SAFETY INSTRUCTIONS

To prevent injury and property damage, follow these instructions during the installation and operation of VFD.

Incorrect operation due to ignoring these instructions may cause harm or damage. The following symbols are used throughout the manual to highlight important information.

⚠ **DANGER**	**This symbol indicates death or serious injury can occur if you do not follow instructions.**
⚠ **WARNING**	**This symbol indicates the possibility of death or serious injury.**
⚠ **CAUTION**	**This symbol indicates the possibility of damage to VFD or other components.**

■ The meaning of each symbol in this manual and on your equipment is as follows.

⚠ **This is the safety alert symbol.**
Read and follow instructions carefully to avoid a dangerous situation.

⚠ **This symbol alerts the user to the presence of "dangerous voltage" inside the product that might cause bodily harm or electric shock.**

■ This manual should be placed in a location where it can be accessed by users.

■ This manual should be given to the person who actually uses VFD and is responsible for its maintenance.

⚠ WARNING

- **Do not remove VFD cover for wiring or periodic inspections while power is applied or the unit is in operation.**
  Otherwise, electric shock could occur to the exposed terminals and bus bars.

- **Wiring and periodic inspections should be performed at least 10 minutes after disconnecting the input power with DC link voltage below 30VDC.**
  Otherwise, electric shock could occur.

- **Operate VFD and control devices with dry hands.**
  Otherwise, electric shock could occur.

- **Do not use VFD if power or motor cable is damaged.**
  Otherwise, electric shock could occur.

⚠ CAUTION

- **Install VFD on a non-flammable surface. Do not place flammable materials nearby.**
  Otherwise, fire could occur.

- **Disconnect the input power if VFD has been damaged.**
  Otherwise, it could result in a secondary accident and fire.

- **Do not touch VFD after shutting down or disconnecting it. It can remain hot for a few minutes.**
  Otherwise, bodily injuries such as skin-burn or damage could occur.

- **Do not apply power to a damaged VFD or to VFD with missing parts.**
  Otherwise, electric shock could occur.

- **Do not allow lint, paper, wood chips, dust, metallic chips or other foreign material into the drive.**
  Otherwise, fire or accident could occur.

PRECAUTIONS

(1) **Handling and installation**

- Check VFD environmental conditions and electrical requirements before purchasing VFD.
- The higher HP rated P series VFD can be heavy. Lift according to the weight of the product. Use a hoist or crane to move and install VFD if necessary. Failure to do so may result in personal injury or damage to the VFD.
- Do not stack VFD boxes higher than the number recommended.
- Do not place heavy items on VFD.
- Install and wire VFD according to the instructions in this manual.
- Do not open the cover during delivery.
- Do not drop VFD or subject it to hard impact.
- Verify if ground impedance is less than 100Ω for 230V Class VFDs and 10Ω for 460V class VFDs.
- Take protective measures against ESD (Electrostatic Discharge) before touching control boards during inspection, installation or repair.

(2) **Wiring**

- Input power wires should be connected to R, S and T VFD terminals for three-phase power or R and S for a single-phase power. Power Ground and Motor Ground should be connected to a VFD ground terminal.
- **Do not connect** any wires, except dynamic braking unit or DC reactor, to VFD terminals **N, P1** or **P2**.
- **Do not connect** power factor correction capacitors, surge suppressors, or RFI filter to the **VFD output**.
- The phase sequence on VFD terminals U, V, W to motor will affect the direction of motor rotation. The input power phase sequence does not affect a direction of motor rotation.
- Incorrect VFD terminal wiring could result in VFD and/or equipment damage.
- Reversing the polarity (+/-) of the digital control terminals can damage VFD.
- Only authorized personnel familiar with FCS VFDs should perform wiring and start-up.
- Perform wiring after VFD installation is done. Otherwise, electric shock or bodily injury can occur.

(3) **Start-up**

- Check if input power voltage is within acceptable range before applying power to VFD
- Check all the motor data and control parameters when VFD is powered. Some parameter values might require adjustment depending on the application.
- Start VFD in forward direction and check the motor rotation. Swap any two motor leads to change the motor rotation when VFD power is off. It is not recommended to correct motor rotation by using reverse start command to run motor forward.
- Run motor up to full speed and check if system has resonance frequencies (vibration) in the normal speed range. Make notes at what frequencies the vibration started and stopped. Set these frequencies in Jump Frequency parameters to prevent a system vibration.
- Check the motor run current on VFD display when run at full speed and if it is higher than motor FLA, check motor wiring and for any mechanical problems (valves, dampers, etc.) that could create extra load on motor shaft. If the wiring is correct and there is no any mechanical problem, stop VFD, change control mode from V/F to Sensorless and run auto-tune. If the motor has different motor winding parameters of standard industrial motor, this procedure will fix the problem.

(4) **Operation**

- When the Auto restart function is selected, VFD can restart multiple times automatically during operation.
- The Stop key on the keypad can only be used to stop VFD when Local control is

enabled. Install a separate emergency stop circuit if necessary.

- If restart after fault reset is selected, the VFD can start automatically after fault reset.
- Do not modify VFD internal components and circuits.
- Set correct motor data from the motor nameplate and overload protection parameters for proper motor overload protection.
- The use of any disconnecting device (contactor, disconnect etc.) in motor circuit during VFD run can cause a damage of VFD power components. Stop VFD before opening the motor circuit with disconnect or contactor.
- Install line reactor or harmonics filter to reduce harmonics distortion and EMI/RFI filter for electromagnetic and high frequency interference to sensitive electronic equipment.
- Install a line reactor if input power is unbalanced or distance from VFD to power transformer is greater than 45 feet to increase VFD protection from transient power surges.
- Power factor capacitors and generators may become overheated and damaged due to harmonics distortion created by VFD.
- Use, if possible, an inverter rated motor or motor with insulation class “F” or higher. The VFD generates high frequency output pulses with spikes, which can deteriorate motor winding insulation and eventually damage the motor. The longer distance to the motor the higher amplitude of these voltage spikes will be applied to motor winding. Any cables with paralleled wires will increase the amplitude of these spikes at motor terminals.
- Install output reactor or filter to protect motor winding insulation based on distance range from VFD to a motor specified on page 3-7 (3.2.6.9). Install an output reactor for shorter distance than specified on page 3-7 if motor is old or if insulation class is lower than “F”.
- Use dynamic braking unit and resistor in high inertia applications when VFD trips on Overvoltage during deceleration if short deceleration time is required.
- VFD can operate motor at frequency higher than 50HZ or 60Hz. Verify the maximum allowed speed with motor and machinery manufacturers prior to increasing a VFD output frequency because it can overheat motor or damage machinery.
- The DC-Braking mode produces an extra motor braking force but does not provide a holding torque.

(5) **Safety**

- If required, provide an emergency mechanical brake to prevent any hazardous conditions when VFD fails during operation.
- Some VFD parameters are set as default to automatically start VFD in some applications. Disable these parameters if automatic start is not safe for personnel or equipment.

(6) **Maintenance, inspection and parts replacement**

- Disconnect all motor leads from VFD before checking the motor insulation with Megger tester. The Megger tester 1000VDC output can damage the VFD power components.
- Refer to Chapter 8 for periodic inspection and parts replacement details.

(7) **Disposal**

- Dispose of VFD properly as an industrial equipment wastes.

Table of Contents

CHAPTER 1 - BASIC INFORMATION

1.1 Part Number Code and Initial Inspection

The VFD part numbering system is shown below.

CI- 007- P 2 NE

Horse power rating	
007	7.5 HP
≀	≀
700	700HP

VFD Series
P

	Input Voltage
2	200 - 230V
4	380 - 480V
6	525 - 600V

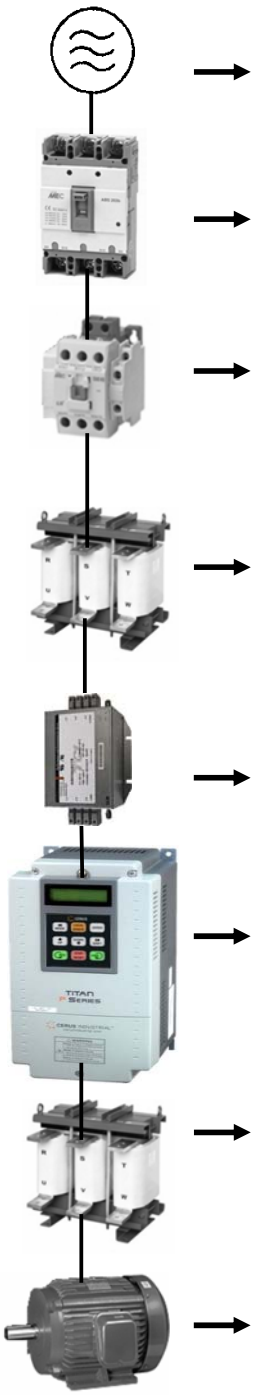
N: No Keypad
O: UL Open Type
E: UL Enclosed Type 1
L: Built-in DC Choke

VFD unpacking and inspection

- Remove VFD from its packing and inspect its exterior for shipping damage. If there is damage, notify the shipping agent and your FCS (Franklin Control Systems) sales representative.
- Remove the VFD cover and inspect VFD for any damage or foreign objects. Check VFD part number, HP rating and nominal voltage on the sticker attached to the side of the VFD. Verify if VFD electrical and environmental ratings are correct and adequate for the application.

1.2 Basic configuration

The following are the most common devices used in motor control branch operated by VFD. Adequate peripheral devices must be selected and correct connections made to ensure proper VFD operation. An incorrectly applied or installed VFD can result in system malfunction or reduction in product life as well as component damage. You must read and understand this manual thoroughly before proceeding with installation.



AC Power Source	Use three-phase or single-phase power source with voltage within the permissible range of VFD input power rating. Size VFD properly for single-phase power.
MCCB	Select circuit breakers or fuses in accordance with NEC and applicable local codes.
Inline Magnetic Contactor	Do not use input power contactor for frequent starting and stopping the VFD, otherwise VFD power components can be damaged.
AC Line Reactor or Harmonic Filter	The line reactor provides some degree of surge protection and decreases a level of harmonic distortion in power line. It is recommended to use it when power source kVA rating is more than 10 times higher than VFD rating. The Harmonic filter provides higher level of harmonic mitigation.
EMI/ RFI Filter	Install EMI/RFI filter to decrease VFD Electromagnetic and Radio Frequency Interference with operation of sensitive electronic equipment.
Variable Frequency Drive	Install VFD with proper orientation, ventilation, spacing etc. according to the manufacturer requirements described in this manual with all necessary protective and filtering devices to provide long and reliable VFD operation.
AC Load Reactor or Output Filter	In order to protect motor windings, install a load reactor or an output filter based on recommendations on page 21, line nine.
Three Phase AC Induction Motor	The P series VFD is not compatible with permanent magnet motors and servomotors. Opening the motor circuit by disconnect or contactor during VFD run can damage VFD power components.

Note: Do not install magnetic contactor in the motor circuit for start/stop or emergency stop purpose. !!**Opening the motor circuit when VFD runs at above 50% its rated capacity can cause VFD power components failure!!**

CHAPTER 2 - SPECIFICATION

The P-Series VFDs can be used in phase conversion (single-phase input power and three-phase output at the same voltage) applications. The below tables contain VFD ratings for three-phase variable and constant torque applications. For FCS to maintain warranty on VFD for phase conversion and Open-Delta power applications, the customer should call FCS with application information and line reactor installation is required. Refer to page 21 for power wiring description.

2.1 200~230V Class 7.5~40HP (5.5~30kW)

Part Number (CI-xxx-P2) & UL Type (U1-Type 1, UO-Open Type)		**007** U1	**010** U1	**015** U1	**020** U1(5)	**025** U1(5)	**030** U1(5)	**040** U1(5)
Standard Duty Variable Torque Motor Rating (1)	**HP** (1)	**7.5**	**10**	**15**	**20**	**25**	**30**	**40**
	kW	5.5	7.5	11	15	18.5	22	30
	FLA[A]	**24**	**32**	**46**	**60**	**74**	**88**	**115**
Heavy Duty Variable Torque or Standard Duty Constant Torque Motor Rating (1)	**HP** (1)	5	7.5	10	15	20	25	30
	kW	3.7	5.5	7.5	11	15	18.5	22
	FLA[A]	**17**	**23**	**33**	**44**	**54**	**68**	**84**
Output ratings	Capacity [kVA]	9.1	12.2	17.5	22.9	28.2	33.5	43.8
	Voltage (2)	3ϕ 200 ~ 230 VAC						
	Frequency	0.01 ~ 120 Hz						
Input ratings	Voltage (3)	3ϕ 200 (-15%) ~ 230 VAC (+10 %)						
	Frequency	50/60 Hz (± 5 %)						
Weight kg (**lbs.**)		4.9 (**11**)	6 (**13.2**)	6 (**13.2**)	13 (**29**)	13.5 (**30**)	20 (**44.1**)	20 (**44.1**)

2.2 380~480V Class 7.5~40HP (5.5~30kW)

Part Number (CI-xxx-P4) & UL Type (U1-Type 1, UO-Open Type)		**007** U1	**010** U1	**015** U1	**020** U1(5)	**025** U1(5)	**030** U1(5)	**040** U1(5)
Standard Duty Variable Torque Motor Rating (1)	**HP** (1)	**7.5**	**10**	**15**	**20**	**25**	**30**	**40**
	kW	5.5	7.5	11	15	18.5	22	30
	FLA[A]	**12**	**16**	**24**	**30**	**39**	**45**	**61**
Heavy Duty Variable Torque or Standard Duty Constant Torque Motor Rating (1)	**HP** (1)	5	7.5	10	15	20	25	30
	kW	3.7	5.5	7.5	11	15	18.5	22
	FLA[A]	**8**	**11**	**17**	**22**	**28**	**34**	**44**
Output ratings	Capacity [kVA]	9.6	12.7	19.1	23.9	31.1	35.9	48.6
	Voltage (2)	3ϕ 380 ~ 480 VAC						
	Frequency	0.01 ~ 120 Hz						
Input ratings	Voltage (3)	3ϕ 380 (-15%) ~ 480 VAC (+10 %)						
	Frequency	50/60 Hz (± 5 %)						
Weight kg (**lbs.**)		4.9 (**11**)	6 (**13.2**)	6 (**13.2**)	12.5 (**28**)	13 (**29**)	20 (**44.1**)	20 (**44.1**)

2.3 525~600V Class 7.5~40HP (5.5~30kW)

Part Number (CI-xxx-P6) & UL Type (U1-Type 1, UO-Open Type)		**007** U1	**010** U1	**015** U1	**020** U1(5)	**025** U1(5)	**030** U1(5)	**040** U1(5)
Standard Duty Variable Torque Motor Rating (1)	**HP** (1)	**7.5**	**10**	**15**	**20**	**25**	**30**	**40**
	kW	5.5	7.5	11	15	18.5	22	30
	FLA[A]	**9**	**12**	**17**	**23**	**27**	**34**	**43**
Heavy Duty Variable Torque or Standard Duty Constant Torque Motor Rating (1)	**HP** (1)	5	7.5	10	15	20	25	30
	kW	3.7	5.5	7.5	11	15	18.5	22
	FLA[A]	**6.1**	**9**	**12**	**17**	**23**	**27**	**34**
Output ratings	Capacity [kVA]	9.6	12.7	19.1	23.9	31.1	35.9	48.6
	Voltage (2)	3ϕ 525 ~ 600 VAC						
	Frequency	0.01 ~ 120 Hz						
Input ratings	Voltage (3)	3ϕ 525 (-10%) ~ 600 VAC (+10 %)						
	Frequency	50/60 Hz (± 5 %)						
Weight kg (**lbs.**)		6.5 (**14.4**)	7 (**15.5**)	7 (**15.5**)	12 (**26**)	12 (**26**)	19 (**42**)	19 (**42**)

2.4 380~480V Class 50~125HP (37~90kW)

Part Number (CI-xxx-P4) & UL Type (U1-Type 1, UO-Open Type)		**050** U1(5)	**060** U1(5)	**075** U1(5)	**100** U1(5)	**125** U1(5)
Standard Duty Variable Torque Motor Rating (1)	**HP** (1)	**50**	**60**	**75**	**100**	**125**
	kW	37	45	55	75	90
	FLA[A]	**75**	**91**	**110**	**152**	**183**
Heavy Duty Variable Torque or Standard Duty Constant Torque Motor Rating (1)	**HP** (1)	40	50	60	75	100
	kW	30	37	45	55	75
	FLA[A]	**61**	**75**	**91**	**110**	**152**
Output ratings	Capacity [kVA]	59.8	72.5	87.6	121.1	145.8
	Voltage (2)	3ϕ 380 ~ 480 VAC				
	Frequency	0.01 ~ 120 Hz				
Input ratings	Voltage (3)	3ϕ 380 (-15%) ~ 480 VAC (+10 %)				
	Frequency	50/60 Hz (± 5 %)				
Weight kg (**lbs.**)		27 (**60**)	27 (**60**)	29 (**64**)	42 (**93**)	43 (**95**)

2.5 525~600V Class 50~150HP (37~110kW)

Part Number (CI-xxx-P6) & UL Type (U1-Type 1, UO-Open Type)		050 U1(5)	060 U1(5)	075 U1(5)	100 U1(5)	125 U1(5)	150 U1(5)
Standard Duty Variable Torque Motor Rating (1)	**HP** (1)	**50**	**60**	**75**	**100**	**125**	**150**
	kW	37	45	55	75	90	110
	FLA[A]	**55**	**64**	**80**	**104**	**128**	**150**
Heavy Duty Variable Torque or Standard Duty Constant Torque Motor Rating (1)	**HP** (1)	40	50	60	75	100	125
	kW	30	37	45	55	75	90
	FLA[A]	**43**	**55**	**64**	**80**	**104**	**128**
Output ratings	Capacity [kVA]	59.8	72.5	87.6	121.1	145.8	178
	Voltage (2)	3ϕ 525 ~ 600 VAC					
	Frequency	0.01 ~ 120 Hz					
Input ratings	Voltage (3)	3ϕ 525 (-15%) ~ 600 VAC (+10 %)					
	Frequency	50/60 Hz (± 5 %)					
Weight kg (**lbs.**)		32 (**71**)	32 (**71**)	32 (**71**)	46 (**102**)	46 (**102**)	101 (**223**)

2.6 380~480V Class 150~700HP (110~450kW)

Part Number (CI-xxx-P4) & UL Type (U1-Type 1, UO-Open Type)		150 UO	200 UO	250 UO	350 UO	400 UO	500 UO	600 UO	700 UO
Standard Duty Variable Torque Motor Rating (1)	**HP** (1)	**150**	**200**	**250**	**350**	**400**	**500**	**600**	**700**
	kW	110	132	160	220	280	315	375	450
	FLA[A]	**223**	**264**	**325**	**432**	**547**	**613**	**731**	**877**
Heavy Duty Variable Torque or Standard Duty Constant Torque Motor Rating (1)	**HP** (1)	125	150	200	250	350	400	500	600
	kW	90	110	132	160	220	280	315	375
	FLA[A]	**183**	**223**	**264**	**325**	**432**	**547**	**613**	**731**
Output ratings	Capacity [kVA]	178	210	259	344	436	488	582	699
	Voltage (2)	3ϕ 380 ~ 480 VAC							
	Frequency	0.01 ~ 120 Hz							
Input ratings	Voltage (3)	3ϕ 380 (-15%) ~ 480 VAC (+10 %)							
	Frequency	50/60 Hz (± 5 %)							
Weight kg (**lbs.**)		101 (**223**)	101 (**223**)	114 (**252**)	200 (**442**)	200 (**442**)	243 (**536**)	380 (**837**)	380 (**837**)

Notes:

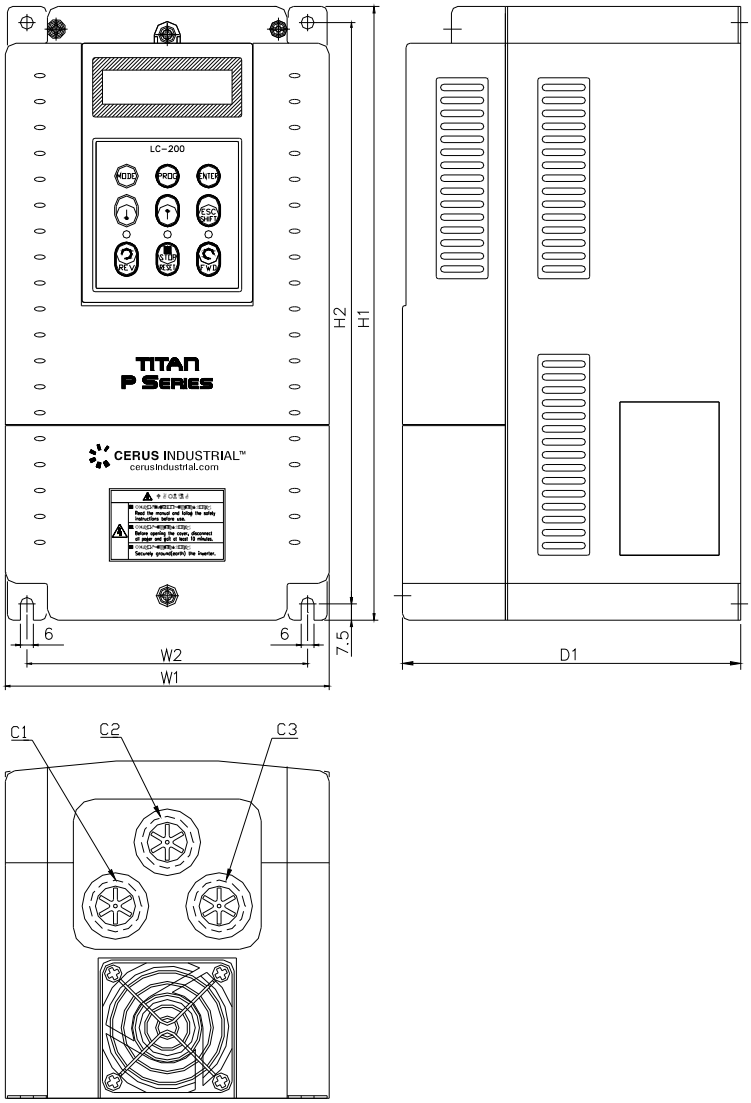
1) Standard duty VT motor rating based on a 110% overload for 1 minute. Heavy-duty VT or Standard Duty CT motor ratings based on 150% overload for 1 minute. The motor horsepower ratings are based on VFD nominal voltage and standard 4-pole induction motor design. Operation at lower input voltages or motors with six or more motor poles may require to upsize the drive depending on actual motor FLA rating.
2) The VFD cannot produce output voltage greater than input voltage. An output voltage parameter should be programmed in the range from a minimum of VFD output voltage rating to input voltage.
3) The input voltage setting determines Low Voltage Trip level and input to output voltage ratio.
4) The standard conduit box attachment adds 1.8kg (4 lbs.), as minimum, to the weight of the drive.
5) UL Open Type VFD with installed UL Type 1 kit.

2.7 Common Specifications

Cooling method			Forced air cooling by internal fans
Short Circuit Rating			100kA, suitable for use on a circuit capable of delivering not more than 100,000 RMS Symmetrical Short Circuit Amperes
Agency Approvals			UL and cUL listed, CE marked
CONTROL	Control Method		V/F, Slip Compensation, Sensorless Vector with auto-tune (no disconnecting from the load)
	Frequency Setting Resolution		Digital Reference: 0.01 Hz (Below 100 Hz), 0.1 Hz (Over 100 Hz) Analog Reference: 0.01 Hz / 60 Hz
	Frequency Accuracy		Digital: 0.01 % of Max. Output Frequency Analog: 0.1 % of Max. Output Frequency
	V/F Control Curve		Linear, S-Pattern, User Defined Pattern
	Overload Capacity		110 % variable torque (120% below 25°C/77°F) for 1 min. 150% constant torque for 1 min. (20% de-rated VFD).
	Torque Boost		Manual FWD & REV Torque Boost adjustment (0 ~ 15 %) and Auto Torque Boost
OPERATION	Operation Method		Keypad / Terminals / Communication
	Frequency Setting		Analog: 0 ~ 10VDC, ±10VDC and 4 ~ 20mA Digital: Keypad or Communication
	Input Signals	Start Signal	Forward, Reverse and Jog
		Multi-Step	Up to 18 Speeds can be set including Jog (Use binary coded combinations of Programmable Digital Inputs)
		Multi Step Accel/Decel Time	0.1~ 6,000 sec, Max 4 types can be set via Multi- Function Terminals. Accel/Decel Pattern: Linear, U-Curve or S-Curve
		Emergency Stop	Immediately Interrupts the VFD Output in any control method
		Jog	Jog Operation with adjustable Jog frequency
		Fault Reset	Resets VFD. Some critical faults can only be reset by recycling the VFD power.
		Hardware Disable	600V VFDs have a redundant safety input SA & SB for N.C. external disable contact
	Output signals	Four Multi-Function Relays	Each relay can be set to Frequency Detection Level, Analog signal High or Low level, Multi-function timer, System Overpressure, Damper, Lubrication, Local or Remote control, Sleep mode, Overload Alarm, Stalling, Over Voltage, Low Voltage, VFD Overheating/ Running/ Stopping/ At Speed, Speed Search etc.
		Fault Output	Double Throw Relay Contact (3A, 3C, 3B) – 1A up to 250VAC or 30VDC
		Two Analog Outputs	Selections: Output Frequency, Output Current, Output Voltage, Output kW, DC Link Voltage, V1 or I input signal level. Both outputs are 0-10VDC scalable from 10 to 200%.
	Operation Functions		DC Braking, Frequency Limit, Jump Frequencies, 2nd Function, Slip Compensation, Reverse Rotation Prevention, Auto Restart, Auto-Tuning, PID Control, Flying Start, Flux Braking, Low leakage, Pre-PID, Sleep mode, MMC, Motor Pre-heat, Speed limiting by VFD or motor temperature, etc.
PROTECTION	VFD Fault Trips		Over Voltage, Low Voltage, Over Current, Overload Protection, Short Circuit Protection, Ground Fault, VFD Overheat, Motor Overheat, Output Phase Open, External Trip, CPU Communication Error, Loss of Speed Command, Hardware Fault, etc.
	VFD Alarm		Stall Prevention, Overload Alarm, Thermal Sensor Fault
DISPLAY	Keypad	Operation Information	Output Frequency, Output Current, Output Voltage, Frequency Set Value, Operating Speed, DC Voltage, kWattmeter, Run-time, Last Trip Time
		Fault History	The VFD stores 5 last faults with Hz, A, VFD mode and trip time for each fault.
ENVIRONMENT	Ambient Temperature		14°F~ 104°F (-10°C~ 40°C). De-rate VFD by 20% to increase rating to 122°F (50°C)
	Storage Temperature		-4°F~ 149°F (-20°C ~ 65°C)
	Ambient Humidity		Up to 95 % RH. (Non-Condensing)
	Altitude		Max. 3,300ft (1,000m). De-rate VFD by 1% for every additional 330 feet. De-rating by 20% is adequate for altitude up to 10,000 feet.
	Vibration		Max. 0.6g (5.9m/sec^2)
	Environmental Conditions		Pollution degree 2. No Corrosive Gas, Combustible Gas, Oil Mist or Dust

2.8 Dimensions

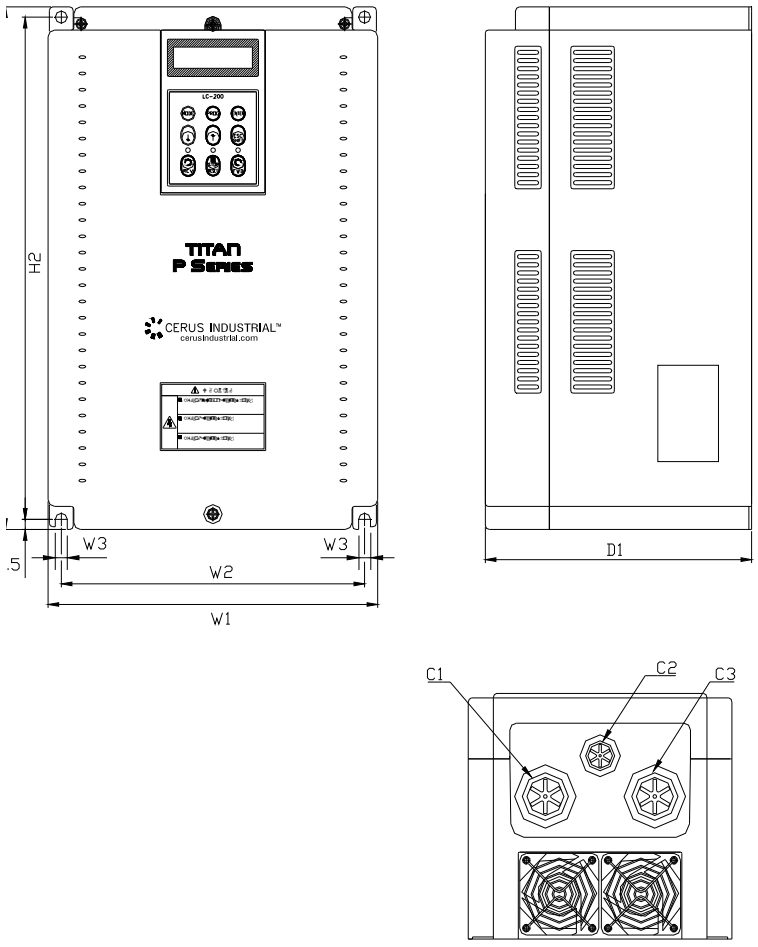
1) CI-007-P2/4 (200/400V Class) and CI-007~015-P6 (600V Class)



inches (mm)

Model	W1	W2	H1	H2	D1	C1	C2	C3	Enclosure Type
CI-007-P2/4	5.91 (150)	5.12 (130)	11.18 (284)	10.69 (269)	6.16 (156.5)	0.98 (24)	0.98 (24)	0.98 (24)	UL Type 1 IP20
CI-007~15-P6	7.87 (200)	7.09 (180)	13.98 (355)	13.39 (340)	7.19 (182.5)	1.12 (28.5)	0.94 (24)	1.12 (28.5)	UL Type 1 IP20

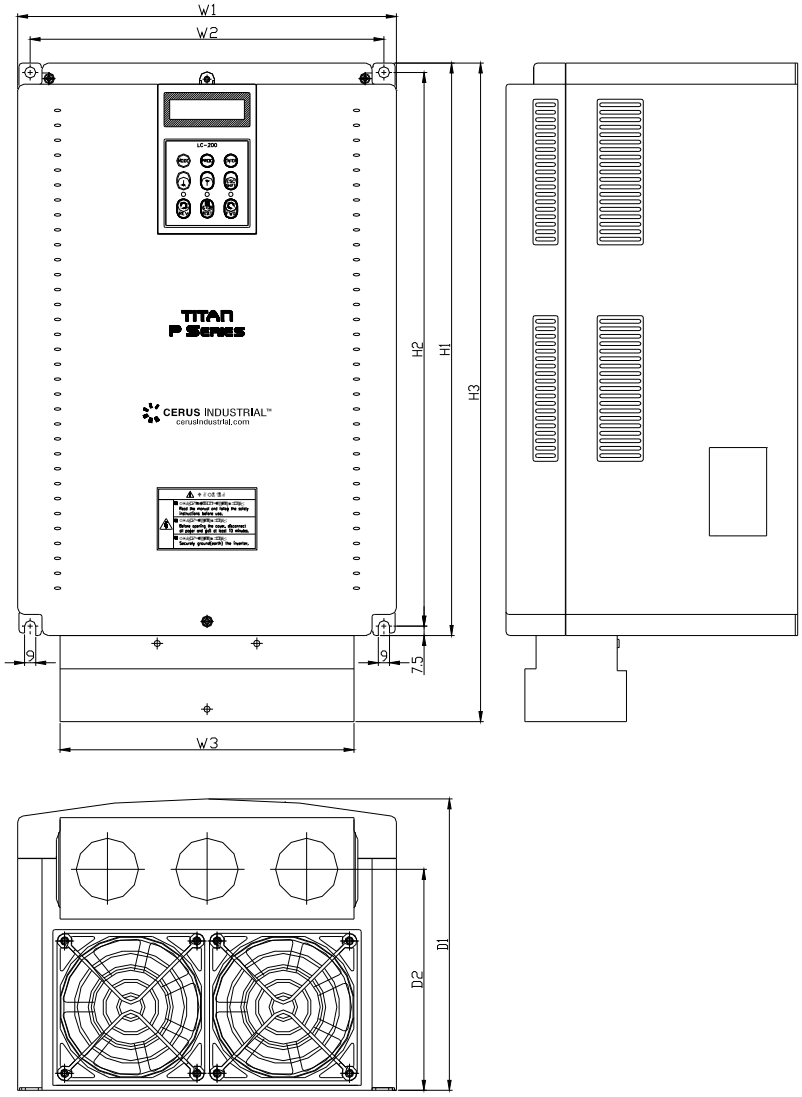
2) CI-010~015-P2/4 (200/400V Class)



inches (mm)

Model	W1	W2	W3	H1	H2	D1	C1	C2	C3	Enclosure Type
CI-010~015-P2/4	7.87 (200)	7.09 (180)	0.23 (6)	11.18 (284)	10.69 (269)	7.16 (182)	1.37 (35)	0.98 (24)	1.37 (35)	UL Type 1 IP20

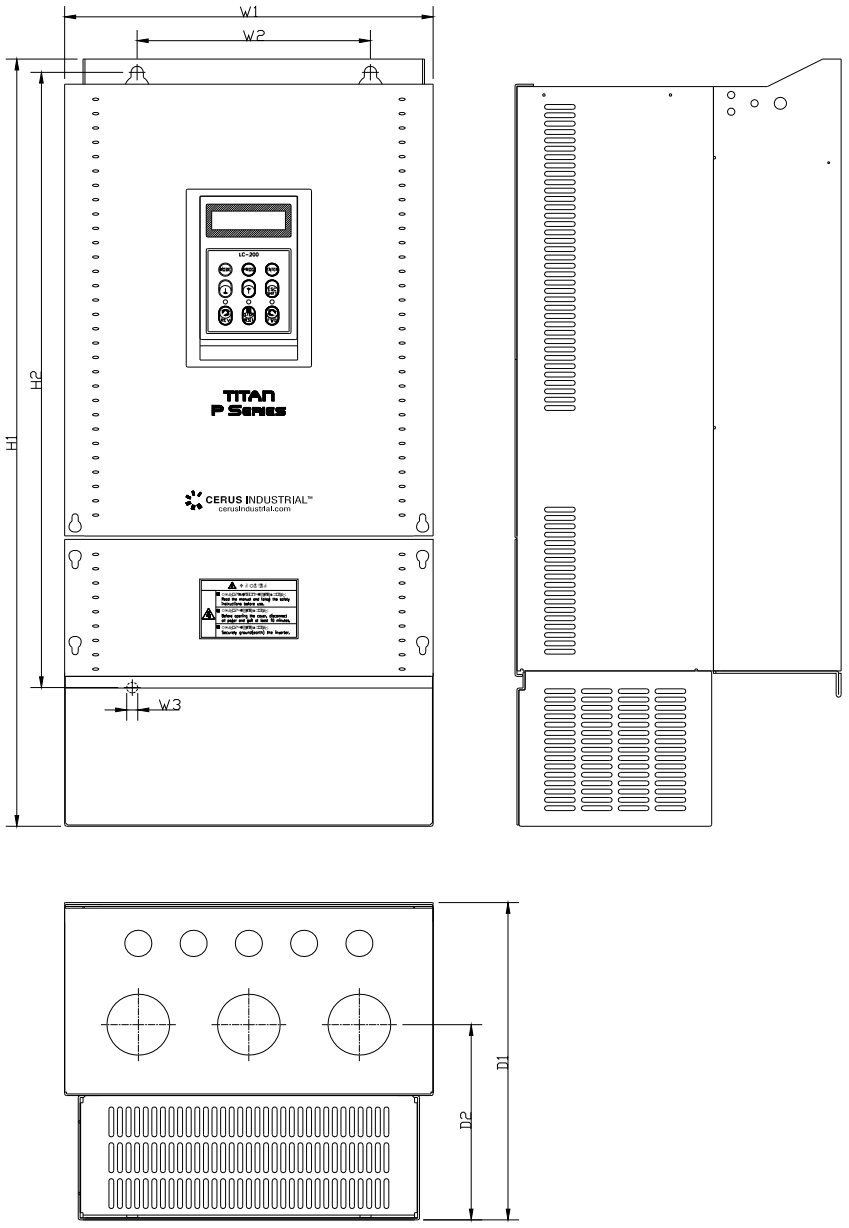
3) CI-020~040-P2/4 (UL Open Type with installed UL Type 1 kit) and CI-020~040-P6 (UL Open Type)



inches (mm)

Model	W1	W2	W3	H1	H2	H3	D1	D2	Enclosure Type
CI-020~25-P2/4 CI-020~25-P6	9.84 (250)	9.06 (230)	7.9 (200.8)	15.16 (385)	14.57 (370)	17.88 (454.2)	7.91 (201)	5.74 (146)	UL Type 1 IP20
CI-030~40-P2/4 CI-030~40-P6	11.97 (304)	11.18 (284)	9.29 (236)	18.11 (460)	17.52 (445)	23.59 (599.2)	9.21 (234)	6.98 (177.5)	UL Type 1 IP20

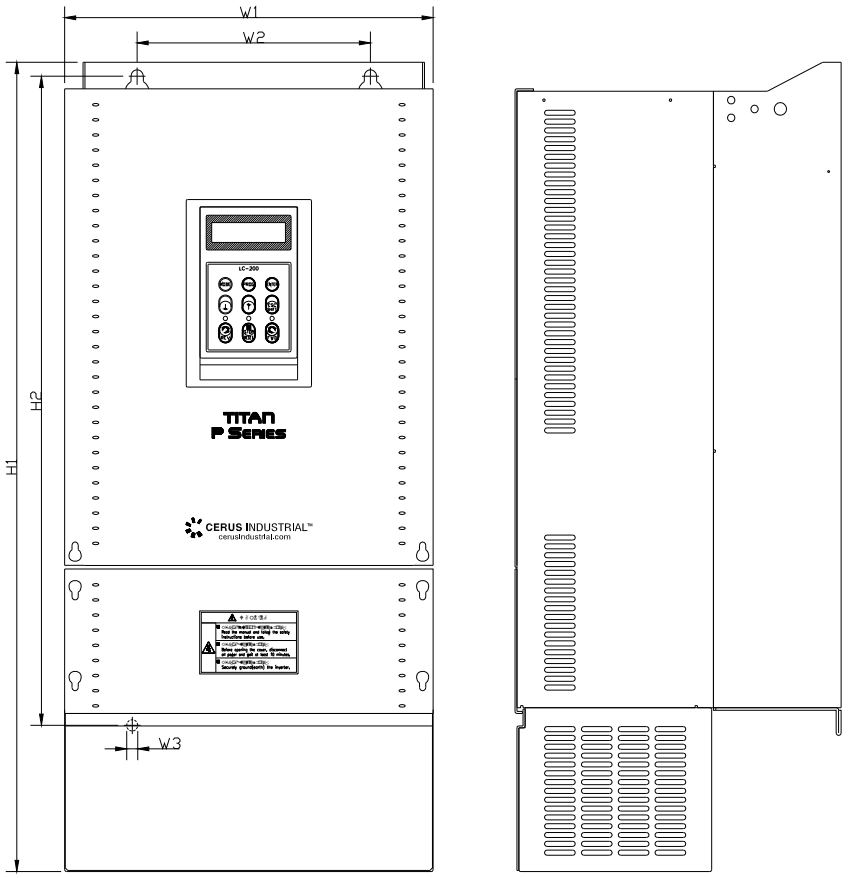
4) CI-050~075-P4/6 (UL Open Type 400V and 600V VFDs with installed UL Type 1 kit)

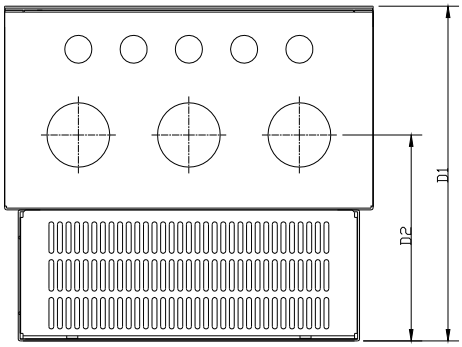


inches (mm)

Model	W1	W2	W3	H1	H2	D1	D2	Enclosure Type
CI-050~060-P4	**11.81** (300)	7.48 (190)	0.35 (9)	**25.28** (642)	**20.28** (515)	**10.46** (265.6)	6.43 (163.4)	UL Type 1 IP20
CI-075-P4 CI-050~075-P6	**11.81** (300)	7.48 (190)	0.35 (9)	**25.28** (642)	**20.28** (515)	**11.52** (292.6)	7.5 (190.4)	UL Type 1 IP20

5) CI-100, 125-P4/6 (UL Open Type VFD with installed UL Type 1 kit)

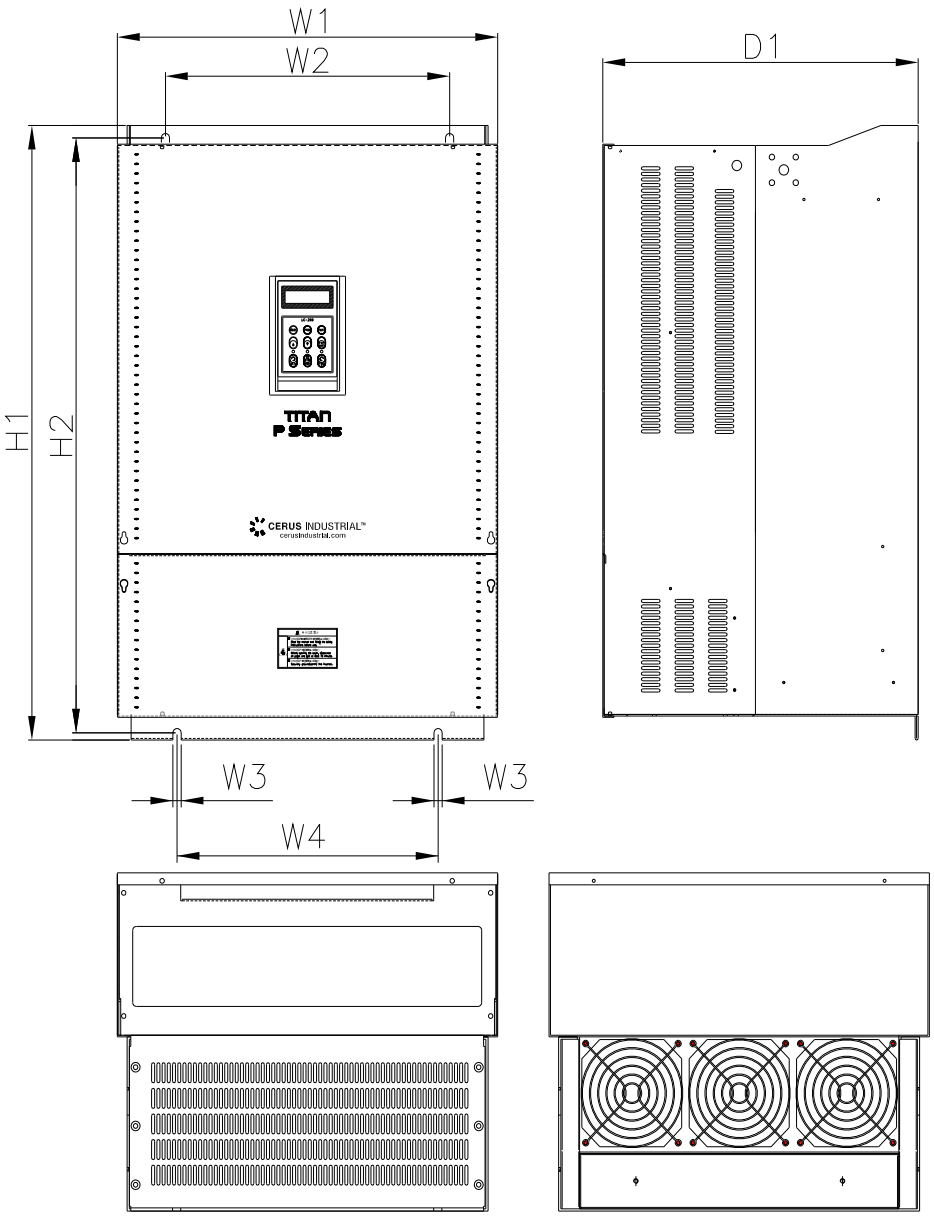




inches (mm)

Model	W1	W2	W3	H1	H2	D1	D2	Enclosure Type
CI-100~125-P4/6	**14.57** (370)	8.66 (220)	0.35 (9)	**30.22** (767.5)	**23.09** (586.5)	**13.29** (337.6)	8.8 (223.4)	UL Type 1 IP20

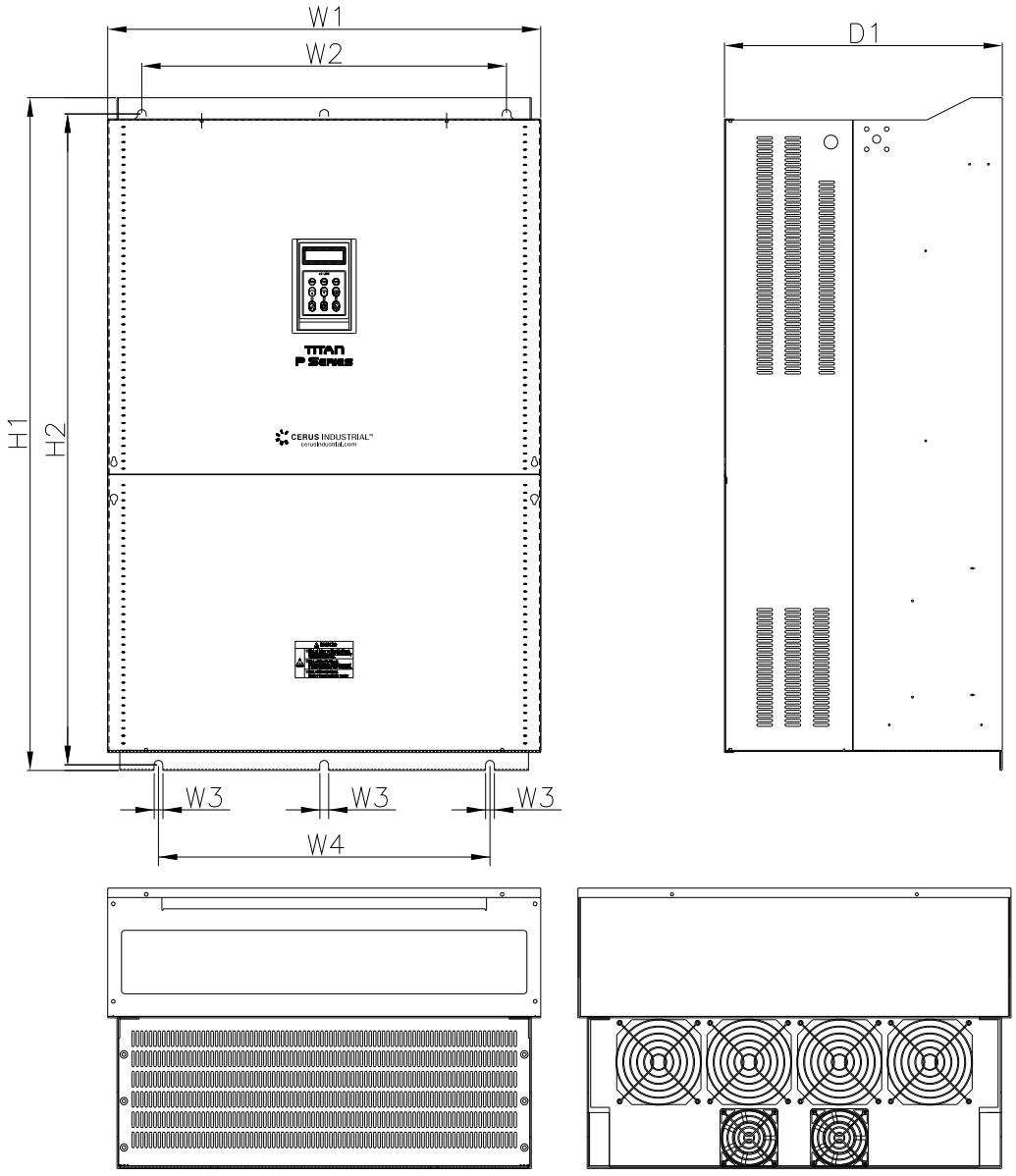
6) CI-150~250-P4 & CI-150-P6 (UL Open Type VFDs)



inches (mm)

Model	W1	W2	W3	W4	H1	H2	D1	Enclosure Type
CI-150~200-P4 CI-150-P6	**20.08** (510)	15.00 (381)	0.43 (11)	13.78 (350)	**30.87** (784)	29.92 (760)	**16.64** (422.6)	UL Open IP00
CI-250-P4	**20.08** (510)	15.00 (381)	0.43 (11)	13.78 (350)	**33.90** (861)	33.00 (838)	**16.64** (422.6)	UL Open IP00

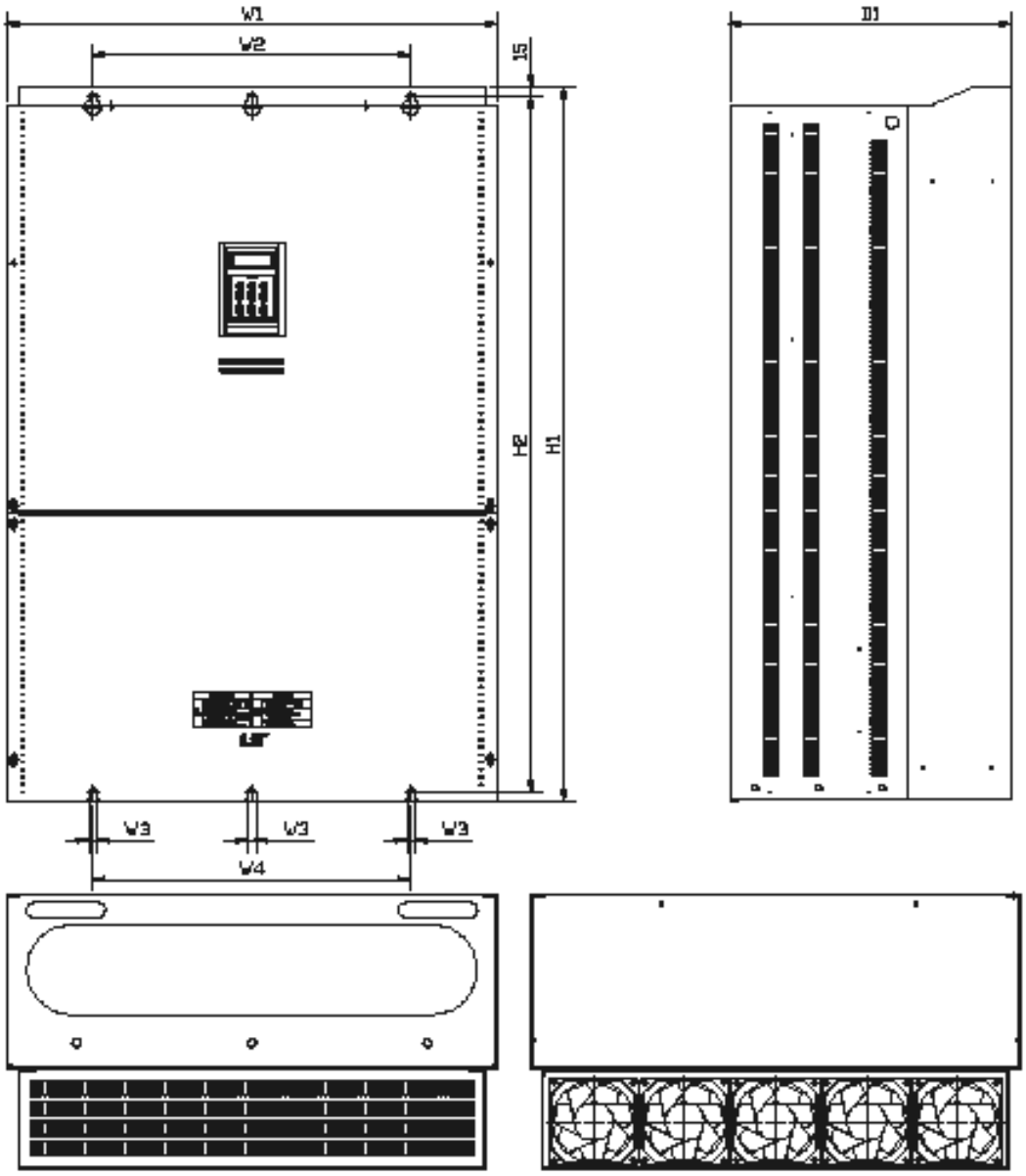
7) CI-350~ 400-P4 (UL Open Type VFDs)



inches (mm)

Model	W1	W2	W3	W4	H1	H2	D1	Enclosure Type
CI-350~400-P4	**27.17** (690)	22.87 (580)	0.55 (14)	20.79 (528)	**42.44** (1078)	41.14 (1045)	**17.70** (449.6)	UL Open IP00

8) CI-500~ 700-P4 (UL Open Type VFDs)

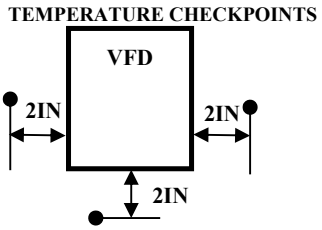


inches (mm)

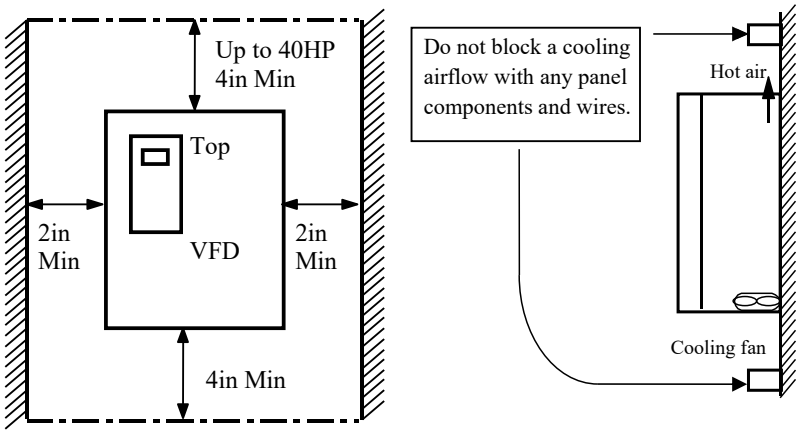
Model	W1	W2	W3	W4	H1	H2	D1	Enclosure Type
CI-500-P4	30.4 (772)	19.7 (500)	0.51 (13)	19.7 (500)	44.9 (1141)	43.7 (1110)	17.4 (442)	UL Open IP00
CI-600~700-P4	36.3 (922)	22.83 (580)	0.55 (14)	22.83 (580)	51.3 (1303)	50.06 (1272)	19.5 (495)	UL Open IP00

CHAPTER 3 - INSTALLATION AND WIRING

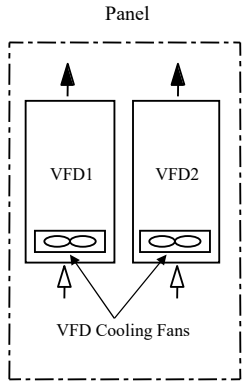
3.1 Installation precautions



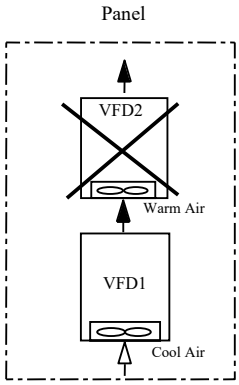
1) Handle VFD with care to prevent damage to the plastic components. Do not hold VFD by the front cover.
2) **Do not mount** VFD on the equipment with excessive vibration above 5.9 m/sec^2.
3) Install VFD in a location where temperature is within the permissible range 14~104°F (-10~40°C).
4) Install it on a non-combustible surface because VFD generates heat during normal operation.
5) Mount VFD vertically (top up) for proper heat dissipation. Provide sufficient clearance for an airflow around VFD. Increase minimum clearance by one inch for 50~75HP VFDs, by two inches for 100~150HP VFDs, by three inches for 200~300HP VFDs, by four inches for 350~700HP VFDs to provide sufficient cooling airflow.
6) **Do not mount** VFD in direct sunlight or near other heat sources.
7) VFD shall be mounted in a Pollution Degree 2 environment. If VFD is going to be installed in an environment with a high probability of dust, metallic particles, mists, corrosive gas or other contaminants, the VFD must be mounted inside the appropriate electrical enclosure with proper NEMA, UL or IP rating and adequate cooling. If VFD is mounted inside enclosure, the maximum allowed ambient temperature would be 12°F less than VFD rating (104°F-12°F= 92°F). If VFD is de-rated by 20%, the maximum allowed ambient temperature for it will be increased to 122°F and for the enclosed VFD to 110°F (122°F-12°F= 110°F). If VFD is enclosed in ventilated enclosure and installed in direct sun light, the maximum ambient temperature for gray enclosure will be approximately 25°F less than VFD rating (104°F-25°F= 79°F) and for 20% de-rated VFD 97°F (122°F-25° F= 97°F). Thus, the VFD for direct sun light installation should be enclosed in an air-conditioned enclosure. For white enclosures, the temperature difference is about 15°F.



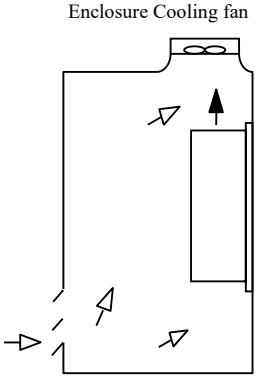
8) Mount VFD using proper screws or bolts.
9) When two or more VFDs are installed in a ventilated enclosure, the cooling system should provide adequate airflow for all the VFDs. Do not install VFD above another heat source (another VFD, inductive reactors, etc.)



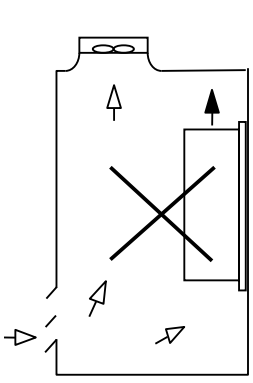
GOOD (☻)



BAD (X)



GOOD (☻)

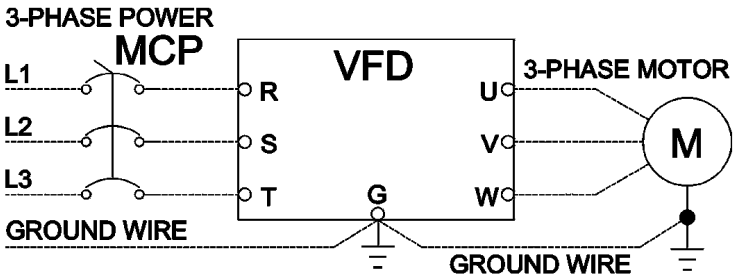


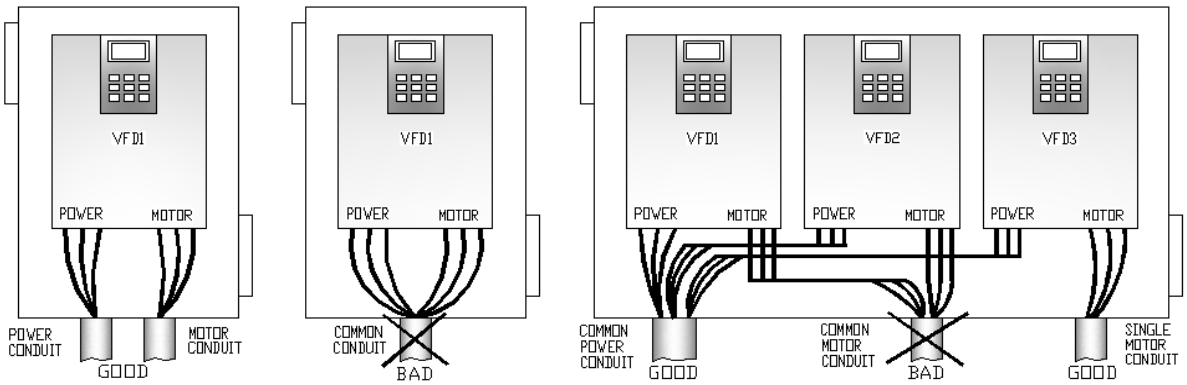
BAD (X)

3.2 Basic Wiring Diagrams

Power wiring diagrams

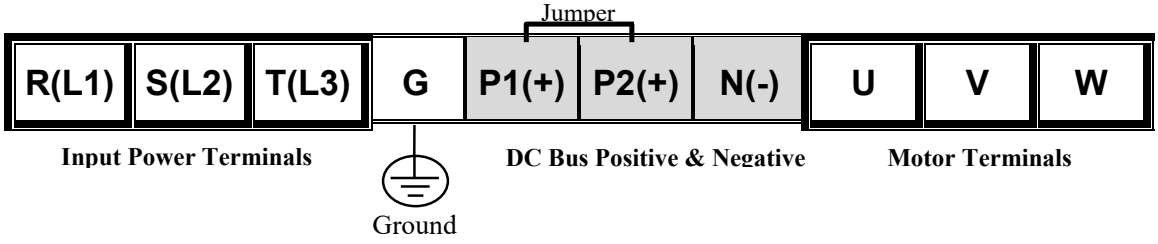
Basic Power wiring for 7.5~700HP (5.5~450kW) VFDs.
For single-phase power, connect **L1** to **R** and **L2** to **S** terminals.



