequency (Base Freq) (Fmax)	0.1 to 400 Hz	60.0
01-02	Maximum Output Voltage (Vmax)	230V series: 0.10V to 255.0V	220
		460V series: 0.10V to 510.0V	440
01-03	Mid-Point Frequency (Fmid)	0.10 to 400 Hz	0.5
01-04	Mid-Point Voltage (Vmid)	230V: 0.1V to 255V	1.7
		460V: 0.1V to 510V	3.4
01-05	Minimum Output Frequency (Fmin)	0.10 to 400.00 Hz	0.50
01-06	Minimum Output Voltage (Vmin)	230V series: 0.1V to 255V	1.7
		460V series: 0.1V to 510V	3.4
01-07	Upper bound of freq.	1 to 110%	100
01-08	Lower bound of freq.	0 to100 %	00
01-09	Accel Time 1 ★	0.1 to 3600.0 Sec	10.0/60.0
01-10	Decel Time 1 ★	0.1 to 3600.0 Sec	10.0/60.0
01-11	Accel Time 2 ★	0.1 to 3600.0 Sec	10.0/60.0
01-12	Decel Time 2 ★	0.1 to 3600.0 Sec	10.0/60.0
01-13	Jog accel/decel Time ★	0.1 to 3600.0 Sec	1.0
01-14	Jog Frequency ★	0.10 Hz to 400.00 Hz	6.00
01-15	Auto Accel/Decel	d0: Linear Accel/Decel	00
		d1: Auto Accel, Linear Decel	
		d2: Linear Accel, Auto Decel	
		d3: Auto Accel/Decel	
		d4: Linear Accel/Decel Stall Prevention during deceleration	
01-16	S-Curve in Accel	00 to 07	00
01-17	S-Curve in Decel	00 to 07	00
01-18	Accel Time 3 ★	0.1 to 3600.0 sec	10.0
01-19	Decel Time 3 ★	0.1 to 3600.0 sec	10.0
01-20	Accel Time 4 ★	0.1 to 3600.0 sec	10.0
01-21	Decel Time 4 ★	0.1 to 3600.0 sec	10.0

APPENDIX D: ZVD Summary of Default Program Codes

Group 2: Operation Method Parameters			
Parameters	**Explanation**	**Settings**	**Factory Default Setting**
02-00	Source of Frequency Command	d0: Digital keypad	00
		d1: 0 to +10V from AVI	
		d2: 4 to 20mA from ACI	
		d3: Potentiometer control (-10 to +10Vdc)	
		d4: RS-485 communication Interface	
02-01	Source of Operation Command	d0: Determined by digital keypad	00
		d1: Master Frequency determined by external terminal, STOP key enable	
		d2: Master Frequency determined by external terminal, STOP key disable	
		d3: Master Frequency determined by RS-485 communication interface, STOP key enable	
		d4: Master Frequency determined by RS-485 communication interface, STOP key disable	
02-02	Stop Method	d0: Ramp Stop; E.F. COAST stop	00
		d1: Coast Stop; E.F. COAST stop	
		d2: Ramp Stop; E.F. RAMP stop	
		d3: Coast Stop; E.F. RAMP stop	
02-03	PWM Carrier Frequency	0.75kW to 3.7kW (1 to 5 HP): d1 to d15	15
		5.5kW to 18.5kW (7.5 to 25 HP): d1 to d15	9
		22kW to 45kW (30 to 60 HP): d1 to d9	9
		55kW to 75kW (75 to 100 HP): d1 to d9	6
02-04	Reverse Operation	d0: Enable REV	00
		d1: Disable REV	
02-05	2-wire/3-wire Operation Control Mode Selection	d0: 2-wire Operation Control Mode (1)	00
		d1: 2-wire Operation Control Mode (2)	
		d2: 3-wire Operation Control Mode	
2-06	Line Start Lockout	d0: Disable	0
		d1: Enable	
02-07	Loss of ACI	d0: Decelerate to 0 Hz	0
		d1: Stop immediately and display “EF”	
		d2: Continue operation by last frequency command	

