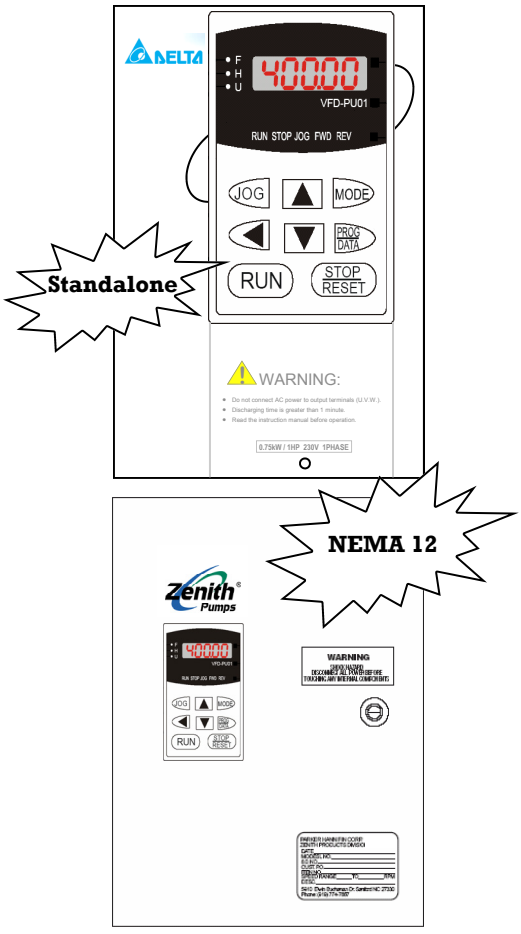
CIRCOR Precision Metering, LLC

Date: 10/2019

ZVD AC Motor Drive
User Manual

Setup Your System Easily



- **Typical Application Examples**
- **Detailed Explanation and Instructions**
- **Assistance for Calculation, Configuration and Wiring**

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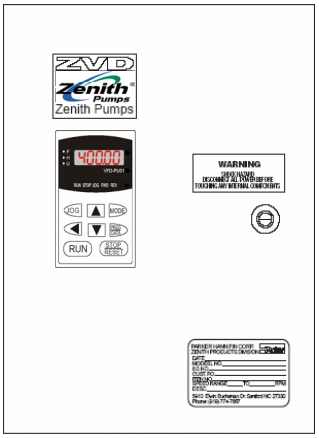
Introduction

This manual contains information required to complete installation, wiring, and startup operation for ZVD AC Vector Drive.

Be sure to follow all WARNINGS, CAUTIONS, and NOTES prior to proceeding with a particular task.

NOTE: Customer is required to make field wiring connections and adjust some of the protection codes dependent on specific applications.

Customer should become familiar with this manual to avoid electromagnetic interference (EMI) noise pickup, damage to equipment, and personal injury.



The standard ZVD AC Vector Drive consists of an AC vector drive, mounted in a NEMA 12 control cabinet. All internal cabinet wiring is complete and pre-wired to a terminal strip for customer terminations.

The unit is also pre-programmed according to customer specifications (except some protection codes dependent on specific applications).

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 (refer to "ZVD NEMA 12 Standard Products").

Standalone NEMA 1 version of ZVD vector drive is also available with the Pulse Generator card installed.

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 an operation requires 1 HP and the input voltage is 380 VAC, specify a 2 HP drive and motor).

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 ZVD vector drive cabinet to limit sensor current to safe levels.

WARNINGS:

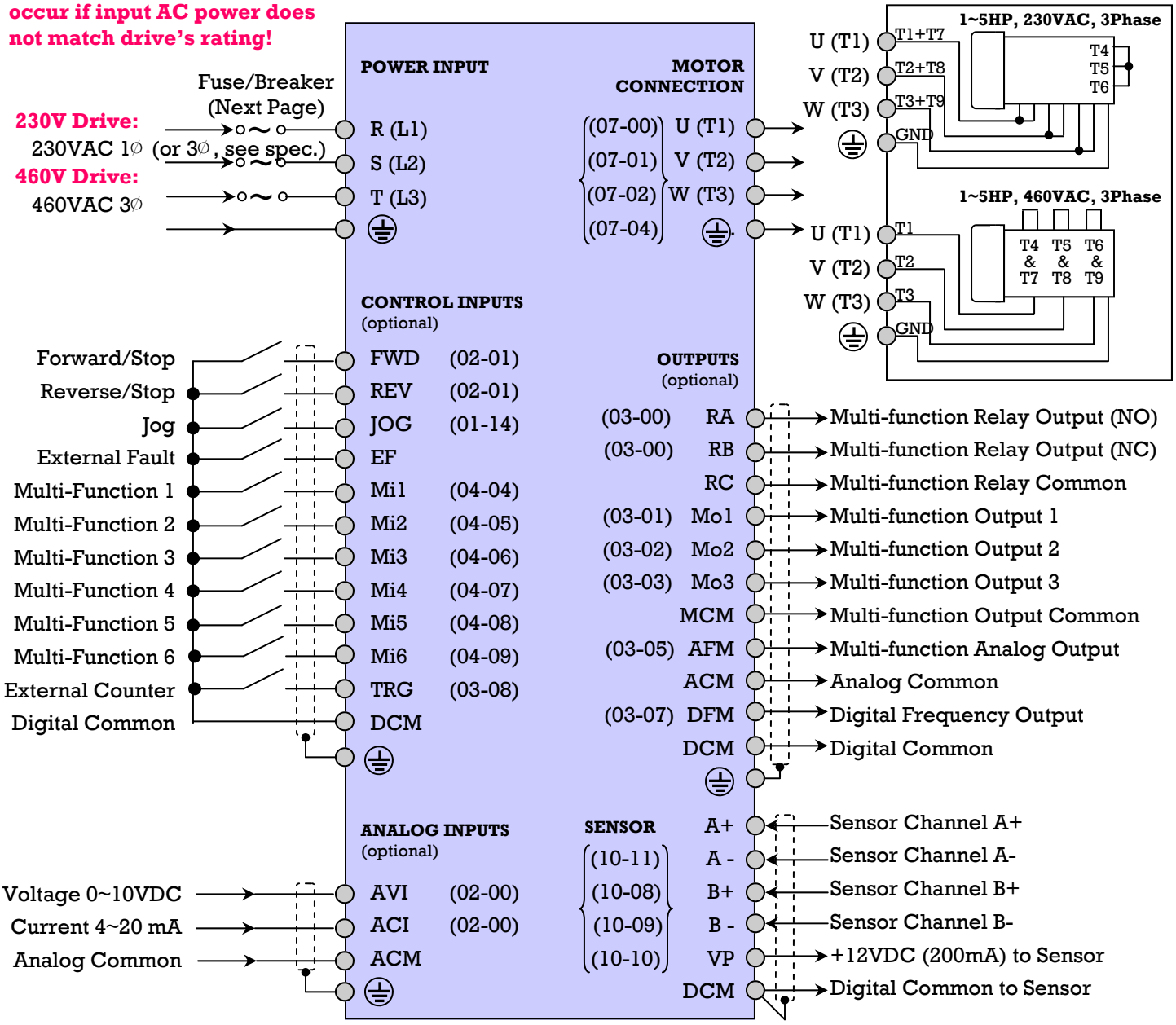
- Do not mount ZVD drive near heat-radiating elements or in direct sunlight.
- Do not install ZVD drive in a place subjected to high temperature, high humidity, excessive vibration, corrosive gasses or liquids, or airborne dust or metallic particles.
- Mount ZVD drive vertically and do not restrict the air flow to the drive.
- 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.

ZVD Standard Specification

Voltage Class	Unit	230 VAC Class				460 VAC Class			
Rated Input Voltage	VAC	230 (180 ~ 264), 3 Phase				460 (342 ~ 528), 3 Phase			
Rated Input Frequency	Hz	60/50 (Range: 47 ~ 63)							
Horse Power Rating	HP	1	2	3	5	1	2	3	5
		Single/3-Phase			3-Phase Only				
Rated Input Current	A	11.9 / 5.7	15.3 / 7.6	22.0 /	20.6	3.2	4.3	5.9	11.2
Rated Output Current	A	5.0	7.0	11.0	17.0	2.7	4.2	5.5	8.5
Rated Output Voltage	VAC	Proportional to Input Voltage							
Rated Output Frequency	Hz	0.1 ~ 400							
Environment	˚C	Ambient: -10˚C ~ 50˚C, Storage: -20˚C ~ 60˚C							
Relative Humidity		90%, Non-condensing							
Vibration		1G to 20Hz, 0.6G above 20Hz							
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 Ratio		100:1 Constant Torque, Vector Mode							
Tuning		PID, Auto Detection of Motor in Vector Mode							
Password Protection		Yes							
PLC Function		15 Step Function (Speed, Time, Direction)							
Keypad Controls		FWD, REV, STOP, JOG, Program, Monitor							
Serial Communication		RS485, Modbus Protocol							
Fault Detection		Self-test, Over-voltage, Over-current, Under-voltage, Overload, Overheating, External Fault, Electronic Thermal, Ground Fault							
Analog Inputs		0 ~ 10 VDC, or, 4 ~ 20 mA							
Analog Outputs	VDC	0 ~ 10							
Setpoints		User Defined Keypad, 0.01Hz Resolution Analog, 0.1Hz resolution							
Control Inputs		5 Standard Digital Inputs 6 Multi-function Digital Inputs 1 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							
Options		Certified EMI filter to meet CE requirements Intrinsically Safe Barrier							

Standalone ZVD Wiring Diagram (230VAC or 460VAC Drive)

WARNING: Damages will occur if input AC power does not match drive's rating!



Sensors	Ch A+	Ch A -	Ch B+	Ch B -	DCM	VP
Magnetic Pickup	WHT or GRN	to DCM	to DCM	to DCM	BLK & Shield	——
Hall Effect	WHT or GRN	to DCM	to DCM	to DCM	BLK & Shield	RED
Encoder	WHT	BRN	BLU	VLT	BLK & Shield	RED

Fuse/Breaker Specifications

Per UL 508C, paragraph 45.8.4, part a, the current rating of the breaker shall be:

- 4 times maximum of ***input*** current rating, to 1-phase drives.
- 4 times maximum of ***output*** current rating, to 3-phase drives.

Based on experience, we suggest to use 1.5 ~ 2 times maximum of input/output current rating.

NOTE: Model Number can be found on the top of ZVD drive.

230 VAC Class							
Model	**Input Voltage (VAC)**	**Phase**	**Motor Rating (kW) (Hp)**	**Output Power (kVA)**	**Input Current (A)**	**Output Current (A)**	**Line Fuse (A)**
VFD 007 B 21 A	180~264	1	0.75 (1)	1.9	11.9	5	30
	180~264	3	0.75 (1)	1.9	7.0	5	30
VFD 007 B 23 A	180~264	3	0.75 (1)	1.9	5.7	5	20
VFD 015 B 21 A	180~264	1	1.50 (2)	2.5	15.3	7	40
	180~264	3	1.50 (2)	2.5	9.4	7	40
VFD 015 B 23 A	180~264	3	1.50 (2)	2.5	7.6	7	25
VFD 022 B 21 A	180~264	1	2.20 (3)	4.2	22	11	60
	180~264	3	2.20 (3)	4.2	14	11	60
VFD 022 B 23 A	180~264	3	2.20 (3)	4.2	15.5	11	40
VFD 022 B 23 B	180~264	3	2.20 (3)	4.2	15.5	11	40
VFD 037 B 23 A	180~264	3	3.70 (5)	6.5	20.6	17	60

460 VAC Class							
Model	**Input Voltage (VAC)**	**Phase**	**Motor Rating (kW) (Hp)**	**Output Power (kVA)**	**Input Current (A)**	**Output Current (A)**	**Line Fuse (A)**
VFD 007 B 43 A	342~528	3	1.50 (1)	2.3	3.2	2.7	10
VFD 015 B 43 A	342~528	3	1.50 (2)	3.2	4.3	4.2	15
VFD 022 B 43 A	342~528	3	2.20 (3)	4.2	5.9	5.5	20
VFD 022 B 43 B	342~528	3	2.20 (3)	4.2	5.9	5.5	20
VFD 037 B 43 A	342~528	3	3.70 (5)	6.5	11.2	8.5	30

Wiring Instructions

ZVD drive will arrive with all internal wiring of NEMA 12 cabinet complete, for most customer requirements. Customers will be required to wire to the terminal strip mounted inside the cabinet. If customers desire to use some available functions of ZVD that are considered non-routine, customers may have to wire to ZVD, too.

If ZVD drive is ordered as a NEMA 1 standalone drive, customers are required to make all connections to the drive.

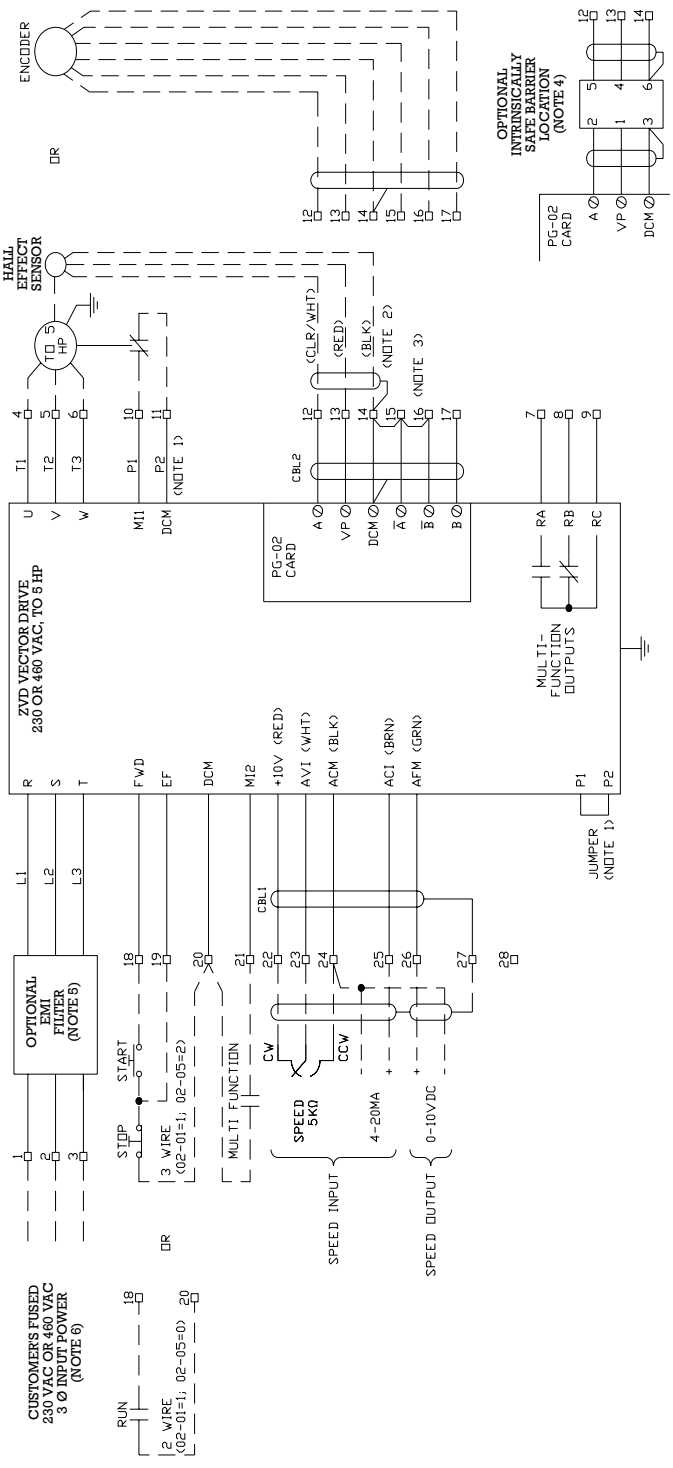
CAUTION: TO PREVENT PERSONNEL ELECTROCUTION OR DAMAGE TO THE EQUIPMENT, MAKE SURE ALL POWER TO THE ZVD IS REMOVED BEFORE MAKING ANY WIRING CONNECTIONS OR CHANGES.

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 ZVD is installed in.