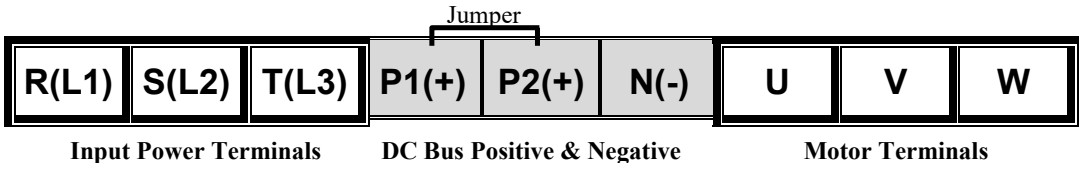


VFD can malfunction or be damaged if motor and power wires are in the same conduit or motor wires from two or more VFDs are in the same conduit!

Power terminals for 7.5 ~ 40HP (200V/400V/600V) VFDs

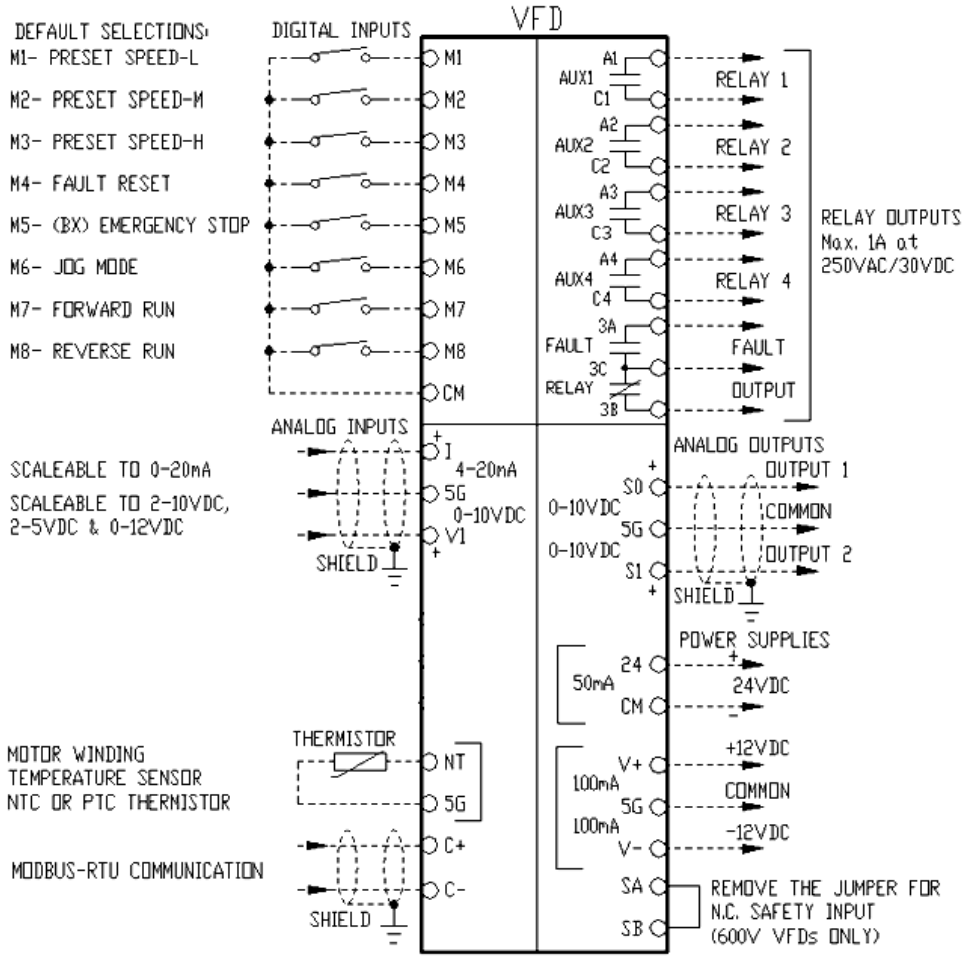


Power terminals for 50~125HP (400V/600V) VFDs



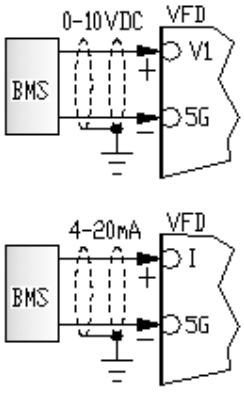
Notes: a) The Ground wire should be connected to the VFD ground terminal or chassis ground screw.
b) **Do not connect** any wires except dynamic braking unit to **P1(+)**, **P2(+)** and **N(-)** terminals.
c) **Do not remove** the jumper between terminals **P1(+)** & **P2(+)** except for DC bus reactor wiring**.**

Basic Control wiring for 7.5~40HP (5.5~30kW) VFDs.

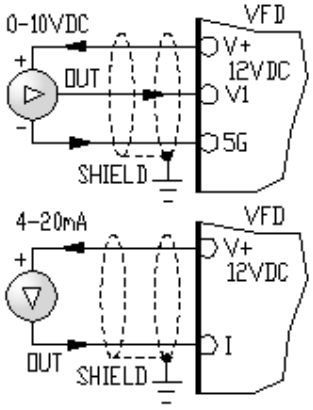


Basic types of analog inputs wiring with 5G common terminal

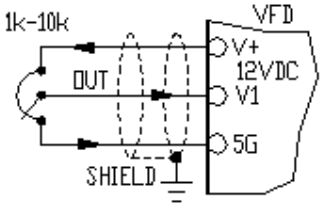
BMS or PLC output



PID control with transducer

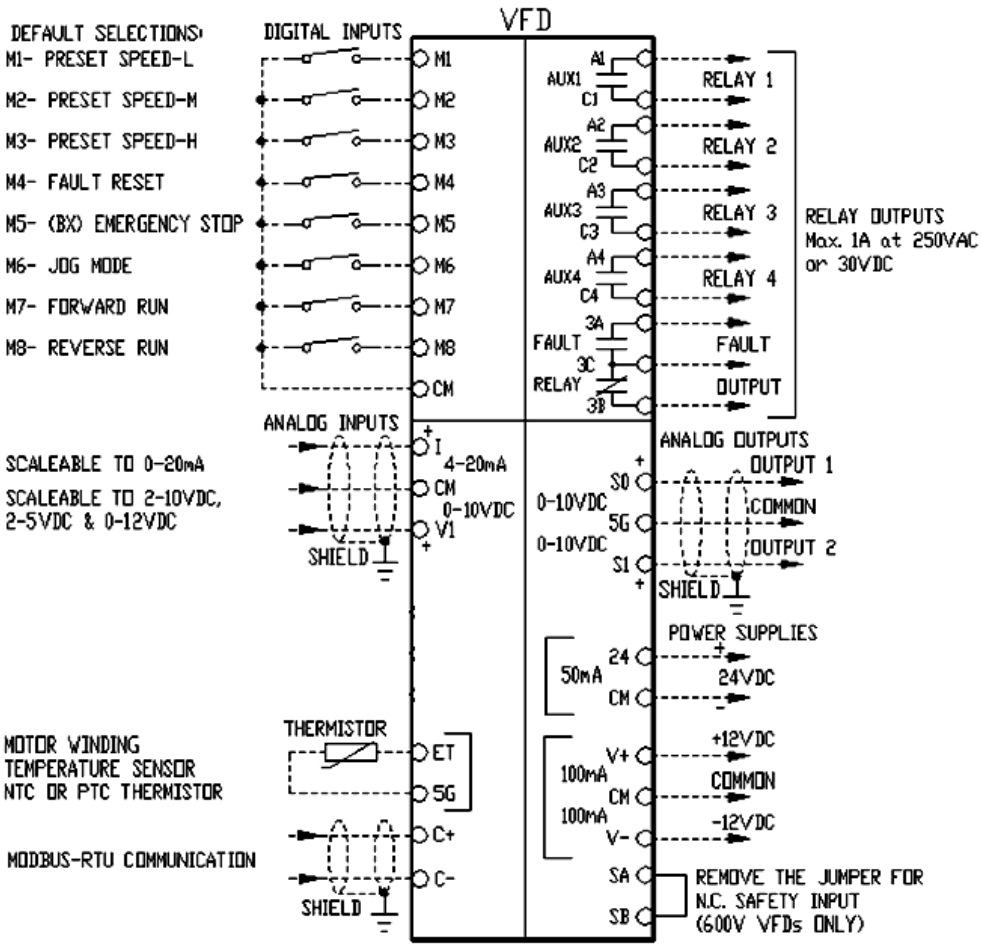


Potentiometer



Note: See section 4.4 for more details on analog inputs wiring.

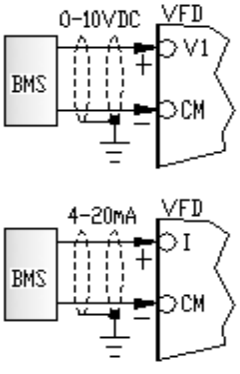
Basic Control wiring for 50~700HP (37~525kW) VFDs



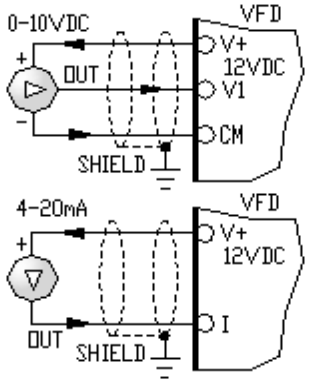
Note: Use terminal CM for analog inputs and ±12VDC power supply common.

Basic types of analog inputs wiring with CM common terminal

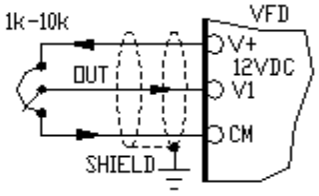
BMS or PLC output



PID control with transducer



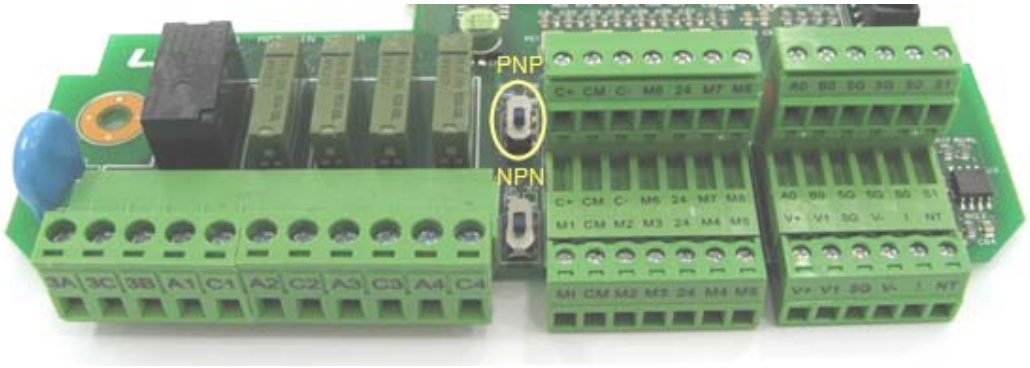
Potentiometer

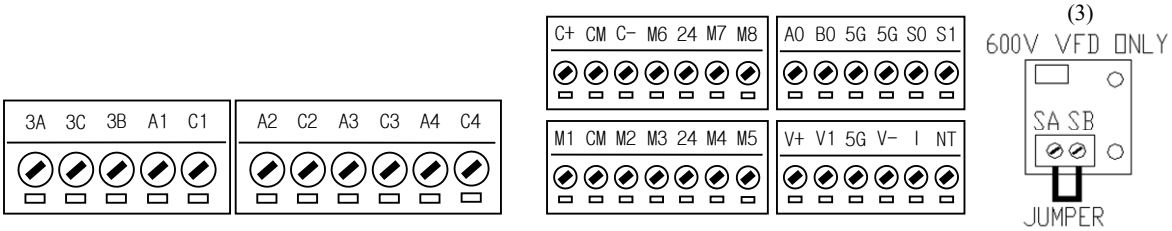


Note: See section 4.4 for more details on analog inputs wiring.

Digital and analog control circuits terminals layout

7.5~40HP (5.5 ~ 30kW) 200V/400V/600V Class VFDs

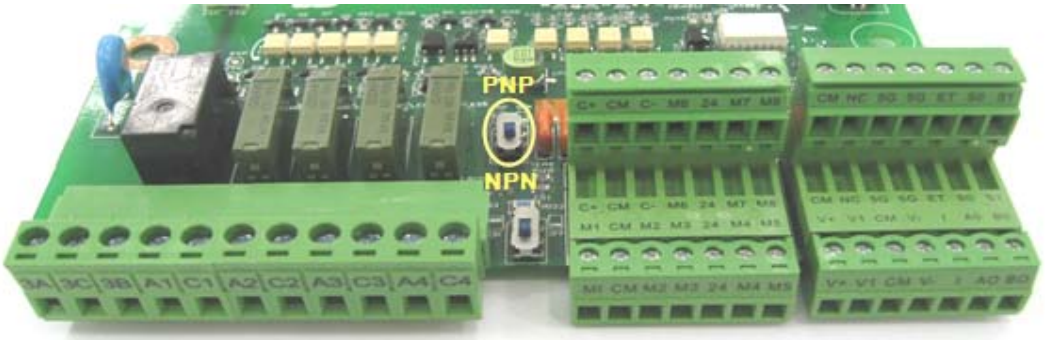


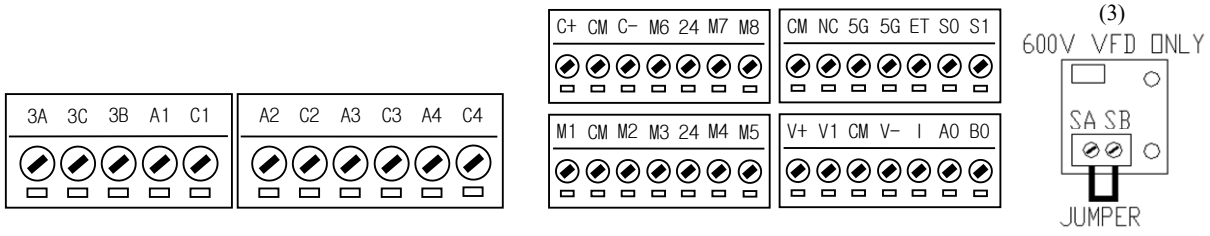


Note:

1. All **CM** terminals are common for 24VDC circuits and they are connected together internally.
2. All **5G** terminals are common for analog and 12VDC circuits and they are connected together internally.
3. Terminals A0 and B0 are not used.

50~700HP (37~525kW) 400V and 50~150HP (37~110kW) 600V Class VFDs





Note:

1. All **CM** terminals are common for 24VDC, 12VDc and analog circuits and they are connected together internally.
2. All **5G** terminals are common for analog output and ET circuits and they are connected together internally.
3. Terminals A0 and B0 are not used.
4. The 600V series VFDs have a redundant input for N.C. disable contact. When this contact is open, the IGBT gate control will be disabled. In order to use Disable input, remove factory installed wire jumper.

Control Inputs and Outputs Description

Notes: 1) M1~M8 digital inputs can be re-programmed from Normally Open to Normally Closed in parameter I/O-95.
2) Analog Input Common Terminal: **5G** for 7.5~40HP VFDs and **CM** for 50~700HP VFDs.

Type		Symbol	Name	Description
Input signal	Digital Inputs Selections	M1, M2 & M3[1]	Programmable Digital Inputs 1, 2 & 3	Multi-Function Programmable Digital Inputs. (Factory setting: Multi-Step Frequencies 1, 2 & 4)
		FX [M7][1]	Forward Run Command	Forward Run When Closed and Stopped When Open.
		RX [M8][1]	Reverse Run Command	Reverse Run When Closed and Stopped When Open.
		JOG [M6][1]	Jog Run	Runs at Adjustable Jog Frequency when the Jog Signal is ON. The Direction is set by the FX (or RX) Signal.
		BX [M5][1]	VFD Disable	When the BX Signal is ON the Output of VFD is Turned Off. When Motor uses an Electrical Brake to Stop, BX is used to Turn Off the Output Signal. Take caution when BX Signal is OFF (Not Turned Off by Latching) and FX Signal (or RX Signal) is ON. If so, motor continues to Run.
		RST [M4][1]	Fault Reset	Used for Fault Reset.
		CM	Digital -24VDC Common	All CM (digital inputs common) terminals are connected together internally.
		24	+24VDC Power Supply	24VDC power supply for digital inputs and external loads with maximum current consumption of 50mA
		V+ & V- [2]	Bipolar +/-12VDC 100mA Power Supply	DC power to sensors, potentiometer etc. Provides +12VDC and -12VDC corresponding to Common terminal 5G (CM)[2]
	Analog Inputs	V1[2]	0-10VDC Analog Input Impedance 20 kΩ	Analog input for speed reference or process feedback transducer can be set to any configuration up to 12VDC.
		I [2]	4-20mA Analog Input. Impedance 249Ω	Analog input for speed reference or process feedback transducer can be set to 0-20mA range.
		5G (CM) [2]	Analog I/O Common Terminal	Common Terminal for Analog Inputs, outputs and +12VDC and -12VDC power supplies.
	Motor sensor	NT (ET)	External motor winding temperature sensor	Motor temperature sensor input is used to prevent motor from overheating by monitoring NTC or PTC thermistor sensor installed in motor windings.
		5G	Common for NT(ET)	Common Terminal for motor temperature sensor.
RS485 terminal		C+ & C-	RS485 signal (High and Low)	RS485 signal (See RS485 communication in the manual for more details.)
Output signal	Voltage	S0, S1, 5G	Programmable analog Voltage Output	Voltage output for one of the following: Output Frequency, Output Current, Output Voltage, DC Link Voltage. Default is set to Output Frequency. (Maximum Output Voltage range is 0-12V at 1mA).
	Relay Contacts	3A, 3C, 3B	Fault Contact Output	When VFD trips, the fault relay will be activated. Normal contact state: 3A-3C Open and 3B-3C Closed. Contact ratings: 1A up to 250VAC/30VDC
		A1/C1~A4/C4	Programmable Digital Outputs	Programmable Digital Output Relays. Contact ratings: 1A up to 250VAC/30VDC

Power Wiring

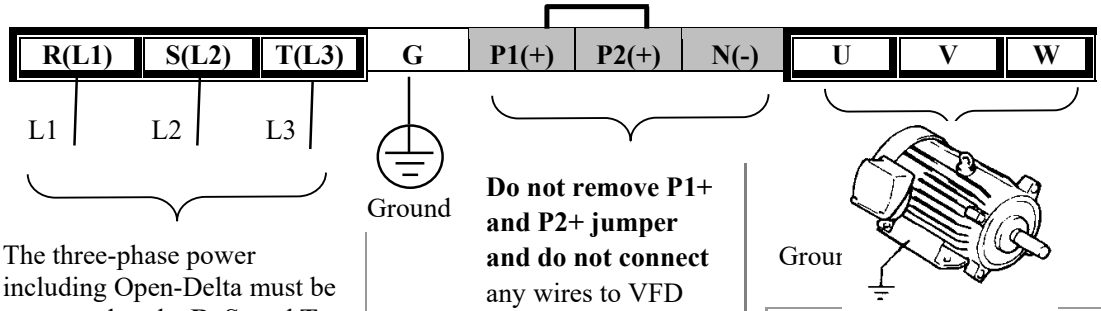
Wiring Recommendations

1) **Do not connect** input power to VFD Motor terminals **U, V,** and **W** otherwise VFD can be damaged.
2) **Do not run** input power and motor wires in the same conduit, otherwise the VFD can malfunction or be damaged.
3) **Do not run** input power wires or motor leads for multiple VFDs in common conduit.
4) **Do not install** power factor correction capacitors, surge suppressors, or RFI filters on the VFD output. These devices can trigger some VFD faults or even damage the VFD.
5) Use ring type terminals for the VFD power wiring.
6) **Do not leave** wire fragments, metal shavings or other metal objects inside the VFD, otherwise VFD can be damaged.
7) Size power wire to maintain a voltage drop less than 2% at VFD or motor terminals. Treat Open-Delta power as a single-phase and size VFD and power wiring accordingly.
8) Install a line reactor for VFDs in pump systems with dedicated service transformer to protect VFD from transient power surges and provide some degree of harmonics distortion mitigation.
9) Install a load (output) reactor to protect motor windings if distance from 460V or 600V VFD to a motor is in the range 45-100 feet or output dV/dt filter for a range 100-1000 feet (800 feet for submersible pumps) or a sine wave filter for greater distances.
10) ⚠ Always check if DC bus charge LED is off and DC voltage on the terminals **P1+** and **N-** is less than 30VDC before working on VFD wiring. The DC bus capacitors may hold high-voltage charge for several minutes after the VFD power is disconnected.

Grounding

1) Connect a dedicated ground wire from power transformer or power distribution panel to VFD ground terminal and dedicated ground wire from VFD to the motor for ground fault protection proper operation. If metal construction or conduits are used as a ground leak current path, the VFD can have inadequate grounding and ground fault protection.
2) Ground VFD to the power source ground and motor ground to avoid electrical shock. The ground impedance for 230VAC VFDs should be less than 100 Ω and 10 Ω for 460VAC and 600VAC VFDs.
3) Connect ground wire first before any other wires and only connect it to the dedicated ground terminal of the VFD. **Do not use** the case or the chassis assembly screws for grounding.
4) VFD Grounding wire should be as short as possible.
5) Do not install a ground rod at VFD package if it is not a service entrance rated panel, otherwise the VFD cannot provide proper ground fault protection or it can intermittently trip on Ground Fault.

Power and Motor Connections for 7.5~40HP (5.5~30kW) VFDs



The three-phase power including Open-Delta must be connected to the **R, S,** and **T** terminals and single-phase power to **R** and **S** terminals. The proper phase sequence is not necessary.
Do not apply power to motor terminals **U, V**, and **W,** otherwise the VFD can be

Do not remove P1+ and P2+ jumper and do not connect any wires to VFD terminals **P1+**, **P2+** and **N-** except dynamic braking unit, otherwise the VFD can be damaged.

Three-phase induction motor must be connected to the U, V, and W terminals. If VFD starts in forward direction, the motor shaft should rotate clockwise when viewed from motor to the load. If rotation is incorrect, swap any two motor leads.

Wire sizes and terminal lugs

Refer to below table for recommended wires sizes, terminal lugs, and screws for VFD power and motor wiring.

VFD capacity HP (kW)		Screw Size Metric	Screw Torque		Wire size			
					R(L1), S(L2), T(L3)		U, V, W	
			kgf · cm	lb · in	mm^2	AWG or kcmil	mm^2	AWG or kcmil
230VAC	**7.5HP** (5.5kW)	M4	7.1 ~ 12.2	**6.2~10.6**	5.5	**10**	5.5	**10**
	10HP (7.5kW)	M5	24.5 ~ 31.8	**21.2~27.6**	8	**8**	8	**8**
	15HP (11kW)	M5			14	**6**	14	**6**
	20HP (15kW)	M6	30.6 ~ 38.2	**26.6~33.2**	22	**4**	22	**4**
	25HP (18.5kW)	M6			38	**2**	38	**2**
	30HP (22kW)	M8	61.2 ~ 91.8	**53.1~79.7**	38	**2**	38	**2**
	40HP (30kW)	M8			60	**1/0**	60	**1/0**
460VAC	**7.5HP** (5.5kW)	M4	7.1 ~ 12.2	**6.2~10.6**	3.5	**12**	3.5	**12**
	10HP (7.5kW)							
	15HP (11 kW)				5.5	**10**	5.5	**10**
	20HP (15kW)	M6	30.6~38.2	**26.6~33.2**	8	**8**	8	**8**
	25HP (18.5kW)				14	**6**	14	**6**
	30~40HP (22~30kW)	M8	61.2~91.8	**53.1~79.7**	22	**4**	22	**4**
	50~75HP (37~55kW)		67.3~87.5	**58.4~75.9**	38	**2**	38	**2**
	100~125HP (75~90kW)	M10	89.7~122.0	**77.9~105.9**	60	**1/0**	60	**1/0**
	150~200HP (110~132kW)	M12	182.4~ 215.0	**158.3~ 186.6**	100	**4/0**	100	**4/0**
	250HP (160kW)				150	**300**	150	**300**
	350HP (220kW)				200	**400**	200	**400**
	400HP (280kW)				250	**500**	250	**500**
	500HP (315kW)				325	**700**	325	**700**
	600HP (375kW)				2x200	**2x400**	2x200	**2x400**
	700HP (450kW)				2x250	**2x500**	2x250	**2x500**
600VAC	**7.5HP** (5.5kW)	M4	7.1 ~ 12.2	**6.2~10.6**	3.5	**12**	3.5	**12**
	10HP (7.5kW)							
	15HP (11kW)				5.5	**10**	5.5	**10**
	20HP (15kW)	M6	30.6~38.2	26.6~33.2	8	**8**	8	**8**
	25HP (18.5kW)				14	**6**	14	**6**
	30~40HP (22~30kW)	M8	61.2~91.8	53.1~79.7	22	**4**	22	**4**
	50~75HP (37~55kW)				38	**2**	38	**2**
	100~125HP (75~90kW)	M10	89.7~122	77.9~105.9	60	**1/0**	60	**1/0**
	150 (110kW)	M12	182.4~215	158.3~186	100	**4/0**	100	**4/0**

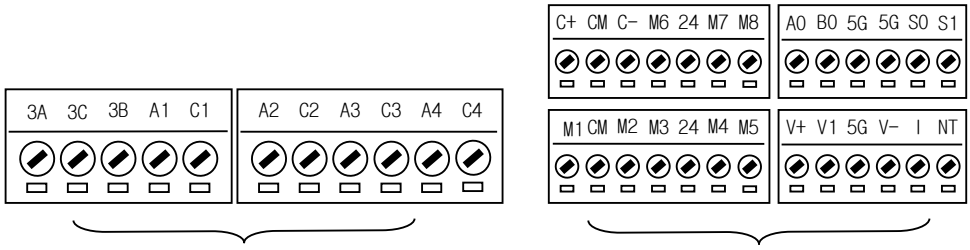
Notes: Apply the rated torque to terminal screws providing proper wire connection and protecting the thread from damage. Loose screws can cause VFD malfunction or damage. Use copper wires with 600V, 75°C ratings. For 10~15HP (7.5~11kW) 230V type VFDs the power and motor terminals are only for use with insulated ring type connectors.

3.3 Control Circuits Wiring

Wiring Recommendations

The **CM** and **5G** terminals are isolated from each other and from the ground. **Do not connect** these terminals to the ground, otherwise it can cause some electrical noise in control circuits and unstable VFD operation or malfunction.
Use shielded cable or twisted wires for 24VDC digital control circuits wiring and separate these wires from the main power and motor wiring and other high voltage circuits.
Use shielded cable for analog control circuits with shield connected to the ground.

Control terminals layout and recommended wire gauge.



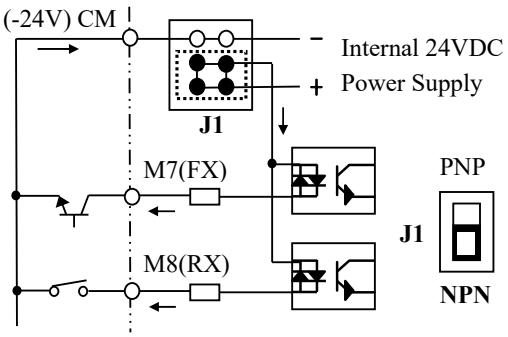
22 AWG (0.33mm^2) ~ 14 AWG (2.0mm^2) **28 AWG (0.08mm^2) ~16 AWG (1.25mm^2)**

NPN and PNP 24VDC Digital Control Modes

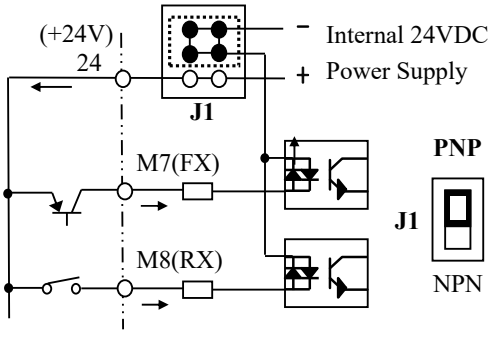
P Series provides Sink or Source (NPN or PNP) modes for digital control inputs.
The digital inputs configurations are selectable by J1 switch between Sink mode (NPN) and Source mode (PNP).

- **Sink (NPN) mode.** Put J1 switch down to NPN position. CM terminal (-24VAC) is common terminal for digital inputs. The factory default is Sink mode (NPN).
- **Source (PNP) mode with internal power supply.** Put J1 switch up to PNP position. Terminal 24 (+24VDC) is common terminal for digital inputs.
- **Source (PNP) mode with external power supply.** Put J1 switch up to set to PNP position. The external 24VDC Power Supply negative terminal should be connected to VFD CM terminal and positive terminal will be common for all digital inputs.

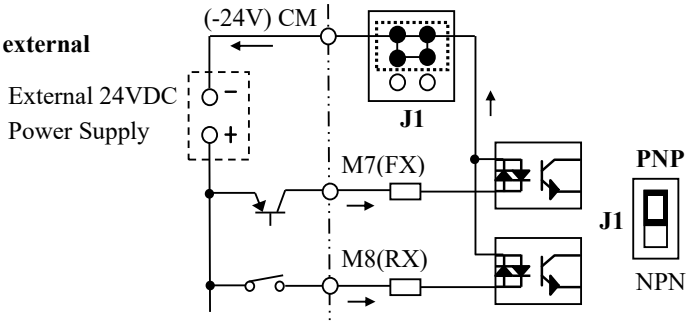
Sink mode (NPN)



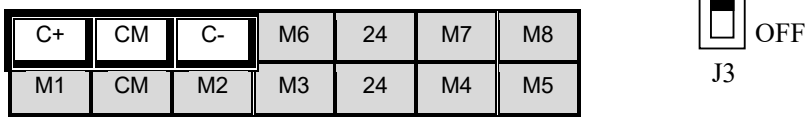
Source mode (PNP)



Source mode (PNP) with external 24VDC Power source



RS485/Modbus RTU communication circuit wiring



Use shielded cable for Modbus-RTU communication and connect it to terminals **C+** for signal High and **C-** for signal Low. Connect cable shield to **CM** or **Ground** terminal. Set the **J3** dipswitch to ON (Upward) position to connect 120Ω termination resistor for long distance or for electrically noisy environment.

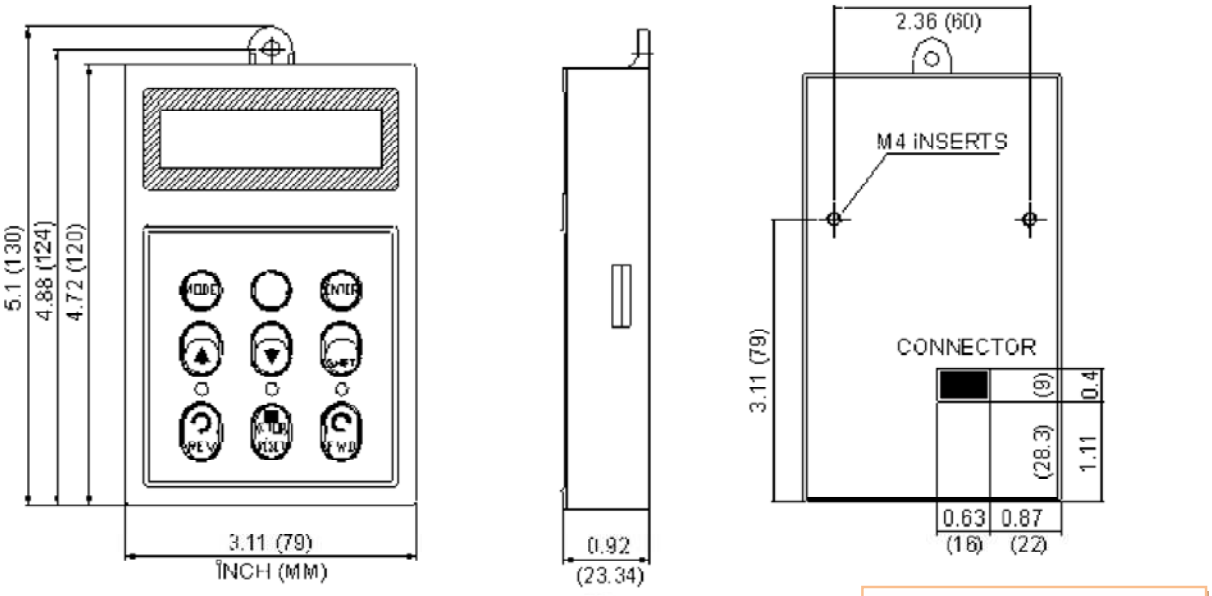
Item	Specification
Transmission type	Bus method, Multi drop Link System
Applicable VFD	P Series
Number of VFDs	Max. 31
Transmission distance	4000 feet (1200m) Max. Up to 2300 feet (700m) recommended
Recommended cable	Shielded Cable Twisted-pair 0.75mm^2 (18AWG)
Installation	C+, C- & CM terminals on the control terminal block
Power supply	Isolated from VFD power supply

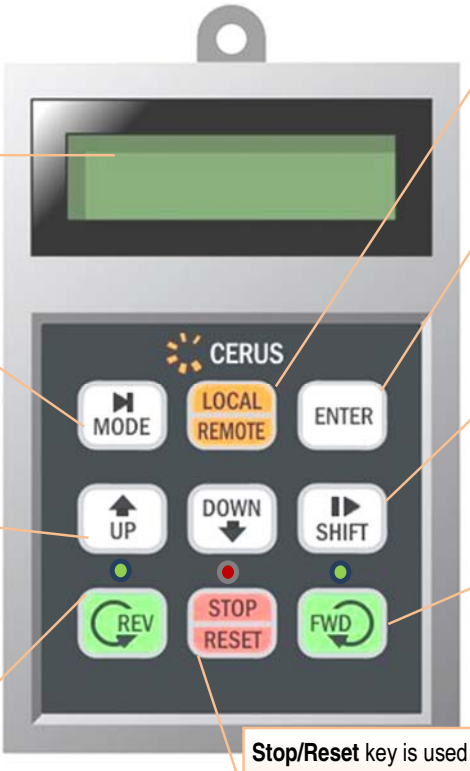
CHAPTER 4 - OPERATION

4.1 VFD Programming Keypad

LCD Keypad

LCD keypad can display up to 32 alphanumeric characters, and various settings can be checked directly from the display. The following pictures are a dimensional drawing and illustration of the keypad.





32 character LCD **Display** with backlight. The contrast is adjustable.

The **Mode** key allows to scroll parameter groups in direct sequence:
SET →DRV → FG1→ FG2→…

The **UP** and **DOWN** arrow keys allow to scroll through parameters up or down or increase/decrease any numerical value.

Reverse Run key allows to start motor in reverse direction. The Reverse Run Green LED flashes when VFD speed changes and stays solid if speed is steady.

The **Local/Remote** key allows to switch control mode between Remote and Local.

The **Enter** key allows to enter a programming mode and after parameter is changed to accept the change and exit programming mode.

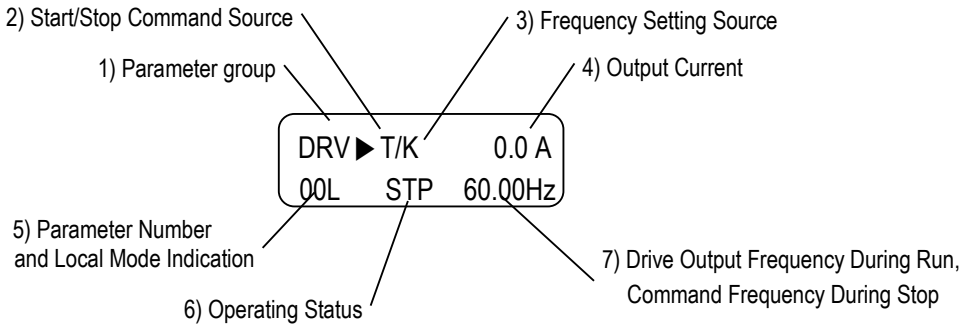
The **SHIFT** key allows to shift flashing cursor to the right during programming and scroll parameter groups in reversed sequence **SET→ APP→ I/O → FG2 →…**

Forward Run key allows to start motor in forward direction. The Forward Run Green LED flashes when VFD speed changes and stays solid if speed is steady.

Stop/Reset key is used to stop the drive in local mode and reset VFD Faults. In remote mode, it can be used to stop VFD for programming (refer to page 28 for details).
Red LED blinks at fault and stays solid at complete stop.

Note: 1. Both green LEDs may flash during VFD operation when run sequence activates internal time delays, or VFD is ready for auto restart, or during Auto Tuning and Pre-Heat modes.
2. Red VFD will flash when VFD was stopped by **Stop For Programming** feature (refer to page #28).

Display Description



Displays	Description
1) Parameter Group	Displays the current parameter group. Parameter groups include: SET, DRV, FG1, FG2, I/O, EXT, COM and APP.
2) Start/Stop Source	Displays the source of VFD Start and Stop command. **K**: Keypad control. Start/Stop command from FWD or REV keys on the keypad **T**: Terminal Control. Start/Stop command from VFD digital inputs FX or RX **R**: Communication control. Start/Stop command from VFD RS485 port **O**: Option Board Control. Start/Stop from option communication board
3) Frequency Setting Source	Displays the source of VFD frequency reference command **K**: Frequency reference from keypad **V**: Frequency reference 0-10VDC from V1 analog input **W**: Frequency reference ±10VDC from V1S analog input **I:** Frequency reference 4-20mA from I analog input **R**: Frequency reference from RS485 port **U**: Up terminal input when Up/Down operation is selected **D**: Down terminal input when Up/Down operation is selected **S**: Stop status when Up/Down operation is selected **O**: Frequency reference from option communication board **X**: Frequency reference from Sub board **J**: Jog Frequency reference from Jog input **1 ~ 15**: Number of activated by digital input Step frequency
4) Output Current*	Displays the actual Output (motor) Current during operation.
5) Parameter Code	Displays two-digit parameter number (0-99). Use the ▲ (Up) or ▼ (Down) key to cycle through parameters. **L:** Local control mode. VFD is in local control mode and PID mode is disabled. **P**: Stop For Programming mode is activated (refer to page #28).
6) Operating Status	Displays the operation information. **STP**: Stop mode. VFD does not produce any output to the motor. **FWD**: During Forward operation **REV**: During Reverse operation **DCB**: During DC Braking or DC injection modes **LOP**: Loss of Reference from Option Board (DPRAM fault) **LOR**: Loss of Reference from Option Board (Communication network fault) **LOV**: Loss of 0-10VDC Analog Frequency Reference signal on V1 input **LOI**: Loss of 4-20mA Analog Frequency Reference signal on I input **LOS**: Loss of Reference from Sub-Board
7) VFD Output or Command Frequency	Displays the Output Frequency during run. Displays the Command Frequency during stop.

* The VFD displays a true value of a motor current measured by Hall Effect current sensors. The most of the current clamp meters have inductive current sensors and cannot properly read a VFD output current with high frequency components.

Programming the VFD Parameters

Do not program VFD parameters in Local mode it can create conflicts with some parameters.

The navigation through VFD parameters is similar to the book reading process. Finding a desired parameter group is similar to finding a right page in the book- flip pages one after another. Finding a desired parameter in the parameter group is the same as finding a desired line on the book page- scroll Up or Down.

1) Press **[MODE]** key until the desired parameter group is displayed.
2) Press **[▲]** or **[▼]** keys to scroll to the desired parameter. If you know the desired parameter number, you can set its number in the first parameter #00 "Jump code" of any parameter group (except SET and DRV groups) and after pressing **[ENT]** key display will show that parameter.
3) Press **[ENT]** key to enter the programming mode, which is indicated by a flashing cursor.
4) Press **[▲]** or **[▼]** keys to change parameter selection or **[SHIFT]** key to move the cursor to the right to the desired digit.
5) Press **[▲]** or **[▼]** keys to change the digit in numerical parameter value.
6) Press **[ENT]** key to finish programming for this parameter. The flashing cursor disappears.

Note: 1.Some parameters cannot be changed during run mode and a flashing cursor will not appear. If Parameter Lock function activated in parameter FU2-94, all parameters are protected from programming.
2. If two or more parameters are set to the same function, the "Overlap" message can be displayed.

Example: Changing Motor FLA setting from 9.6A to 9.9A.

The VFD display shows parameter DRV-00 in the DRIVE group. Press **[MODE]** key several times until display shows parameter SET-00 in parameter group SET.

DRV▶T/K 0.0 A 00 STP 60.00 Hz	**[MODE] ►. . . . [MODE] ►**	SET▶ App. Select 00 Supp Fan

Press **[▲]** key three times to go to parameter SET-03 Motor FLA. (Some parameter groups have parameter #00 with Jump Code # that can be used to jump to any parameter directly).

SET▶ Motor FLA 03 9.6 A	Press **[ENT]** key to start parameter programming and flashing cursor will appear on the left side of the FLA number. If **[▲]** or **[▼]** key is pressed, the number will be changed to a minimum or maximum possible value for this parameter.
SET▶ Motor FLA 03 ▌9.6 A	Press **[SHIFT]** key to move the cursor to a digit "6" and press **[▲]** key three times to change this digit to "9".
SET▶ Motor FLA 03 9.▌ A	Press **[ENT]** key and flashing cursor will disappear and VFD exits a programming mode.
SET▶ Motor FLA 03 9.9 A	Press **[▲]** or **[▼]** key to go to another parameter in SET group or **[MODE]** or **[SHIFT]** key to go to another program group.

Parameter groups

All P Series VFD parameters are divided in eight program groups by functionality.

Parameter Group	Code	Description
Set Group	SET	Application selection, Motor Data, Basic control and timers' settings, PID.
Drive Group	DRV	Step Frequencies and monitoring parameters
Function Group-1	FG1	Max. Frequency, Control Modes selections, Pre-heat, Motor Overload Protection, VFD overload protection, and Run Delay.
Function Group-2	FG2	Fault History, Dwell Time, Jump Frequencies, Motor Slip, Auto Tune, Torque Boost, Parameter Save and Lock, Auto Reset, Power-up delay.
Input / Output Group	I/O	Programmable Digital and Analog Inputs and Outputs Settings, Damper/Lube Selection. RS485 communication settings.
Application Group	APP	External PID settings.

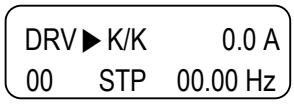
Extension Group	EXT	Shows the model of installed SUB board and settings for it. Available when SUB board is installed.
Communication Group	COM	Shows the type of communication Board and all the settings for it. Available when COM board is installed.

Notes:
1. Refer to the parameter function descriptions for detailed information for each group.
2. Some groups are available only when Option Board is installed. When a new VFD is powered up, the proper application type must be selected in initial parameter SET-00 in order to have access to other parameters.
3. The programming of VFD parameters can be done by utilizing a 32-character alphanumeric LCD keypad or DriveView PC software.

4.2 Control Modes

Keypad Control Mode

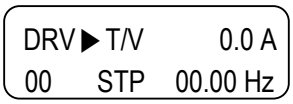
To control Start/Stop Forward or Reverse command and speed reference of the VFD from a Keypad, set Drive Mode parameter **SET-09** to Keypad and Speed Ctrl parameter **SET-10** to a Keypad-1. The display should show the following screen. Now VFD is ready to be controlled by the keypad.

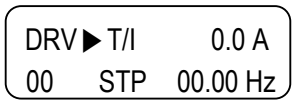


If frequency command needs to be changed, press **[ENTER]** key, then **[SHIFT]** key to move flashing cursor to proper position and **[▲]** or **[▼]** key to change the number, then press **[ENTER]** key to finish programming. Press **[FWD]** or **[REV]** key to start VFD in forward or reverse direction and **[STOP]** key to stop it. If VFD loses power during run mode and then receives power again, it stays in Stop mode until **[FWD]** or **[REV]** key is pressed.

Remote (Terminal) Control Mode

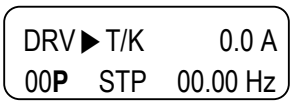
To control VFD Start/Stop Forward or Reverse command and speed reference of the VFD from external controller via VFD terminals, set Drive Mode parameter **SET-09** to Remote-1 and Speed Ctrl parameter **SET-10** to **V1** for 0-10VDC and **I** for 4-20mA signals.





The display should show **T/V** or **T/I** control mode. Wire the control and speed signal wires to VFD and it is ready to be controlled by external controller. When VFD is at stop mode, the parameter DRV-00 shows frequency reference Hz coming from external analog signal source. When VFD started, this display shows VFD actual output frequency.

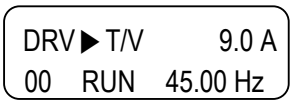
Stop for Programming Mode. If the VFD is in remote mode and it is difficult to remove the run command, the VFD can be stopped for programming by following this procedure. This will allow adjustment to all parameters. First go to DRV-00 parameter and press ENTER key to enter programming mode (flashing cursor should appear). Then press and hold the STOP key for 6 seconds and VFD will stop and the letter P will appear next to DRV-00 parameter number [00**P**]. The VFD is now in Stop for Programming Mode. After finishing programming of the parameters, it is recommended to save all changes by setting FG2-95 to YES. Verify that it is safe to for the motor to start. To exit Stop for Programming Mode, press the STOP key for 6 seconds. Letter P will disappear indicating that VFD has returned to normal operation. **Caution:** VFD will start if remote run command is still present when Stop for Programming Mode is exited. **Note**: LOCAL/REMOTE key is disabled when Stop For Programming mode is activated.

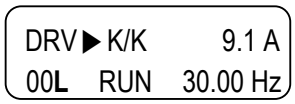


Local/Remote Control Mode

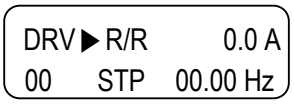
When VFD is controlled remotely and **[LOCAL/REMOTE]** key is pressed on VFD keypad or digital input programmed for LOC/REM is activated, the VFD control mode changes from remote to local mode based on the parameter **SET-90** selection. The parameter **DRV-00** should show the following screen with letter **L** (Local) next to parameter number. Now VFD is ready for a keypad control mode.

The Start/Stop and speed control for this mode is described in **Keypad Control Mode** in 4.2.2 section. If **[LOCAL/REMOTE]** key is pressed again or LOC/REM digital input is deactivated, VFD returns to remote control mode.





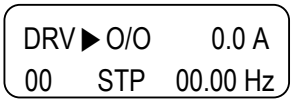
Modbus-RTU Communication Control Mode



To provide Start/Stop Forward or Reverse command and speed reference of the VFD from external communication device via VFD Modbus-RTU terminals, set Drive Mode parameter **SET-09** to **Int.485** and Speed Ctrl parameter **SET-10** to **Int. 485**. The parameter DRV-00 should show **R/R** control mode. Connect two-wire communication cable to VFD terminals maintaining proper polarity and VFD is ready to be controlled by external controller via Modbus-RTU communication. VFD parameter address mapping is shown in parameter description tables in Hex-Decimal format.

Option Communication Card Control Mode

The optional communication cards include LonWorks, N2 and BACnet communication protocols. When option card is installed, the **COM** parameter group will be available.
To control Start/Stop Forward or Reverse command and speed reference of the VFD from external communication device via VFD Option Card, set Drive Mode parameter **SET-09** to **Int.485,** Speed Ctrl parameter **SET-10** to **Int. 485** and Opt. Mode parameter **COM-02** to **Cmd. + Freq**. The parameter DRV-00 should show **O/O** control mode. Connect communication cable to Option Card terminals and VFD is ready to be controlled via communication. VFD parameter address mapping is shown in the option card manual.



4.3 Function Settings and Descriptions

Function parameters settings

All VFD parameters have default factory settings based on application and can be changed in programming mode. Some parameters have critical role in VFD operation and motor protection and can be changed only in stop mode. The VFD will run a motor with default settings but for better performance and reliable operation it is recommended to set motor data, control and protection features based on the application. The following table shows common parameter settings that should be checked before VFD startup.

Parameter Name	Code	Description (Default Value for Basic Application)
Application	SET-00	Application Selection (none)
Input Phase	SET-01	Single-Phase or 3-Phase power Selection (3-Phase)
Motor HP	SET-02	Motor Horse Power Rating (Full or half VFD rating based on SET-01)
Motor FLA	SET-03	Motor Nameplate Full Load Amperes (UL Table FLA based on SET-02)
Motor RPM *	SET-04	Motor Synchronous RPM (1800RPM)
VAC	SET-07	Input power voltage (240, 480 & 575)
Motor Volt	SET-08	Motor Voltage (240, 480 & 575)
Drive Mode	SET-09	Drive Start/Stop Control Mode (Remote-1)
Speed Ctrl.	SET-10	Speed Reference Source (I)
PID Mode	SET-20	Internal Proportional Control (No)
F/B Unit Max.	SET-25	Maximum Sensor Rating (Available if SET-20 is set to YES)
PID SetPoint	SET-26	PID control Set-point (50% of SET-25 if SET-20 is set to YES)
Local RemKey	SET-90	Local/Remote Mode Function (Cntl&RefRun)
Line Freq.	FG1-29	Power Line Frequency (60Hz)
Max. Freq.	FG1-30	VFD Maximum Output Frequency (60Hz)
Base Freq.	FG1-31	VFD provides full output voltage at this frequency (60Hz)
Rated Slip	FG2-42	Motor Slip= [SET-04]- [Motor Nameplate RPM] (50RPM)

* Note: The synchronous speed is a speed of the motor winding magnetic field without slip. Round the motor nameplate RPM to determine this speed. Example: 1750RPM is 1800RPM Synchronous with 50RPM slip and 3450RPM is 3600RPM Synchronous with 150RPM slip.

V/F (Voltage/Frequency) control mode

The control mode parameter FG2-60 is set to V/F mode by default, which changes output voltage corresponding to output frequency based on V/F pattern selected in parameter FG1-40. This mode uses standard industrial motor parameters for internal calculations and provides stable and reliable control for most of the motors in HVAC and pump applications.

Slip Compensation control mode

The control mode parameter FG2-60 should be set to Slip Comp. This mode is mostly used in heavy load applications when the constant speed is required. The induction motor usually deceases speed when load on the shaft increases. The VFD monitors a motor current, calculates approximate speed drop and compensates it by increasing a speed reference in a range of motor slip set in parameter FG2-42. This control provides a constant motor speed regardless of the load change.

Sensorless control mode

Set FG2-60 to Sensorless to enable Sensorless vector control. The Sensorless control mode provides better torque control at low speeds, load fluctuation compensation, and better response on rapid load changes. It is required to perform Auto tuning before starting Sensorless control in order to provide a stable motor control. The Auto-Tuning operation does not turn a motor shaft and can be performed without disconnecting a load from the motor. During Auto-tuning, the VFD sends different types of pulses to a motor winding and calculates required motor parameters. Then it stores these parameters in the memory and uses them for more precise motor control calculations. It is recommended to use this mode instead of V/F if motor draws higher than FLA current at full speed with nominal load or speed control at higher speeds is unstable. The no-load motor current parameter FG2-44 and Inertia Rate FG2-46 are used in Sensorless control calculations and should be set manually.

Note: The VFD keeps motor parameters determined by Auto-tuning even if control mode switched back to V/F. If Sensorless mode did not improve VFD operation or even made it worse, select parameter group FG2 in parameter FG2-93 and restore it to factory settings. If some other than Control mode parameters were changed in FG2 parameter group before reset, they need to be set again.

Monitoring VFD and Motor status

Parameter Name	Code	Description (Unit)
Current	DRV-17	VFD output current (A)
Speed	DRV-18	Motor speed (RPM)
DC link	DRV-19	DC bus voltage (V)
User Disp.	DRV-20	VFD output voltage or power selected in FG2-81 (V or kW)
Fault	DRV-21	VFD Current fault.
TAR / OUT	DRV-22	VFD Target (**T**) and Output (**O**) frequency (Hz)
R/F	DRV-23	PID Reference (**R**) and Feedback (**F**). Unit is selected in SET-22.
R/F/T/O	DRV-25	PID **R**eference and **F**eedback (%), **T**arget/**O**utput Frequency (Hz)
Input Display	DRV-96	Displays 2nd Analog input value in Feet, PSI or Custom unit (DRV-93~95).
V1 & I Input	DRV-97 DRV-98	DRV-97 shows V1 input signal value (V) DRV-98 shows I input signal value (mA)
Kilowatt-hour	FG1-54	kW/h reading. Can be monitored via communication.
VFD Temp. °C	FG1-55	VFD power module temperature (°C)
Motor Temp. °C	FG1-56	Motor temperature (requires thermistor sensor in motor winding).
Last Trip-1~5	FG2-1~5	Last 5 faults with Hz, A, Mode and Run Time information.
LastTripTime	FG2-7	Accumulative time counter after last VFD fault relay activation
On-Time	FG2-8	Accumulative time counter for VFD Powered time
Run-Time	FG2-9	Accumulative time counter for VFD Run time
In Status	I/O-28	Digital inputs status (0=OFF, 1=ON). ...00000000= ...M8,M7,M6,M5,M4,M3,M2,M1
Out Status	I/O-81	Relay outputs status (0=OFF, 1=ON). 0...0000= Flt...Aux4,Aux3,Aux2, Aux1

VFD and Motor Protection Parameters

Parameter Name	Code	Description (Default Setting for Basic application)
MOH Trip Sel	DRV-30~32	Motor Overheat Trip Selection (010). Requires thermistor sensor in motor.
VHT Value °C	DRV-34~36	Hot VFD Temperature settings (110°C). Hz limited by VFD temperature.
No Motor Sel	FG1-57~59	Trips VFD if motor is disconnected from VFD (Yes)
ETH Select	FG1-60~62	Electronic Motor Overload Protection (Yes)
OL Level	FG1-64~65	VFD Overload Warning Level to trigger an alarm output (105%)
OLT Selection	FG1-66~68	VFD Overload protection selection (YES)
Trip Select	FG1-69	111=At Exchange, In Phase, Out Phase (111)
Stall Mode	FG1-70~71	Motor Stall Protection works as a current limiter by lowering Hz (Yes)
Retry Mode	FG2-24	VFD trips after set number of automatic restart retries (Yes)

Application and Control Features

Parameter Name	Code	Description (Default Setting for Basic application)
Input Phase	SET-01	De-rates VFD HP by 50% for Single-Phase Input Power (3-Phase)
Load Rotation	SET-15	Enables Forward or Reverse or Both directions (FWD Only)
Sleep Mode	SET-32~35	Enables VFD Sleep Mode when set for greater than 0Hz (00.00Hz)
Pipe Fill Mode	SET-36~38	Enables Pre-PID when set for greater than 0Hz (00.00Hz)
Pipe Broken	SET-40~44	Enables Pipe Broken Protection Mode when set to YES (No)
Over Pressure	SET-45~46	VFD stops or trips on system Over Pressure based on SET-46 selection
MMC Control	SET-50~67	Multi-motor control via AUX relays up to 4 auxiliary motors
Level Detection	SET-74~82	Under or Over Level Detection for Dry Well and other protections (No)
Local/Remote Key	SET-90	Local/Remote Key behavior selections (Control/Reference Run)
Proof of Flow	DRV-38~39	No flow protection with Flow Switch Input
Dual Demand and Pipe Leak	DRV-41~47	VFD automatically switches between Low and High Demand modes and detects leaks in the pipe system
I Hi/Lo Level	DRV-51~57	Analog Input I Low and High trigger Levels to activate AUX relays
V1 Hi/Lo Level	DRV-61~67	Analog Input V1 Low and High trigger Levels to activate AUX relays
Frequency by Level	DRV-70	VFD limits output frequency based on well water level (None)
Run Delay T	FG1-81	Time Delay at every VFD start including wakeup and fault reset (0sec)
Backspin TMR	FG1-82	Backspin timer protects from starting pump during rotation by backflow
Dwell Time	FG2-10~11	During acceleration VFD stays at Dwell frequency for Dwell Time (0sec)
Powerup Run Delay	FG2-20	Delay to start at every power-up (10sec)
Fly Start Mode	FG2-30	VFD starts with already spinning load without tripping (No)
Flow Switch	I/O-20~27	Proof of flow with flow switch and internal adjustable frequency and timer
Duplex Mode	I/O-33~37	Duplex Mode with Alternation by switch, timer or power up (None)
In-Out Timer	I/O-45~48	Internal multi-function timer activates AUX relay by selected input (M7)
Damper/ Lube	I/O-68~69	Damper or Lubrication Solenoid Control with internal adjustable timer
Freq. Detection	I/O-74~75	Activates Aux relay at FDT frequency based on FDT selection (1Hz)
Pump Screen Clean	I/O-86~87	Periodic AUX relay activation for pump screen cleaning solenoid control
LOI/V Latch	I/O-16	Two transducers wired to VFD input via external relay for redundancy

Saving and Resetting Parameters

Parameter Name	Code	Description (Default Setting for Basic application)
Para. Read	FG2-91	Reads parameters from VFD and saves to a keypad memory (No)
Para. Write	FG2-92	Writes parameters from keypad memory to VFD memory (No)
Para. Init.	FG2-93	Initializes either all program groups or selected one (No)
Para. Save	FG2-95	Saves parameters permanently to VFD memory (No)

Note: All these parameters work only in VFD stop mode. It is recommended to save current parameters to a keypad before initializing VFD during trouble-shooting. This way the VFD can be returned to current state at any point.

Auto start parameters

Parameters for VFD auto start in different conditions

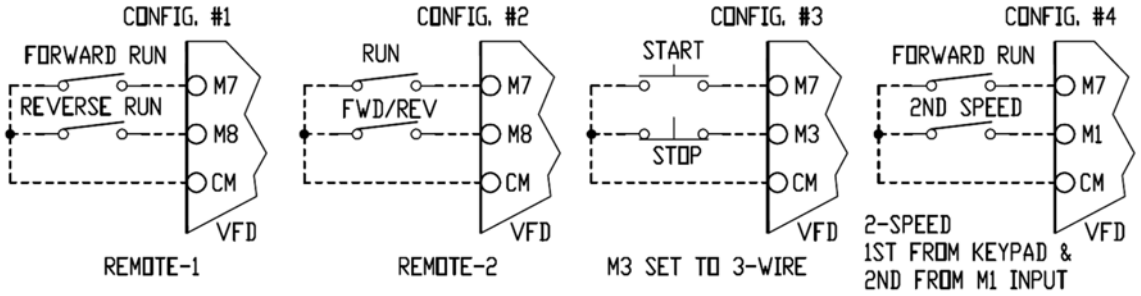
Parameter Name	Code	Description (Default Setting for Basic application)
Power On Run	FG2-19	VFD auto starts after power up with present run command (Yes)
RST Restart	FG2-21	VFD auto starts after fault reset with present run command (Yes)
IPF Mode	FG2-22	VFD auto starts after Instantaneous Power Failure (Yes)

Control Methods and Patterns

Parameter Name	Code	Description (Default Setting for Basic application)
Stop Mode	SET-16	Four Stop Modes: Decel, DC-Brake, Cost, Flux Brake (Coast)
PID Mode	SET-20	Proportional-Integral control mode (No)
MMC Mode	SET-50	Starts Auxiliary Motors based on Demand (No)
Acc. Pattern	FG1-01	Acceleration curves: Linear, S-curve, U-curve (Linear)
Dec. Pattern	FG1-02	Deceleration curves: Linear, S-curve, U-curve (Linear)
PreHeat Mode	FG1-10	Provides Motor Winding Preheat in VFD stop mode (No)
Start Mode	FG1-20	Three Start Modes: Accel, DC-Start, Flying Start (Accel)
V/F Pattern	FG1-40	Three Patterns: Linear, Square, User V/F (Linear)
Energy Save	FG1-51	VFD decreases output voltage at steady speed to save energy. (None)
Control Mode	FG2-60	Three modes: V/F, Sleep Compensation and Sensorless (V/F)
Torque Boost	FG2-67	Provides initial voltage at start for torque boost (Manual)

4.4 Control Wiring Configurations

Examples of digital control configurations



The 4.4.1 picture shows four most common control configurations.

Configuration #1

VFD controlled by separate Forward and Reverse inputs when SET-09 parameter is set to Remote-1 mode. If both inputs are activated simultaneously, the VFD will stop.

Configuration #2

VFD controlled by Run and Forward/Reverse inputs when SET-09 parameter is set to Remote-2 mode. Forward Run mode is activated by Run input and Reverse mode by both Run and FWD/REV inputs.

Configuration #3

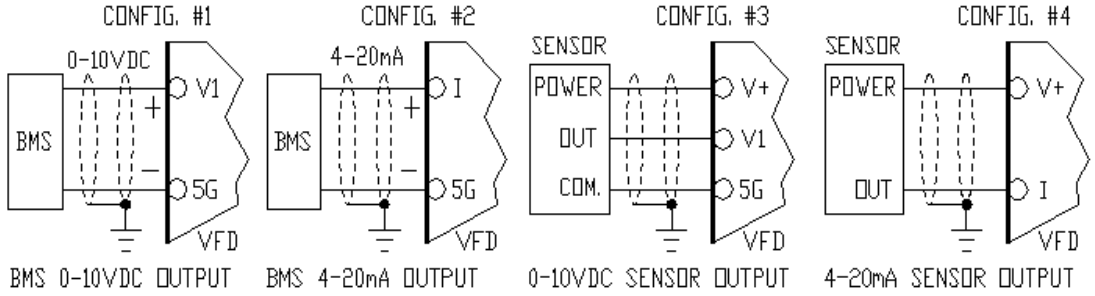
VFD controlled by Start/Stop momentary push buttons when SET-09 parameter is set to Remote-1 mode and M3 input to 3-Wire. When Start button is pressed, the VFD starts forward. The VFD stops when Stop button is pressed.

