

Indverter V2

User Manual



Software version 12.7 updates

1. Updated for serial Start/Stop/JOG Operation.
2. From serial control there is no FOR/REV, instead JOG Operation is introduced.
3. BX is implemented with JOG TB Function
4. Auxiliary Inputs are limited to Analog and serial references

Software version 12.8 updates

1. Acceleration / Deceleration time setting accuracy is now 0.1 seconds if < 999.9
After 999.9 it is 1 sec. Minimum Acceleration time settable is 1.0 Seconds. Minimum Deceleration time settable is 0.1 Seconds

Software version 12.9 updates 15-11-2011

When FOR and REV and both are closed, and the control location is set to 4, the drive controller selects REV direction (REV has the higher priority)

Software version 13.3 updates 25-07-2011

Pulse blocking is introduced above 200%, whereas Current limits are below 200%
Torque boost is based on load current, instead of constant value.

Software version 13.4 17-02-2012

Problem --> of Serial display not working during RUN Mode is solved.

Software version 13.5 21-02-2012

Raise / Lower Input --> Works based on ACC1 and DEC1 acceleration / Deceleration settings when the Main speed reference is set to RAISE/ LO,(5).

Software version 13.6 27-02-2012

Acceleration time lower limit is changed from 0.5 to 0.1 for faster acceleration requirement in several applications. Start time delay of about 200mS has been removed.

User manual issue 7

Software version 13.92 important updates:

1. PWM Frequency maximum settable range is changed to 10kHz from 6kHz
2. Slip compensation entry is in terms of Hz compared to %
3. Torque boost settable range is modified to 100%
4. For Raise Lower ST0 operation, frequency will be reset to 0 on OFF
5. Parameter 11, now is used for OC trip level 100% → 250% range

User manual issue 8

Software version 13.95 important updates:

1. Additional options included for Main speed reference
2. AUTO RUN MODE option 4 is added, in which the reference for AUTO RUN SPEED is taken from Parameter 3 and not from MULTI SPEED values as in other modes.
3. Drive re-starts if start command is given when DC INJ Braking is running.

Introduction

Dear Customer,

We thank you for buying our “Indverter V2” series AC Drive.

Please read this user manual carefully before installation, operation, maintenance or inspection of the drive system.

Hexmoto make Indverter V2 series drives are simple to configure and easy to operate. This manual is intended to provide sufficient information for installation and operation of the drive system. Also, information on trouble-shooting and various features of the drive controller is included to enable the user for getting optimum performance out of the drive system.

We will be happy to assist you in case of any doubts, clarifications regarding drive configuration and usage for a particular application.

Thanking you and assuring you of our best attention and services

HEXMOTO Controls Pvt. Ltd

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1. GLOSSARY OF TERMS USED

| | |
|-----------------------------|---|
| Drive Module | Refers to Hexmoto make Indverter V2 series controller. Term is used in combination “Drive Module” or separately as “Drive” or “Module” to indicate the Indverter V2 Controller |
| Inverter | Refers to Drive module |
| Display | 7-Segment display unit on the drive module |
| Keypad | 5-function keypad on the drive module |
| Display LEDs | Refers to Individual LEDs on the Display, which indicates status of drive |
| IGBT | Insulated Gate Bipolar Transistor |
| PCB | Printed Circuit Board |
| TB | Terminal block. |
| Control Card | Is a control PCB in Drive module with control ICs, analog and digital circuits |
| Power TB | TB for external cable connections for input 3-Phase power supply and Motor connections |
| Control TB | TB on the Control card for panel logic connections, Frequency/ Speed reference input connections.. Etc. |
| Power Board | PS&GD (Power supply and Gate Drive) is mounted with Electrolytic capacitors, IGBTs and Power supply components. This is mounted directly on Heat sink of the module. Power connection TBs are brought out from this card. |
| Function code | Refers to the programmable parameter number. For example, function code 03 refers to Main speed reference. |
| Parameter | is a function code |
| Para | is a function code |
| Data | Refers to Data contained in a parameter. For example, in function code 03, Data 0000 corresponds to speed reference from Keypad, whereas 0001 corresponds to speed reference from Analog input Vin from TB. |
| PWM | Pulse Width Modulation |
| Ready to Run | If there are no faults sensed by the drive and no RUN command is given, drive is placed in <u>Ready to Run</u> mode indicating drive is ready to accept RUN command |
| Store | Data is stored permanently in controller memory. |
| Run | Inverter output pulses are enabled |
| Authorized Personnel | Personnel trained in handling Power electronics control equipments and authorized by Hexmoto for commissioning and troubleshooting of drive modules |

2. SAFETY PRECAUTIONS

It is recommended that only authorized personnel be permitted to perform handling, maintenance and inspection of the drive module.

In this manual, notes for safe operation are classified under “ **WARNING**” or “**CAUTION**” using the symbols as shown below



WARNING

Indicates a potentially dangerous situation which, if not avoided will result in death, serious injury or permanent damage to the machinery



CAUTION

Indicates a potentially dangerous situation which, if not avoided will result in minor or moderate injury and damage to the machinery and drive controller. This symbol is also used for indicating any prohibited operation.



IMPORTANT NOTE

Throughout the manual, * symbol indicates an important note or information relevant for the proper functioning of the drive system.



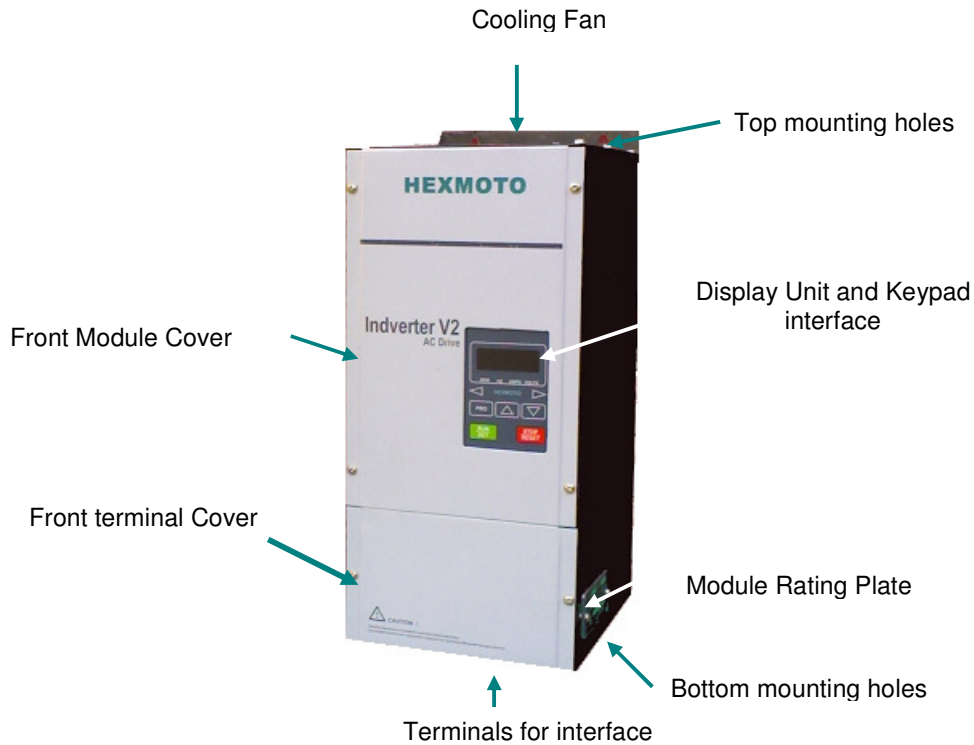
WARNING

- Please follow the instructions in the manual before installation and commissioning
- Ensure to disconnect all power lines to the drive before handling or commissioning
- After power is disconnected wait for at least 1 minute until DC bus capacitors are fully discharged
- Use proper grounding techniques
- UVW terminals are for motor connections. Do not connect Power supply to these terminals.
- Operation of the module is by authorized, trained personnel experienced in handling high voltage electrical equipments and fixtures.

3. INSPECTION OF THE MODULE

Visual inspection of items delivered against the Purchase Order and Transit damage if any, is to be carried out by the user before starting the process of installation and commissioning. Visual check of module parts such as display unit, cooling fan and mounting arrangements is necessary. Except for the Indverter V2 module and the User manual, all other items are optional and must be checked for list of ordered items. In case of Natural air-cooled modules, Cooling Fans are not mounted inside the module.

3.1. Indverter V2 drive Module (√)




3.2. User Manual (√)

3.3. AC Reactor – Optional

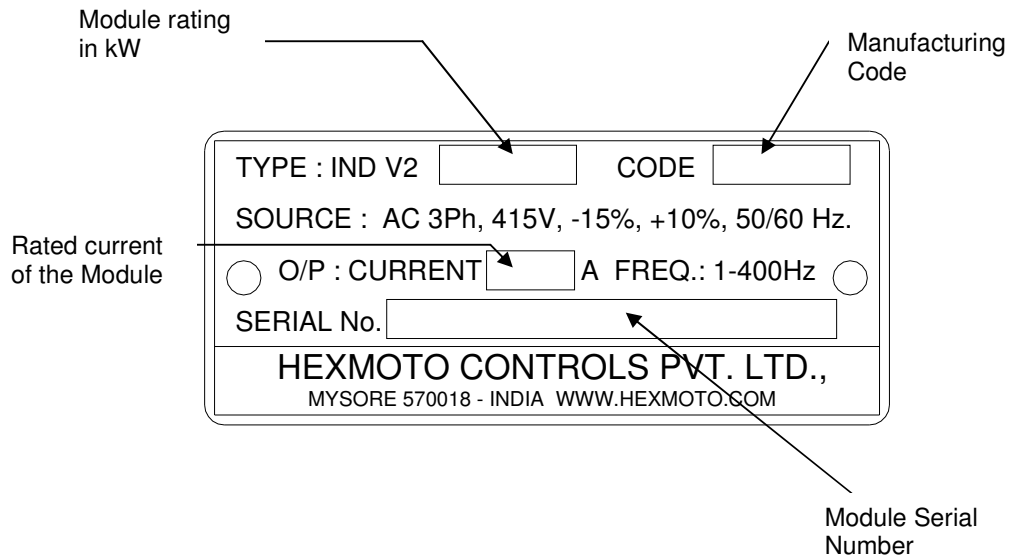
3.4. DC Reactor – Optional

3.5. Serial Display Unit - Optional

| | |
|--|-----------------------|
|  | <p>WARNING</p> |
| <p>Do not open the Indverter module with Input Power ON. Indverter should be opened only after the LED display switches off. The internal components or PCBs should be handled/ removed only after the Red charge LED on the Power board is visibly OFF. Contact with internal components while input power is ON or the charge LED is ON, may cause severe Electric Shock</p> | |

Inspection of Rating Plate details

As shown in the figure in section 3.1, user can find the rating plate on the right hand side of the module. Rating plate contains all the details of the module such as Module Type, Input/Output ratings and Module serial Number.



| Selection Chart | | | | | | | | |
|---------------------------------|-----------------|--------|--------|--------|-----------------|--------|--------|--------|
| Type | V2 2K2 | V2 3K7 | V2 5K5 | V2 7K5 | V2 11K | V2 15K | V2 18K | V2 22K |
| Applicable Motor output in KW | 0.4~2.2 | 3.7 | 5.5 | 7.5 | 11 | 15 | 18.5 | 22 |
| Inverter Output at 415V in KVA | 4.1 | 6.8 | 9.9 | 13 | 18 | 22 | 29 | 34 |
| Rated Output Current in Amperes | 5.5 | 9 | 13 | 18 | 24 | 30 | 39 | 45 |
| Dimensions (W D H) | 155 x 187 x 364 | | | | 180 x 230 x 468 | | | |