APPENDIX D: ZVD Summary of Default Program Codes

Group 3: Output Function Parameters			
Parameters	**Explanation**	**Settings**	**Factory Default Setting**
03-00	Multi-Function Output1 (Relay Output)	d0: Not Used d1: AC Drive Operational d2: Max. Output Freq. Attained d3: Zero Speed	08
03-01	Multi-Function Output2 (Photocoupler Output)	d4: Over Torque d5: Base-Block (B.B.) d6: Low Voltage Detection d7: AC Drive Operation Mode	01
03-02	Multi-Function Output3	d8: Fault Indication d9: Desired Freq. Attained d10: PLC Program Running d11: PLC Program Step Complete	02
03-03	Multi-Function Output4	d12: PLC Program Complete d13: PLC Program Operation Pause d14: Terminal Count Value Attained d15: Preliminary Count Value Attained d16: Auxiliary Motor No.1 d17: Auxiliary Motor No.2 d18: Auxiliary Motor No.3 d19: Heat Sink Overheat Warning d20: AC Drive Ready d21 Emergency Stop Indication d22: Desired Frequency Attained 2 d23: Software Break Signal d24: Zero Speed Output Signal	20
03-04	Desired Freq. Attained	0.00 to 400.00 Hz	0.00
03-05	Analog Output Signal	d0: Output Frequency d1: Output Current d2: Output Voltage d3: Frequency command d4: Motor output speed d5: Output power factor	0
03-06	Analog Output Gain ★	1 to 200%	100
03-07	Digital Output Gain ★	1 to 20	01
03-08	Terminal Count Value	0 to 65500	0
03-09	Preliminary Count Value	0 to 65500	0
03-10	Desired Freq. attained 2	0.00 to 400.00 Hz	0.00

APPENDIX D: ZVD Summary of Default Program Codes

Group 4: Input Function Parameters

Parameters	Explanation	Settings	Factory Default Setting
04-00	Potentiometer Bias Frequency ★	0.0 to 350 Hz	0.0
04-01	Potentiometer Bias Polarity ★	d0: Positive Bias	0
		d1: Negative Bias	
04-02	Potentiometer Frequency Gain ★	1 to 200 %	100
04-03	Potentiometer Reverse Motion Enable	d0: Forward Motion Only	0
		d1: Reverse Motion Enabled	
		d2: Forward and Reverse Motion Enable	
04-04	Multi-Function Input Terminal 1 (MI0, MI1)	d0: Parameter Disable	0
		d1: Multi-Step Speed Command 1	1
04-05	Multi-Function Input Terminal 2 (MI2)	d2: Multi-Step Speed Command 2	2
		d3: Multi-Step Speed Command 3	3
		d4: Multi-Step Speed Command 4	4
04-06	Multi-Function Input Terminal 3 (MI3)	d5: Reset	5
		d6: Accel/Decel Speed Inhibit	6
04-07	Multi-Function Input Terminal 4 (MI4)	d7: First or Second Accel/Decel Time Selection	
		d8: Third or Forth Accel/Decel Time Selection	
04-08	Multi-Function Input Terminal 5 (MI5)	d9: External Base Block (N.C) Input	
		d10: External Base Block (N.O) Input	
		d11: Increase Master Frequency	
04-09	Multi-Function Input Terminal 6 (MI6)	d12: Decrease Master Frequency	
		d13: Counter Reset	
		d14: Run PLC Program	
		d15: Pause PLC	
		d16: Auxiliary Motor No.1 Output Failure	
		d17: Auxiliary Motor No.2 Output Failure	
		d18: Auxiliary Motor No.3 Output Failure	
		d19: Emergency Stop (NO)	
		d20: Emergency Stop (NC)	
		d21: Analog Output Frequency AVI/ACI	
		d22: Analog Output Frequency AVI/AUI	
		d23: Operation Command Keypad/external Terminal	
		d24: Auto/Linear Accel/Decel Selection	
04-10	Digital Terminal Input Delay Time	d01 to d20m sec	01