Configuration #4

2-Speed VFD control. Parameter SET-09 is set to Remote-1 mode and SET-10 to Keypad-1. The frequency in DRV-00 parameter is the 1st speed and the 2nd speed is activated by M1 input and can be adjusted in parameter DRV-01.

Examples of analog speed control configurations

Four most common VFD speed control configurations



Note: For 50HP and larger drives use CM terminal instead of 5G.

Configuration #1

VFD with speed controlled by remote 0-10VDC signal from BMS, PLC or any other controller. The VFD parameter SET-10 is set to V1 input. During normal operation if an electrical noise level in analog signal is too high, VFD output can stay at maximum frequency for some time when speed reference signal is decreasing. Increase a filtering time setting in parameter I/O-01 up to 500mS.

Configuration #2

VFD with speed controlled by remote 4-20mA signal from BMS, PLC or any other controller. The VFD parameter SET-10 is set to I input. During normal operation if a noise level in analog signal is too high, VFD output can stay at maximum frequency for some time when speed reference signal is decreasing. Increase a filtering time setting in parameter I/O-06 up to 500mS.

Configuration #3

VFD with automatic speed control by internal PID control and 0-10VDC feedback signal from pressure, temperature or any other transducer. For PID control mode parameter SET-20 is set to YES and SET-21 is set to V1 input. Increasing a filtering time setting in parameter I/O-01, when PID control is enabled, can decrease a control accuracy.

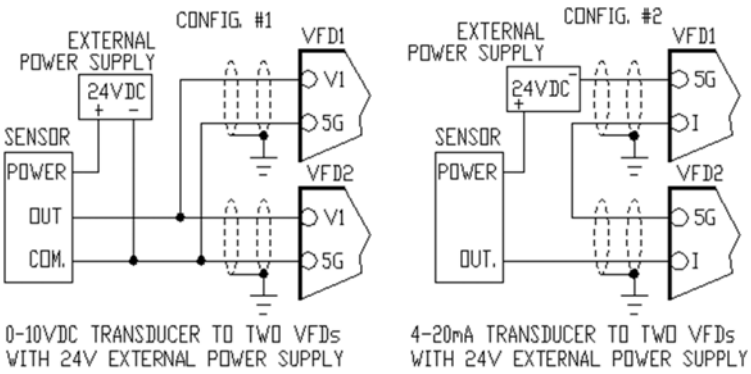
Configuration #4

VFD with automatic speed control by internal PID control and 4-20mA feedback signal from pressure, temperature or any other transducer. The VFD PID parameter SET-20 is set to YES and SET-21 is set to I input. Increasing a filtering time setting in parameter I/O-06, when PID control is enabled, can decrease a control accuracy.

Two VFDs wired to one transducer.

The analog and digital inputs of P-series VFD are isolated from the ground, which allows to use one 4-20mA transducer with two VFDs or 0-10VDC transducer to two or more VFDs. Either external power supply or one of the VFD's internal power supply should provide power to transducer. The transducers with 4-20mA output are usually limited to 600Ω load impedance. The VFD input impedance is 249Ω thus only two VFDs can be connected in 4-20mA loop with one transducer. The shield wire of a transducer cable should be connected to a ground point at VFD. The same impedance limitation exists for long control cables. If two VFDs with total impedance of 500Ω are connected in 4-20mA loop with pressure transducer, the maximum allowed cable impedance is 600Ω-500Ω=100Ω. Standard 20AWG wire has 10Ω resistance per 1000 feet, which allows us to use 5,000-foot 2-wire cable (10,000 feet of wire) from transducer to VFD. It is recommended to use wireless transducers instead of long cables in irrigation pump installations to prevent equipment damage by lightning strike.

Two VFDs connected to one transducer fed by external 24VDC power supply



Configuration #1

Two VFDs with automatic speed controls by internal PID control and 0-10VDC feedback signal from one pressure, temperature or any other transducer with external 24VDC power source. The sensor with 0-10VDC output can be paralleled with multiple VFDs. Losing the power on one VFD does not affect the PID operation of another VFD with transducer feedback.

Note: Use CM instead of 5G for VFDs 50HP and above.

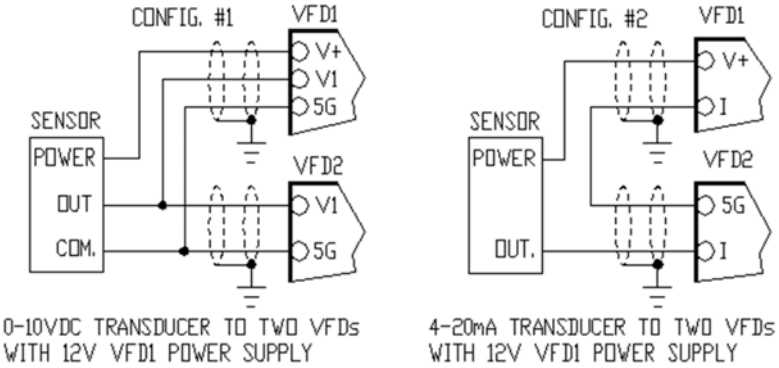
Configuration #2

Two VFDs with automatic speed controls by internal PIDs and 4-20mA feedback signal from one pressure, temperature or any other transducer with external 24VDC power source. Losing the power on one VFD does not affect the PID operation of another VFD with transducer feedback.

Note: Use CM instead of 5G for VFDs 50HP and above.

Two VFDs connected to one transducer fed by VFD1 12VDC internal power supply

P-series VFD provides 12VDC power on terminals V+ and 5G (CM for 50HP and above). Check if system pressure transducer is rated to 12VDC power (usually it has 9-30VDC rating) otherwise use 24VDC internal power supply.



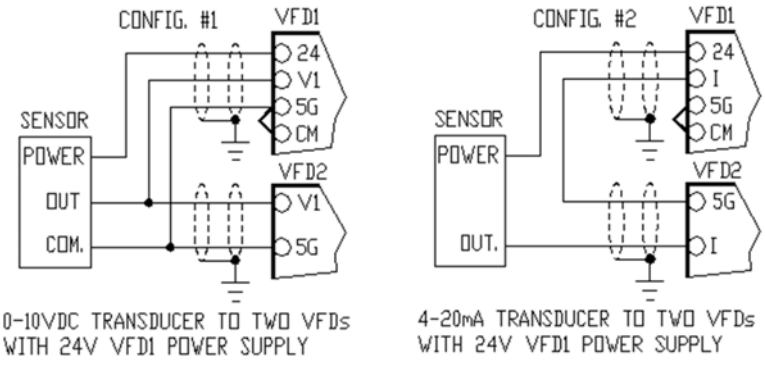
Configuration #1

Two or more VFDs connected to one 0-10VDC transducer fed by VFD1 12VDC internal power supply.

Configuration #2

Two VFDs connected to one 4-20mA transducer fed by VFD1 12VDC power supply. If VFD1 is not powered, 4-20mA loop is not powered and VFD2 cannot operate properly on PID control without feedback signal. If VFD2 is not powered, VFD1 still operates with PID control and transducer feedback. **Do not jumper** terminal 5G on VFD1 to terminal 5G on VFD2 for VFDs below 50HP. **Do not jumper** terminal CM on VFD1 to terminal CM on VFD2 for VFDs above 40HP otherwise VFD1 will lose feedback signal.

Two VFDs connected to one transducer fed by VFD1 24VDC internal power supply

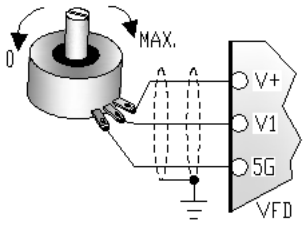


P-series VFD provides 24VDC power on terminals 24 and CM. Check if system pressure transducer is rated for 24VDC. The 24VDC power is used for digital inputs with common terminal CM. Install a jumper between 5G and CM terminals on VFD1 for VFDs below 50HP.

Configuration #1
Two or more VFDs connected to one 0-10VDC transducer fed by VFD1 24VDC internal power supply.

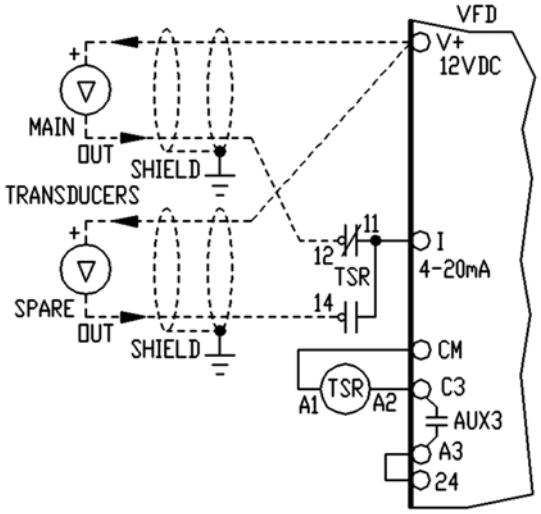
Configuration #2
Two VFDs connected to one 4-20mA transducer fed by VFD1 24VDC power supply. If VFD1 is not powered, 4-20mA loop is not powered and VFD2 cannot operate properly on PID control without feedback signal. If VFD2 is not powered, VFD1 still operates with PID control and transducer feedback. Do not jumper terminal 5G on VFD1 to terminal 5G on VFD2 for VFDs below 50HP. Do not jumper terminal CM on VFD1 to terminal CM on VFD2 for VFDs above 40HP otherwise VFD1 will lose feedback signal.

Speed Control Potentiometer Wiring

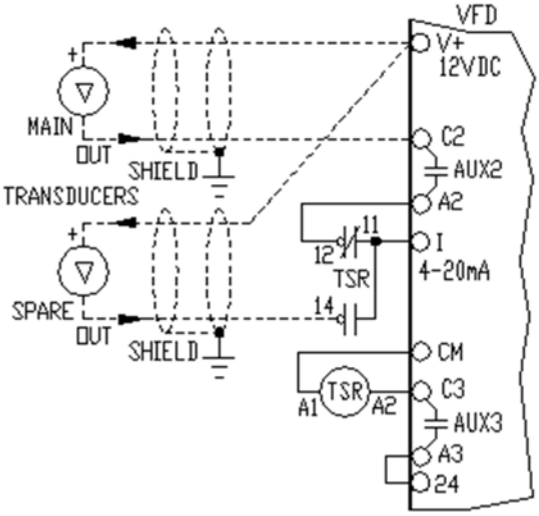


VFD speed control potentiometer wiring with VFD internal 12VDC power supply. The recommended potentiometer parameters: Resistance from 1kΩ to 10kΩ and Wattage 0.5W or higher. The multi-turn potentiometer provides more precise speed adjustment compare to a single-turn potentiometer. The internal power supply provides 12VDC and in order to have full range of speed control by potentiometer, change the I/O-04 parameter from 10VDC to 12VDC.

Two transducers connected to one VFD via external relay for redundancy



If in critical application a pressure transducer redundancy is required, use external Finder or equivalent low current (less than 20mA) 24VDC relay to switch transducers. Relay should be wire to VFD internal 24VDC power supply via any internal AUX relay as shown on the diagram. The AUX relay should be programmed for Lost I Latch in parameter I/O-76~79. Analog signal loss protection should be set in parameters I/O-16~19. The example wiring diagram on the left shows AUX3 relay programmed in I/O-78 for Lost I Latch and VFD monitors only loss of pressure transducer signal.
When I input reading is be below 4 mA, VFD will trip on LOI (Loss of mA signal). The TSR (Transducer Switch Relay) will be activated and latched switching I input from Main to Spare transducer. The relay can be reset by changing I/O-16 to No or by cycling the VFD power.



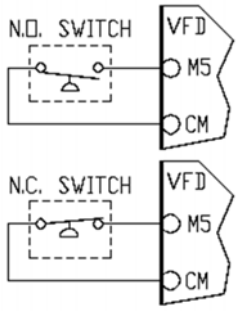
When in addition to monitoring pressure transducer signal loss the maximum reading protection is required, follow the wiring diagram on the left and program one of the AUX relays for I Max. Lvl. In the example the AUX2 relay was programmed in I/O-77 for I Max. Lvl. This relay contact will be closed until transducer reading stays at maximum level for 6 seconds. When AUX2 relay opens its contact, VFD trips on LOI and TSR relay switches transducers. The I Max. Lvl relay can be reset by cycling VFD power.

Note: The TSR relay Finder part number is 34.51.7.024.

Cut-off pressure switch wiring

The VFD has overpressure protection based on pressure transducer reading. If pressure transducer is mechanically damaged by hydraulic surge, it will provide incorrect pressure reading and VFD will not provide proper overpressure protection.

For more reliable constant pressure system operation it is recommended to install pressure relieve valve and high-pressure cut-off switch. Wire pressure cut-off switch contact based on below description.



N.O. (Normally Open Contact). Wire its N.O. contact to VFD's CM and M5 (BX Emergency Stop) terminals. By default, I/O-30 parameter is set to Yes (Automatic Reset for BX trip) and VFD will restart when cut-off pressure switch contact is open again. In case if only manual reset is acceptable, change I/O-30 setting to No. The wiring diagram shows pressure switch connection to VFD terminals.

N.C. (Normally Closed Contact). For N.C. contact change input M5 to N.C. configuration by setting in parameter I/O-95 fifth bit from the right from (…00**0**0000) to (…00**1**0000) and then connect switch to CM and M5 VFD terminals.

CHAPTER 5 - PARAMETER LIST

5.1 [SET] Setup Parameter Group

The parameter codes in gray are hidden until the corresponding feature parameter in bold is activated.
The parameters marked with ☑ can be changed during run mode and with ☒ in stop mode only.
Note:

CODE	Com. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
SET-00	9100	Application Selection	App. Select	None Basic Supply Fan Exhaust Fan Cooling Twr Centif. Pump Subm. Pump Vacuum Const Trq	☒	59
SET-01	9101	3-phase or Single phase power	Input Phase	1-Phase 3-phase	☒	
SET-02	9102	Rated Motor HP/kW	Motor HP/kW	0.5~700 HP/ 0.37~450kW	☒	60
SET-03	9103	Rated Motor Current	Motor FLA/SFA	1.0~999.9A	☒	
SET-04	9104	Rated Motor Synchronous RPM	Motor RPM	**60Hz** = 600, 720, 900, 1200, 1800, 3600 **50Hz** = 500, 600, 750, 1000, 1500, 3000	☒	
SET-06	9106	Carrier Frequency	Carrier Freq	0.7 ~15.0kHz 40HP = ~10.0kHz 50~100HP = ~ 4.0kHz 125~ 400HP= ~ 3.0kHz 500HP~ = ~ 2.0kHz	☑	
SET-07	9107	Input voltage adjustment	VAC 575.0 VAC 460.0 VAC 230.0	77.6 to 115.0 [%] 73.0 to 115.0 [%] 73.0 to 115.0 [%]	☒	
SET-08	9108	Motor Rated Voltage	Motor Volt	0.0 to 600.0 [V]	☒	
SET-09	9109	Run/Stop Method	Drive Mode	0 (Keypad) 1 (Remote-1) 2 (Remote-2) 3 (Int. 485)	☒	
SET-10	910A	Speed Control Reference	Speed Ctrl	0 (Keypad-1) 1 (Keypad-Up/Dwn) 2 (V1) 3 (V1S) 4 (I) 5 (V1+I) 6 (Reserved) 7 (Int. 485) 8 (Reserved)	☒	
SET-11	910B	Acceleration Time	ACC Time	0.0 to 600.0 [sec]	☑	58
SET-12	910C	Deceleration Time	DEC Time	0.0 to 600.0 [sec]	☑	
SET-13	910D	V/F Frequency **LowLimit**	Low Limit	0.00 to SET-14	☑	
SET-14	910E	V/F Frequency **High Limit**	High Limit	SET-13 to FG1-30	☒	
SET-15	910F	Load Rotation Selection	LoadRotation	0 (FWD & REV) 1 (REV Only) 2 (FWD Only)	☒	59
SET-16	9110	Stop Mode	Stop Mode	0 (Decel) 1 (Dc-brake) 2 (Coast)	☒	

CODE	Com. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
				3 (Flux-brake)		
SET-20	**9114**	**PID Operation Selection**	**PID Mode**	0 (No) 1 (Yes)	☒	61 103
SET-21	9115	PID Feedback Signal	PID F/B	0 (I) 1 (V1) 2 (Reserved)	☒	59
SET-22	9116	Feedback Unit Select	F/B Unit	0 (PSI) 1 (°F) 2 (°C) 3 (inWC) 4 (inHg) 5 (Bar) 6 (mBar) 7 (Feet) 8 (kPa) 9 (CUST)	☒	
SET-23	9117	PID Unit Format	Unit Format	0 0.01 1 0.1	☒	
SET-24	9118	Feedback Unit Minimum (Negative) Value	F/B Unit Min	-250.0 to 0.0 [Unit]		
SET-25	9119	Feedback Unit Maximum Value	F/B Unit Max	0.0 to 3000.0 [Unit]		
SET-26	911A	PID Set Point Value	PID SetPoint	0 to SET-25 [Unit]	☑	
SET-27	911B	PID Frequency Low Limit	PID Limit-L	FG1-32 to SET-28 [Hz]	☑	60
SET-28	911C	PID Frequency High Limit	PID Limit-H	SET-27 to FG1-30	☒	
SET-29	911D	P Gain for PID Control	PID P Gain	0.0 to 999.9 [%]	☑	
SET-30	911E	I Gain for PID Control	PID I Time	0.0 to 32.0 [sec]		
SET-31	911F	PID Output Inverse	Out Inverse	0 (No) 1 (Yes)	☒	
SET-32	**9120**	**Sleep Mode Frequency**	**Sleep Freq**	0.00 to SET-23 [Hz]	☑	
SET-33	9121	Sleep Mode **Delay Time**	Sleep Delay	0 to 9999 [sec]		
SET-34	9122	Sleep Mode **Boost Value**	Sleep Boost	0.0 to 3000.0 [Unit]		
SET-35	9123	Sleep Mode **Wake-Up Level**	WakeUp Level	0.0 to 100.0 [%]		
SET-36	**9124**	**PrePID Reference Frequency**	**PrePID Freq**	0.00 to FG1-30 [Hz]		
SET-37	9125	PrePID **Exit delay**	PrePID Dly	0 to 9999 [sec]		
SET-38	9126	PrePID **Exit Level**	PrePID Exit	0.0 to 3000.0 [Unit]		
SET-40	**9128**	**Pipe Broken Mode Selection**	**PBrokenMode**	0 (No) 1 (Yes)	☒	61
SET-41	9129	Pipe Broken Mode **Frequency**	PBrokenFreq	0.00 to FG1-30 [Hz]	☑	
SET-42	912A	Pipe Broken Mode **Delay Time**	PBrokenDly	0 to 9999 [sec]		
SET-43	912B	Pipe Broken Mode **Feedback Level**	PBroken F/B	0.0 to 3000.0 [Unit]		
SET-44	912C	Pipe Broken Mode **Output Relay**	PBrokenRelay	0 None 1 AUX_3 2 AUX_4	☒	
SET-45	**912D**	**Over Pressure Trip Level**	**OverPressLvl**	0.0 to 3000.0 [Unit]	☑	
SET-46	912E	Over Pressure Auto Restart	OP AutoStart	0 (No) 1 (Yes)		
SET-47	912F	Boost Time Limit	Boost Timer	0 to 9999 [sec]		
SET-50	**9132**	**MMC / Lead-Lag Operation**	**MMC Mode**	0 (No) 1 (Yes)	☒	62
SET-51	9133	Number of Auxiliary Motors in Use	Nbr Aux's	0 to 4		
SET-52	9134	**Start** Frequency of Aux. Motor 1	Start Freq 2	0 to FG1-30 [Hz]	☑	
SET-53	9135	Start Frequency of Aux. Motor 2	Start Freq 2			
SET-54	9136	Start Frequency of Aux. Motor 3	Start Freq 3			
SET-55	9137	Start Frequency of Aux. Motor 4	Start Freq 4			
SET-56	9138	**Stop** Frequency of Aux. Motor 1	Stop Freq 1			
SET-57	9139	Stop Frequency of Aux. Motor 2	Stop Freq 2			
SET-58	913A	Stop Frequency of Aux. Motor 3	Stop Freq 3			

CODE	Com. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
SET-59	913B	Stop Frequency of Aux. Motor 4	Stop Freq 4			
SET-60	913C	**Delay** Time before Aux Motor Start	Aux Start DT	0.0 to 999.9 [sec]	☑	62
SET-61	913D	Delay Time before Aux Motor Stop	Aux Stop DT	0.0 to 999.9 [sec]	☑	
SET-62	913E	Accel time when Aux motor stops	MMC AccTime	0.0 to 600.0 [sec]	☑	
SET-63	913F	Speed VFD ramps up to when Aux stops	MMC AccFreq	0.00 to FG1-30 [Hz]		
SET-64	9140	Decel time when Aux motor starts	MMC DecTime	0.0 to 600.0 [sec]		63
SET-65	9141	Speed VFD ramps down to when Aux starts	MMC DecFreq	0 to FG1-30		
SET-66	9142	MMC Feedback Start Differential	AuxStartDiff	0.0 to 100.0 [%]		
SET-67	9143	MMC Feedback Stop Differential	AuxStopDiff	0.0 to 100.0 [%]		
SET-74	**914A**	**Under/Over Level Detection Mode**	**Level Detect**	0 (No) 1 (Under Level) 2 (Over Level)	☒	
SET-75	914B	Level Detection Mode **Source**	LDT Source	0 (Current) 1 (DC Voltage) 2 (Output Voltage) 3 (kW) 4 (V1) 5 (I)	☒	
SET-76	914C	Level Detection Mode **Frequency**	LDT Freq	0.00 to FG1-30 [Hz]	☑	
SET-77	914D	Level Detection Mode **Delay Time**	LDT Delay	0 to 9999 [sec]		
SET-78	914E	Level Detection Mode **Level**	LDT Level	0.0 to 999.9 [Unit]		
SET-79	914F	Level Detection Mode **Hysteresis**	LDT Hyst	0.0 to 999.9 [Unit]		
SET-80	**9150**	**Level Detection mode Trip Setting**	**LDT Trip**	0 (No) 1 (Yes)	☒	
SET-81	9151	Level Detection Mode **Well Fill Time**	LDT FillTime	0.0 to 3000.0 [min]	☑	
SET-82	9152	Level Detection Mode **Output Relay**	LDT Relay	0 None 1 AUX_3 2 AUX_4	☒	64
SET-90	**915A**	**Local / Remote Key Operation Selection**	**LocalRemKey**	0 (2nd Source) 1 (Cntl&RefStop) 2 (Control Stop) 3 (Ref Only) 4 (Cntl&Ref Run) 5 (Control Run) 6 (Disabled)	☑	

[SET] Parameter Group Default Settings

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque
SET-00	App. Select	Basic	Supply Fan	Exhaust Fan	Cooling Twr	Centrif. Pump	Subm. Pump	Vacuum	Const Trq
SET-01	Input Phase	3	3	3	3	3	3	3	3
SET-02	Motor HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP
SET-03	Motor FLA	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP
SET-04	Motor RPM	1800	1800	1800	1800	1800	3600	3600	1800
SET-06	Carrier Freq (400-700HP)	2.5kHz (2.0kHz)	2.5kHz (2.0kHz)	2.5kHz (2.0kHz)	2.5kHz (2.0kHz)	2.5kHz (2.0kHz)	2.5kHz (2.0kHz)	2.5kHz (2.0kHz)	2.5kHz (2.0kHz)
SET-07	VAC 575.0V VAC 480.0V VAC 230.0V	100% 104.4% 100%	100% 104.4% 100%	100% 104.4% 100%	100% 104.4% 100%	100% 104.4% 100%	100% 104.4% 100%	100% 104.4% 100%	100% 104.4% 100%
SET-08	Motor Volt	575V 480V 230V	575V 480V 230V	575V 480V 230V	575V 480V 230V	575V 480V 230V	575V 480V 230V	575V 480V 230V	575V 480V 230V
SET-09	Drive Mode	Remote1	Remote1	Remote1	Remote1	Remote1	Keypad	Remote1	Remote1
SET-10	Speed Ctrl	I	Keypad1	Keypad1	Keypad1	Keypad1	Keypad1	Keypad1	Keypad1
SET-11	ACC Time (150-700HP)	20.0sec (60.0sec)	20.0sec (60.0sec)	20.0sec (60.0sec)	20.0sec (60.0sec)	20.0sec (60.0sec)	2.0sec (2.0sec)	30.0sec (60.0sec)	20.0sec (60.0sec)
SET-12	DEC Time (150-700HP)	30.0sec (90.0sec)	30.0sec (90.0sec)	30.0sec (90.0sec)	30.0sec (90.0sec)	30.0sec (90.0sec)	2.0sec (2.0sec)	120.0sec (120.0sec)	30.0sec (90.0sec)

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque
SET-13	Low Limit	20.00Hz	20.00Hz	20.00Hz	20.00Hz	30.00Hz	30.00Hz	30.00Hz	10.00Hz
SET-14	High Limit	60.00Hz	60.00Hz	60.00Hz	60.00Hz	60.00Hz	60.00Hz	60.00Hz	60.00Hz
SET-15	LoadRotation	FWD Only	FWD Only	FWD Only	FWD Only	FWD Only	FWD Only	FWD Only	FWD&REV
SET-16	Stop Mode	Coast	Coast	Coast	Coast	Decel	Coast	Coast	Decel
SET-20	**PID Mode**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**
SET-21	PID F/B	I	I	I	I	I	I	I	I
SET-22	F/B Unit	CUST	inWC	inWC	°F	PSI	PSI	inWC	CUST
SET-23	Unit Format	0.1	0.01	0.01	0.1	0.1	0.1	0.1	0.1
SET-25	F/B Unit Max	100.0	1.00	1.00	150.0	100.0	100.0	406.9	100.0
SET-26	PID SetPoint	00.0 [CUST]	0.50 [inWC]	0.50 [inWC]	80.0 [°F]	50.0 [PSI]	50.0 [PSI]	60.0[inWC]	00.0 [CUST]
SET-27	PID Limit-L	20.00Hz	20.00Hz	20.00Hz	20.00Hz	30.00Hz	30.00Hz	30.00Hz	10.00Hz
SET-28	PID Limit-H	60.00Hz	60.00Hz	60.00Hz	60.00Hz	60.00Hz	60.00Hz	60.00Hz	60.00Hz
SET-29	PID P Gain	1.0 [%]	1.0 [%]	1.0 [%]	10.0 [%]	10.0 [%]	50.0 [%]	50.0 [%]	1.0 [%]
SET-30	PID I Time	1.0 [sec]	1.0 [sec]	1.0 [sec]	1.0 [sec]	1.0 [sec]	0.5 [sec]	0.5 [sec]	1.0 [sec]
SET-31	Out Inverse	No	No	Yes	Yes	No	No	No	No
SET-32	**Sleep Freq**	**0.00[Hz]**	**0.00[Hz]**	**0.00 [Hz]**	**0.00 [Hz]**	**35.00 [Hz]**	**35.00 [Hz]**	**0.00 [Hz]**	**0.00 [Hz]**
SET-33	Sleep Delay	20 [sec]	20 [sec]	20 [sec]	20 [sec]	10 [sec]	10 [sec]	20 [sec]	20 [sec]
SET-34	Sleep Boost	0.0 CUST	0.00 inWC	0.00 inWC	0.00 °F	2.0 PSI	3.0 PSI	5.0 inWC	0.0 CUST
SET-35	WakeUp Level	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	8.0 [%]	2.0 [%]	2.0 [%]
SET-36	**PrePID Freq**	**0.00 [Hz]**	**0.00 [Hz]**	**0.00 [Hz]**	**0.00 [Hz]**	**0.00 [Hz]**	**0.00 [Hz]**	**0.00 [Hz]**	**0.00 [Hz]**
SET-37	PrePID Dly	60 [sec]	60 [sec]	60 [sec]	60 [sec]	60 [sec]	180 [sec]	60 [sec]	60 [sec]
SET-38	PrePID Exit	25.0 CUST	0.25 inWC	0.25 inWC	40.0 °F	25.0 PSI	25.0 PSI	30.0 inWC	5.0 CUST
SET-40	**PBrokenMode**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
SET-41	PBrokenFreq	59.00 Hz	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 Hz
SET-42	PBrokenDly	30 [sec]	30 [sec]	30 [sec]	30 [sec]	30 [sec]	30 [sec]	30 [sec]	30 [sec]
SET-43	PBroken F/B	5.0 CUST	0.05 inWC	0.05 inWC	8.0 [°F]	25.0 [PSI]	35.0 [PSI]	6.0 inWC	1.0 CUST
SET-44	PBrokenRelay	None	None	None	None	None	None	None	None
SET-45	**OverPressLvl**	**0.0 CUST**	**0.00 inWC**	**0.00 inWC**	**00.0 F**	**80.0 PSI**	**80.0PSI**	**00.0 inWC**	**00.0 CUST**
SET-46	OP AutoStart	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SET-47	**Boost Timer**	**10 [sec]**	**10 [sec]**	**10 [sec]**	**10 [sec]**	**10 [sec]**	**10 [sec]**	**10 [sec]**	**10 [sec]**
SET-50	**MMC Mode**	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
SET-51	Nbr Aux's	1	1	1	1	1	1	1	1
SET-52	**Start** Freq 1	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]
SET-53	Start Freq 2	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]
SET-54	Start Freq 3	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]
SET-55	Start Freq 4	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]
SET-56	**Stop** Freq 1	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]
SET-57	Stop Freq 2	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]
SET-58	Stop Freq 3	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]
SET-59	Stop Freq 4	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]	40.00 [Hz]
SET-60	Aux Start DT	5.0 [sec]	5.0 [sec]	5.0 [sec]	5.0 [sec]	5.0 [sec]	5.0 [sec]	5.0 [sec]	5.0 [sec]
SET-61	Aux Stop DT	2.0 [sec]	2.0 [sec]	2.0 [sec]	2.0 [sec]	2.0 [sec]	2.0 [sec]	2.0 [sec]	2.0 [sec]
SET-62	MMC AccTime	2.0 [sec]	2.0 [sec]	2.0 [sec]	2.0 [sec]	2.0 [sec]	2.0 [sec]	2.0 [sec]	2.0 [sec]
SET-63	MMC AccFreq	0.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]
SET-64	MMC DecTime	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]	2.0 [sec]	2.0 [sec]	30.0 [sec]	10.0 [sec]
SET-65	MMC DecFreq	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]
SET-66	AuxStartDiff	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]
SET-67	AuxStopDiff	0.0 [%]	0.0 [%]	0.0 [%]	0.0 [%]	0.0 [%]	0.0 [%]	0.0 [%]	0.0 [%]
SET-74	**Level Detect**	**No**	**No**	**No**	**No**	**No**	**Under Lvl**	**No**	**No**
SET-75	LDT Source	Current	Current	Current	Current	Current	Current	Current	Current
SET-76	LDT Freq	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]	59.00 [Hz]
SET-77	LDT Delay	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]	1[sec]	2 [sec]	2 [sec]
SET-78	LDT Level	0.0 [A]	0.0 [A]	0.0 [A]	0.0 [A]	0.0 [A]	0.0 [A]	0.0 [A]	0.0 [A]
SET-79	LDT Hyst	1.0 [A]	1.0 [A]	1.0 [A]	1.0 [A]	1.0 [A]	1.0 [A]	1.0 [A]	1.0 [A]
SET-80	**LDT Trip**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**
SET-81	LDT FillTime	0.0 [min]	0.0 [min]	0.0 [min]	0.0 [min]	0.0 [min]	60.0 [min]	0.0 [min]	0.0 [min]

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque
SET-82	LDT Relay	None	None	None	None	None	None	None	None
SET-90	**LocalRemKey**	Cntl&Ref Run	Cntl&Ref Run	Cntl&Ref Run	Cntl&Ref Run	Cntl&Ref Run	Cntl&Ref Run	Cntl&Ref Run	Cntl&Ref Stop

5.2 [DRV] Drive parameter group

CODE	Comm. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
DRV-00	9200	Command/ Output Frequency	Cmd. freq	0.00 to FG1-30[Hz]	☑	68
DRV-01	9201	Step Frequency 1	Step Freq-1			
DRV-02	9202	Step Frequency 2	Step Freq-2			
DRV-03	9203	Step Frequency 3	Step Freq-3			
DRV-04	9204	Step Frequency 4	Step Freq-4			
DRV-05	9205	Step Frequency 5	Step Freq-5			
DRV-06	9206	Step Frequency 6	Step Freq-6			
DRV-07	9207	Step Frequency 7	Step Freq-7			
DRV-08	9208	Step Frequency 8	Step Freq-8			
DRV-09	9209	Step Frequency 9	Step Freq-9			
DRV-10	920A	Step Frequency 10	Step Freq-10			
DRV-11	920B	Step Frequency 11	Step Freq-11			
DRV-12	920C	Step Frequency 12	Step Freq-12			
DRV-13	920D	Step Frequency 13	Step Freq-13			
DRV-14	920E	Step Frequency 14	Step Freq-14			
DRV-15	920F	Step Frequency 15	Step Freq-15			
DRV-16	9210	Jog Frequency Setting	Jog Freq			
DRV-17	9211	Output Current Display	Current	* [A]	Display	
DRV-18	9212	Motor Speed Display	Speed	* [rpm]		
DRV-19	9213	DC link Voltage Display	DC Link Vtg	* [V]		
DRV-20	9214	User Parameter Display	User Disp	*		
DRV-21	9215	Current Trip Display	Fault	*		
DRV-22	9216	Target/Output Frequency Display	Tar. Out. Freq.	* [Hz]		
DRV-23	9217	Reference/Feedback Values Display	Ref. Fbk. Freq.	* [Unit]		
DRV-24	9218	Frequency or Speed Selection	0 Hz 1 RPM	Hz or Rpm (Hz in PID control)	☑	66
DRV-25	9219	R/F=%, T/O=Hz for PID	R/F/T/O	0-100% and 0-Max.Hz	Display	
DRV-26	921A	V1, V2, V1S, and I inputs readings	V1, V2, V1S, I	Raw Value 0-4095		
DRV-30	**921E**	**Motor Overheat Trip Selection**	**MOH Trip Sel**	**000 to 111**	☒	
DRV-31	921F	Motor Overheat Temperature	MOH Temp. °C	0 to 255 [°C]		
DRV-32	9220	Motor Overheat Reset Hysteresis	MOH Hyst. °C	0 to 255 [°C]		
DRV-34	9222	**VFD High Temperature**	**VHT Value °C**	**0 to 255 [°C]**		
DRV-35	9223	Frequency Max. Limit at VHT	VHT Hz Limit	0 to FG1-30[Hz]	☑	
DRV-36	9224	VHT Reset Hysteresis T°	VHT Hyst.°C	0 to 255 [°C]		
DRV-38	**9226**	**Flow Switch Timer**	**Flow Timer**	**0 to 9999 [sec]**		
DRV-39	9227	Flow Switch monitoring frequency	Flow Freq.	0 to FG1-30[Hz]		
DRV-41	**9229**	**Dual Demand Mode Selection**	**Dual Demand**	0 **No** 1 **Yes**		67
DRV-42	922A	Pipe Leak Protection Selection	Pipe Leak	0 None 1 Alarm 2 Trip		
DRV-43	922B	How Long it Took for Last Wakeup	LastWakeup T	* [sec]	Display	
DRV-44	922C	Time to Wake up at High Demand	Tw Hi Demand	0 to DRV-45 [sec]	☑	
DRV-45	922D	Time to Wake up at Low Demand	Tw Lo Demand	0 to 9999 [sec]		
DRV-46	922E	Low Demand Pressure Set-point	LD Set-point	0 to SET-25 [Unit]		
DRV-47	922F	Low Demand Max. Freq. Limit	LD Max Freq.	0.00 to FG1-30 [Hz]		
DRV-48	9230	Low Demand Time Limit	LD Timer	0.0 to 600.0 [sec]		
DRV-51	**9233**	**I Input High Trigger Value (mA)**	I Hi Level	0.0 to 20.0 [mA]		68
DRV-52	9234	I Input High Hysteresis Value (mA)	I Hi Hyster.	0.0 to 20.0 [mA]		
DRV-53	9235	I Input High Level Trigger Delay	I Hi Delay	0 to 9999 [sec]		
DRV-55	9237	I Input Low Trigger Value (mA)	I Lo Level	0.0 to 20.0 [mA]		
DRV-56	9238	I Input Low Hysteresis Value (mA)	I Lo Hyster.	0.0 to 20.0 [mA]		

CODE	Comm. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
DRV-57	9239	I Input Low Level Trigger Delay	I Lo Delay	0 to 9999 [sec]		
DRV-61	**923D**	**V1 Input High Trigger Value (V)**	V Hi Level	0.0 to 12.0 [V]		
DRV-62	923E	V1 Input High Hysteresis Value (V)	V Hi Hyster.	0.0 to 12.0 [V]		
DRV-63	923F	V1 Input High Level Trigger Delay	V Hi Delay	0 to 9999 [sec]		
DRV-65	9241	V1 Input Low Trigger Value (V)	V Lo Level	0.0 to 12.0 [V]	☑	68
DRV-66	9242	V1 Input Low Hysteresis Value (V)	V Lo Hyster.	0.0 to 12.0 [V]	☑	
DRV-67	9243	V1 Input Low Level Trigger Delay	V Lo Delay	0 to 9999 [sec]		
DRV-70	**9246**	**Freq. Limit by Well Water Level**	Freq by Lvl	0 (None) 1 (I) 2 (V1)	☑	
DRV-91	925B	Drive Mode 2 (2nd Source)	DriveMode2	0 (Keypad) 1 (Remote-1) 2 (Remote-2)		
DRV-92	925C	Speed Control Reference 2 (2nd Source)	Speed Crl 2	0 (Keypad-1) 1 (Keypad-Up/Dwm) 2 (V1) 3 (V1S) 4 (I) 5 (V+I)	☒	69
DRV-93	925D	2nd Analog input Selection	Input Select	0 (V1) 1 (I)		
DRV-94	925E	2nd Analog Input Unit Selection	Input Unit	0 (Cust) 1 (PSI) 2 (Feet)	☒	
DRV-95	925F	2nd Analog Input Max. Value	In Max Value	0.0-3000.0		
DRV-96	9260	2nd Analog Input Actual Reading	In Reading	Display	-	
DRV-97	9261	Voltage (V) Reading on V1 Input	V1 Input V	0.0~12.0VDC	Display	70
DRV-98	9262	Current (mA) Reading on I Input	I Input mA	0.0~ 20.0mA		

5.3 [DRV] Parameter Group Default Settings

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant. Torque
DRV-00	Cmd. freq	0.00 [Hz]	0.50inWC	0.50inWC	80.00 [°F]	50.00 [PSI]	50.00 [PSI]	60.0inWC	0.00 [Hz]
DRV-01	Step Freq-1	10.00[Hz]	0.10inWC	0.10inWC	70.0 [°F]	52.0 [PSI]	52.0 [PSI]	50.0inWC	10.00[Hz]
DRV-02	Step Freq-2	20.00[Hz]	0.20inWC	0.20inWC	72.0 [°F]	54.0 [PSI]	54.0 [PSI]	52.0inWC	20.00[Hz]
DRV-03	Step Freq-3	30.00[Hz]	0.30inWC	0.30inWC	74.0 [°F]	56.0 [PSI]	56.0 [PSI]	54.0inWC	30.00[Hz]
DRV-04	Step Freq-4	40.00[Hz]	0.40inWC	0.40inWC	76.0 [°F]	58.0 [PSI]	58.0 [PSI]	56.0inWC	40.00[Hz]
DRV-05	Step Freq-5	50.00[Hz]	0.50inWC	0.50inWC	78.0 [°F]	60.0 [PSI]	60.0 [PSI]	58.0inWC	50.00[Hz]
DRV-06	Step Freq-6	40.00[Hz]	0.40inWC	0.40inWC	80.0 [°F]	62.0 [PSI]	62.0 [PSI]	60.0inWC	40.00[Hz]
DRV-07	Step Freq-7	30.00[Hz]	0.30inWC	0.30inWC	82.0 [°F]	64.0 [PSI]	64.0 [PSI]	62.0inWC	30.00[Hz]
DRV-08	Step Freq-8	20.00[Hz]	0.20inWC	0.20inWC	84.0 [°F]	66.0 [PSI]	66.0 [PSI]	64.0inWC	20.00[Hz]
DRV-09	Step Freq-9	10.00[Hz]	0.10inWC	0.10inWC	86.0 [°F]	68.0 [PSI]	68.0 [PSI]	66.0inWC	10.00[Hz]
DRV-10	Step Freq-10	20.00[Hz]	0.20inWC	0.20inWC	88.0 [°F]	70.0 [PSI]	70.0 [PSI]	68.0inWC	20.00[Hz]
DRV-11	Step Freq-11	30.00[Hz]	0.30inWC	0.30inWC	90.0 [°F]	68.0 [PSI]	68.0 [PSI]	70.0inWC	30.00[Hz]
DRV-12	Step Freq-12	40.00[Hz]	0.40inWC	0.40inWC	88.0 [°F]	66.0 [PSI]	66.0 [PSI]	68.0inWC	40.00[Hz]
DRV-13	Step Freq-13	50.00[Hz]	0.50inWC	0.50inWC	86.0 [°F]	64.0 [PSI]	64.0 [PSI]	66.0inWC	50.00[Hz]
DRV-14	Step Freq-14	40.00[Hz]	0.40inWC	0.40inWC	84.0 [°F]	62.0 [PSI]	62.0 [PSI]	64.0inWC	40.00[Hz]
DRV-15	Step Freq-15	30.00[Hz]	0.30inWC	0.30inWC	82.0 [°F]	60.0 [PSI]	60.0 [PSI]	62.0inWC	30.00[Hz]
DRV-16	Jog Freq	10.00[Hz]	0.10inWC	0.10inWC	80.0 [°F]	58.0 [PSI]	58.0 [PSI]	60.0inWC	10.00[Hz]
DRV-24	Hz/RPM	Hz	Hz	Hz	Hz	Hz	Hz	Hz	Hz
DRV-30	**MOH Trip Sel**	010	010	010	010	010	010	010	010
DRV-31	MOH Temp.°C	110 [°C]	110 [°C]	110 [°C]	110 [°C]	110 [°C]	110 [°C]	110 [°C]	110 [°C]
DRV-32	MOH Hyst. °C	5 [°C]	5 [°C]	5 [°C]	5 [°C]	5 [°C]	5 [°C]	5 [°C]	5 [°C]
DRV-34	**VHT Value °C**	75 [°C]	75 [°C]	75 [°C]	75 [°C]	75 [°C]	75 [°C]	75 [°C]	75 [°C]
DRV-35	VHT Hz Limit	55.0 [Hz]	55.0 [Hz]	55.0 [Hz]	55.0 [Hz]	55.0 [Hz]	55.0 [Hz]	55.0 [Hz]	55.0 [Hz]
DRV-36	VHT Hyst.°C	5 [°C]	5 [°C]	5 [°C]	5 [°C]	5 [°C]	5 [°C]	5 [°C]	5 [°C]

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant. Torque
DRV-38	**Flow Timer**	10 [sec]	10 [sec]	10 [sec]	10 [sec]	10 [sec]	10 [sec]	10 [sec]	10 [sec]
DRV-39	Flow Freq.	35.0 [Hz]	35.0 [Hz]	35.0 [Hz]	35.0 [Hz]	35.0 [Hz]	35.0 [Hz]	35.0 [Hz]	35.0 [Hz]
DRV-41	**Dual Demand**	No	No	No	No	No	No	No	No
DRV-42	Pipe Leak	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm	Alarm
DRV-44	Tw Hi Demand	20 [sec]	20 [sec]	20 [sec]	20 [sec]	20 [sec]	20 [sec]	20 [sec]	20 [sec]
DRV-45	Tw Lo Demand	20 [sec]	20 [sec]	20 [sec]	20 [sec]	20 [sec]	20 [sec]	20 [sec]	20 [sec]
DRV-46	LD Set-point	4.5 [Cust]	1.00inWC	1.00inWC	45.0 [°F]	45.0 [PSI]	45.0 [PSI]	45.0inWC	4.5 [Cust]
DRV-47	LD Max Freq.	40.0 [Hz]	40.0 [Hz]	40.0 [Hz]	40.0 [Hz]	40.0 [Hz]	40.0 [Hz]	40.0 [Hz]	40.0 [Hz]
DRV-48	LD Timer	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]
DRV-51	**I Hi Level**	19.0 [mA]	19.0 [mA]	19.0 [mA]	19.0 [mA]	19.0 [mA]	19.0 [mA]	19.0 [mA]	19.0 [mA]
DRV-52	I Hi Hyster.	1.0 [mA]	1.0 [mA]	1.0 [mA]	1.0 [mA]	1.0 [mA]	1.0 [mA]	1.0 [mA]	1.0 [mA]
DRV-53	I Hi Delay	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]
DRV-55	I Lo Level	5.0 [mA]	5.0 [mA]	5.0 [mA]	5.0 [mA]	5.0 [mA]	5.0 [mA]	5.0 [mA]	5.0 [mA]
DRV-56	I Lo Hyster.	1.0 [mA]	1.0 [mA]	1.0 [mA]	1.0 [mA]	1.0 [mA]	1.0 [mA]	1.0 [mA]	1.0 [mA]
DRV-57	I Lo Delay	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]
DRV-61	**V Hi Level**	9.00 [V]	9.00 [V]	9.00 [V]	9.00 [V]	9.00 [V]	9.00 [V]	9.00 [V]	9.00 [V]
DRV-62	V Hi Hyster.	1.00 [V]	1.00 [V]	1.00 [V]	1.00 [V]	1.00 [V]	1.00 [V]	1.00 [V]	1.00 [V]
DRV-63	V Hi Delay	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]
DRV-65	V Lo Level	0.50 [V]	0.50 [V]	0.50 [V]	0.50 [V]	0.50 [V]	0.50 [V]	0.50 [V]	0.50 [V]
DRV-66	V Lo Hyster.	1.00 [V]	1.00 [V]	1.00 [V]	1.00 [V]	1.00 [V]	1.00 [V]	1.00 [V]	1.00 [V]
DRV-67	V Lo Delay	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]	2 [sec]
DRV-70	**Freq By Lvl**	None	None	None	None	None	None	None	None
DRV-91	DriveMode2	Remote1	Remote1	Remote1	Remote1	Remote1	Remote1	Remote1	Remote1
DRV-92	Speed Crl 2	Keypad1	Keypad1	Keypad1	Keypad1	Keypad1	Keypad1	Keypad1	Keypad1
DRV-93	Input Select	V1	V1	V1	V1	V1	V1	V1	V1
DRV-94	Input Unit	Cust	Cust	Cust	Cust	Cust	Cust	Cust	Cust
DRV-95	In Max Value	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0	1000.0

5.4 [FG1] Function Group 1 parameter group

CODE	Com. Addr	Description	LCD Keypad Display	Setting Range	Adjust Run	Page
FG1-00	9300	Jump to Desired Code #	Jump Code	1 to 90	☑	74
FG1-01	9302	Acceleration Pattern	Acc. Pattern	0 (Linear) 1 (S-curve) 2 (U-curve)	☒	
FG1-02	**9303**	**Deceleration Pattern**	**Dec. Pattern**	0 (Linear) 1 (S-curve) 2 (U-curve)		
FG1-03	9304	Accel. S-Curve Ratio	Start Curve	0 to 100 [%]	☒	
FG1-04	9305	Decel. S-Curve Ratio	End Curve	0 to 100 [%]		
FG1-10	**930A**	**Pre-Heat**	**PreHeat Mode**	0 (No) 1 (Yes)	☒	
FG1-11	930B	Pre-Heat Value (%)	PreHeatLevel	1 to 50 [%]		72
FG1-12	930C	Pre-Heat Duty Cycle	PreHeatDuty	1 to 100 [%]		
FG1-13	930D	Pre-Heat Delay	PreHeatDelay	1 to 3600 [sec]		
FG1-20	**9314**	**Start Mode**	**Start Mode**	0 (Accel) 1 (Dc-start) 2 (Flying-start)	☒	
FG1-21	9315	DC Injection Start **Time**	DcSt Time	0.0 to 60.0 [sec]		
FG1-22	9316	DC Injection Start **Value**	DcSt Value	0 to 150 [%]		
FG1-24	9318	DC Injection Braking **On-delay**	DcBr Delay	0.10 to 60.00 [sec]	☒	

FG1-25	9319	DC Injection Braking **Frequency**	DcBr Freq	0.10 to 60.00 [Hz]		
FG1-26	931A	DC Injection Braking **Time**	DcBr Time	1.0 to 60.0 [sec]		
FG1-27	931B	DC Injection Braking **Value**	DcBr Value	0 to 200 [%]		
FG1-29	**931D**	**Power Source Freq**	**Line Freq**	40 to 120 [Hz]	☒	73
FG1-30	931E	Maximum Frequency	Max Freq	40 to 120 [Hz]		
FG1-31	931F	Base Frequency	Base Freq	30 to 120 [Hz]		
FG1-32	9320	Starting Frequency	Start Freq	0.01 to 10.00 [Hz]		
FG1-40	**9328**	**Volts/Hz Pattern**	**V/F Pattern**	0 (Linear) 1 (Square) 2 (User V/F)	☒	
FG1-41	9329	User V/F - Frequency 1	User Freq 1	0 to FG1-30	☒	74
FG1-42	932A	User V/F - Voltage 1	User Volt 1	0 to 100 [%]		74
FG1-43	932B	User V/F - Frequency 2	User Freq 2	0.00 to FG1-30		
FG1-44	932C	User V/F - Voltage 2	User Volt 2	0 to 100 [%]		
FG1-45	932D	User V/F - Frequency 3	User Freq 3	0.00 to FG1-30		
FG1-46	932E	User V/F - Voltage 3	User Volt 3	0 to 100 [%]		
FG1-47	932F	User V/F - Frequency 4	User Freq 4	0.00 to FG1-30		
FG1-48	9330	User V/F - Voltage 4	User Volt 4	0 to 100 [%]		
FG1-51	**9333**	**Energy Save**	**Energy Save**	0 (None) 1 (Manual) 2 (Auto)	☒	
FG1-52	9334	Energy Save %	Manual Save%	0 to 30 [%]	☑	
FG1-54	9336	Integrating Wattmeter	KiloWattHour	M kWh	Display	
FG1-55	9337	Inverter Temperature	Inv. Temp.	0 to 160 [°C]		
FG1-56	9338	Motor Temperature	Motor Temp.	0 to 160 [°C]		
FG1-57	**9339**	**No Motor Trip Selection**	**No Motor Sel**	0 (No) 1 (Yes)	☒	
FG1-58	933A	No Motor Trip Current Level	NoMotorLevel	5 to 100 [%]	☑	
FG1-59	933B	No Motor Trip Time Setting	NoMotorTime	0.1 to 10.0 [Sec]		
FG1-60	**933C**	**Electronic Motor Overload**	**ETH Select**	0 (No) 1 (Yes)	☑	
FG1-61	933D	Electronic Thermal Level for 1 Minute	ETH 1min	FG1-62 to 200 [%]		
FG1-62	933E	Electronic Thermal Level for Continuous (Service Factor)	ETH Cont	50 to FG1-61[%] (Maximum 200%)		
FG1-63	933F	Motor Cooling Type Selection	Motor Type	0 (Self-cool) 1 (Forced-cool)	☑	75
FG1-64	9340	Overload Warning Level	OL Level	30 to 110 [%]	☑	
FG1-65	9341	Overload Warning Time	OL Time	0.0 to 30.0 [sec]		
FG1-66	**9342**	**Overload Trip Selection**	**OLT Select**	0 (No) 1 (Yes)		
FG1-67	9343	Overload Trip Level	OLT Level	30 to 150 [%]		
FG1-68	9344	Overload Trip Delay Time	OLT Time	0.0 to 60.0 [sec]		
FG1-69	9345	Input/Output Phase Loss Protection	Trip Select	000 to 111 (Bit Set)	☑	
FG1-70	**9346**	**Stall Mode Selection**	**Stall Mode**	0 (No) 1 (Yes)	☒	
FG1-71	9347	Stall Mode Level	Stall Level	30 to 200 [%]		
FG1-73	**9349**	**Frequency Range for Acc/Dec**	Acc/Dec Freq	0 (Max Freq) 1 (Delta Freq)	☒	
FG1-74	934A	Accel/Decel Time Scale	Time Scale	0 (0.01 sec) 1 (0.1 sec) 2 (1 sec)	☒	76
FG1-81	**9351**	**Start Delay at Run Command**	Run Delay T	0 to 6000 sec	☑	
FG1-82	9352	Backspin Timer	Backspin TMR	0 to 6000 sec		
FG1-90	935A	Up/Down Save Mode	UpDnSaveMode	0 (No) 1 (Yes)	☒	
FG1-91	935B	Up/Down Save Freq	xx.xxHz	0.00 to FG1-30 [Hz]	Display	

5.5 [FG1] Parameter Group Default Settings

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifug. Pump	Submers. Pump	Vacuum Pump	Constant Torque
FG1-00	Jump Code	70	70	70	70	70	70	70	70
FG1-02	**Acc. Pattern**	**(Linear)**	**(Linear)**	**(Linear)**	**(Linear)**	**(Linear)**	**(Linear)**	**(Linear)**	**(Linear)**
FG1-03	Dec. Pattern	(Linear)	(Linear)	(Linear)	(Linear)	(Linear)	(Linear)	(Linear)	(Linear)
FG1-04	Start Curve	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]
FG1-05	End Curve	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]
FG1-10	**PreHeat Mode**	**(No)**	**(No)**	**(No)**	**(No)**	**(No)**	**(No)**	**(No)**	**(No)**
FG1-11	PreHeatLevel	20 (%)	20 (%)	20 (%)	20 (%)	20 (%)	20 (%)	20 (%)	20 (%)
FG1-12	PreHeatDuty	30 (%)	30 (%)	30 (%)	30 (%)	30 (%)	30 (%)	30 (%)	30 (%)
FG1-13	PreHeat Delay	1800 [sec]	1800 [sec]	1800 [sec]	1800 [sec]	1800 [sec]	1800 [sec]	1800 [sec]	1800 [sec]
FG1-20	**Start Mode**	**Accel**	**Accel**	**Accel**	**Accel**	**Accel**	**Accel**	**Accel**	**Accel**
FG1-21	DcSt Time	0.0 [sec]	0.0 [sec]	0.0 [sec]	0.0 [sec]	0.0 [sec]	0.0 [sec]	0.0 [sec]	0.0 [sec]
FG1-22	DcSt Value	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]
FG1-24	DcBr Delay	0.1 [sec]	0.1 [sec]	0.1 [sec]	0.1 [sec]	0.1 [sec]	0.1 [sec]	0.1 [sec]	0.1 [sec]
FG1-25	DcBr Freq	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]
FG1-26	DcBr Time	3.0 [sec]	3.0 [sec]	3.0 [sec]	3.0 [sec]	3.0 [sec]	3.0 [sec]	3.0 [sec]	3.0 [sec]
FG1-27	DcBr Value	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]
FG1-29	**Line Freq**	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]
FG1-30	Max Freq	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]
FG1-31	Base Freq	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]
FG1-32	Start Freq	0.5 [Hz]	0.5 [Hz]	0.5 [Hz]	0.5 [Hz]	0.5 [Hz]	0.5 [Hz]	0.5 [Hz]	0.5 [Hz]
FG1-40	**V/F Pattern**	(Linear)	(Linear)	(Linear)	(Linear)	(Linear)	(Linear)	(Linear)	(Linear)
FG1-41	User Freq 1	15.00 [Hz]	15.00 [Hz]	15.00 [Hz]	15.00 [Hz]	15.00 [Hz]	15.00 [Hz]	15.00 [Hz]	15.00 [Hz]
FG1-42	User Volt 1	25 [%]	25 [%]	25 [%]	25 [%]	25 [%]	25 [%]	25 [%]	25 [%]
FG1-43	User Freq 2	30.00 [Hz]	30.00 [Hz]	30.00 [Hz]	30.00 [Hz]	30.00 [Hz]	30.00 [Hz]	30.00 [Hz]	30.00 [Hz]
FG1-44	User Volt 2	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]	50 [%]
FG1-45	User Freq 3	45.00 [Hz]	45.00 [Hz]	45.00 [Hz]	45.00 [Hz]	45.00 [Hz]	45.00 [Hz]	45.00 [Hz]	45.00 [Hz]
FG1-46	User Volt 3	75 [%]	75 [%]	75 [%]	75 [%]	75 [%]	75 [%]	75 [%]	75 [%]
FG1-47	User Freq 4	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]
FG1-48	User Volt 4	100[%]	100[%]	100[%]	100[%]	100[%]	100[%]	100[%]	100[%]
FG1-51	**Energy Save**	**(None)**	**(None)**	**(None)**	**(None)**	**(None)**	**(None)**	**(None)**	**(None)**
FG1-52	Manual Save%	10 [%]	10 [%]	10 [%]	10 [%]	10 [%]	10 [%]	10 [%]	10 [%]
FG1-57	**No Motor Sel**	**[Yes]**	**[Yes]**	**[Yes]**	**[Yes]**	**[Yes]**	**[Yes]**	**[Yes]**	**[Yes]**
FG1-58	NoMotorLevel	5 [%]	5 [%]	5 [%]	5 [%]	5 [%]	5 [%]	5 [%]	5 [%]
FG1-59	NoMotorTime	0.2 [sec]	0.2 [sec]	0.2 [sec]	0.2 [sec]	0.2 [sec]	0.2 [sec]	0.2 [sec]	0.2 [sec]
FG1-60	**ETH Select**	**[Yes]**	**[Yes]**	**[Yes]**	**[Yes]**	**[Yes]**	**[Yes]**	**[Yes]**	**[Yes]**
FG1-61	ETH 1min	120 [%]	120 [%]	120 [%]	120 [%]	120 [%]	105 [%]	120 [%]	120 [%]
FG1-62	ETH Cont	110 [%]	110 [%]	110 [%]	110 [%]	110 [%]	100 [%]	110 [%]	110 [%]
FG1-63	Motor Type	(Self-cool)	(Self-cool)	(Self-cool)	(Self-cool)	(Self-cool)	(Self-cool)	(Self-cool)	(Self-cool)
FG1-64	OL Level	105 [%]	105 [%]	105 [%]	105 [%]	105 [%]	105 [%]	105 [%]	105 [%]
FG1-65	OL Time	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]
FG1-66	**OLT Select**	**[Yes]**	**[Yes]**	**[Yes]**	**[Yes]**	**[No]**	**[No]**	**[No]**	**[No]**
FG1-67	OLT Level	110[%]	110[%]	110[%]	110[%]	110[%]	110[%]	110[%]	110[%]
FG1-68	OLT Time	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]
FG1-69	Trip Select	111	111	111	111	111	111	111	111
FG1-70	**Stall Mode**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**	**Yes**
FG1-71	Stall Level	110[%]	110[%]	110[%]	110[%]	110[%]	110[%]	110[%]	110[%]
FG1-73	**Acc/Dec Freq**	0 (Max freq)	0 (Max freq)	0 (Max freq)	0 (Max freq)	0 (Max freq)	0 (Max freq)	0 (Max freq)	0 (Max freq)
FG1-74	Time Scale	0.1 [sec]	0.1 [sec]	0.1 [sec]	0.1 [sec]	0.1 [sec]	0.1 [sec]	0.1 [sec]	0.1 [sec]
FG1-81	**Run Delay T**	0 [sec]	0 [sec]	0 [sec]	0 [sec]	0 [sec]	0 [sec]	0 [sec]	0 [sec]
FG1-82	Backspin TMR	0 [sec]	0 [sec]	0 [sec]	0 [sec]	0 [sec]	0 [sec]	0 [sec]	0 [sec]
FG1-90	UpDnSave	(No)	(No)	(No)	(No)	(No)	(No)	(No)	(No)