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

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

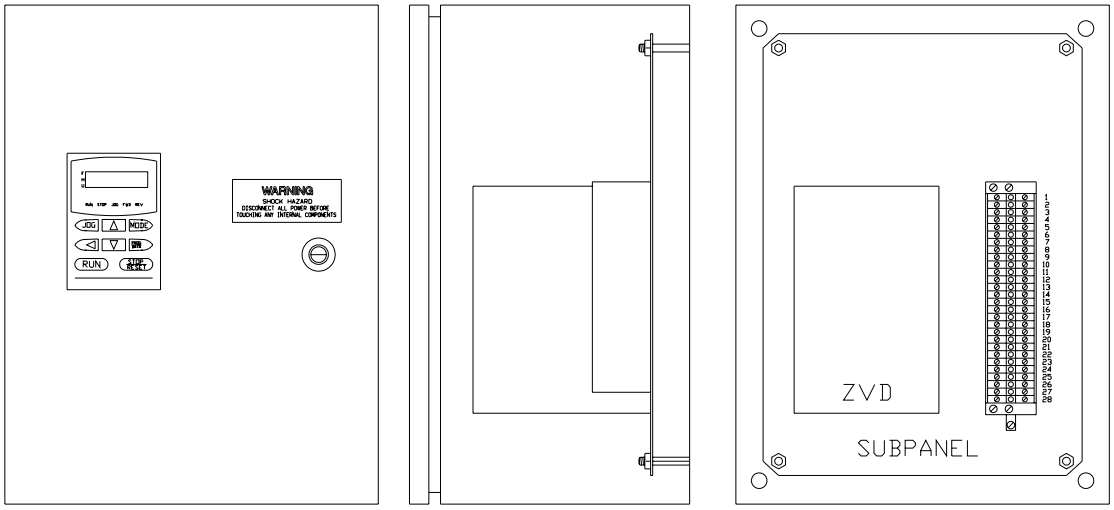
Control Cabinet Wiring



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. WHEN CONNECTING THE FEEDBACK SENSOR, MAKE SURE THAT THE SHIELD AND COMMON ARE CONNECTED TOGETHER AT THE ZVD END.
3. WHEN USING A HALL EFFECT SENSOR, A JUMPER IS REQUIRED FROM A AND B TO DCM OR A "PG-Err" WILL OCCUR IF CODE 00-09 IS SET TO 01 OR 03. IF USING AN ENCODER, REMOVE THE JUMPERS.
4. THE OPTIONAL INTRINSICALLY SAFE BARRIER IS REQUIRED WHEN THE HALL EFFECT SENSOR IS LOCATED IN A HAZARDOUS AREA.
5. THE OPTIONAL EMI FILTER IS USED WHEN CE CERTIFICATION IS REQUIRED. A LARGER CONTROL CABINET MAY BE NECESSARY.
6. 230 VAC 1-PHASE MAY BE SUPPLIED TO A 230 VAC ZVD, 1~3 HP ONLY. CONNECT TO ANY TWO TERMINALS.

Field Wiring

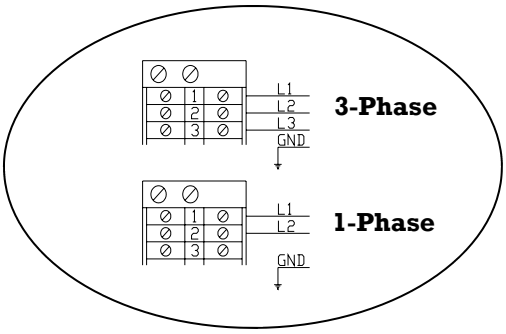


1. Connect Input Power

Customer supplies input AC power

WARNING:

DAMAGES WILL OCCUR IF INPUT AC POWER DOES NOT MATCH ZVD'S IN-PUT POWERRATING!
CHECK YOUR ZVD, MAKE SURE IF IT IS RATED AS 230VAC OR 460VAC!



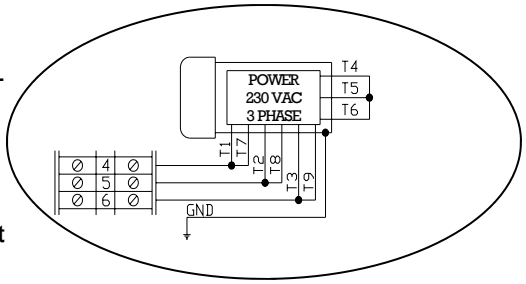
- **230VAC ZVD**
  - 180 ~ 264 VAC
  - 1-Phase/3-Phase (ONLY FOR ≤3 HP)
    3-Phase (ONLY FOR ≥ 5 HP)
  - 47~63 Hz
- **460VAC ZVD**
  - 342 ~ 528 VAC
  - 3-Phase ONLY
  - 47~63 Hz

Field Wiring (cont'd)

2. Connect AC Motor Cable

- **230 VAC 3-Phase AC Motors**

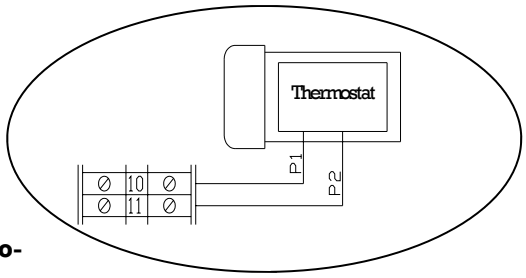
  AC motor has 11 labeled wires. Motor supports both low voltage (230VAC) and high voltage (460VAC). Depending on AC power voltage output from ZVD, the connection of these wires to ZVD will be different. The connection diagram at the right hand side shows a motor being connected with a 230 VAC ZVD drive.



  NOTE:

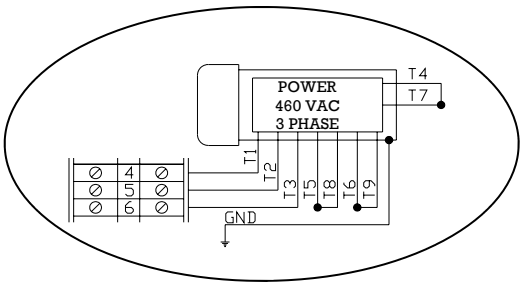
  – **Do not connect motor thermostat wires P1 and P2 to ZVD terminals P1 and P2.**

  – **Always refer to pump drawing for correct pump rotation. To change rotation, swap either two of three motor power input cables**



- **460 VAC 3-Phase AC Motors**

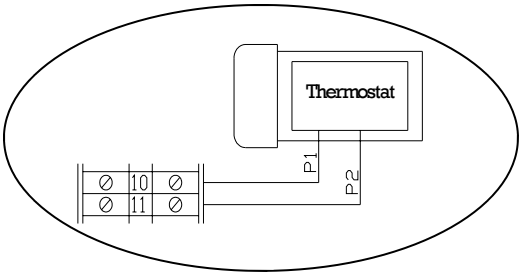
  AC motor has 11 labeled wires. Motor supports both low voltage (230VAC) and high voltage (460VAC). Depending on AC power voltage output from ZVD, the connection of these wires to ZVD will be different. The connection diagram at the right hand side shows a motor being connected with a 460 VAC ZVD drive.



  NOTE:

  – **Do not connect motor thermostat wires P1 and P2 to ZVD terminals P1 and P2.**

  – **Always refer to pump drawing for correct pump rotation. To change rotation, swap either two of three motor power input cables**

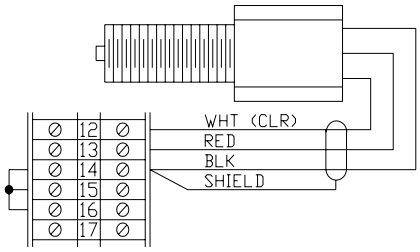


Field Wiring (cont'd)

3. Connect Feedback Signal Cable

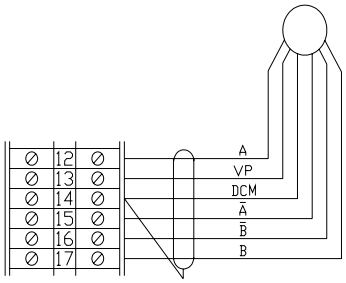
Hall effect sensor is usually located between motor and reducer. Encoder is usually located at the rear of motor.

Hall Effect Sensor
(Non-Explosion Proof Area)



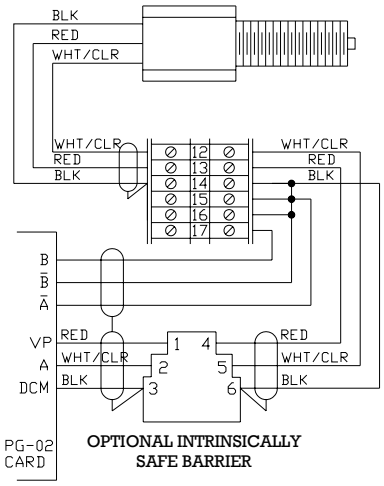
Wire Color	Function	Connect To
Red	+12VDC	13
White/Clear	Feedback Signal	12
Black	Common	14
Bare	Shielding	14

Encoder
(Non-Explosion Proof Area)



Wire Color	Function	Connect To
Depend on Sensor	VP — Input Power	13
	A+ — Signal A+	12
	DCM — Signal Common	14
	A- — Signal A-	15
	B+ — Signal B+	17
	B- — Signal B-	16
	Shielding	14

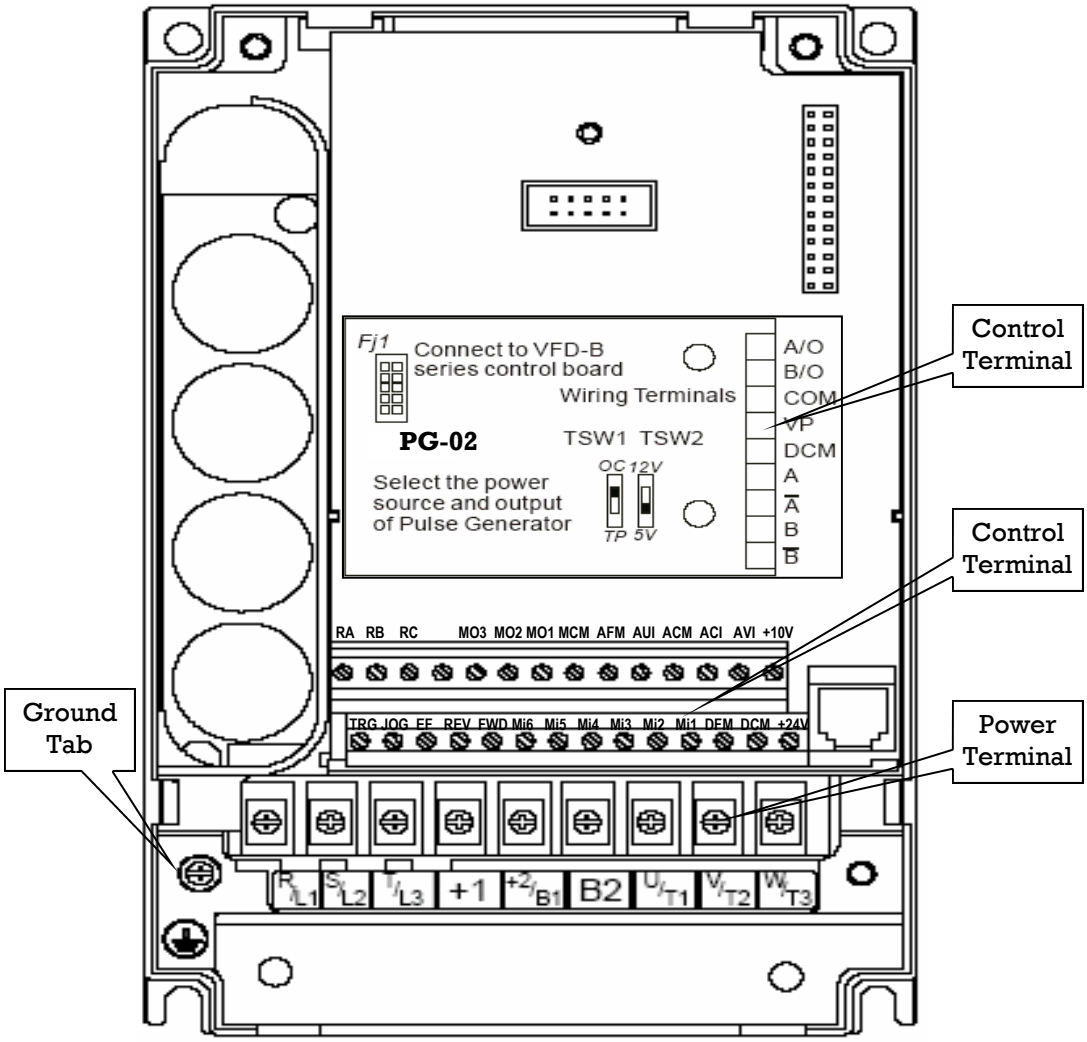
Hall Effect Sensor
(Explosion Proof Area)



NOTE:

WHEN USING A HALL EFFECT SENSOR OR ENCODER IN A HAZARDOUS ATMOSPHERE, THE OPTIONAL INTRINSICALLY SAFE BARRIER MUST BE USED.

Internal Circuit & Terminals



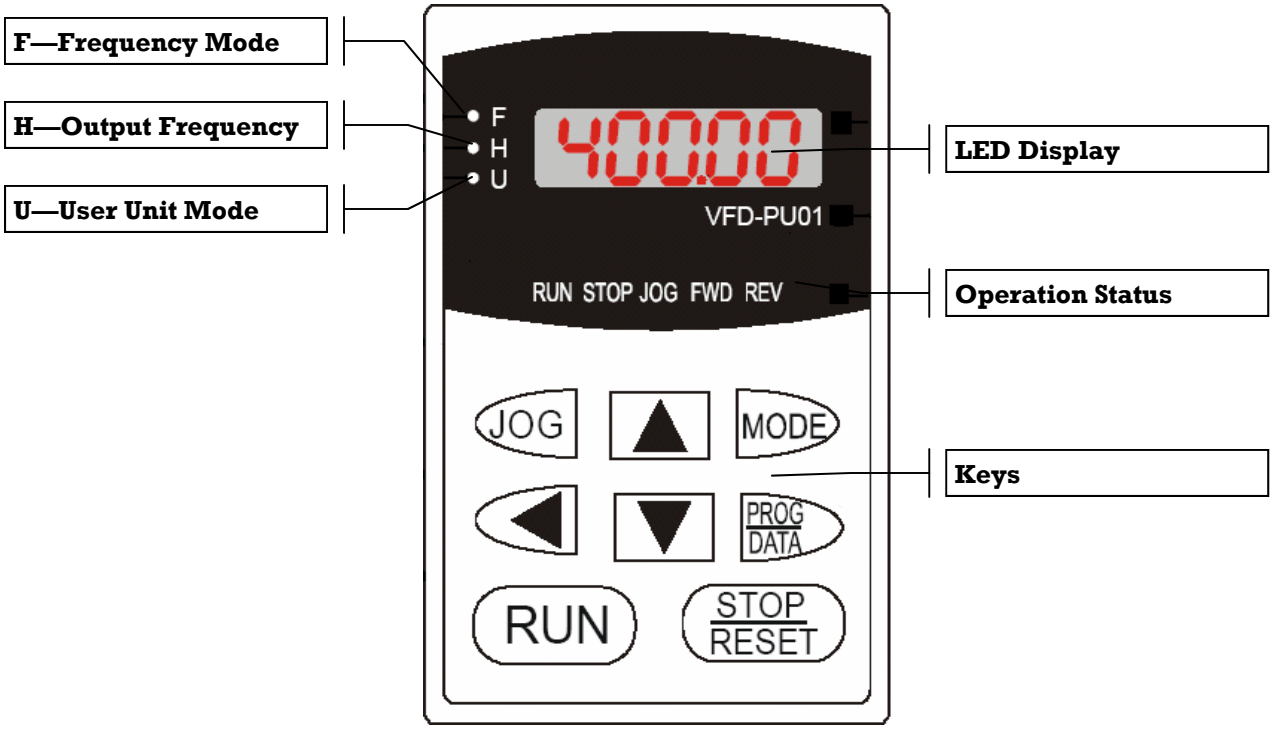
Control Terminal:

Torque: 4 Kgf-cm (3 in-lbf)
Wire Gauge: 12 ~ 24 AWG

Power Terminal:

Torque: 18 Kgf-cm (15.6 in-lbf)
Wire Gauge: 10 ~ 18 AWG
Wire Type: Stranded Copper Only, 75˚C

Keypad & Display Messages



Master Frequency Setpoint

Actual Operation Frequency

Setpoint in User Unit

Display Output Current

Forward Direction

Reverse Direction

Parameter Code

Value for a Parameter Code

Set Parameter Successfully

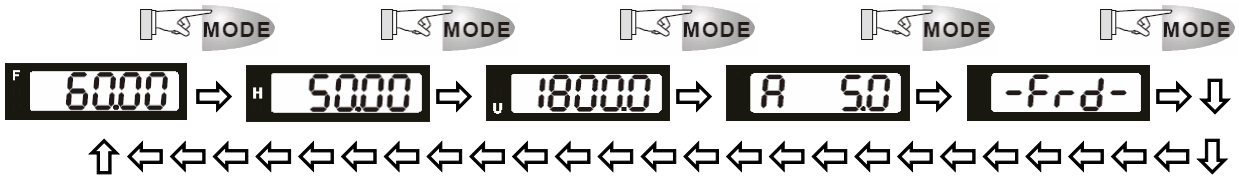
Set Parameter Incorrectly

External Fault

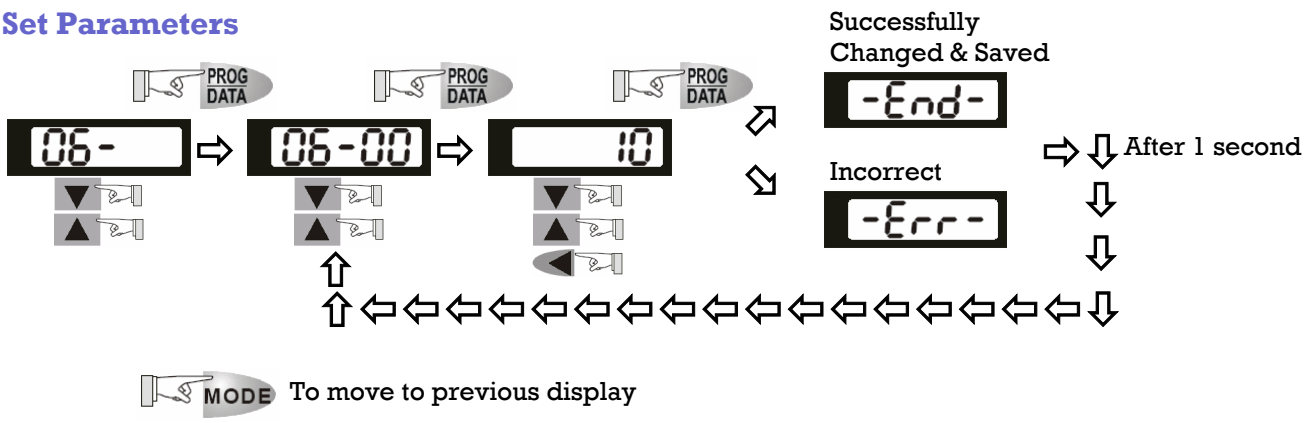
Counter Value

Keypad Operations

Select Mode

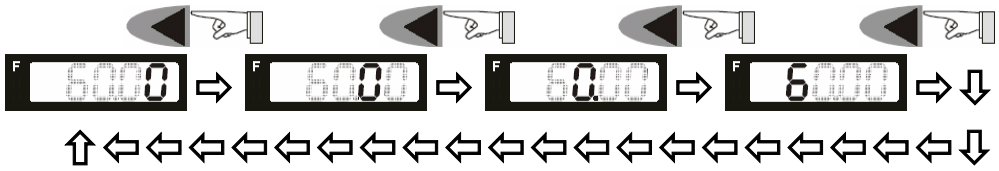


Set Parameters



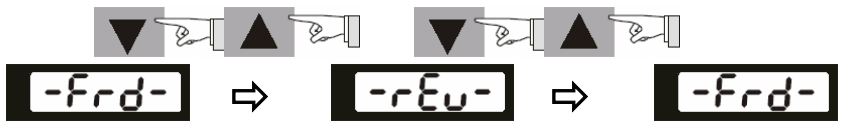
MODE To move to previous display

Shift Digits



Modify Data

Set Direction



Standard Programming

NOTE: The codes below should meet the needs of most users for normal pump operations. If other functions are desired from ZVD, consult "Complete Code List".