4. TECHNICAL SPECIFICATIONS

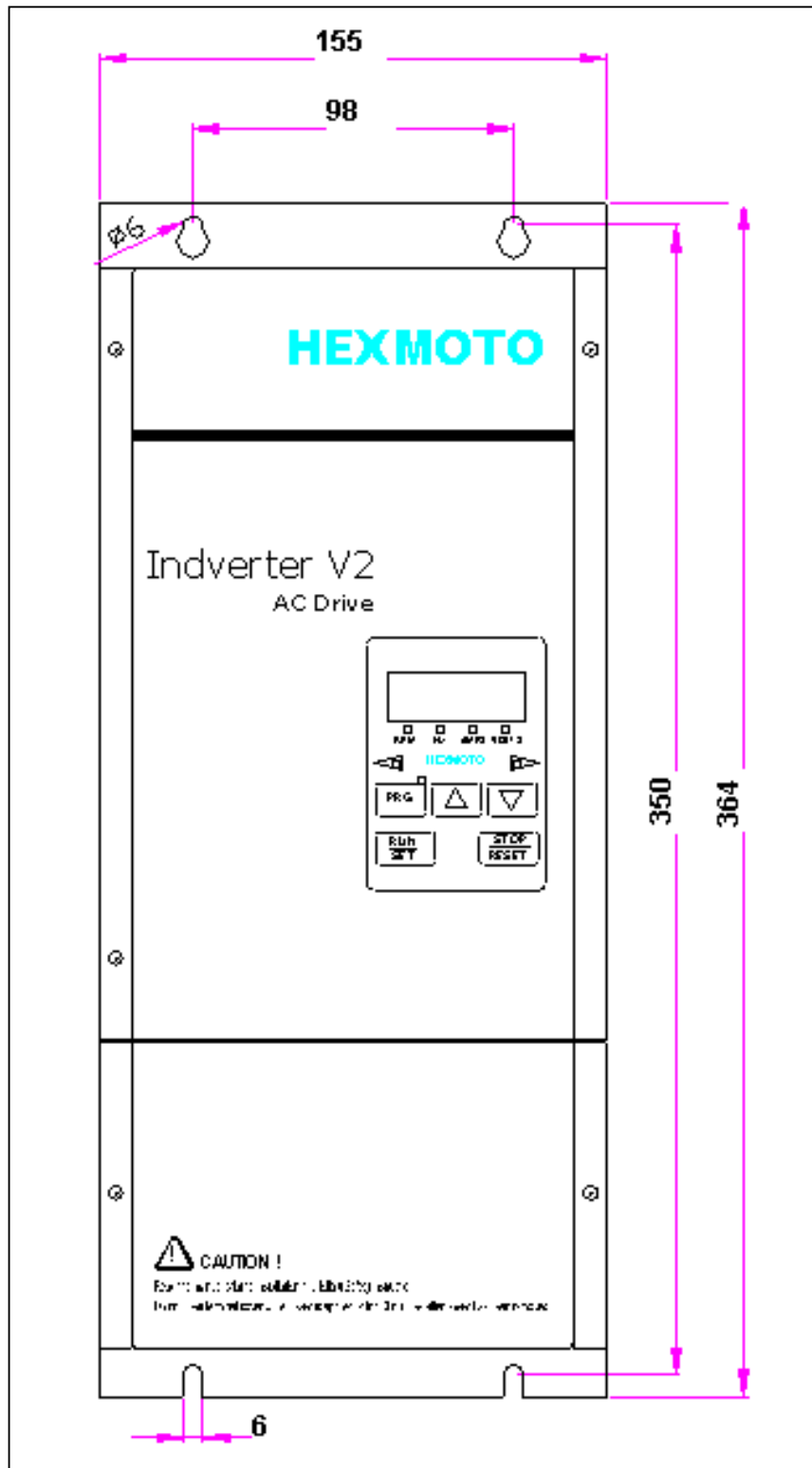
| Specifications | | |
|------------------------|--|--|
| Input Rating | Power Supply | 3 Phase, 380V/415V/480V, 50/60Hz |
| | | Tolerance Voltage: +10%, -15%, Frequency: +/-5%, Imbalance less than 3% |
| Output Rating | Output Voltage | 3 Phase, 380V to 480V (Proportional to input voltage) |
| | Output Frequency Range | 1Hz to 400Hz |
| | Frequency Stability | Digital setting: +/-0.01% of max. Frequency Analog setting: +/-0.2% of max. Frequency (at temperatures -10°C to +50°C ambient) |
| | Overload Capacity | 150% for one minute |
| Control Specification | Control system | Space vector modulation with bus ripple compensation |
| | Adjustable current limit | Programmable 30 to 200% of drive rated current |
| | Starting frequency | 1 to 6Hz adjustable |
| | Max./ Min. Frequency limit | Frequency low limit/ Frequency upper limit(Fstart to Fmax) |
| | Base Frequency | 30 to 400Hz |
| | Carrier frequency | 2kHz to 6kHz programmable in steps of 1kHz |
| | Frequency setting | Up/Down keys Raise/Lower Switch 0-10V, 0-20mA 4-20mA 8 Preset frequencies with X1, X2 and X3 Serial communication. |
| | Frequency resolution | Digital: 0.01Hz step up to 100Hz Analog: 0.05Hz step (at Fmax. 50Hz) |
| | Jog function | Available with programmable speed/Acc/Dec |
| | Catch on fly | Drive will search the running Motor speed, catches it and then proceeds to the set speed. |
| | Jump frequency | One jump frequency control with adjustable jump range |
| | Acceln./Deceln. Rate | Settable with accuracy of 0.1 Sec. Range: Acc 1.0 -> 9999 and Dec 0.1 → 9999 seconds |
| | DC injection Braking | DC injection braking during stop from max. frequency is possible for 60 seconds of braking time. With adjustable braking voltage and braking frequency. |
| | Dynamic Braking | Available up to 150% torque. |
| | Slip compensation | Available, load current dependent. |
| | S-curve | Available. |
| | Filters for analog inputs | Digital filters available with Programmable Min/Max values, and filter selection from 50Hz to 1 Hz crossover frequencies |
| Fault history display | Present fault and up to 9 previous faults. | |
| Protection | Inverter trip and Error messages | Under voltage, Over voltage, Over current during acceln/decln/Steady state condition, External fault, Heat sink over temperature, Short circuit, Electronic thermal overload trip. |
| | Functions | Stall prevention, Auto restart during power failure for 5 second duration |
| Indication and Control | Analog output | One analog output programmable for output frequency, Set frequency, RMS Motor current, DC bus voltage and output voltage. |

| | | |
|----------------------------|---|---|
| | External output | 1No. Fault alarm relay output 1No. Programmable relay output rated for 230V, 2A. |
| | Display unit | 7 segment LED display: Output frequency, RPM, Load current & DC voltage, 5 keys touch pad for programming |
| Environmental Conditions | Installation location | Indoor not more than 1000m above sea level. Do not install in a dirty location or expose to corrosive gases or direct sunrays. Protection class: IP20 |
| | Ambient temperature | 10°C to +40°C (-10°C to +50°C when mounted inside the switch board) |
| | Humidity | 90% RH or less (non-condensing) |
| | Cooling system | Forced air cooling type / Natural air cooling type (Optional) |
| Dynamic Braking Facility | | Standard, Dynamic braking Resistors are Optional and are to be externally connected. |
| Communication | RS-485 with MODBUS RTU protocol. | |
| Synchronization (Optional) | Multiple drives can be synchronized by programming one drive as MASTER. The synchronization is done through the serial communication which is most accurate and fine adjustments can be done locally | |
| Applications | Various types of Constant torque/variable torque and energy saving applications in Industries such as: Plastic, Textile, Sugar, Cement, Chemical, Pharmaceutical, Material Handling, Process Automation, Machine Tool etc., | |

5. DIMENSIONAL DETAILS

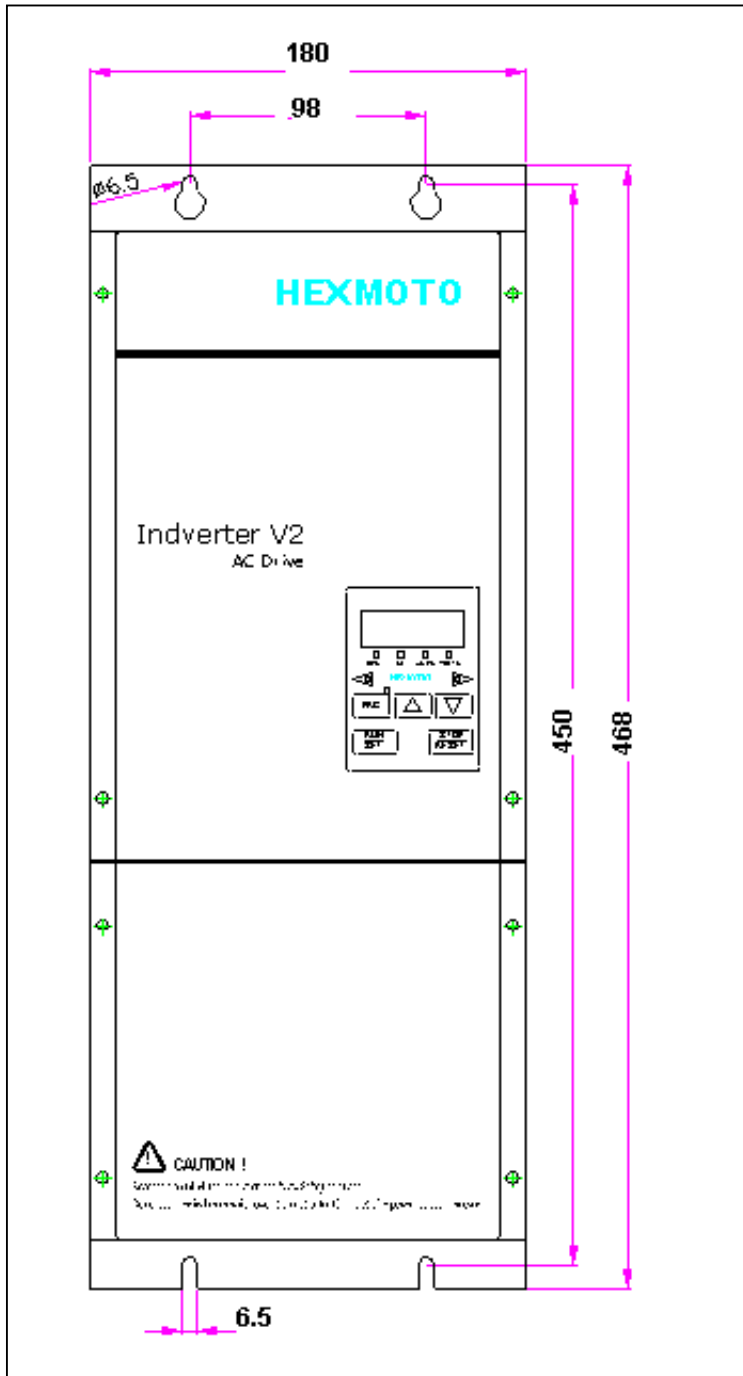
- With Forced Cooling 2.2kW to 7.5kW (3 Hp to 10 Hp)

Dimensions: 155 mm x 187 mm x 364 mm (W x D x H)