5.6 [FG2] Function Group 2 parameter group

CODE	Com. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page

FG2-00	9400	Jump to Desired Code #	Jump Code	1 to 95	☑	77
FG2-01	9401	Last trip 1	Last Trip-1	Press **[ENTER]** then **[▲]** key to see Hz, **[▲]** Amps, **[▲]** Mode and **[▲]** trip time then **[ENTER]**	Display ☑	
FG2-02	9402	Last trip 2	Last Trip-2			
FG2-03	9403	Last trip 3	Last Trip-3			
FG2-04	9404	Last trip 4	Last Trip-4			
FG2-05	9405	Last trip 5	Last Trip-5			
FG2-06	9406	Erase trips	Erase Trips	0 (No) 1 (Yes)	☑	
FG2-07	9407	Last Trip Time	LastTripTime	X:XX:XX:XX:XX:X	Display	
FG2-08	9408	Power On Time	On-Time	X:XX:XX:XX:XX:X		
FG2-09	9409	Run-time	Run-Time	X:XX:XX:XX:XX:X		
FG2-10	940A	Dwell Time	Dwell Time	0 to 6000 [sec]	☒	77
FG2-11	940B	Dwell/ Frequency	Dwell Freq	FG1-32 to FG1-30		
FG2-12	940C	Jump Frequency Selection	Jump Freq	0 (No) 1 (Yes)	☒	
FG2-13	940D	Jump Frequency 1 Low	Jump Low 1	FG1-32 to FG2-14	☑	
FG2-14	940E	Jump Frequency 1 High	Jump High 1	FG2-13 to Max		
FG2-15	940F	Jump Frequency 2 Low	Jump Low 2	FG1-32 to FG2-16		
FG2-16	9410	Jump Frequency 2 High	Jump High 2	FG2-15 to Max		
FG2-17	9411	Jump Frequency 3 Low	Jump Low 3	FG1-32 to FG2-18		
FG2-18	9412	Jump Frequency 3 High	Jump High 3	FG2-17 to Max		
FG2-19	9413	Power ON Start Selection	Power On Run	0 (No) 1 (Yes)	☑	78
FG2-20	**9414**	**Start Delay Time** at Power Up	PwrUpRun Dly	0 to 9999 sec	☑	
FG2-21	9415	Restart after Fault Reset	RST Restart	0 (No) 1 (Yes)	☑	
FG2-22	9416	IPF Mode	IPF Mode	0 (No) 1 (Yes)	☒	
FG2-24	**9418**	**Retry Selection**	**Retry Mode**	0 (No) 1 (Yes)	☑	
FG2-25	9419	Number of Auto Retry	Retry Number	0 to 10		
FG2-26	941A	Delay Time Before Auto Retry	Retry Delay	0 to 6000 [sec]		
FG2-27	941B	Flying Start Level	FlySt Level	50 to160 [%]	☒	
FG2-30	941C	Flying Start Mode	FlySt Mode	0 (No) 1 (Yes)	☑	
FG2-42	**942A**	**Rated Motor Slip RPM**	Rated Slip	0 to 16% of motor RPM	☒	
FG2-44	942C	No Load Motor Current (RMS)	Noload Curr	0.5 to 999.9 [A]		79
FG2-46	942E	Load Inertia	InertiaRate	1 to 40		
FG2-47	942F	Scale for Motor Speed Display	RPM Scale	1 to 1000 [%]	☑	
FG2-49	9430	PWM Type Selection	PWM Mode	0 (Normal) 1 (Low leakage)	☒	
FG2-60	**943C**	**Control Mode Selection**	**Control Mode**	0 (V/F) 1 (Slip compen) 2 (Sensorless)	☒	
FG2-61	943D	Auto Tuning Selection	Auto Tuning	0 (No) 1 (Yes)	☒	
FG2-62	943E	Motor Stator Resistance	%Rs	0 to Motor Nom. Ω		
FG2-63	943F	Motor Leakage Inductance	%Lsigma	0 to Motor Nom. mH		
FG2-64	9440	Pre-Excitation (Magnetization) Time	PreEx Time	0.0 to 60.0 [sec]	☑	
FG2-67	**9443**	**Manual or Auto Torque Boost**	Torque Boost	0 (Manual) 1 (Auto)	☒	
FG2-68	9444	Forward Torque Boost	Fwd Boost	0.0 to 15.0 [%]		
FG2-69	9445	Reverse Torque Boost	Rev Boost	0.0 to 15.0 [%]		
FG2-80	9450	Power On display	PowerOn Disp	0 to 27	☑	80
FG2-81	9451	User Display Selection	User Disp	0 (Voltage) 1 (kWatt)		
FG2-82	9452	Cerus Software Version	Cerus S/W	Ver 1.0	Display	
FG2-87	9457	Scaling for Power Meter	PowerSet	0.1 to 400.0 %	☑	

FG2-90	945A	Parameter Display	Para. Disp	0	(Default)		
				1	(All Para)		
				2	(Diff Para)		
FG2-91	**945B**	**Save Parameters to Keypad**	**Para. Read**	0	(No)	☒	
				1	(Yes)		
FG2-92	945C	Load Parameters from Keypad	Para. Write	0	(No)	☒	
				1	(Yes)		
FG2-93	945D	Initialize Parameters	Para. Init	0	(No)	☒	81
				1	(All Groups)		
				2	(DRV)		
				3	(FG1)		81
				4	(FG2)		
				5	(I/O)		
				6	(APP)		
				7	(COM)		
				8	(EXT)		
FG2-94	945E	Lock Code (Parameters Protection)	Para. Lock	0 to 9999		☑	
FG2-95	945F	Save Parameters Changes to VFD	Para. Save	0	(No)	☒	
				1	(Yes)		
FG2-97	9461	Voltage Reading on V1 Input	V1 Input V	00.00 to 12.00 (V)		Display	
FG2-98	9462	mA Reading on I Input	I Input mA	00.00-20.00 (mA)			

5.7 [FG2] Parameter Group Default Settings

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque
FG2-00	Jump Code	22	22	22	22	22	22	22	22
FG2-06	Erase Trips	No	No	No	No	No	No	No	No
FG2-10	Dwell Time	0 [sec]	0 [sec]	0 [sec]	0 [sec]	0 [sec]	0 [sec]	0 [sec]	0 [sec]
FG2-11	Dwell Freq	5.00 [Hz]	5.00 [Hz]	5.00 [Hz]	5.00 [Hz]	40.00 [Hz]	45.00 [Hz]	5.00 [Hz]	5.00 [Hz]
FG2-12	Jump Freq	No	No	No	No	No	No	No	No
FG2-13	Jump Low 1	10.00 [Hz]	10.00 [Hz]	10.00 [Hz]	10.00 [Hz]	10.00 [Hz]	10.00 [Hz]	10.00 [Hz]	10.00 [Hz]
FG2-14	Jump High 1	15.00 [Hz]	15.00 [Hz]	15.00 [Hz]	15.00 [Hz]	15.00 [Hz]	15.00 [Hz]	15.00 [Hz]	15.00 [Hz]
FG2-15	Jump Low 2	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]	20.00 [Hz]
FG2-16	Jump High 2	25.00 [Hz]	25.00 [Hz]	25.00 [Hz]	25.00 [Hz]	25.00 [Hz]	25.00 [Hz]	25.00 [Hz]	25.00 [Hz]
FG2-17	Jump Low 3	30.00 [Hz]	30.00 [Hz]	30.00 [Hz]	30.00 [Hz]	30.00 [Hz]	30.00 [Hz]	30.00 [Hz]	30.00 [Hz]
FG2-18	Jump High 3	35.00 [Hz]	35.00 [Hz]	35.00 [Hz]	35.00 [Hz]	35.00 [Hz]	35.00 [Hz]	35.00 [Hz]	35.00 [Hz]
FG2-19	Power On Run	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	0 (No)
FG2-20	PwrUpRun Dly	10 [sec]	10 [sec]	10 [sec]	10 [sec]	10 [sec]	10 [sec]	10 [sec]	10 [sec]
FG2-21	RST Restart	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	0 (No)
FG2-22	IPF Mode	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)
FG2-24	**Retry Mode**	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	1 (Yes)	0 (No)
FG2-25	Retry Number	3	3	3	3	3	3	3	0
FG2-26	Retry Delay	120 [sec]	120 [sec]	120 [sec]	120 [sec]	120 [sec]	120 [sec]	120 [sec]	120 [sec]
FG2-27	FlySt Level	70 [%]	70 [%]	70 [%]	70 [%]	70 [%]	70 [%]	70 [%]	70 [%]
FG2-30	FlySt Mode	No	No	No	No	No	No	No	No
FG2-42	Rated Slip	50 [RPM]	50 [RPM]	50 [RPM]	50 [RPM]	50 [RPM]	150 [RPM]	150 [RPM]	50 [RPM]
FG2-44	Noload Curr	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP
FG2-46	InertiaRate	10	10	10	10	10	10	10	10
FG2-47	RPM Scale	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]
FG2-49	PWM Mode	(Normal 1)	(Normal 1)	(Normal 1)	(Normal 1)	(Normal 1)	(Normal 1)	(Normal 1)	(Normal 1)
FG2-50	Safety Time	100.0 sec	100.0 sec	100.0 sec	100.0 sec	100.0 sec	100.0 sec	100.0 sec	100.0 sec
FG2-51	SafetyGain	21	21	21	21	21	21	21	21
FG2-60	Control Mode	0 (V/F)	0 (V/F)	0 (V/F)	0 (V/F)	0 (V/F)	0 (V/F)	0 (V/F)	0 (V/F)
FG2-61	Auto Tuning	No	No	No	No	No	No	No	No
FG2-62	%Rs	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP
FG2-63	%Lsigma	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD	By VFD HP

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifugal Pump	Submersible Pump	Vacuum Pump	Constant Torque
								HP	
FG2-64	PreEx Time	0.0 sec.	0.0 sec.	0.0 sec.	0.0 sec.	0.0 sec.	0.0 sec.	0.0 sec.	0.0 sec.
FG2-67	Torque Boost	0 (Manual)	0 (Manual)	0 (Manual)	0 (Manual)	0 (Manual)	0 (Manual)	0(Manual)	0 (Manual)
FG2-68	Fwd Boost	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
FG2-69	Rev Boost	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
FG2-80	PowerOn Disp	0	0	0	0	0	0	0	0
FG2-81	User Disp	Voltage	Voltage	Voltage	Voltage	Voltage	Voltage	Voltage	Voltage
FG2-87	PowerSet	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %
FG2-90	Para. Disp	0 (Default)	0 (Default)	0 (Default)	0 (Default)	0 (Default)	0 (Default)	0(Default)	0 (Default)
FG2-91	**Para. Read**	No	No	No	No	No	No	No	No
FG2-92	Para. Write	No	No	No	No	No	No	No	No
FG2-93	Para. Init	No	No	No	No	No	No	No	No
FG2-94	Para. Lock	0	0	0	0	0	0	0	0
FG2-95	Para. Save	No	No	No	No	No	No	No	No

5.8 [I/O] Inputs/Outputs parameter group

CODE	Comm. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
I/O-00	9500	Jump to desired code #	Jump Code	1 to 98	☑	85
I/O-01	9501	**V1 Input Noise Filtering Time**	**V1 Filter**	0 to 9999 [ms]		
I/O-02	9502	V1 Input Minimum Value	V1 V Min	0.00 to I/O-04 [V]		
I/O-03	9503	Frequency at V1 Input Minimum Value	V1 Freq Min	0.00 to FG1-30 [Hz]	☑	
I/O-04	9504	V1 Input Maximum Value	V1 V Max	I/O-02 to 12.00[V]		
I/O-05	9505	Frequency at V1 Input Maximum Value	V1 Freq Max	0.00 to FG1-30 [Hz]		
I/O-06	9506	**I Input Noise Filtering Time**	**I Filter**	0 to 9999 [ms]		
I/O-07	9507	I Input Minimum Value	I mA Min	0.00 to I/O-09 [mA]		
I/O-08	9508	Frequency at I Input Minimum Value	I Freq Min	0.00 to FG1-30 [Hz]	☑	
I/O-09	9509	I Input Maximum Value	I mA Max	I/O-07 to 20.00 [mA]		
I/O-10	950A	Frequency at I Input Maximum Value	I Freq Max	0.00 to FG1-30		
I/O-16	950B	LOI/V Latch	LOI/V Latch	0 (No) 1 (Yes)		83
I/O-17	**9511**	**Criteria for Analog Signal Loss**	V/I Loss Lvl	0 (None) 1 (Half of Min) 2 (Below Min)	☑	
I/O-18	9512	Action at Analog Signal Loss	Lost Command	0 (LastFreq Run) 1 (Coast Stop) 2 (Decel Stop) 3 (Trip Stop)	☒	
I/O-19	9513	V or I Signal Loss Time Delay	V/I Loss Dly	0.1 to 120.0 [sec]	☑	
I/O-20	9514	**Programmable Digital Input** Terminal 'M1' Define	M1 Define	0 (Speed-L) 1 (Speed-M) 2 (Speed-H) 3 (XCEL-L) 4 (XCEL-M) 5 (Reserved) 6 (DC Inj.Brake) 7 (2nd Function) 8 (Exchange) 9 (LAG_Enable) 10 (Up) 11 (Down) 12 (3-Wire) 13 (Ext Trip)	☑	

CODE	Comm. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
				14 (Pre-Heat)		
				15 (PID-i Clear)		
				16 (Disable PID)		
				17 (LOC/REM)		
				18 (Analog hold)		
				19 (XCEL stop)		
				20 (P Gain2)		
				21 (Another LEAD)		
				22 (interlock1)		
				23 (interlock2)		
				24 (interlock3)		
				25 (interlock4)		
				26 (Speed_X)		
				27 (Fault Reset)		
				28 (E-Stop BX)		
				29 (JOG Speed)		
				30 (FWD Run FX)		
				31 (REV Run RX)		
				32 (V/I Change)		
				33 (LEAD Switch)		
				34 (Up/Dwn Clear)		
				35 (Jog FWD Run)		
				36 (Jog REV Run)		
				37 (Damper Sw)		
				38 (Smoke Purge)		
				39 (Com/Main)		
				40 (FLOW Switch)		83
				41 (HOA Hand/Off)		
				42 (ALT Input)		
I/O-21	9515	Programmable Digital Input Terminal 'M2' Define	M2 Define	Same as I/O-20		
I/O-22	9516	Programmable Digital Input Terminal 'M3' Define	M3 Define	Same as I/O-20		
I/O-23	9517	Programmable Digital Input Terminal 'M4' Define	M4 Define	Same as I/O-20		
I/O-24	9518	Programmable Digital Input Terminal 'M5' Define	M5 Define	Same as I/O-20	☑	
I/O-25	9519	Programmable Digital Input Terminal 'M6' Define	M6 Define	Same as I/O-20		
I/O-26	951A	Programmable Digital Input Terminal 'M7' Define	M7 Define	Same as I/O-20		
I/O-27	951B	Programmable Digital Input Terminal 'M8' Define	M8 Define	Same as I/O-20		
I/O-28	**951C**	**Digital Inputs Status**	In Status	00000000000 (bit)	Display	
I/O-29	951D	Digital Input Filter Time	DI Filter	2-1000 [ms]	☑	
I/O-30	**951E**	**E-Stop BX Auto Reset**	BX Self Reset	0 (No)		
				1 (Yes)		85
I/O-31	951F	Smoke Purge Mode Selection	SmokeP Mode	0 (At MaxSpeed)		
				1 (At M Speeds)		
				2 (PID M S-P)		
I/O-33	**9521**	**VFD #1 or VFD #2 Selection**	VFD ID Sel	0 VFD-1	☒	
				1 VFD-2		
I/O-34	9522	**Duplex Mode Selection**	Duplex Mode	0 (None)		
				1 (Lead SW/FLT)		
				2 (Timer/FLT)		86
				3 (PowerUp/FLT)		
I/O-35	9523	Lead or Lag VFD Selection	Lead/Lag Sel	0 (Lead VFD)		
				1 (Lag VFD)	☑	
I/O-36	9524	Alternating Timer (Lead Run Time)	ALT Timer	1-3000 [hrs]		

CODE	Comm. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
I/O-37	9525	Lead or Lag Present Mode Display	Lead/Lag Now	0 (Lead Now) 1 (Lag Now)	Display	
I/O-45	**952D**	**In-Out Timer Input Selection**	Timer Input	0 (M1) 1 (M2) 2 (M3) 3 (M4) 4 (M5) 5 (M6) 6 (M7) 7 (M8)	☑	87
I/O-46	952E	In-Out Timer Mode Selection	Timer Mode	0 (ON Delay) 1 (OFF Delay) 2 (ONE Pulse) 3 (SYMM Pulses)		87
I/O-47	952F	In-Out Timer Setting	Timer Set	0 to 6000 [sec]		
I/O-48	9530	Timer N.O./N.O. Input Selection	NO/NC TMR In	0 (Normal Open) 1 (Normal Closed)		
I/O-49	**9531**	**Accel/Decel Change Frequency**	XCEL-L Ch Hz	0.00 to FG1-30 [Hz]	☒	
I/O-50	9532	Acceleration Time 1 (XCEL-L)	Acc Time-1	0.0 to 600.0 [sec]	☑	88
I/O-51	9533	Deceleration Time 1 (XCEL-L)	Dec Time-1			
I/O-52	9534	Acceleration Time 2 (XCEL-M)	Acc Time-2			
I/O-53	9535	Deceleration Time 2 (XCEL-M)	Dec Time-2			
I/O-54	9536	Acceleration Time 3 (XCEL-L+M)	Acc Time-3			
I/O-55	9537	Deceleration Time 3 (XCEL-L+M)	Dec Time-3			
I/O-68	**9544**	**Damper or Lubrication Mode**	**Dmpr LubeSel**	0 (None) 1 (Damper) 2 (Lubrication)	☒	
I/O-69	9545	Damper/Lubrication Mode Timer	Dmpr/LubeTMR	0 to 6000 [sec]	☑	
I/O-70	**9546**	**S0 Output Selection**	**S0 Mode**	0 (Frequency) 1 (Current) 2 (Voltage) 3 (kW) 4 (Reserved) 5 (DC LinkVolt) 6 I Input 7 V Input	☑	
I/O-71	9547	S0 Output Scale	S0 Adjust	10 to 200 [%]		
I/O-72	9548	S1 Output Selection	S1 Mode	Same as I/O-70		
I/O-73	9549	S1 Output Scale	S1 Adjust	10 to 200 [%]		
I/O-74	**954A**	**Frequency Detection Hz Value**	**FDT Freq**	0.00 to FG1-30 [Hz]	☑	89
I/O-75	954B	Frequency Detection Bandwidth	FDT Band	0.00 to FG1-30 [Hz]		
I/O-76	**954C**	**Programmable Digital Output** Relay1 Define **(A1-C1)**	Aux Relay1	0 (NONE) 1 (FDT-1) 2 (FDT-2) 3 (FDT-3) 4 (FDT-4) 5 (FDT-5) 6 (OL) 7 (IOL) 8 (Stall) 9 (OV) 10 (LV) 11 (OH) 12 (Lost Command) 13 (RUN) 14 (STOP) 15 (Steady) 16 (Pre-PID Mode)	☑	

CODE	Comm. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
				17 (Sleep Mode) 18 (SpeedSearch) 19 (Ready) 20 (MMC) 21 (Local) 22 (Remote) 23 (PIPE BROKEN) 24 (Damper) 25 (Lube Only) 26 (Lube/Refill) 27 (LEVEL DETECT) 28 (Screen Clean) 29 (In-Out Timer) 30 (Over Pressure) 31 (I Hi Level) 32 (I Lo Level) 33 (V Hi Level) 34 (V Lo Level) 35 (THIS LEAD) 36 (Pipe Leak) 37 (V1 Max. Lvl) 38 (I Max. Lvl) 39 (Lost I Latch) 40 (Fan Check)		89
I/O-77	954D	Programmable Digital Output Relay2 Define **(A2-C2)**	Aux Relay2	Same as I/O-76	☑	
I/O-78	954E	Programmable Digital Output Relay3 Define **(A3-C3)**	Aux Relay3	Same as I/O-76		
I/O-79	954F	Programmable Digital Output Relay4 Define **(A4-C4)**	Aux Relay4	Same as I/O-76		
I/O-80	**9550**	**Fault Relay (3A-3B-3C)** Mode	FltRelayMode	000 to 111 [bit]	☑	92
I/O-81	9551	Output Relays Status	Out Status	00000000 <…Aux2, Aux1	Display	93
I/O-82	9552	Fault Relay On Delay	RelayOnDly	0 to 9999 [sec]	☒	
I/O-83	9553	Fault Relay Off Delay	RelayOffDly	0 to 9999 [sec]		
I/O-84	**9554**	**Fan Control Mode Selection**	Fan Control	0 Power On 1 Run 2 Temperature	☒	
I/O-85	9555	Fan Start Temp	Fan Temp	0 to 60 [°C] Hyst=5°C	☑	
I/O-86	**9556**	**Screen Clean Timer Setting**	**TMR to Clean**	**0.0 to 3000.0 [min]**	☑	
I/O-87	9557	Screen Clean Duration Time	Clean Time	0.0 to 300.0 [min]		
I/O-90	**955A**	**Inverter Communication ID#**	Inv No.	1 to 250	☑	
I/O-91	955B	Baud Rate Selection	Baud Rate	0 (9600 bps) 1 (19200 bps) 2 (38400 bps) 3 (57600 bps) 4 (76800 bps)	☑	
I/O-92	955C	Operating Method at Loss of Communication	COM Lost Cmd	0 (LastFreq Run) 1 (Coast Stop) 2 (Decel Stop)		
I/O-93	955D	Communication Loss Delay	COM Time Out	0.1-120.0 [sec]	☑	
I/O-94	955E	Comm. Response Delay Time	Delay Time	5-1000 [ms]		
I/O-95	955F	**Digital Inputs N.O./N.C.** Selection	In No/Nc Set	00000000000 <…..M2, M1	☒	94
I/0-98	9562	Analog Test Signal on S0 Output	S0 Test Out	0 (No) 1 (Yes)	☒	

5.9 [I/O] Parameter Group Default Settings

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifug. Pump	Submers. Pump	Vacuum Pump	Constant Torque
I/O-00	Jump Code	28	28	28	28	28	28	28	28
I/O-01	**V1 Filter**	200 [ms]	200 [ms]	200 [ms]	200 [ms]	200 [ms]	200 [ms]	200 [ms]	200 [ms]
I/O-02	V1 V Min	0.00 [V]	0.00 [V]	0.00 [V]	0.00 [V]	0.00 [V]	0.00 [V]	0.00 [V]	0.00 [V]
I/O-03	V1 Freq Min	0.00 [Hz]	0.00 [Hz]	0.00 [Hz]	0.00 [Hz]	0.00 [Hz]	0.00 [Hz]	0.00 [Hz]	0.00 [Hz]
I/O-04	V1 V Max	10.00 [V]	10.00 [V]	10.00 [V]	10.00 [V]	10.00 [V]	10.00 [V]	10.00 [V]	10.00 [V]
I/O-05	V1 Freq Max	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]
I/O-06	**I Filter**	100 [ms]	100 [ms]	100 [ms]	100 [ms]	100 [ms]	100 [ms]	100 [ms]	100 [ms]
I/O-07	I mA Min	4.00 [mA]	4.00 [mA]	4.00 [mA]	4.00 [mA]	4.00 [mA]	4.00 [mA]	4.00 [mA]	4.00 [mA]
I/O-08	I Freq Min	0.00 [Hz]	0.00 [Hz]	0.00 [Hz]	0.00 [Hz]	0.00 [Hz]	0.00 [Hz]	0.00 [Hz]	0.00 [Hz]
I/O-09	I mA Max	20.00 [mA]	20.00 [mA]	20.00 [mA]	20.00 [mA]	20.00 [mA]	20.00 [mA]	20.00 [mA]	20.00 [mA]
I/O-10	I Freq Max	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]
I/O-16	LOI/V Latch	No	No	No	No	No	No	No	No
I/O-17	**V/I Loss Lvl**	None	None	None	None	(Half of Min)	(Half of Min)	None	None
I/O-18	Lost Command	Coast Stop	Coast Stop	Coast Stop	Coast Stop	Coast Stop	Coast Stop	Coast Stop	Coast Stop
I/O-19	V/I Loss Delay	1.0 [sec]	1.0 [sec]	1.0 [sec]	1.0 [sec]	1.0 [sec]	1.0 [sec]	1.0 [sec]	1.0 [sec]
I/O-20	**M1 Define**	Speed-L	Speed-L	Speed-L	Speed-L	Speed-L	Speed-L	Speed-L	Speed-L
I/O-21	M2 Define	Speed-M	Speed-M	Speed-M	Speed-M	Speed-M	Speed-M	Speed-M	Speed-M
I/O-22	M3 Define	Speed-H	Speed-H	Speed-H	Speed-H	Speed-H	Speed-H	Speed-H	Speed-H
I/O-23	M4 Define	Fault Reset	Fault Reset	Fault Reset	Fault Reset	Fault Reset	Fault Reset	Fault Reset	Fault Reset
I/O-24	M5 Define	E-Stop BX	E-Stop BX	E-Stop BX	E-Stop BX	E-Stop BX	E-Stop BX	E-Stop BX	E-Stop BX
I/O-25	M6 Define	JOG Speed	JOG Speed	JOG Speed	JOG Speed	JOG Speed	JOG Speed	JOG Speed	JOG Speed
I/O-26	M7 Define	FWD Run FX	FWD Run FX	FWD Run FX	FWD Run FX	FWD Run FX	FWD Run FX	FWD Run FX	FWD Run FX
I/O-27	M8 Define	REV Run RX	REV Run RX	REV Run RX	REV Run RX	REV Run RX	REV Run RX	REV Run RX	REV Run RX
I/O-29	DI Filter	15 [ms]	15 [ms]	15 [ms]	15 [ms]	15 [ms]	15 [ms]	15 [ms]	15 [ms]
I/O-30	**BX Self Reset**	Yes	No	No	No	Yes	Yes	Yes	No
I/O-31	**SmokeP Mode**	At MaxSpeed	At MaxSpeed	At MaxSpeed	At MaxSpeed	At MaxSpeed	At MaxSpeed	At MaxSpeed	At MaxSpeed
I/O-33	VFD ID Sel	VFD-1	VFD-1	VFD-1	VFD-1	VFD-1	VFD-1	VFD-1	VFD-1
I/O-34	**Duplex Mode**	None	None	None	None	None	None	None	None
I/O-35	Lead/Lag Sel	Lead VFD	Lead VFD	Lead VFD	Lead VFD	Lead VFD	Lead VFD	Lead VFD	Lead VFD
I/O-36	ALT Timer	168 [hrs]	168 [hrs]	168 [hrs]	168 [hrs]	168 [hrs]	168 [hrs]	168 [hrs]	168 [hrs]
I/O-37	Lead/Lag Now	Lead Now	Lead Now	Lead Now	Lead Now	Lead Now	Lead Now	Lead Now	Lead Now
I/O-45	**Timer Input**	M7	M7	M7	M7	M7	M7	M7	M7
I/O-46	Timer Mode	ON Delay	ON Delay	ON Delay	ON Delay	ON Delay	ON Delay	ON Delay	ON Delay
I/O-47	Timer Set	30 (sec)	30 (sec)	30 (sec)	30 (sec)	30 (sec)	30 (sec)	30 (sec)	30 (sec)
I/O-48	NO/NC Input	Normal Open	Normal Open	Normal Open	Normal Open	Normal Open	Normal Open	Normal Open	Normal Open
I/O-49	**XCEL Ch Hz**	0.00 (Hz)	0.00 (Hz)	0.00 (Hz)	0.00 (Hz)	0.00 (Hz)	0.00 (Hz)	0.00 (Hz)	0.00 (Hz)
I/O-50	Acc Time-1	20.0 [sec]	20.0 [sec]	20.0 [sec]	20.0 [sec]	20.0 [sec]	20.0 [sec]	20.0 [sec]	20.0 [sec]
I/O-51	Dec Time-1	20.0 [sec]	20.0 [sec]	20.0 [sec]	20.0 [sec]	20.0 [sec]	20.0 [sec]	20.0 [sec]	20.0 [sec]
I/O-52	Acc Time-2	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]
I/O-53	Dec Time-2	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]	30.0 [sec]
I/O-54	Acc Time-3	40.0 [sec]	40.0 [sec]	40.0 [sec]	40.0 [sec]	40.0 [sec]	40.0 [sec]	40.0 [sec]	40.0 [sec]
I/O-55	Dec Time-3	40.0 [sec]	40.0 [sec]	40.0 [sec]	40.0 [sec]	40.0 [sec]	40.0 [sec]	40.0 [sec]	40.0 [sec]
I/O-68	**DmprLube Sel**	0 (None)	1 (Damper)	1 (Damper)	0 (None)	0 (None)	0 (None)	0 (None)	0 (None)
I/O-69	DmpLubeTMR	30 [sec]	60 [sec]	60 [sec]	30 [sec]	30 [sec]	30 [sec]	30 [sec]	30 [sec]
I/O-70	S0 Mode	0 (Frequency)	0 (Frequency)	0 (Frequency)	0 (Frequency)	0 (Frequency)	0 (Frequency)	0 (Frequency)	0 (Frequency)
I/O-71	S0 Adjust	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]
I/O-72	S1 Mode	1 (Current)	1 (Current)	1 (Current)	1 (Current)	1 (Current)	1 (Current)	1 (Current)	1 (Current)
I/O-73	S1 Adjust	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]
I/O-74	**FDT Freq**	1.00 [Hz]	1.00 [Hz]	1.00 [Hz]	1.00 [Hz]	1.00 [Hz]	1.00 [Hz]	1.00 [Hz]	1.00 [Hz]
I/O-75	FDT Band	1.00 [Hz]	1.00 [Hz]	1.00 [Hz]	1.00 [Hz]	1.00 [Hz]	1.00 [Hz]	1.00 [Hz]	1.00 [Hz]
I/O-76	**Aux Relay1**	13 (Run)	13 (Run)	13 (Run)	13 (Run)	13 (Run)	13 (Run)	13 (Run)	13 (Run)
I/O-77	Aux Relay2	0 (NONE)	10 (Damper)	10 (Damper)	10 (Damper)	0 (NONE)	0 (NONE)	0 (NONE)	0 (NONE)
I/O-78	Aux Relay3	0 (NONE)	0 (NONE)	0 (NONE)	0 (NONE)	0 (NONE)	0 (NONE)	0 (NONE)	0 (NONE)
I/O-79	Aux Relay4	4 (FDT-4)	4 (FDT-4)	4 (FDT-4)	4 (FDT-4)	4 (FDT-4)	4 (FDT-4)	4 (FDT-4)	4 (FDT-4)
I/O-80	**FltRelayMode**	100 [bit]	100 [bit]	100 [bit]	100 [bit]	100 [bit]	100 [bit]	100 [bit]	100 [bit]

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifug. Pump	Submers. Pump	Vacuum Pump	Constant Torque
I/O-82	RelayOnDly	0[sec]	0[sec]	0[sec]	0[sec]	0[sec]	0[sec]	0[sec]	0[sec]
I/O-83	RelayOffDly	0[sec]	0[sec]	0[sec]	0[sec]	0[sec]	0[sec]	0[sec]	0[sec]
I/O-84	**Fan Control**	2(Temper)	2(Temper)	2(Temper)	2(Temper)	2(Temper)	2(Temper)	2(Temper)	2(Temper)
I/O-85	Fan Temp	45 [°C]	45 [°C]	45 [°C]	45 [°C]	45 [°C]	45 [°C]	45 [°C]	45 [°C]
I/O-86	**TMR to Clean**	180 [min]	180 [min]	180 [min]	180 [min]	180 [min]	180 [min]	180 [min]	180 [min]
I/O-87	Clean Time	1.0 [min]	1.0 [min]	1.0 [min]	1.0 [min]	1.0 [min]	1.0 [min]	1.0 [min]	1.0 [min]
I/O-90	Inv No.	1	1	1	1	1	1	1	1
I/O-91	Baud Rate	9600 [bps]	9600 [bps]	9600 [bps]	9600 [bps]	9600 [bps]	9600 [bps]	9600 [bps]	9600 [bps]
I/O-92	Com Lost Cmd	Last Freq Run	Last Freq Run	Last Freq Run	Last Freq Run	Last Freq Run	Last Freq Run	Last Freq Run	Last Freq Run
I/O-93	COM Time Out	1.0 [sec]	1.0 [sec]	1.0 [sec]	1.0 [sec]	1.0 [sec]	1.0 [sec]	1.0 [sec]	1.0 [sec]
I/O-94	Delay Time	5 [ms]	5 [ms]	5 [ms]	5 [ms]	5 [ms]	5 [ms]	5 [ms]	5 [ms]
I/O-95	**In NO/NC Set**	00000000000	00000000000	00000000000	00000000000	00000000000	00000000000	00000000000	00000000000
I/O-98	**S0 Test Out**	No	No	No	No	No	No	No	No

5.10 [APP] Application parameter group

CODE	Comm. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
APP-00	9600	Jump to Desired Code #	Jump Code	1 to 69	☑	95
APP-01	9601	PID F Gain Selection	PID F Gain	0 to 999.9[%]		
APP-02	9602	PID Auxiliary Reference Mode Selection	Aux Ref Mode	0 (No) 1 (Yes)	☒	
APP-03	9603	PID Auxiliary Reference Signal Selection	Aux Ref Sel	0 (Keypad-1) 1 (Keypad-Up/Dwn) 2 (V1) 3 (V1S) 4 (I) 5 (V1+I) 6 (Reserved) 7 (Int. 485) 8 (Reserved)	☒	
APP-04	9604	PID Feedback I Max Limit	PIDFB I Max	0.00 to 20.00mA	☑	
APP-05	9605	PID Feedback V1 Max Limit	PIDFB V1 Max	0.00 to 12.00V		
APP-09	9609	D Time for PID Control	PID D Time	0.0 to100.0 [msec]		
APP-12	960C	PID Output Scale	PID OutScale	0.0 to 999.9 [%]	☒	
APP-13	960D	PID P2 Gain	PID P2 Gain	0.0 to 999.9 [%]	☑	
APP-14	960E	P Gain Scale	P Gain Scale	0.0 to 100.0 [%]	☒	
APP-17	9611	**PID U curve feedback select**	PID U Fbk	0 (No) 1 (Yes)		
APP-20	9614	2nd Acceleration Time	2nd Acc Time	0 to 6000 [sec]	☑	
APP-21	9615	2nd Deceleration Time	2nd Dec Time	0 to 6000 [sec]		
APP-22	9616	2nd Base Frequency	2nd BaseFreq	30.00 to FG1-30 [Hz]	☒	
APP-23	9617	2nd V/F Pattern	2nd V/F	0 (Linear) 1 (Square) 2 (User V/F)		
APP-24	9618	2nd Forward Torque Boost	2nd F Boost	0.0 to 15.0 [%]		96
APP-25	9619	2nd Reverse Torque Boost	2nd R Boost	0.0 to 15.0 [%]		
APP-26	961A	2nd Stall Prevention Level	2nd Stall	30 to 150 [%]		
APP-27	961B	2nd Electronic Thermal Level for 1 minute	2nd ETH 1min	APP-28 to 200 [%]	☑	
APP-28	961C	2nd Electronic Thermal Level for continuous	2nd ETH Cont	50 to 150%		
APP-29	961D	2nd Rated Motor Current	2nd R Curr	1.0~999.9A	☒	
APP-40	9628	**Number of Running Auxiliary** Motors Display	Aux Mot Run	*	Display	
APP-41	9629	Aux. Motor Start Selection	Starting Aux	1 to 4	☒	
APP-42	962A	Auto Alternation Time Display	Auto Op Time	*	Display	
APP-44	962C	Aux motor First-In and Last-Out	F-in L-out	0 (No)	☒	

CODE	Comm. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
				1 (Yes)		
APP-45	962D	All Aux. motors Simultaneous Stop	All Stop	0 (No) 1 (Yes)		
APP-66	9642	Auto Change Mode Selection	AutoCh Mode	0 (None) 1 (Aux) 2 (Main)	☒	
APP-67	9643	Auto Change Time	AutoEx Intv	00:00 to 99:00 (h)	☑	
APP-68	9644	Auto Change Level (Hz)	AutoEx Level	00.00 to FG1-30 [Hz]		
APP-69	9645	Inter-Lock Selection	Interlock	0 (No) 1 (Yes)	☑	97

5.11 [APP] Parameter Group Default Settings

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifug. Pump	Submers. Pump	Vacuum Pump	Constant Torque
APP-00	Jump Code	1	1	1	1	1	1	1	1
APP-01	PID F Gain	0.0 [%]	0.0 [%]	0.0 [%]	0.0 [%]	0.0 [%]	0.0 [%]	0.0 [%]	0.0 [%]
APP-02	Aux Ref Mode	(No)	(No)	(No)	(No)	(No)	(No)	(No)	(No)
APP-03	Aux Ref Sel	(V1)	(V1)	(V1)	(V1)	(V1)	(V1)	(V1)	(V1)
APP-04	PIDFB I Max	20.00 [mA]	20.00 [mA]	20.00 [mA]	20.00 [mA]	20.00 [mA]	20.00 [mA]	20.00 [mA]	20.00 [mA]
APP-05	PIDFB V1 Max	10.0 [V]	10.0 [V]	10.0 [V]	10.0 [V]	10.0 [V]	10.0 [V]	10.0 [V]	10.0 [V]
APP-09	PID D Time	0.0 [msec]	0.0 [msec]	0.0 [msec]	0.0 [msec]	0.0 [msec]	0.0 [msec]	0.0 [msec]	0.0 [msec]
APP-12	PID OutScale	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]
APP-13	PID P2 Gain	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]
APP-14	P Gain Scale	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]	100.0 [%]
APP-17	**PID U Fbk**	0 (No)	0 (No)	0 (No)	0 (No)	0 (No)	0 (No)	0 (No)	0 (No)
APP-20	2nd Acc Time	5.0 [sec]	5.0 [sec]	5.0 [sec]	5.0 [sec]	5.0 [sec]	5.0 [sec]	5.0 [sec]	5.0 [sec]
APP-21	2nd Dec Time	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]	10.0 [sec]
APP-22	2nd BaseFreq	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]	60.00 [Hz]
APP-23	2nd V/F	0 (Linear)	0 (Linear)	0 (Linear)	0 (Linear)	0 (Linear)	0 (Linear)	0 (Linear)	0 (Linear)
APP-24	2nd F Boost	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]
APP-25	2nd R Boost	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]	2.0 [%]
APP-26	2nd Stall	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]
APP-27	2nd ETH 1min	130[%]	130[%]	130[%]	130[%]	130[%]	130[%]	130[%]	130[%]
APP-28	2nd ETH Cont	120[%]	120[%]	120[%]	120[%]	120[%]	120[%]	120[%]	120[%]
APP-29	2nd R Curr	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP	By VFD HP
APP-41	**Starting Aux**	1	1	1	1	1	1	1	1
APP-44	F-in L-out	Yes	Yes	Yes	Yes	Yes	Yes	Yes	(No)
APP-45	All Stop	(No)	(No)	(No)	(No)	(No)	(No)	(No)	(No)
APP-62	Regul Bypass	(No)	(No)	(No)	(No)	(No)	(No)	(No)	(No)
APP-66	AutoCh Mode	(None)	(None)	(None)	(None)	(None)	(None)	(None)	(None)
APP-67	AutoEx Intv	72:00	72:00	72:00	72:00	72:00	72:00	72:00	72:00
APP-69	Interlock	(No)	(No)	(No)	(No)	(No)	(No)	(No)	(No)

5.12 [EXT] Extension parameter group

CODE	Com. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
EXT-00	9700	Jump Code	Jump Code	1 to 45	☑	101
EXT-01	9701	Type of SUB Board	Sub B, D or E	Sub-B to E	Display	
EXT-40	9728	Current Output Terminal 1(CO1) Selection	AM1 Mode	0 (Frequency) 1 (Current) 2 (Voltage) 3 (DC link Vtg)	☑	
EXT-41	9729	Adjust Gain of Current Output Terminal 1(CO1)	AM1 Adjust	10 to 200 [%]	☑	
EXT-42	972A	Adjust Offset of Current Output Terminal 1(CO1)	AM1 Offset	0 to 100 [%]	☑	
EXT-43	972B	Current Output Terminal 2(CO2) Selection	AM2 Mode	Same as EXT-40	☑	
EXT-44	972C	Adjust Gain of Current Output Terminal 2(CO2)	AM2 Adjust	10 to 200 [%]	☑	
EXT-45	972D	Adjust Offset of Current Output Terminal 2(CO2)	AM2 Offset	0 to 100 [%]	☑	

5.13 [EXT] Parameter Group Default Settings

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifug. Pump	Submers. Pump	Vacuum Pump	Constant Torque
EXT-00	Jump Code	1	1	1	1	1	1	1	1
EXT-40	AM1 Mode	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency
EXT-41	AM1 Adjust	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]
EXT-42	AM1 Offset	0 [%]	0 [%]	0 [%]	0 [%]	0 [%]	0 [%]	0 [%]	0 [%]
EXT-43	AM2 Mode	kW	DC link Vtg	DC link Vtg	DC link Vtg	DC link Vtg	DC link Vtg	DC link Vtg	DC link Vtg
EXT-44	AM2 Adjust	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]	100 [%]
EXT-45	AM2 Offest	0 [%]	0 [%]	0 [%]	0 [%]	0 [%]	0 [%]	0 [%]	0 [%]

5.14 [COM] Communication parameter group

CODE	Com. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
COM-00	9800	Jump Code	Jump Code	1 to 67	☑	98
COM-01	9801	Type of SUB Board	Opt B/D	0 (RS485) 1 (DeviceNet) 2 (ProfiBus) 3 (BACnet) 4 (LonWorks)	Display	
COM-02	9802	Option Control Mode	Opt Mode	0 None 1 Command 2 Freq 3 Cmd + Freq	☒	
COM-03	9803	Option Version	Opt Version	Ver X.X	Display	
COM-10	980A	MAC ID	MAC ID	0 ~ 63	☑	
COM-11	980B	Baud Rate	Baud Rate	0 125kbps 1 250kbps 2 500kbps	☑	99
COM-12	980C	Out Net Instance	Out Instance	0 20 1 21 2 100 3 101	☒	
COM-13	980D	DeviceNet Input Instance	In Instance	(70) (71) (110) (111)	☒	
COM-17	9811	PLC Option Station ID	Station ID	0 to 63	☑	
COM-20	9814	Profibus ID	Profi MAC ID	1 to 127		

CODE	Com. Addr	Description	LCD Keypad Display	Setting Range	Run Adj.	Page
COM-30	981E	Output Number	Output Num	0 to 8		
COM-31	981F	Output1	Output 1	0000 - FFFF (HEX)		
COM-32	9820	Output2	Output 2	0000 - FFFF (HEX)		
COM-33	9821	Output 3	Output 3	0000 - FFFF (HEX)		
COM-34	9822	Output 4	Output 4	0000 - FFFF (HEX)	☑	
COM-35	9823	Output 5	Output 5	0000 - FFFF (HEX)		
COM-36	9824	Output 6	Output 6	0000 - FFFF (HEX)		
COM-37	9825	Output 7	Output 7	0000 - FFFF (HEX)		
COM-38	9826	Output 8	Output 8	0000 - FFFF (HEX)		
COM-40	9628	Input Number	Input Num	0 - 8		
COM-41	9629	Input 1	Input 1	0000 - FFFF (HEX)		
COM-42	962A	Input 2	Input 2	0000 - FFFF (HEX)		
COM-43	962B	Input 3	Input 3	0000 - FFFF (HEX)		
COM-44	962C	Input 4	Input 4	0000 - FFFF (HEX)	☑	
COM-45	962D	Input 5	Input 5	0000 - FFFF (HEX)		
COM-46	962E	Input 6	Input 6	0000 - FFFF (HEX)		
COM-47	962F	Input 7	Input 7	0000 - FFFF (HEX)		
COM-48	9630	Input 8	Input 8	0000 - FFFF (HEX)		
COM-60	963C	Parity Selection	Parity/Stop	8None/1Stop		
				8None/2Stop	☑	
				8Even/1Stop		
				8 Odd/1Stop		
COM-61	963D	Communication Option Common Parameter 1	Opt Para-1	0000 - FFFF (HEX)		
COM-62	963E	Communication Option Common Parameter 2	Opt Para-2	0000 - FFFF (HEX)		
COM-63	963F	Communication Option Common Parameter 3	Opt Para-3	0000 - FFFF (HEX)		
COM-64	9640	Communication Option Common Parameter 4	Opt Para-4	0000 - FFFF (HEX)	☑	
COM-65	9641	Communication Option Common Parameter 5	Opt Para-5	0000 - FFFF (HEX)		99
COM-66	9642	Communication Option Common Parameter 6	Opt Para-6	0000 - FFFF (HEX)		
COM-67	9643	Communication Option Parameter Update	Comm UpDate	0 (No)		
				1 (Yes)	☒	

5.15 [COM] Parameter Group Default Settings

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifug. Pump	Submers. Pump	Vacuum Pump	Constant Torque
COM-00	Jump Code	2	2	2	2	2	2	2	2
COM-02	Opt Mode	None	None	None	None	None	None	None	None
COM-10	MAC ID	63	63	63	63	63	63	63	63
COM-11	Baud Rate	125kbps	125kbps	125kbps	125kbps	125kbps	125kbps	125kbps	125kbps
COM-12	Out Instance	21	21	21	21	21	21	21	21
COM-13	In Instance	70	70	70	70	70	70	70	70
COM-17	Station ID	1	1	1	1	1	1	1	1
COM-20	Profi MAC ID	1	1	1	1	1	1	1	1
COM-30	Output Num	3	3	3	3	3	3	3	3
COM-31	Output 1	000A(HEX)	000A(HEX)	000A(HEX)	000A(HEX)	000A(HEX)	000A(HEX)	000A(HEX)	000A(HEX)
COM-32	Output 2	000E(HEX)	000E(HEX)	000E(HEX)	000E(HEX)	000E(HEX)	000E(HEX)	000E(HEX)	000E(HEX)
COM-33	Output 3	000F(HEX)	000F(HEX)	000F(HEX)	000F(HEX)	000F(HEX)	000F(HEX)	000F(HEX)	000F(HEX)
COM-34	Output 4	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-35	Output 5	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-36	Output 6	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-37	Output 7	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-38	Output 8	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-40	Input Num	2	2	2	2	2	2	2	2
COM-41	Input 1	0005(HEX)	0005(HEX)	0005(HEX)	0005(HEX)	0005(HEX)	0005(HEX)	0005(HEX)	0005(HEX)

CODE	LCD Keypad Display	Basic	Supply Fan	Exhaust Fan	Cooling Tower	Centrifug. Pump	Submers. Pump	Vacuum Pump	Constant Torque
COM-42	Input 2	0006(HEX)	0006(HEX)	0006(HEX)	0006(HEX)	0006(HEX)	0006(HEX)	0006(HEX)	0006(HEX)
COM-43	Input 3	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-44	Input 4	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-45	Input 5	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-46	Input 6	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-47	Input 7	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-48	Input 8	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-60	Parity/Stop	8None/1Stop	8None/1Stop	8None/1Stop	8None/1Stop	8None/1Stop	8None/1Stop	8None/1Stop	8None/1Stop
COM-61	Opt Para-1	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-62	Opt Para-2	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-63	Opt Para-3	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-64	Opt Para-4	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-65	Opt Para-5	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-66	Opt Para-6	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)	0000(HEX)
COM-67	Comm UpDate	1 (No)	1 (No)	1 (No)	1 (No)	1 (No)	1 (No)	1 (No)	1 (No)

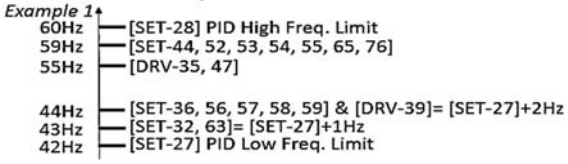
CHAPTER 6 - PARAMETER DESCRIPTION

The current 4.2 revision of the firmware will automatically adjust parameters tied to frequency based on changes to frequency limits. Most of the frequency related parameters are divided into two groups:

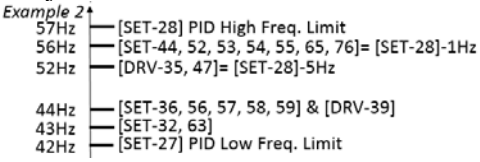
1. Parameters that usually are set slightly above SET-27 PID Freq. Low Limit will be automatically set 0.5 or 1Hz above Set-27 if that parameter is set below SET-27.
2. Parameters that usually are set slightly below SET-28 PID Freq. High Limit will be automatically set 0.5 or 1Hz below Set-28 if that parameter is above SET-28.

This will prevent from losing some protective or control features when PID frequency limits are changed. These parameters may require some final adjustments after PID frequency limits are changed. The following examples show how frequency parameters are divided by two groups and how they will be automatically set when frequency limit setting is changed.

Example 1 shows parameters grouping by frequency values and how they will be automatically changed by VFD when PID Low Freq. limit is increased. When customer determines new PID low frequency limit and sets parameter SET-27 to 42.00Hz, SET-32 and SET-63 will be changed to 42.00+1=43.00Hz, SET36 and SET-56~59 will be changed to 42.00+2=44.00Hz. Then customer can readjust them if needed.



Example 2 shows parameters grouping by frequency values which will be automatically changed when PID High Frequency Limit is decreased. Operator needs to limit pump maximum speed to 57.00Hz. As soon as SET-28 is changed to 57.00Hz, SET-44, 52~55, 65 and 76 will be changed to 57.00-1=56.00Hz, DRV-35 and 47 will be changed to 57.00-5=52.00Hz. Then operator can readjust them if needed.



Note: If [SET-28]-[SET-27] is less than 7.00Hz (flat curve pump application) after changing either [SET-27] or [SET-28], parameters will be set to following new values:
SET-32 and SET-63 to [SET-27] +0.5Hz
SET36 and SET-56~59 to [SET-27] +1Hz
SET-44, 52~55, 65 and 76 to [SET-28] -0.5Hz
DRV-35 and 47 to [SET-28] -1Hz

6.1 Setup group [SET]

SET-00: Application Selection

```
SET▶ App. Select
00     None
```

The first step in VFD setup is an application selection. When VFD is powered up first time, the screen SET-00 shows no application selected (None). Press [ENTER] key and [UP] key to select proper application for your motor. Many parameters in VFD parameter groups will be automatically set to provide most stable and reliable equipment operation.

There are eight application choices: Basic, Supply Fan, Exhaust Fan, Cooling Tower Fan, Circulating Pump, Submersible Pump, Vacuum Pump, and Constant Torque.

The Basic selection provides a standard basic VFD control with start/stop command from via keypad and speed reference via remote 4-20mA analog signal. Most of the advanced motor control and protective features such as, Damper Control, Under Load Protection, Pipe Broken, etc. are disabled. This control method can be used in many applications where VFD simply needs to follow a remote speed reference signal and start/stop command from the keypad.

The Supply or Exhaust Fan selection sets VFD for remote BMS (Building Management System) or PLC (Programmable Logic Controller) Start/Stop control and 4-20mA speed reference signal. If application requires the VFD to utilize internal PID (Proportional- Integral) control with pressure transducer feedback, the PID parameter SET-20 should be enabled. All other related parameters such as Transducer range, Process Unit inWC, Direct or Inverse PID, etc. will be automatically set to the most common factory default values providing accurate motor control. In some cases extra adjustment of some parameters is necessary to achieve better control. Stop mode is set to Coast mode to protect from any possible overvoltage trips while decelerating during stop mode.

The Cooling Tower selection configures VFD for fan motor with internal inverse PID control and feedback from a temperature transducer. The process unit is set to °F with 0-150°F temperature transducer range and 80°F PID set point. If MMC (Multi-Motor Control) feature is enabled with one of the auxiliary relays, the VFD can start a spray pump based on VFD speed and system temperature.

The inverse PID control increases fan motor speed if temperature is above set point.

The Centrifugal Pump selection provides constant pressure PID control with pressure transducer feedback. The process unit is set to PSI with 0-100PSI transducer range and 50PSI set-point. The sleep mode is enabled and parameters are set to optimal values, which should be readjusted for better performance based on the system parameters and type of pump. There is an adjustable run time delay parameter FG1-81 that can be used as a backspin timer. If the application is a hollow shaft pump and it requires to run water for bearing lubrication before motor starts, there are selections "Lubrication Mode" and "Lubrication Timer" in parameters I/O-68, 69, 76~79, which will control a selected auxiliary relay to activate a water solenoid valve for an adjustable time delay before pump motor starts.

The Submersible Pump selection provides all the necessary default settings for submersible motor. The pump control and protection features such as Pre-PID (Pipe Fill) mode, Pipe Broken and Under Level (Dry Well) protection with well fill timer can be enabled as needed. The default settings for some parameters are: Acceleration Time and Deceleration Time are 2 sec.; motor speed is 3600RPM; the process unit is set to PSI with 0-100PSI transducer range and 50PSI set-point. Some parameters should be readjusted for better control based on the pump type and system parameters.

The Vacuum Pump selection provides constant vacuum (negative pressure) PID control with vacuum transducer feedback. The process unit is set to inWC with 0-406.9inWC transducer range and 60inWC vacuum set-point. The sleep mode and other pump control features are disabled but can be activated. The default parameter settings are set to optimal values and should be readjusted based on system parameters.

The Constant Torque application selection sets VFD to 20% de-rated motor HP (horsepower) rating, start/stop command from terminal blocks and speed reference control from a keypad. This control selection is suitable for conveyors, grinders, mixers and similar applications.

SET-01: Input Phase Selection

```
SET▶ Input Phase
01     3-Phase
```

The VFD is capable of running from 3-Phase or Single-Phase power source but it should be 50% de-rated for Single-Phase input power. When this parameter is set to Single-Phase mode, the motor HP rating is automatically changed to 50% of the VFD capacity. All protective and filtering devices on VFD power input should be sized based on doubled motor FLA.

SET-02: Motor HP rating

```
SET▶ Motor HP/kW
02     7.5/ 5.5
```

The HP rating from the motor nameplate should be put in this parameter. The default setting will be changed if parameter SET-00 changed to "Const Trq" or SET-01 to 1-Phase. If VFD temperature rating needs to be increased up to 122°F, de-rate this parameter by 20%.
The kW rating is for 230V or 415V motor with FLA close to UL table for corresponding HP rating.

SET-03: Motor Full Load Amps

```
SET▶  Motor FLA
03          11 A
```

This parameter is set automatically from UL FLA table based on motor HP rating selection in SET-02. All internal overload protection features for VFD and motor are calculated based on the value in parameter SET-03. Some motors FLA ratings are different of the UL table so this parameter should be set to the actual motor nameplate FLA rating. The service factor for a motor is set in parameter FG1-62. If SET-00 is set to Sub. Pump (submersible), SET-03 should be set to SFA motor rating.

SET-04: Motor Synchronous Speed (RPM)

```
SET▶ Motor RPM
04     1800
```

The induction squirrel cage motor stator magnetic field and rotor speeds are different. The stator magnetic field is synchronized with power line frequency 50Hz or 60Hz and is called the Synchronous speed. The synchronous speed calculations are:

for 50Hz $\text{Synch. Speed} = \frac{6000}{\text{Number of Poles}}$,

and for 60Hz $\text{Synch. Speed} = \frac{7200}{\text{Number of Poles}}$.

The motor rotor speed is less than the synchronous speed by slip value. Motor Slip value depends on the design of the motor and can be determined by subtracting Motor Name Plate RPM from Synchronous Speed.

SET-06: Carrier Frequency

```
SET▶Carrier Freq
05     2.5 kHz
```

The carrier frequency determines how many pulses the inverter transistors will create during one cycle. Some motors can create an audible noise, which can be eliminated by adjusting this carrier frequency during stop or run mode.

SET-07: Input Power Voltage

SET► VAC 480.2 V 07 104.4 %	**SET►** VAC 230.1 V 07 104.6 %

The input power voltage value is a percentage of the VFD basic voltage 575V, 440V and 220V. The Low Voltage protection level of the VFD is calculated based on this parameter value.

SET-08: Motor Voltage

SET► Motor Volt 08 480 V	**SET►** Motor Volt 07 230 V

The motor voltage rating should be checked on the motor nameplate and set in SET-08 parameter. The VFD can produce output voltage equal to or less than input power voltage.

SET-09: Drive Control Mode

SET► Drive Mode 09 Remote-1

The Drive Mode determines the source of the Start/Stop command to VFD.

Keypad mode. VFD is started by keypad Forward and Reverse keys and stopped by Stop key.

Remote-1 mode. VFD is started and stopped forward by digital input M7 and reverse by input M8. If both M7 and M8 inputs are activated simultaneously, the VFD will stop.

Remote-2 . VFD is started and stopped by digital input M7 and input M8 will change the motor rotation.

Int.485 mode. VFD start/stop control is operated via Modbus-RTU communication.

SET-10: Speed Control Mode

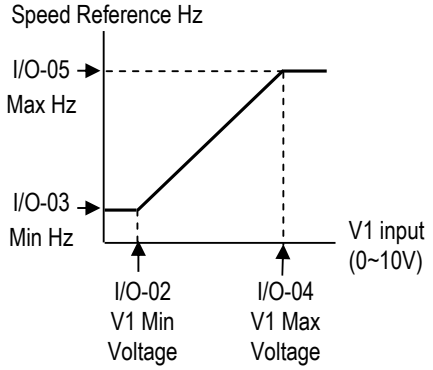
SET► Speed Ctrl 10 Keypad-1

The Speed Control Mode determines the source of the speed reference command to VFD.

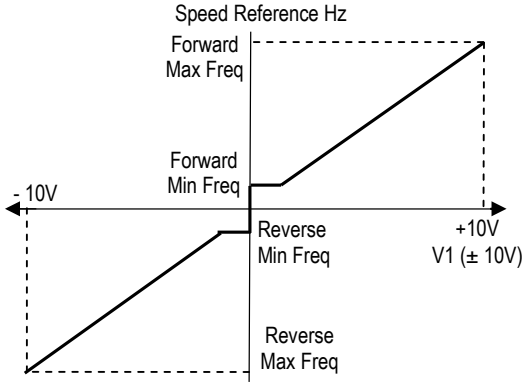
Keypad-1 mode. VFD speed is controlled by keypad and speed can be changed during run and stop modes. In order to change the VFD frequency, change parameter DRV-00 setting to desired frequency and VFD will follow a new speed reference once [ENTER] key is pressed.

Keypad-Up/Down mode. VFD frequency is controlled by keypad and motor speed is changed during run mode by pressing [UP] or [DOWN] keys. In order to change the VFD speed reference value, use [UP] or DOWN keys in parameter DRV-00. Use the [Shift] key to move the flashing cursor to proper position to make fast or slow change of the speed reference value.

V1 mode. VFD speed is controlled by 0-10VDC analog input signal from BMS, PLC, potentiometer or other control device. This input is polarity sensitive with V1 terminal as signal positive and 5G (up to 40HP) or CM (50HP and larger) terminal as negative. Use shielded cable because voltage input is sensitive to any electrical noise. The input range is adjustable in I/O group parameters from 0 to 12VDC.



V1S mode. VFD frequency is controlled by bipolar ±10VDC analog input signal from PLC, potentiometer or other control device. The polarity of the signal corresponding to analog common 5G (up to 40HP) or CM (50HP and larger) determines Forward or Reverse direction and the absolute value of the signal changes the speed reference. Use shielded cable because voltage input is sensitive to any electrical noise. The input range is adjustable in I/O group parameters up to ±12VDC.



I mode. VFD speed is controlled by 4-20mA analog input signal from BMS, PLC or other control device. This input is polarity sensitive with I terminal as signal positive and 5G (up to 40HP) or CM (50HP and larger) terminal as negative. The current input is less sensitive to any electrical noise but shielded cable is recommended. The input range is adjustable in I/O group parameters.

V1+I mode. VFD speed is controlled by both 0-10VDC and 4-20mA analog input signals from BMS, PLC, potentiometer or other control device. Both analog signals are compared with each other and the greatest value determines the VFD speed reference. The VFD speed reference can be switched between V1 and I inputs by digital input set to ANA_CHG (Analog change). The input ranges are adjustable in I/O group parameters.

Int.485 mode. VFD frequency is controlled via Modbus-RTU communication from BMS, Process Controller, PLC or other control device. See parameter addressing in parameter list.

SET-11 & 12: Acceleration and Deceleration Time

SET► ACC. Time 11 20.0 sec	**SET►** DEC. Time 12 30.0 sec

The VFD increases and decreases the output Voltage and Frequency using acceleration and deceleration time.

If parameter FG1-73 is set to **Max. Frequency**, the ACC or DEC time will be applied from 0Hz to Max. Hz. It will take 10sec to accelerate from 20Hz to 30Hz with ACC set to 60sec. and max. speed set to 60Hz.

If parameter FG1-73 is set to **Delta Frequency**, the ACC or DEC time will be applied from Current Speed Reference to new Speed Reference. It will take 60sec to accelerate from 20Hz to 30Hz with ACC set to 60sec. and max. speed set to 60Hz.

The VFD can trip on ETH (Electronic Thermal) motor overload protection if ACC time is set to very small value.

The VFD can trip on Over Voltage protection because of regenerative power from the motor if DEC time is set to very small value.

SET-13 & 14: Low and High Speed Limits

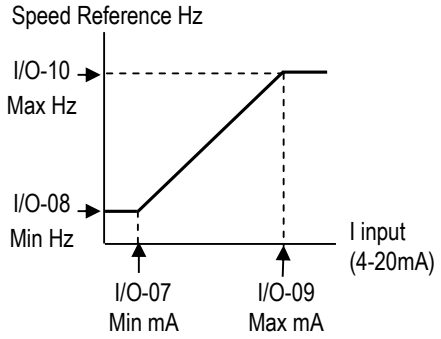
SET► Low Limit 13 30.00 Hz	**SET►** High Limit 14 60.00 Hz

The VFD has High and Low limit settings for the output frequency in both Remote and Local control modes. The PID control mode has separate output frequency limit settings. When VFD speed reference is set below Low Frequency limit or above High limit, the VFD output will stay at frequency limit. The minimum recommended low limit frequency is 20Hz which should be sufficient to provide adequate air flow for motor cooling.

SET-15: Load Rotation Forward, Reverse or Both

```
SET►LoadRotation
15   FWD Only
```

The SET-15 parameter has three selections:



- **FWD/REV**-motor can run Forward and Reverse directions
- **REV Only**- motor can run Reverse direction only
- **FWD Only**- motor can run Forward direction only

For most of the applications, the factory default setting is FWD Only.