	Code	Description	Value/Calculation	Meaning
User	00-03	Startup Display Selection	02	User defined unit mode
	00-04	Multi-function Display	07	Actual motor speed
	00-05	User Defined Coefficient	30/Gear Ratio	The unit of User Defined mode is in pump (RPM)
	00-09	Operating Mode	01	Volts/Hertz with feedback
Basic	01-09	Acceleration Rate (second)	10.0	10 seconds to ramp from 0Hz to Max. Output Freq. (01-00)
	01-10	Deceleration Rate (second)	10.0	10 seconds to ramp from Max. Output Freq. (01-00) to 0Hz
Operation	02-00	Source of Frequency	00	Keypad local control mode
	02-01	Source of Operation	00	Keypad local operation mode
	02-02	Stop Method	00	Ramp stop based on (01-10)
	02-03	Carrier Frequency	2	2KHz
	02-04	Reverse Operation	01	Disable reverse direction
	02-05	Operation Control Mode	00	2-wire FWD/STP control
Output	03-00	Multi-function Output (Relays)	08	Desired frequency attained
	03-05	Analog Output Signal	00	Analog frequency meter from 0 Hz to Max. Output Freq.
Input	04-04	Multi-function Input Mi1	20	Emergency stop (Require wiring. To turn off, change to 00)
	04-05	Multi-function Input Mi2	00	Disabled
Protection	06-01	Over-current Stall Prevention during Acceleration (%)	250	250% of Rated Output Current of the drive
	06-02	Over-voltage Stall Prevention during Operation (%)	250	250% of Rated Output Current of the drive
	06-03	Over-Torque Detection	02	Enabled during constant speed operation, and operation halted after detection
	06-04	Over-Torque Detection Level	$A_A/A_D \times 100+1$	Refer to "Setup System Protection" section
	06-05	Over-Toque Detection Time	0.1	0.1 second
	06-06	Thermal Overload Relay	01	Constant torque motor
	06-07	Thermal Characteristic	120	120 seconds to activate I^2t electronic thermal protection
Motor Parameters	07-00	Motor Rated Current	Motor Rated Current / Drive Rated Current × 100%	Add 1% or 2% more if necessary
	07-01	Motor No Load Current	01	1% of Drive Rated Current
	07-02	Torque Boost	08	To obtain a higher initial starting torque
	07-04	Number of Motor Poles	04	
PID Controls	10-08	Feedback Signal Detection Time	5.0	5 seconds to alarm any abnormal feedback signal
	10-09	Treatment of Signal Fault	00	Alarm and keep operating
	10-10	PG Pulse Range	120	120 teeth of the sensing gear. For encoder, typically 1024.
	10-11	PG Input Type	01	Enable single-phase sensor. For encoder, 02 or 03.
	10-12	Proportional Speed Control (P)	0.2	
	10-13	Integral Speed Control (I)	0.5	

Typical Applications & Solutions

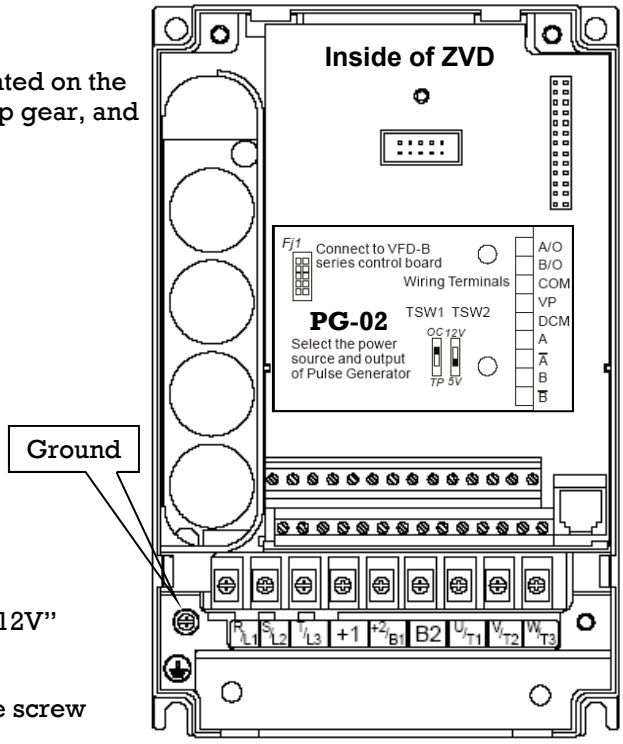
Create Simplest System to Verify Drive's Functionality

1. Prepare ZVD:

- Loose up one screw located at bottom of the front panel, and lift up the front panel
- Connect motor cables to U, V, W terminals
- Connect power wires to R, S, T terminals. For 230VAC single-phase, connect L and N to either 2 terminals. Connect power ground wire to the Ground terminal (**Do NOT connect power at this time**)

2. Prepare the Sensor:

- Screw the sensor into the thread hole located on the gear reducer, until it hits the inside pickup gear, and back up about 1/8 of a turn (45 degrees)
- Place jumpers on PG-02 Card between
  DCM - /A (A bar)
  DCM - /B (B bar)
- If it is a 2-wire sensor, connect
  White wire - A on PG-02 Card
  Black wire - DCM on PG-02 Card
  Bare wire - DCM on PG-02 Card
- If it is a 3-wire sensor, connect
  Red wire - VP on PG-02 Card
  White wire - A on PG-02 Card
  Black wire - DCM on PG-02 Card
  Bare wire - DCM on PG-02 Card
- Flip TSW1 switch to "OC", and TSW2 to "12V"



3. Connect Power to the Drive:

- Place the front panel back, and secure the screw
- Turn the power on for ZVD

4. Configure ZVD:

A 5.091:1 reducer and 120 teeth pickup gear is used for the following example.

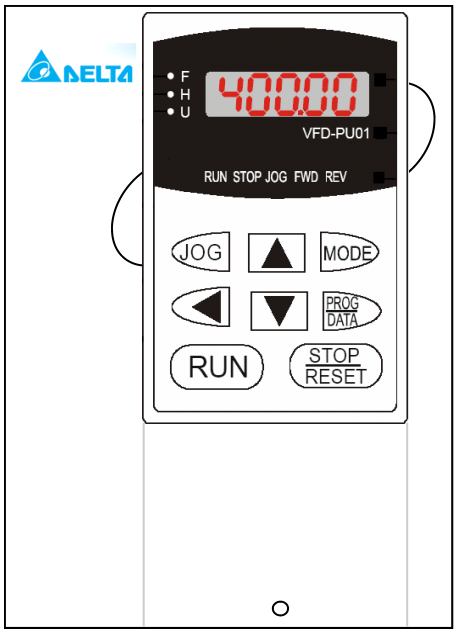
Change values for the following codes:

Code 00-05 = 30/5.091 = 5.89	User Unit: Pump RPM
Code 00-09 = 3	Control Method: Vector + PG Control
Code 02-00 = 0	Frequency Source: Keypad
Code 02-01 = 0	Operation Source: Keypad
Code 10-08 = 5	Feedback Signal Detection Time: 5 sec.
Code 10-10 = 120	PG Pulse Range: 120 number of teeth per rev.
Code 10-11 = 1	PG Input: Enabled and single-phase signal

Click PROG DATA once, the display shows "XX-". Use ▲ to change the first 2 digits of the code
Click PROG DATA again, the display shows "XX-XX". Use ▲ to change the last 2 digits of the code
Click PROG DATA to show the value of this code
Use ▲ ▼ ◀ to change the value. When finish, click PROG DATA to store the new value.

Create Simplest System to Verify Drive's Functionality (cont'd)

5. Verify Feedback Signal Manually:



- Click "Mode" button until U light lit up
- Use ▲ to input a small value, i.e., 5, on the display
- Click "RUN" button
- If the shaft starts to rotate, use ▼ to decrease the value on the display, until the shaft stops, meanwhile, "RUN" light lit up and "STOP" light is off
- Wait about 5 seconds, "PGErr" message should pop up for warning that there is no feedback signal
- If there is no "PGErr" message, check the configuration in section 4.
- When "PGErr" message pops up, turn the shaft by hand. If the message goes away whenever the shaft turns, it indicates that the installation of feedback sensor is correct
- If the "PGErr" message never goes away, for most of cases, it indicates the location of the sensor is too far from the pickup gear inside of the gear reducer. The gap between the sensor and the pickup gear should be maintained around 0.005", and also make sure the sensor does not touch the pickup gear. Turn the sensor inward very small amount, and repeat the above steps

6. Run the System:

Let reducer's shaft run at 60 rpm (**Do not connect to the pump**)

- Click "Mode" button until U light lit up
- Use ▲ ▼ ◀ to input 60 on the display
- Click "RUN" button

Monitor the reducer's shaft, if

- the system can not run, Turn off the power, and verify the steps in the previous sections
- the system does not run at right speed, check the section 4 and 5, especially, number of teeth of the pickup gear and gear ratio of the reducer
- the system runs at right speed, stop the system and disconnect the power. The system is ready for normal operation

Speed Sensor Issues

1. Installation:

- Screw the sensor by hand into the thread hole located on the gear reducer, until it hits the inside pickup gear, and back up about 1/8 of a turn (Gap: 0.005" ±0.003"). Hold the sensor at this location, and tighten the locking nut on the sensor.
- If the sensor is NOT an encoder, place jumpers on PG-02 Card between
  DCM - /A (A bar)
  DCM - /B (B bar)
- If it is a 2-wire sensor, connect
  White wire - A on PG-02 Card
  Black wire - DCM on PG-02 Card
  Bare wire - DCM on PG-02 Card
- If it is a 3-wire sensor, connect
  Red wire - VP on PG-02 Card
  White wire - A on PG-02 Card
  Black wire - DCM on PG-02 Card
  Bare wire - DCM on PG-02 Card
- Flip TSW1 switch to "OC", and TSW2 to "12V"
- If it is an encoder, connect wires according to manufacturer's instructions. Make sure to select correct settings for TSW1 switch and TSW2

2. Verify Feedback Signal Manually:

- Click "Mode" button until U light is lit up
- Use ▲ to input a small value, i.e., 5, on the display
- Click "RUN" button
- If the shaft starts to rotate, use ▼ to decrease the value on the display, until the shaft stops, meanwhile, "RUN" light is still lit up and "STOP" light is off
- Wait about 5 seconds, "PGErr" message should pop up indicating that there is no feedback signal
- If there is no "PGErr" message, check the configuration for the codes listed in the section 4 of "Create Simplest System to Verify Drive's Functionality".
- When "PGErr" message pops up, turn the shaft by hand or a wrench (it requires the coupling be disconnected). If the message goes away whenever the shaft turns, it indicates that the installation of feedback sensor is correct
- If the "PGErr" message never goes away, for most of cases, it indicates the gap between the sensor and the pickup gear inside of the gear reducer is too large. The gap between the sensor and the pickup gear should be maintained around 0.005", and also make sure the sensor does not touch the pickup gear. Turn the sensor inward very small amount, and repeat the above steps
- If the "PGErr" message never goes away, even the sensor has already touched the pickup gear inside, it may indicate it is a defected sensor

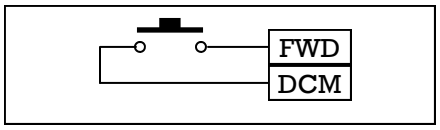
Connect Run/Stop Buttons or Other External Controls

1. Run Button:

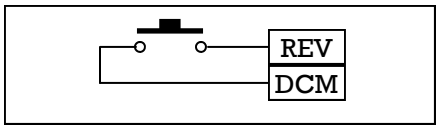
- Use a normally-opened button
- Connect the button to FWD (for Forward) and DCM Terminals, or REV (for Reverse) and DCM Terminals.
- Check and change the following codes:

  Code 02-01 = 01 (enable external control)
  Code 02-05 = 00 (2-wire control mode)

- When the button is closed, ZVD will ramp up based on Acceleration Time defined in Code 01-09
- When the button is opened, ZVD will ramp down based on Deceleration Time defined in Code 01-10



or



2. Stop Button:

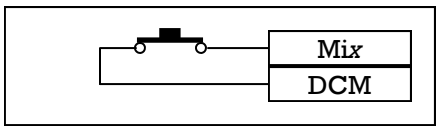
- Same as "Run Button" shown above

3. Emergency Stop Button:

- Use a normally-closed button
- Connect the button to one of Mi1 to Mi6 terminals and DCM Terminals
- Check and change the following code:

  If use Mi1: Code 04-04 = 20 (emergency stop)
  If use Mi2: Code 04-05 = 20 (emergency stop)
  If use Mi3: Code 04-06 = 20 (emergency stop)
  If use Mi4: Code 04-07 = 20 (emergency stop)
  If use Mi5: Code 04-08 = 20 (emergency stop)
  If use Mi6: Code 04-09 = 20 (emergency stop)

- When the button is opened, ZVD will stop the motor immediately, and the display shows "EF1" message. Click "STOP/RESET" button on the keypad to clear off the message



4. Other External Controls:

- Based on needed control functions, select and enter the appropriate control value for Code 04-04 to 04-09 (refer to "Complete Code List")
- Connect the control wires between the corresponding Mi terminal and DCM Terminal

  If use Mi1: use Code 04-04
  If use Mi2: use Code 04-05
  If use Mi3: use Code 04-06
  If use Mi4: use Code 04-07
  If use Mi5: use Code 04-08
  If use Mi6: use Code 04-09

- **One function can only be used ONCE, except the value 00 (Disable)**

Set and Display as Pump RPM

1. Preliminary Action:

- Reducer Gear Ratio — R. If the pump is directly coupled with the motor, the gear ratio R=1

2. Calculation:

2.1 User Defined Coefficient K:

- K = 30 / R (assume a 1,800 RPM and 60 HZ motor)

2.2 The display value U when ZVD is under U Mode:

- U = 60 × K (RPM)

2.3 The actual output value H on the display when ZVD is under H Mode:

- H = Actual Speed (RPM)

3. Coding:

Check and change the following codes

Code 00-05 = K = 30 / R

4. Wiring:

No extra wiring requirements for this application

5. Result:

- The unit of setpoint will be in Pump's RPM
- The unit of display under H Mode will be in Pump's RPM

Set and Display as "cc/min"

1. Preliminary Action:

- Reducer Gear Ratio — R. If the pump is directly coupled with the motor, the gear ratio R=1
- Pump Capacity — C_P (cc/rev)

2. Calculation:

2.1 User Defined Coefficient K:

- $K = 30 / R \times C_P$ (assume a 1,800 RPM and 60 HZ motor)

2.2 The display value U when ZVD is under U Mode:

- $U = 60 \times K$ (cc/min)

2.3 The actual output value H on the display when ZVD is under H Mode:

- H = Actual Speed (cc/min)

3. Coding:

Check and change the following codes

Code 00-05 = $K = 30 / R \times C_P$

4. Wiring:

No extra wiring requirements for this application

5. Result:

- The unit of setpoint will be in (cc/min) of pump output
- The unit of display under H Mode will be in (cc/min) of pump output

Set and Display as Other Units

1. Preliminary Action:

- Reducer Gear Ratio — R. If the pump is directly coupled with the motor, the gear ratio R=1
- Pump Capacity — C_P (cc/rev)
- Coefficient between other unit and "cc/min" — K_U
- **NOTE: It supports the customer's unit only in (volume/time) format**

2. Calculation:

2.1 Coefficient between other unit and "cc/min" — K_U:

- Find out 1 new volume unit is equal to V (cc)
- Find out 1 new time unit is equal to T (min)
- 1 (volume/time) = V (cc) / T (min) = V/T (cc/min)

$K_U = V/T$

Example:
If the preferred unit is (gallon/hour),
1 (gallon) = 3785 (cc)
1 (hour) = 60 (min)
1 (gallon/hour) = 3785 (cc) / 60 (min) = 63.08 (cc/min)
Therefore, $K_U = 63.08$

2.2 User Defined Coefficient K:

- $K = 30 / R \times C_P / K_U$ (assume a 1,800 RPM and 60 HZ motor)

2.3 The display value U when ZVD is under U Mode:

- $U = 60 \times K$ (volume/time)

2.4 The actual output value H on the display when ZVD is under H Mode:

- H = Actual Speed (volume/time)

3. Coding:

Check and change the following codes

Code 00-05 = $K = 30 / R \times C_P / K_U$

4. Wiring:

No extra wiring requirements for this application

5. Result:

- The unit of setpoint will be in (volume/time) of pump output
- The unit of display under H Mode will be in (volume/time) of pump output

Monitor Operation Status

1. Preliminary Action:

none

2. Calculation:

none

3. Coding:

Based on needed operation status, select and enter the appropriate control value for Code 03-00 to 03-03 in "Complete Code List"

For monitoring output frequency, current, output voltage, frequency command, output motor speed or load power factor, select and enter the appropriate value for Code 03-05. The monitoring signal from ZVD drive is a 0-10 (VDC) analog signal.