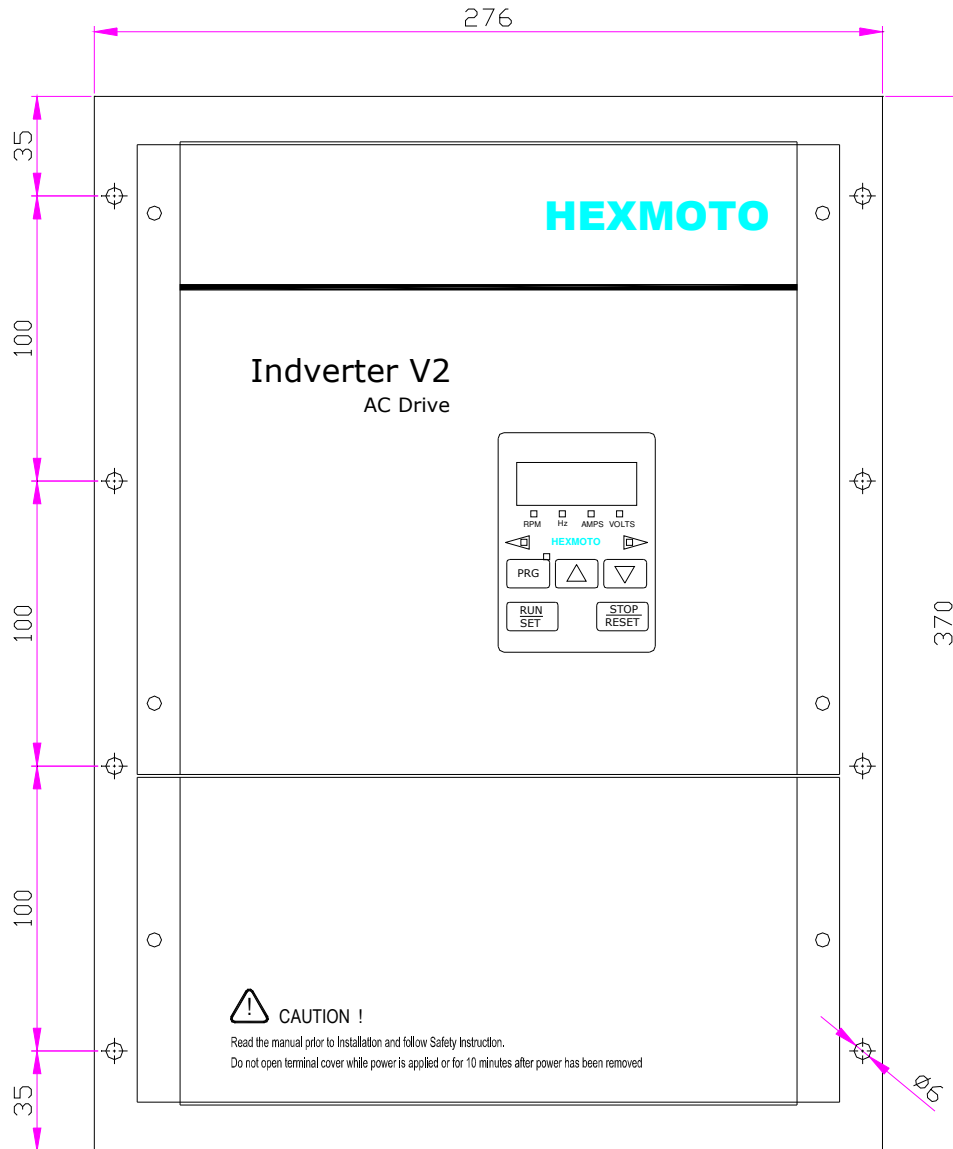
- With Forced Cooling 11kW to 22kW (15 Hp to 30 Hp)

Dimensions: 180 mm x 230 mm x 468 mm (W x D x H)

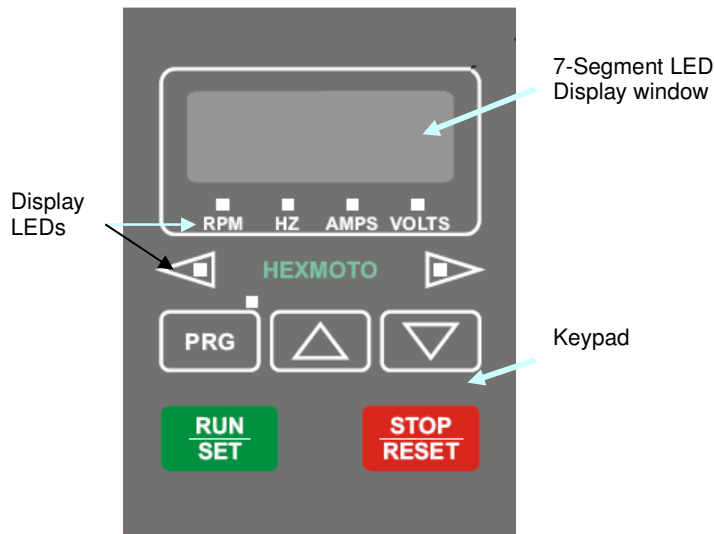









- **With Natural Cooling 2.2kW to 7.5kW (3 Hp to 10 Hp)**

Dimensions: 276 mm x 177 mm x 370 mm (W x D x H)











6. DISPLAY AND KEYPAD



| Keys | Description |
|---|---|
|  | Used as Program Key <ul style="list-style-type: none"> Used to enter Programming mode, when the drive is not running. When the drive is running, this key is used to select RPM, Hz, AMPS, VOLTS display |
|  | Used as UP key <ul style="list-style-type: none"> When Main speed reference is from Keypad, UP key is used to increase the reference frequency/ speed when the drive is running or in <u>ready to run</u> mode. In programming mode, UP key is used to increase Function code Or increase data for a function code. |
|  | Used as DOWN key <ul style="list-style-type: none"> When Main speed reference is from Keypad, DOWN key is used to decrease the reference frequency/ speed when the drive is running or in <u>ready to run</u> mode. In programming mode, DOWN key is used to decrease Function code Or decrease data for a function code. |
|  | Used as RUN or SET Key <ul style="list-style-type: none"> If the Start command is from Keypad, RUN/SET Key is used to start a drive In programming mode, RUN/SET Key is used to store data corresponding to a Function code |
|  | Used as STOP or RESET Key <ul style="list-style-type: none"> If the Start command is from Keypad,  Key is used to stop a drive STOP/RESET is also used as return from Menu if in programming mode In case of fault,  is used to reset the fault. Refer to "Maintenance and Troubleshooting" section for more details |

Description of Display LEDs

| Display LED | Description |
|---|---|
|  | LED is ON when display is showing RPM. This selection of display function is based on function code 01 or operation of PRG key while drive is running |
|  | LED is ON when display is showing Frequency. This selection of display function is based on function code 01 or operation of PRG key while drive is running |
|  | LED is ON when display is showing drive output current. This selection of display function is based on function code 01 or operation of PRG key while drive is running |
|  | LED is ON when display is showing DC bus voltage of the drive. This selection of display function is based on function code 01 or operation of PRG key while drive is running |
|  | If user enter Programming mode by pressing PRG key, PRG LED is ON. This is to indicate to the user that drive is in Programming mode and cannot be starting by giving a start command. User can exit from programming mode by pressing  key. Once drive comes out of programming mode, PRG LED is OFF. |
|  | FORWARD LED LED starts blinking when the motor accelerates/ decelerates in Forward direction. When motor reaches set speed, LED stops blinking and glows continuously. |
|  | REVERSE LED LED starts blinking when the motor accelerates/ decelerates in Reverse direction. When motor reaches set speed, LED stops blinking and glows continuously. |

- Pressing PRG again in programming mode, user can modify the data. In this situation Forward and reverse LEDs will be ON along with PRG LED.
- For detailed description on programming refer to “ Description of parameters and programming”
- Forward OR Reverse direction of the motor rotation depends on phase sequence of motor connection and on operation of FOR/REV TB inputs.

7. INSTALLATION AND COMMISSIONING



WARNING

- Please follow the instructions in the manual before installation and commissioning
- Ensure to disconnect all power lines to the drive before handling or commissioning
- Input power cable must be connected tightly and the equipment must be grounded securely using proper grounding techniques
- When the inverter is not running, the motor terminals U,V,W will have dangerous voltages.
- UVW terminals are for motor connections. Do not connect Power supply to these terminals.
- Operation of the module is by authorized, trained personnel experienced in handling high voltage electrical equipments and fixtures.



CAUTION

- When handling the inverter, please lift as a whole unit. Otherwise may cause the main unit to fall off resulting in personal injury or damage to the unit.
- Install the inverter on a metal base.
- Air temperature around the inverter cabinet should be maintained below 50Deg C. For this purpose use fans for air circulation inside the panel.
- Refer to Technical Specifications for environment conditions in which this product can be operated.
- Do not install the inverter in any place exposed to dust, direct sunlight, corrosive gas, inflammable gas or oil

Please follow instructions mentioned below for safe and trouble free installation of Inverter modules.

- 1 After receipt of the drive controller, inspection of the module is necessary as per the procedure mentioned in "**Inspection of the Module**" chapter.
- 2 Module is designed for vertical mounting inside a panel. Always fix the module with vertical alignment.
- 3 Ensure that the Mounting hole dimensions on the Panel U-sheet is as per the dimensional details given in this manual

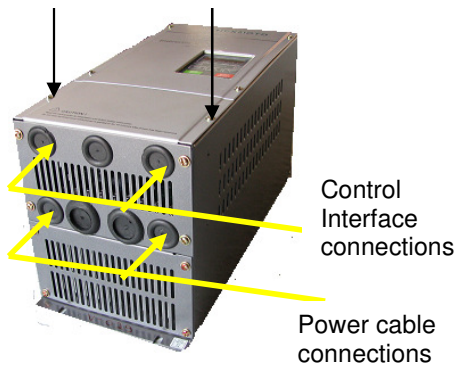
- Installation of the inverter should be done with following spacing/ clearance from panel doors/walls or other modules. This is required to maintain enough air circulation and ease of identification and wiring.



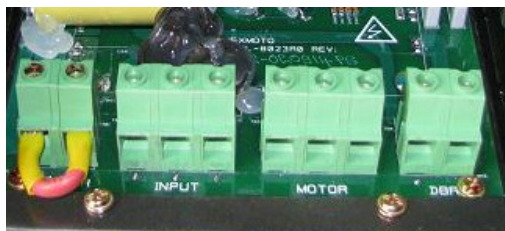
- To access the power and control terminals for wiring purpose, remove front terminal cover screws as shown below

Access to Control and Power terminals

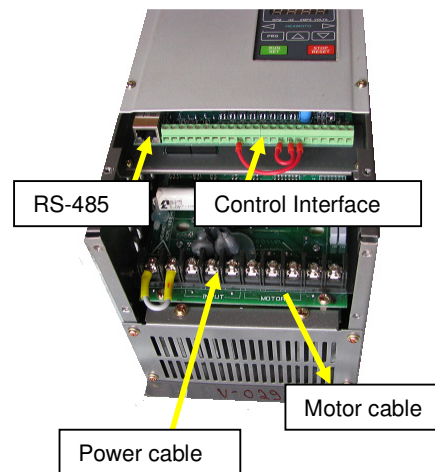
Remove screws to open Front terminal cover



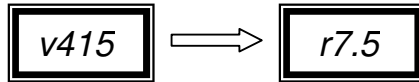
Power TB of 11kW to 22kW rating module



Module inner view 2.2kW to 7.5kW



- 6 Prepare control and power cables as per the recommendations and ratings mentioned in “ Recommended cable type and terminations”. Grommets are provided to prevent entry of dust into the module inner space.
- 7 Before connecting input power supply or motor to the drive module, ensure that motor shaft is free to rotate and check for motor winding short circuit or Grounding faults.
- 8 Use proper lugs, ensure connectivity of the cables to the input, and output terminals on the drive module.
- 9 Check proper operation of the control logic by referring to description of “ Control circuit interface”.
- 10 Switch ON input 415V mains voltage and measure 3-Phase input supply at INPUT terminals on the drive module Power TBs using a multimeter in AC voltage mode.
- 11 On start-up, drive module displays rated input voltage and module rating on LED display




indicating input rated supply voltage selection is for 3-Ph, 415V +10% -15%,50-60Hz input
 Followed by module rating in kW