SET-16: Stop Mode

```
SET► Stop Mode
16       Decel
```

The SET-16 parameter has four selections:

- **Decel**- the VFD will decrease output frequency from current speed reference to 0Hz based on SET-12 parameter setting after a stop command was received
- **DC-brake**- the VFD will inject DC current in motor winding during deceleration after stop command was received and output frequency is below FG1-25 setting. DC injection brake provides a faster stop for the motor but it generates heat in the motor winding and depending on settings in parameters FG1-21~27 and braking duty cycle the motor can be overheated.
- **Coast**- the VFD will stop generating any output upon receiving a stop command. The motor will coast to stop without any control from VFD similar to opening the contactor of a motor starter.
- **Flux Brake**- the VFD provides a faster stop for the motor by magnetizing it with regenerative power and dissipating this energy as heat in the motor windings.

SET-20: PID Mode

```
SET► PID Mode
20      Yes
```

The SET-20 parameter enables the internal PID control. The PID control allows the VFD to maintain a process value (pressure, temperature etc.) by varying the output frequency based on the difference between a set

point and actual feedback value. When this parameter is set to Yes, the PID parameters SET-21~31 become available. Refer to page 103 for PID control diagram

SET-21: PID Feedback Source

SET▶	PID F/B
21	I

The SET-21 parameter has three selections:

- **I**- 4-20mA analog signal from transducer or other sensor
- **V1**- 0-10VDC analog signal from transducer or other sensor

SET-22: PID Feedback Unit

SET▶	F/B Unit
22	PSI

The SET-22 parameter has following selections for feedback unit: PSI,°F, °C, inWC, inHg, Bar, mBar, Feet, kPa and Custom. The custom unit can be used to show an actual value for line speed, liquid level, airflow or other units depending on type of transducer used for feedback monitoring.

SET-23: PID Feedback Unit Format

SET▶	Unit Format
23	0.1

The Unit Format parameter has selection for 0.1 or 0.01. To provide more accurate control if transducer range is small or set point should have two decimals, select 0.01 format.

SET-24: Feedback Unit Min. Negative Value

SET▶F/B Unit Min	
24	-10.0PSI

Set the negative feedback unit value based on compound transducer range for display purpose only. Example: for transducer -14.7~30PSI change the parameter SET-24 to -14.7PSI. This parameter provides proper scaling for compound transducer pressure and vacuum reading. PID control loop does not have negative range for pressure set-point and it registers negative value from transducer as 0.0. This parameter provides ability to read negative value on VFD display only and it does not affect PID control.

SET-25: Feedback Unit Maximum Value

SET▶F/B Unit Max	
25	100.0PSI

Set the maximum feedback unit value based on transducer range. Example: for transducer 0-250PSI change the parameter SET-25 to 250PSI. This parameter provides proper scaling of an analog feedback signal to transducer range.

SET-26: PID Set Point Value

SET▶PID SetPoint	
26	50.0PSI

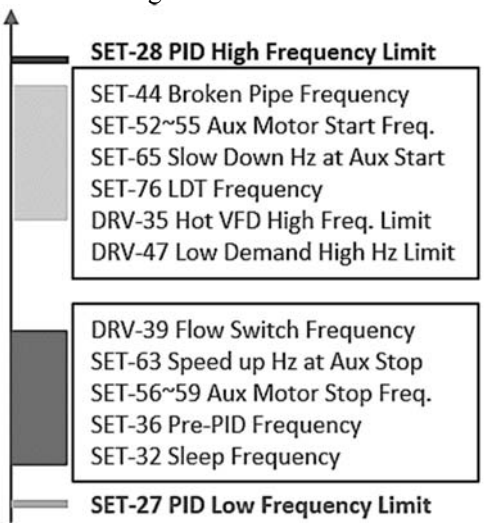
Determine and set the set point value for the PID control in parameter SET-26. This setting should be within the transducer range.

SET-27 & 28: PID Low and High Speed Limits

SET▶ PID Limit-L	
27	30.00 Hz

SET▶ PID Limit-H	
28	60.00 Hz

The VFD PID control has High and Low limit settings for output frequency. When PID calculated output frequency is less than Low limit or higher than High limit, the VFD output will stay at frequency limit. The minimum recommended low limit frequency is 20Hz which should be sufficient to provide adequate air flow for motor cooling. If sleep mode is enabled for pump application, the PID Low limit should be set 1Hz or more above no-demand VFD frequency. This will provide more stable sleep mode operation.
The frequency based parameters are divided by groups related to PID high and low frequency limits. See diagram below.



If during VFD programming SET-28 is changed to smaller number, any parameter in corresponding group with value greater than new SET-28 value will be changed to [SET-28]-0.5Hz.
If during VFD programming SET-27 is changed to greater number, any parameter in corresponding group with value smaller than new SET-27 value will be changed to [SET-27]+0.5Hz.
This way the features that utilize those parameters will always be operational.

SET-29: PID Proportional Gain

SET▶ PID P Gain
29 10.0%

The **P-Gain** determines how much the output frequency will be changed depending on the process error (difference between Feedback value and Set-point). Basically, it changes the system sensitivity. If P-Gain is set too high, the system becomes unstable and PID will create a frequency output oscillation. The default settings for P-Gain are different for different applications to provide optimal and stable control.

SET-30: PID Integral Time

SET▶ PID I Time
30 1.0 sec

The **I-Time** determines how much of the process error will be accumulated and used as an additional offset to the PID output frequency. If I-Time setting is low, the PID output will be calculated based on a present error only so the system will be more responsive to any change of the feedback signal and will be less likely to overshoot set point. If I-Time and P-Gain values are set too high, the system can overshoot the set point and create an oscillation (unstable control).

SET-31: PID Output Inverse

SET▶ Out Inverse
31 No

The PID control can be set to Direct or Inverse type. If feedback is below set point, Direct PID will increase and Inverse PID will decrease the output frequency.

SET-32 & 33: Sleep Mode Frequency and Delay

SET▶ Sleep Freq
32 35.00 Hz

SET▶ Sleep Delay
33 20 sec

When SET-32 parameter value is changed from 0Hz to any frequency value, sleep mode parameters SET-33~35 become available. The Sleep frequency should always be 1Hz or higher than SET-27 PID Low limit. When there is no demand in the system, the VFD will decrease speed below Sleep Frequency to PID Low limit and after SET-33 time delay will go to sleep mode and stop based on SET-16 setting if SET-34 Sleep Boost set to 0PSI. Refer to page 104 for Sleep Mode operation diagram.
If any digital input is set to Flow Switch and No Flow protection is disabled, the Flow switch becomes an additional condition for Sleep mode.

SET-34: Sleep Boost

SET▶ Sleep Boost
34 2.0 PSI

If SET-34 is set to 0.0 [Unit], the sleep boost mode is disabled. If SET-34 is enabled and there is no demand in the system the VFD will decrease speed below Sleep Frequency to PID Low limit and, after SET-33 time delay, will go to sleep boost mode to increase system pressure by SET-34 value before VFD switches to sleep mode and stops.
There is SET-47 Pressure Boost Timer for Sleep mode that determines the time limit for pressure boost.

SET-35: Wakeup level

SET▶ WakeUp Level
35 8%

The SET-35 Wake up level is a percentage of SET-25 Maximum Feedback Unit value.

Wakeup PSI Value=

$$\textbf{[SET-26]-}\left(\frac{\textbf{[SET-25]x[FG1-35]}}{\textbf{100}}\right)$$

The VFD will wake up and run on PID control when feedback value falls below Wakeup PSI Value.

SET-36~ 38: Pre-PID Frequency, Delay and Level

SET▶ PrePID Freq
36 37.00 Hz

SET▶ PrePID Dly
37 180 sec

SET▶ PrePID Exit
38 25.0 PSI

The Pre-PID mode is used to fill empty pipes at initial start of the system. When SET-36 is changed from 0Hz to any value, the Pre-PID mode and parameters are enabled. When VFD receives a start signal, the PID is disabled and VFD ramps up to SET-36 speed based on SET-11 ACC time. This speed should be high enough to provide good water flow to fill pipes slowly increasing a system pressure. The VFD will switch to PID control when SET-37 time delay is expired or system pressure becomes greater than SET-38 Pre-PID exit level.

SET-40: Pipe Broken Mode

SET▶ PBrokenMode
40 Yes

The SET-40 parameter enables Pipe Broken protection. The VFD will determine if pipe is broken by monitoring the output speed and feedback signal. When SET-40 is set to Yes, Broken Pipe parameters SET-41~44 become available. Refer to diagram on page 105.

SET-41~ 43: Pipe Broken Protection Settings

SET▶ PBroken Freq	SET▶ PBroken Dly
41 59.00 Hz	42 30 sec

SET▶ PBroken F/B
43 50.0 PSI

During normal operation when VFD runs with PID control at high demand and feedback is below set-point, the VFD will increase speed and then when demand is satisfied the speed will be decreased to some level. When any pipe in the system is broken, the VFD will continuously run pump at full speed trying to satisfy the demand. If VFD runs above SET-41 Pipe Broken Frequency for more than SET-42 Pipe Broken Delay and the feedback signal level is below SET-43 Pipe Broken Feedback, the VFD will trip on Pipe Broken Fault. This fault can be reset by pressing the Stop key on VFD keypad, by enabling a digital Reset input, or by recycling VFD input power.

SET-44: Pipe Broken Relay

SET▶PBrokenRelay
44 AUX-3

The SET-44 parameter has three selections: None, AUX-3 and AUX-4. The SET-44 parameter enables a selected AUX-3 or AUX-4 relay output and sets corresponding I/O-78 or I/O-79 to indicate a Pipe Broken Fault. If at some point SET-44 is set to None, the corresponding I/O-78 or I/O-79 will be changed to None. If SET-44 is set to AUX-3 and later I/O-78 is changed from Pipe Broken to any other setting, the I/O-78 setting will return to Pipe Broken after VFD power cycling.

SET-45 & 46: Overpressure Protection

SET▶ OverPressLvl	**SET▶**OP AutoStart
45 80.0PSI	46 No

There are two modes for system Overpressure protection when VFD runs in PID control: Trip and Stop with auto restart.

- If parameter SET-46 is set to No (No Auto Restart) and system pressure exceeds the level adjusted in parameter SET-45, VFD trips with "Over Pressure" message flashing on the screen and activates Fault relay. VFD can be reset by Stop key on the keypad, or by Reset digital input or by cycling VFD power.
- If Set-46 is set to Yes (Auto Restart) and system pressure exceeds SET-45 level, VFD stops with "Over Pressure" message flashing on the screen. When pressure drops below SET-45 level but stays above Set-point SET-26, VFD stays at stop mode with "Over P Sleep" message on the screen. When pressure drops below SET-26, VFD will start automatically is run command is present.

In order to disable Over Pressure protection, set SET-45 to 0.0PSI.

SET-47: Sleep Pressure Boost Timer

SET▶ Boost Timer
47 10sec

The sleep boost timer sets time for pressure boost at sleep. After timer expires, VFD based on system pressure can either enter a sleep mode or return to normal PID control.

- If VFD meets all the conditions for sleep mode and ready for pressure boost mode, the pressure Set-point will be increased by SET-34 value and VFD will try to reach new pressure set-point within SET-47 time. When pressure is above new Set-point or stays between SET-26 and new Boost Set-point and SET-47 timer expires, VFD initiates a sleep mode. At this point, pressure Set-point returns to original SET-26 value.
- If during pressure boost mode the system pressure drops below SET-26 Set-point level before SET-47 timer expires, VFD will cancel a sleep mode and return to normal PID control with SET-26 Set-point.

This Boost Timer will prevent pump or piping damage due to a long run in deadhead condition especially for flat curve pumps.

SET-50: Multi-Motor Control Mode (MMC)

SET▶ MMC Mode
50 Yes

The SET-50 parameter enables Multi-Motor Control parameters and Lead-Lag Control, which allows to control up to four Lag motors. The VFD will control the speed of the lead motor based on internal PID control and provide start/stop relay outputs for Lag motor starters, Soft starts or VFDs.

The MMC mode can be used to start and stop auxiliary motors at programmed output speeds when PID is disabled.

Note: When SET-50 set to Yes, AUX-1 relay parameter I/O-76 will be automatically set to MMC mode.

SET-51: MMC Number of Controlled Motors

SET▶ Nbr Aux's
51 1

The SET-51 parameter allows selecting the number of Lag AUX motors from 0 to 4. The Lag motors start and stop sequence depends on the settings in parameters APP-41~45.

SET-52: MMC AUX-1 Motor Start Frequency

SET▶	Start Freq 1
52	59.00 Hz

If SET-50 is set to Yes, SET-51 is set to value greater than 0 and VFD runs at frequency exceeding SET-52 for SET-60 time delay, the AUX-1 motor will start.

SET-56: MMC AUX-1 Motor Stop Frequency

SET▶	Stop Freq 1
56	40.00 Hz

When VFD runs at frequency below SET-56 and SET-61 time delay expires, the AUX-1 motor will stop.

SET-53: MMC AUX-2 Motor Start Frequency

SET▶	Start Freq 2
53	59.00 Hz

When VFD runs at frequency exceeding SET-53 with AUX-1 motor running for SET-60 time delay, the AUX-2 motor will start.

SET-57: MMC AUX-2 Motor Stop Frequency

SET▶	Stop Freq 2
57	40.00 Hz

When VFD runs at frequency below SET-57 with AUX-1 motor running for SET-61 time delay, the AUX-2 motor will stop.

SET-54: MMC AUX-3 Motor Start Frequency

SET▶	Start Freq 3
54	59.00 Hz

When VFD runs at frequency exceeding SET-54 with AUX-1 and AUX-2 motors running for SET-60 time delay, the AUX-3 motor will start.

SET-58: MMC AUX-3 Motor Stop Frequency

SET▶	Stop Freq 3
58	40.00 Hz

When VFD runs at frequency below SET-58 with AUX-1, AUX-2 and AUX-3 motors running for SET-61 time delay, the AUX-3 motor will stop.

SET-55: MMC AUX-4 Motor Start Frequency

SET▶	Start Freq 4
55	59.00 Hz

When VFD runs at frequency exceeding SET-55 with AUX-1, AUX-2 and AUX-3 motors running for SET-60 time delay, the AUX-4 motor will start.

SET-59: AUX-4 Motor Stop Frequency

SET▶	Stop Freq 4
59	40.00 Hz

When VFD runs at frequency below SET-59 with AUX-1, AUX-2, AUX-3 and AUX-4 motors running for SET-61 time delay, the AUX-4 motor will stop.

SET-60 & 61: MMC Aux Motors Start/Stop Delays

SET▶	Aux Start DT
60	5.0 sec

SET▶	Aux Stop DT
61	2.0 sec

SET-60 is a time delay to start AUX motor and works for all four AUX motors.
SET-61 is a time delay to stop AUX motor and works for all four AUX motors.

SET-62 & 63: MMC Acc Time and Frequency

SET▶	MMC Acc Time
62	2.0 sec

SET▶	MMC AccFreq
63	30.00 Hz

When AUX motor stops based on MMC control, the VFD will ramp up to SET-63 speed using SET-62 acceleration time to minimize the temporary drop in system pressure.

SET-64 & 65: MMC Dec Time and Frequency

SET▶	MMC Dec Time
64	10.0 sec

SET▶	MMC DecFreq
65	59.00 Hz

When an AUX motor starts based on MMC control, the VFD will ramp down to SET-65 speed using SET-64 deceleration time to minimize the temporary surge in system pressure.

SET-66 & 67: MMC AUX Motor Start/Stop Level

SET▶	AuxStartDiff
66	2.0 %

SET▶	AuxStopDiff
67	2.0 %

If PID control is enabled and SET-66 and/or SET-67 are greater than 0.0%, there will be an additional Feedback Level condition that must be met to start or stop an AUX motor:

$$\textbf{\textit{AUX Start Feedback Level}} = [\text{SET-26}] - \frac{[\text{SET-25}]\text{x}[\text{SET-66}]}{100}$$

$$\textbf{\textit{AUX Stop Feedback Level}} = [\text{SET-26}] + \frac{[\text{SET-25}]\text{x}[\text{SET-67}]}{100}$$

If SET-66 and SET-67 are set to 0.0%, VFD will start and stop AUX motors only based on start/stop Frequencies and Delays and does not

monitor feedback signal.

SET-74: Under or Over Level Detection

```
SET▶Level Detect
74    Under Level
```

Under or Over Level Detection feature provides relay output or trips VFD when selected source signal is under or over set LDT level value.

The SET-74 parameter has three selections:

- **No**- the level detection function and related parameters are disabled.
- **Under Level**- VFD monitors a selected Level Detection Source signal for Under Level condition.
- **Over Level**- VFD monitors a selected Level Detection Source signal for Over Level condition.

SET-75: Level Detection Source Selection

```
SET▶   LDT Source
75       Current
```

The SET-75 parameter provides six LDT source selections: V1, I, Current, DC Voltage, Output Voltage or kW.

- **Current**-the LDT function monitors VFD output current
- **DC Voltage**- the LDT function monitors DC bus voltage
- **Output Voltage**- the LDT function monitors VFD output voltage
- **kW**- the LDT function monitors VFD output kW reading
- **V1**- the LDT function monitors 0-10VDC analog input signal
- **I**- the LDT function monitors 4-20mA analog input signal.

SET-76: LDT Frequency

```
SET▶      LDT Freq
76       59.00 Hz
```

The LDT function starts monitoring the level of selected source when VFD speed increases above SET-76 setting.

SET-77: LDT Delay

```
SET▶      LDT Delay
77          2 sec
```

The LDT function will activate LDT relay or trip VFD when monitored level meets trigger conditions for SET-77 delay time.

SET-78: LDT Level

```
SET▶      LDT Level
78          9.0 A
```

The SET-78 LDT Level parameter sets the trigger point for LDT function. If SET-74 is set to Under Level, the LDT function will be triggered at level below SET-78. If SET-74 is set to Over Level, the LDT function will be triggered at level above SET-78.

SET-79: LDT Hysteresis

```
SET▶      LDT Hyst
79          1.0 A
```

The SET-79 LDT Level parameter sets a hysteresis for resetting the triggered LDT function. If LDT trips on Under Level, the LDT function will be reset at level above [SET-78]+[SET-79]. If LDT trips on Over Level, the LDT function will be reset at level below [SET-78]-[SET-79].

SET-80 & 81: Level Detection (Dry Well Trip)

```
SET▶      LDT trip
80          Yes
```

```
SET▶  LDT FillTime
81        60.0 min
```

When SET-80 LDT VFD Trip is set to YES the SET-81 LDT Fill Time parameter is enabled. The VFD will trip at LDT Level and try to restart after SET-81 time delay. This feature is intended for Dry Well protection and SET-81 should be adjusted properly to provide enough time for the well to be filled. If VFD trips first time on Under Level, it will start after SET-81 timer expires. If VFD trips again, the SET-81 timer set value will be doubled. If VFD trips during second attempt, the SET-81 will be doubled again. If well is still dry the VFD will continue restart attempts every time doubling the SET-81. When VFD finally runs without tripping for three minutes, the last timer setting will be saved and used at next under level trip. If SET-81 is set to 0.0min, VFD will follow auto restart mode set in FG2-24~26.

Note: SET-81 will show doubled timer value right after VFD trips on Under Level but if it restarts and runs, SET-81 will return to previous setting.

SET-82: LDT Relay Output

```
SET▶      LDT Relay
82          AUX_3
```

The SET-82 selection will automatically set I/O-78 or I/O-79 to Level Detection selection.

The selected relay output AUX-3 or AUX-4 will be activated when LDT function is triggered and deactivated when LDT is reset at hysteresis level.

Example: If SET-74 is set to Under Level, SET-75 to Current, SET-76 to 59.0Hz, SET-78 to 9.0A and SET-79 to 1A, the LDT function will activate LDT relay when VFD runs at speed higher than 59Hz with current less than 9A and deactivate when current increases above 10A.

Note: If SET-82 was set to AUX-3 or AUX-4 and later changed to NONE, change corresponding I/O-78 or I/O-79 from Level Detection to NONE or any other selection. If SET-82 was set to AUX-3 but I/O-78 was changed from Level Detection to any other selection, I/O-78 will return to Level Detection after VFD power is cycled.

SET-90: Local/Remote Key Function

```
SET►  LocalRemKey
90   Cntl&RefStop
```

The SET-90 parameter has seven selections: 2nd Source, Cntl&RefStop, Control Stop, Ref Only, Cntl&RefRun, Control Run, Disabled. When VFD is switched to local control in all the selections except 2nd Source, the command and reference will be changed to keypad. If VFD package has HOA (Hand-Off-Auto) switch and controls motor based on internal PID loop in Auto mode, it will disable PID and change control to 2nd source when HOA is switched to Hand mode.

- **2nd Source**- changes control to a second source selected in parameters DRV-91 & DRV-92. This mode is usually used when a digital input is programmed for LOC/REM.

Example: When HOA (Hand-Off-Auto) switch is used in VFD control, the Hand position contact should enable a digital input programmed for LOC/REM to switch control to 2nd source. VFD frequency in Auto mode can be controlled by keypad, 0-10VDC, 4-20mA signal selected in DRV-92 parameter.

- **Cntl&Ref Stop**- when Local/Remote Key is pressed while VFD is running in remote control, the VFD will stop the motor and switch Command and Speed control to keypad.
- **Control Stop**- when Local/Remote Key is pressed while VFD is running in remote control, the VFD will stop the motor and switch Command control to keypad leaving remote Speed control.
- **Ref Only**- when Local/Remote Key is pressed while VFD is running in remote control, the VFD will switch Speed control to keypad and continue running motor based on remote Command control.
- **Cntl&Ref Run**- when Local/Remote Key is pressed while VFD is running in remote control, the VFD will continue to run motor and switch both Command and Speed control to keypad.
- **Control Run**- when Local/Remote Key is pressed while VFD is running in remote control, the VFD will continue to run motor and switch Command control to keypad leaving remote Speed control.
- **Disabled**- pressing the Local/Remote Key or a digital input programmed for LOC/REM will not change VFD control (Local/Remote mode is disabled).

6.2 Drive Group [DRV]

DRV-00: Main Display w/Command Frequency

```
DRV► T/K      0.0A
00 STP   30.00 Hz
```

```
DRV► Cmd. Freq
00     ▌ 30.00 Hz
```

DRV-00 as a Main Screen and DRV-00 as Parameter
When [Enter] key is pressed in DRV-00 screen the display will enter programming mode for the Command Frequency and a flashing cursor will be displayed which can be moved with the [Shift] key. When [Enter] key is pressed after the Command Frequency number (Hz) has been changed, the display will show DRV-00 screen with new speed command. The DRV-00 screen will show actual VFD output frequency instead of Command Frequency when VFD starts running the motor.
If PID control is enabled, DRV-00 screen will display PID set point while in stop mode and actual output frequency while in run mode.
When DRV-24 is changed from Hz to RPM, the DRV-00 screen will show Speed reference and actual Speed in RPM.

DRV-01~ 15: Step Frequency 1 ~ 15

```
DRV► Step freq-1
01     10.00 Hz
```

```
DRV► Step freq-1
15     30.00 Hz
```

The Step Frequencies are the preset speeds activated by a binary coded combination of four programmable digital inputs set to Speed-L, -M, -H, and -X in parameters I/O-20 ~I/O-27 (see table below).

SPEED				Parameter	Step Speed
X (8)	H (4)	M (2)	L (1)		
0	0	0	0	-	N/A
0	0	0	**1**	DRV-01	Speed 1
0	0	**1**	0	DRV-02	Speed 2
0	0	**1**	**1**	DRV-03	Speed 3
0	**1**	0	0	DRV-04	Speed 4
0	**1**	0	**1**	DRV-05	Speed 5
0	**1**	**1**	0	DRV-06	Speed 6
0	**1**	**1**	**1**	DRV-07	Speed 7
1	0	0	0	DRV-08	Speed 8
1	0	0	**1**	DRV-09	Speed 9
1	0	**1**	0	DRV-10	Speed 10
1	0	**1**	**1**	DRV-11	Speed 11
1	**1**	0	0	DRV-12	Speed 12
1	**1**	0	**1**	DRV-13	Speed 13
1	**1**	**1**	0	DRV-14	Speed 14
1	**1**	**1**	**1**	DRV-15	Speed 15

DRV-16: Jog Frequency

```
DRV►     Jog Freq
16     10.00 Hz
```

If any digital input I/O-20~27 is programmed to **Jog_FX** or **Jog_RX** and activated, the VFD will run forward or reverse at DRV-16 Jog Speed based on ACC or DEC time until input is disabled.

DRV-17~ 19: Monitoring Displays

```
DRV►     Current
17         7.6A
```

```
DRV►     Speed
18      1350RPM
```

```
DRV► DC Link Vtg
19       646.0V
```

```
DRV►     User Disp
20   Out   424.0V
```

DRV-17 shows the actual motor current.
DRV-18 shows the actual motor speed.
DRV-19 shows the actual DC bus voltage
DRV-20 shows the actual VFD output voltage or kW selected in FG2-81.
These parameters show actual (non-adjustable) values and can be used for monitoring and trouble-shooting purposes.

DRV-21: Current Trip Display

```
DRV►      Fault
21         None
```

DRV-21 shows None (VFD is ready) or the current fault if VFD is tripped. It is possible to check Hz, Amps, VFD mode and Trip time by pressing [ENTER] key and then [UP] key for each reading. When readings are checked, press [ENTER] key to return to the fault display.

DRV-22: Target and Output Speed Display

```
DRV► TAR  35.00Hz
22   OUT  21.00Hz
```

The Target value shows what speed command VFD should follow.
The Output value shows the actual VFD output speed. This parameter is very useful for trouble-shooting.

DRV-23: PID Reference and Feedback Display

```
DRV► R    50.0PSI
22   F    28.0PSI
```

When VFD runs in PID mode the Reference is the PID set-point (desired pressure, temperature etc.) and Feedback is the actual process value read from the transducer. This display is shown with unit set in SET-22 and it is very useful for PID operation trouble-shooting.
Note: R and F Modbus addresses are on page #123.

DRV-24: Speed Display Selection Hz or RPM

```
DRV► Hz/RPM Disp
24        Hz
```

The speed display can be changed from Frequency (Hz) to

Revolution Per Minute (RPM) format. When PID is enabled, only Hz are shown.

DRV-25: PID Values Display

```
R 50.0%  T 20.0Hz
F 28.0%  O 18.5Hz
```

The parameter number DRV-25 will flash over Output value while VFD is stopped as an indication of the current parameter. The PID Values Display shows **[R]** Reference (Set-point) and **[F]** Feedback (Transducer reading) as a percentage of the SET-25 transducer range. The **[T]** Target Hz is the speed reference that PID provides to VFD to follow and **[O]** Output Hz is the actual VFD output frequency. This parameter display is very useful for PID and transducer operation adjustment or trouble-shooting.

DRV-26: AD (Analog to Digital) Converter Values

```
V1   1240  V2      0
V1S     0  I    3980
```

The readings shown on this display are raw AD converter values from 0 to approximately 4095 depending on VFD calibration values.

V1 value divided by 337 approximately represents the analog 0-10VDC signal on V1 input.

V1S value will be shown only when bi-polar analog input is selected in SET-10. The following readings approximately represent analog signal values: 0 is -12VDC, 2047 is 0VDC and 4095 is +12VDC.

V2 value will be shown when expansion analog card is installed.

I value divided by 204 approximately represents the analog 4-20mA signal on I input. This parameter is very useful for PID and transducer operation adjustment or trouble-shooting.

DRV-30~ 32: Motor Overheat Trip

```
DRV► MOH TripSel
30             000
```

```
DRV►MotTrip Temp
31           110°C
```

```
DRV► MotTripHyst
32             5°C
```

The VFD can monitor motor temperature with thermistor PTC (positive temperature coefficient) or NTC (negative temperature coefficient) sensor connected to NT or NE and 5G terminal.

DRV-30 has three bits for motor overheat protection settings.

1st bit is protection Enable/Disable setting (1=Enable)

2nd bit is Auto/Manual reset (1=Auto)

3rd bit is NTC/PTC sensor type selection (1=NTC).

Example: If DRV-30 is set to 011, the overheat protection is enabled (01**1**) with Auto reset (0**1**1) and PTC sensor (**0**11).

DRV-31 is a Motor Overheat trip temperature value setting in Celsius. VFD will trip on MOH fault when motor winding temperature exceeds DRV-31 value. The default setting 110°C is set for motors with insulation class B or better. For motor with insulation class A decrease DRV-31 setting to 105°C, otherwise the lifetime of the motor can be reduced.

DRV-32 is a Motor Overheat hysteresis parameter. The Motor Overheat fault condition will be reset when temperature decreases from trip level by hysteresis value.

The thermistor rating ±5% at 25°C for PTC sensor is 1kΩ and for NTC is 2.545kΩ. The temperature range for PTC sensor is 0-125°C and for NTC is 0-150°C.

DRV-34~ 36: Frequency Limit by VFD Temp. °C

```
DRV►  VFD Max. T
34           110°C
```

```
DRV► Hot VFD Freq
35           60.00Hz
```

```
DRV► VOH Hyster
36             5°C
```

The VFD will decrease a maximum frequency limit to a value set in DRV-35 if VFD temperature exceeds the value set in DRV-34. The maximum frequency limit will return to an original setting when VFD temperature decreases by Hysteresis value set in parameter DRV-36. Adjust DRV-35 frequency limit parameter to an optimal value sufficient for VFD cooling but not small enough to interfere with VFD output frequency dependent protection and control functions such as Broken Pipe, Under Level Trip, etc.

Note: The VFD does not have any indication that maximum frequency limit was changed.

DRV-38 & 39: Proof of Flow by Flow Switch

```
DRV►   Flow Timer
38             10
```

```
DRV► Flow  Freq.
39         30.00Hz
```

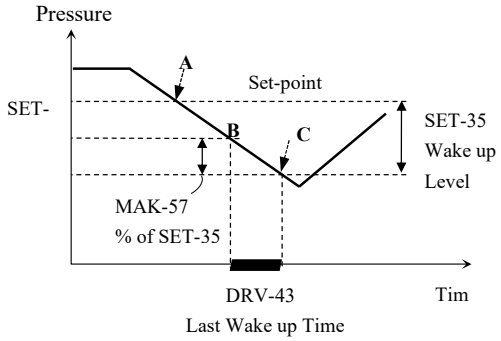
The VFD can monitor a system flow switch to provide a better pump protection and more reliable sleep mode operation. If any digital input is set to Flow Switch in parameters I/O-20~27 and VFD runs longer than time set in DRV-38 at frequency above setting in DRV-39 with open Flow Switch, VFD will trip on No Flow fault with "No Flow" message flashing on the screen. VFD will try to restart based on FG2-24~26 settings. If Flow Switch is open and VFD frequency drops below DRV-39 Flow Freq. before VFD trips on No Flow fault, it will reset the Flow Timer. The No Flow

fault should be reset manually by Stop key, or by digital Reset input or by cycling VFD power. If DRV-39 is set to 0.00Hz, the No Flow protection will be disabled and Flow SW works as an additional condition for Sleep Mode. When VFD runs in PID mode and meets conditions for sleep, it will still run at minimum speed and wait until Flow SW is open.

DRV-41~48: Dual Demand Mode & Pipe Leak

DRV► Dual Demand 41 Yes	DRV► Pipe Leak 42 Alarm
DRV►LastWakeup T 43 0.0	DRV► Tw HiDemand 44 5.0 sec
DRV► Tw LoDemand 45 5.0	DRV►LD Set-point 46 40.0 PSI
DRV► LD Max Freq 47 50.00Hz	DRV► LD Timer 48 10.0 sec

The Dual Demand control mode was designed for pump systems with distinct high and low demand requirements and to provide Pipe Leak protection. If pump is sized to high demand system (pivot) but at some point, it will supply water to low demand line (sprinklers), the system can be quickly over-pressurized and pump will cycle because it is too big for this low demand. With Dual Demand control VFD will determine what demand level is activated by wakeup time. If VFD is in sleep mode and pivot system (high demand) valve is open, VFD will wake up in short period of time. If sprinkler system (low demand) valve is open, it will take longer to wake up VFD. If wakeup time exceeds low demand wake up time, VFD activates pipe leak alarm or protection. The following Wakeup time chart shows relationship between High and Low demand modes and Pipe Leak protection.



DRV-41 has two selections: No and Yes.

- **No**- Dual Demand Mode is disabled
- **Yes**- Dual Demand Mode is enabled

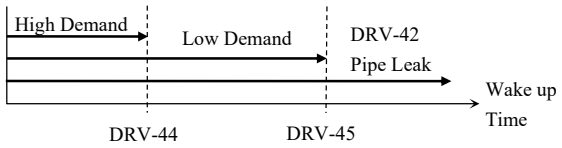
DRV-42 has three selections: None, Alarm and Trip

- **None**- Pipe Leak protection is disabled
- **Alarm**- The selected in I/O-76~79 relay output will be activated when pipe leak is detected.
- **Trip**- VFD will trip on Pipe Leak fault with flashing fault message on the screen.

DRV-43 shows how much time it took for last VFD wake up. The Wake up monitoring mode starts when pressure value drops below SET-26 Set-point setting at point **A** on the diagram below. The Wake up time counter starts below point **B** and stops at VFD wake up point **C**. The position of point **B** is determined by parameter MAK-57 set as percentage of SET-35 value. By default, MAK-57 is set to 50% and can be changed in 0-100% range.

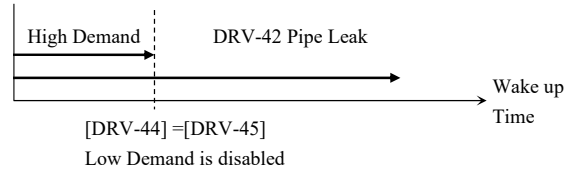
DRV-44 is an adjustable setting for High Demand wake up time, which should be determined during system startup. It is recommended to set time in this parameter to 20-30% greater value than DRV-43 shows to compensate for any future system changes.

DRV-45 is an adjustable setting for Low Demand wake up time, which should be determined during system startup. It is recommended to set time in this parameter to 20-30% greater value than DRV-43



shows for proper Pipe Leak protection operation.

If DRV-44 and DRV-45 are set to the same value, the Low Demand Mode is disabled and DRV-42 Pipe Leak can be set to Alarm or Trip action.



DRV-46 is an adjustable setting for Low Demand pressure set-point. It can be adjusted to lower pressure setting to prevent overpressure trip at pump start.

DRV-47 is an adjustable setting for Low Demand PID high frequency limit. Adjust to lower frequency setting to prevent overpressure trips during run but enough to maintain pressure at LD Set-point.

DRV-48 is an adjustable setting for Low Demand Timer. When VFD determines Low Demand mode during wake but at any point pressure cannot reach DRV-46 set-point within DRV-48 time frame, VFD switches control to High Demand mode.

Note: If VFD trips on fault or power is cycled during Low Demand control mode, it will start in Low Demand mode after reset or power up.

DRV-51~53: I Input High Level Trigger Settings

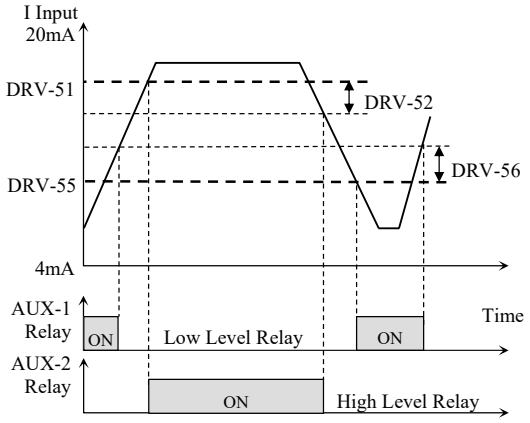
DRV▶ I Hi Level 51 19.00 mA	DRV▶ I Hi Hyst. 52 1.00 mA
DRV▶ I Hi Delay 53 2 sec	

DRV-51 is an adjustable setting for high level of I input signal in mA to trigger any selected in I/O-76~79 digital output. When mA signal exceeds the DRV-51 value for DRV-53 delay, the I Hi Level AUX relay will be activated.
DRV-52 is an adjustable setting for mA high level hysteresis value. When AUX relay was activated at mA high level then signal decreases below [DRV-51]-[DRV-52] value, the AUX relay will be de-activated.
DRV-53 is an adjustable setting for high level delay time. The AUX relay will be activated only if mA signal stays above DRV-51 value for DRV-53 delay time.

DRV-55~57: I Input Low Level Trigger Settings

DRV▶ I Lo Level 55 5.00 mA	DRV▶ I Lo Hyst. 56 1.00 mA
DRV▶ I Lo Delay 57 2 sec	

DRV-55 is an adjustable setting for low level of I input signal in mA to trigger any selected in I/O-76~79 digital output. When mA signal is below the DRV-55 value for DRV-57 delay, the I Lo Level AUX relay will be activated.
DRV-56 is an adjustable setting for mA low level hysteresis value. When AUX relay was activated at mA low level then signal increases above [DRV-55]+[DRV-56] value, the AUX relay will be de-activated.
DRV-57 is an adjustable setting for low level delay time. The AUX relay will be activated only if mA signal stays below DRV-55 value for DRV-57 delay time.
The following diagram shows I input mA Low and High relays operations.



Note: If better accuracy required for analog level monitoring feature, use parameters MAK-37 and MAK-38 for analog mA signal calibration

DRV-61~63: V1 Input High Level Trigger Settings

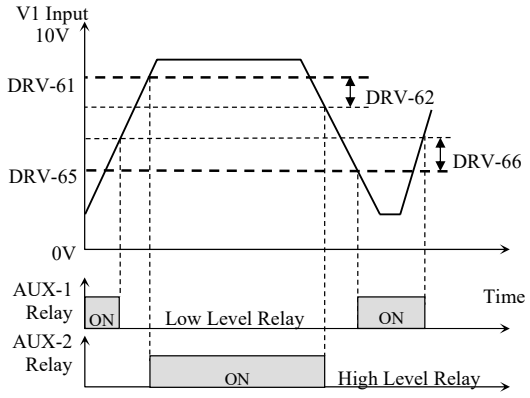
DRV▶ V Hi Level 61 9.00 V	DRV▶ V Hi Hyst. 62 1.00 V
DRV▶ V Hi Delay 63 2 sec	

DRV-61 is an adjustable setting for high level of V1 input signal in V to trigger any selected in I/O-76~79 digital output. When V signal exceeds the DRV-61 value for DRV-63 delay, the V Hi Level AUX relay will be activated.
DRV-62 is an adjustable setting for V high level hysteresis value. When AUX relay was activated at V high level then signal decreases below [DRV-61]-[DRV-62] value, the AUX relay will be de-activated.
DRV-63 is an adjustable setting for high level delay time. The AUX relay will be activated only if V signal stays above DRV-61 value for DRV-63 delay time.

DRV-65~67: V1 Input Low Level Trigger Settings

DRV▶ V Lo Level 65 0.50 V	DRV▶ V Lo Hyst. 66 1.00 V
DRV▶ V Lo Delay 67 2 sec	

DRV-65 is an adjustable setting for low level of V1 input signal in V to trigger any selected in I/O-76~79 digital output. When V signal is below the DRV-65 value for DRV-67 delay, the V Lo Level AUX relay will be activated.
DRV-66 is an adjustable setting for V low level hysteresis value. When AUX relay was activated at V low level then signal increases above [DRV-65]+[DRV-66] value, the AUX relay will be de-activated.
DRV-67 is an adjustable setting for low level delay time. The AUX relay will be activated only if V signal stays below DRV-65 value for DRV-67 delay time.
The following diagram shows V1 input V Low and High relays operations.



Note: If better accuracy required for analog level monitoring feature, use parameters MAK-35 and MAK-36 for analog voltage signal calibration.

DRV-70: High Frequency Limit by I/V Level

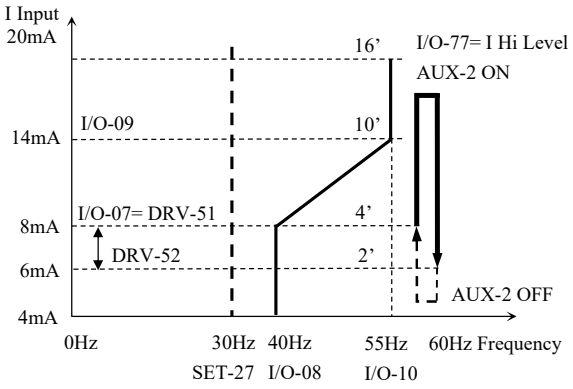
```
DRV► Freq By Lvl
70      None
```

The DRV-70 Frequency Limit by Level parameter has three selections: None, I and V1. This function is designed to limit maximum pump speed in constant pressure systems by well water level. It requires a level (pressure) transducer to be installed in the well. If system pressure transducer is 0-10V, use 4-20mA (less sensitive to electrical noise) level transducer and wire it to VFD I input terminal. Adjust mA signal scaling parameters I/O-7~10 to desired maximum frequency range based on well water level.

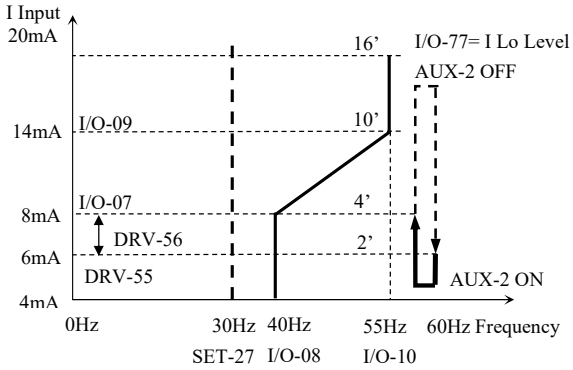
Example: The following diagram shows how pump speed limiting control by well water level operates. Water level transducer range is 0-16 feet, I/O-07 setting at 8mA equals to 4 feet and I/O-09 setting at 14mA equals to 10 feet. If I/O-08 is set to 40Hz and I/O-10 to 55Hz and water level is above 10 feet, VFD will maintain pressure with frequency range from 30Hz to 55Hz. The I/O-10 value will override SET-28 PID Max. Frequency limit (60Hz). When water level starts dropping below 10 feet, the VFD maximum frequency limit will be decreased linearly from 55Hz at 10 feet to 33Hz at 4 feet water level. If water level drops below 4 feet, the frequency limit stays at 40Hz and drive will operate from 30Hz to 40Hz.

There two ways to protect pump from running at critically low water level.

1st. Set AUX relay to high level trigger and wire it in series with VFD start signal. I/O-77 is set to I Hi Level, DRV-51 to 8mA and DRV-52 to 2mA. AUX-2 relay contact was wired in series with start signal on VFD M7 terminal. When water level is above 4' AUX-2 relay closes its contact and VFD starts and runs. When water level drops below 2', AUX-2 relay opens its contact and VFD stops. The VFD will start again when water level rises above 4' level.



2nd. Set AUX relay for low level trigger and wire it to M5 Emergency Stop input. Set I/O-77 to I Lo Level, DRV-55 to 6mA and DRV-56 to 2mA. Wire AUX-2 relay contact between VFD M5 and CM terminals. When water level is above 2' AUX-2 relay contact is open and VFD runs. When water level drops below 2', AUX-2 relay closes its contact and VFD stops by BX fault. The VFD will start again when water level rises above 4' level and



AUX-2 relay opens its contact.

DRV-91: Drive Control Mode 2

```
DRV► Drive Mode2
91      Remote-1
```

The Drive Mode2 parameter will be available when SET-90 is set to 2nd Source. It determines the source of the VFD Start/Stop command when LOC/REM key or LOC/REM digital input is used to switch to Local mode. The selection choices are: Keypad, Remote-1 and Remote-2. Refer to parameter SET-09 for detailed control mode descriptions.

DRV-92: Speed Control Mode

```
DRV► Freq Mode2
92      Keypad-1
```

The Frequency Mode2 parameter will be available when SET-90 is set to 2nd Source and determines the source of the

speed reference command to VFD when LOC/REM key or LOC/REM digital input is used to switch VFD to 2nd Source. The selection choices are: Keypad-1, Keypad-Up/Down, V1, V1S, I, V1+I, and Pulse. Refer to parameter SET-10 for detailed descriptions.

DRV-93~96: 2nd Analog Input Setting

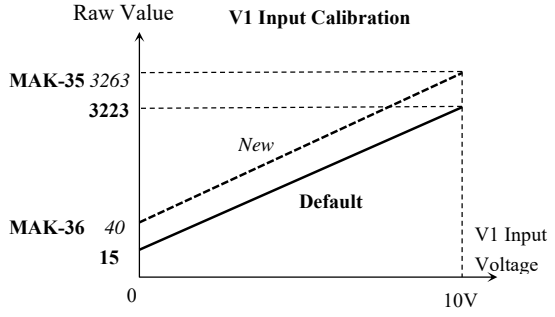
DRV►Input Select 93 V1	DRV► Input Unit 94 Feet
DRV►In Max Value 95 1000.0Feet	DRV► **In Display** 96 424.0 Feet

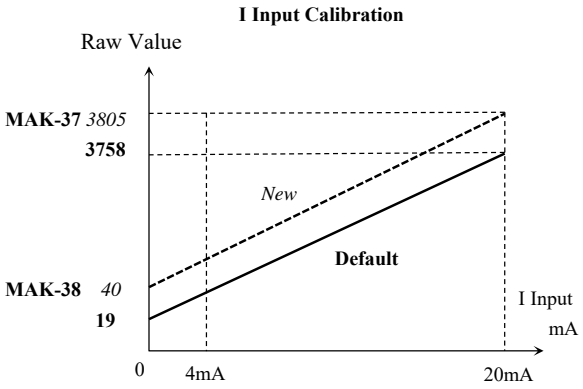
The purpose of 2nd Analog Input parameters is to provide proper scaling for displaying 2nd Analog Input reading in chosen engineering unit.
DRV-93 2nd Analog Input Source Selection: V1 for 0-10V and I for 4-20mA.
DRV-94 2nd Analog Input Unit Selection: Custom; PSI; Feet.
DRV-95 2nd Analog Input Maximum Value (Transducer range): 0.0-3000.0.
DRV-96 2nd Analog Input Actual Reading (scaled to selected unit and transducer range). This display parameter will help to monitor actual pressure or level reading from 2nd analog input source.

DRV-97: V1 Input Reading Volts

DRV► V1 Input V
97 00.00 V

DRV-97 is a display parameter showing analog signal voltage applied to V1 input. From the factory VFD comes with basic analog input calibration and it can have up to 2% reading error. For more precise V1 input calibration use parameters MAK-35 and MAK-36. Connect a multimeter set to 20VDC range to V1 and 5G terminals. First, adjust minimum value in parameter MAK-36 corresponding to 0V multimeter reading. Then apply analog signal close to 10VDC and adjust maximum value in parameter MAK-35 to match multimeter and DRV-97 readings. If parameter DRV-97 reads greater value than multimeter, increase setting value in parameter MAK-35 or MAK-36.





Note: Resetting VFD parameters to factory default settings in parameter FG2-93 with reset both analog inputs calibrations in MAK group.

DRV-98: I Input Reading in mA

DRV► I Input mA
98 00.00 mA

DRV-98 is a display parameter showing analog signal current applied to I input. From the factory VFD comes with generic analog input calibration and it can have up to 2% error. For precise V1 input calibration use parameters MAK-37 and MAK-38. Use the same procedure as described in DRV-97 parameter above.

6.3 Function Group 1 [FG1]

FG1-00: Jump Code

FG1▶ Jump Code
00 70

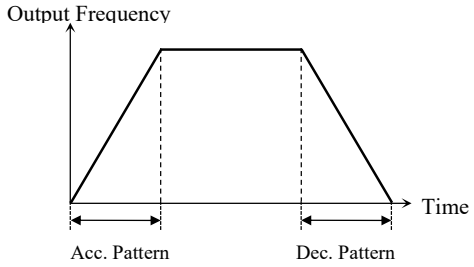
The FG1-00 parameter allows jumping to any parameter in FG1 group without scrolling to it. Press [ENTER] key and input desired parameter code by using [SHIFT] and [UP]/[DOWN] keys.
When [ENTER] key is pressed again, the desired parameter will be on the display.

FG1-01 & 02: Acc and Dec Patterns

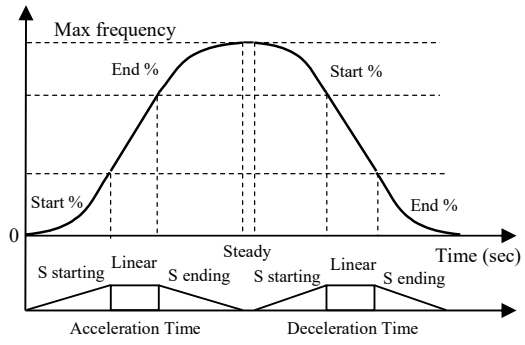
FG1▶Acc. Pattern
01 Linear

FG1▶Dec. Pattern
02 Linear

The FG1-01and FG1-02 parameters have following selections for acceleration pattern: Linear, S-Curve and User-Curve.
The **Linear Curve** provides linear relation between VFD output frequency and time. The maximum and minimum frequency limits are set in SET-13 and SET-14.



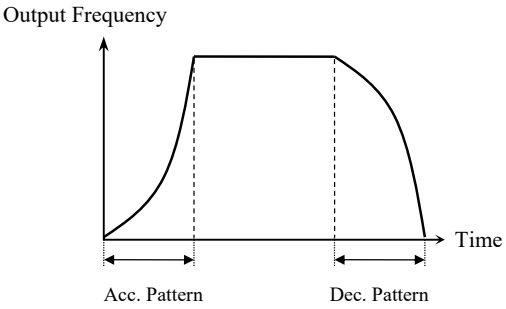
The **S-Curve** provides non-linear relation between VFD output frequency and time. The maximum and minimum frequency limits are set in SET-13 and SET-14. This pattern allows the motor to accelerate and decelerate smoothly.
The actual acceleration and deceleration time will be about 40% longer than the time set in SET-11 and SET-12.
The S-Curve prevents mechanical shock of the equipment during acceleration and deceleration modes.



The Actual $\textbf{Accel time} = [\textbf{SET} - \textbf{11}] + \left(\frac{[\textbf{SET}-\textbf{11}]\textbf{x}[\textbf{FG1}-\textbf{03}]}{\textbf{2}}\right) + \left(\frac{[\textbf{SET}-\textbf{11}]\textbf{x}[\textbf{FG1}-\textbf{04}]}{\textbf{2}}\right)$.

The Actual $\textbf{Decel time} = [\textbf{SET} - \textbf{12}] + \left(\frac{[\textbf{SET}-\textbf{12}]\textbf{x}[\textbf{FG1}-\textbf{03}]}{\textbf{2}}\right) + \left(\frac{[\textbf{SET}-\textbf{12}]\textbf{x}[\textbf{FG1}-\textbf{04}]}{\textbf{2}}\right)$.

The **U-Curve** provides slower acceleration or deceleration from beginning to about 2/3 of the SET-13 ACC Time and SET-14 DEC Time.



FG1-03 & 04: Start and End Segments of S-Curve

FG1▶ Start Curve
03 25%

FG1▶ End Curve
04 25%

The FG1-03 parameter is a percentage of the Delta Frequency (from current to new reference) and it determines the ACC time at the beginning and end of the S-Curve for the acceleration pattern. The FG1-04 parameter is a percentage of the Delta Frequency and determines the DEC time at the beginning and end of the S-Curve for the deceleration pattern. The segment of the S-Curve between Start curve and End curve is linear. Example: If FG1-03 is set to 25% and speed changes from current 20Hz to new 40Hz, the linear segment between them will be 50% of 20Hz (Delta=40Hz-20Hz).

FG1-10: Motor Pre-Heat Mode

FG1▶PreHeat Mode
10 Yes

The Pre-Heat Mode allows the motor to be heated during VFD stop mode to protect it from moisture accumulating in the windings. The VFD generates DC voltage pulses in the motor windings and heats it to some level based on settings in FG1-11 and FG1-12. If FG1-10 is set to Yes, the Pre-Heat Mode is enabled and parameters FG1-11 and FG1-12 are available. The Pre-Heat mode will be activated by any digital input programmed for Pre-Heat and deactivated when input is off. When VFD activates Pre-Heat mode, the screen will show flashing green lights and message “PreHeat”. There is a Pre-Heat Delay

parameter FG1-13 set by default to 1800sec. If this parameter value is greater than 0, the Pre-Heat mode starts after time delay expires. Do not adjust Pre-Heat Delay value too low, it can cause an OC1 or OC2 fault if stop mode is set to Coast Stop and the load is still spinning.

FG1-11~ 13: Pre-Heat Mode Settings

FG1▶ PreHeatLevel 11 20%	**FG1▶** PreHeat Duty 12 30%
FG1▶ PreHeatDelay 13 1800 sec	

The FG1-11 parameter determines the pre-heat current as a percentage of SET-03 Motor FLA. Increase this level from default setting if ambient temperature is lower than 41°F (5°C).
The FG1-12 parameter determines the pre-heat duty cycle for on time as a percentage of Pre-Heat 10 sec. cycle. Increase this level from default setting if ambient temperature is lower than 32°F (0°C).
Parameter FG1-13 is a delay time at every VFD stop to activate a Pre-heat mode.

FG1-20: Start Mode

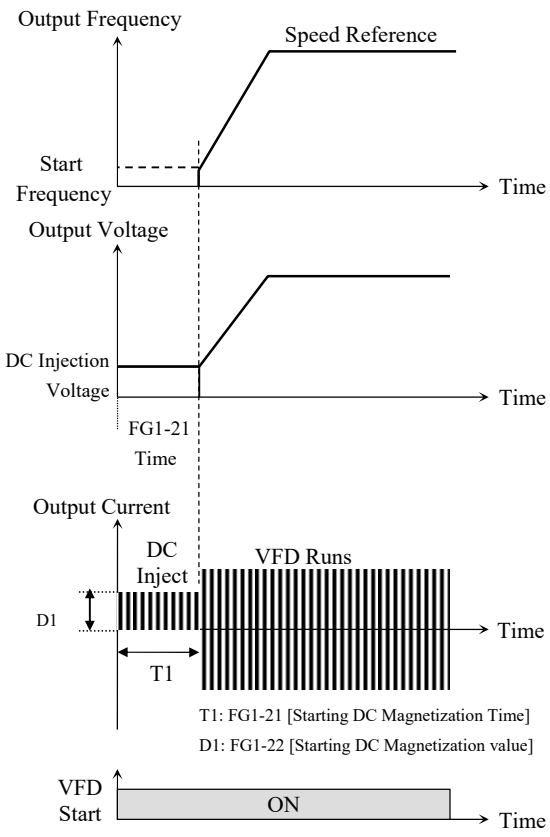
FG1▶ Start Mode 20 Accel

The FG1-20 parameter has three selections: Accel, DC-Start and Flying Start.
Accel-the VFD acceleration pattern is based on FG1-01 selection.
DC-Start-the VFD stays at start frequency for FG1-21 time providing an initial motor magnetization by DC current to a level set in FG1-22 and then ramps up to the speed reference.
Flying Start- the VFD can start with motor load already rotating in forward or reverse direction. The FG2-27 Flying Start Level should be set to less than 50% if load rotation direction is opposite of the supplied command.

FG1-21 & 22: DC-Injection Start Time and Value

FG1▶ DcSt Time 21 0.0 sec	**FG1▶** DcSt Value 22 50%

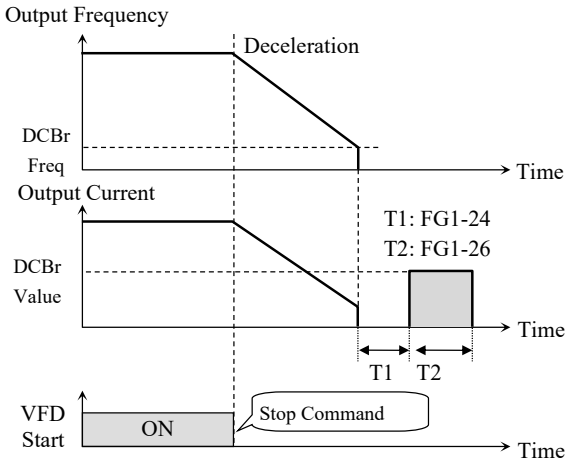
If both parameters FG1-21 and FG1-22 are set to 0 or Sensorless Control Mode is selected in parameter FG2-60, the DC-Start mode will be disabled.
The FG1-21 parameter determines the time for initial magnetization and FG1-22 determines the DC current value as a percentage of the Motor FLA.
The VFD can trip on No Motor Trip or Output Phase Loss when DC-start is activated.



FG1-24~ 27: DC Injection Braking Settings

FG1▶ DcBr Delay 24 0.10 sec	**FG1▶** DcBr Freq 25 20.00 Hz
FG1▶ DcBr Time 26 3.0 sec	**FG1▶** DcBr Value 27 50%

These parameters become available when SET-16 Stop Mode is set to DC-Brake.
FG1-24 is the setting for the time delay before DC Braking is activated.
FG1-25 is the frequency setting below which the DC Braking is activated.
FG1-26 is the setting for DC Braking operating time.
FG1-27 is the setting for DC Braking current as a percentage of the Motor FLA.
The DC Braking mode is useful for low duty cycle stopping of low inertia high speed loads such as saw blade, spindle etc. Frequent use of DC Braking mode can cause the motor overheating



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FG1-29: Line Frequency

FG1▶	Line Freq
29	60.00 Hz

The Line Frequency parameter should be set to match the power line frequency 50Hz or 60Hz. If Line Frequency parameter is changed from 60Hz to 50Hz, the FG1-30 and FG1-31 parameters will automatically be changed to 50Hz. They can be manually programmed back to 60Hz.

FG1-30: Maximum Output Frequency

FG1▶	Max Freq
30	60.00 Hz

The FG1-30 parameter should be set to the maximum output frequency that VFD can produce at full speed reference signal. For most standard industrial motors it should be set to 50Hz or 60Hz.

FG1-31: Base Frequency

FG1▶	Base Freq
31	60.00 Hz

The FG1-31 parameter should be set to the motor nameplate frequency rating. The VFD will produce full voltage output at Base frequency. If Maximum Frequency is set to 70Hz, Base to 60Hz and Motor Voltage to 230V, the VFD during acceleration will output 230V at 60Hz and from this point increase only frequency to 70Hz.

FG1-32: Starting Frequency

FG1▶	Start Freq
32	0.50 Hz

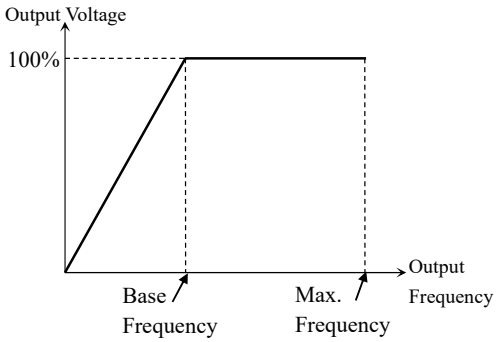
The FG1-32 Starting Frequency parameter is set to 0.5Hz as a default and normally it should not be changed. This parameter determines from which frequency VFD will start generating output to a motor.

FG1-40: Volts/Hertz Pattern

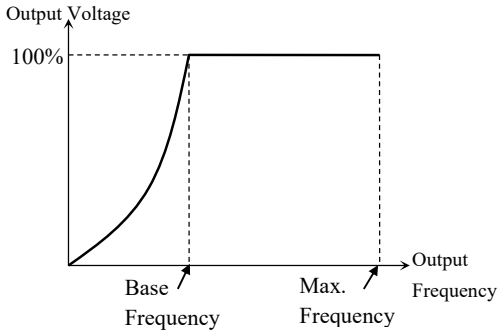
FG1▶	V/F Pattern
40	Linear

The FG1-40 parameter has three selections for Volts/Hertz curve: Linear, Square and User V/F.

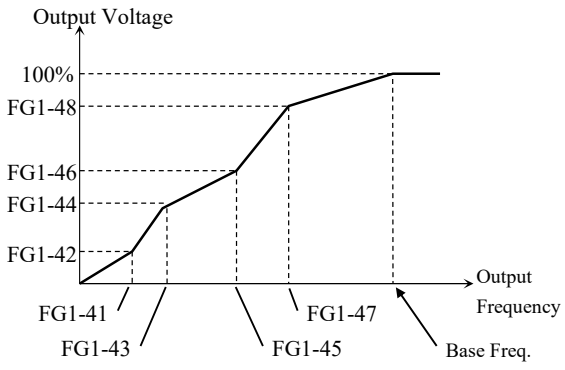
Linear pattern is a basic control pattern and can be used for constant and variable torque applications. This pattern maintains a linear Volts/Hz ratio from zero to base frequency. The motor control can be improved with proper Torque Boost level settings.



Square pattern is used for variable torque applications such as fans, pumps etc. This pattern maintains squared Volts/Hertz ratio creating slow acceleration on 2/3 of the Base Frequency.



User V/F pattern is used for special applications with up to five different Volts/Frequency ratio step requirements. The User V/F curve can have one or two standard V/F segments and up to three custom V/F ratio segments. The parameters FG1-41~48 define Voltage and Frequency for each point on the User V/F curve.



FG1-41~ 48: User V/F Curve Settings

FG1► User Freq 1 41 15.00Hz	**FG1►** User Volt 1 42 25%
FG1► User Freq 4 47 60.00Hz	**FG1►** User Volt 4 48 100%

When FG1-40 is set to User V/F curve, FG1-41~48 parameters become available. Parameters FG1-41, 43, 45, and 47 determine frequency at every step of the V/F curve. Parameters FG1-42, 44, 46, and 48 determine voltage at every step of the V/F curve. The following diagram shows custom five-step V/F curve.