4. Wiring:

- To monitor operation status by using Multi-function Relay Output, connect signal wire to either RA or RB, and connect the signal return wire to RC. RA is a normally-opened relay, and RB is a normally-closed relay. Code 03-00 must be selected and configured.
- To monitor operation status by using Multi-function Outputs MO1, MO2 or MO3, connect signal wire to either MO1, MO2 or MO3, and connect the signal return wire to MCM. Based on the selected code, the corresponding terminal should be used, for example:

  If use MO1: use Code 03-01
  If use MO2: use Code 03-02
  If use MO3: use Code 03-03

- For monitoring output frequency, current, output voltage, frequency command, output motor speed or load power factor, connect the signal wire to AFM terminal, and connect the signal return wire to ACM. Code 03-05 must be selected and configured.

5. Result:

- Operation status and various signals of the drive can be monitored or used to alarm and control other devices

Use 4-20 (mA) as Setpoint

1. Preliminary Action:

- Pump Capacity — C_P (cc/rev)
- Reducer Gear Ratio — R. If the pump is directly coupled with the motor, the gear ratio R=1
- Motor maximum speed — V_M (RPM), 1800 (RPM) for most of systems supplied by Zenith
- External speed control device which supplies 4-20 (mA) speed setpoint signal to ZVD drive

2. Calculation:

- 4 (mA) is equivalent to 0 (RPM) of the motor, 0/R (RPM) for the pump, $0/R \times C_P$ (cc/min)
- 20 (mA) is equivalent to V_M (RPM) of the motor, V_M/R (RPM) for the pump, $V_M/R \times C_P$ (cc/min)
- To set the motor speed to be V (RPM) ($0 \le V \le V_M$), the pump to be V (RPM) ($0/R \le V \le V_M/R$), or the output to be V (cc/min) ($0/R \times C_P \le V \le V_M/R \times C_P$), the corresponding formula for the mA current value C_{mA} is:

$$C_{mA} = (20 - 4) / (V_M - 0) \times V + 4 \text{ (mA)}$$
$$C_{mA} = (20 - 4) / (V_M/R - 0/R) \times V + 4 \text{ (mA)}$$
$$C_{mA} = (20 - 4) / (V_M/R \times C_P - 0/R \times C_P) \times V + 4 \text{ (mA)}$$

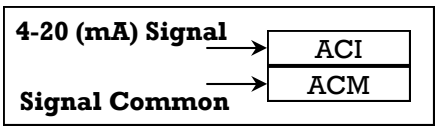
3. Coding:

Check and change the following codes

- Code 02-00 = 2 (defines the source of speed command, value 2 specifies external analog signal 4-20 (mA))
- Code 02-01 = 1 (Code 02-01 defines the source of the operation command, value 1 specifies external start/stop button)
- Code 02-05 = 0 (Code 02-05 defines the operation mode, value 0 specifies a 2-wire control)

4. Wiring:

Please refer to the wiring diagram



5. Result:

- External 4-20(mA) analog signal controls the speed of the system

Use 0-10 (VDC) as Setpoint

1. Preliminary Action:

- Pump Capacity — C_P (cc/rev)
- Reducer Gear Ratio — R. If the pump is directly coupled with the motor, the gear ratio R=1
- Motor maximum speed — V_M (RPM), 1800 (RPM) for most of systems supplied by Zenith
- External speed control device which supplies 0-10 (VDC) speed setpoint signal to ZVD drive

2. Calculation:

- 0 (VDC) is equivalent to 0 (RPM) of the motor, 0/R (RPM) for the pump, $0/R \times C_P$ (cc/min)
- 10 (VDC) is equivalent to V_M (RPM) of the motor, V_M/R (RPM) for the pump, $V_M/R \times C_P$ (cc/min)
- To set the motor speed to be V (RPM) ($0 \le V \le V_M$), the pump to be V (RPM) ($0/R \le V \le V_M/R$), or the output to be V (cc/min) ($0/R \times C_P \le V \le V_M/R \times C_P$), the corresponding formula for the control voltage C_{VDC} is:

$$C_{VDC} = (10 - 0) / (V_M - 0) \times V \text{ (VDC)}$$
$$C_{VDC} = (10 - 0) / (V_M/R - 0/R) \times V \text{ (VDC)}$$
$$C_{VDC} = (10 - 0) / (V_M/R \times C_P - 0/R \times C_P) \times V \text{ (VDC)}$$

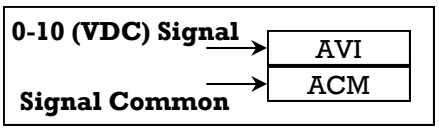
3. Coding:

Check and change the following codes

- Code 02-00 = 1 (defines the source of speed command, value 1 specifies external analog signal 0-10 (VDC))
- Code 02-01 = 1 (defines the source of the operation command, value 1 specifies external start/stop button)
- Code 02-05 = 0 (Code 02-05 defines the operation mode, value 0 specifies a 2-wire control)

4. Wiring:

- Please refer to the wiring diagram



5. Result:

- External 0-10(VDC) analog signal controls the speed of the system

Feedback Control by Using a Flowmeter with Frequency Signal

1. Preliminary Action:

- A flowmeter which can send frequency flow signal to ZVD
- Max. Flowrate — F_m (cc/min) (or, in other units. Find out from the flowmeter)
- Max. Frequency Output — Q_m (Hz) (Find out from the flowmeter)

2. Calculation:

2.1 Equivalent Pulses Per Revolution of Motor — N_p (pulses/rev)

$N_p = Q_m / 30$ (pulses/rev)

2.2 Calculate User Defined Coefficient K for Engineering Unit, i.e. (cc/min):

$K = F_m / 60$ (Engineering Unit / Hz)

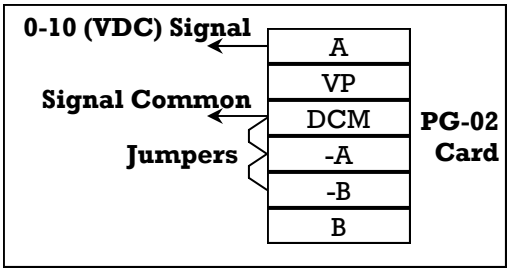
3. Coding:

Check and change the following codes

Code 00-05 = $K = F_m / 60$
Code 10-08 = 10
Code 10-09 = 0
Code 10-10 = $N_p = Q_m / 30$
Code 10-11 = 1
Code 10-12 = Adjust as needed based on performance
Code 10-13 = Adjust as needed based on performance

4. Wiring:

- Connect the wires as shown at left
- Leave anything else unchanged as before



5. Result:

- The output from the pump will be controlled by the flowmeter
- The units of the setpoint and the Tach are same as the unit of F_m

6. IMPORTANT NOTE:

- **The unit is no longer in (RPM). It is in the engineering unit, same as F_m**
- **The pump speed may vary widely. Do not to exceed the factory suggested speed limit**
- **Any restriction at the discharge side of the pump can rapidly increase the pump speed.** Check any down-stream restrictions before the operation
- **Always test the system without any down-stream restrictions. Gradually increase the restrictions, and monitor the pump speed closely, make sure not to over-run the pump**
- **You should test your system for safety under all potential conditions. Failure to do so can result in damage to the equipment and/or serious injury to personnel**

Feedback Control by Using a Flowmeter with 4-20 (mA) Signal

1. Preliminary Action:

- A flowmeter which can send 4-20 (mA) flow signal to ZVD
- Max. Flowrate — F_m (cc/min) (or, in other units. Find out from the flowmeter)

2. Calculation:

2.1 Calculate User Defined Coefficient K for Engineering Unit, i.e. (cc/min):

$K = F_m / 60$ (Engineering Unit / Hz)

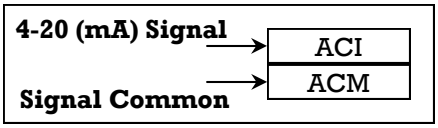
3. Coding:

Check and change the following codes

Code 00-05 = K = F_m / 60
Code 02-00 = 0
Code 10-00 = 2
Code 10-01 = Adjust as needed based on performance
Code 10-02 = Adjust as needed based on performance
Code 10-03 = Adjust as needed based on performance
Code 10-04 = Adjust as needed based on performance
Code 10-05 = Adjust as needed based on performance
Code 10-06 = Adjust as needed based on performance
Code 10-07 = Adjust as needed based on performance
Code 10-08 = 10
Code 10-09 = 0

4. Wiring:

- Connect the wires as shown at left
- Leave anything else unchanged as before



5. Result:

- The output from the pump will be controlled by the flowmeter
- The units of the setpoint and the Tach are same as the unit of F_m

6. IMPORTANT NOTE:

- **The unit is no longer in (RPM). It is in the engineering unit, same as F_m**
- **The pump speed may vary widely. Do not to exceed the factory suggested speed limit**
- **Any restriction at the discharge side of the pump can rapidly increase the pump speed.** Check any down-stream restrictions before the operation
- **Always test the system without any down-stream restrictions. Gradually increase the restrictions, and monitor the pump speed closely, make sure not to over-run the pump**
- **You should test your system for safety under all potential conditions. Failure to do so can result in damage to the equipment and/or serious injury to personnel**

Feedback Control by Using a Flowmeter with 0-10 (VDC) Signal

1. Preliminary Action:

- A flowmeter which can send 0-10 (VDC) flow signal to ZVD
- Max. Flowrate — F_m (cc/min) (or, in other units. Find out from the flowmeter)

2. Calculation:

2.1 Calculate User Defined Coefficient K for Engineering Unit, i.e. (cc/min):

$K = F_m / 60$ (Engineering Unit / Hz)

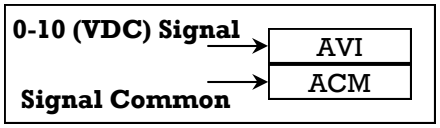
3. Coding:

Check and change the following codes

Code 00-05 = K = F_m / 60
Code 02-00 = 0
Code 10-00 = 1
Code 10-01 = Adjust as needed based on performance
Code 10-02 = Adjust as needed based on performance
Code 10-03 = Adjust as needed based on performance
Code 10-04 = Adjust as needed based on performance
Code 10-05 = Adjust as needed based on performance
Code 10-06 = Adjust as needed based on performance
Code 10-07 = Adjust as needed based on performance
Code 10-08 = 10
Code 10-09 = 0

4. Wiring:

- Connect the wires as shown at left
- Leave anything else unchanged



5. Result:

- The output from the pump will be controlled by the flowmeter
- The units of the setpoint and the Tach are same as the unit of F_m

6. IMPORTANT NOTE:

- **The unit is no longer in (RPM). It is in the engineering unit, same as F_m**
- **The pump speed may vary widely. Do not to exceed the factory suggested speed limit**
- **Any restriction at the discharge side of the pump can rapidly increase the pump speed.** Check any down-stream restrictions before the operation
- **Always test the system without any down-stream restrictions. Gradually increase the restrictions, and monitor the pump speed closely, make sure not to over-run the pump**
- **You should test your system for safety under all potential conditions. Failure to do so can result in damage to the equipment and/or serious injury to personnel**

Master/Follower System

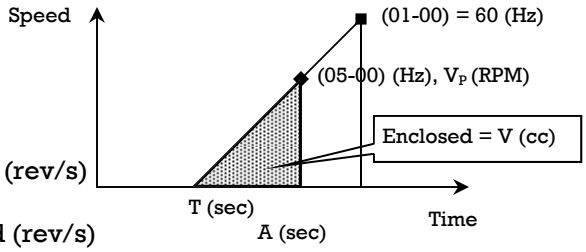
IMPORTANT NOTE:

- **ZVD drive does NOT support master/follower application directly. Contact the manufacturer of the drive for possible solutions.**
- **Additional controller(s) may need for forming master/follower application when using ZVD drive, i.e., a voltage divider, or a PLC, or a single board computer**
- **This specific controller should have the following resources and capability:**
    1. **Two-channel analog outputs, either current (4-20mA) or voltage (0-10VDC)**
    2. **Regulate these two signals to a fixed (or, varied) ratio**
- **The following is a solution for setting up ZVD drives to a master/follower system:**
    1. **The goal is to set ZVD drives to use either 4-20 (mA) or 0-10 (VDC) as setpoints. To do this, please refer to the sections of "Use 4-20 (mA) as Setpoint" or, "Use 0-10 (VDC) as Setpoint"**
    2. **ZVD drives will take the analog signals as setpoints, and change their speeds, accordingly**
    3. **Maintaining the ratio between two analog signals will make the speed ratio between two ZVD systems fixed**
    4. **Varying the ratio between two analog signals will make the speed ratio between two ZVD systems being changing, accordingly.**

Dispensing Fluid (PLC—Process Logic Control)

1. Preliminary Action:

- Reducer Gear Ratio — R. If the pump is directly coupled with the motor, the gear ratio R=1
- Pump Capacity — C_P (cc/rev)
- Relays or contacts which can be used to control the timing of dispensing process
- Target Dispensing Volume — V (cc)
- Target Dispensing Time — T (sec)



2. Calculation:

2.1 Calculate Maximum Dispensing Frequency:

$V = 1/2 \times C_P V_P T$ (cc) V_P — Pump Speed (rev/s)

$V_P = 2V/(T\ C_P)$ (rev/s)

$V_M = 2VR/(T\ C_P)$(rev/s) V_M — Motor Speed (rev/s)

$V_H = 4VR/(T\ C_P)$ (Hz) V_H — Drive Frequency (Hz), V_H <60Hz (01-00) for this case.

2.2 Calculate Acceleration Value A:

$60 / A = V_H / T$

$A = 60T / V_H = 15T^2C_P/(VR)$ (sec)

2.3 Assumption & Adjustment:

Due to the inertia, load and the strength of the system, the deceleration may not be large enough to stop the system immediately.
It is highly suggested that, test the system, adjust the parameters (especially increase the dispensing time (PLC time)), and re-test system until it is close to the requirements.

3. Coding:

Check and change the following codes

Code 01-09 = $A = 15T^2C_P/(VR)$	(acceleration)
Code 01-10 = 0.1	(deceleration is short)
Code 04-04 = 14	(run PLC program)
Code 04-05 = 20	(emergency stop (NC))
Code 05-00 = V_H	(1st step speed frequency)
Code 05-01 ~ 05-14 = 0	(disable other frequency segments)
Code 05-15 = 01	(execute one PLC program cycle)
Code 05-16 = 00	(direction 15^{th} [0000 0000 0000 0000] 1^{st})
Code 05-17 = 10T	(time(sec) × 10 (0.1 sec))
Code 05-18 ~ 05-31 = 0	(disable other frequency segments)
Code 05-32 = 01	(time unit = 0.1 sec)

4. Wiring:

- Connect a normally-closed button (E-STOP) between multi-function input Mi2 and DCM
- Connect a normally-opened button (Run-PLC) between multi-function input Mi1 and DCM

5. Result:

- Once Run-PLC button is pressed down (closed), the pump will run T (sec) to deliver V (cc) fluid. Press E-STOP button to stop the process, and clear the error message by pressing RE-SET button on the keypad, and the system will be ready for another same process.