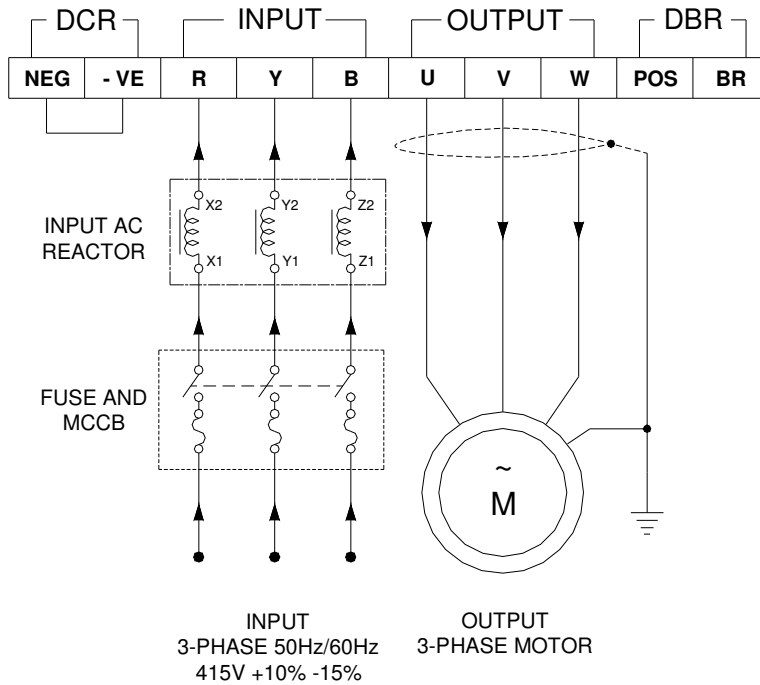
Example: r7.5 indicates 7.5kW Module, r22.0 indicates 22.0kW module

If input voltage is sufficiently high and if there are no faults, drive enters Ready To Run mode.

- 12 Refer to “Description of Parameters and programming” to configure drive for the application requirement.
- 13 Close FOR/ REV TB input to start drive controller and run the motor. If start command as per **Para 02** is from Display unit, press RUN/SET key to run the motor. Drive enters RUN mode and motor starts rotating in FOR/REV direction.
- 14 Refer to “Maintenance and Troubleshooting” for any problem related to controller performance and fault condition.

| | |
|---|-----------------------|
|  | <p>WARNING</p> |
| <ul style="list-style-type: none"> • Before switching on the input power supply ensure that there is no cable short circuit at the input/ output terminals <p style="text-align: center;">Shorting of cables between U, V, W terminals and OR shorting U, V, W terminals to ground due to cable/ connection faults will result in IGBT failure and damage to the drive controller.</p> | |

Description of Power Connection



- NEG, -VE : DC Reactor Terminals**
- R, Y, B : Input Power Terminals**
- U, V, W : Output Connection to Motor**
- POS, BR : Dynamic Braking Terminals**
- ⏏ : Earthing Terminal**

- R, Y and B are input power terminals for 415V-15%, +10%, 3-Phase supply. The connection is not phase sensitive. The connection can be done with any phase sequence.
- U, V, W are output terminals to the motor. The motor direction is dictated by the motor winding pattern and phase sequence. To change the direction of rotation of the motor, change the connection sequence to the motor or the direction (FOR/REV) command to the inverter. It is recommended to use a 3 core armored cable or cable inside an earthed metallic conduit for motor connection to reduce the electromagnetic emission and interference.

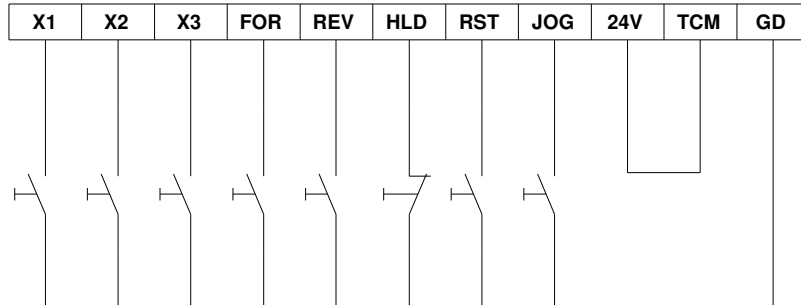
CAUTION

- When using the inverter for application where the direction of rotation is critical, check the motor direction by running it with the load disconnected.

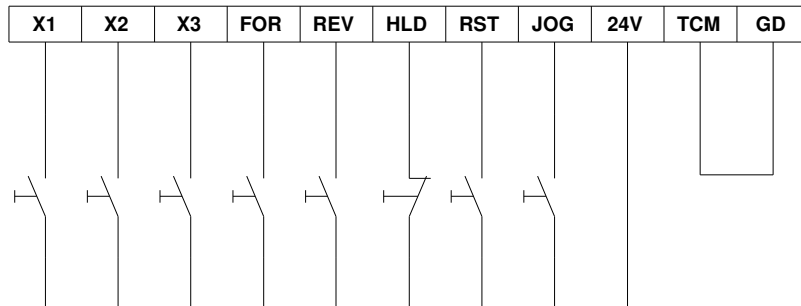
- POS, BR are connections for optional dynamic braking resistor
- If DC Reactor is not used, NEG, -VE terminals are shorted with a suitable cable rated for the inverter rating. If DC reactor is used, disconnect this wiring and connect DC reactor here.

Control Circuit Interface

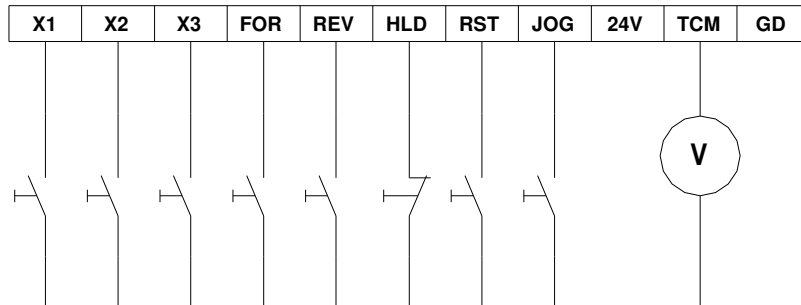
NPN CONNECTION



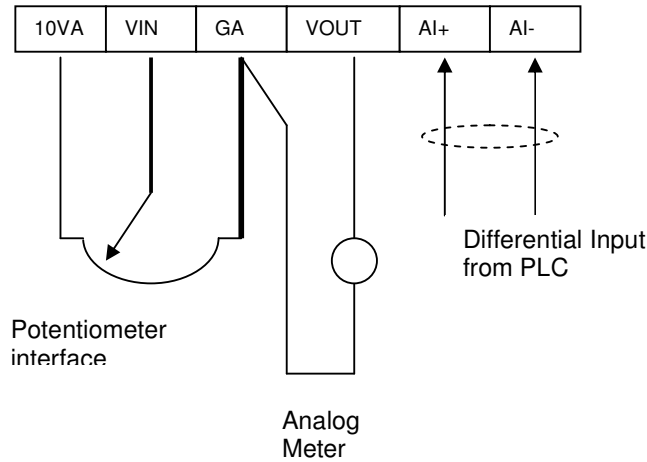
PNP CONNECTION



USING EXTERNAL SUPPLY (12 TO 24DC)



Analog input connections




Relay Outputs

| Sl.No | Name | Description |
|-------|------|--|
| 1 | FLB | Fault Relay Normally Closed contact (230VAC / 24 VDC, 2A) |
| 2 | FLC | Fault Relay Common (230VAC / 24 VDC, 2A) |
| 3 | FLA | Fault Relay Normally Open contact (230VAC / 24 VDC, 2A) |
| 4 | RLB | Programmable Relay Normally Closed contact (230VAC / 24 VDC, 2A) |
| 5 | RLC | Programmable Relay Common (230VAC / 24 VDC, 2A) |
| 6 | RLA | Programmable Relay Normally Open contact (230VAC / 24 VDC, 2A) |

Digital Inputs

| Sl.No | Name | Description |
|-------|------|--|
| 7 | X1 | Multi-speed Digital Input 1 or Rise |
| 8 | X2 | Multi-speed Digital Input 2 or Lower |
| 9 | X3 | Multi-speed Digital Input 3 / AUX Enable |
| 10 | FOR | Forward run digital input |
| 11 | REV | Reverse run digital input |
| 12 | HLD | Hold input for 3 wire operation |
| 13 | RST | Fault Reset input. |
| 14 | JOG | JOG Input, must be operated with FOR/REV inputs |
| 15 | 24V | Short circuit protected auxiliary voltage source 24V, 90mA w.r.t GD |
| 16 | TCM | Digital input common, Connect 24V, GD or External 12 to 24V source of either polarity. (-12V ≤ TCM ≤ +12V w.r.t Digital Input) |
| 17 | GD | Auxiliary voltage source common for digital inputs |

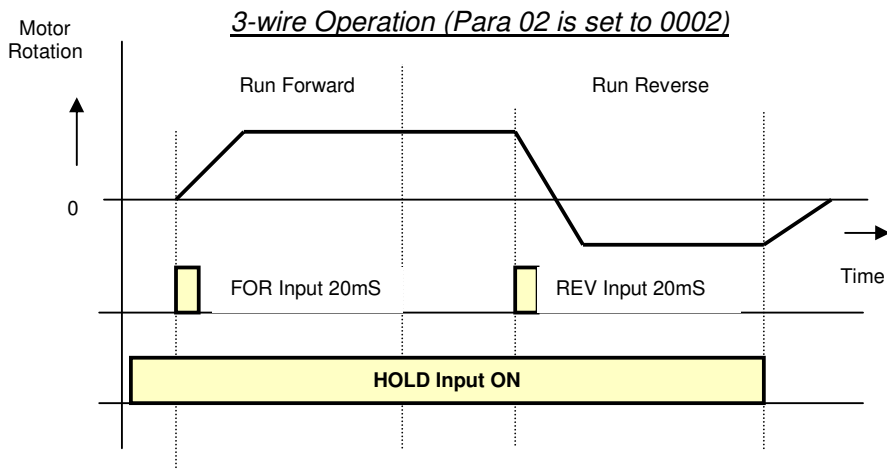
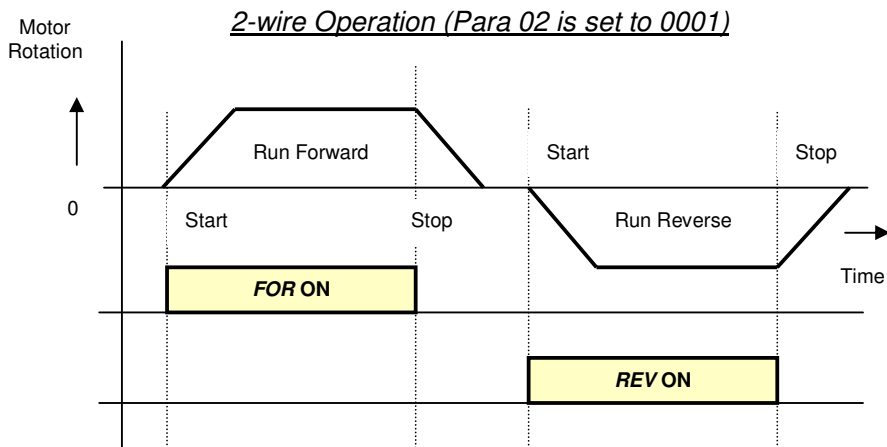
| Sl.No | Name | Description |
|-------|------|---|
| 18 | 10VA | 10V Potentiometer reference source. (1kΩ ≤ R ≤ 10kΩ) |
| 19 | VIN | Voltage reference input |
| 20 | GA | -Potentiometer reference source common -Common for VOUT -If differential analog input AI+ AI- is used with Reference voltage from 10VA, connect AI- to GA |
| 21 | VOUT | 0-10V analog output corresponding to the selected variable in the program (Output Frequency and Motor Current) |
| 22 | AI+ | Differential Analog input positive (Short JP4 for current input) |
| 23 | AI- | Differential Analog input negative (Short JP4 for current input) |