APPENDIX D: ZVD Summary of Default Program Codes

Group 5: Multi-Step Speed and PLC Parameters			
Parameters	**Explanation**	**Settings**	**Factory Default Setting**
05-00	1st Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-01	2nd Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-02	3rd Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-03	4th Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-04	5th Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-05	6th Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-06	7th Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-07	8th Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-08	9th Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-09	10th Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-10	11th Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-11	12th Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-12	13th Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-13	14th Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-14	15th Step Speed Freq.	0.00 to 400.00 Hz	0.00
05-15	PLC Mode	d0: Disable PLC Operation d1: Execute one program cycle d2: Continuously execute program cycles d3: Execute one program cycle step by step d4: Continuously execute one program cycle step by step	00
05-16	PLC Forward/ Reverse Motion	00 to 32767 sec (0:FWD 1:REV)	00
05-17	Time Duration Step 1	00 to 65500 sec	00
05-18	Time Duration Step 2	00 to 65500 Sec	00
05-19	Time Duration Step 3	00 to 65500 Sec	00
05-20	Time Duration Step 4	00 to 65500 Sec	00
05-21	Time Duration Step 5	00 to 65500 Sec	00
05-22	Time Duration Step 6	00 to 65500 Sec	00
05-23	Time Duration Step 7	00 to 65500 Sec	00
05-24	Time Duration Step 8	00 to 65500 Sec	00
05-25	Time Duration Step 9	00 to 65500 Sec	00
05-26	Time Duration Step 10	00 to 65500 Sec	00
05-27	Time Duration Step 11	00 to 65500 Sec	00
05-28	Time Duration Step 12	00 to 65500 Sec	00
05-29	Time Duration Step 13	00 to 65500 Sec	00
05-30	Time Duration Step 14	00 to 65500 Sec	00
05-31	Time Duration Step 15	00 to 65500 Sec	00

APPENDIX D: ZVD Summary of Default Program Codes

Group 6: Protection Parameters			
Parameters	**Explanation**	**Settings**	**Factory Default Setting**
06-00	Over-Voltage Stall Prevention	d0: Disable d1: Enable	01
06-01	Over-Current Stall Prevention during Accel	20 to 250%	170
06-02	Over-Current Stall Prevention during Operation	20 to 250%	170
06-03	Over-Torque Detection Mode	d0: Disabled d1: Enabled during constant speed operation and continues until the continuous limit (Pr.06-05) is reached. d2: Enabled during Constant Speed Operation and halted after detection d3: Enabled during Accel and continues before Continuous Output Time Limit (Pr.6-05) is reached d4: Enabled during Accel and halted after Over-Torque detection	00
06-04	Over-Torque Detection Level	30 to 200%	150
06-05	Continuous Output Time Limit	0.1 to 60.0 Sec	0.1
06-06	Electronic Thermal Overload Relay	d0: Reduce Torque Motor d1: Constant Torque Motor d2: Inactive	02
06-07	Electronic Thermal characteristic ★	30 to 600 Sec	60
06-08 06-09 06-10	Present Fault Record Second Most Recent Third Most Recent Fault Record	d0: No Fault occurred d1: Over Current (oc) d2: Over Voltage (ov) d3: Over Heat (oH) d4: Over Load (oL) d5: Over Load (oL1) d6: External Fault (EF) d7: IGBT Protection (occ) d8: CPU Fault (cF3) d9: Hardware Protection Failure (HPF) d10: Current exceed during Acceleration (ocA) d11: Current exceed during Deceleration (ocd) d12: Current exceed during Steady State (ocn) d13: Ground Fault (GF)	00 0

APPENDIX D: ZVD Summary of Default Program Codes

Group 6: Protection Parameters (Cont.)			
Parameters	**Explanation**	**Settings**	**Factory Default Setting**
06-11	Fourth Most Recent Fault Record	d14: Lv	0
		d15: CF1	
		d16: CF2	
		d17: Base Block (B.B.)	
		d18: oL2	
		d19: CFA	
		d20: codE	
		d21: EF1 (External Emergency Stop)	
06-12	Over-voltage Stall Level	230V serues: 330V to 410V	390
		460V Series: 660V to 820V	780