FG1-51, 52: Energy Save Mode Settings

FG1► Energy Save 51 Auto	**FG1►** Manual Save 52 10%

The Energy Save function is used to reduce the output voltage in applications that do not require full torque and current at steady speed. The inverter reduces its output voltage for energy saving at steady speed.
The FG1-51 parameter has three selections: None, Manual and Auto.
Manual-If the manual energy save level is set at 20%, the output voltage will be decreased by 20% when VFD runs at steady speed.
Auto- The VFD determines the energy saving level automatically.
This function may cause over-current trip due to the lack of output torque in a fluctuating load system. When Energy Save is ON, it may take longer to decelerate to stop.

FG1-54: Integrating Wattmeter

FG1► KiloWattHour
54 0M 0.0kWh

This display parameter shows accumulated power meter reading in Megawatt- Hours and Kilowatt- Hours.

FG1-55: Inverter Power Module Temperature °C

FG1► VFD Temp.°C
55 37

This display parameter shows actual temperature of the VFD power module in Celsius. For a reference, the module temperature of the VFD running at full speed with adequate cooling at ambient temperature below 77°F should not exceed 60°C.

FG1-56: Motor Temperature °C Display

FG1►MotorTemp.°C
56 N/A

This display parameter shows the actual motor temperature in Celsius if thermistor sensor is installed in motor winding and connected to VFD's terminals 5G and NT or ET. The motor overheat protection can be set in parameters DRV-30~32. If temperature sensor reading is over the sensor range or is disconnected, VFD shows N/A or 0°C on FG1-56 screen.

FG1-57~ 59: No Motor Protection Settings

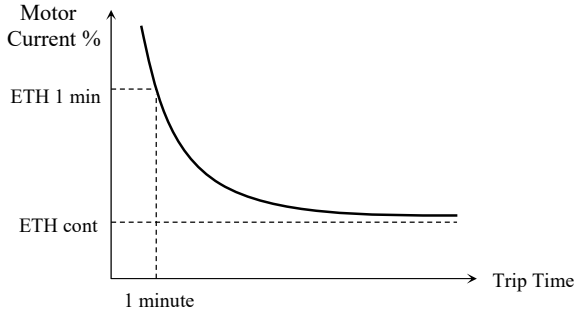
FG1►No Motor Sel 57 Yes	FG1►NoMotorLevel 58 5%
FG1► NoMotorTime 59 0.2 sec	

When FG1-57 is set to Yes, FG1-58 to 5% of motor FLA, SET-03 FLA to 10A and FG1-59 to 0.2sec., the VFD will trip on No Motor fault when output current is less than 0.5A for 0.2sec and VFD frequency is above SET-13. This parameter can provide some degree of protection for VFD when motor circuit is open during VFD operation.

FG1-60~ 62: Electronic Motor Overload Settings

FG1► ETH Select 60 Yes	**FG1►** ETH 1min 61 120%
FG1► ETH Cont 62 110%	

The electronic motor overload protection [ETH] provides motor protection based on inversed thermal curve.
FG1-60 enables ETH protection mode.
FG1-61 sets the slope of the thermal curve as a percentage of the motor FLA for 1min to trip VFD.

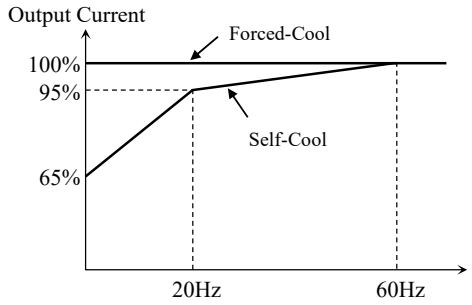


FG1-62 sets the service factor current (SFA) as a percentage of the motor FLA for continuous run.
Note: For submersible pump application FG1-62 is set to 100% and SET-03 should be set to motor SFA not FLA.

FG1-63: Motor Cooling Type Selection

FG1► Motor Type
63 Self-cool

This parameter has two motor cooling type selections: Self Cooled and Forced Cooled.
The self-cooled motors have a fan attached to the motor shaft providing cooling airflow when motor runs. Because of their design, these motors always need to run above 20Hz to provide enough cooling otherwise VFD should be de-rated.
The forced-cooled motors have an electrical air blower providing cooling airflow continuously. These motors can run at low frequency continuously without overheating.



FG1-64 & 65: VFD Overload Warning Settings

FG1► OL Level
64 105%

FG1► OL Time
65 10.0sec

If the motor current exceeds FG1-64 level (%) of VFD current rating for FG1-65 time, the VFD will activate a selected in I/O-76~79 AUX relay and show Overload warning message on the display.

FG1-66~ 68: VFD Overload Trip Settings

FG1► OLT Select
66 Yes

FG1► OLT Level
67 110%

FG1► OLT Time
68 30.0 sec

If FG1-66 is set to Yes and the motor current exceeds VFD rating by FG1-67 level for FG1-68 time, the VFD will trip on Overload fault.

FG1-69: Input & Output Phase Loss Protection

FG1► Trip Select
69 111

FG1-69 has a 3-bit selection system starting from the right to the left:
Bit #1 is Output Phase Loss, Bit #2 is Input Phase Loss, Bit #3 Direct Input operation.

This function is used to trip VFD on input or output phase loss.

1st bit [xx0]: Output phase loss protection
0: [xx0] Output phase loss protection is disabled.
1: [xx1] Output phase loss protection is enabled.
The VFD will trip if output current sensors do not read current in one of the output phases.

2nd bit [x0x]: Input phase loss protection
0: [x0x] Input phase loss protection is disabled.
1: [x1x] Input phase loss protection is enabled.
The VFD monitors the pattern of DC bus ripples and trips if it detects a single-phase ripple pattern. Parameter MAK-06 is a trip ripple amplitude setting in volts.

3rd bit [0xx]: Direct input operation protection selection.
0: [0xx] Direct operation protection is disabled.
1: [1xx] Direct operation protection is enabled.
The VFD will trip when direct input magnetic contactor is turned On and Off during direct input operation.

FG1-70 & 71: Stall Prevention Mode Settings

FG1► Stall Mode
70 Yes

FG1► Stall Level
71 110 %

FG1-70 enables parameter FG1-71 and Stall Prevention Mode. FG1-71 is set as a percentage of the motor FLA. This mode works as a current limiting function protecting motor from excessive current above FG1-71 setting by decreasing the motor speed. If VFD cannot accelerate over 0.5~3.5Hz and trips on ETH fault, the FG1-71 stall level is most likely set too low for the current application and VFD keeps very low speed trying to decrease motor current. Stall level will be automatically reduced if inverter operates at a frequency higher than the base frequency.
If stall prevention level is set above 120% of VFD current rating, the level will be limited at 120% of VFD current rating set in MAK-08 parameter. The default setting is sufficient for most Fan and Pump applications.
Note**:** Acceleration or Deceleration time may get longer due to stall prevention function operation. If stall prevention level setting is close to an actual run current, the VFD can create an output speed oscillation.

FG1-73: Frequency Range for Accel/Decel Time

FG1► Acc/Dec Freq
73 Max Freq

The Acceleration and Deceleration time frequency range can be set to Maximum Frequency or Delta Frequency.

Max. Frequency- the VFD will increase its output frequency from 0Hz to Max. Frequency during acceleration time or decrease it from Max. Frequency to 0Hz during deceleration time.
Example: If Accel time is set to 60sec. and Max.

Frequency to 60Hz, the VFD will increase speed from 10Hz to 30Hz in 20sec.

Delta Frequency- the VFD will increase its output frequency from current speed to a new Frequency command during Accel time or decrease it from current speed to new Frequency command during Decel time. If Accel time is set to 60sec. and Max. Frequency to 60Hz, it will take same time 60sec. to increase speed from 10Hz to 30Hz or from 0Hz to Max. Frequency.

FG1-74: Accel and Decel Time Scale

FG1► Time Scale
74 0.1 sec

FG1-74 has three selections for Accel/Decel time decimal point: 0.01sec., 0.1sec., 1sec.

0.01sec- This selection provides more precise Accel/Decel time adjustment but limits it to 60.00sec.

0.1sec- This is the most common selection, provides one decimal point for Accel/Decel time adjustment, and limits it to 600.0sec.

1sec- This selection provides no decimal points for Accel/Decel time adjustment and limits it to 6000sec.

FG1-81: VFD Start Delay Time

FG1► Run Delay T
81 10 sec

If FG1-81 parameter is set to any number from 1 to 6000sec and start command is received, the VFD will start when Run Delay time expires. The Run Delay can be used in case if some auxiliary equipment should start before motor controlled by VFD.

FG1-82: Backspin Timer

FG1►Backspin TMR
82 0 sec

If FG1-82 parameter is set to any number from 1 to 6000sec and VFD receives stop command and then run command, the VFD will start when Backspin Timer time expires. If Backspin Timer expires before start command is received, VFD will start immediately. The Backspin timer starts counting at every VFD stop including VFD fault trips.

The Backspin timer is used in pump applications to prevent from starting the motor rotated in reverse direction by back feed of water flow (no check valve in pipe system).

FG1-90 & 91: Up/Dn Speed Control Save Mode

FG1► UpDnSaveMode
90 Yes

FG1► UpDnSaveFreq
91 30.00 Hz

When FG1-90 is set to Yes, the Up/Dn Save feature is enabled and FG1-91 Up/Down Saved Frequency parameter is available. If SET-10 is set to Up/Down Keypad speed control and speed reference was adjusted at 35Hz, the VFD will save this frequency when power is turned off and when power is turned on again, FG1-91 will show 35Hz (saved VFD speed reference before power was down).

6.4 Function Group 2 [FG2]

FG2-00: Jump Code

FG2► Jump Code
00 22

The FG2-00 parameter allows jumping to any parameter in FG2 group without scrolling to it. Press [ENTER] key and input desired parameter code by using [SHIFT] and [UP]/[DOWN] keys.
When [ENTER] key is pressed again, the desired parameter will be on the display.

FG2-01~06: Last Five Faults and Fault Erase

FG2► Last Trip-1
01 None

FG2► Erase Trips
06 No

The VFD fault history saves information for up to five last faults. FG2-01 parameter shows the latest VFD fault. Each registered fault contains the following information at trip moment: Frequency (Hz), Current (A), VFD Mode (ACC, DEC, Steady or Stop) and Run time at trip. In order to read the fault information press **[ENTER]** key and use the **[UP]**/[DOWN] keys to cycle trough Hz, Amps, VFD status, and trip time. Press **[ENTER]** key to return to fault parameter.
When all faults are checked, they can be cleared by setting FG2-06 to Yes. After all faults are erased in the fault history, FG2-06 parameter will show No.

FG2-07~09: Last Trip, On-Time and Run Time

FG2►LastTripTime
07 0:00:00:09:54

FG2► On-Time
08 0:00:01:16:45

FG2► Run Time
09 0:00:00:45:12

The following time format [**1:12:30:24:60]** is used in the VFD. Starting from the left to the right, (1) is the number of years, (12)- number of months, (30)- number of days, (24)- number of hours, (60)- number of minutes.

FG2-07 shows accrued On-Time since last activation of fault relay.

FG2-08 shows total VFD powered up time.

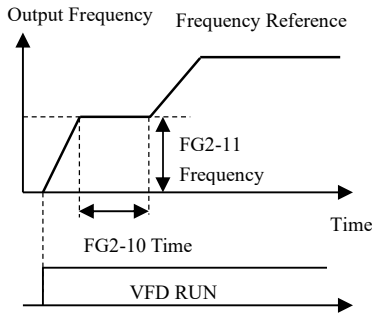
FG2-09 shows total VFD run time.

FG2-10 & 11: Dwell Time and Frequency

FG2► Dwell Time
10 0 sec

FG2► Dwell Freq
11 45.00 Hz

When FG2-10 is set to 1~6000sec., the dwell function is enabled. The VFD will ramp up to FG2-11 frequency and stay at that frequency for FG2-10 time and then continue ramping up to the speed reference frequency. This function can be used in mixer type applications where premixing in lower speed is required before switching to high speed.
If the SET-34 Sleep Boost Value is set greater than 0 for pump applications, the VFD uses FG2-11 frequency as Sleep Boost Frequency which VFD will ramp up to in order to increase system pressure before Sleep Mode is activated.



FG2-12: Jump Frequency Mode Selection

FG2► Jump Freq
12 Yes

The Jump (Skip) Frequencies are used to bypass mechanical system resonance frequencies in order to protect system from damage by vibration. The mechanical systems can have more than one resonance frequency. When FG2-12 is set to Yes, the Jump Frequency parameters FG2-13~18 become available.

FG2-13~18: Jump Frequency

FG2► Jump Low 1
13 10.00 Hz

FG2► Jump High 1
14 15.00 Hz

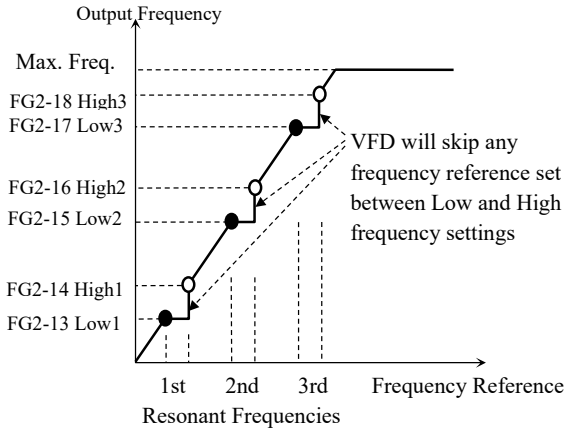
FG2► Jump Low 2
15 20.00 Hz

FG2► Jump High 2
16 25.00 Hz

FG2► Jump Low 3
17 30.00 Hz

FG2► Jump High 3
18 35.00 Hz

The mechanical resonance frequency is actually a small frequency range. VFD allows setting Low and High frequencies for each resonance frequency range up to three ranges total. The diagram below shows settings for three resonance frequency ranges.



FG2-19: Power On Run

FG2► Power On Run	
19	Yes

If FG2-19 is set to Yes, VFD is controlled via terminals and start command is present during power up, VFD will start after power up sequence is done. This feature is used for Fan and Pump applications when the system runs in automatic mode and there is nobody available to restart VFD.

Note: If VFD control is set to keypad and VFD loses power, it will not automatically start at power up.

FG2-20: Power Up Run Delay

FG2► PwrUpRun Dly	
20	10 sec

If FG2-19 is set to Yes (VFD should start after power up) and FG2-20 is set to 1~9999sec., VFD will start after FG2-20 delay time is expired. This feature can be used to protect system from starting during power line transient surges and voltage fluctuation.

FG2-21: Restart After Fault Reset

FG2► RST Restart	
21	Yes

If FG2-21 is set to Yes, VFD is controlled via terminals and start signal is present at the moment of manual or automatic VFD fault reset, VFD will start automatically after VFD fault is reset.

If VFD control is set to keypad mode and VFD is tripped on fault, it will not automatically start at fault reset.

FG2-22: Instantaneous Power Failure (IPF)

FG2► IPF Mode	
22	Yes

If FG2-22 is set to Yes and VFD loses power momentarily, the motor and load are still rotating by inertia. The VFD will start in Flying Start Mode when power is restored regardless of FG1-20 setting but only when FG2-22 is set to Yes.

FG2-24~26: Automatic Restart Mode Settings

FG2► Retry Mode	
24	Yes

FG2► Retry Number	
25	3

FG2► Retry Delay	
26	120 sec

The VFD can be programmed to try restarting automatically after it has tripped on fault.

If **FG2-24** is set to Yes, the retry mode will be enabled and parameters FG2-25 and FG2-26 become available.

FG2-25 sets the number of retry attempts. VFD will try to restart as many times as FG2-25 is set for and if it still trips after last attempt, it will activate the fault relay and stay in fault mode.

FG2-26 sets the time delay before retry attempts. Do not set this number too small because some faults such as Overheat, Overload, Over current etc require a long time to cool down the VFD or motor, otherwise VFD or motor can be damaged. The Retry Delay starts after each VFD trip. The last attempt will be removed from FG2-25 counter if VFD does not trip at next restart attempt during 180sec.

FG2-27 & 30: Flying Start Mode Settings

FG2► FlySt Level	
27	70 %

FG2► FlySt Mode	
30	No

The Flying Start feature allows VFD to start with already rotating motor load without tripping on Overvoltage or Overcurrent fault. The VFD calculates the remaining load speed based on FG2-46 Load Inertia rate and provides output based on FG2-27 setting. If load is rotating in opposite direction, VFD will stop the load first and then start motor in proper direction.

FG2-42: Rated Motor Slip

FG2► Rated Slip	
42	50RPM

The induction motor does not run at synchronous speed because it always has a slip. Rated slip is used by VFD for internal speed control calculations. In order to determine this value, subtract the motor nameplate rated speed from SET-04 Synchronous Speed.

Example: If motor nameplate speed is 3450RPM and SET-04 is set to 3600RPM, the **Slip= 3600rpm-3450rpm=150RPM.**

FG2-44: Motor No Load Current

FG2► Noload Curr
44 3.9 A

The FG2-44 motor No Load Current value is used for internal calculations for accurate speed control in Slip Compensation and Sensorless modes. The default value is set based on standard industrial motor parameters and the capacity of the VFD. If motor name plate does not have No Load rating, it can be determined by running motor without load on the shaft. If it is difficult to check the motor current with disconnected load, set FG2-44 for 35-40% of SET-03 Motor FLA for most of the induction motors or check with motor manufacturer.

FG2-46: Load Inertia Rate

FG2► InertiaRate
46 10

The FG2-46 Inertia Rate value is used by VFD for internal speed control calculations for different modes. The range is 1-40 and the smaller number means higher load inertia.

FG2-47: RPM Scale %

FG2► RPM Scale
47 100 %

The FG2-47 parameter sets the scaling factor for RPM display. This parameter can be used to show RPM of the gearbox output shaft instead of the motor shaft.

FG2-49: PWM (Pulse Width Modulation) Type

FG2► PWM Select
49 Normal

The FG2-49 parameter has two selections: Normal and Low Leakage modes.

Normal- The VFD increases the carrier frequency from minimum to SET-06 value during start.

Low Leakage- The VFD will automatically decrease the carrier frequency to decrease leakage current. If SET-06 is set below 2kHz and FG2-49 is set to Low Leakage, the SET-06 Carrier Frequency will be automatically changed to 2kHz in order to provide proper control range for this feature.

FG2-60~63: VFD Control Mode Settings

FG2► ControlMode
60 V/F

FG2► Auto Tuning
61 No

FG2► %Rs
62 4.00 %

FG2► %Lsigma
63 12.00 %

The FG2-60 Control Mode parameter has three selections: V/F, Slip Compensation and Sensorless.

V/F (Voltage/Frequency) control mode

The control mode parameter FG2-60 is set to V/F mode by default which changes output voltage corresponding to output frequency based on V/F pattern selected in parameter FG1-40. This mode uses standard industrial motor parameters for internal calculations and provides simple, stable and reliable control for most of the motors in HVAC and pump applications.

Slip Compensation control mode

Set FG2-60 to "Slip compen" to enable Slip Compensation control. This mode is mostly used in heavy load applications when constant speed is required. The motor usually decreases speed when load on the shaft increases. The VFD monitors motor current, calculates approximate speed drop, and compensates it by increasing the speed reference in the range of motor slip set in parameter FG2-42. This control provides a constant motor speed regardless of the load change.

Sensorless control mode

Set FG2-60 to "Sensorless" to enable Sensorless vector control. The Sensorless control mode provides better torque control at low speeds, load fluctuation compensation, and better response on rapid load changes. It is required to perform Auto-Tuning before starting Sensorless control in order to provide stable motor control in this mode. The Auto-Tuning operation does not turn the motor shaft and can be performed without disconnecting the load from the motor. During Auto-Tuning the VFD sends different types of pulses to the motor windings and calculates required motor parameters. Then it stores these parameters in memory and uses them for calculations to provide more precise control for the motor. It is recommended to use this mode instead of V/F if motor draws higher than FLA current at full speed with nominal load or speed control at higher speeds is unstable. The no-load motor current parameter is used in Sensorless control calculations and should be set manually in parameter FG2-44.

FG2-67~69: Torque Boost Settings

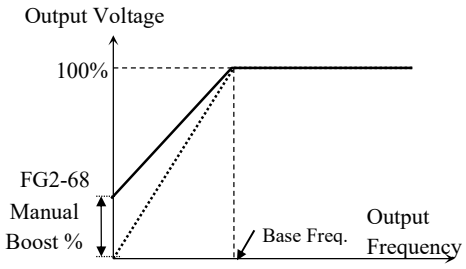
FG2►Torque Boost
67 Manual

FG2► Fwd Boost
68 0.2 %

FG2► Rev Boost
69 0.2 %

This function is used to increase torque at low starting speed by increasing the VFD output voltage. If the boost value is set too high, it may cause motor flux saturation and VFD over current trip. The longer distance to the motor the higher value should be set for torque boost for constant torque applications.

Manual Torque Boost- When FG2-67 is set to Manual, the torque boost values are set in FG2-68



for Forward Boost and FG2-69 for Reverse Boost. The Torque Boost value is a percentage of SET-08 Motor Voltage.

If FG1-40 V/F Pattern is set to User V/F, the torque boost function is disabled.

Auto Torque Boost- When FG2-67 is set to Auto, VFD provides a torque boost level calculated based on the load characteristics.

If FG2-60 is set to Sensorless mode, the Auto Torque boost is disabled.

FG2-80: Power On Display

FG2►	PowerOn Disp
80	0

FG2-80 allows VFD to show the selected parameter in DRV group as a default at power up. Default selection is 0 for DRV-00 Main Display. Example: If operator needs to see DRV-26 analog inputs raw readings as a default screen, set FG2-80 to 26.

FG2-81: User Display Selection

FG2►	User Disp
81	Voltage

FG2-81 determines what value VFD will show in DRV-20 User Display. There are two choices: output Voltage or kWatts. The default selection is Voltage.

FG2-82: Software Version

FG2►	CERUS S/W
82	Ver. 1.0

FG2-82 shows the Cerus VFD firmware version number 1.0 and MAK-04 shows its revision number. Different firmware versions are incompatible with each other. If VFD parameters were saved to a keypad with earlier firmware version and loaded into VFD with newer version, all the parameter settings will be scrambled.

VFD with compatible control board can always be updated with new revision of the firmware at any location.

FG2-87: Power Scaling %

FG2►	Power Set
87	100.0 %

FG2-87 is a scaling value for VFD FG1-54 wattmeter parameter. The range is from 0.1 to 400.0%.

FG2-90: Parameter Display Mode

FG2►	Para. Disp
90	Default

FG2-90 has three selections: Default, All Parameters and Different Parameters.

Default- VFD shows only active parameters. Some parameters are hidden until corresponding mode or feature is enabled. VFD will not show these parameters if their mode is disabled.

All Parameters- VFD shows all available parameters regardless of their activation by some modes.

Different Parameters- VFD shows only parameters that were changed from Basic application default settings. If any other than Basic application is selected, the VFD will show all the parameters that differ from Basic default parameters. This mode is very helpful for VFD operation problem trouble shooting.

FG2-91: Read VFD Parameters to Keypad (Save)

FG2►	Para. Read
91	No

FG2-91 allows saving all the VFD parameters to a keypad. When VFD is at stop mode and FG2-91is set to Yes, the VFD parameters will be saved to both VFD and Keypad memories. It is recommended to use this parameter to save all parameter changes to a keypad when system is adjusted for proper operation. When saving process is done, the display will show No again.

FG2-92: Write Parameters from Keypad to VFD

FG2►	Para. Write
92	No

FG2-92 allows loading all previously saved VFD parameters from keypad to VFD memory. When VFD is at stop mode and FG2-92is set to Yes, the VFD parameters will be loaded from Keypad to VFD memory. One keypad can be used to load the same set of parameters to multiple VFDs with different HP ratings. When loading process is done, the display will show No again. Loading of parameters from keypad to VFD is possible only with identical software versions.

FG2-93: Initialize VFD Parameters

```
FG2►  Para. Init
93          No
```

FG2-93 allows different modes of resetting the VFD parameters to default settings. There are eight selections: All Groups, DRV, FG1, FG2, I/O, APP, COM, and EXT. In order to reset all VFD parameters to default settings, the All Groups option should be selected. For example, if multiple parameters were changed in I/O group and they need to be set to default settings again, select I/O group in FG2-92 to reset only this group. When reset process is done, the display will show No.

FG2-94: Parameters Write Protection (Lock)

```
FG2►   Para. Lock
94               0
```

FG2-94 is used to lock the parameters from being changed. When the parameters are locked, the display arrow changes from solid to triangle. The lock and unlock code is 12.

FG2-95: Parameter Save to VFD memory

```
FG2►   Para. Save
95           No
```

FG2-95 should be used every time a parameter setting is changed. Some parameters can lose their new value at VFD power cycling if they were not saved with FG2-91or FG2-95.

6.5 Input/ Output Group [I/O]

I/O-00: Jump Code

I/O► Jump Code
00 28

The I/O-00 parameter allows jumping to any parameter in I/O group without scrolling to it. Press [ENTER] key and input desired parameter code by using [SHIFT] and [UP]/[DOWN] keys.
When [ENTER] key is pressed again, the desired parameter will be on the display.

I/O-01~05: Analog Voltage Input Settings

I/O► V1 Filter
01 200 ms

I/O► V1 V Min
02 0.0 V

I/O► V1 Freq Min
03 0.00 Hz

I/O► V1 V Max
04 10.0 V

I/O► V1 Freq Max
05 60.00 Hz

These parameters are used to adjust and scale analog voltage input parameters.
I/O-01 provides a noise filtering time adjustment. The voltage 0-10VDC input is very sensitive to electrical noise and can create some speed control problems at high noise levels. The VFD typically follows a speed reference up to maximum speed but sometimes does not follow it back to minimum speed because of AC noise in the speed reference signal. If increasing the filtering time does not fix this problem, this indicates that the noise level is too high because of system wiring or layout problems. Check if analog input V1 cable is shielded, shield is connected to system ground, and analog cable is spaced from input power and motor wires.
I/O-02 should be set to the minimum analog voltage signal value. For example, if voltage signal from BMS is 2-10VDC, I/O-02 should be set to 2VDC. The default value is 0VDC and can be changed from 0 to I/O-04. Set it to desired value if DRV-70 is set to V.
I/O-03 should normally be set to 0Hz.
Do not set it to any frequency to be used as the minimum speed limit because this changes the speed reference control curve. The default value is 0Hz and can be changed from 0 to VFD maximum Frequency. Set it to desired value if DRV-70 is set to I. The frequency Low limit should be programmed in SET-13 or SET-27.
I/O-04 should be set to the maximum analog voltage signal value. For example, if voltage signal from BMS is 0-5VDC, I/O-04 should be set to 5VDC. The default value is 10VDC and can be changed from 0 to 12VDC. Set it to desired value if DRV-70 is set to V.
I/O-05 should normally be set to 50Hz or 60Hz.
Do not set it to any Frequency to be used as maximum speed limit because this changes the speed reference control curve. The default value is 60Hz and can be changed from 0 to VFD Maximum Frequency. Set it to desired value if DRV-70 is set to V. The frequency High limit should be programmed in parameter SET-14 or SET-28.

I/O-06~10: Analog Current Input Settings

I/O► I Filter
06 100 ms

I/O► I mA Min
07 4.0 mA

I/O► I Freq Min
08 0.00 Hz

I/O► I mA Max
09 20.0 mA

I/O► I Freq Max
10 60.00 Hz

These parameters are used to adjust and scale analog current (mA) input parameters.
I/O-06 provides a noise filtering time adjustment. The current input is less sensitive to electrical noise but it can create some speed control problems at high noise levels. The VFD typically follows a speed reference up to maximum speed but sometimes does not follow it back to minimum speed because of AC noise in the speed reference signal. If increasing the filtering time does not fix this problem, this indicates that the noise level is too high because of system wiring or layout problems. Check if analog I input cable is shielded, shield is connected to system ground, and analog cable is spaced from input power and motor wires.
I/O-07 should be set to the minimum analog current signal value. For example, if current signal from BMS is 4-20mA, I/O-07 should be set to 4mA. The default value is 4mA and can be changed from 0 to 20mA. Set it to desired value if DRV-70 is set to I.
I/O-08 should normally be set to 0Hz. Set it to desired value if DRV-70 is set to I.
Do not set it to any frequency to be used as the minimum speed limit when controlled by BMS or PLC because this changes the speed reference control curve. The default value is 0Hz and can be changed from 0 to VFD maximum Frequency. The frequency low limits should be programmed in parameters SET-13 or SET-27.
I/O-09 should be set to the maximum analog current signal value. For example, if current signal from BMS is 4-20mA, I/O-09 should be set to 20mA. The default value is 20mA and can be changed from 0 to 20mA. Set it to desired value if DRV-70 is set to I.
I/O-10 should normally be set to 50Hz or 60Hz.

Do not set it to any Frequency to be used as the maximum speed limit when controlled by BMS or PLC because this changes the speed reference control curve. The default value is 60Hz and can be changed from 0 to VFD Maximum Frequency. Set it to desired value if DRV-70 is set to I. The frequency High limit should be programmed in parameter SET-14 or SET-28.

I/O-16: LOI or LOV Analog Signal Loss Latch

```
I/O► LOI/V Latch
16           No
```

The Loss of I or V analog signal is a self-reset trip. When VFD trips on LOI and then signal is present again, VFD resets and starts if run command is still present. The I/O-16 parameter when set to YES allows latching VFD trip until next power cycle or when I/O-16 parameter is changed to NO. This feature is used for Transducer Redundancy configuration when spare transducer will replace main failed transducer. See detailed description in Control Wiring Configuration chapter 4.4.

I/O-17: Analog Signal Loss Criteria

```
I/O► V/I Loss Lvl
17    Half of Min
```

The I/O-17 parameter has three selections: None, Half of Min and Below Min.

None- VFD does not monitor an analog signal loss.
Half of Min- VFD monitors the analog signal value and if it decreases below 0.5x[I/O-02] or 0.5x[I/O-07], the VFD will act based on I/O-18 selection.
Below Min- VFD monitors the minimum analog signal value and if it decreases below [I/O-02] or [I/O-07], the VFD will act based on I/O-18 selection.
The VFD cannot determine a signal loss condition if analog minimum value is set to zero.

I/O-18 & 19: Analog Signal Loss Protection

```
I/O►Lost Command
18   Coast Stop
```

```
I/O► V/I Loss Dly
19       1.0 sec
```

The **I/O-18** parameter has four selections: Hold, Decel, Coast, and Protection.
Last Freq. Run- VFD will run at speed captured 2 sec. before signal loss condition in V/F or PID control mode with LOI message after I/O-19 delay.
Coast Stop- VFD will stop producing output immediately and motor will coast to stop.
Decel Stop- VFD will decelerate to 0Hz based on Decel Time setting.
Trip Stop- VFD will trip on Loss of Command.
I/O-19 determines the delay time for Analog Signal Loss fault.

I/O-20~27: Digital Programmable Inputs

```
I/O►    M1 Define
20       Speed-L
```

```
I/O►    M8 Define
27       RX
```

The all eight VFD digital inputs M1~M8 are universal and have identical programming choices. Each input has a unique default setting but it can be changed to any available selection. The following tables show default settings and available selections for all eight inputs.

Code	LCD display	Default
I/O-20	M1 define	SPEED-L (Low)
I/O-21	M2 define	SPEED-M (Middle)
I/O-22	M3 define	SPEED-H (High)
I/O-23	M4 define	Reset
I/O-24	M5 define	BX (Emergency Stop)
I/O-25	M6 define	JOG
I/O-26	M7 define	FX (Forward Run)
I/O-27	M8 define	RX (Reverse Run)

Note: Programming mode is disabled when BX input is active.

Selection of M1~ M8 in I/O-20~27

Setting Range	Description
Speed-L	Multi-step speed - Low
Speed-M	Multi-step speed - Middle
Speed-H	Multi-step speed - High
XCEL-L	Multi-Accel/Decel - Low
XCEL-M	Multi-Accel/Decel - Middle
Reserved	No selection
DC Inj.Brake	DC injection braking during stop
2nd Func	Switch to 2nd functions
Exchange	Switch to bypass contactor
LAG_Enable	Starts Lag VFD (Duplex mode)
Up	Increase Speed
Down	Decrease Speed
3-Wire	Start/Stop Pushbutton operation
Ext Trip	External trip
Pre-heat	Motor Winding Pre-heat function
PID-i Clear	Clears accumulated error for PID
Disable PID	Switches from PID to V/F mode
LOC/REM	Switches between Remote to Local control modes
Analog hold	Holds analog input signal value
XCEL stop	Disable Accel and Decel modes
P Gain2	Switches to 2nd P-Gain for PID
Another LEAD	Detects if another VFD is Lead (Duplex mode).
Interlock1	Used for MMC operation
Interlock2	
Interlock3	
Interlock4	
Speed-X	Additional Step Frequency
Fault Reset	Resets VFD fault by digital input
E-Stop BX	BX (Emergency stop)
JOG Speed	Changes speed to Jog Frequency

FWD Run FX	Forward Run
REV Run RX	Reverse Run
V/I Change	Switches from V1 to I input
LEAD Switch	LEAD selector switch (Duplex)
Up/Dwn Clr	Clears Up/Dwn Control Speed
Jog_FX	Jog Forward
Jog_RX	Jog Reverse
Damper SW	Damper Switch Input
Smoke Purge	Smoke Purge at High Speed Limit
Com/Main	Communication or Local control
Flow Switch	Proof of flow by Flow Switch
HOA Hand/Off	HOA not in Auto (Duplex Mode)
ALT Input	Alternating input (Duplex Mode)

Speed-L, M, H and X- VFD can run at different preset speeds based on digital inputs combinations shown in table for DRV-01~15.
XCEL-L and M- If M1 and M2 inputs are set to XCEL-L and XCEL-M respectively, three different Accel and Decel time settings can be used.
DC Inj.Brake- DC Injection Braking can be activated during inverter deceleration by configuring to DC-Brake and activating one of the Programmable digital inputs (M1-M8). The DC-Brake function is described in parameter FG1-15.
2nd Function- The 2nd function can be activated during inverter stop mode by activating digital input M1~M8 set to 2nd Function. See APP 20~29 for details.
EXCHANGE- When any digital input is set to Exchange and activated, the VFD stops, deactivates VFD output contactor and activates Bypass contactor by pre-programmed AUX relay outputs.
LAG Enable- When digital input is activated in Duplex mode (M7 input should be always activated) on the Lag VFD, the VFD will start. When input is deactivated, VFD will stop.
Up and Down- When using the Up and Down inputs, the VFD speed will be increased by pressing UP button and decreased by DOWN button. This function does not work with PID control.
3-Wire- This function provides VFD control by Start/Stop momentary push buttons. When any digital input is set to 3-Wire, this control mode is enabled.
Ext Trip- This N.O. (normally open) contact input provides protection for the system by tripping VFD. The input configuration can be changed from N.O. to N.C. in parameter I/O-95.When this input is wired to a N.C. thermostat of Dynamic Braking and resistor, VFD will trip and show fault message if thermostat contact opens under overheat condition. If Ext. Trip input was deactivated during retry attempts set in FG2-24~26, the VFD will restart automatically. If input was activated during all the retry attempts, VFD will stay tripped until it is reset manually or by reset input
Pre-heat- After time delay at every stop VFD will provide DC pulses to heat motor winding when Pre-Heat input is activated. The settings for Pre-heat mode are in parameters FG-10~13.
PID-i Clear- This function is used for PID control to clear an accumulated process error based on I-Time setting.
Disable PID- This input will switch VFD control from PID to regular V/F based on SET-10 selection.
LOC/REM- When this input is activated, VFD switches from Remote to Local control. If VFD runs in Remote mode with PID control, it will disable PID control in Local mode. When communication board or embedded RS485 communication is used for the speed reference and run command, the VFD will switch to Local control (see SET-90 settings) when input LOC/REM is activated.
Analog hold- When this input is activated, VFD will "freeze" an analog speed reference signal and run steady at this speed.
XCEL stop- The VFD stops accelerating and decelerating when this input is activated.
P-Gain 2- This input can change P-Gain during PID operation to second value.
Another LEAD- If input is activated in Duplex mode, that indicates that another VFD is Lead VFD now and this VFD should be Lag VFD.
Interlock 1, 2, 3 & 4- This function is used for MMC operation to disable and remove any auxiliary motor from the normal start/stop sequence. When MMC is enabled and M1, M2, M3 or M4 is set to Interlock and activated, the corresponding AUX relay output will be disabled.
Speed-X- This input works in combination with Speed-L, Speed-M and Speed-H inputs to provide up to fifteen preset speeds.
Fault Reset- When this input is activated, the VFD fault will be reset. Some critical faults can only be reset by cycling power to VFD.
E-Stop BX- When this input is activated, the VFD will stop in emergency stop mode without deceleration. There are two ways to return to normal control mode based on I/O-30 setting: automatic or by VFD reset. This is not a fault and it will not be saved in the fault history. The input is N.O. and can be changed to N.C. in I/O-95.
JOG Speed- When Jog input and FX or RX inputs are activated in V/F control mode, the VFD starts forward or reverse with jog speed reference set in DRV-16.
FWD Run FX- If SET-09 is set to Remote-1 or Remote-2 control mode and this input is activated, the VFD will start in forward direction.
REV Run RX- If SET-09 is set to Remote-1 or Remote-2 control mode and this input is activated, the VFD will start in reverse direction.
V/I Change- If SET-10 is set to V1+I speed control mode and this input is activated, the VFD will switch from V1 0-10VDC input to I 4-20mA input. When input is deactivated, the control switches back to V1 input.
LEAD Switch- This input is used for Lead VFD selector switch in Duplex mode. When input is activated, this VFD becomes Lead VFD.

Up/Dwn - When two digital inputs are set to UP and DOWN speed control mode and Up/Dwn Clr input is activated, the VFD speed reference will be reset to 0 and VFD will run at minimum frequency limit set in Set-13. If parameter FG1-90 /Down Save Mode is set to default setting NO, the VFD speed reference will be reset to 0 at every stop. If parameter FG1-90 is set to YES, the last VFD speed reference adjusted during run will be saved at stop.
Jog_FWD Run and **Jog_REV Run-** When Jog FWD RUN input is activated, the VFD starts forward in jog mode with jog speed set in DRV-16 and standard ACC and DEC time values. When Jog REV Run input is activated, the VFD starts reverse in jog mode with jog speed set in DRV-16. When both inputs are activated, VFD will stop.
Damper SW- When any input is set to Damper Switch, I/0-68 is set to Damper and VFD receives run command, the selected Damper AUX Relay will be activated to start a damper actuator and VFD will start the motor when the Damper Switch input closes. If damper switch is not closed during Damper Delay time or open at any point, VFD will trip on fault with Damper Fault message on screen.
Smoke Purge- When input is activated, VFD will start and run the motor at frequency determined by parameter I/O-31 with most of the motor and VFD protections disabled. When input is deactivated, VFD will return to previous normal operation.
Com/Main- When digital input is activated, the VFD switches current control mode to Communication (Int.485). If VFD runs in PID mode, it will continue to run with PID control but set-point value can be changed via communication. If there is no control activity via communication for 30 minutes, VFD disables communication control and switches to normal control mode.
FLOW Switch- VFD can monitor a flow switch wired to digital input and will stop motor or go to sleep mode when there is no flow after time delay.
HOA Hand/Off- In Duplex mode with HOA switches the N.C. contact is installed in Auto position to provide signal to VFD when HOA is not in Auto (Hand or Off) position. When input is activated, this VFD switches to Lag mode and another VFD becomes Lead VFD.
ALT Input- If in Duplex mode alternating input on each VFD is wired to N.O. momentary Alternating pushbutton contact and when this contact is activated, VFDs will alternate Lead and Lag modes. This input is an addition to main alternation mode and works only in alternation by timer or at power up modes. Do not use it in alternation by Lead switch or with HOA switches.

I/O-28: Digital Inputs Status Display

```
I/O►   In Status
28   00001000000
```

The I/O-28 parameter shows real time inputs status in 0/1= OFF/ON bit format. Each digit (bit) represents one digital input status starting from the right to the left.

Input	P6	P5	P4	M8	M7	M6	M5	M4	M3	M2	M1
Bit	10	9	8	7	6	5	4	3	2	1	0

This display parameter is very useful for VFD control troubleshooting.

I/O-29: Filtering Time for Digital Inputs

```
I/O►   DI Filter
29        15 ms
```

The I/O-29 parameter sets the filtering time for digital inputs. The default value is sufficient for electrical noise filtering in most of the applications.

I/O-30: E-Stop BX Self Reset

```
I/O►BX SelfReset
30        Yes
```

There are two ways to reset Emergency Stop mode BX: Manual and Automatic.
If I/O-30 is set to No and BX input is activated momentarily, the VFD will stay in Emergency Stop mode until VFD is reset manually or remotely.
If I/O-30 is set to Yes and BX input is activated, the VFD will stop in Emergency Stop mode and resets automatically when BX input is deactivated.

I/O-31: Smoke Purge Mode Settings

```
I/O► SmokeP Mode
31   At MaxSpeed
```

The Smoke Purge mode is designed to run building exhaust fan to purge the smoke in case of fire with limited number of motor and VFD protections. When Fireman's Switch is deactivated, VFD returns to normal control enabling all the available protections. There are three selections for parameter I/O-31: At Max Speed, At M Speeds and with PID M S-Points.
At Maximum Speed- If digital input set to Smoke Purge is activated by Fireman's Switch, VFD will run at maximum speed set in parameter SET-14 with most of the motor and VFD protection features disabled.
At Multiple Speeds- If digital input set to Smoke Purge and any input set for preset speed are activated by Fireman's Switch, VFD will run at preset speed set in corresponding to digital input parameter I/O-20~27 with most of the motor and VFD protection features disabled. The fan speed can be change by activating a different preset speed digital input.
At Multiple PID Set-Points- If digital input set to Smoke Purge and any input set for preset Set-point are activated by Fireman's Switch, VFD will run

with PID control with selected set-point. The PID set-point can be changed in parameter DRV-01~15 for selected in parameter I/O-20~27 digital input. VFD will run with most of the motor and VFD protection features disabled. The pressure set-point can be change by activating different preset digital inputs.

I/O-33~37: Duplex VFD configuration Settings

I/O► VFD ID Sel 33 VFD-1	I/O► Duplex Mode 34 None
I/O►LEAD/LAG SEL 35 Lead VFD	I/O► ALT Timer 36 168 hrs
I/O►LEAD/LAG NOW 37 Lead Now	

The Duplex mode allows to run two VFDs in Lead-Lag control mode with alternation. VFDs monitor each other's state via digital I/Os and some wiring between VFDs is necessary. There are following alternation options: at Lead VFD fault; at every start; at Power up; by Lead selector switch; by Alternating timer; by HOA switches; by momentary Alternating pushbutton. In any configuration if Lead VFD fails, Lag VFD becomes Lead automatically.

I/O-33 parameter is very critical for reliable Duplex system operation. When VFDs are ready for Duplex mode programming, set I/O-33 on VFD #1 to VFD-1 and on VFD #2 to VFD-2. This way if for any reason alternation control becomes unstable, the VFD1 becomes Lead and VFD becomes Lag automatically.

I/O-34 parameter has four Duplex mode selections: None; Lead SW/FLT; Timer/FLT; Power up/FLT.

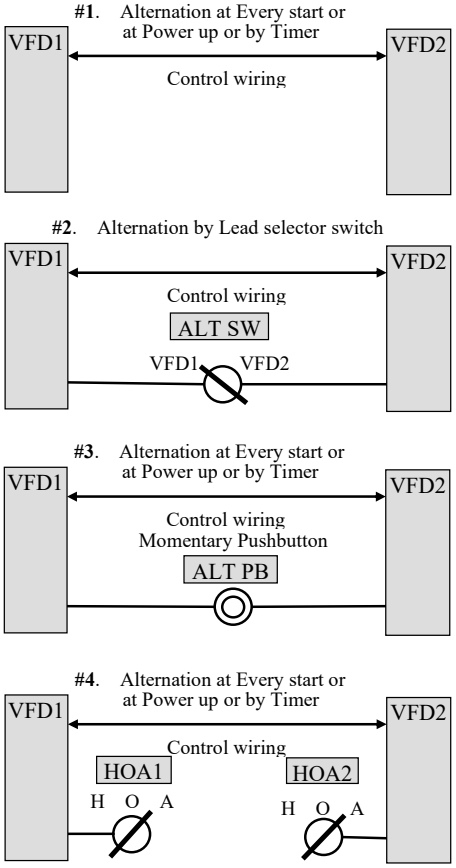
- **None**- Duplex mode is disabled (Default)
- **Lead SW/FLT**- The manual alternation mode when one two-position maintained switch is wired to both VFDs. The Lead switch will have N.C. contact on left position and N.O. contact on right position.
- **Timer/FLT**- The alternation will be controlled by internal Lead VFD run time counter. When Lead VFD stops or goes in sleep mode, the counter stops and when VFD starts again, the counter continues to count run time. When Lead VFD changes mode to Lag, the run time counter will be reset. MAK-55 parameter shows an actual alternating timer accumulated time in minutes. If alternating timer set to 10 hours and alternation needs to be tested, set MAK-55 to 600 minutes and VFDs will alternate next minute.
- **PowerUp/FLT**- The alternation will occur every time when system is powered up. The Low Voltage mode does not activate a system alternation.

I/O-35 is an adjustable VFD Lead/Lag mode selection parameter. Set VFD1 to Lead and VFD to Lag during initial startup. The parameter setting will change automatically during Duplex system normal operation.

I/O-36 a timer setting parameter (Lead VFD run time) for alternation by timer mode. Default setting is 168 hours (7 days) and can be adjusted from 0 to 168 hours. If value is set to 0, the alternation by timer is disabled.

I/O-37 a Lead/Lag status display parameter. It shows the actual Lead or Lag VFD status based on current alternating function operation. In some cases I/O-35 and I/O-37 can show different Lead/Lag modes because I/O-35 is a command to change Lead/Lag status and I/O-37 is an actual status. Example: If system is set to alternation by Lead switch, VFD1 is a Lead VFD and it trips on fault, I/O-35 still shows Lead mode from switch input but I/O-37 changes to Lag and VFD2 becomes Lead with its I/O-35 showing Lag and I/O-37 switched to Lead. When VFD1 fault is reset, its I/O-37 changes to Lead and second VFD becomes Lag again.

The following diagrams show four common alternating configurations.

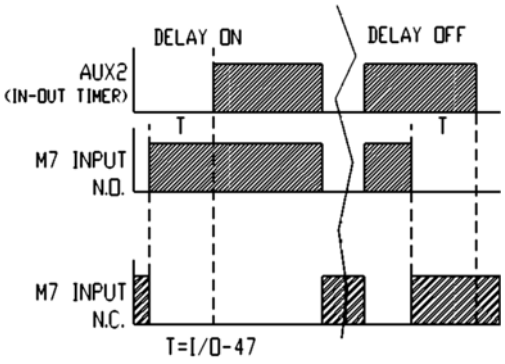


The configuration #1 is for two VFDs with only control wiring between them. The alternation mode can be set to By Timer , At Power up or can be configured for alternation at Every start (refer to VDP manual)
The configuration #2 is for two VFDs with control wiring between them and Lead selector switch. The alternation mode is set to Lead SW/FLT. When Lead switch is in VFD1 position and VFD1 fails, VFD2 becomes Lead VFD. When VFD1 is reset, VFD2 becomes Lag VFD and VFD1 runs as Lead again.
The configuration #3 is for two VFDs with control wiring between them and one alternating momentary pushbutton. The alternation mode can be set to By Timer, At Power up or can be configured for alternation at Every start. The pushbutton acts as a manual alternator additional to selected alternation mode.
The configuration #4 is for two enclosed VFDs with HOA switches and control wiring between them. The alternation mode can be set to By Timer, At Power up or can be configured for alternation at Every start. If Lead VFD HOA is put in Off or Hand position, this VFD becomes Lag and Lag VFD switches to Lead mode. When HOA switch is put back in Auto position, VFD still stays in Lag mode thus HOA switch can be used for manual alternation.
If other type of alternation is required, please contact FCS tech support for assistance.

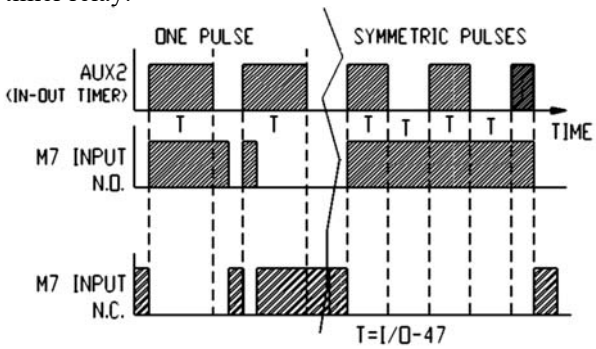
I/O-45~48: Internal Auxiliary In-Out Timer

I/O► Timer Input 45 M7	I/O► Timer Mode 46 ON Delay
I/O► Timer Set 47 30 sec	I/O►NO/NC Timer In 48 Normal Open

In-Out Timer is an auxiliary multi-function timer that can simplify some VFD projects. The timer activation input can be set to any VFD digital inputs and timer relay output to any VFD AUX relay.
I/O-45 is timer input M1~M7 selection. When selected input is activated, the timer starts its operation mode.
I/O-46 has four operation mode selections: ON Delay; OFF Delay; ONE Pulse; SYMM. Pulses. The following diagram shows timer operation in ON Delay and OFF Delay modes with M7 as N.O. and N.C. contact and AUX2 relay set as a timer relay.



The following diagram shows timer operation in ONE Pulse and SYMM. Pulse modes with M7 as N.O. and N.C. contact and AUX2 relay set as a timer relay.

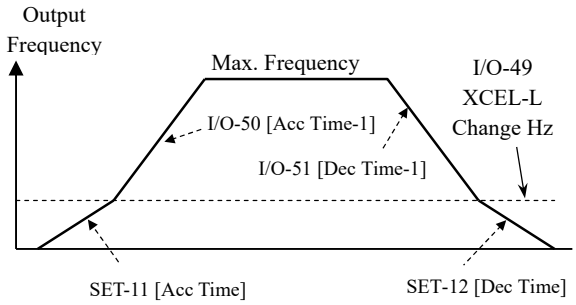


The timer set to ONE Pulse mode will generate one pulse for duration set in I/O-47 after input was activated momentarily or continuously.
The timer set to Symmetric Pulses mode will generate pulses with identical ON and OFF duration set in I/O-47 when input is activated.
I/O-47 is a In-Out timer time setting in seconds. The default setting is 30 seconds and can be changed in 0-6000 range.
I/O-48 is a timer input N.O. or N.C. type selection. The default setting is N.O.
Example: if I/O-47 is set to N.C., I/O-46 to SYMM. Pulses, I/O-45 to M2 and AUX-2 relay to In-Out Timer, VFD will continuously provide symmetric pulses until M2 input is activated.

I/O-49: XCEL-L Change Frequency

I/O► XCEL-L Ch Hz 49 0.00 Hz

This function is used to change Accel/Decel time to XCEL-L values [Acc Time-1] and [Dec Time-1] when VFD runs at frequency above I/O-49 setting. For example, when run command is activated, VFD accelerates with standard SET-11 Accel time to FG1-72 frequency then changes to I/O-50 ACC Time-1 setting.
If SET-00 is set to Subm. Pump and digital input set to XCEL-L is activated during start, VFD ramps up to PID frequency minimum limit with SET-11 ACC time and then switches to ACC Time-1. Normal acceleration time overrides XCEL-L time to provide acceleration to 30Hz within 1 second.



I/O-50~55: Accel/Decel Time 1~3

I/O▶ Acc Time-1 50 20.0 sec	I/O▶ Dec Time-1 51 20.0 sec
I/O▶ Acc Time-2 52 30.0 sec	I/O▶ Dec Time-2 53 30.0 sec
I/O▶ Acc Time-3 54 40.0 sec	I/O▶ Dec Time-3 55 40.0 sec

These parameters provide three different Accel/Decel time settings activated by digital inputs for custom speed control curve. When any two digital inputs are programmed for XCEL-L and XCEL-M, Accel/Decel time will be determined by binary combination of these inputs. (0= Off and 1= On).

Parameter Code	Accel/Decel Time #	XCEL-	
		M	L
SET-11	Accel Time-0	0	0
SET-12	Decel Time-0		
I/O-50	Accel Time-1	0	**1**
I/O-51	Decel Time-1		
I/O-52	Accel Time-2	**1**	0
I/O-53	Decel Time-2		
I/O-54	Accel Time-3	**1**	**1**
I/O-55	Decel Time-3		

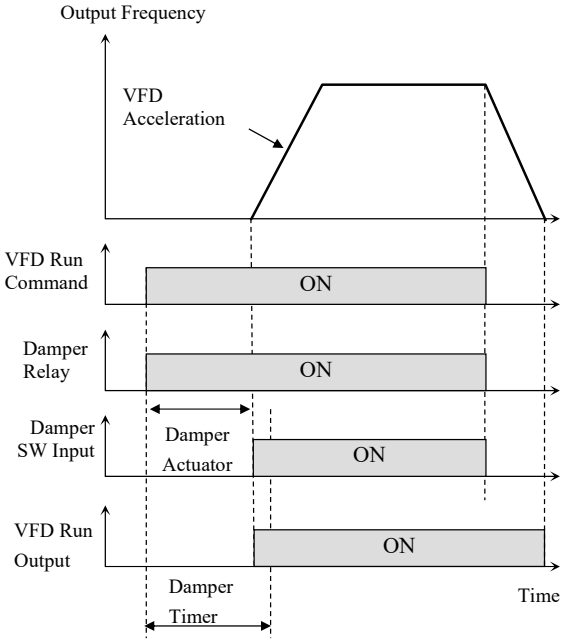
I/O-68 & 69: Damper/Lubrication Mode Settings

I/O▶ Dmpr/LubeSel 68 None	I/O▶Dmpr/LubeTMR 69 30 sec

I/O-68 has three selections: None, Damper and Lubrication.

None- Damper/Lubrication mode is disabled.

Damper- Damper mode is enabled. If AUX relay is set to Damper in I/O-76~79 and VFD start signal is received, the selected AUX relay contact will be closed to activate a damper actuator and after time delay set in I/O-69, the VFD will start the motor. If any digital input is set to Damper Switch in I/O-20~27, the VFD will start the motor only when Damper switch closes. If switch is not activated during I/O-69 Damper Timer delay, the VFD will trip on Damper Fault. Thus, the Damper Timer should be set to longer time than it normally takes for damper to open. The damper AUX relay and timer will be activated at every VFD start.



Lubrication- The lubrication mode for hollow shaft pumps is enabled. If any AUX relay is set to Lube Only or Lube/Refill in I/O-76~79 and start signal is received, the AUX relay contact will be closed and lubrication solenoid is activated for a time delay I/O-69 Lube Timer. When Lube Timer delay expires, a lubrication solenoid will be deactivated and VFD will start the motor.

I/O-70~73: Analog 0-10VDC S0 and S1 Outputs

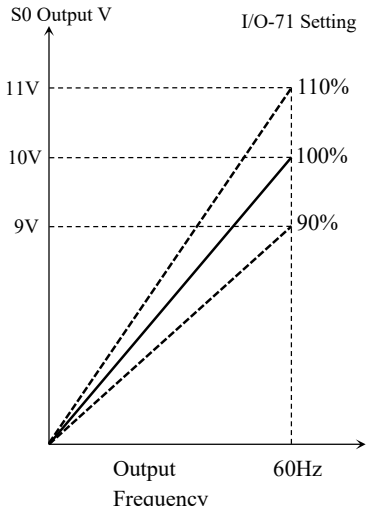
I/O▶ S0 Mode 70 Frequency	I/O▶ S0 Adjust 71 100 %
I/O▶ S1 Mode 72 Current	I/O▶ S1 Adjust 73 100 %

I/O-70 and I/O-72 Analog 0-10VDC (up to 12V scalable) outputs have following selections: Frequency, Current, Voltage, kW, DC Link Volt., I Input and V Input. I/O-71 and I/O-73 are parameters for analog outputs scaling factors with default setting at 100%.

Frequency- S0 or S1 output provides 0-10VDC signal corresponding to VFD speed output from 0Hz to Max. frequency. The output voltage is determined by scaling factor set in I/O-71 and I/O-73.

$$\textbf{S0 Output Voltage} = \frac{\textbf{[Out.Freq.] x [I/O-71] x 10V}}{\textbf{[Max.Freq] x 100}}$$

Example: The diagram below shows different S0 output voltages at 60Hz output frequency with three I/O-71 scaling settings.



Current- S0 or S1 output provides 0-10VDC signal corresponding to VFD output current from 0A to VFD current rating.
Voltage- S0 or S1 output provides 0-10VDC signal corresponding to VFD output voltage from 0V to Maximum Voltage.
kW- S0 or S1 output provides 0-10VDC signal corresponding to VFD output kW from 0kW to Maximum VFD kW output rating.
DC Link Voltage- S0 or S1 output provides 0-10VDC signal corresponding to VFD's DC bus voltage. It will provide 10VDC output at 410VDC for 230V VFD, 820VDC for 480V VFD and 1025VDC for 600V VFD.
I Input- S0 or S1 output provides 0-10VDC signal corresponding to analog 0-20mA signal on I input
V Input- S0 or S1 output provides 0-10VDC signal corresponding to analog voltage signal on V1 input.

I/O-74 & 75: FDT Frequency Detection Settings

I/O► FDT Freq	I/O► FDT Band
74 1.00 Hz	75 1.00 Hz

The FDT function allows VFD to activate a selected AUX relay at set frequency based on FDT-1, 2, 3, 4 or 5 modes. Refer to I/O-76~79 for FDT modes detailed descriptions.

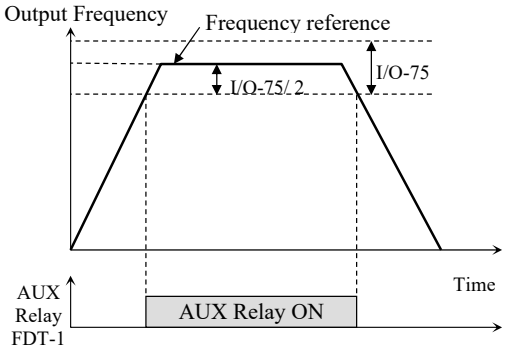
I/O-76~79: Digital AUX1~4 Relay Outputs

I/O► Aux Relay1	I/O► Aux Relay4
76 Run	79 FDT-4

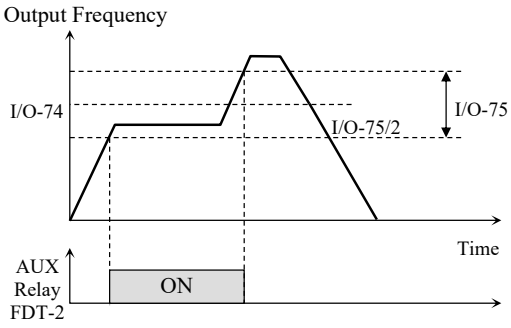
The digital programmable AUX relay can be set to any available function from the following table.

Setting Range	Description
None	Relay Output is disabled
FDT-1	Output frequency at Reference target
FDT-2	Output frequency at FDT freq.
FDT-3	Output Frequency within FDT range
FDT-4	Output frequency above FDT Freq.
FDT-5	Output frequency below FDT Freq.
OL	Motor Overloaded
IOL	VFD overloaded
Stall	Motor Stalled
OV	Over voltage
LV	Low voltage
OH	VFD overheated
Lost Command	V/I Signal Loss indication
Run	VFD is in run mode
Stop	VFD is in stop mode
Steady	VFD speed is steady
Pre PID Mode	VFD runs in PrePID mode
Sleep Mode	VFD is in Sleep Mode
SpeedSearch	Speed search mode is ON
Ready	VFD is ready
MMC	Used for MMC operation
Local	Local Control Mode is ON
Remote	Remote Control Mode is ON
Pipe Broken	Pipe Broken Fault is ON
Damper	Relay is closed to open damper
Lube Only	Relay is closed to lubricate pump
Lube/Refill	Relay is closed to lubricate & refill
Level Detect	Level Detection is triggered
Screen Clean	Closed during pump screen cleaning
In-Out Timer	Closed by In-Out timer function
OverPressure	When VFD trips on overpressure
I Hi Level	Closed above mA high setting
I Lo Level	Closed below mA low setting
V Hi Level	Closed above V high setting
V Lo Level	Closed below V low setting
This LEAD	In Duplex mode when VFD is Lead
Pipe Leak	When VFD trips on Pipe Leak
V1 Max. Lvl	When V1 reads full 4095 raw value
I Max. Lvl	When I reads full 4095 raw value
Lost I Latch	At LOI trip relay is active and latched
Fan Check	When VFD trips on cooling fan fault

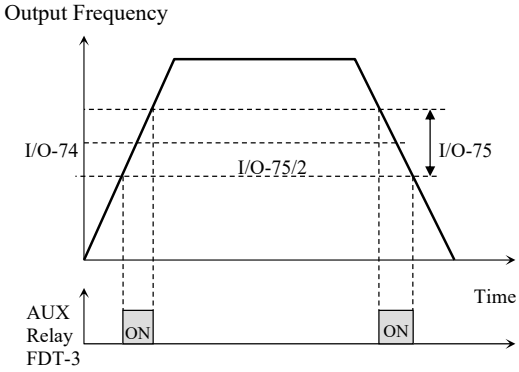
[FDT-1]
If any AUX relay is set to FDT-1 and VFD accelerates or decelerates, the AUX relay will be closed and stay closed only if difference between speed reference and output frequency is less than [I/O-75]/2.