CAUTION

- All digital inputs are sensed as enabled based on the type of connection as shown in Control circuit diagram.
- All analog inputs and outputs are with reference to GA terminal. Except in case of AI+/AI- terminal where differential input is provided
- Do not short GD and GA terminals

Operation of FOR, REV and HOLD inputs

- * If programmed command location in Para 02 is Display unit and when RUN key is pressed, Inverter will start provided either of the FOR/REV digital inputs are connected to GD terminal. The direction of rotation depends on the FOR/REV selection on TB.
- * When both TB inputs FOR/REV are closed, the Inverter will not start if it is in *Ready to Run* Mode OR it will stop if in *Run* Mode



Recommended Cable type and termination

Control Cable wiring details

Tool: Screw driver blade size: 0.6 x 3.5 mm

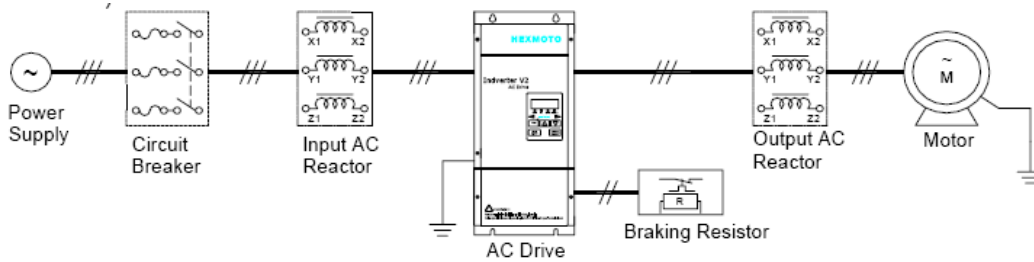
Recommended Conductor size 0.14 mm² to 1.5mm² (26 to 16 AWG)

Conductor strip length 6 mm (8 mm for twin wires for looping)

Recommended LAPPKABLE make Crimps for single wire crimp

| Part Number | Type | For cable size | AWG | Core Color |
|-------------|-------------------|----------------------|-----|------------|
| 61801580 | AHI DIN K 0,5/6 | 0.5 mm ² | 20 | White |
| 61801620 | AHI DIN K 0, 75/6 | 0.75 mm ² | 20 | Grey |
| 61801660 | AHI DIN K 1/6 | 1 mm ² | 18 | Red |
| 61801700 | AHI K 1, 5/6 | 1.5 | 16 | Black |

Power Cable wiring details



Recommended Circuit Breaker, Contactor, Power Cable and Reactor ratings

| Model Type | Circuit Breaker (Amps) | Input Contactor (Amps) | Input/ Output Cable (mm ²) | AC Reactor Type/ Current |
|------------|------------------------|------------------------|--|--------------------------|
| V2 2K2 | 16 | 10 | 2.5 | IAC5.5kW/ 14A |
| V2 3K7 | 25 | 16 | 4 | IAC5.5kW/ 14A |
| V2 5K5 | 25 | 16 | 4 | IAC5.5kW/ 14A |
| V2 7K5 | 40 | 25 | 6 | IAC7.5kW/ 22A |
| V2 11K | 63 | 32 | 6 | IAC22KW/ 57A |
| V2 15K | 63 | 50 | 6 | IAC22KW/ 57A |
| V2 18K5 | 100 | 63 | 10 | IAC22KW/ 57A |
| V2 22K | 100 | 80 | 16 | IAC22KW/ 57A |

Recommended Dynamic Braking Resistors

| Model Type | Braking Resistor (100% braking Torque) |
|-------------------|---|
| V2 2K2 | 315 Ohms/ 220W |
| V2 3K7 | 175 Ohms/ 400W |
| V2 5K5 | 120 Ohms/ 550W |
| V2 7K5 | 100 Ohms/ 750W |
| V2 11K | 70 Ohms/ 1100W |
| V2 15K | 47 Ohms/ 1500W |
| V2 18K5 | 38 Ohms/ 2000W |
| V2 22K | 32 Ohms/ 2200W |

* Important Notes on Braking resistor selection

- Above selection is based on 700V DC braking voltage threshold, 100% braking torque and 10% usage rate.
- Wiring length between inverter and braking unit must be less than 5 Meters
- Braking unit is in-built in all the Indverter V2 Type modules. Only braking resistor of sufficient capacity must be connected to get good braking performance.
- For very large inertial loads if the braking capacity is not sufficient, drive controller trips for Over Voltage dCOV during deceleration.

Important Notes on Power wiring

- For cable connections from drive to motor, use 3-Core shielded cable or a cable running through metal conduit to reduce EMI Noise from the drive output affecting other instruments in the panel.
- For input contactors, use R-C Snubbers across the Contractor coil to prevent malfunctioning of drive control circuitry due to Contactor operation within the panel
- For long cables more than 20 meters, it is recommended to use optional AC reactor at drive output.

8. LIST OF PARAMETERS

| Function Code | Name | Data | | | | |
|---------------|-----------------------------|---------------|---|--|--------------|-----------------|
| | | Selection | Description | Range | Set accuracy | Factory Setting |
| 00 | Parameter Lock | 0000 | Locked | 0000 to 0001 | 0001 | 0001 |
| | | 0001 | Un-Locked | | | |
| 01 | LED display | 0000 | RPM Display | 0000 to 0003 | 0001 | 0001 |
| | | 0001 | Hz Display | | | |
| | | 0002 | Amps Display | | | |
| | | 0003 | DC Volts Display | | | |
| 02 | Control Location | 0000 | Display Keypad | 0000 to 0004 Selection 04 Open REV and FOR = STOP Close REV+FOR → REV Close FOR → FOR Close REV → STOP | | 0000 |
| | | 0001 | TB 2-Wire | | | |
| | | 0002 | TB 3-Wire | | | |
| | | 0003 | Serial interface Start/Stop | | | |
| | | 0004 | 2Wire > REV Priority | | | |
| 03 | Main speed reference | 0000 | Display Keypad | Range 0 to 8 | | 0000 |
| | | 0001 | Analog VIN TB | | | |
| | | 0002 | Analog AI+ AI- Voltage | | | |
| | | 0003 | Analog AI+ AI- Current | | | |
| | | 0004 | Serial interface | | | |
| | | 0005 | Raise-Lower TB- X1/X2 | | | |
| | | 0006 | Raise-Lower Stop 0 | | | |
| | | 0007 X1 | X1 ON → Raise freq X1 OFF→ Lower Freq In Run mode only. Frequency reset to minimum when drive is not running. | | | |
| | | 0008 X1,X2 | X1 ON → Raise freq X2 ON → Lower Freq In Run mode only. Frequency reset to minimum when drive is not running. | | | |
| 04 | Maximum Frequency | Hz | Maximum frequency | 00.00 to 400.0 | 00.01 | 50.00 |
| 05 | BASE Frequency | Hz | Base or Synchronous frequency | 30.00 to 400.0 | 00.01 | 50.00 |
| 06 | Frequency Bias | % | Frequency bias in % of maximum frequency | 0000 | 0001 | 0000 |
| 07 | Start Frequency | Hz | Starting frequency | 01.00 to 06.00 | 00.01 | 01.00 |
| 08 | Acc time | Seconds | Acceleration time | 0.1 to 9999 | 0.1 * | 10.0 |
| 09 | Dec time | Seconds | Deceleration time | 0.1 to 9999 | 0.1 * | 10.0 |
| 10 | Torque boost | % | Initial torque boost voltage in % of output voltage | 0000 - 0100 | 0001 | 0004 |
| 11 | OC Trip Level | 100 to 250% | Percentage of Motor current for OC Trip | 100 - 250 | 0001 | 200% |
| 12 | RPM Multiplier | k | RPM Display = k* Frequency | 00.00 – 99.99 | 00.01 | 30.00 |
| 13 | Current Limit | % | Drive Current limit | 0030 - 0200 | 0001 | 0150 |
| 14 | Motor Current | Amps | Rated current of the motor connected | 0 →Module rated current | 00.01 | 18.00 |
| 15 | Electronic Thermal Overload | 0000 | No overload function | 0000 - 0002 | 0001 | 0001 |
| | | 0001 | For separately cooled | | | |
| | | 0002 | For self-cooled motor | | | |
| 16 | Frequency low limit | % | Frequency low set | 0000 - 0099 | 0001 | 0000 |
| 17 | Frequency High limit | % | Frequency High set | 0000 - 0100 | 0001 | 0100 |
| 18 | Jump Start | Hz | Jump start frequency | 00.00 - Para 04 | 00.01 | 00.00 |
| 19 | Jump End | Hz | Jump End frequency | 00.00 - Para 04 | 00.01 | 00.00 |

| Function Code | Name | Data | | | | | | | |
|---------------|--|-----------|---|-----------------|--------------|-----------------|--|------|------|
| | | Selection | Description | Range | Set accuracy | Factory Setting | | | |
| 20 | Aux Enable | 0000 | Disable | 0000 to 0007 | 0001 | 0000 | | | |
| | | 0001 | Reserved | | | | | | |
| | | 0002 | Analog VIN TB | | | | | | |
| | | 0003 | Analog AI+ AI- Voltage | | | | | | |
| | | 0004 | Analog AI+ AI- Current | | | | | | |
| | | 0005 | Serial interface | | | | | | |
| | | 0006 | Reserved | | | | | | |
| 21 | Restart after UV | 0000 | Trip and Latch | 0000 - 0002 | 0001 | 0001 | | | |
| | | 0001 | Stop and Start with start frequency | | | | | | |
| | | 0002 | Stop and Start with Set frequency | | | | | | |
| 22 | DC Inj Freq | Hz | Frequency at which DC Injection starts | 00.00 - Para 04 | 00.01 | 00.00 | | | |
| 23 | DC Inj Time | Seconds | Time for which DC Injection is ON | 00.00 – 60.00 | 00.01 | 00.00 | | | |
| 24 | DC Inj Volts | % | % of Output voltage applied to motor | 0000-0020 | 0001 | 0000 | | | |
| 25 | CatchOnFly | 0000 | Disable | 0000 - 0001 | 0001 | 0000 | | | |
| 26 | CFLY Current | % | % of Motor current in Para 14 | 0030 - 0200 | 0001 | 0100 | | | |
| 27 | Acc time-1 | Seconds | Acceleration time | 1.0 to 9999 | 0.1 * | 10.0 | | | |
| 28 | Dec time-1 | Seconds | Deceleration time | 0.5 to 9999 | 0.1 * | 10.0 | | | |
| 29 | JOG Acc time | Seconds | Acceleration time | 1.0 to 9999 | 0.1 | 10.0 | | | |
| 30 | JOG Dec time | Seconds | Deceleration time | 0.5 to 9999 | 0.1 | 10.0 | | | |
| 31 | JOG Frequency | Hz | When JOG input is enabled in TB | 01.00 –Para 04 | 00.01 | 05.00 | | | |
| 32 | Multi-1 | Hz | Selection of Multi speed frequency is based on operation of X1, X2, X3 TB terminals | 00.00 –Para 04 | 00.01 | 05.00 | | | |
| 33 | Multi-2 | Hz | | 00.00 –Para 04 | 00.01 | 10.00 | | | |
| 34 | Multi-3 | Hz | | 00.00 –Para 04 | 00.01 | 15.00 | | | |
| 35 | Multi-4 | Hz | | 00.00 –Para 04 | 00.01 | 20.00 | | | |
| 36 | Multi-5 | Hz | | 00.00 –Para 04 | 00.01 | 25.00 | | | |
| 37 | Multi-6 | Hz | | 00.00 –Para 04 | 00.01 | 30.00 | | | |
| 38 | Multi-7 | Hz | | 00.00 –Para 04 | 00.01 | 35.00 | | | |
| 39 | Arun Dir (Direction of rotation for each step of Auto Run function) | 0000 | Same as FOR/REV TB | | | | St1, St2, St3 and St4 represents Step1, Step2, Step3 and Step4 of the Auto run function F= Forward R = Reverse Range 0000 - 0014 | 0001 | 0000 |
| | | | St 4 | St 3 | St 2 | St 1 | | | |
| | | 0001 | F | F | F | R | | | |
| | | 0002 | F | F | R | F | | | |
| | | 0003 | F | F | R | R | | | |
| | | 0004 | F | R | F | F | | | |
| | | 0005 | F | R | F | R | | | |
| | | 0006 | F | R | R | F | | | |
| | | 0007 | F | R | R | R | | | |
| | | 0008 | R | F | F | F | | | |
| | | 0009 | R | F | F | R | | | |
| | | 0010 | R | F | R | F | | | |
| | | 0011 | R | F | R | R | | | |
| | | 0012 | R | R | F | F | | | |
| | | 0013 | R | R | F | R | | | |
| 0014 | R | R | R | F | | | | | |