Setup System Protection (next page)

1. Preliminary Action:

- Drive Rated Output Current — A_D (A) (on the nameplate on the top of drive)

2. Calculation:

2.1 Determine the Current under Normal Operation:

- Select the display so that it shows Drive Output Current 

- Operate the system normally, and increase the load (i.e., pressure, speed) gradually until it reaches possible maximum normal condition (**NOTE:** Do NOT damage the system and pump)
- Once the system is stable, record the current reading A_A (A) showing on the display

3. Coding:

Check and change the following codes

Code 06-03 = 02	(Enable Over-Torque detection during constant speed operation, operation halted after detection)
Code 06-04 = $A_A/A_D \times 100+1$	(set Over-Torque detection level to be the maximum normal condition or slightly larger. It is the percentage number of Drive Rated Output Current)
Code 06-05 = 0.1	(Over-Torque detection time is set to 0.1 (sec))
Code 06-06 = 01	(protect the motor from overload or overheat)
Code 06-07 = 120	(time required activating protection is set to 120 (sec))

4. Wiring:

None

- It is a good practice to set a multi-function output terminal to monitor the situation of over-torque. Please refer to "Monitor Operation Status".

5. Result:

- Whenever the load increases beyond the possible maximum normal condition, the system will stop the operation and display "oL2"error message. Investigate the causation of over-load, find the solution to prevent overload in the future, click "RESET" button to clear this message, and the system will be ready for operation.
- The system will be protected from further damage by limiting the over-torque detection level. The pump will have less chance to be completely locked or damaged.

Setup System Protection (cont'd)

1. Preliminary Action:

- Set up the system correctly

2. Calculation:

2.1 Determine the Value V_A for Over-Current Stall Prevention During Acceleration:

- It is a trial process
- Lower down the initial value
- Start the system normally. If there is no error message "**ocA**", stop the system
- Repeat previous 2 steps until "**ocA**" error message occurs
- Change the value back to the one V_A giving last successful operation

2.2 Determine the Value V_V for Over-Voltage Stall Prevention During Operation:

- It is a trial process
- Lower down the value
- Start the system normally, and keep the load be constant. If there is no error message "**ocn**", stop the system
- Repeat previous 2 steps until "**ocn**" error message occurs
- Change the value back to the one V_V giving last successful operation

3. Coding:

Check and change the following codes

Code 06-01 = V_A (Over-Current Stall Prevention During Acceleration)
Code 06-02 = V_V (Over-Voltage Stall Prevention During Operation)

4. Wiring:

None

- It is a good practice to set a multi-function output terminal to monitor the situation of over-current, and/or over-voltage. Please refer to "Monitor Operation Status".

5. Result:

- Whenever the load increases abnormally during either acceleration or operation, the system will stop. Investigate the causation of overload, find the solution to prevent overload in the future, click "RESET" button to clear this message, and the system will be ready for operation.
- The system will be protected from further damage by limiting the over-current and over-voltage detection level. The pump will have less chance to be completely locked or damaged.

Setup Motor Parameters

1. Preliminary Action:

- Drive Rated Output Current — A_D (A) (on the nameplate on the top of drive)
- Motor Rated Current — A_M (A) (on the nameplate on the motor, for low-voltage wiring, use larger number; for high-voltage wiring, use smaller number)
- Drive Rated Input Voltage Series — V_D (V) (on the nameplate on the top of drive, 230V or 460V)

2. Calculation:

None

3. Coding:

Check and change the following codes

Code 07-00 = $A_M/A_D \times 100$	(set Motor Rated Current)
Code 07-01 = 01	(set Motor No-Load Current as small as possible)
Code 07-02 = 08	(Torque Compensation)
Code 07-04 = 04	(Number of Motor Poles)

4. Wiring:

None

5. Result:

- The motor will be matched with the drive.

Trouble-shooting & Fault Information

Trouble-shooting & Common Questions

1. Good Sensor or Bad Sensor:

It is a good practice to always perform this step before proceed to any trouble-shooting.

- Use a voltmeter to measure DC voltage between VP and DCM on PG-02 card of ZVD drive.
- If a Hall Effect sensor is used, make sure TSW2 switch points to 12V location (up location). The reading should be about 12 (VDC). If the reading is small or it is always 0V, it may indicate a defected PG-02 card. Replace another card to verify again. If the reading is correct, proceed the following steps.
- Disconnect the power, and connect the sensor wires to PG-02 card (or, use a separate 12VDC power supply), and turn the power back on
- Measure DC voltage between A (signal wire) and DCM on PG-02 card inside of ZVD drive
- Slowly turn the motor shaft (or reducer shaft) by using a wrench, the voltage should vary between 0 (VDC) and 12 (VDC). If the shaft is turned fast, the voltage may stay at about 6 (VDC) level.
- If the voltage always stay at 0 (VDC), or any value below 1 (VDC), please check the sensor wiring. If the wiring is correct, it may be a defected sensor. Please contact Zenith for a replaced one
- If the voltage is always above 12 (VDC), when the shaft is turning, please check the sensor wiring. If the wiring is correct, it may be a defected sensor. Please contact Zenith for a replaced one
- If the voltage varies between 0 (VDC) and 12 (VDC), or it stays at 6 (VDC), it indicates that the sensor is good. Please proceed to the proper section for further trouble-shooting

2. No Feedback Signal:

Please refer to "Speed Sensor Issues" to manually verify the feedback signal.

- Make sure the air gap is correct. If the simple method shown in "Speed Sensor Issues" has already been tried, and the problem persists, a feeler gauge may be required to ensure the right gap (it requires to separate the motor from the gear reducer)
- Make sure the wiring for the sensor is correct
- Make sure the DC voltage between VP and DCM on PG-02 card is 12 (VDC), if TSW2 switch points at 12V position. If TSW2 points at 5V position, the voltage should be 5 (VDC).
- If a Hall Effect sensor is used, make sure TSW2 switch points at 12V position
- Make sure the shield wire on the sensor cable is connected correctly
- Make sure there are two jumpers between A-, B– and DCM terminals, if a Hall Effect sensor or a Magnetic Pickup is used
- If there is a safety barrier connected between the sensor and ZVD drive, make sure the wiring is correct, especially the shield wire. The shield wire on the sensor should be connected to the safety barrier. A shielded cable must also be used between safety barrier and ZVD drive, and the shield should be connected at both ends to form a continuous shielding from the sensor up to ZVD drive.

Trouble-shooting & Common Questions

3. System Always Runs at Full Speed:

Refer to section 1— "Good Sensor or Bad Sensor", and 2—"No Feedback Signal"

4. System Can Not Run Slow Enough (below 30 RPM or 40 RPM):

- Refer to section 1— "Good Sensor or Bad Sensor", and 2—"No Feedback Signal"
- Lower the value of Code 01-05 (Minimum Output Frequency)

5. System Never Runs:

- Disconnect the power first
- If electric arc, explosion-like noise, burning smell or smoke is observed, ZVD drive may be damaged. Contact Zenith for replacing a new ZVD drive
- Check the wiring for ZVD drive, especially the power wiring, motor wiring, and fuses. For motor wiring, double check the wiring against the diagram shown on the motor
- Make sure to release any Emergency button(s) and/or Stop button(s)
- Make sure the setpoint (either user defined under U mode, or frequency command under F mode) is not 0, or too small
- If there is an error message showing on the display, make sure to click "STOP/RESET" button to clear the error message first. Under this circumstance, check the Fault Code List to trouble-shoot the system and make sure the system is not under any error conditions
- Make sure and check the following codes:

Code 01-00 = 60	(Maximum Output Frequency)
Code 01-09 = NOT TOO LARGE	(Acceleration Time)
Code 02-00 = 00	(Source of Frequency Command)
Code 02-01 = 00	(Source of Operation Command)
Code 02-04 = 00	(Motor Direction Control)

  and, try to run the system again with these settings.
  If the system still can not run with the above settings. The problem could be very complicated, contact Zenith for further assistance.
  If the system can run with the above settings, it indicates the system is functionally correct. The old settings could be configured for special purpose. If Code 01-09 was a very large value, the system takes a very long time to ramp up to the speed, since the code defines system acceleration time. If Code 02-00 was set to other than 00, the speed of the system will be controlled by sources other keypad. If Code 02-01 is other than 00, the keypad operation will be ignored. If Code 02-04 is set to 01 (Disable Reverse Operation), and reverse direction is desired, the system simply will not run since it is inhibited.
- If the system is under PLC (Process Logic Control) mode, make sure the settings are correct, and make sure the frequency settings are large enough to make the system operate

6. Speed Is Not High Enough:

- The motor rated speed is 1,800 (RPM). Due to the reducer, the pump speed is much lower, and its maximum speed is 1800/Gear Ratio (RPM)

NOTE: OVER-SPEEDING OF MOTOR VOIDS THE SYSTEM WARRANTY. PLEASE PROCEED WITH EXTREME CAUTION.

Trouble-shooting & Common Questions

NOTE: OVER-SPEEDING OF MOTOR VOIDS THE SYSTEM WARRANTY. PLEASE PROCEED WITH EXTREME CAUTION.

- The motor rated speed usually is 60 (Hz) or 1800 (RPM). The motor can run over rated speed. However, the torque drops significantly, high heat may present, and the life of the motor will be shortened. To over-run the system, set Code 01-00 to a value larger than 60 but less than 90. **IT IS NOT SUGGESTED TO SET CODE 01-00 TO A VALUE LARGER THAN 90!**

7. System Speed Does Not Match Set Speed:

- Make sure the system is under feedback control mode, and check if
  Code 00-09 = 01 or 03
- Make sure PG input is not disabled, and check if
  Code 10-11 = 01, 02, or 03 (01 is used for Magnetic Pickup or Hall Effect sensors)
  (02, 03 is usually used for Encoders)
- Make sure the number of the teeth of the pickup gear match the corresponding setting
  Code 10-10 = 120 (For pickup gear, usually it is 120. Check sales order)
  (For encoder, usually it is 1024. Check sales order)
- Make sure the load is not excessive

8. System Needs Help to Start to Rotate:

- Check the wiring for ZVD drive, especially motor wiring. For motor wiring, double check the wiring against the diagram shown on the motor

9. System Turns at Wrong Direction:

- Swap either two wires of the motor cable
- Use keypad to set the desired direction

10. It Takes Very Long Time to Ramp Up:

- Check Code 01-09 for acceleration time, and make sure it is not too large

NOTE: Smaller the acceleration time, lesser the time for the motor to ramp up. However, it may increase the chance to damage the pump, due to the quick pressure build-up caused by the restriction down the stream of the pump

11. It Takes Very Long Time to Slow Down or Stop:

- Check Code 01-10 for deceleration time, and make sure it is not too large

12. Reset ZVD Drive:

CAUTION: All the customer settings will be permanently lost once the following step is proceeded. Use with caution!

- To reset ZVD drive back to drive's manufacturer settings, set Code 00-02 = 10

13. Can Not Operate from Keypad:

- Make sure Code 02-00 = 00
- Make sure Code 02-00 = 00, and Code 02-01 = 00, and the system is NOT controlled by other devices and the system is NOT operated by other devices

Trouble-shooting & Common Questions

14. The Display Would Not Light Up:

- Check the wiring of the system, and also fuses
- The keypad is attachable. Make sure the keypad is placed securely on ZVD drive.
- If there is a cable connected between ZVD drive and the keypad, make sure the connection is secure
- If all above steps have been performed, and the problem still persists, it may indicate a defected ZVD drive. Contact Zenith for replacing a new ZVD drive

15. Excessive Audible Noise:

- Gradually increase the value of Code 02-03 (PWM Carrier Frequency Selections), until the noise is reduced, and meanwhile, the temperature of the motor and drive is not increased significantly
- PWM carrier frequency has a significant influence on the electromagnetic noise, heat dissipation of the AC drive, and the acoustic noise to the motor
- Basically, the higher the value, the lower the acoustic noise from the motor, the higher the electromagnetic noise, and higher the heat dissipation

16. Excessive Heat of Drive or Motor:

- Gradually decrease the value of Code 02-03 (PWM Carrier Frequency Selections), until the heat is reduced, and meanwhile, the noise of the motor is not increased significantly
- PWM carrier frequency has a significant influence on the electromagnetic noise, heat dissipation of the AC drive, and the acoustic noise to the motor
- Basically, the higher the value, the lower the acoustic noise from the motor, the higher the electromagnetic noise, and higher the heat dissipation

Fault Code List

Code	Fault Description	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.	Check whether the input voltage falls within the rated AC drive's input voltage.
oL	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 (07-02). 3. Increase the AC drive's output capacity.
oL 1	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 (07-00).

Fault Code List

Code	Fault Description	Corrective Actions
oL2	Motor Overload	1. Reduce the motor load. 2. Adjust the over-torque detection setting to an appropriate setting ((06-03) to (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: • Short-circuit at motor output. • Torque boost too high. • Acceleration time too short. • AC drive output capacity is too small.	1. Check for possible poor insulation at the output line. 2. Decrease the torque boost setting in (07-02). 3. Increase the acceleration time. 4. Replace the AC drive with one that has a higher output capacity (next HP size).
ocd	Over-current during deceleration: • Short-circuit at motor output. • Deceleration time too short. • 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: • Short-circuit at motor output. • Sudden increase in motor loading. • 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 the AC drive with one that has a higher output capacity (next HP size).
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 multi-function input terminals (Mi1 to Mi6) are set to emergency stop, AC drive stops any output.	Press RESET after fault has been cleared.
Lc	Low Current	1. Check Load current 2. Check (06-12) to (06-15) settings
PHL	Phase Loss	Check Power Source Input

Fault Code List

Code	Fault Description	Corrective Actions
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	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 or ACI open circuit PGErr: PG feedback signal error	1. Check both parameter settings and wiring of Analog/PG (10-00). 2. Check for possible fault between system reaction time and the feedback signal detection time (10-08).
AUE	Auto Tuning Error	1. Check cabling between drive and motor 2. Try again
cEF	EF when preliminary count value attained	1. Check counter trigger signal 2. Check (03-09), (03-11) setting

Complete Code List

GROUP 00: User Parameters

00-00 Identity Code of AC Drive Default: --

00-01 Rated Current Display of Drive Default: --

00-02 Parameter Reset Default: 00

Settings: 08 Lock Keypad
10 Reset parameters to factory settings

00-03 Start-up Display Page Selection Default: 00

Settings: 00 Master frequency (F)
01 Actual operation frequency (H)
02 Content of user-defined unit (U)
03 Multifunction display [default: output current (A)]
04 FWD/REV command

00-04 Content of Multi Function Display Default: 00

Settings: 00 Output current (A)
01 Counter value (C)
02 Content of PLC time (1.tt)
03 DC BUS voltage (U)
04 Output voltage (E)
05 Power factor angle (n.)
06 Output power (P), unit: kW
07 Actual motor speed (enable during vector control or Pulse Generator feedback control) (HU)
08 Estimated value of torque ratio(t)
09 PG numbers/10ms (G)
10 Analog feedback signal value (b) (%)
11 AVI (U1.) (%)
12 ACI (U2.) (%)
13 AUI (U3.) (%)

00-05 User Defined Coefficient K Default: 1.00

Settings: 0.01 to 160.00
To set the user unit to be pump RPM, the value should be:
K = 30 / Gear Ratio

00-06 Software Version Default: --

00-07 Password Input Default: 00

Settings: 1 to 65535

00-08 Password Setting Default: 00

Settings: 1 to 65535

00-09 Control Methods Default: 00

Settings: 00 V/F control
01 V/F + PG Control
02 Vector Control
03 Vector + PG Control

GROUP 01: Basic Parameters

01-00 Maximum Output Frequency (Fmax) Default: 60.00

Settings: 50.00 to 400.00 Hz

To a 60Hz 1800RPM AC motor, default max. speed of the motor will be 1800RPM. Analog inputs (0~+10V, 4~20mA, -10V~+10V) are scaled to this range.

01-01 Maximum Voltage Frequency (Fbase) Default: 60.00

Settings: 0.10 to 400.00Hz

01-02 Maximum Output Voltage (Vmax) Default:

Settings: 0.1 to 255.0V (230 V Series) 230 V Series: 220.0

0.1 to 510.0V (460 V Series) 460 V Series: 440.0

01-03 Mid-Point Frequency (Fmid) Default: 0.50

Settings: 0.10 to 400.00 Hz

01-04 Mid-Point Voltage (Vmid) Default:

Settings: 0.1 to 255.0V (230 V Series) 230 V Series: 1.7

0.1 to 510.0V (460 V Series) 460 V Series: 3.4

01-05 Minimum Output Frequency (Fmin) Default: 0.50

Settings: 0.10 to 400.00Hz

To a 60Hz 1800RPM AC motor, default min. speed of the motor will be 15RPM.