Group 7: Motor Parameters			
Parameters	**Explanation**	**Settings**	**Factory Default Setting**
07-00	Motor Rated Current ★	30 to 120%	100
07-01	Motor No-Load Current ★	0 to 90%	40
07-02	Torque Compensation ★	0 to 10	00
07-03	Slip Compensation ★	0.00 to 3.00.	0.00
07-04	Number of Motor Poles	02 to 10	04
07-05	Motor Auto Detection	d0: Disable	00
		d1: Enable	
07-06	Motor Line-to-Line Resistance (R1)	0.00 to 655.35	0.0
07-07	Equivalent Rotor Resistance (R2)	00 to 200%	100
07-08	Motor Rated Slip	0 to 20 Hz	3
07-09	Slip Compensation Limit	0 to 250%	200
07-10	Vector Control Current Compensation Limit	d0.0 to d2.0	1.5

APPENDIX D: ZVD Summary of Default Program Codes

Group 8: Special Parameters			
Parameters	**Explanation**	**Settings**	**Factory Default Setting**
08-00	DC Braking Current Level	0.0 to 100%	0
08-01	DC Braking Time during Start-Up	0.0 to 60.0 Sec	0.0
08-02	DC Braking Time during Stopping	0.0 to 60.0 Sec	0.0
08-03	Start-Point for DC Braking	0.00 to 400.00 Hz	0.00
08-04	Momentary Power Loss	d0: Stop Operation after Momentary Power Loss	0
		d1: Continues after Momentary Power Loss, speed search starts with Master Frequency	
		d2: Continues after Momentary Power Loss, speed search starts with Minimum Output Frequency	
08-05	Maximum Allowable Power Loss Time	0.3 to 5.0 Sec	2.0
08-06	B.B. Time for Speed Search	0.1 to 5.0 Sec	0.5
08-07	Maximum Speed Search Current Level	30 to 200%	150
08-08	Skip Frequency 1 Upper Bound	0.00 to 400.00 Hz	0.0
08-09	Skip Frequency 1 Lower Bound	0.00 to 400.00 Hz	0.0
08-10	Skip Frequency 2 Upper Bound	0.00 to 400.00 Hz	0.0
08-11	Skip Frequency 2 Lower Bound	0.00 to 400.00 Hz	0.0
08-12	Skip Frequency 3 Upper Bound	0.00 to 400.00 Hz	0.0
08-13	Skip Frequency 3 Lower Bound	0.00 to 400.00 Hz	0.0
08-14	Auto Restart After Fault	0 to 10	0
08-15	Auto Energy Saving	d0: Disable	0
		d1: Enable	
8-16	AVR Function	d0: AVR Function Enable	0
		d1: AVR Function Disable	
		d2: AVR Function Disable for Decel	
08-17	Dynamic Braking Voltage	230V: 370V to 430V	380
		460V: 740V to 860V	760
08-18	Base-block Speed Trace	d0: Speed Search Starts with Last Frequency Command	0
		d1: Speed Search Starts with Minimum Output Frequency	
08-19	Speed Search	d0: Speed Search Disable	0
		d1: Speed Search Enable	