| Function Code | Name | Data | | | | |
|---------------|------------------|--------------|---|--------------|--------------|-----------------|
| | | Selection | Description | Range | Set accuracy | Factory Setting |
| 40 | Arun Mode | 0000 | Auto Run Disabled | 0000 - 0004 | 0001 | 0000 |
| | | 0001 | After completion of one cycle, runs at Main speed reference Freq. | | | |
| | | 0002 | Cycle is repeated | | | |
| | | 0003 | After completion of one cycle, drive stops | | | |
| | | 0004 | Use Reference frequency set by para 3 | | | |
| 41 | Arun Step-1 time | Seconds | Time for which drive runs in Multi-1 Speed | 0001 to 9999 | 0001 | 0000 |
| 42 | Arun Step-2 time | Seconds | Time for which drive runs in Multi-2 Speed | 0001 to 9999 | 0001 | 0000 |
| 43 | Arun Step-3 time | Seconds | Time for which drive runs in Multi-3 Speed | 0001 to 9999 | 0001 | 0000 |
| 44 | Arun Step-4 time | Seconds | Time for which drive runs in Multi-4 Speed | 0001 to 9999 | 0001 | 0000 |
| 45 | PWM Frequency | kHz | Switching frequency of the drive system | 0002-0010 | 0001 | 0004 |
| 46 | S-Curve | 0000 | Disable | 0000 to 0001 | 0001 | 0000 |
| | | 0001 | Enable | | | |
| 47 | S-Time | Seconds | Time duration for which S-Pattern is used during Acc/ Dec | 0.0 – 10.0 | 0.1 | 0.0 |
| 48 | AI V_Min | % | Minimum value for Analog input through AI+/ AI- TB | 0000 – 0099 | 0001 | 0005 |
| 49 | AI V_Max | % | Maximum value for Voltage input through AI+/ AI- TB | 0000 – 0100 | 0001 | 0095 |
| 50 | AI V_Filt | 0000 | No Filter | 0000 – 0006 | 0001 | 0002 |
| | | 0001 to 0006 | 50Hz to 1 Hz Digital filter cut-off frequency | | | |
| 51 | AI V_Neg | 0000 | No inversion | 0000 – 0001 | 0001 | 0000 |
| | | 0001 | Analog input is inverted | | | |
| 52 | VIN_Min | % | Minimum value for Analog input through VIN TB | 0000 – 0099 | 0001 | 0005 |
| 53 | VIN_Max | % | Maximum value for Voltage input through VIN TB | 0000 – 0100 | 0001 | 0095 |
| 54 | VIN_Filt | 0000 | No Filter | 0000 – 0006 | 0001 | 0002 |
| | | 0001 to 0006 | 50Hz to 1 Hz Digital filter cut-off frequency | | | |
| 55 | VIN_Neg | 0000 | No inversion | 0000 – 0001 | 0001 | 0000 |
| | | 0001 | Analog input is inverted | | | |
| 56 | AI I_Min | % | Minimum value for Current input through AI+/ AI- TB | 0000 – 0099 | 0001 | 0000 |
| 57 | AI I_Max | % | Maximum value for Current input through AI+/ AI- TB | 0000 – 0100 | 0001 | 0100 |
| 58 | AI I_Filt | 0000 | No Filter | 0000 – 0006 | 0001 | 0000 |
| | | 0001 to 0006 | 50Hz to 1 Hz Digital filter cut-off frequency | | | |

| Function Code | Name | Data | | | | |
|---------------|--|------------------|--|------------------|--------------|-----------------|
| | | Selection | Description | Range | Set accuracy | Factory Setting |
| 59 | AI I_Neg | 0000 | No inversion | 0000 – 0001 | 0001 | 0000 |
| | | 0001 | Analog input is inverted | | | |
| 60 | Slip Comp | 00.00 | No slip compensation | 00.00 – 03.00 Hz | 00.01 | 00.00 |
| | | 00.01 to 3.00 Hz | Slip percentage considering slip at rated current at base speed | | | |
| 61 | V Out | 0000 | Output frequency | 0000 – 0004 | 0001 | 0000 |
| | | 0001 | Output current | | | |
| | | 0002 | Set Frequency | | | |
| | | 0003 | DC Bus volts | | | |
| 62 | OL Warn | % | Over load warning level <i>Refer to Para 65</i> | 0000 – 0200 | 0001 | 0100 |
| 63 | Freq Det | Hz | Frequency Detection level <i>Refer to Para 65</i> | 01.00 – Para 04 | 00.01 | 10.00 |
| 64 | Stop signal Freq | Hz | | 01.00 – Para 04 | 00.01 | 01.00 |
| 65 | RL2 Select <i>Conditions for which RL2 Operates</i> | 0000 | Motor Running | 0000-0025 | 0001 | 0000 |
| | | 0001 | Drive accelerating ACC | | | |
| | | 0002 | Drive decelerating DEC | | | |
| | | 0003 | Forward Motion FOR | | | |
| | | 0004 | Reverse motion REV | | | |
| | | 0005 | DC Injection braking | | | |
| | | 0006 | Heat sink Over temperature | | | |
| | | 0011 | Stopped | | | |
| | | 0016 | Over Load Warning | | | |
| | | 0017 | Frequency detected | | | |
| | | 0018 | Stop frequency detect | | | |
| | | 0019 | Drive is Tripped | | | |
| | | 0020 | Reference frequency reached | | | |
| | | 0021 | Zero speed | | | |
| | | 0022 | Forward Acceleration | | | |
| 0023 | Forward Deceleration | | | | | |
| 0024 | Reverse Acceleration | | | | | |
| 0025 | Reverse Deceleration | | | | | |
| 66 | Master-Slave Mode | 0000 | Disable Serial Communication | 0000 – 0033 | 0001 | 0002 |
| | | 0001 | Enable as Master | | | |
| | | 0002 – 0033 | Enable as slave with address 1 to 32 <i>Refer to "Serial Communication Interface"</i> | | | |

| Function Code | Name | Data | | | | |
|---------------|----------------------|---------------------|--|--|--------------|-------------------|
| | | Selection | Description | Range | Set accuracy | Factory Setting |
| 67 | Fault Memory | 00 | Latest Fault information | 00 – 09 <i>This parameter is Read-Only,</i> | 01 | 00 |
| | | 01-09 | Previous faults | | | |
| 68 | JOG TB Select | 0000 | JOG Operation | 0000 - 0002 | 0001 | 0000 |
| | | 0001 | AC1 Select | | | |
| | | 0002 | THR function | | | |
| | | 0003 | BX Operation | | | |
| 69 | Stop Type | 0000 | Stop with Deceleration | | 01 | 00 |
| | | 0001 | Free stop | | | |
| 70 | Stability parameter | 0 → 100% | PWM output waveform is corrected to maintain motor stability at low speeds and prevents oscillations at certain frequencies | | 1 | 30% |
| 71 | SW version | | <i>Shows Software Version used</i> | <i>Read Only</i> | | 13.95 |
| 72 | Arun Step-1 Acc | Seconds | Acceleration time Step1 | 1.0 to 9999 | 0.1 * | 10.0 |
| 73 | Arun Step-2 Acc | Seconds | Acceleration time Step2 | 1.0 to 9999 | 0.1 * | 10.0 |
| 74 | Arun Step-3 Acc | Seconds | Acceleration time Step3 | 1.0 to 9999 | 0.1 * | 10.0 |
| 75 | Arun Step-4 Acc | Seconds | Acceleration time Step4 | 1.0 to 9999 | 0.1 * | 10.0 |
| 76 | Baud Rate | 0000 | 4800 bps | 0000 to 0003 | 0001 | 0001 |
| | | 0001 | 9600 bps | | | |
| | | 0002 | 19200 bps | | | |
| | | 0003 | 38400 bps | | | |
| 77 | Protocol | 0000 | < 8,E,1 > RTU 8 data bits, Even Parity, 1 stop bit | | | 0000 |
| | | 0001 | < 8,O,1 > RTU 8 data bits, Odd parity, 1 stop bit | | | |
| | | 0002 | < 8,N,2 > RTU 8 data bits, 2 Stop bits | | | |
| | | 0003 | < 7,E,1 > ASCII 7 bit data Even Parity, 1 stop bit | | | |
| | | 0004 | < 7,O,1 > ASCII 7 bit data Odd Parity, 1 stop bit | | | |
| | | 0005 | < 7,N,2 > ASCII , No parity, 1 stop bit | | | |
| 78 | Time Out | 0.0 | Disable Time-out function | | | 0.0 (Disabled) |
| | | 0.1 to 60.0 seconds | No communication activity time-out in seconds. If a module configured as slave, does not get error-free messages for the period set here, slave device takes action as per the settings in Para 79. Communication faults are cleared when a error-free message is received by the master | | | |
| 79 | COM Fault Processing | 0000 | No Warning | | | 0000 |
| | | 0001 | Warning | | | |
| | | 0002 | Trip for Fault | | | |
| 80 | Serial Bias | 0 – 100% | Input bias for AI+/ AI- scaling inputs to get accurate scaling adjustments. Frequency bias in % of maximum frequency. <i>Refer to Synchronization of drives manual for more information</i> | | | 0000 |
| 81 | Service Password | | <i>Reserved</i> | | | |

* Setting accuracy of 0.1 seconds for Acceleration and deceleration parameters is applicable for values < 999.9 seconds, after that it is settable with 1 sec accuracy.

9. DESCRIPTION OF PARAMETERS AND PROGRAMMING

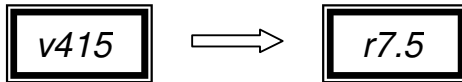
Function codes and data for setting up drive functionality are described below in detail. Understanding different modes of operation of drive controller is essential before setting up the drive parameters.