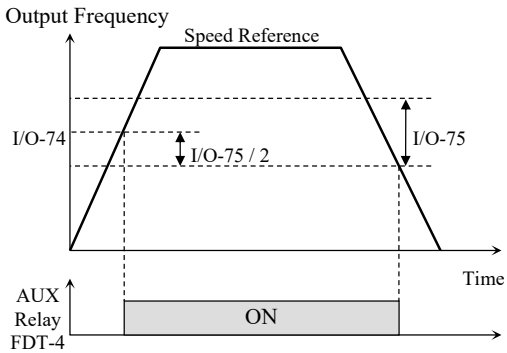
[FDT-2]
If any AUX relay is set to FDT-2 and VFD accelerates or decelerates, the AUX relay will be closed while the speed reference and output frequency are within I/O-75 centered on I/O-74.



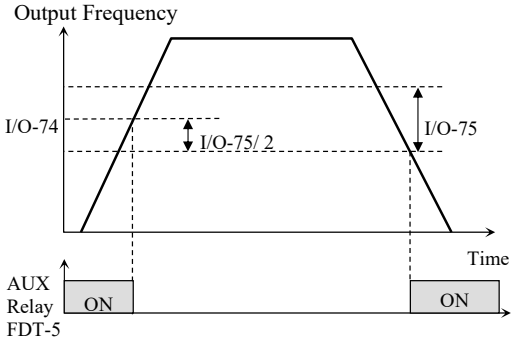
[FDT-3]
The selected AUX relay will be closed when the output frequency during acceleration or deceleration is within I/O-75 FDT bandwidth centered on I/O-74.
If output frequency is outside FDT bandwidth, AUX relay is open.



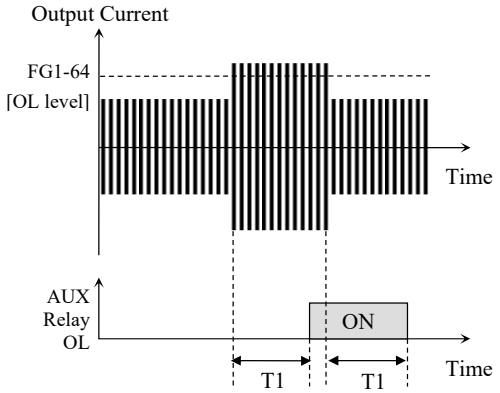
[FDT-4]
The selected AUX relay will be closed when the output frequency reaches I/O-74 FDT frequency. The AUX relay will then open when output frequency falls below [I/O-74]-([I/O-75]/2).



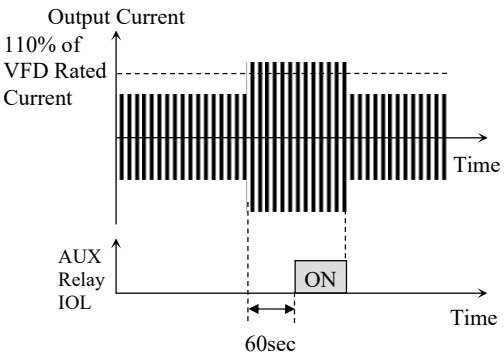
[FDT-5]
This is an inverted version of the [FDT-4] function. The selected AUX relay will be closed at VFD stop mode and remain closed until output frequency is at or above I/O-74 during acceleration and then remain open until output frequency falls below [I/O-74]-([I/O-75]/2) during deceleration.



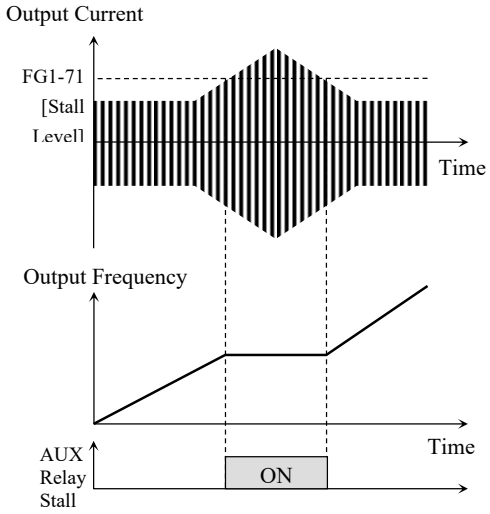
[OL]
The selected AUX relay will be closed when the output current exceeds the FG1-64 Overload Warning Level for the FG1-65 Overload Warning Time. This is a motor overload warning relay output. Timer T1 on the diagram is set in FG1-65 parameter.



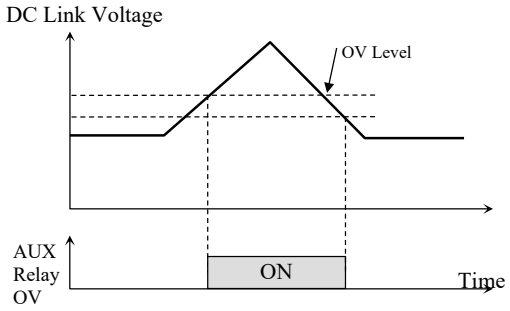
[IOL]
If VFD output current is above 110% (adjustable) of VFD current rating for 60 seconds The selected AUX relay will be closed. This is a VFD overload relay output.



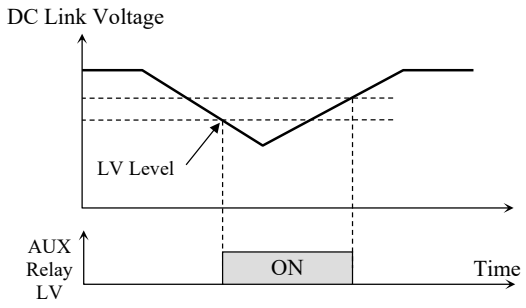
[Stall]
The selected AUX relay will be closed when VFD is in stall prevention (current limiting) mode.



[OV]
The selected AUX relay will be closed when VFD DC bus voltage is above the non-adjustable Over-voltage protection level (410VDC for 230V VFD, 820VDC for 480V VFD and 1025VDC for 600V VFD).



[LV]
The selected AUX relay will be closed when the DC link voltage is below the Low-voltage level (200VDC for 240V line voltage setting and 400VDC for 480V line voltage setting). The Low Voltage level is internally calculated based on SET-07 Input Voltage setting.



[OH]
The selected AUX relay will be closed when the temperature of the VFD power module is above the non-adjustable level. If motor temperature sensor is connected to VFD terminals NT or NE and 5G, this relay will be activated at VFD or motor overheat condition. This is VFD or motor overheat relay output.

[Lost Command]
The selected AUX relay will be closed when frequency reference signal selected in I/O-17 is lost.

[Run]
The selected AUX relay will be closed when VFD starts producing any output frequency (run mode).

[Stop]
The selected AUX relay will be closed when VFD stops producing any frequency (stop mode).

[Steady]
The selected AUX relay will be closed when VFD is running at constant speed (keypad green light is solid).

[Pre PID Mode]
The selected AUX relay will be closed when VFD is running at Pre-PID speed (Pipe Fill Mode).

[Sleep Mode]
The selected AUX relay will be closed when VFD is in Sleep Mode.

[Speed Search]
The selected AUX relay will be closed during VFD speed search mode.

[Ready]
The selected AUX relay will be closed when VFD is ready for operation (Powered and no faults).

[MMC]
The selected AUX relay will be closed when MMC mode is activated and AUX (Lag) motor start command is generated.

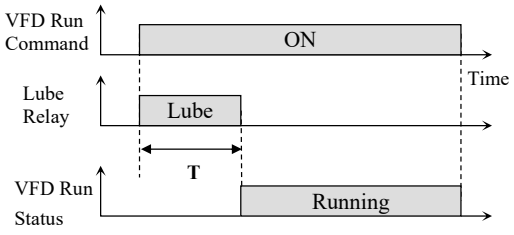
[Local]
The selected AUX relay will be closed when VFD is in local control mode.

[Remote]
The selected AUX relay will be closed when VFD is in remote control mode.

[Pipe Broken]
The selected AUX relay will be closed when VFD detects a Pipe Broken condition and trips.

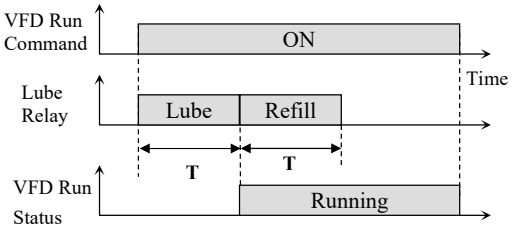
[Damper]
The selected AUX relay will be closed to activate a damper actuator when VFD receives a start command. If damper does not have a damper switch, VFD will start when start command is received and Damper/Lube time delay is expired. If damper has damper switch and it is wired to digital input set to Damper Switch, VFD will start when start command is received and after damper switch is closed. In this configuration Damper Timer works as a Damper Fault time delay. Damper output stays closed until VFD is in stop mode.

[Lube Only]
The selected AUX relay will be closed to activate a lubrication solenoid when VFD receives a start command. The VFD will start after Damper/Lube time delay expires and Lubrication relay is open.



T is set in I/O-69 (Damper/Lube Timer)

[Lube/Refill]
The selected AUX relay will be closed to activate a lubrication solenoid when VFD receives a start command. The VFD will start after Damper/Lube time delay expires but Lubrication relay will stay closed for another duration of Damper/Lube timer to fill the lubrication water tank (see diagram below).



T is set in I/O-69 (Damper/Lube Timer)

[Level Detect]
If Parameter Set-74 is set to **Under Level** detection, the selected AUX relay closes when VFD detects an Under-level condition for the source in SET-75. The relay will be open again when signal level is above [SET-78] + [SET-79].
If Parameter Set-74 is set to **Over Level** detection, the selected AUX relay closes when VFD detects an Over level condition for the source in SET-75. The relay will be open again when signal level is below [SET-78] - [SET-79].
Note: If any AUX relay was set to Level Detect then changed to any other selection, change parameter SET-82 to None.
[Screen Clean]
The VFD will provide periodical relay output based on I/O-86 and I/O-87 settings during run mode. When suction screen of the pump in water reservoir needs periodical cleaning, set any AUX relay to Screen Clean mode and wire screen cleaning water solenoid valve via RIB relay to AUX relay.
[In-Out Timer]
The AUX relay set to In-Out Timer will be closed based on I/O-35~38 settings.
[OverPressure]
The VFD will provide relay output when system pressure exceeds the Overpressure setting in SET-45 parameter. Relay will be open when pressure drops below SET-45 level.
[I Hi Level]
The selected relay will be closed when analog mA signal is greater than setting in DRV-51 for DRV-53 time delay and will be open when mA signal drops below [DRV-51] – [DRV-53].
[I Lo Level]
The selected relay will be closed when analog mA signal is lower than setting in DRV-55 for DRV-57 time delay and will be open when mA signal increases above [DRV-51] + [DRV-53].
[V Hi Level]
The selected relay will be closed when analog V signal is greater than setting in DRV-61 for DRV-63 time delay and will be open when V signal drops below [DRV-61] – [DRV-63].
[V Lo Level]
The selected relay will be closed when analog V signal is lower than setting in DRV-65 for DRV-67 time delay and will be open when V signal increases above [DRV-61] + [DRV-63].
[This LEAD]
The VFD will provide relay output when it is in Lead mode in Duplex setup.
[Pipe Leak]
The VFD will provide relay output when it detects a pipe leak during wakeup.
[V1 Max. Lvl]
The VFD will provide relay output when it detects a maximum raw reading of 4095 for more than 6 seconds on V1 input (transducer electrical failure).
[I Max. Lvl]
The VFD will provide relay output when it detects a maximum raw reading of 4095 for more than 6 seconds on I input (transducer electrical failure).
[Lost I Latch]
The VFD will provide latched relay output when VFD trips on LOI or LOV. The relay can be reset by setting I/O-16 to NO or by cycling VFD power. See detailed description on page 35.
[Fan Check]
The VFD will provide relay output when it trips on cooling fan fault [Fan Lock].

I/O-80: Fault Relay Mode

```
I/O►FltRelay Mode
80          010
```

The I/O-80 setting is in binary bit format with the following numbering.

There are six combinations for Fault Relay setting:
000- Fault relay is disabled
001- Fault relay is activated at Low Voltage Trip
010- Fault relay is activated at every fault except Low Voltage trip regardless of Auto-Retry settings.
011- Fault relay is activated at every fault including

Low Voltage trip regardless of Auto-Retry settings.

100- Fault relay is activated at every fault except Low Voltage trip. If Auto-retry is enabled, the fault relay will be activated only at trip after last retry.

101- Fault relay is activated at every fault including Low Voltage trip. If Auto-retry is enabled, the fault relay will be activated only at trip after last retry.

Note: The **BX** input is an Emergency Stop input and it does not activate Fault relay.

I/O-81: Output Relays Status

I/O▶ Out status
81 00000000

I/O-81 displays real time relay output status in binary format (0=OFF and 1=ON).

Relay outputs bit mapping table

Relay Output	Fault	Q3	Q2	Q1	AUX 4	AUX 3	AUX 2	AUX 1
Bit	7	6	5	4	3	2	1	0
Status	0	0	0	0	0	0	0	0

I/O-82 & 83: Fault Relay ON and OFF Delays

I/O▶ RelayOnDly
82 0 sec

I/O▶ RelayOffDly
82 0 sec

I/O-82-the time delay to activate Fault Relay after VFD trip.

I/O-83-the time delay to deactivate Fault Relay after VFD trip is reset.

I/O-84 & 85: Cooling Fan Mode Setting

I/O▶ Fan Control
84 Power On

I/O▶ Fan Temp
85 70

I/O-84- has three selections: Power On, Run, and Temperature.

Power On- The VFD cooling fan runs when VFD is powered.

Run- The VFD cooling fan runs during VFD run mode. When VFD stops, fan will stop if VFD temperature is less than 60°C. If during VFD stop its temperature is greater than 60°C, fan will continue to run until temperature drops below 57°C.

Temperature- The VFD cooling fan runs when VFD temperature is above the SET-85 temperature setting in Celsius (°C).

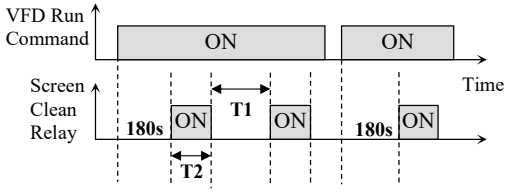
Note: In 7.5~40HP VFDs there is an expansion board for cooling fan control. It provides the same fan control and protection features as VFD 50HP and above without board.

I/O-86 & 87: Screen Cleaning Settings

I/O▶ TMR to Clean
86 180.0 min

I/O▶ Clean Time
87 1.0 min

When any AUX relay is set to Screen Clean and VFD starts, the AUX relay will be closed after 180 seconds for duration of the I/O-87 timer and then it will close relay when I/O-86 timer expires. VFD will continue cycling AUX relay OFF/ON. At every start the first delay before AUX relay cycling is 180 seconds.



T1 is set in I/O-86 (TMR to Clean)

T2 is set in I/O-87 (Clean Time)

I/O-90~94: Communication Parameters

I/O▶ Inv No.
90 12

I/O▶ Baud Rate
91 9600

I/O▶ COM LostCmd
92 Decel

I/O▶ COM Time Out
93 1.0 sec

I/O▶ Delay Time
94 5 msec

I/O-90 [VFD Number] sets the VFD ID for Modbus RTU communication.

I/O-91 [Baud rate] sets the communication speed and it should be identical to other devices in the network. To make a multi-drop system, connect VFDs in parallel: terminals C+ from one VFD to C+ on another VFD and C- to C-. Activate a termination resistor by dipswitch on the last node VFD.

I/O-92 & 93 are only displayed when SET-09 [Drive mode] or SET-10 [Frequency mode] are set to Int. 485.

I/O-92 has three selections for VFD control when communication signal is lost: Hold, Coast and Decel.

I/O-93 is a communication Time Out parameter and if is set to 1 sec., the VFD triggers a com. loss mode when signal is lost for more than 1 sec.

If I/O-92 is set to Hold and signal was lost, the VFD will continue to run at speed captured 2 seconds before the signal was lost. Use this feature with caution for very sensitive to process value applications (example: pump can over pressurize and damage piping when signal was lost at speed close to a maximum speed limit). It could be useful for some fan and cooling tower applications.

If I/O-92 is set to Coast and signal was lost, the VFD will stop producing output and motor will coast to stop.
If I/O-92 is set to Decel and signal was lost, the VFD will stop by decelerating based on SET-12. The VFD display will show LOR fault at com. loss.
I/O-94 setting is for communication using RS232-RS485 converter and should be set per converter specification. This time setting creates a delay before VFD sends response.

I/O-95: Normally Open or Normally Closed select

```
I/O► In No/NC Set
95   00000000000
```

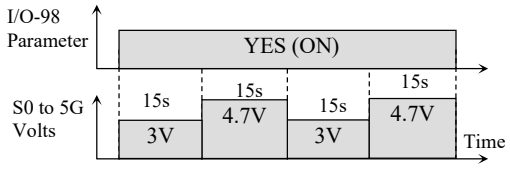
The digital input N.O. type can be changed to N.C. in I/O-95 by setting a corresponding bit to 1. The below table shows the digital inputs bit mapping.

Input	P6	P5	P4	M8	M7	M6	M5	M4	M3	M2	M1
bit	10	9	8	7	6	5	4	3	2	1	0
N.O.	0	0	0	0	0	0	0	0	0	0	0
N.C.	1	1	1	1	1	1	1	1	1	1	1

I/O-98: 0-10VDC S0 Test Output Function

```
I/O► S0 Test Out
98          No
```

When I/O-98 is set to Yes and Enter key is pressed, VFD will produce two different level outputs (approximately 3VDC and 4.7VDC 15 seconds each) twice on S0 output. The purpose of this function is to make the VFD or BMS analog input testing easier. For VFD's up to 40HP for I input test or all VFDs for V1 input test remove transducer or BMS wire from V1 or I input and wire S0 output to it (all 5G terminals are internally connected). Monitor parameter DRV-26 for raw analog value during test to determine if VFD reads signal properly. The DRV-26 parameter readings on following diagram depend on VFD AD converter calibration and can be slightly different on each VFD.



3.0V on **I** input is 12.0mA and DRV-26 reads I= 2300
4.7V on **I** input is 17.5mA and DRV-26 reads I= 3500
3.0V on **V1** input DRV-26 reads V1= 1040
4.7V on **V1** input DRV-26 reads V1= 1550

Note: For VFD's 50HP and above because of different analog circuit the I input test with S0 output does not work (it will read the maximum value 4095).

6.6 Application Group [APP]

APP-00: Jump Code

APP▶ Jump Code
00 40

APP-00 allows jumping to any parameter in APP group without scrolling to it. Press [ENTER] key and input desired parameter code by using [SHIFT] and [UP]/[DOWN] keys.
When [ENTER] key is pressed again, the desired parameter will be on the display.

APP-01: PID Feedback Scale %

APP▶ PID F Gain
01 100.0%

APP-01 parameter sets the PID Feedback scaling percentage. The default setting is 100% and it is optimal for most applications. If it is set to a higher number, the PID control will be more responsive but can be unstable.

APP-02: Auxiliary Reference Mode

APP▶ AuxRef Mode
02 Yes

APP-02 parameter enables APP-03 and auxiliary reference mode for PID control.

APP-03: Auxiliary Reference Signal Selection

SET▶ Aux Ref Sel
03 V1

APP-03 parameter has nine selections for auxiliary reference signal: Keypad-1, Keypad Up/Down, V1, V1S, I, V1+I and Int.485. Refer to SET-10 parameter for detailed description.

APP-04~06: PID Feedback Maximum Value

APP▶ PIDFB I Max
04 20.00 mA

APP▶PIDFB V1 Max
05 10.0 V

APP▶ PIDFB P Max
06 10.0 kHz

One of these three PID Feedback Max. Value parameters will be available when corresponding input is selected in SET-21. The value can be set from 0 to maximum SET-04, SET-09 or SET-15.

APP-09: PID Derivative Gain (Time)

APP▶ PID D Time
09 0.0 sec

The Derivative parameter of the PID control allows creating an offset on the PID output value based on rate of error change. In other words, this parameter predicts a future error level and PID adjusts its output to correct it.

APP-12: PID Output Scale

APP▶PID OutScale
12 100.0 %

APP-12 setting determines the PID output scaling factor. The default is 100% and it is optimal for most of the applications.

APP-13: PID Second P-Gain

APP▶ PID P2 Gain
13 100.0 %

APP-13 setting determines the PID second P Gain value. The PID P gain will be switched to P Gain 2 when digital input set to P-Gain2 is activated. The default is 100%.

APP-14: PID P Gain Scale

APP▶ P GainScale
14 100.0 %

APP-14 setting determines the PID P-Gain and second P Gain scaling factor. The default is 100%.

APP-17: PID Feedback U Curve Selection

APP▶ PID U Fbk
17 No

APP-17 setting switches the PID feedback curve to U type. If VFD control is set to S curve, the APP-17 can be set to Yes to match control and feedback curves.

APP-20 & 21: 2nd Accel and Decel Time

APP▶ 2nd AccTime
20 5.0 sec

APP▶ 2nd DecTime
21 10.0 sec

The VFD will switch control to second settings when digital input set to 2nd Function is activated.
APP-20- The second acceleration time setting.
APP-21- The second deceleration time setting.

APP-22 & 23: 2nd Base frequency and V/F pattern

APP▶2nd BaseFreq
22 60.00 Hz

APP▶ 2nd V/F
23 Linear

APP-22- The second acceleration time setting.
APP-23- The second V/F pattern has three selections: Linear, Square and User V/F.

APP-24 & 25: 2nd FWD and REV Torque Boost

APP▶ 2nd F Boost	APP▶ 2nd R Boost
24 2.0 %	25 2.0 %

APP-24- The second forward torque boost level.
APP-25- The second forward torque boost level.

APP-26: 2nd Stall Level

APP▶ 2nd Stall
26 100.0 %

APP-26 is a second stall level for motor current limiting function.

APP-27~29: 2nd Motor Current & ETH Settings

APP▶2nd ETH 1min	APP▶2nd ETH Cont
27 130.0 %	28 120.0 %

APP▶ 2nd R Curr
29 3.6 A

APP-27- The second Electronic Motor Overload setting for 1 minute to trip.
APP-28- The second Electronic Motor Overload setting for continuous run.
APP-29- The second motor FLA setting.

APP-40: Number of MMC Running Aux Motors

APP▶ Aux Mot Run
40 0

APP-40 is a display for the number of running Aux motors by MMC control.

APP-41: Aux Number for MMC 1st Motor

APP▶Starting Aux
41 1

APP-41 is the number of the 1st Aux motor to start in MMC control.

APP-42: Run Time for Aux Motors Alternation

APP▶Starting Aux
42 1

APP-41 shows the actual run time for Aux motors alternation for MMC control.

APP-44: MMC Aux Motors 1st In and Last Out

APP▶ F-In L-Out
44 Yes

APP-44 changes Aux motors Start/Stop sequence from 1st Starts and 1st Stops to 1st Starts and Last stops by setting it to Yes.

APP-45: MMC Aux Motors Simultaneous Stop

APP▶ All Stop
45 No

APP-45 changes Aux motors Stop sequence to simultaneous stop by setting it to Yes.

APP-66~68: MMC Aux Motors Alternation

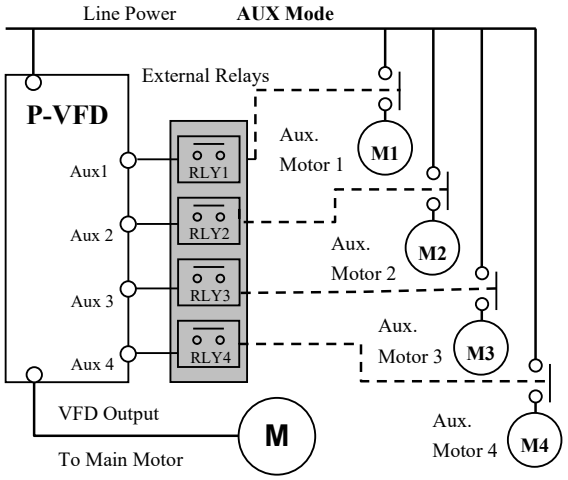
APP▶ AutoCh Mode	APP▶Auto Ex Intv
66 Aux	67 72.00 h

APP▶AutoEx Level
68 20.00 Hz

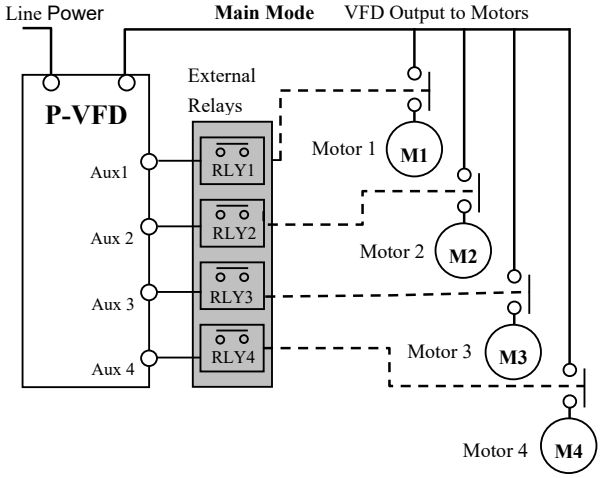
APP-66 has three selections for alternation mode: None, Aux and Main.

None- the alternation mode is disabled.

Aux- the alternation mode is enabled and VFD will alternate auxiliary motors when APP-67 run time timer is expired and VFD frequency is below APP-68 setting. The below one-line diagram shows MMC control configuration for four Aux motors. The VFD will open current Aux motor relay and close next Aux motor relay.



Main- the alternation mode is enabled and VFD



will alternate auxiliary motors on the VFD output by run time timer.

APP-67- the alternation run time timer setting is in hours. The VFD counts only run time and when it exceeds APP-67 and VFD output frequency is lower than APP-68 setting, VFD stops the motor, deactivates its relay, then closes next motor relay and starts again.
APP-68- the frequency below which the alternation is activated.

APP-69: Aux Motor MMC Interlock

```
APP►  interlock
69           No
```

APP-69 enables an MMC motor interlock (disable) feature if it is set to Yes. Any motor Aux relay can be disabled by corresponding digital input setting in I/O-20~27 to Interlock-1~4.

6.7 Extension Group [EXT]

EXT-00: Jump Code

EXT▶ Jump Code
00 1

EXT-00 allows jumping to any parameter in EXT group without scrolling to it. Press [ENTER] key and put a desired parameter code by using [SHIFT] and [UP]/[DOWN] keys.
When [ENTER] key is pressed again, the desired parameter will be on the display.

EXT-01: Sub Board Type

EXT▶ Sub B/D
01 Sub-E

EXT-01 shows what type of sub-board is installed.

EXT-40~45: CO1 and CO2 4-20mA Outputs

EXT▶ AM1 Mode
40 Frequency

EXT▶ AM1 Adjust
41 100.0 %

EXT▶ AM1 Offset
42 0.0 %

EXT▶ AM2 Mode
43 Frequency

EXT▶ AM2 Adjust
44 100.0 %

EXT▶ AM2 Offset
45 0.0 %

The CO1 and CO2 terminals are analog 4-20mA outputs and they have four selections: Frequency, Current, Voltage and kW. EXT-41, 42, 44 and 45 are parameters for analog outputs scaling factors and offsets.

[Frequency]
CO1 or CO2 output provides 4-20mA signal corresponding to VFD speed output from 0Hz to Max. frequency.

[Current]
CO1 or CO2 output provides 4-20mA signal corresponding to VFD output current from 0A to VFD current rating.

[Voltage]
CO1 or CO2 output provides 4-20mA signal corresponding to VFD output voltage from 0V to Maximum Voltage.

[kW]
CO1 or CO2 output provides 4-20mA signal corresponding to VFD output kW from 0kW to Maximum VFD kW output rating.

6.8 Communication Group [COM]

The communication card manual provides a detailed description of the installation, wiring and set-up procedures.

COM-00: Jump Code

COM▶ Jump Code
00 2

COM-00 allows jumping to any parameter in COM group without scrolling to it. Press [ENTER] key and put a desired parameter code by using [SHIFT] and [UP]/[DOWN] keys.
When [ENTER] key is pressed again, the desired parameter will be on the display.

COM-01: Option Board Type

COM▶ Opt B/D
01 BACnet

COM-01 shows what type of communication board is installed. There are five types of communication boards: RS-485, DeviceNet, ProfiBus, BACnet and LonWorks

COM-02: Option Board Control Mode

COM▶ Opt Mode
02 None

COM-03 has four selections for VFD control via communication card: None, Command, Freq and Cmd+Freq.

None- The communication provides only monitoring of the VFD parameters but no control.

Command- The communication provides monitoring of the VFD parameters and start/stop control. The VFD speed control is based on SET-10 selection.

Freq- The communication provides monitoring of the VFD parameters and speed control. The VFD start/stop control is based on SET-09 selection.

Cmd+Freq- The communication provides monitoring of the VFD parameters, start/stop and speed control.

COM-03: Option Board Version

COM▶ Opt Version
03 Ver x.x

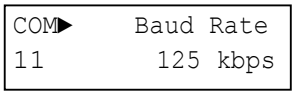
COM-03 shows the communication board version number.

COM-10: MAC ID

COM▶ MAC ID
10 63

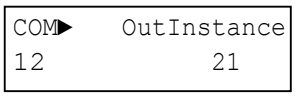
COM-10 allows to set MAC ID from 0 to 63.

COM-11: Baud Rate



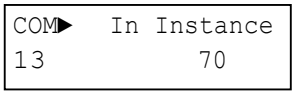
COM-11 allows to set Baud rate: 125, 250 or 500kbps.

COM-12: Out Instance



COM-10 allows to set Out Instance: 20, 21, 100 or 101.

COM-13: DeviceNet Input Instance

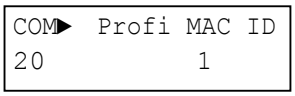


COM-13 allows to set DeviceNet input instance number: 70, 71, 110 or 111.

COM-17: PLC Option Station ID Number

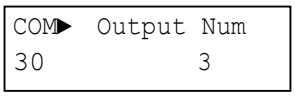
COM-17 allows to set station ID number from 0 to 63.

COM-20: ProfiBus MAC ID Number



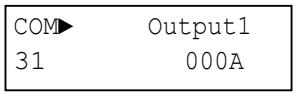
COM-20 is a Profibus station ID number from 1 to 127.

COM-30: Output Number



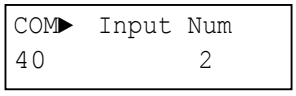
COM-30 allows to set output number from 0 to 8.

COM-31~38: Output Address (HEX)



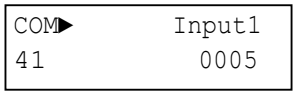
COM-31 through COM-38 are parameters for eight communication output address settings.

COM-40: Input Number



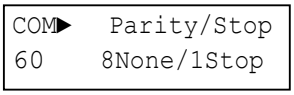
COM-40 allows to set input number from 0 to 8.

COM-41~48: Input Address (HEX)



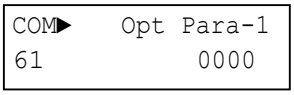
COM-41 through COM-48 are parameters for eight communication input address settings.

COM-60: Parity/Stop Selection



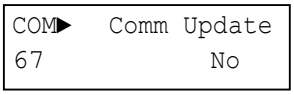
COM-60 has four Parity/Stop selections: 8None/1Stop, 8None/2Stop, 8Even/1Stop and 8Odd/1Stop.

COM-61~66: Communication Option Parameters



COM-41 through COM-48 are parameters for eight communication input address settings.

COM-67: Communication Option Update

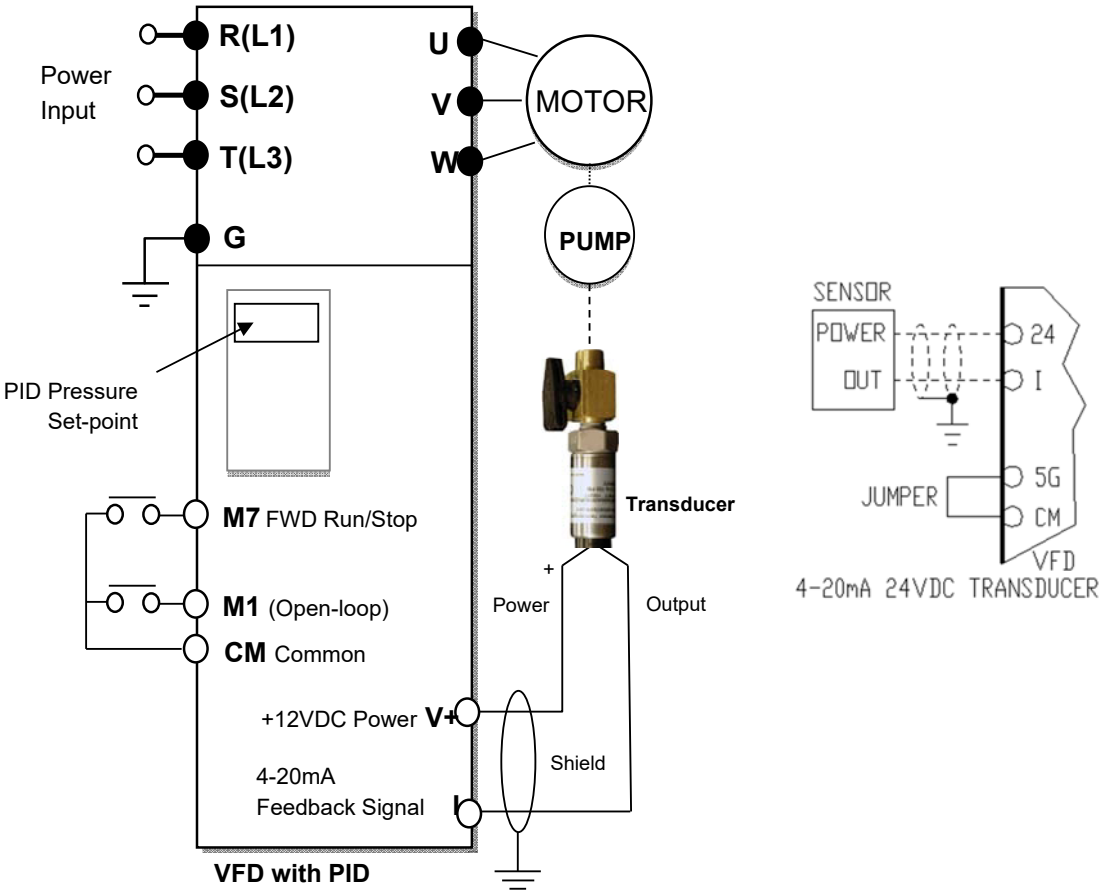


COM-67 enables common parameters update when set to Yes.

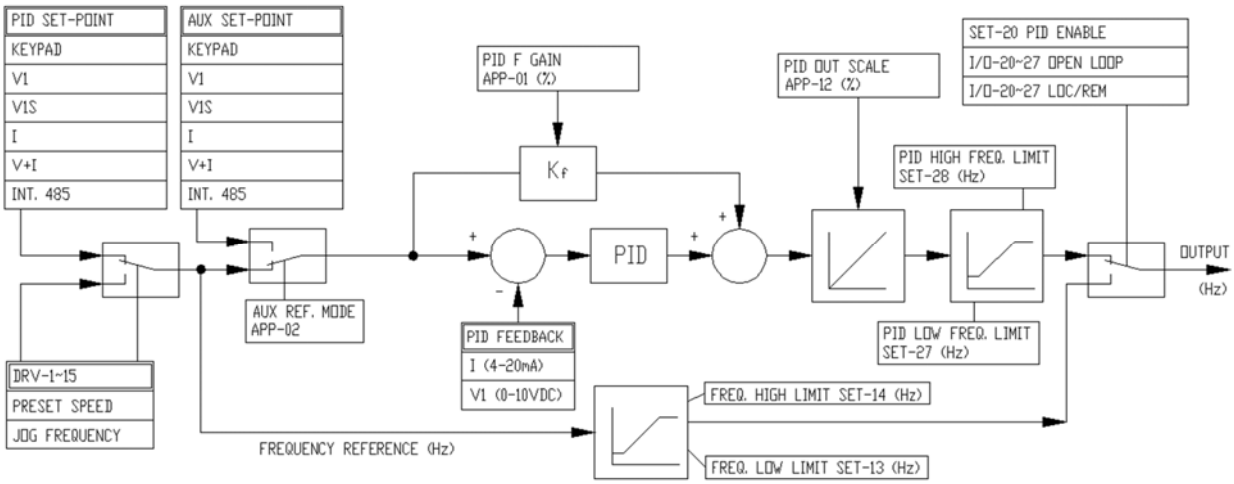
CHAPTER 7 - PID CONTROL WIRING AND BLOCK DIAGRAM

7.1 VFD Wiring for PID Control

The keypad is normally used for PID set-point adjustment (desired pressure, temperature, etc.) Any digital input can be programmed for Open-Loop function, which allows disabling PID control. Feedback transducer can be fed by 12VDC or 24VDC internal VFD power supplies. If 24VDC is used on VFD up to 40HP, connect CM terminal to 5G as shown on below diagram. Install properly sized pressure relief valve. Installation of cut-off pressure switch for system overpressure protection is recommended.

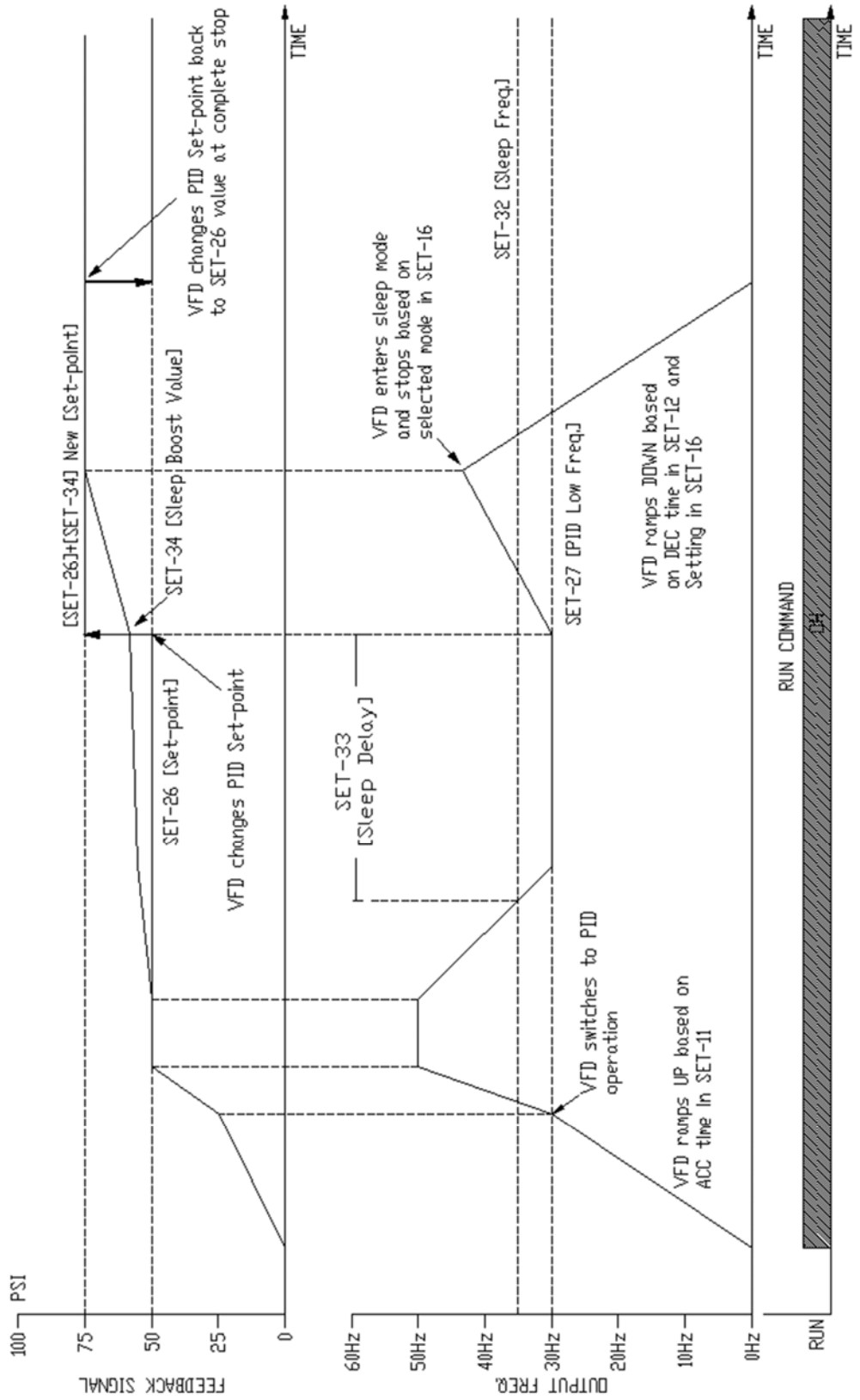


7.2 PID Control Block Diagram



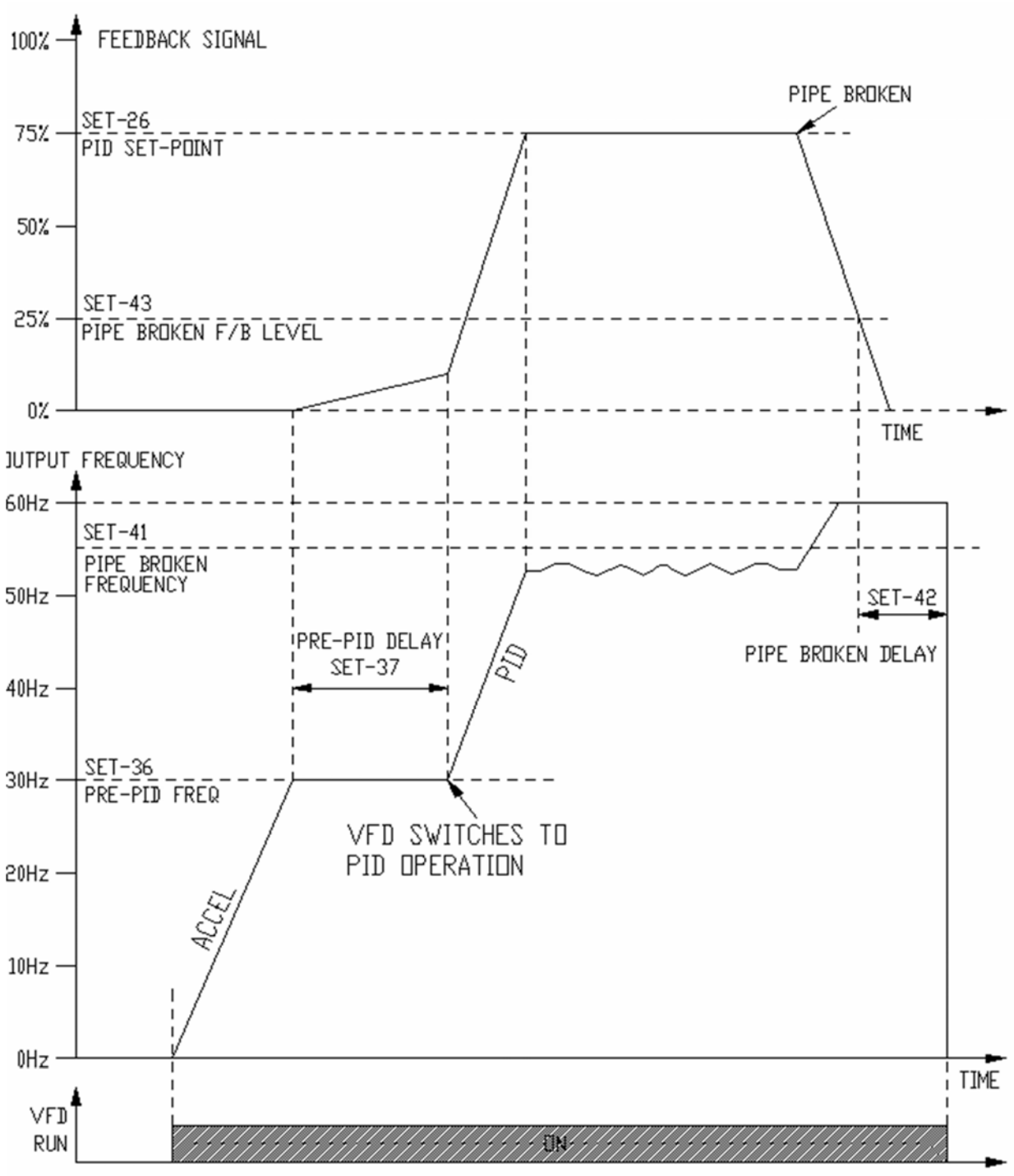
The picture above shows a PID block diagram with most of the required PID operation parameters. The PID output (Target) and VFD output frequency (Out) can be viewed on parameter DRV-25 screen.

7.3 PID control Sleep mode with Sleep Pressure Boost function diagram.

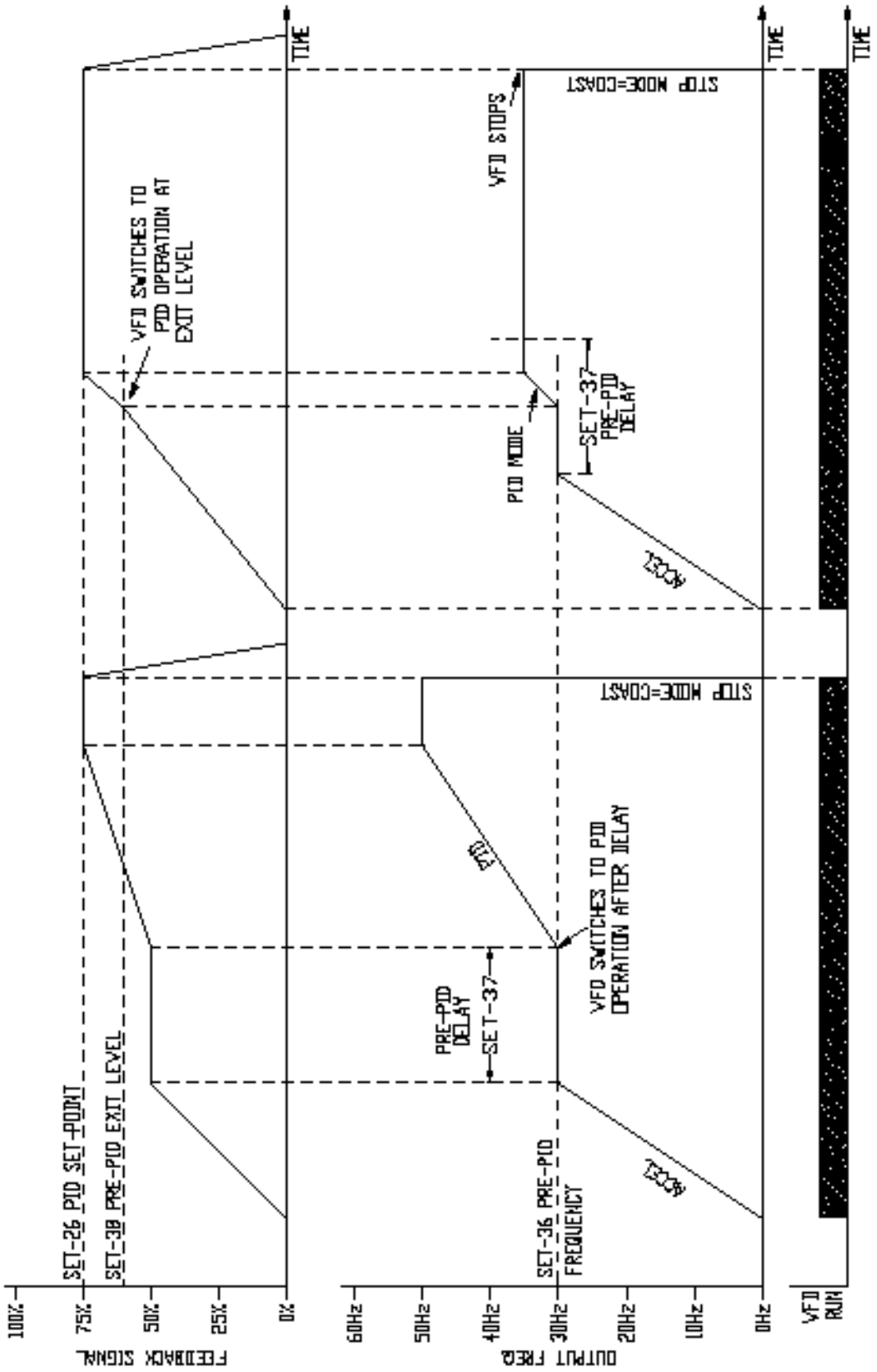


Note: If VFD in boost mode cannot reach boost Set-point but system pressure is still above original Set-point, it goes to sleep after sleep boost timer expires.

7.4 PID control with Pipe Broken function diagram.



7.5 Pre-PID (Pipe Fill) function diagram.



7.6 PID Control Setting Notes:

CHAPTER 8 - TROUBLESHOOTING & MAINTENANCE

8.1 Fault Display

When VFD trips on any fault, VFD turns off its output and displays the fault status in DRV-21. The last five faults are saved in FG2-01~05 with the operation parameters and status at the trip moment.

Keypad Display	Protective Function	Description
No Motor	No Motor Protection	Output current is below No Motor trip level for No Motor time delay. Motor circuit is open or has loose connection. [FG1-57]
Over Current 1 (OC1)	Over Current Protection	VFD trips when motor current exceeds 200% of VFD rated current. Reasons: motor miss wiring, partial motor winding short, undersized VFD, VFD overheat, long motor leads without filtering or very short ACC time for high inertia load.
Over Current 2 (OC2)	Output Short	VFD trips if internal IGBTs or motor wiring or winding are shorted. The motor winding can have intermittent insulation break downs in VFD applications. The Megger test most likely will not detect this damage.
Over Load (OLT)	VFD Overload Adjustable	VFD trips if the output current exceeds adjusted level (%) of VFD rated current.
Inv. OLT	VFD Overload Protection	VFD trips when the output current exceeds 110% for 1 minute or 130% for 4 seconds of the VFD rated current.
E-Thermal (ETH)	Motor Electronic Overload Protection	The electronic motor overload protection provides motor overload protection based on inverse curve. If the motor is overloaded, VFD trips to protect motor from overheating. For multi-motor array controlled by one VFD provide individual overload protection for each motor.
Ground Fault	Ground Fault Protection	VFD trips when ground fault current exceeds the internal ground fault level value. VFD may trip on Over Current fault when ground fault current value is too high.
Over Voltage	Over voltage protection	VFD trips if the DC Bus voltage exceeds the internal over voltage trip setting. It can happen when regenerative energy flows back to VFD during high inertia load deceleration, high power line voltage or power surge.
Low Voltage	Low Voltage Protection	VFD trips if the DC bus voltage is below the internal Low voltage trip setting.
Over Heat	VFD Over Heat	VFD turns off its output if the heat sink is over heated due to insufficient cooling (failed VFD cooling fan or dirty enclosure ventilation filter).
Fan Lock	Cooling Fan Fault	If cooling fan current draw is less or greater than nominal value, VFD trips.
Ext. OHT	Motor Over Heat	VFD turns off its output if motor winding temperature sensor (Thermistor) reading exceeds a set value.
Over Pressure	System Over Pressure	System pressure exceeded the trip level to protect equipment from damage.
Ext. Trip	External Trip	The VFD trips when digital input set for Ext. Trip is activated. When input is deactivated, VFD can be reset by Stop key or by recycling the input power. Use for Dynamic Braking overheat protection.
BX	BX stop (Emergency Stop)	The VFD trips when digital input set for BX is activated. When BX input is deactivated, VFD can be reset automatically or by Stop key (selectable).
Pipe Broken	Pipe Broken	VFD trips when system pressure is below Pipe Broken F/B level and time delay is expired. This fault requires a manual reset.
Pipe Leak	Pipe Leak	VFD trips when system pressure drops below wakeup level slower than at minimum demand. DRV-43 shows last wakeup time.
Output Phase Open	Out Phase open	VFD detects the output current of all three phases and trips when any output phase (U, V or W) is open.
Input Phase Open	In Phase open	VFD monitors an amplitude of DC bus ripples and trips when it exceeds set value. Disable it in [FG1-69] for single-phase power input. MAK-06 is an IPO level (V).
HW-Diag	VFD H/W Fault	Hardware diagnostic fault includes the control PCB malfunction, the EEP error, NTC open and A/D Offset.
COM Error CPU Error	Communication Error	VFD trips when it cannot communicate with the keypad. Reasons: Loose keypad cable connectors, damaged keypad or damaged control board.
NTC open	NTC Open	This fault is displayed when VFD cannot read an internal temperature sensor.
LOP LOR LOV LOI LOX	Frequency Reference is Lost (Loss of … signal)	LOP: Frequency reference is lost from I/O Option board (DPRAM time out) LOR: Frequency reference is lost from Communication Option board LOV: Frequency reference is lost from 'V1' analog input. LOI: Frequency reference is lost from 'I' analog input. LOX: Frequency reference is lost from analog sub-board (V2, ENC).

To reset any fault, press **STOP/RESET** key on the VFD keypad, or activate a digital input set for reset (RST) function, or cycle the VFD input power. If a problem persists, try to find and eliminate the source of the problem or contact the factory or your local distributor for technical support.
Note: If VFD control board operates at excessive temperature and processor is overheated, it triggers false faults and VFD can trip on any or multiple faults.

8.2 Fault Remedy

The VFD is a very complex electronic device that monitors and controls many I/O points during operation. It can generate false faults or even malfunction when processor is overheated or AC voltage is injected into DC control or analog circuits. The 7.5~40HP VFDs do not have cooling fan control and monitoring circuits and faulty cooling fan can overload power supply and decrease VFD control voltages (24VDC, +12VDC and -12VDC) to critical levels. This can trigger VFD false trips by some faults monitored by processor I/O. Always check FG1-55 parameter for VFD temperature and 24VDC, +12VDC and -12VDC voltages during VFD trips trouble-shooting.

Protective Function	Cause	Remedy
Over Current 2 (OC2)	Short circuit between the upper and lower IGBTs. Short has occurred in motor circuit or windings. Acceleration/Deceleration time is too short.	Check IGBT with multimeter in diode check mode. Check motor wiring and windings. Set SET-06 to 0.7kHz and if VFD does not trip or it takes longer to trip, the motor winding has insulation problems. Install output reactor. Increase acceleration time. (a) Disconnect all VFD control board green terminals and try to run VFD. If it runs motor without tripping, one of the external signals (control or speed) injected with electrical noise. Determine which one and use relay or signal isolator.
Over Current 1 (OC1)	Accel/Decel time is too short for high inertia load. VFD is undersized for the motor rating. Output short or ground fault has occurred. Mechanical motor brake is not controlled properly. The VFD is overheated.	Increase Accel/Decel time. Upsize VFD. Check motor wiring and windings. Check mechanical brake operation timing. Check VFD temperature and cooling fans. ***Caution:** Frequent VFD starting with this fault may damage the VFD power components. Try step (a) from remedy for OC2.
Overload Protection	The VFD and motor are undersized for application. Incorrect VFD capacity is selected in MAK-01. Incorrect V/F pattern is selected.	Upsize VFD and motor. Select correct VFD capacity. Select correct V/F pattern.
(ETH) Electronic Thermal Motor Overload	ETH level setting is too low. Accel time is too low. Motor is overloaded. Motor is undersized for this load. Incorrect HP rating is selected. The control is set to incorrect V/F pattern. Motor operates at low speed too long.	Set ETH to a proper level. Increase Accel time. Reduce motor load and/or run duty cycle. Increase motor size. Select correct HP rating. Select correct V/F pattern. Increase VFD frequency limit to 20-30Hz.
Ground Fault Protection	Ground fault has occurred in the motor circuit.	Check output wiring and insulation of motor windings with Megger tester. ***Caution:** Disconnect motor leads from VFD before performing Megger test. Try step (a) from remedy for OC2.
Over Voltage Protection	Deceleration time is too short. Mechanically unbalanced load. Regenerative power from motor during Decel. Line voltage is too high. Motor OC1 or OC2 fault triggers this fault if output dV/dt filter is installed	Increase deceleration time. Check DC bus voltage, change V/F curve, or use Dynamic Braking Unit and Resistor. Check line voltage and call utility company.
Low Voltage Protection	Line voltage low. Some large loads are connected to power line in that area creating voltage drop during start or	Check voltage during normal and rush hours and contact utility company.

Protective Function	Cause	Remedy
	operation. (Welding machine, motors with high starting current, etc.) Faulty contactor at input side of the VFD Faulty DC bus pre-charge circuit	 Replace contactor. Call FCS tech support for troubleshooting
VFD Overheat	Cooling fan malfunction. Enclosure cooling fan filter is dirty. Ambient temperature is too high.	Replace cooling fan(s). Clean or replace enclosure cooling fan filter. Upsize VFD for higher temperature rating.
Fan Lock	Fan is dirty and overloaded or disconnected.	Clean fan with compressed air and/or replace fan(s)
Output Phase Open	Faulty contact of motor service disconnect switch Loose output wiring or motor junction box wiring.	Check motor switch or contactor on VFD output. Check output wiring from VFD to motor.
Input Phase Open	Power line phase drop, Bad power disconnect contact, Loose wire on VFD input wiring. VFD is undersized for motor/application.	Check voltages on VFD power terminals, check voltages on disconnect and line reactor input and output lugs. Replace faulty device. Check VFD and motor size for application. Upsize VFD if it is undersized.
Over Pressure	PID P-Gain setting is too high creating pressure overshooting. SET-26 Set-point set too high.	Decrease P-Gain value and if necessary slightly increase I-Time. Check SET-26 setting.
External Trip	Digital input set for External Trip is activated	Eliminate trip condition at circuit connected to external trip terminal or remove external trip input.
H/W Fault	W-Dog error (CPU fault) EEP error (memory fault) ADC Offset (current feedback circuit fault)	Call FCS tech support for troubleshooting. Electrical noise generated in analog or digital control circuits can trigger this fault. In some cases, control PCB or even VFD should be replaced.
Com./CPU Error	Faulty connection between VFD and keypad. Control board malfunction. Keypad is bad	Check connector. Replace control board Replace keypad.
Frequency Reference is Lost	LOP (Loss of reference from the Option card), LOR (Remote) LOV (V1), LOI (I), LOX (Sub-V2, ENC)	Eliminate the reference signal loss problem (bad wiring, controller or transducer is not powered or disconnected).

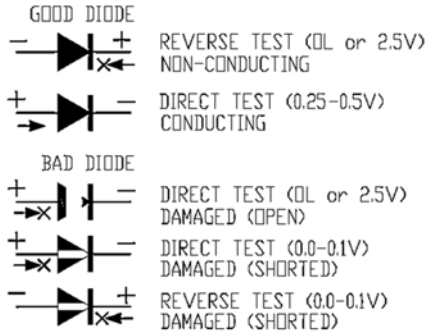
8.3 Troubleshooting

Condition	Checking and Fixing Procedures
The motor does not start.	Check if red light on keypad is not flashing (no VFD fault). Check if display shows FWD when start command is applied. • If not, check parameter I/O-28 for FWD and REV run bits, only one of them should be 1. 1. If not, check start contact wiring and closure and PNP-NPN dip switch position. 2. If yes, check parameter SET-15 for Run Prevention setting. • If yes, check if speed reference is greater than 0.5Hz 1. If not, check speed reference selection in SET-10, analog signal wiring and level. 2. If yes, check the motor wiring, motor disconnect or contactor. All disconnecting devices should be closed and motor should have connection to VFD output terminals. Check VFD output voltage corresponding to the output frequency. If VFD is running at some frequency and there is no output voltage, call Franklin Control Systems tech support.
The motor rotates in opposite direction.	If VFD is running and shows FWD but motor rotates in reverse direction, stop and power down VFD, wait at least 10 minutes, and then swap any two motor wires to change the motor rotation.
The VFD stays at high	The electrical noise in analog signal can cause VFD not to follow a speed

speed when speed reference decreases.	reference, especially for 0-10VDC signal with non-shielded cable. Increase I/O-1 filtering time up to 500ms. If this does not help, install shielded cable.
The Motor current is higher than FLA rating.	Check mechanical system for conditions that can overload the motor (dirty filter, closed valve or brake, etc.) In a new installation, check motor windings wiring. If motor windings wiring is correct, switch FG2-60 to Sensorless mode and run FG2-61 Auto Tuning.
The motor runs at very low speed regardless of speed reference signal.	Increase FG1-71 Stall level if FG1-70 is set to Yes. Decrease FG2-68 Torque Boost level.
The motor speed is not stable (oscillates).	Check motor winding configuration wiring. If motor speed oscillates because of speed reference oscillation, check analog signal for noise. Check mechanical system for conditions that can create load level oscillation (vibration, unbalanced load, etc.). If distance to the motor is greater than 1500 feet, install output filter.

8.4 Checking VFD Power Components

The VFD input and output power components are semiconductors and can be checked by multimeter with diode check mode (⏭). When DC voltage positive is applied to the diode anode (triangle ►) and negative to cathode (bar ▌), the diode is conducting.