APPENDIX D: ZVD Summary of Default Program Codes

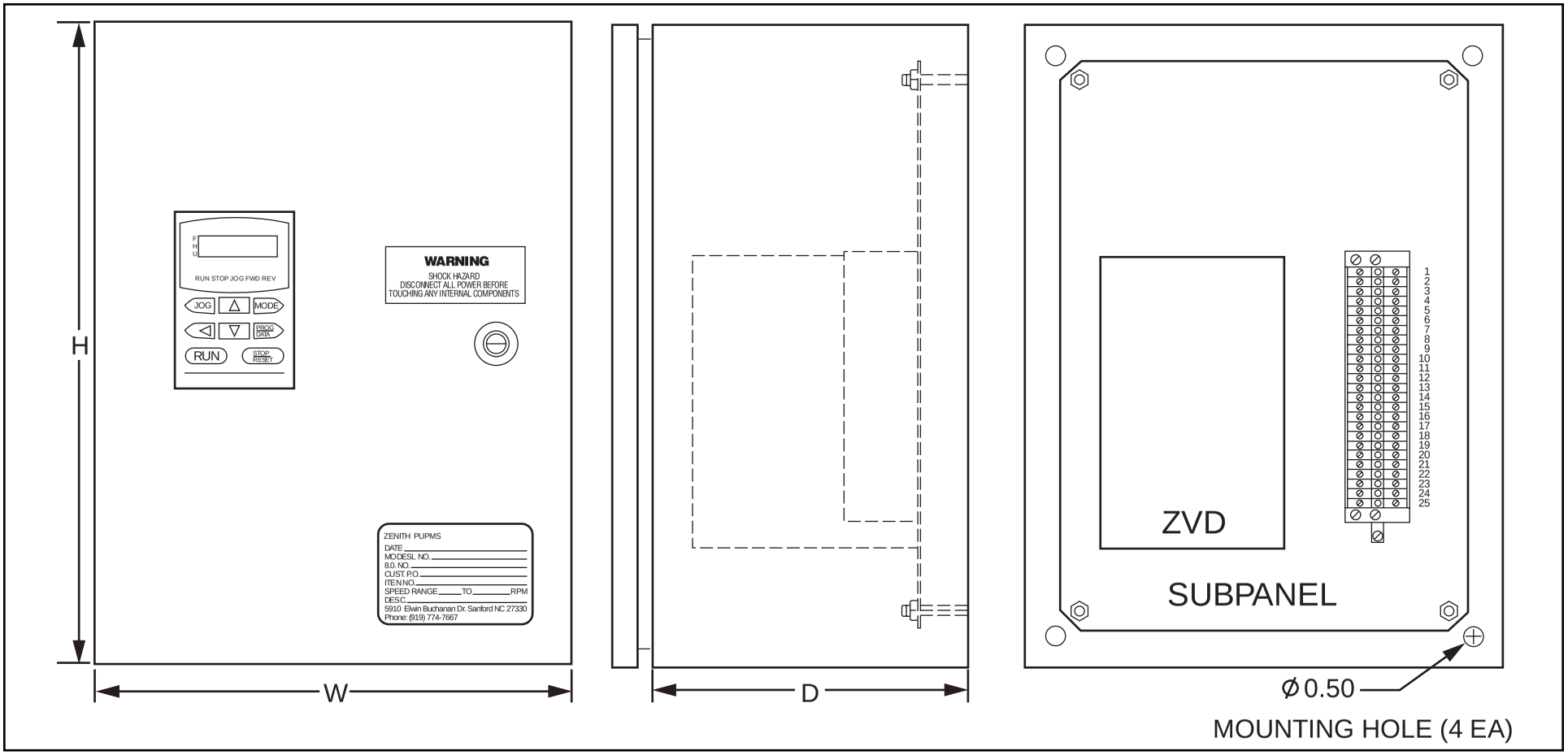
Group 9: Communication Parameters			
Parameters	**Explanation**	**Settings**	**Factory Default Setting**
09-00	Communication Address ★	1 to 254	1
09-01	Transmission Speed ★	d0: Baud Rate 4800bps	1
		d1: Baud Rate 9600bps	
		d2: Baud Rate 19200bps	
		d3: Baud Rate 38400bps	
09-02	Transmission Fault Treatment ★	d0: Warn and keep Operating	0
		d1: Warn and RAMP to Stop	
		d2: Warn and COAST to Stop	
		d3: No warning and keep Operating	
09-03	Overtime Detection	d0: Disable	1
		d1: Enable	
09-04	Communication Protocol ★	d0: 7,N,2 (Modbus, ASCII)	0
		d1: 7,E,1 (Modbus, ASCII)	
		d2: 7,O,1 (Modbus, ASCII)	
		d3: 8,N,2 (Modbus, RTU)	
		d4: 8,E,1 (Modbus, RTU)	
		d5: 8,O,1 (Modbus, RTU)	