Operation of the drive controller is divided into 5 modes

- a. Start-up mode
- b. Ready To Run Mode
- c. Run Mode
- d. Programming Mode
- e. Fault Mode

Start-up Mode

Each time the drive controller is switched-ON, LED display will show



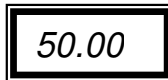
indicating input rated supply voltage selection is for 3-Ph, 415V +10% -15%,50-60Hz input
Followed by module rating in kW

Example : r7.5 indicates 7.5kW Module, r22.0 indicates 22.0kW module

If input voltage is sufficiently high and if there are no faults, drive enters Ready To Run mode

Ready To Run Mode

Drive controller is Ready to accept Run command. User can enter Programming mode from this menu. Based on the selection of Display parameter in Para 01, LED displays set reference speed in Hz or RPM.



Blinking display

Run Mode

Drive is running in the direction selected by FOR/REV TB input. In this mode, programming of parameters is disabled. Instead display will scroll from Hz→ Amps→Volts→RPM each time PRG Key is pressed. Actual running frequency/ RPM is displayed instead of reference frequency/ RPM in this mode. Sensing of faults is enabled here. If the reference is from keypad, user can increase or decrease the set frequency using UP/DOWN keys. Forward/Reverse LEDs operate on the Display to indicate direction of rotation. A blinking Forward/ Reverse LED indicates that the drive is accelerating/ decelerating towards set speed. LED stops blinking on reaching the set speed.

Programming Mode

From Ready To Run mode, pressing PRG key will enable user to enter programming mode where Function codes can be selected. In this mode Run commands are not accepted. Pressing PRG key again will enable user to modify data.



Fault Mode

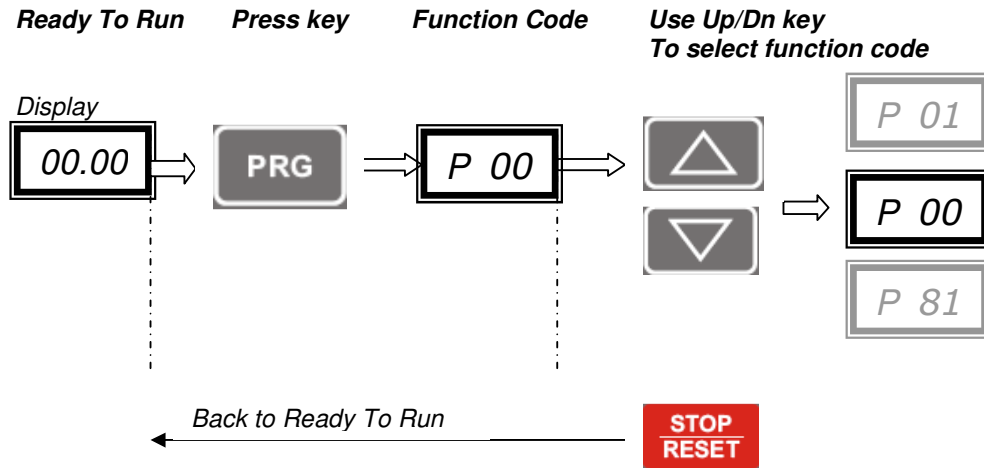
Drive enters fault mode if it encounters any fault when it is running. The fault can be reset only if the system

returns to healthy condition. For resetting of faults, use  button on the display Keypad or use RST input from TB.

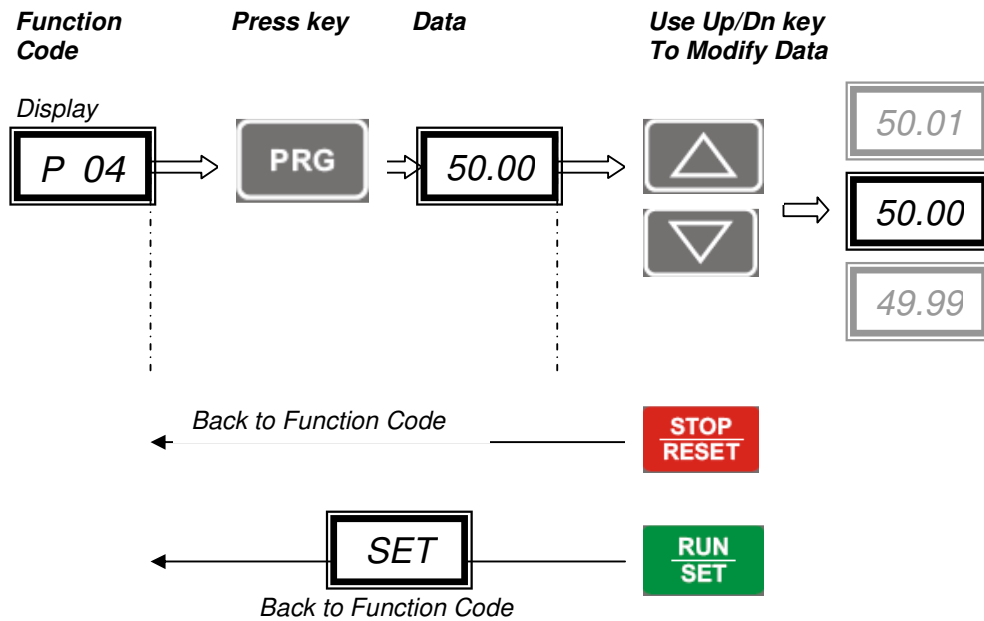


* Refer to "Maintenance and Troubleshooting" Chapter for more details

Step-1 Selecting a Function code



Step-2 Modify Function data



00 Parameter Lock

To protect un-intentional use of programmable parameters, user can lock the parameter values using this function. After drive is configured for particular application functionality and all the parameters are set, this parameter may be enabled to prevent further mis-handling of the settings. Once this parameter is enabled, drive displays “Prot” whenever user tries to store a new value.



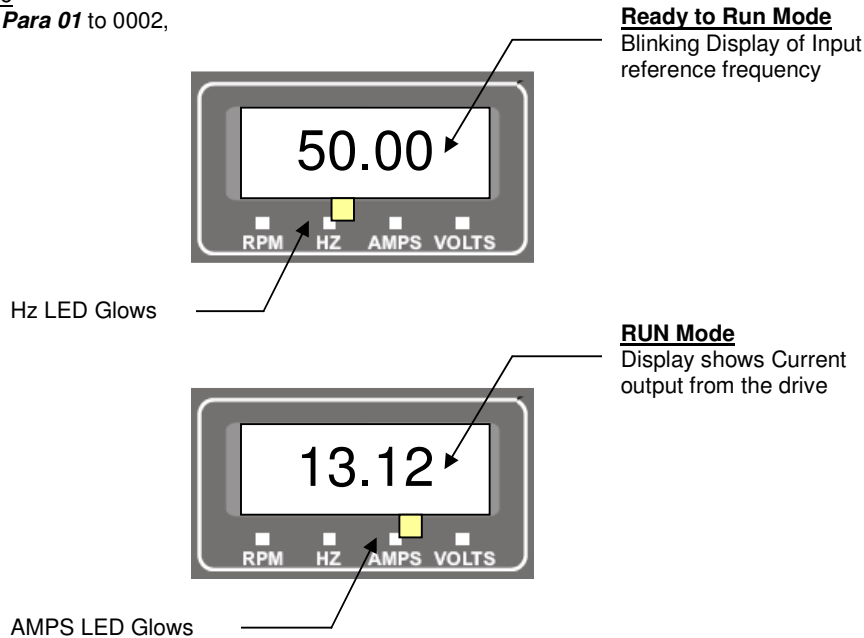
* By disabling Parameter Lock, user can modify the parameters

01 LED Display

By default, drive is configured to display Set Frequency when in Ready To Run Mode and Running frequency in Run mode. Setting Para 01 to various other options such as Motor RPM, Motor Current, and DC bus voltage will enable user to view these values in the same LED display. But, when in Ready To Run mode display either shows Hz or RPM based on the selection and other values can only be observed in Run mode.


Example

Setting **Para 01** to 0002,



02 Control Location

By default, drive is configured to be controlled using  key and  key on the display Unit. User can modify this parameter to enable control of RUN/STOP commands from other inputs such as from Terminal block or from Serial Communication (if enabled in Para 66 as slave).

- Setting 0000 → Press  button to start when in Ready To Run mode
Press STOP/RESET button to stop drive when in Run mode
Direction of rotation is determined by FOR/REV TB inputs.
- Setting 0001 → **2-Wire operation**
Start/Stop operation is from TB FOR/REV terminals
FOR ON, drive runs in Forward direction
REV ON, drive runs in Reverse direction
- Setting 0002 → **3-Wire operation**
Direction of rotation is determined by FOR/REV inputs, which are push buttons
If HOLD input is ON, Pressing forward pushbutton will enable drive to run in the forward direction. Drive will continue to run in Forward direction as long as HOLD is ON. If HOLD is released, drive will be stopped.
- Setting 0003 → **Serial Communication for start/stop**
Direction of rotation is controlled by serial communication data from a host computer or Drive. Refer to “Serial communication interface” for more details.
- Setting 0004 → **FOR/REV with REV Priority. Refer to parameter list for more information**

* Refer to “Operation of FOR, REV and HOLD inputs “ in Page 20

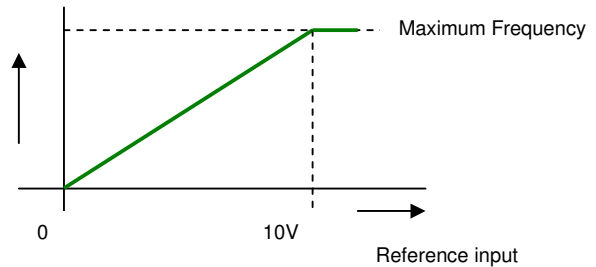
03 Main Speed Reference

Speed or Frequency reference is given to the drive controller using

- Setting → 0000 Display keypad UP/DOWN keys
Use UP/DOWN keys on display unit to increase or decrease speed reference
- 0001 Analog input from VIN terminal on TB
Potentiometer input using 10VA and GA from TB. Voltage range is 0-10V
0 – 10V corresponds to 0 to Maximum frequency in Para 04. Refer *Para 52-55*
- 0002 Analog Voltage input from AI+ AI- terminals on TB
Differential voltage input from PLC and other devices may be connected here.
If 10VA from Drive TB is used as voltage source, connect AI- to GA. Refer *Para 48-51*
- 0003 Analog Current input from AI+ AI- terminals on TB
If Jumper JP4 is inserted in Control card, AI+ and AI- terminals are used as current inputs. 0-20mA or 4-20mA range can be set using *Para 56 to 58*
- 0004 Reference from Serial communication. If drive is configured as Slave in Para 66, frequency/ speed reference is from Serial communication.
- 0005 Activating terminal X1 on TB will increase the speed with acceleration time in Para 27. The digital input X2 will decrease the speed with a deceleration time in Para 28. If the drive is stopped or switched-OFF, the current frequency/ RPM is stored in the drive memory. When the start command is issued, the drive will initially start running at this stored frequency/ RPM.
- 0006 Function is similar to selection 0005. Except for if the drive is stopped or switched-OFF, when the start command is issued again, the drive always starts from minimum/ starting frequency. Also, X1 and X2 can be activated in *Run mode* only

04 Maximum Frequency


This is the maximum frequency output possible from the drive. All the other parameters, which control frequency, are limited to this value. Maximum reference input from any source such as analog input or Digital keypad is scaled to Maximum Frequency value.



05 Base Frequency

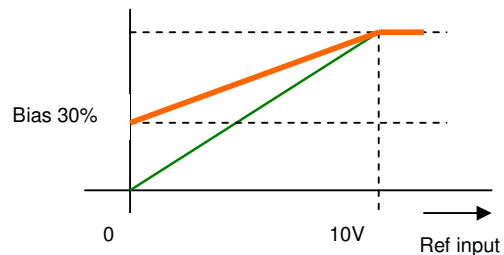
Base frequency is one at which the rated voltage is fed to the motor. The Inverter will maintain the linear relation with the frequency (That is V/F ratio) and the rated output voltage will be applied to the motor at Base frequency.