01-06 Minimum Output Voltage (Vmin) Default:

Settings: 0.1 to 255.0V (230 V Series) 230 V Series: 1.7

0.1 to 510.0V (460 V Series) 460 V Series: 3.4

01-07 Upper Bound of Output Frequency Default: 100

Settings: 1 to 120%

01-08 Lower Bound of Output Frequency Default: 00

Settings: 00 to 100%

01-09 Acceleration Time 1 Default: 10.0

01-10 Deceleration Time 1 Default: 10.0

01-11 Acceleration Time 2 Default: 10.0

01-12 Deceleration Time 2 Default: 10.0

Settings: 0.01 to 3600.0 sec

Acceleration Time determines the time for the AC drive to ramp from 0 Hz to its Maximum Output Freq. (01-00). The rate is linear unless S-Curve is enabled. Deceleration Time is the time for the AC drive to decelerate from its Maximum Output Freq. (01-00) to 0 Hz. The rate is linear unless S-Curve is enabled.

01-13 Jog Acceleration Time Default: 1.0

Settings: 0.1 to 3600.0 sec

01-14 Jog Frequency Default: 6.00

Settings: 0.10 to 400.00Hz

GROUP 01: Basic Parameters (cont'd)

01-15 Auto-Acceleration / Deceleration Default: 00

Settings: 00 Linear acceleration / deceleration
01 Auto acceleration, linear Deceleration.
02 Linear acceleration, auto Deceleration.
03 Auto acceleration / deceleration
04 Linear acceleration/deceleration, stall prevention during deceleration

01-16 Acceleration S-Curve Default: 00
01-17 Deceleration S-Curve Default: 00

Settings: 00 to 07
Setting 01 offers the quickest S-curve and 07 offers longest and smoothest S-curve. The drive will not follow Accel/Decel Time in (01-09) to (01-12). To Disable S-curve, set (01-16) and (01-17) to 00.

01-18 Acceleration Time 3 Default: 10.0
01-19 Deceleration Time 3 Default: 10.0
01-20 Acceleration Time 4 Default: 10.0
01-21 Deceleration Time 4 Default: 10.0

Settings: 0.01 to 3600.0 sec
Acceleration Time determines the time for the AC drive to ramp from 0 Hz to its Maximum Output Freq. (01-00). The rate is linear unless S-Curve is enabled. Deceleration Time is the time for the AC drive to decelerate from its Maximum Output Freq. (01-00) to 0 Hz. The rate is linear unless S-Curve is enabled.

01-22 Jog Deceleration Time Default: 1.0

Settings: 0.1 to 3600.0 sec

01-23 Unit for Accel/Decel Time Default: 00

Settings: 00 Unit: 1 sec
01 Unit: 0.1 sec
02 Unit: 0.01 sec

GROUP 02: Operation Method Parameters

02-00 Source of First Frequency Command Default: 00

Settings: 00 Determined by digital keypad or external keys of the Multi Function Inputs.
01 Determined by analog signal DC 0V to +10V from AVI
02 Determined by analog signal DC 4mA to 20mA from ACI
03 Determined by analog signal DC -10V to +10V from AUI
04 Determined by RS-485 serial communication (RJ-11)
05 Determined by RS-485 serial communication (RJ-11), freq. is not memorized.
06 Combined master and auxiliary frequencies (02-10), (02-11) and (02-12)

02-01 Source of First Operation Command Default: 00

Settings: 00 Controlled by digital keypad
01 Controlled by external terminals, keypad STOP enabled.
02 Controlled by external terminals, keypad STOP disabled.
03 Controlled by the RS-485 communication interface, keypad STOP enabled.
04 Controlled by the RS-485 communication interface, keypad STOP disabled.

02-02 Stop Method Default: 00

Settings: 00 STOP: ramp to stop; E.F. (External Fault) : coast to stop
01 STOP: coast to stop; E.F. : coast to stop
02 STOP: ramp to stop; E.F. : ramp to stop
03 STOP: coast to stop; E.F. : ramp to stop

02-03 PWM Carrier Frequency Selections Default: 15

It has significant influence on the electromagnetic noise, heat dissipation of the motor, and the acoustic noise to the motor.
Basically, the higher the value, the lower the acoustic noise from the motor, the higher the electromagnetic noise, and higher the heat dissipation.

02-04 Motor Direction Control Default: 00

Settings: 00 Enable Forward/Reverse operation
01 Disable Reverse operation
02 Disabled Forward operation

02-05 2-wire/ 3-wire Operation Control Mode Selection Default: 00

Settings: 00 FWD/STOP, REV/STOP
01 FWD/REV, RUN/STOP
02 3-wire Operation

02-06 Line Start Lockout Default: 00

Settings: 00 Disable
01 Enable
When enabled, the drive will not start when powered up. To start in Line Start Lockout mode, the drive must see the run command go from stop to run.
When Line Start Lockout is disable (also known as Auto-Start), the drive will start when powered-up with run commands applied.
CAUTION: This feature does not guarantee the motor will never start under this condition. Motor may be set in motion by a malfunctioning switch.

GROUP 02: Operation Method Parameters (cont'd)

02-07 Loss of ACI Signal (4-20mA) Default: 00

Settings: 00 Decelerate to 0Hz.
01 Stop immediately and display "EF".
02 Continue operation by the last frequency command.

02-08 Up/Down Key Mode Default: 00

Settings: 00 Based on Accel/Decel Time
01 Constant speed

02-09 Acce/Decel Speed of UP/DOWN Key with Constant Speed Default: 0.01

Settings: 0.01~1.00 Hz/msec
It determines increasment/decreasment method of frequency when Multi-function Input parameters (04-04)~(04-09) are set to 11 (Up command) or 12 (Down command).
If (02-08)=1, it will accel/decel frequency by (02-09).
If (02-08)=0, it will accel/decel frequency by using accel/decel settings..

02-10 Source of the Master Frequency Command (FCHA) Default: 00

Settings: 00 Digital keypad
01 0 to +10V from AVI
02 4 to 20mA from ACI
03 -10 to +10Vdc from AUI
04 RS-485 communication interface

02-11 Source of the Master Frequency Command (FCHB) Default: 00

Settings: 00 Digital keypad
01 0 to +10V from AVI
02 4 to 20mA from ACI
03 -10 to +10Vdc from AUI
04 RS-485 communication interface

02-12 Combination of the Master and Auxiliary Frequency Default: 00

Settings: 00 Master frequency + Auxiliary frequency
01 Master frequency - Auxiliary frequency
Parameters (02-10)~(02-12) are enabled when (02-00) or (02-13) is set to 06.

02-13 Source of First Frequency Command Default: 00

Settings: 00 Determined by digital keypad or external keys of the Multi Function Inputs.
01 Determined by analog signal DC 0V to +10V from AVI
02 Determined by analog signal DC 4mA to 20mA from ACI
03 Determined by analog signal DC -10V to +10V from AUI
04 Determined by RS-485 serial communication (RJ-11)
05 Determined by RS-485 serial communication (RJ-11), freq. is not memorized.
06 Combined master and auxiliary frequencies (02-10), (02-11) and (02-12)

GROUP 02: Operation Method Parameters (cont'd)

02-07 Loss of ACI Signal (4-20mA) Default: 00

Settings: 00 Decelerate to 0Hz.
01 Stop immediately and display "EF".
02 Continue operation by the last frequency command.

02-08 Up/Down Key Mode Default: 00

Settings: 00 Based on Accel/Decel Time
01 Constant speed

02-09 Acce/Decel Speed of UP/DOWN Key with Constant Speed Default: 0.01

Settings: 0.01~1.00 Hz/msec
It determines increasment/decreasment method of frequency when Multi-function Input parameters (04-04)~(04-09) are set to 11 (Up command) or 12 (Down command).
If (02-08)=1, it will accel/decel frequency by (02-09).
If (02-08)=0, it will accel/decel frequency by using accel/decel settings..

02-10 Source of the Master Frequency Command (FCHA) Default: 00

Settings: 00 Digital keypad
01 0 to +10V from AVI
02 4 to 20mA from ACI
03 -10 to +10Vdc from AUI
04 RS-485 communication interface

02-11 Source of the Master Frequency Command (FCHB) Default: 00

Settings: 00 Digital keypad
01 0 to +10V from AVI
02 4 to 20mA from ACI
03 -10 to +10Vdc from AUI
04 RS-485 communication interface

02-12 Combination of the Master and Auxiliary Frequency Default: 00

Settings: 00 Master frequency + Auxiliary frequency
01 Master frequency - Auxiliary frequency
Parameters (02-10)~(02-12) are enabled when (02-00) or (02-13) is set to 06.

02-13 Source of First Frequency Command Default: 00

Settings: 00 Determined by digital keypad or external keys of the Multi Function Inputs.
01 Determined by analog signal DC 0V to +10V from AVI
02 Determined by analog signal DC 4mA to 20mA from ACI
03 Determined by analog signal DC -10V to +10V from AUI
04 Determined by RS-485 serial communication (RJ-11)
05 Determined by RS-485 serial communication (RJ-11), freq. is not memorized.
06 Combined master and auxiliary frequencies (02-10), (02-11) and (02-12)

GROUP 03: Output Function Parameters

03-00	**Multi-function Output Terminal (Relay Output)**	Default:	08
03-01	**Multi-function Output Terminal MO1**		01
03-02	**Multi-function Output Terminal MO2**		02
03-03	**Multi-function Output Terminal MO3**		20

Settings:

00 Not used

01 AC Drive Operational
Activated when there is an output from drive or RUN command is on.

02 Master Frequency Attained
Activated when drive attains Output Frequency Setting.

03 Zero Speed
Activated when Frequency is lower than the Minimum Output Freqency.

04 Over-Torque Detection
Activated as long as over-torque is detected (refer to (06-03) ~ (06-05)).

05 Baseblock (B.B.) Indication
Activated when the output of drive is shut off by external baseblock

06 Low-Voltage Indication
Activated when low voltage is detected.

07 Operation Mode Indication
Activated when operation command is controlled by external terminal.

08 Fault Indication
Activated when faulted (oc, ov, oH, oL, oL1, EF, cF3, HPF, ocA, ocd, ocn, GFF).

09 Desired Frequency Attained 1
Activated when the desired frequency (03-04) is attained.

10 PLC Program Running
Activated when PLC Program is running.

11 PLC Program Step Completed
Activated for 0.5 sec when each multi-step speed is attained.

12 PLC Program Completed
Activated for 0.5 sec when PLC program cycle has completed

13 PLC Operation Paused
Activated when PLC operation is paused.

14 Terminal Count Value Attained
Activated when the counter reaches Terminal Count Value.

15 Preliminary Count Value Attained
Activated when the counter reaches Preliminary Count Value.

16 Auxiliary Motor 1

17 Auxiliary Motor 2

18 Auxiliary Motor 3
For fan & pump control, one can use Multi-function Output Terminals to define auxiliary motor 1~3 (refer to PID Controls, Fan & Pump Control).

19 Heatsink Overheat Warning (OH1)
When heatsink overheats, activate to prevent OH turn off drive. > 85˚C (185˚F) ON, < 85˚C (185˚F) OFF.

GROUP 03: Output Function Parameters

20 AC Drive Ready
Activated when drive is on and no abnormality detected.

21 Emergency Stop Indication
Activated once drive's emergency stop function is activated.

22 Desired Frequency Attained 2
Activated when desired frequency (03-10) is attained.

23 Soft Braking Signal
It is used in conjunction with a VFDB Braking Unit.
Activated when drive needs help braking the load.

24 Zero Speed Output Signal
It is always active unless an output frequency presents at terminals U, V, W.

25 Low-current Detection
Activated once drive's current is too low (refer to (06-12), (06-13)).

26 Operation Indication (H≥Fmin)
Activated when there is output voltage from U, V, W.

27 Feedback Signal Error
Activated once the feedback signal is abnormal (refer to (10-08), (10-16)).

28 User-defined Low-voltage Detection
Activated once DC Bus voltage is too low (refer to (06-16), (06-17)).

03-04 Desired Frequency Attained 1 Default: 0.00

Settings: 0.00 to 400.00 Hz

03-05 Analog Output Signal (AFM) Default: 00

Settings: 00 Analog Frequency Meter (from 0 to Maximum Output Frequency)
01 Analog Current Meter (from 0 to 250% of rated AC drive current)
02 Output voltage (from 0 to (01-02)).
03 Output frequency command (from 0 to Maximum Frequency)
04 Output motor speed (from 0 to Maximum Frequency)
05 Load power factor ($\cos\theta$ = 90°to $\cos\theta$ = 0°)

03-06 Analog Output Gain Default: 100

Settings: 01 to 200%

03-07 Digital Output Multiplying Factor Default: 01

Settings: 01 to 20 times

03-08 Terminal Count Value Default: 00

Settings: 00 to 65500
It determines the value of internal counter. Internal counter is triggered by external terminal TRG. Upon completion of counting, the specified output terminal will be activated ((03-00) ~ (03-03) set to 14).
When the display shows c5555, it has counted 5,555 times. If the display shows c5555., the real counter value is between 55,550 to 55,559.

03-09 Preliminary Count Value Default: 00

Settings: 00 to 65500

GROUP 03: Output Function Parameters

03-10 Desired Frequency Attained 2 Default: 0.00

Settings: 0.00 to 400.00 Hz

03-11 EF Active when Preliminary Count Value Attained Default: 00

Settings: 00 Not used
01 Preliminary count value attained, EF active.

03-12 Fan Control Default: 00

Settings: 00 Fan always on
01 Power off 1 minute later, fan off
02 Run and fan on, stop and fan off
03 Preliminary temperature attained, Fan start to run

GROUP 04: Input Function Parameters

04-00 AVI Analog Input Bias Default: 0.00

Settings: 0.00 to 200.00%

04-01 AVI Bias Polarity Default: 00

Settings: 00 Positive Bias
01 Negative Bias

04-02 AVI Input Gain Default: 100

Settings: 1 to 200%

04-03 AVI Negative Bias, Reverse Motion Enabled Default: 00

Settings: 00 Forward motion only
01 Forward and reverse motion enabled. Forward motion with positive bias. Reverse motion with negative bias.
02 Forward and reverse motion enabled. Forward and Reverse motion with positive or negative bias. Select direction via the keypad or external terminals.

04-04 Multi-function Input Terminal (Mi1) Default: 01
04-05 Multi-function Input Terminal (Mi2) Default: 02
04-06 Multi-function Input Terminal (Mi3) Default: 03
04-07 Multi-function Input Terminal (Mi4) Default: 04
04-08 Multi-function Input Terminal (Mi5) Default: 05
04-09 Multi-function Input Terminal (Mi6) Default: 06

Settings: 0.00 to 400.00 Hz
00 Not used
Any unused terminals should be programmed to 00 to insure they have no effect on drive operation.
01 Multi-Step Speed Command 1
02 Multi-Step Speed Command 2
03 Multi-Step Speed Command 3
04 Multi-Step Speed Command 4
Program any four of Multi-Function Input Terminals for multi-step speed function. These four inputs select multi-step speeds defined by (05-00) to (05-14)
05 External Reset (NO)
Program to be an External Reset.
06 Accel/Decel Inhibit
Program the input for Accel/Decel Inhibit. When active, drive maintains a constant speed, acceleration and deceleration is stopped
07 Accel/Decel Time Selection Command 1
08 Accel/Decel Time Selection Command 2
Program any two of the inputs to select the one of four Accel/Decel Time ((01-09) to (01-12), (01-18) to (01-21)).
09 External Base Block (NO)
10 External Base Block (NC)
Program for external Base Block control.
NOTE: When a Base-Block signal is received, drive will stop all output and the motor will free run. When base block control is deactivated, drive will start its

GROUP 04: Input Function Parameters (cont'd)

speed search function and synchronize with the motor speed, and then accelerate to Master Frequency.

11 Increase Master Frequency

12 Decrease Master Frequency

Program inputs to incrementally increase/decrease the Master Frequency.

13 Counter Reset Parameter

Program to reset the counter.

14 Run PLC Program

15 Pause PLC Program

Program to enable/pause drive internal PLC program

16 Auxiliary Motor No.1 Output Failure

17 Auxiliary Motor No.2 Output Failure

18 Auxiliary Motor No.3 Output Failure

Parameter value 16 to 18 program Multi-Function

Program to disable the corresponding multi-function relay outputs

19 Emergency Stop (NO)

20 Emergency Stop (NC)

Program to be emergency stop. Press "RESET" after fault has been cleared.

21 Master Frequency Selection AVI/ACI

When enabled, (02-00) will automatically be disabled. If the terminal is open, it is AVI; if closed, it is ACI.

22 Master Frequency Selection AVI/AUI

When enabled, (02-00) will automatically be disabled. If the terminal is open, it is AVI; if closed, it is AUI.

23 Operation Command Selection Keypad/External

When enabled, (02-01) will automatically be disabled. If the terminal is open, it is via keypad; if closed, it is via the external terminal.

24 Auto Accel/Decel Mode Disable

If enabled, auto accel/decel mode set by (01-15) will be disabled

25 Forced Stop (NC)

26 Forced Stop (NO)

These parameters are the same as "STOP" command. Press "RUN" to run motor.

27 Parameter Lock Enable

When enabled, all parameters will be locked, and read/write is not allowed.

28 PID Function Disabled

When enabled, PID function will be disabled.

29 Jog Fwd/Rev Command

When enabled, only external terminal JOG is allowed.

30 External Reset (NC)

It is the same as setting 05, but it uses in normal close.