APPENDIX D: ZVD Summary of Default Program Codes

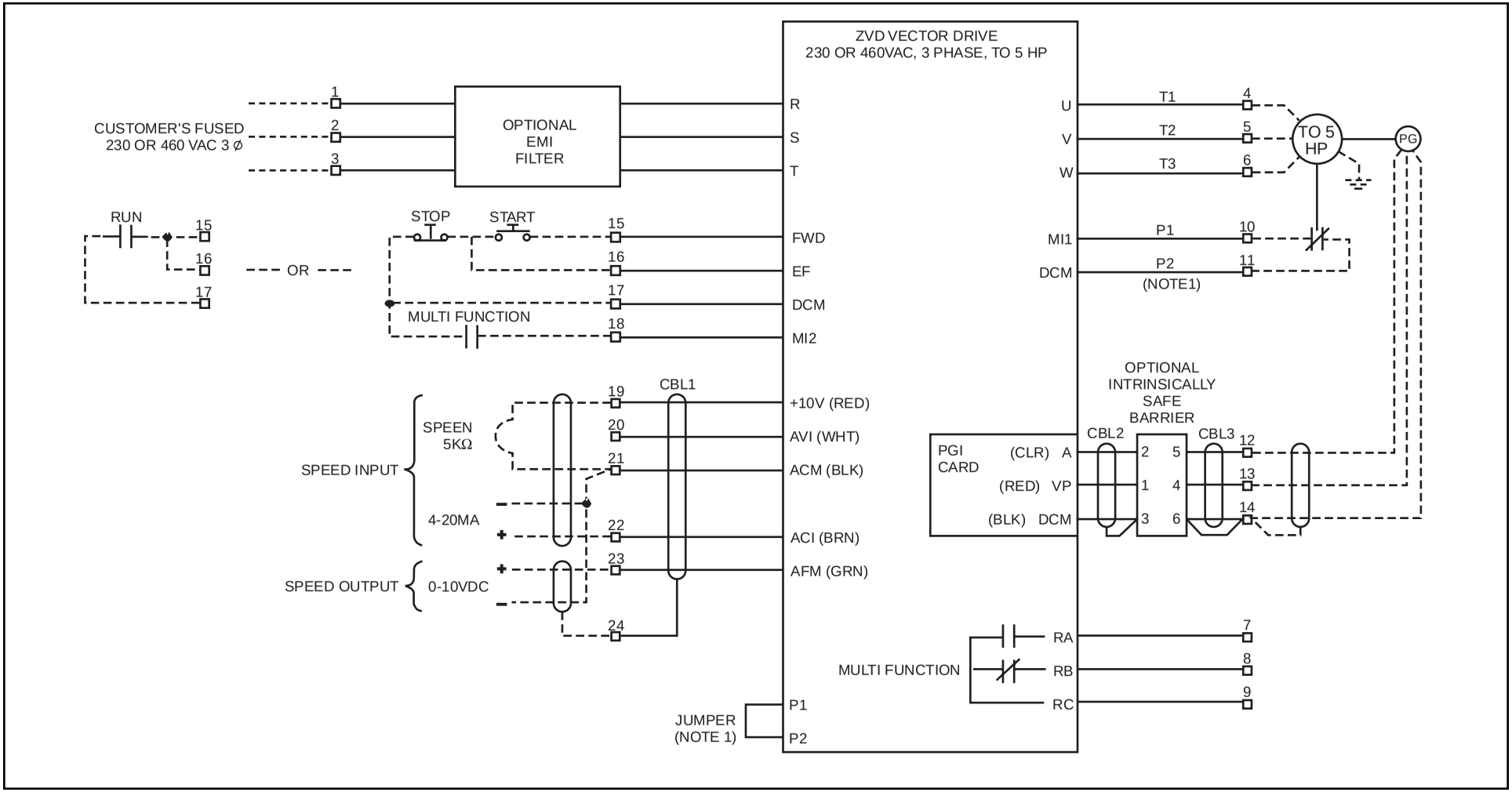
Group 10: PID Control Parameters			
Parameters	**Explanation**	**Settings**	**Factory Default Setting**
10-00	Input terminal for Frequency	d0: Inhibit PID operation d1: Input negative PID feedback from external terminal (AVI) 0 to +10V d2: Input negative PID feedback from external terminal (ACI) 4to 20mA d3: Input positive PID feedback from external terminal (AVI) 0 to +10V d4: Input positive PID feedback from external terminal (ACI) 4 to 20mA	00
10-01	Gain over Frequency Input	d0.01 to d10.0	1.00
10-02	Proportional Gain (P)	d0.0 to d10.0	1.0
10-03	Integral Gain (I)	d0.00 to d100.00 sec	1.00
10-04	Derivative Control (D)	d0.00 to d1.00 sec	0.00
10-05	Upper Bound for Integral Control	0 to 110%	100
10-06	Derivative Filter time Constant	0.0 to 2.5 sec	0.0
10-07	PID Output Freq Limit	0 to 110%	100
10-08	Feedback Signal Detection time	0.0 to 3600.0 sec	60.0
10-09	Transmission Fault Treatment	d0: Warn and keep operation d1: Warn and RAMP to stop d2: Warn and COAST to stop	0
10-10	PG Pulse Range	d1 to d40000	600
10-11	PG Input	d0: Disable PG d1: Single phase d2: Forward/Counterclockwise rotation d3: Reverse/Clockwise rotation	00
10-12	Proportional Speed control (P)	d0 to d20.	0.1
10-13	Integral Speed Control (I)	0.0 to 100.0	1.0
10-14	Speed Control Output Frequency Limit	00 to 20.00 Hz	10.00
10-15	PG Detected Output Renewal Time	d1 to d500	500