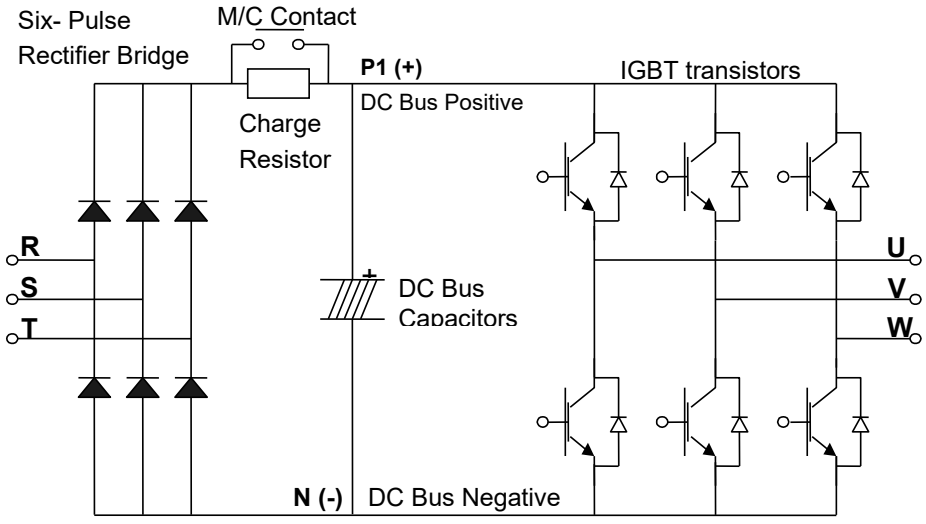
The multimeter red lead is positive (+) and black lead is negative (-). For direct polarity test put positive (red) lead to diode anode and negative (black) lead to cathode, the reading should be for diode conducting state 0.25~0.5 V. For reverse polarity test swap multimeter leads, the reading should be about 2.5V ("OL" on some meters) for diode non-conducting (open circuit) state. If diode is shorted, the reading in direct and reverse test will be close to 0V. If diode is open (exploded), the reading in direct and reverse test will be about 2.5V ("OL" on some meters). The IGBT transistors cannot be checked with multimeter but diodes across IGBTs can.

Diode Bridge and IGBT Module Test for 7.5~40HP VFDs

Before checking the power components, disconnect AC input power and wait for about 10 minutes.

- Check that there is no DC voltage on P1 and N terminals.
- Disconnect power wires from R, S, and T terminals and motor leads from U, V, and W terminals.
- Check diodes in the rectifier bridge and IGBT module with multimeter in the sequence shown in below table and diagram.

Diode state codes: ☑- Conducting; ☒- Non-conducting.



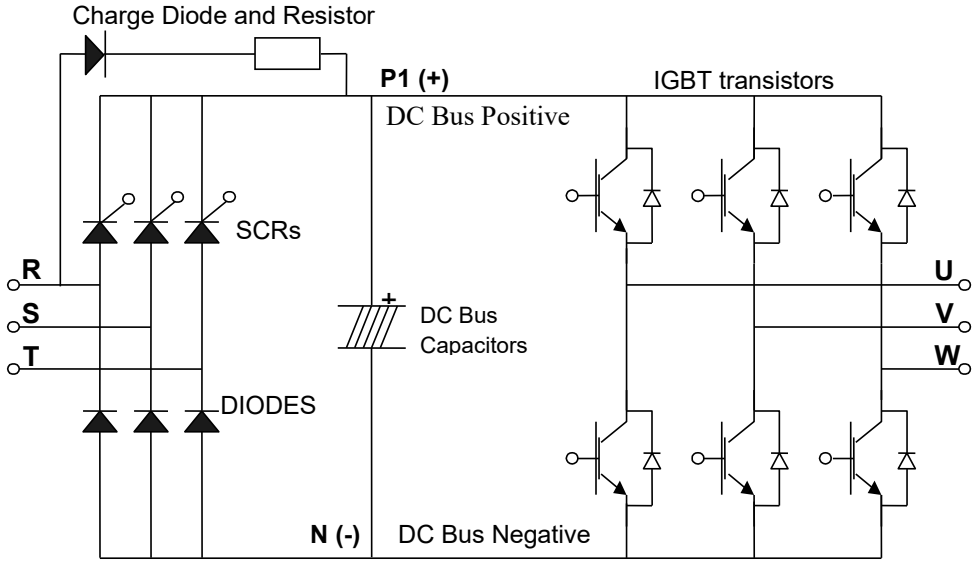
Black Lead to **P1+**				**Black** to **N**			**Red** to **P1+**				**Red** to **N**		
Red to	**R**	**S**	**T**	**R**	**S**	**T**	**Black** to	**R**	**S**	**T**	**R**	**S**	**T**
State	☑	☑	☑	☒	☒	☒	**State**	☒	☒	☒	☑	☑	☑
Red to	**U**	**V**	**W**	**U**	**V**	**W**	**Black** to	**U**	**V**	**W**	**U**	**V**	**W**
State	☑	☑	☑	☒	☒	☒	**State**	☒	☒	☒	☑	☑	☑

Diode Bridge and IGBT Module Test for 50~700HP VFDs

Before checking the power components, disconnect AC input power and wait for about 10 minutes.

- Check that there is no DC voltage on P1 and N terminals.
- Disconnect power wires from R, S, and T terminals and motor leads from U, V, and W terminals.
- Check diodes in the rectifier bridge and IGBT module with multimeter in the sequence shown in below table and diagram.

Diode state codes: ☑- Conducting; ☒- Non-conducting.



Note: The 50-700HP VFDs have half controlled rectifier bridge with SCRs (silicon controlled rectifier). The SCR cannot be checked for conducting state with multimeter. The reading from R to P1 terminals will represent charge diode and resistor circuit. Terminals S and T to P1 will show closed state in direct and reverse test if SCRs are not shorted.

Black Lead to **P1+**				**Black** to **N**			**Red** to **P1+**				**Red** to **N**		
Red to	**R**	**S**	**T**	**R**	**S**	**T**	**Black** to	**R**	**S**	**T**	**R**	**S**	**T**
State	☑	☒	☒	☒	☒	☒	**State**	☒	☒	☒	☑	☑	☑
Red to	**U**	**V**	**W**	**U**	**V**	**W**	**Black** to	**U**	**V**	**W**	**U**	**V**	**W**
State	☑	☑	☑	☒	☒	☒	**State**	☒	☒	☒	☑	☑	☑

8.5 Maintenance

The P series VFD is an industrial electronic product with advanced semiconductor components and its operation depends on installation and operation conditions such as temperature, humidity, vibration, dust etc. It is recommended to perform routine inspections of all operating VFDs.

Precautions

☞ Remove the VFD input power while performing maintenance procedures.

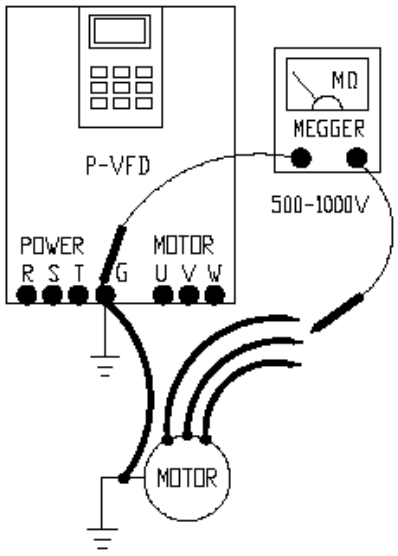
☞ Use a true RMS multimeter to check VFD output voltage. Other type of voltmeters cannot read VFD high frequency PWM output voltage correctly.

Periodic Inspection

☞ Check for loose connections, bolts, nuts or rust build up caused by surrounding conditions.
☞ Remove any built-up dirt or debris in the VFD-cooling fans using compressed air. Replace cooling fans if debris cannot be completely removed or if cooling fans no longer spin freely for any reason
☞ Carefully remove a built-up dirt or debris inside the VFD and on the surface of all circuit boards using compressed air. If debris build up cannot be removed easily, call Franklin Control Systems for support.
☞ Check for any discoloration or visual damage to the various connectors inside the VFD. Call Franklin Control Systems for support if any discolored or damaged connectors are found.
☞ Check the visual condition of the DC Bus capacitors. If any capacitors are bulging, deformed, or have ruptured in any way, call Franklin Control Systems for troubleshooting advice and possible solutions.

Motor Winding Megger Test

The Megger tester provides static 500-1000V output to test motor ground leak path resistance (windings insulation). **Perform a Megger test of the motor windings ONLY after the motor wiring is disconnected from VFD.**



The windings insulation resistance should be in the Mega Ohm range.
Do not connect Megger tester leads to VFD power terminals, otherwise VFD power components can be damaged.
Do not perform Megger test on control wiring.
When VFD trips on OC2 (output short circuit) fault because of motor winding insulation breakdown, most likely the motor windings will pass the Megger test. The reason for that is that the VFD creates output pulses with spikes on each pulse which can cause an intermittent insulation breakdown. The Megger tester cannot simulate the VFD output and cannot provide adequate surge test for the motor windings. Usually, a motor with insulation breakdown on VFD output can still run normally from power line. If your VFD system with OC2 faults does not have an output reactor or filter but it has an input reactor, rewire it to the VFD output as a temporary solution for testing and order proper output filtering device.

Maintenance and Inspection Scheduling

Inspection Location	Inspection Item	Inspection	Every		Inspection Method	Criteria
			Month	Year		
Inspection Location	Equipment	Is there any abnormal vibration or noise?	O		No special tools required	No abnormality
	Input Voltage	Is the input voltage of the main circuit normal?	O		Measure the voltage between the terminals R, S and T.	Stable line voltage within operating range of VFD
Main Circuit	Power Wiring	Is any conductor corroded or overheated (discolored)? Is the wire insulation damaged?		O O	Visual check	No fault
	Internal Power Circuit	Is any bus bar corroded or overheated (discolored)? Is any DC bus capacitor damaged?		O	Visual check	No fault
	Terminals	Is there any damage?		O	Visual check	No fault

Cooling Fans	VFD Cooling Fan(s)	Is cooling fan spinning? Is there any vibration or noise?	O O		Turn OFF the power and turn the fan by hand.	Fan must rotate smoothly. No fault
Motor	Motor Insulation	Motor Winding Insulation Megger check.		O	Disconnect Motor leads from VFD U, V & W terminals and Megger each motor lead to ground.	Over 5MΩ No fault

Replacement Parts

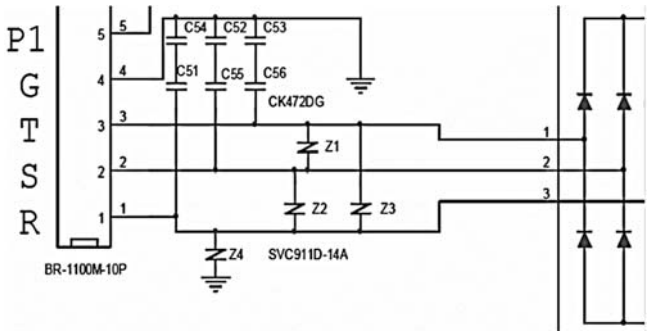
Part name	Period	Comments
Cooling fan	1-3 years	Replace with new fan
Keypad	When failed	Replace with new keypad
Control Board	When failed	Replace with new control PCB
Power Supply PCB	When failed	Replace with new SMPS PCB

The life expectancy of any part depends on environmental and operating conditions.

Filtering and Surge Protection

The P-Series VFD has MOVs (Metal Oxide Varistors) and capacitors on power input circuit to provide some degree of filtering and surge suppression. MOVs are designed to shunt the downstream circuits by conducting electrical current when applied voltage exceeds its "clamping voltage". When MOVs conduct current, they produce heat. The amount of energy that can be dissipated as heat depends on the size of MOV (energy rating). With excessive current and generated heat, the MOV can fail and downstream circuits will be damaged. That is why they provide just some degree of surge suppression. For better surge suppression it is recommended to install external surge suppressors with greater energy rating.

The below diagram shows example of P-VFD input power circuits with C51-56 capacitors and Z1-4 MOVs for filtering and surge suppression. The R, S and T are power input terminals and G is a ground terminal.



CHAPTER 9 - OPTIONS

9.1 Option List

External	Keypad	LCD	32-character display keypad Download and Upload available	All units
	Remote	Remote cable	6, 9 and 15-foot long keypad cable to control VFD from remote keypad.	Optional
	Dynamic braking	DB unit and resistor	Allows VFD to decelerate rapidly without overvoltage fault.	Optional
	Conduit box option	NEMA TYPE 1 Conduit box	Install it for NEMA TYPE 1 rating.	20~125HP 15~90kW

Note: Refer to Option manual for details.

9.2 Remote Keypad Cable

Ordering No.	Description
CI-RKPK-EXT2M-P/S	Remote cable –6ft (2m)
CI-RKPK-EXT3M-P/S	Remote cable – 9ft (3m)
CI-RKPK-EXT5M-P/S	Remote cable – 15ft (5m)

9.3 DBU (Dynamic Braking Unit) sizes

VFD	Applicable motor rating	DB Unit	Dimension
230V class	**15 ~ 20 HP** (11 ~ 15 kW)	**CI-DBU-20-2**	Frame 1
	25 ~ 30 HP (18.5 ~ 22 kW)	**CI-DBU-30-2**	Frame 2
	40 ~ 50 HP (30 ~ 37 kW)	**CI-DBU-40-2**	
	60 ~ 75 HP (45 ~ 55 kW)	**CI-DBU-50-2**	Frame 3
480V class	**15 ~ 20 HP** (11 ~ 15 kW)	**CI-DBU-20-4**	Frame 1
	25 ~ 30 HP (18.5 ~ 22 kW)	**CI-DBU-30-4**	Frame 2
	40 ~ 50 HP (30 ~ 37 kW)	**CI-DBU-40-4**	
	60 ~ 75 HP (45 ~ 55 kW)	**CI-DBU-50-4**	Frame 3
	100 HP (75 kW)	**CI-DBU-60-4**	
	125 ~ 700 HP (90~525 kW)	DBU Combination	DBU Combination

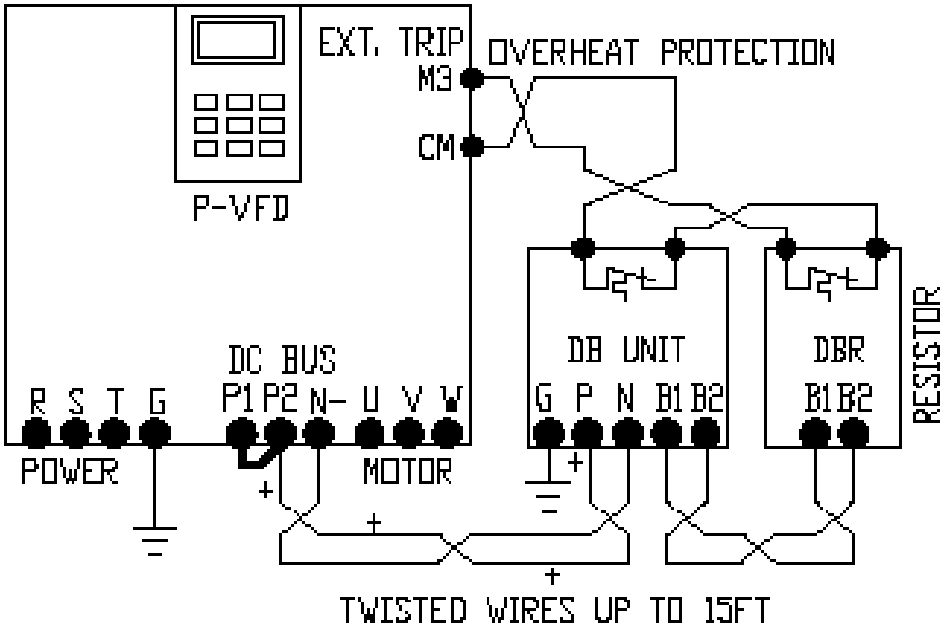
Note: P Series VFD does not have internal dynamic braking transistor and DB resistor and requires external DBU and DBR set. Refer to DBU manual for multiple units and resistors arrangement.

9.4 DBU and DBR (resistor) terminals and wiring

Terminals	Description
G	Connect to system Ground terminal
B2	Connect to DB Resistor's **B2**
B1	Connect to DB Resistor's **B1**
N	Connect to VFD Negative terminal **N-**
P	Connect to VFD Positive terminal **P1+**

Note: Refer to DBU and DBR manuals for proper wiring instructions.

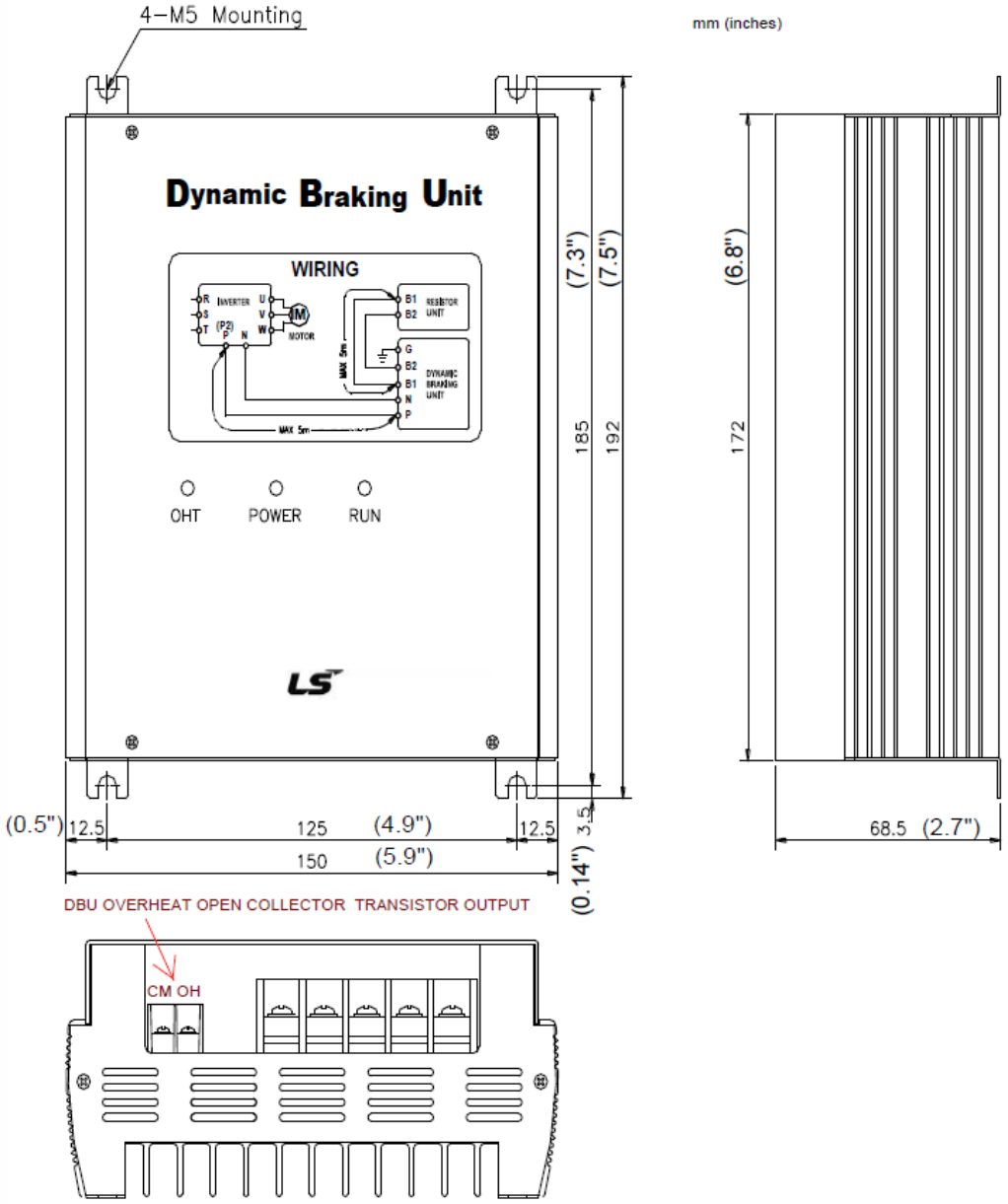
9.5 The basic wring diagram for Dynamic Braking Unit and Resistor.



Notes:

1. Use 600V rated twisted wires for DBU and DBR wiring.
2. If DBU overheat protection terminals are labeled CM and OH, this is an open collector transistor output rated 100mA up to 30VDC and it is closed when DBU is powered and will be open when DBU trips on overheat
3. The multi-DBU configuration can be used for one VFD. Refer to DBU and DBR manuals for wiring details.

9.6 DBU Frame 1 dimensions



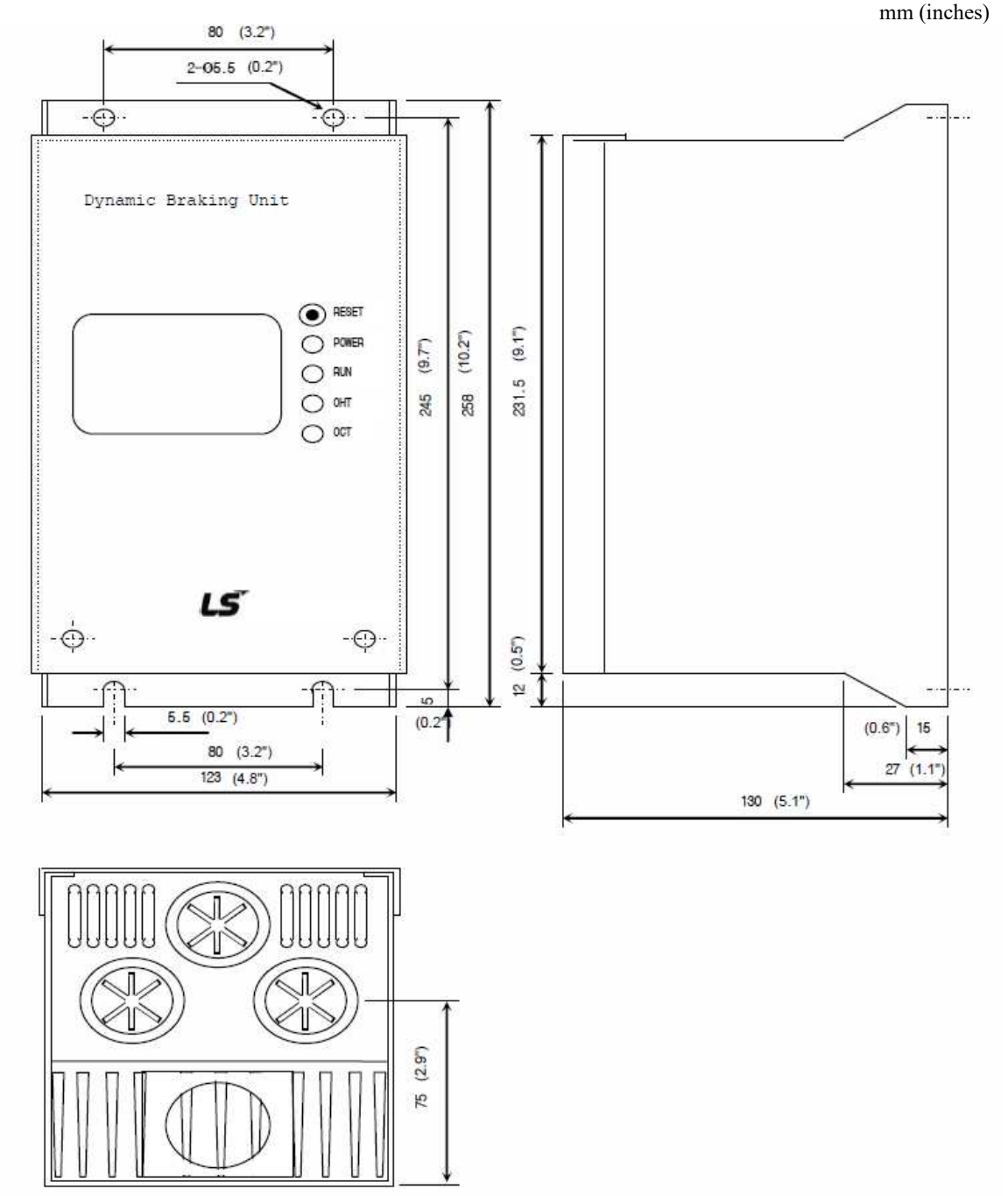
Note: Open collector transistor output is N.C. type. When DBU is not powered, OH output is open and will be closed when power is applied and DBU is not overheated. When DBU is powered and overheated, the OH output will be open.

LED indication description table

LED	Description
OHT (GREEN)	When DB unit heat sink temperature exceeds the internal setting, the Unit trips on Overheat and OHT LED will be ON.
POWER (RED)	POWER LED is ON while VFD is powered.
RUN (GREEN)	RUN LED flashes when DBU sends regenerated energy to resistor.

9.7 DBU Frame 2 dimensions

mm (inches)

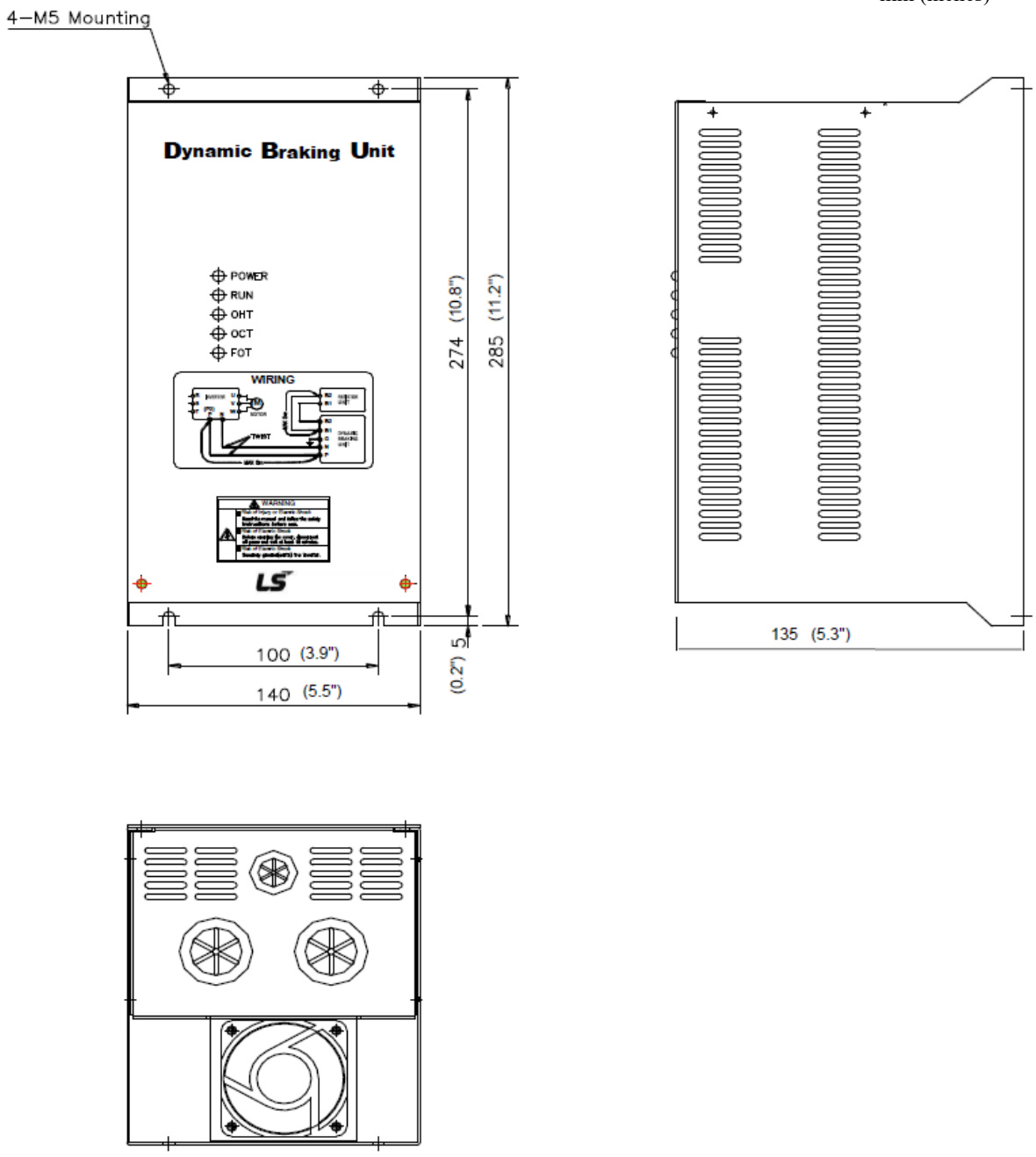


LED indication description table

LED	Description
RESET	Press this button to reset OCT FAULT.
POWER (GREEN)	When DB unit heat sink temperature exceeds the internal setting, the Unit trips on Overheat and OHT LED will be ON.
RUN (GREEN)	POWER LED is ON while VFD is powered.
OHT (RED)	RUN LED flashes when DBU sends regenerated energy to resistor.
OCT (RED)	Over current trip signal. When DBU generates excessive current through resistor, it trips on Over Current Fault.

9.8 DBU Frame 3 dimensions

mm (inches)



LED indication description table

LED	Description
POWER (GREEN)	When DB unit heat sink temperature exceeds the internal setting, the Unit trips on Overheat and OHT LED will be ON.
RUN (GREEN)	POWER LED is ON while VFD is powered.
OHT (RED)	RUN LED flashes when DBU sends regenerated energy to resistor.
OCT (RED)	Over current trip signal. When DBU generates excessive current through resistor, it trips on Over Current Fault.
FOT (RED)	DBU trips on Fuse Open fault and FOT LED is on when internal fuse is blown.

9.9 Dynamic Braking Resistor Sizing

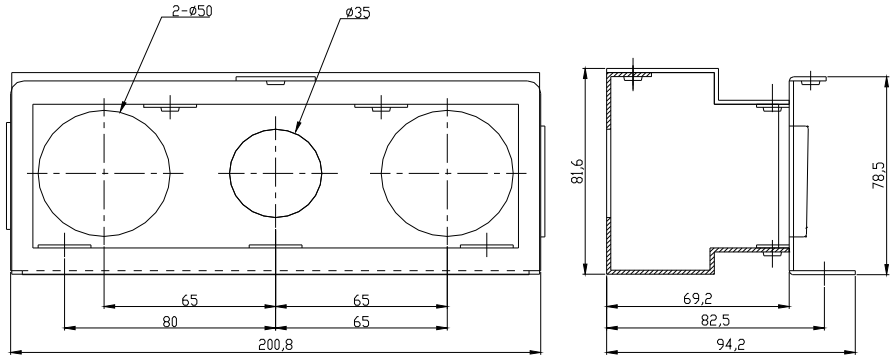
When dynamic braking is required for the application, the dynamic braking resistor should be sized based on the table below. Determine an ED (Enable Duty) cycle and continuous braking time and select proper resistor values. If ED is increased from 5% to 10%, the DB resistor Wattage rating should be doubled. Selecting resistor with Ohms values less than values shown in the table below can create over current and overheat faults and even damage DBU IGBT transistors. Decreasing the resistor wattage can create overheat conditions for resistor and even damage it.

	Motor Size (kW / HP)	Enable Duty/ Braking Time	100 % Braking Torque		150% Braking Torque	
			[ohm]	[W]	[ohm]	[W]
230V	5.5 / **7.5**	5% / 15 sec	30	700	**20**	800
	7.5 / **10**	5% / 15 sec	20	1000	**15**	1200
	11 / **15**	5% / 15 sec	15	1400	**10**	2400
	15 / **20**	5% / 15 sec	11	2000	**8**	2400
	18.5 / **25**	5% / 15 sec	9	2400	**5**	3600
	22 / **30**	5% / 15 sec	8	2800	**5**	3600
	30 / **40**	10% / 6 sec	4.2	6400	**-**	-
480V	5.5 / **7.5**	5% / 15 sec	120	700	**85**	1000
	7.5 / **10**	5% / 15 sec	90	1000	**60**	1200
	11 / **15**	5% / 15 sec	60	1400	**40**	2000
	15 / **20**	5% / 15 sec	45	2000	**30**	2400
	18.5/ **25**	5% / 15 sec	35	2400	**20**	3600
	22 / **30**	5% / 15 sec	30	2800	**20**	3600
	30 / **40**	10% / 6 sec	**16.9**	6400	**-**	-
	37 / **50**	10% / 6 sec	**16.9**	6400	-	-
	45 / **60**	10% / 6 sec	**11.4**	9600	-	-
	55 / **75**	10% / 6 sec	**11.4**	9600	-	-
	75 / **100**	10% / 6 sec	**8.4**	12800	-	-
	90 / **125**	10% / 6 sec	**8.4**	12800	-	-

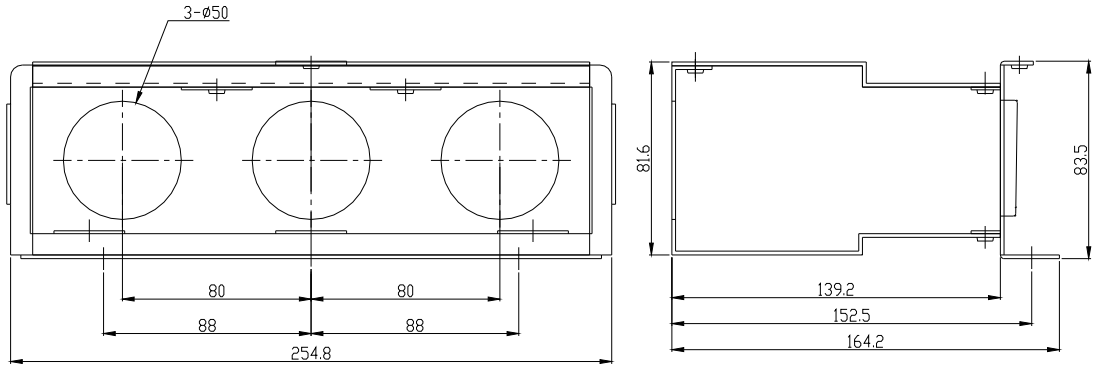
9.10 NEMA TYPE 1 Optional Conduit Box

The NEMA TYPE 1 Conduit Box is required if VFD is installed on the wall to meet NEMA 1 rating.

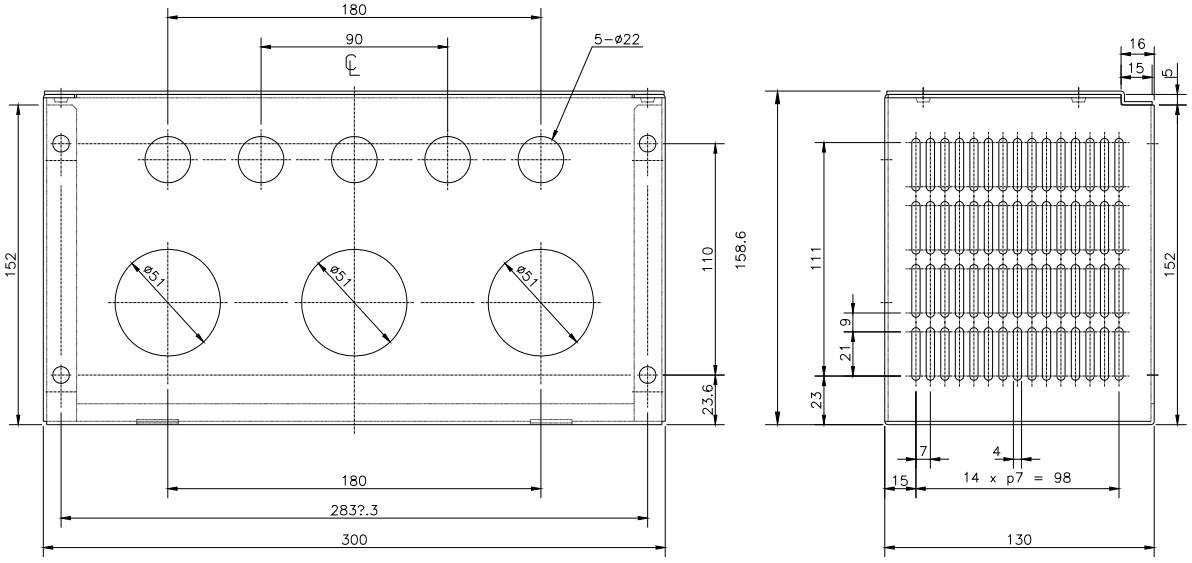
Remove the metal plate on the bottom of the VFD and install this kit using same screws.



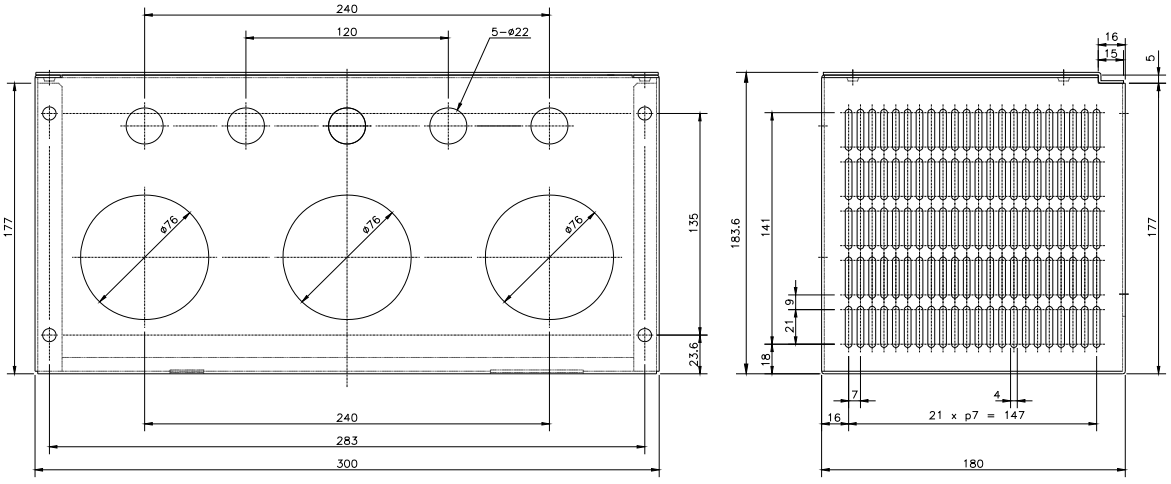
Conduit box for 020~025HP VFD



Conduit box for 030~040HP VFD



Conduit box for 050~075HP VFD



Conduit box for 100~125HP VFD

■ Conduit Hole Size

mm(inches)

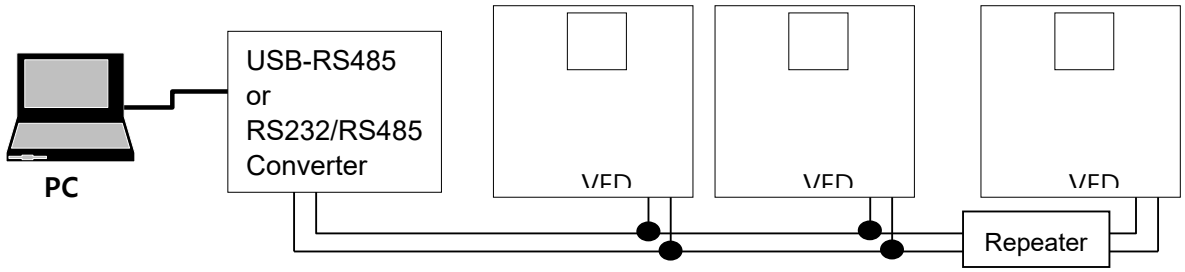
VFD	Control/Power Conduit holes	Size of the Conduit
CI-007-P2/4/6	24 (0.98)/ 24 (0.98)	16 (1/2)/ 16 (1/2)
CI-010-P2/4/6	24 (0.98)/ 35 (1.37)	16 (1/2)/ 27 (1)
CI-015-P2/4/6	24 (0.98)/ 35 (1.37)	16 (1/2)/ 27 (1)
CI-020-P2/4/6	35 (1.37)/ 50 (1.96)	27 (1)/ 41 (3/2)
CI-025-P2/4/6	35 (1.37)/ 50 (1.96)	27 (1)/ 41 (3/2)
CI-030-P2/4/6	50 (1.96)/ 50 (1.96)	41 (3/2)/ 41 (3/2)
CI-040-P2/4/6	50 (1.96)/ 50 (1.96)	41 (3/2)/ 41 (3/2)
CI-050-P4/6	22(0.86)/ 51(2.00)	16(1/2)/ 41(3/2)
CI-060-P4/6	22(0.86)/ 51(2.00)	16(1/2)/ 41(3/2)
CI-075-P4/6	22(0.86)/ 51(2.00)	16(1/2)/ 41(3/2)
CI-100-P4/6	22(0.86)/ 76(2.99)	16(1/2)/ 63(5/2)
CI-125-P4/6	22(0.86)/ 76(2.99)	16(1/2)/ 63(5/2)

CHAPTER 10 - MODBUS-RTU COMMUNICATION

10.1 Introduction

VFD can be controlled and monitored via Modbus RTU communication by the BMS (Building Management System), PLC or other master module.
Drives or other slave devices may be connected in a multi-drop Modbus-RTU network with up to 31 units and may be monitored or controlled by a single master control device. The unique ID number should be assigned to each VFD in the network.
When master sends the same Write Request with HEX-Decimal address 0x0006 (run command) to VFDs' in one network, all VFDs will start. This is used to control multiple VFDs at the same time via RS-485 port with Modbus-RTU communication protocol.
Note: In most of the controllers and PLCs the VFD Modbus addressing should be set with (-1) offset.
For example: VFD frequency reference parameter address in the manual is 0x0005 but in controller communication addressing it should be 0x0004.
Some controllers already implemented (-1) offset and addressing should match the addressing provided in this manual. To determine if your controller has (-1) offset in Modbus addressing, set parameter SET-00 to Basic application and give the command [03] to read parameter DRV-01 with HEX-Decimal address [9201]. If reading is 1000 (10.00Hz), your controller has an internal offset (-1) and addressing matches to the VFD published addressing. If reading is 2000 (DRV-02 setting 20.00Hz), all addressing in the controller should be one less than VFD published addressing.

Connection guide for Modbus-RTU communication with PC, PLC and RS-232C/485



Note: The repeater is used for long-distance communication or high noise environment.

10.2 Specification

Performance specification

Item	Specification
Transmission form	Bus method, Multi-drop Link System
Applicable VFD	P series
Max. drives quantity	31
Transmission distance	Max. 4,000ft (Recommended up to 2,500ft)
Recommended wire	0.75mm^2(12AWG), Shield Type Twisted-Pair Cable

Hardware specification

Item	Specification
Installation	Use C+ and C- terminals

Communication specification

Item	Specification
Communication speed	76,800/ 57,600/ 38,400/ 19,200/ 9,600/ 4,800/ 2,400/ 1,200 bps
Communication system	Half duplex system
Character system	Binary (8 bit)
Stop bit length	1 bit
Error check(CRC16)	2 bytes
Parity bit	None
Protocol supported	Parameter Read/Write, Monitoring parameter register/execution Broadcasting

10.3 Communication Parameters

Parameter	Display	Name	Set value	Unit
SET-09	Drive mode	Drive mode	Int. 485	
SET-10	Freq mode	Freq mode	Int. 485	
I/O_20~27	M1 ~ M8	Programmable Digital Inputs		
I/O_90	Inv Number	VFD ID number	1~250	
I/O_91	Baud rate	Communication speed	1200, 2400, 4800, 9600, 19200, 38,400, 57,600, 76,800	bps
I/O_92	COM Lost Cmd	Operating mode when communication signal is lost	Hold Coast Decel	
I/O_93	COM Time Out	Time to determine the loss of communication signal.	0.1~120.0	sec

10.4 Modbus-RTU Communication protocol

VFD responds to Read/Write commands from Master control device.

Supported function HEX code

Function code	Description
0x03	Read Holding Register
0x04	Read Input Register
0x06	Write Single Register
0x10	Write Multiple Register

Exception HEX code

Function code		Description
0x01		ILLEGAL FUNCTION
0x02		ILLEGAL DATA ADDRESS
0x03		ILLEGAL DATA VALUE
0x06		SLAVE DEVICE BUSY
User define	0x14	1. Write Disable (Address 0x0004 value is 0) 2. Read Only or Not Program during Running.

10.5 Parameter code list

<Common area>: Area accessible regardless of VFD models

Address	Parameter	Format	Unit	R/W	Data value
0x0000	VFD model			R	9 : P series
0x0001	VFD capacity			R	(4) 5.5kW (5) 7.5kW (6) 11kW (7) 15kW (8) 18.5kW (9) 22kW (A) 30kW (B) 37kW (C) 45kW (D) 55kW (E) 75kW (F) 90kW (10) 110kW (11) 132kW (12) 160kW (13) 220kW (14) 280kW (15) 315kW (16) 375kW (17) 450kW
0x0002	VFD Input Voltage			R	0 : 220V Class 1 : 400V Class 2 : 600V Class
0x0003	S/W Version			R	(Ex) 0x0100 : Version 1.00 0x0101 : Version 1.10
0x0004	Write Enable			**R/W**	Change momentarily to 1 to enable Write
0x0005	Frequency Reference	0.01	Hz	**R/W**	0.0- 120.00
0x0006	Run Command (Note 1)			**R/W**	BIT 0: Stop (S) BIT 1: Forward run (F) BIT 2: Reverse run (R) BIT 3: Fault reset (0->1) BIT 4: Emergency stop BIT 5: Not used
				R	BIT 6, BIT 7: Run/Stop command source 0(Terminal), 1(Keypad), 2(Option) 3: Int. 485
					BIT 8 ~12: Freq. reference 0 ~ 16: Multi-step speed freq. (0, 2~16) 17 ~ 19: UpDown (Up, Down, UD Zero) 20 ~ 21: RESERVED 22 ~ 25: Analog (V1, V1S, I, V1I) 26: N/A 27: Sub 28: Int. 485 29: Option, 30: Jog, 31 : PID
					BIT 15: set when Network error
0x0007	Acceleration Time	0.1	sec	**R/W**	0.0-600.0
0x0008	Deceleration Time	0.1	sec	**R/W**	0.0-600.0
0x0009	Output Current	0.1	A	R	1.0- 999.9
0x000A	Output Frequency	0.01	Hz	R	1.0- 120.00
0x000B	Output Voltage	0.1	V	R	0.0- 600.0 (Depends on VFD rating)
0x000C	DC Link voltage	0.1	V	R	0.0-1000.0 (Depends on VFD rating)
0x000D	Output power	0.1	kW	R	0.0-450.0 (Depends on VFD rating)
0x000E	Operating status of VFD			R	BIT 0: Stop BIT 1: Forward running BIT 2: Reverse running BIT 3: Fault (Trip) BIT 4: Accelerating BIT 5: Decelerating BIT 6: speed arrival BIT 7: DC Braking BIT 8: Pre-PID BIT 9: Sleep Mode

Address	Parameter	Format	Unit	R/W	Data value
					BIT10: Local Mode
					BIT11: Forward run command BIT12: Reverse run command BIT13: REM. R/S (Int. 485, OPT) BIT14: REM. Freq. (Int. 485, OPT)
0x000F	Trip information			R	BIT 0 : OCT1 BIT 1 : OV BIT 2 : EXT-A BIT 3 : BX BIT 4 : LV BIT 5 : No Motor BIT 6 : GF (Ground Fault) BIT 7: OHT (VFD overheat) BIT 8: ETH (Motor overload) BIT 9: OLT (Overload trip) BIT10: HW-Diag (Hardware Fault) BIT11: Pipe Broken BIT12: OCT2 BIT13: LDT (Under or Over Level) BIT14 : PO (Phase Open) BIT15: IOLT (VFD Overload Trip)
0x0010	Input terminal status			R	BIT 0 : M1 BIT 1 : M2 BIT 2 : M3 BIT 3 : M4 BIT 4 : M5 BIT 5 : M6 BIT 6 : M7 BIT 7 : M8 BIT 8 : RESERVED BIT 9 : RESERVED BIT 10 : RESERVED
0x0011	Output terminal status			R	BIT 0 : AUX1 BIT 1 : AUX2 BIT 2 : AUX3 BIT 3 : AUX4 BIT 4 : RESERVED BIT 5 : RESERVED BIT 6 : RESERVED BIT 7 : 30AC
0x0012	V1 (0-10V)	1		R	Raw value 0-4095
0x0013	V2 (0-10V)	1		R	Raw value 0-4095
0x0014	I	1		R	Raw value 0-4095
0x0015	RPM of the motor	1		R	xxxx RPM
0x001A	Unit display			R	(0)- Hz, (1)- Rpm
0x001B	Pole number	1		R	
0x001C	Custom Version			R	
0x001D	PID Set-point scaled	Range		R	(R) Reference Value in engineering unit
0x001E	PID Feedback scaled	Range		R	(F) Set-point Value in engineering unit

Detailed description of the address 0x0006

Bit	Value	R/W	Name	Description
0	0x01	R/W	Stop	Stop command via communication (0→1)
1	0x02	R/W	Forward run	Forward run command via communication (0→1)
2	0x04	R/W	Reverse run	Reverse run command via communication (0→1)
3	0x08	R/W	Fault reset	Fault reset command via communication (0→1)
4	0x10	R/W	Emergency stop	Emergency stop command via communication (0→1)
5			Not used	Not Used
6~7		R	Operating command	0=(Terminal), 1=(keypad), 2=(option), 3=(Int. 485)
8~14		R	Frequency command	When operating command is issued via Terminal, Keypad or Option card. 0: DRV-00, 1: Not used, 2 : Multi-step speed 1 3 : Multi-step speed 2 4 : Multi-step speed 3 5 : Multi-step speed 4 6 : Multi-step speed 5 7 : Multi-step speed 6 8 : Multi-step speed 7 9 : Multi-step speed 8 10 : Multi-step speed 9 11: Multi-step speed 10 12: Multi-step speed 11 13: Multi-step speed 12 14: Multi-step speed 13 15 : Multi-step speed 14 16 : Multi-step speed 15 17 :Up 18 : Down, 19: Up/Down Zero 20~21 : RESERVE 22 : V1, 23 : V1S, 24 : I, 25 : V1+I 26 :Reserved 27 : Sub 28 : Int. 485 29 : Option 30 : Jog 31 : PID
15	0x8000	R	Network error	Network malfunction

Note: The Data (including decimal point) displayed on Keypad screen is an actual VFD parameter value.

Address areas for programming groups

SET	9100 - 9163
DRV	9200 – 9263
FG1	9300 – 9363
FG2	9400 - 9463
I/O	9500 - 9563
APP	9600 - 9663
EXT	9700 - 9763
COM	9800 - 9863

Address setting method to access the parameter using Modbus-RTU: Area assigned by VFD+ Address usage area by groups + Parameter #. (Hex).
Example: For parameter I/O-93 [COM Time Out] address is 0x955D (95= I/O group and 5D= #93 parameter).

CHAPTER 11 - APPENDIX "A"- UL MARKING

11.1 Branch protection Fuses and Circuit Breaker Sizing

Use only proper UL listed Fuses and Circuit Breakers. See the table below for maximum current ratings of fuses and circuit breakers per NEC. Depending on applications the fuses and circuit breakers with lower current rating can be used.

VFD Voltage Class	Motor [HP]	VFD Part Number	Time Delayed Fuses	Circuit Breaker	Internal Fuse(s)		
			*Maximum Amps (600V)	*Maximum Amps (600V)	Current [A]	Manufacturer	Model Number
230V	7.5	CI-007-P/2	40	50			
	10	CI-010-P/2	60	60			
	15	CI-015-P/2	80	100			
	20	CI-020-P/2	100	100			
	25	CI-025-P/2	125	225			
	30	CI-030-P/2	150	225			
	40	CI-040-P/2	200	225			
460V	7.5	CI-007-P/4	20	30			
	10	CI-010-P/4	30	30			
	15	Ci-015-P/4	40	50			
	20	CI-020-P/4	60	60			
	25	CI-025-P/4	70	75			
	30	CI-030-P/4	80	100			
	40	CI-040-P/4	100	125			
	50	CI-050-P/4	125	125	160	Hinode	660GH-160SUL
	60	CI-060-P/4	150	150	160	Hinode	660GH-160SUL
	75	CI-075-P/4	175	175	200	Hinode	660GH-200SUL
	100	CI-100-P/4	250	225	250	Hinode	660GH-250SUL
	125	CI-125-P/4	300	300	315	Hinode	660GH-315SUL
	150	CI-150-P/4	350	400	200×2P	Hinode	660GH-200SUL×2P
	200	CI-200-P/4	400	500	250×2P	Hinode	660GH-250SUL×2P
	250	CI-250-P/4	450	600	315×2P	Hinode	660GH-315SUL×2P
	350	CI-350-P/4	700	800	250×3P	Hinode	660GH-250SUL×3P
	400	CI-400-P/4	800	1000	315×3P	Hinode	660GH-315SUL×3P
	500	CI-500-P/4	900	1000	800	Ferraz	6.9URD32TTF0800
	600	CI-600-P/4	1000	1200	900	Ferraz	6.9URD32TTF0900
	700	CI-700-P/4	1200	1200	1000	Ferraz	6.9URD32TTF1000
600V	7.5	CI-007-P/6	20	30			
	10	CI-010-P/6	30	30			
	15	Ci-015-P/6	40	50			
	20	CI-020-P/6	60	60			
	25	CI-025-P/6	70	75			
	30	CI-030-P/6	80	100			
	40	CI-040-P/6	100	125			
	50	CI-050-P/6	125	125	160	Hinode	660GH-160SUL
	60	CI-060-P/6	150	150	160	Hinode	660GH-160SUL
	75	CI-075-P/6	175	175	200	Hinode	660GH-200SUL
	100	CI-100-P/6	250	225	250	Hinode	660GH-250SUL
	125	CI-125-P/6	300	300	315	Hinode	660GH-315SUL
	150	CI-150-P/6	350	400	200×2P	Hinode	660GH-200SUL×2P

* Circuit breaker or fuses with lower current rating are permitted.

11.2 Short Circuit Interrupting Rating

"Suitable for use on a circuit capable of delivering not more than Table1 RMS Symmetrical Amperes, 240V for 240V, 480V for 480V, 600V for 600V rated VFDs Volts Maximum,"

Table 1. RMS Symmetrical Amperes for P Series VFDs.

Model	Rating
CI-007-P/2, CI-007-P/4, CI-007-P/6, CI-010-P/2, CI-010-P/4, CI-010-P/6, CI-015-P/2, CI-015-P/4, CI-015-P/6, CI-020-P/2, CI-020-P/4, CI-020-P/6, CI-025-P/2, CI-025-P/4, CI-025-P/6, CI-030-P/2, CI-030-P/4, CI-030-P/6, CI-040-P/2, CI-040-P/4, CI-040-P/6, CI-050-P/4, CI-050-P/6, CI-060-P/4, CI-060-P/6, CI-075-P/4, CI-075-P/6, CI-100-P/4, CI-100-P/6, CI-125-P/4, CI-125-P/6, CI-150-P/4, CI-150-P/6, CI-200-P/4, CI-250-P/4, CI-350-P/4, CI-400-P/4, CI-500-P/4, CI-600-P/4, CI-700-P/4,	100,000A

11.3 Terminal Screws, Torque and Wire Gauge

VFD Capacity [HP]		Terminal Screw Size	[1] Screw Torque		[2] Wire			
			Kgf·cm	lb-in	mm²		AWG or kcmil	
					R,S,T	U,V,W	R,S,T	U,V,W
200V Class	7.5	M4	7.1 ~ 12.2	6.2~10.6	5.5		10	
	10	M5	24.5 ~ 31.8	21.2~27.6	8		8	
	15	M5			14		6	
	20	M6	30.6 ~ 38.2	26.6~33.2	22		4	
	25	M6			38		2	
	30	M8	61.2 ~ 91.8	53.1~79.7	38		2	
	40	M8			60		1/0	
400V Class	7.5	M4	7.1 ~ 12.2	6.2~10.6	3.5		12	
	10	M4			3.5		12	
	15	M4			5.5		10	
	20	M6	30.6~38.2	26.6~33.2	8		8	
	25	M6			14		6	
	30	M8	61.2~91.8	53.1~79.7	22		4	
	40	M8			22		4	
	50	M8	67.3~87.5	58.4~75.9	38		2	
	60	M8			38		2	
	75	M8			38		2	
	100	M10	89.7~122.0	77.9~105.9	60		1/0	
	125	M10			60		1/0	
	150	M12	182.4~215.0	158.3~186.6	100		4/0	
	200	M12			100		4/0	
	250	M12			150		300	
	350	M12			200		400	
	400	M12	182.4~215.0	158.3~186.6	250		500	
600V Class	7.5	M4	2.0~6.1	1.8~5.2	3.5		12	
	10	M4			3.5		12	
	15	M4			5.5		10	
	20	M6	30.6~38.2	26.6~33.2	8		8	
	25	M6			14		6	
	30	M8	61.2~91.8	53.1~79.7	22		4	
	40	M8			22		4	
	50	M8	67.3~87.5	58.4~75.9	38		2	
	60	M8			38		2	
	75	M8			38		2	
	100	M10	89.7~122	77.9~105.9	60		1/0	
	125	M10			60		1/0	
	150	M12	182.4~215.0	158.3~186.6	100		4/0	

Notes: [1]Apply the rated torque to terminal screws. Use copper wires 600V, 75°C rated.
[2] Use ring type lugs for power wiring of 7.5~15HP VFDs

NOTES:

CHAPTER 12 - CONFORMATION, STANDARDS AND WARRANTY

We, the undersigned,

Representative:	**LSIS Co., Ltd.**
Address:	**LS Tower, Hogye-dong, Dongan-gu, Anyang-si, Gyeonggi-do 1026-6, Korea**
Manufacturer:	**LSIS Co., Ltd.**
Address:	**181, Samsung-ri, Mokchon-Eup, Chonan, Chungnam, 330-845, Korea**

Certify and declare under our sole responsibility that the following apparatus:

Type of Equipment:	**Inverter (Power Conversion Equipment)**
Model Name:	**STARVERT-iP5A series**
Trade Mark:	**LSIS Co., Ltd.**

conforms with the essential requirements of the directives:

2006/95/EC Directive of the European Parliament and of the Council on the harmonisation of the laws of Member States relating to Electrical Equipment designed for use within certain voltage limits

2004/108/EC Directive of the European Parliament and of the Council on the approximation of the laws of the Member States relating to electromagnetic compatibility

based on the following specifications applied:

EN 61800-3:2004
EN 61800-5-1:2007

and therefore complies with the essential requirements and provisions of the 2006/95/CE and 2004/108/CE Directives.

Place: **Chonan, Chungnam,**
Korea

2012. 7. 3 (Signature /Date)

Mr. In Sik Choi / General Manager
(Full name / Position)

TECHNICAL STANDARDS APPLIED

The standards applied in order to comply with the essential requirements of the Directives 73/23/CEE "Electrical material intended to be used with certain limits of voltage" and 89/336/CEE "Electromagnetic Compatibility" are the following ones:

• **EN 50178 (1997)**	“Electronic equipment for use in power installations”.
• **EN 61800-3/A11 (2000)**	“Adjustable speed electrical power drive systems. Part 3: EMC product standard including specific methods”
• **EN 55011/A2 (2002)**	“Industrial, scientific and medical (ISM) radio-frequency equipment. Radio disturbances characteristics. Limits and methods of measurement”
•**EN 61000-4-2/A2 (2001)**	“Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 2: Electrostatic discharge immunity test.
• **EN 61000-4-3/A2 (2001)**	“Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 3: Radiated, radiofrequency, electromagnetic field immunity test.
• **EN 61000-4-4/A2 (2001)**	“Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 4: Electrical fast transients / burst immunity test.
• **EN 61000-4-5/A1 (2000)**	“Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 5: Surge immunity test.
• **EN 61000-4-6/A1 (2001)**	“Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 6: Immunity to conducted disturbances, induced by radio-frequency fields.
• **CEI/TR 61000-2-1 (1990)**	“Electromagnetic compatibility (EMC). Part 2: Environment. Environment description for low-frequency conducted disturbances and signaling in public low voltages supply systems”
• **EN 61000-2-4 (1997)**	“Electromagnetic compatibility (EMC). Part 2: Environment. Compatibility level in industrial plants for low-frequency conducted disturbances”
• **EN 60146-1-1/A1 (1997)**	“Semiconductor convertors. General requirements and line commutated convertors. Part 1-1: Specifications of basic requirements”

Warranty

Warranty terms and conditions are available. These can be found by contacting your Franklin Control Systems or Franklin Electric representative or by visiting our webpages at www.Franklin-Controls.com and from Franklin Electric at www.franklinwater.com.

■ IN-WARRANTY service information

If the defective part has been identified under normal and proper use within the guarantee term, contact your local authorized FCS or FE distributor or FCS or FE service center.

■ OUT-OF WARRANTY service information

Franklin Control Systems and Franklin Electric warranty will not be applied in the following cases, even if the guarantee term has not expired.

- Damage was caused due to misuse, negligence or accident.
- Damage was caused due to abnormal voltage and/or peripheral device malfunction (failure).
- Damage was caused due to improper repair or alteration by any individual or organization other than FCS or FE authorized distributor or service center.
- Damage was caused due to earthquake, fire, flooding, lightning, or any other form of natural calamity.
- FCS or Cerus nameplate is no longer attached.
- The warranty guarantee period has expired.