31 Source of Second Frequency Command Enabled

32 Source of Second Operation Command Enabled

To select first/second frequency/operation command source.

GROUP 04: Input Function Parameters (cont'd)

33 One Shot PLC
The function is the same as setting 14, but the trigger signal is a one-shot pulse.
34 Proximity Sensor Input for Simple Index Function
This function should be used with (04-23) ~ (04-25).
35 Output Shutoff Stop (NO)
36 Output Shutoff Stop (NC)
If enabled, drive will stop output and motor free run. If the state of terminals is changed, the drive will restart from 0Hz.

04-10 Digital Terminal Input Debouncing Time Default: 1
Settings: 1 to 20m sec

04-11 ACI Analog Input Bias Default: 0.00
Settings: 0.00 to 200.00%

04-12 ACI Bias Polarity Default: 00
Settings: 00 Positive Bias
01 Negative Bias

04-13 ACI Input Gain Default: 100
Settings: 01 to 200%

04-14 ACI Negative Bias, Reverse Motion Enable Default: 00
Settings: 00 No ACI Negative bias command
01 Negative bias, REV motion enabled
02 Negative bias, REV motion disabled

04-15 AUI Analog Input Bias Default: 0.00
Settings: 0.00 to 200.00%

04-16 AUI Bias Polarity Default: 00
Settings: 00 Positive Bias
01 Negative Bias

04-17 AUI Input Gain Default: 100
Settings: 01 to 200%

04-18 AUI Negative Bias, Reverse Motion Enable Default: 00
Settings: 00 No AUI Negative bias command
01 Negative bias, REV motion enabled
02 Negative bias, REV motion disabled

04-19 AVI Analog Input Delay Default: 0.05
Settings: 0.00 to 10.00 Sec

04-20 ACI Analog Input Delay Default: 0.05
Settings: 0.00 to 10.00 Sec

04-21 AUI Analog Input Delay Default: 0.05
Settings: 0.00 to 10.00 Sec

04-22 Analog Input Frequency Resolution Default: 01
Settings: 00 0.01Hz

GROUP 04: Input Function Parameters (cont'd)

Settings: 00 0.01Hz
01 0.1Hz

04-23 Gear Ratio for Simple Index Function Default: 200

Settings: 4 to 1000

04-24 Index Angle for Simple Index Function Default: 180.0

Settings: 0.0 to 360.0°

04-25 Deceleration Time for Simple Index Function Default: 0.00

Settings: 0.00 to 100.00 sec

GROUP 05: Multi-step Speed & PLC (Process Logic Control) Parameters

05-00	1st Step Speed Frequency	Default:	0.00
05-01	2nd Step Speed Frequency	Default:	0.00
05-02	3rd Step Speed Frequency	Default:	0.00
05-03	4th Step Speed Frequency	Default:	0.00
05-04	5th Step Speed Frequency	Default:	0.00
05-05	6th Step Speed Frequency	Default:	0.00
05-06	7th Step Speed Frequency	Default:	0.00
05-07	8th Step Speed Frequency	Default:	0.00
05-08	9th Step Speed Frequency	Default:	0.00
05-09	10th Step Speed Frequency	Default:	0.00
05-10	11th Step Speed Frequency	Default:	0.00
05-11	12th Step Speed Frequency	Default:	0.00
05-12	13th Step Speed Frequency	Default:	0.00
05-13	14th Step Speed Frequency	Default:	0.00
05-14	15th Step Speed Frequency	Default:	0.00

Settings: 0.00 to 400.00 Hz

Multi-function Inputs ((04-04) to (04-09)) select one of Multi-Step speeds.

05-15 PLC Mode Default: 00

Settings:
- 00 Disable PLC operation
- 01 Execute one program cycle
- 02 Continuously execute program cycles
- 03 Execute one program cycle step by step
- 04 Continuously execute program cycles step by step

05-16 PLC Forward/Reverse Motion Default: 00

Settings: 00 to 32767

15-bit binary is used to program the forward/reverse motion for each of 15 speed steps. The binary must be converted into decimal number. 0-forward, and 1-reverse. Bit 0 defines the direction of 1st step. Bit 15 defines the direction of 15th step.

05-17	Time Duration of 1st Step Speed	Default:	0.0
05-18	Time Duration of 2nd Step Speed	Default:	0.0
05-19	Time Duration of 3rd Step Speed	Default:	0.0
05-20	Time Duration of 4th Step Speed	Default:	0.0
05-21	Time Duration of 5th Step Speed	Default:	0.0
05-22	Time Duration of 6th Step Speed	Default:	0.0
05-23	Time Duration of 7th Step Speed	Default:	0.0
05-24	Time Duration of 8th Step Speed	Default:	0.0
05-25	Time Duration of 9th Step Speed	Default:	0.0
05-26	Time Duration of 10th Step Speed	Default:	0.0
05-27	Time Duration of 11th Step Speed	Default:	0.0
05-28	Time Duration of 12th Step Speed	Default:	0.0
05-29	Time Duration of 13th Step Speed	Default:	0.0
05-30	Time Duration of 14th Step Speed	Default:	0.0

GROUP 05: Multi-step Speed & PLC (Process Logic Control) Parameters (cont'd)

05-00	1st Step Speed Frequency	Default:	0.00
05-01	2nd Step Speed Frequency	Default:	0.00
05-02	3rd Step Speed Frequency	Default:	0.00
05-03	4th Step Speed Frequency	Default:	0.00
05-04	5th Step Speed Frequency	Default:	0.00
05-05	6th Step Speed Frequency	Default:	0.00
05-06	7th Step Speed Frequency	Default:	0.00
05-07	8th Step Speed Frequency	Default:	0.00
05-08	9th Step Speed Frequency	Default:	0.00
05-09	10th Step Speed Frequency	Default:	0.00
05-10	11th Step Speed Frequency	Default:	0.00
05-11	12th Step Speed Frequency	Default:	0.00
05-12	13th Step Speed Frequency	Default:	0.00
05-13	14th Step Speed Frequency	Default:	0.00
05-14	15th Step Speed Frequency	Default:	0.00

Settings: 0.00 to 400.00 Hz
Multi-function Inputs ((04-04) to (04-09)) select one of Multi-Step speeds.

05-15	PLC Mode	Default:	00

Settings:
- 00 Disable PLC operation
- 01 Execute one program cycle
- 02 Continuously execute program cycles
- 03 Execute one program cycle step by step
- 04 Continuously execute program cycles step by step

05-16	PLC Forward/Reverse Motion	Default:	00

Settings: 00 to 32767
15-bit binary is used to program the forward/reverse motion for each of 15 speed steps. The binary must be converted into decimal number. 0-forward, and 1-reverse. Bit 0 defines the direction of 1st step. Bit 15 defines the direction of 15th step.

05-17	Time Duration of 1st Step Speed	Default:	0.0
05-18	Time Duration of 2nd Step Speed	Default:	0.0
05-19	Time Duration of 3rd Step Speed	Default:	0.0
05-20	Time Duration of 4th Step Speed	Default:	0.0
05-21	Time Duration of 5th Step Speed	Default:	0.0
05-22	Time Duration of 6th Step Speed	Default:	0.0
05-23	Time Duration of 7th Step Speed	Default:	0.0
05-24	Time Duration of 8th Step Speed	Default:	0.0
05-25	Time Duration of 9th Step Speed	Default:	0.0
05-26	Time Duration of 10th Step Speed	Default:	0.0
05-27	Time Duration of 11th Step Speed	Default:	0.0
05-28	Time Duration of 12th Step Speed	Default:	0.0
05-29	Time Duration of 13th Step Speed	Default:	0.0
05-30	Time Duration of 14th Step Speed	Default:	0.0

GROUP 06: Protection Parameters

06-00 Over-Voltage Stall Prevention Default: 390

Settings: 00 Disable Over-Voltage Stall Prevention
230V series: 330 ~ 410V
460V series: 660 ~ 820V
During deceleration, DC bus voltage may exceed its Maximum Allowable Value due to motor regeneration. When enabled, drive will not decelerate and keep the output frequency until the voltage drops below the preset value.

06-01 Over-Current Stall Prevention during Acceleration Default: 170

Settings: 20 to 250%
100% is equal to the Rated Output Current of the drive.
During acceleration, drive output current may increase abruptly and exceed the value specified by (06-01) due to rapid acceleration or excessive load. When enabled, the drive will stop accelerating and keep the output frequency until the current drops below the maximum value.

06-02 Over-current Stall Prevention during Operation Default: 170

Settings: 20 to 250%
If the output current exceeds (06-02) when the drive is operating, the drive will decrease output frequency to prevent motor stall. If the output current is lower than the setting, drive will accelerate to catch up with the frequency specified.

06-03 Over-Torque Detection Mode (OL2) Default: 00

Settings: 00 Over-Torque detection disabled.
01 Enabled during constant speed operation, and keep operation after detection.
02 Enabled during constant speed operation, operation halted after detection.
03 Enabled during acceleration, and keep operation after detection.
04 Enabled during acceleration, and operation halted after detection.

06-04 Over-Torque Detection Level Default: 150

Settings: 10 to 200%

06-05 Over-Torque Detection Time Default: 0.1

Settings: 0.1 to 60.0Sec
Multi-function Inputs ((04-04) to (04-09)) select one of Multi-Step speeds.

06-06 Electronic Thermal Overload Relay Selection Default: 00

Settings: 00 Operate with a Standard Motor (coaxial heat dissipation)
01 Operate with a Special Motor (independent heat dissipation)
02 Operation disabled

06-07 Electronic Thermal Characteristic Default: 60

Settings: 30 to d 600 Sec
It determines the time required activating the I2t electronic thermal protection function.

GROUP 06: Protection Parameters (cont'd)

06-08	**Present Fault Record**	Default: 00
06-09	**Second Most Recent Fault Record**	Default: 00
06-10	**Third Most Recent Fault Record**	Default: 00
06-11	**Fourth Recent Fault Record**	Default: 00

Settings:
- 00 No fault occurred
- 01 Over-current (oc)
- 02 Over-voltage (ov)
- 03 Overheat (oH)
- 04 Overload (oL)
- 05 Overload1 (oL1)
- 06 External fault (EF)
- 07 IGBT protection (occ)
- 08 CPU failure (CF3)
- 09 Hardware protection failure (HPF)
- 10 Current exceeds 2 times rated current during accel.(ocA)
- 11 Current exceeds 2 times rated current during decel.(ocd)
- 12 Current exceeds 2 times rated current during steady state operation (ocn)
- 13 Ground fault (GFF)
- 14 Low voltage (Lv)
- 15 CPU READ failure (CF1)
- 16 CPU WRITE failure (CF2)
- 17 External Base block stop (bb)
- 18 Motor over load (oL2)
- 19 Auto accel/decel failure (CFA)
- 20 Software/password protection (code)
- 21 Emergency stop (EF1)
- 22 PHL (Phase-Loss)
- 23 cEF (Preliminary count value attained, EF active)
- 24 Lc (Low-current)
- 25 AnLEr (Analog feedback signal error)
- 26 PGErr (PG feedback signal error)

Read only. Use RESET key to reset the drive when the fault no longer exits.

06-12	**Low-Current Detection Level**	Default: 00

Settings: 00 ~ 100% (00 - Disabled)

06-13	**Low-Current Detection Time**	Default: 10.0

Settings: 0.1~ 3600.0 Sec

06-14	**Low-Current Treatment**	Default: 00

Settings:
- 00 Warn and keep operating
- 01 Warn and ramp to stop
- 02 Warn and coast to stop
- 03 Warn, after coast to stop, restart (delay 06-15 setting time)

06-15	**Low-Current Detection Restart Delay Time**	Default: 10.0

Settings: 1~600.0 Min.

GROUP 06: Protection Parameters (cont'd)

06-16 User-Defined Low-Voltage Detection Level Default: 00

Settings: 00 Disabled
230V series: 220 ~ 300VDC
460V series: 440 ~ 600VDC

06-17 User-Defined Low-Voltage Detection Time Default: 0.5

Settings: 0.1~ 3600.0 Sec

GROUP 07: Motor Parameters

07-00 Motor Rated Current Default: 100

Settings: 30 to 120%

Calculate the percentage entered into this parameter.

(Motor Rated Current (A) / Drive Rated Output Current (A)) × 100%

07-01 Motor No-load Current Default: 40

Settings: 01 to 90%

Rated current of drive is regarded as 100%.

Value must be less than (07-00).

07-02 Torque Compensation Default: 0.0

Settings: 0.0 to 10.0

This parameter may be set so that drive will increase its voltage output to obtain a higher initial starting torque. Only for V/F control mode.

07-03 Slip Compensation (Used without PG) Default: 0.00

Settings: 0.00 to 3.00

To an asynchronous motor, increasing load on drive will cause an increase in slip. This parameter may be used to compensate the slip by increasing the output frequency.

07-04 Number of Motor Poles Default: 04

Settings: 02 to 10

07-05 Motor Parameters Auto Tuning Default: 00

Settings: 00 Disable

01 Auto Tuning R1

02 Auto Tuning R1 + No-load Test

07-06 Motor Line-to-line Resistance R1 Default: 00

Settings: 00 to 65535 mΩ

07-07 Reserved Default: 60

07-08 Motor Rated Slip Default: 3.00

Settings: 0.00 to 20.00Hz

Rated Slip = Motor Base Frequency – (Rated Rpm × Motor Pole / 120)

07-09 Slip Compensation Limit Default: 200

Settings: 00 to 250%

Rated Slip = Motor Base Frequency – (Rated Rpm × Motor Pole / 120)

07-10 Reserved Default: 00

07-11 Reserved Default: 00

07-12 Torque Compensation Time Constant Default: 0.05

Settings: 0.01 ~10.00 Sec

07-13 Slip Compensation Time Constant Default: 0.10

Settings: 0.05 ~10.00 Sec

07-14 Accumulative Motor Operation Time (Min.) Default: 00

Settings: 00 ~1439

GROUP 07: Motor Parameters (cont'd)

07-15 Accumulative Motor Operation Day Default: 00

Settings: 00 ~65535

GROUP 08: Special Parameters

08-00 DC Braking Current Level Default: 0

Settings: 0 to 100%

The drive rated current is considered as 100%.

08-01 DC Braking Time during Start-up Default: 0.0

Settings: 0.0 to 60.0 sec

08-02 DC Braking Time during Stopping Default: 0.0

Settings: 0.0 to 60.0 sec

08-03 Start-Point for DC Braking Default: 0.00

Settings: 0.00 to 400.00Hz

It determines the frequency that DC Braking will begin while the output frequency reached during deceleration.

08-04 Momentary Power Loss Operation Selection Default: 00

Settings: 00 Operation stops after momentary power loss.

01 Operation continues after momentary power loss, speed search starts with the Master Frequency reference value.

02 Operation continues after momentary power loss, speed search starts with the minimum frequency.

08-05 Maximum Allowable Power Loss Time Default: 2.0

Settings: 0.1 to 5.0 sec

If power loss time is less than this setting, the drive will resume operation. Or, the drive output will turn off.

08-06 Baseblock Time for Speed Search (BB) Default: 0.5

Settings: 0.1 to 5.0 sec

08-07 Current Limit for Speed Search Default: 150

Settings: 30 to 200%

08-08 Skip Frequency 1 Upper Bound Default: 0.00

08-09 Skip Frequency 1 Lower Bound Default: 0.00

08-10 Skip Frequency 2 Upper Bound Default: 0.00

08-11 Skip Frequency 2 Lower Bound Default: 0.00

08-12 Skip Frequency 3 Upper Bound Default: 0.00

08-13 Skip Frequency 3 Lower Bound Default: 0.00

Settings: 0.00 to 400.00Hz

08-14 Auto Restart After Fault Default: 00

Settings: 00 to 10

After fault occurs (allowable faults: over-current OC, over-voltage OV), drive can be reset/restarted automatically up to 10 times. 00 will disable the function. When enabled, the drive will restart with speed search.

08-15 Automatic energy-saving Default: 00

Settings: 00 Disable

01 Enable

GROUP 08: Special Parameters (cont'd)

08-16 Automatic Voltage Regulation (AVR) Default: 00

Settings: 00 Enable
01 Disable
02 Disable for deceleration

08-17 Software Setting of the Braking Level Default:

Settings: 370 to 430V (230V series) Default: 380
740 to 860V (460V series) Default: 760

08-18 Baseblock Speed Search Default: 00

Settings: 00 Speed search starts with last frequency command
01 Starts with minimum output frequency (01-05)

08-19 Speed Search during Start-up Default: 00

Settings: 00 Disable
01 Enable

08-20 Speed Search Frequency during Start-up Default: 00

Settings: 00 Setting Frequency
01 Maximum Operation Frequency (01-00)

08-21 Auto Reset Time at Restart after Fault Default: 600

Settings: 00 to 60000 sec

08-22 Compensation Coefficient for Motor Instability Default: 00

Settings: 00~1000

GROUP 09: Communication Parameters

09-00 Communication Address Default: 01

Settings: 01 to 254
The drive rated current is considered as 100%.