APPENDIX D: ZVD Summary of Default Program Codes

Group 11: Fan & Pump Control Parameters			
Parameters	**Explanation**	**Settings**	**Factory Default Setting**
11-00	V/F Curve Selection	d0: V/F Curve determined by Pr.01-00 to Pr.01-06 d1: 1.5 Power Curve d2: 1.7 Power Curve d3: Square Curve d4: Cube Curve	0
11-01	Start Frequency of the Auxiliary Motor	0.00 to 120.00 Hz	0.00
11-02	Stop Frequency of Auxiliary Motor	0.00 to 120.00 Hz	0.00
11-03	Time Delay before Starting the Auxiliary Motor	0.0 to 3600 sec	0.0
11-04	Time Delay before Stopping the Auxiliary Motor	0.0 to 3600 sec	0.0



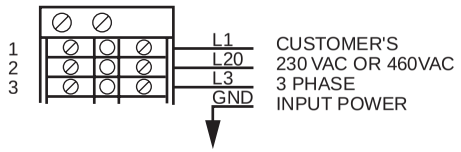
ZVD NEMA 12 Standard Products					
		Without EMI Filter Option		With EMI Filter Option	
Volts	HP	Part No.	H x W x D	Part No.	H x W x D
230	1	64-16814-0693-1	16" x 12" x 8"	68-16814-0705-0	20" x 20" x 12"
230	2	64-16814-0694-1	16" x 12" x 8"	68-16814-0706-0	20" x 20" x 12"
230	3	64-16814-0699-1	24" x 16" x 8"	68-16814-0707-0	20" x 20" x 12"
230	5	64-16814-0702-1	24" x 20" x 12"	68-16814-0708-0	24" x 20" x 12"
460	1	64-16814-0695-1	16" x 12" x 8"	68-16814-0709-0	20" x 20" x 12"
460	2	64-16814-0696-1	16" x 12" x 8"	68-16814-0710-0	20" x 20" x 12"
460	3	64-16814-0700-1	24" x 16" x 8"	68-16814-0711-0	20" x 20" x 12"
460	5	64-16814-0703-1	24" x 20" x 12"	68-16814-0712-0	24" x 20" x 12"