09-01 Transmission Speed Default: 01

Settings: 00 Baud Rate 4800
01 Baud Rate 9600
02 Baud Rate 19200
03 Baud Rate 38400

09-02 Transmission Fault Treatment Default: 03

Settings: 00 Warn and keep operating
01 Warn and RAMP to stop
02 Warn and COAST to stop
03 No warning and keep operating

09-03 Time Out Detection Default: 0.0

Settings: 0.0 Disable
0.0 ~ 60.0 sec

09-04 Communication Protocol Default: 00

Settings: 00 Modbus ASCII mode, protocol <7,N,2>
01 Modbus ASCII mode, protocol <7,E,1>
02 Modbus ASCII mode, protocol <7,O,1>
03 Modbus RTU mode, protocol <8,N,2>
04 Modbus RTU mode, protocol <8,E,1>
05 Modbus RTU mode, protocol <8,O,1>

09-05 HMI Register 1 Default: 00

Settings: 00~65535

09-06 HMI Register 2 Default: 00

Settings: 00~65535

09-07 Response Delay Time Default: 00

Settings: 00 ~ 200

GROUP 10: PID Controls

10-00 Input Terminal for PID Feedback Default: 00

Settings: 00 Inhibit PID operation
01 Negative PID feedback from external terminal AVI (0 ~ +10V).
02 Negative PID feedback from external terminal ACI (4 ~ 20mA).
03 Positive PID feedback from external terminal AVI (0 ~ +10V).
04 Positive PID feedback from external terminal ACI (4 ~ 20mA).

10-01 Gain Over the PID Detection Value Default: 1.00

Settings: 0.00 to 10.00

10-02 Proportional Gain (P) Default: 1.0

Settings: 0.0 to 10.0

10-03 Integral Gain (I) Default: 1.0

Settings: 0.00 Disable
0.00 to 100.00 sec

10-04 Derivative Control (D) Default: 0.00

Settings: 0.00 to 1.00 sec

10-05 Upper Bound for Integral Control Default: 100

Settings: 00 to 100 %
Integral Upper Bound = Maximum Output Frequency (01-00) × (10-05)%

10-06 Primary Delay Filter Time Default: 0.0

Settings: 0.0 to 2.5 sec

10-07 PID Output Frequency Limit Default: 100

Settings: 00 to 110 %
Output Frequency Limit = Maximum Output Frequency (01-00) × (10-07)%

10-08 Feedback Signal Detection Time Default: 60.0

Settings: 0.0 to d 3600.0 sec

10-09 Treatment of the Erroneous Feedback Signals Default: 00

Settings: 00 Warning and keep operating
01 Warning and RAMP to stop
02 Warning and COAST to stop

10-10 PG Pulse Range Default: 600

Settings: 1 to 40000 (Max=20000 for 2-pole motor)
It defines the resolution of speed feedback sensor, i.e., encoder, pickup gear.

10-11 PG Input Default: 00

Settings: 00 Disable PG
01 Single phase
02 Forward / Counterclockwise rotation
03 Reverse / Clockwise rotation
For magnetic pickup and hall effect sensors, select 01, since they have only one channel of signals.
When the phase of channel A leads that of channel B, the motor shaft will turn counter-clockwise facing the motor shaft.

GROUP 10: PID Controls (cont'd)

10-12	**Proportional Speed Control (P)**	Default: 1.0
	Settings: 0.0 to 10.0	
10-13	**Integral Speed Control (I)**	Default: 1.00
	Settings: 0.00 Disable 0.00 to 100.00	
10-14	**Speed Control Output Frequency Limit**	Default: 10.00
	Settings: 0.00 to 10.00 Hz	
10-15	**Sample time for refreshing the content of 210DH and 210EH**	Default: 0.10
	Settings: 0.01~1.00 seconds	
10-16	**Deviation Range of PID Feedback Signal Error**	Default: 100.00
	Settings: 0.00~100.00% The base is (01-00).	

GROUP 11: Fan and Pump Control Parameters

11-00 V / F Curve Selection Default: 00

Settings: 0.00 to 120.00 Hz
01 1.5 power curve
02 1.7 power curve
03 square curve
04 Cube curve

11-01 Start-up Frequency of the Auxiliary Motor Default: 0.00

Settings: 0.00 to 120.00 Hz
It serves as a reference for the startup value of the auxiliary motor; if the setting is 0, the auxiliary motor cannot be activated.

11-02 Stop Frequency of the Auxiliary Motor Default: 0.00

Settings: 0.00 to 120.00 Hz
When Output Frequency reaches this value, the auxiliary motor would come to a stop. There is a minimum of 5 Hz segment between start frequency and stop frequency of auxiliary motor (11-01) - (11-02) > 5 Hz.

11-03 Time Delay before Starting the Auxiliary Motor Default: 0.0

Settings: 0.0 to 3600.0 sec

11-04 Time Delay before Stopping the Auxiliary Motor Default: 0.0

Settings: 0.0 to 3600.0 sec

11-05 Sleep/Wake Up Detection Time Default: 0.0

Settings: 0.0 to 6550.0 sec

11-06 Sleep Frequency Default: 0.00

Settings: 0.00 to Fmax
When actual output frequency H < (11-06) and time exceeds (11-05), the drive will be in sleep mode.

11-07 Wakeup Frequency Default: 0.00

Settings: 0.00 to Fmax
When actual frequency command > (11-07) and time exceeds (11-05), the drive will restart.

ZVD Part Numbers

Standalone Part Numbers (NEMA 1)

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

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

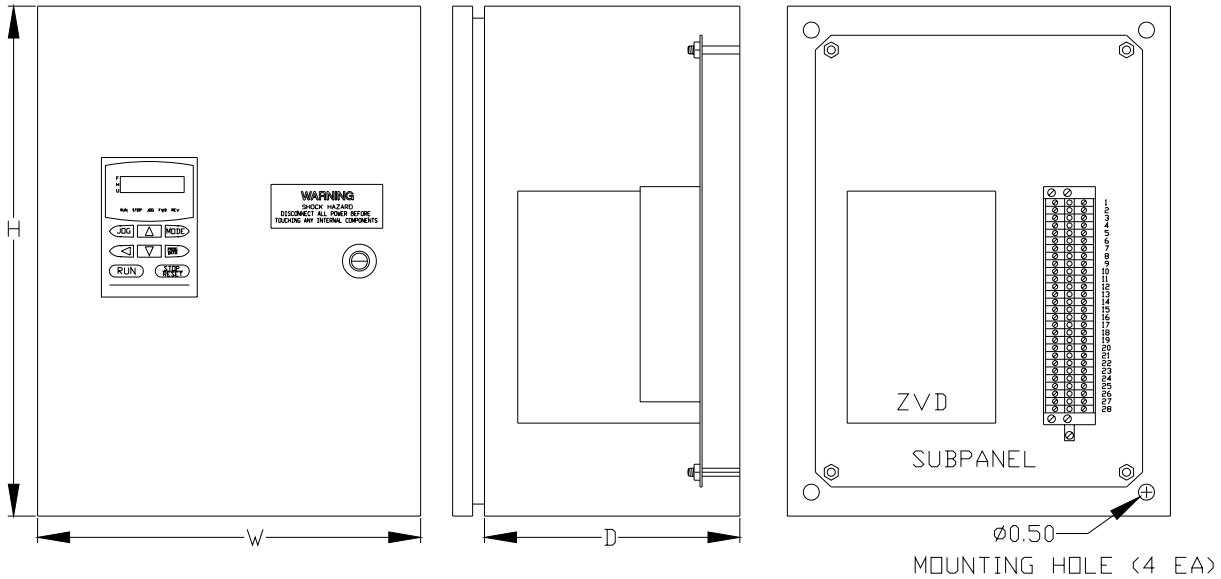
NEMA 12 Part Numbers (with EMI Filter Installed)

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

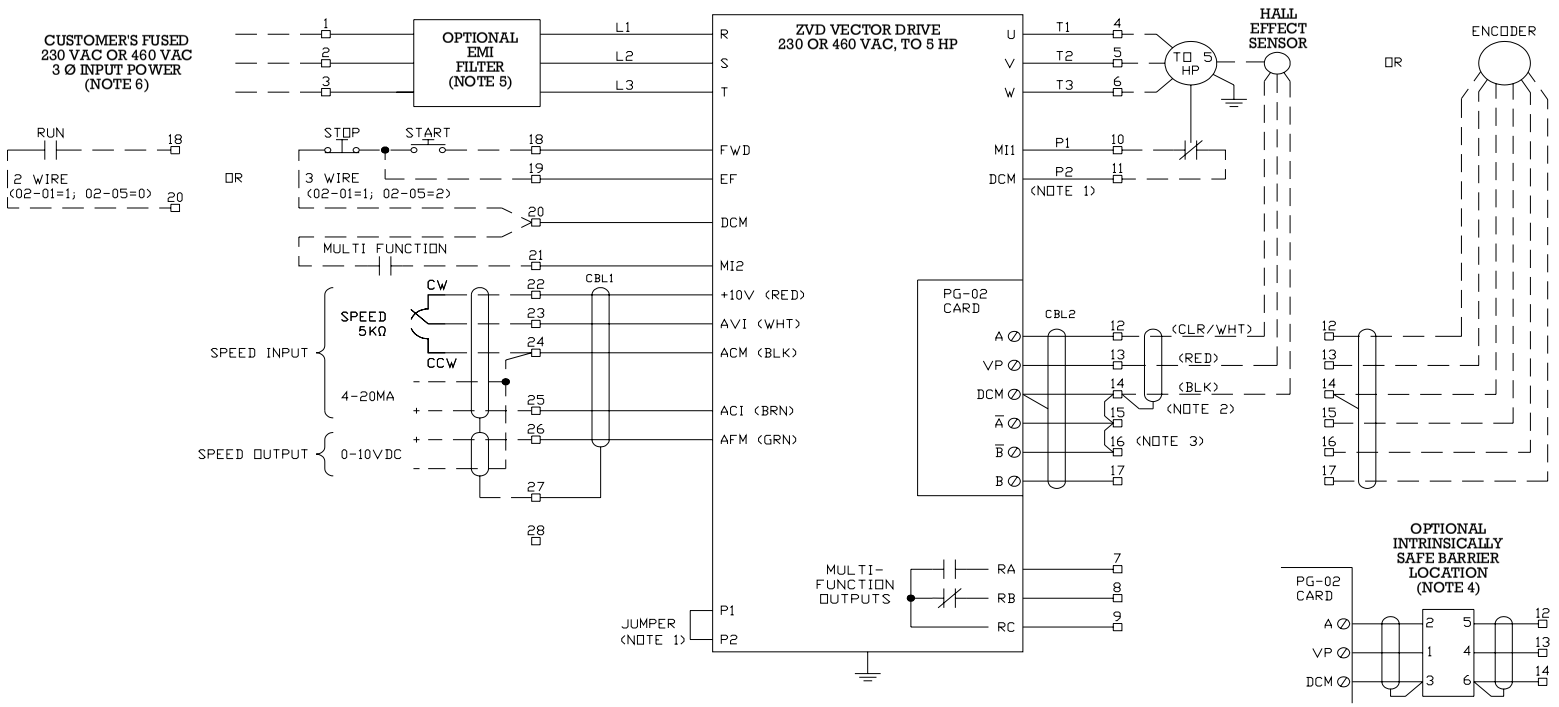
Pulse Generator Card	68-16818-0114-0
EMI Filter, 1 - 2 HP, 230/460 VAC	68-16818-0116-0
EMI Filter, 3 - 5 HP, 230 VAC	68-16818-0117-0
EMI Filter, 3 - 5 HP, 460 VAC	68-16818-0118-0
ZVD to Keypad Cable, 1 meter long	68-17507-0049-0
ZVD to Keypad Cable, 2 meters long	68-17507-0052-0
ZVD to Keypad Cable, 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

ZVD Standard Products



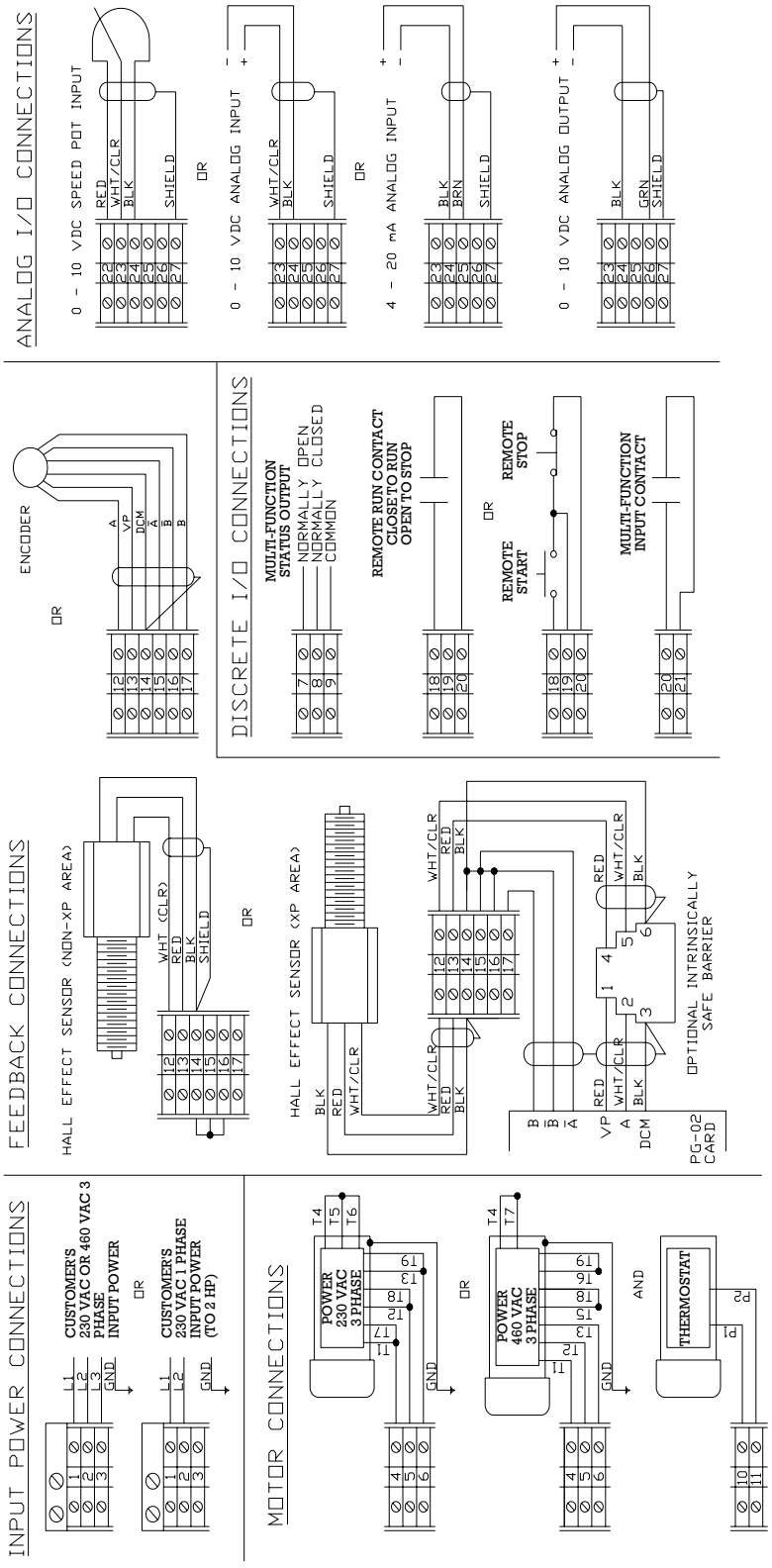
ZVD NEMA 12 Standard Products					
		Without EMI Filter Option		With EMI Filter Option	
Volts	HP	Part Number	H×W×D	Part Number	H×W×D
230	1	64-16814-0693-1	16" x 12" x 8"	68-16814-0705-0	20" x 20" x 12"
230	2	64-16814-0694-1	16" x 12" x 8"	68-16814-0706-0	20" x 20" x 12"
230	3	64-16814-0699-1	24" x 16" 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"

ZVD System Wiring Diagram



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. WHEN CONNECTING THE FEEDBACK SENSOR, MAKE SURE THAT THE SHIELD AND COMMON ARE CONNECTED TOGETHER AT THE ZVD END.
3. WHEN USING A HALL EFFECT SENSOR, A JUMPER IS REQUIRED FROM A AND B TO DCM OR A "PG-Err" WILL OCCUR IF CODE 00-09 IS SET TO 01 OR 03. IF USING AN ENCODER, REMOVE THE JUMPERS.
4. THE OPTIONAL INTRINSICALLY SAFE BARRIER IS REQUIRED WHEN THE HALL EFFECT SENSOR IS LOCATED IN A HAZARDOUS AREA.
5. THE OPTIONAL EMI FILTER IS USED WHEN CE CERTIFICATION IS REQUIRED. A LARGER CONTROL CABINET MAY BE NECESSARY.
6. 230 VAC 1-PHASE MAY BE SUPPLIED TO A 230 VAC ZVD, 1~3 HP ONLY. CONNECT TO ANY TWO TERMINALS.



NOTE:

WHEN USING A HALL EFFECT SENSOR OR ENCODER IN A HAZARDOUS ATMOSPHERE, THE OPTIONAL INTRINSICALLY SAFE BARRIER MUST BE USED.

Zenith Pumps

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