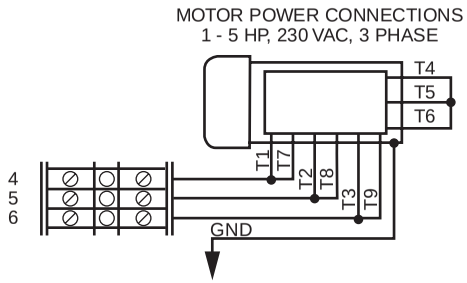


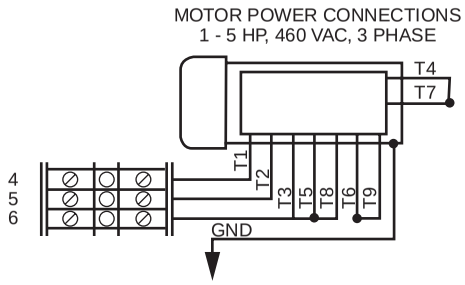
NOTES:

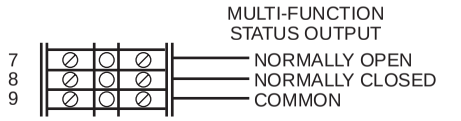
1. Motor thermostat wires P1 and P2 are connected to terminal strip terminals 10 and 11. Do NOT connect them to ZVD terminals P1 and P2.
2. The optional intrinsically safe barrier is used when the feedback sensor is located in a hazardous location.
3. The optional EMI filter is used when CE certification is required. A larger control cabinet is required to add the EMI filter.

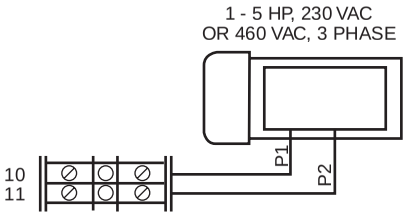
Wiring diagram

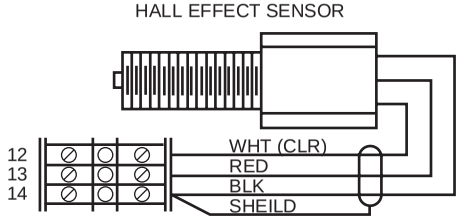


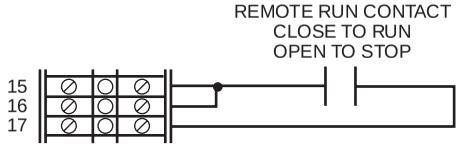


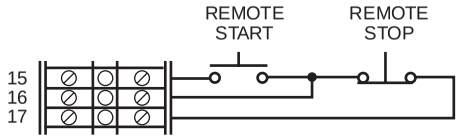


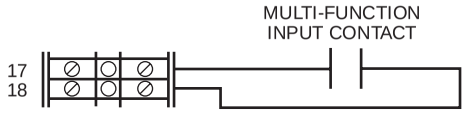


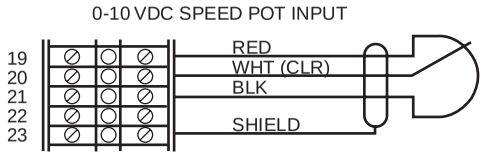


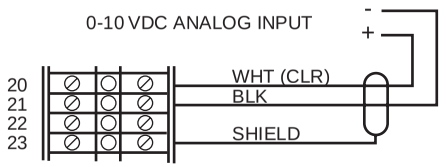


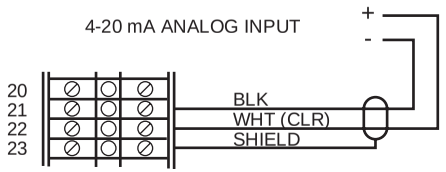


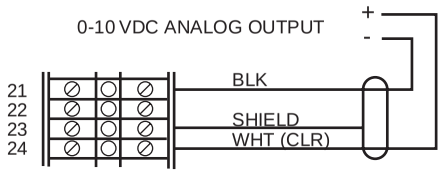












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Zenith® Pumps
1710 Airport Road
Monroe, NC 28110
Phone: 704-289-6511 • Fax: 704-289-9273
zenithpumps@colfaxcorp.com • www.zenithpumps.com

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