Further increase in the frequency will not have any effect on the output voltage and it remains constant.

 *Setting wrong base frequency value may result in damage to the drive and connected motor*

06 Frequency Bias

Bias frequency is the reference frequency when the input reference signal is zero. This is used for increasing the setting resolution. In practical it adds an offset to the input analog signal and increases the analog signal resolution. This is applicable to Analog inputs only when Para 03 is setting is 0001,0002 or 0003.



07 Starting Frequency

In some cases the motor may not be able to develop the required Starting Torque. In these cases the Starting Frequency will be increased. If the set frequency is less than Start Freq, drive cannot be started. When command goes above start freq, motor starts running instantly at Start freq. Start frequency is functional only during initial start, after which drive can be made to run at any frequency above 1.0Hz (Minimum frequency).

08 Acc time

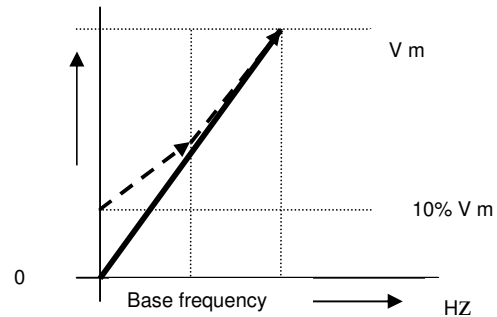
This is the time in seconds for the Inverter to reach Maximum frequency in **Para 04** from Zero frequency when start command is given. The setting resolution is 1Sec and can be programmed for a maximum value of 9999 seconds

09 Dec time

This is the time in seconds for the Inverter to reach Zero frequency from Maximum frequency in Para 04 when STOP is activated. The setting resolution is 1Sec and can be programmed for a maximum value of 9999 seconds. Setting this value to 0000 will enable the drive to stop in 0.5 Seconds.

10 Torque boost

Different motors will have different stator IR drops. This causes drastic torque reduction in some situations at low speed. To overcome this effect, stator voltage is increased at lower speeds and eventually it follows the V/F curve based on the level of LOAD current.



11 Pulse Block

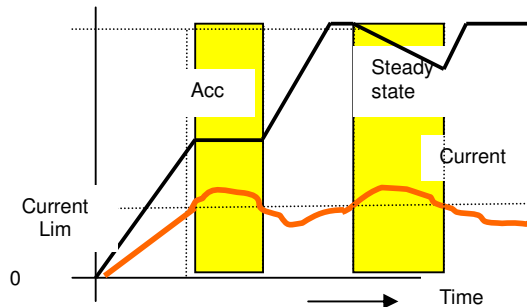
Software version 13.3 onwards, new feature was introduced to prevent abnormal peak currents during motor stalling. This must be always set to 1.

12 RPM Multiplier

This value is used for displaying the motor rpm or line speed. When the LED display **Para 01** is set as “ Motor RPM”, the seven segment LEDs will display the product of output frequency and RPM Multiplier.

13 Current Limit

When the motor is accelerating, if the output current reaches the level programmed here, the output frequency will be steady. It will start accelerating once the current is less than the value programmed.



This avoids the “Over current Trip During Acceleration”
If the Inverter is running in steady state, crossing the current limit will decrease the output frequency. This avoids stalling because of sudden load variations.

14 Motor Current

Rated Current of the motor to be entered by the user. Current limit functionality, Catch-On-Fly and Electronic Thermal overloads work based on this parameter. *Maximum current entered here is limited by the Inverter rating*

15 Electronic Thermal Overload

By default Thermal overload function is Enabled for Separately cooled motor

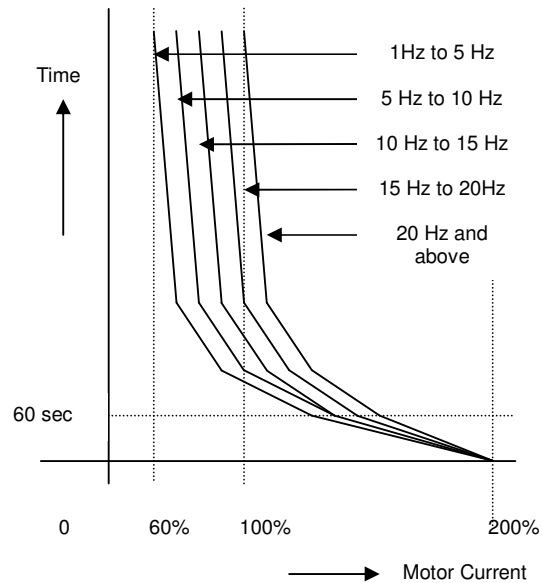
*Selection 0001
Separately Cooled Motor*

When the motor is cooled from an external fan at fixed speed, the cooling will be same irrespective of the motor speed. Hence the Electronic Thermal Overload Function will act like a standard bimetallic Overload Relay. In the figure, 20Hz and above curve is selected.

*Selection 0002
Self-Cooled Motor*

When the motor is cooled from shaft-mounted fan at variable speed, the effect of cooling depends on shaft speed. This is taken into account here and Electronic Thermal Overload function works accordingly. In the figure, 1 Hz to 20 Hz curves are selected when the motor speed corresponds to less than 20 Hz .

The example curve shown is for a motor with base frequency of 50Hz



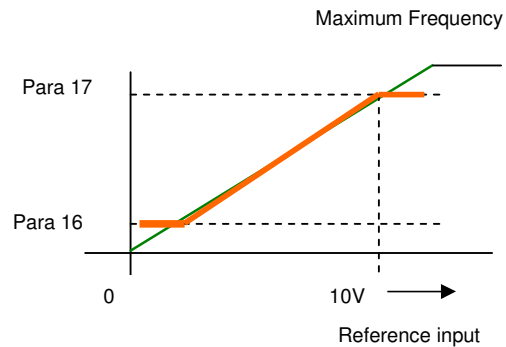
16 Frequency Low Limit

This function limits the running frequency irrespective of the input reference.

Example

If the Frequency Limit Low is 10% and the Maximum Frequency is 50Hz. the Inverter will run at 5Hz even if the input reference is less than 5Hz.

This parameter should be always less than **Para 17**



17 Frequency High Limit

Increase in speed reference beyond this has no effect on output frequency of the Inverter. The parameter should be always more than **Para 16**

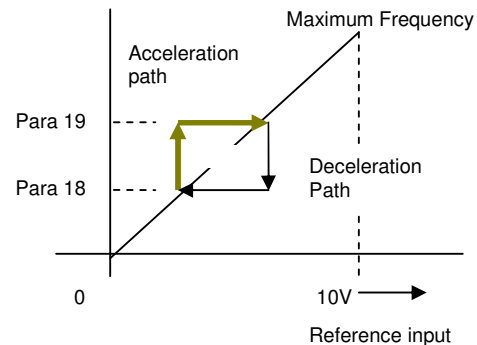
18 Jump Start

This is the starting of the Jump frequency. This feature will make the Inverter to skip the frequency from Jump-start to Jump End **Para 19**. In many systems the resonance will occur when the motor runs at particular speed. The vibration due to resonance will be destructive and so it has to be avoided.

19 Jump End

Refer to **Para 18**

The difference of **Para 19** and **18** cannot be more than 10% of the maximum frequency and **Para 19** cannot be less than **Para 18**.



20 Aux Enable

When Para 20 is disabled, by setting as 0000, X3 terminal is used for multispeed functionality. If set to any of the selection from 0001 to 0007 as described in "List of Parameters", Auxiliary function is enabled. Whenever X3 is activated (closed), reference for the drive is from auxiliary selection.

21 Restart after UV

- | | | |
|-----------|------|--|
| Setting → | 0000 | <p>Trip and Latch</p> <p>When the DC bus voltage goes below the Under voltage setting Para 20, the Inverter will coast to stop. Under voltage trip will be indicated and latched. Upon return to normalcy user has to RESET the fault.</p> |
| | 0001 | <p>Stop and start with starting frequency</p> <p><i>No Latching of fault</i></p> <p>The Inverter will disable outputs as soon as the DC bus voltage reduces to the under voltage setting and the motor stops. When the power returns or the DC bus voltage rises above healthy level the inverter will start from start frequency if the START Command is enabled</p> |
| | 0002 | <p>Stop and start with Set Frequency after power returns</p> <p><i>No Latching of fault</i></p> <p>Operation is similar to setting 0001 except for drive re-starts with set frequency. For safe operation Para 70 can be used to set Restart time limit.</p> |

22 DC Inj Freq

When drive is decelerating to stop, Inverter will apply Dc voltage as set by **Para 24** to the stator on reaching DC injection frequency and will be ON for duration of DC injection time (**Para 23**).

23 DC Inj Time

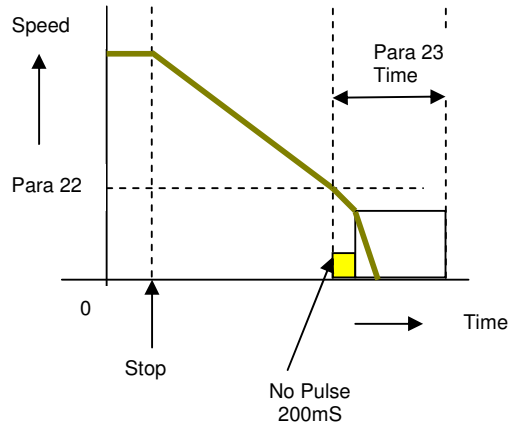
Dc injection brake will be ON for the duration programmed here.

24 DC Inj Volts

0 – 20% of the full output voltage

When installing drive system with DC injection braking, use this parameter to adjust the DC voltage that is to be applied to motor for safe operation.

DC Injection braking is not functional in Free stop mode



25 Catch On Fly

This function enables the drive to find the speed of a free running motor. When this function is enabled, the drive will start checking the motor speed from the maximum frequency. Due to the search time there may be some finite delay between the Start command and the inverter output. The total delay can extend up to 10 seconds if the motor running speed is very low for Catch on Fly. The operation is dependent on **Para 13 and Para 26**

26 CFLY Current

This is the current at which drive catches with the free running motor. If the load is drawing maximum of 100% motor current during normal operation, then this parameter must be set to 100%. It is recommended that the actual load current during steady state operation at full speed be measured and accordingly the current in percentage is set here for better Catch On Fly performance.

27- 28 Acc time-1 -- Dec time-1

Acceleration and deceleration times set here are selected by the drive based on **Para 68** or **Para 03** . Refer to description of these parameters.

29-30 JOG Acc – JOG Dec

Acceleration and deceleration times set here are selected by the drive if JOG terminal on control TB is activated. This selection remains as long as JOG is enabled.

31 JOG Frequency

This is the set frequency for JOG Operation. JOG operation is enabled if JOG terminal on control TB is activated along with FOR/REV terminals. Direction of JOG rotation is from FOR/REV terminals on control TB. JOG input overrides all other frequency reference selections.

32 -- 38 Multi speed selection

This value will be reference frequency depending on the digital inputs X1, X2 and X3. If main speed reference selection in **Para 03** is 0005 or 0006(Raise / Lower), Multi speed is not operational. Also, when Auto run mode **Para 40** is enabled, Multi speed is not operational. JOG input overrides X1,X2 X3 selection.
0 = open 1 = Closed

| X1 | X2 | X3 | Speed Reference | Function code |
|----|----|----|-----------------|----------------|
| 0 | 0 | 0 | Main-Speed-Ref | Para 03 |
| 1 | 0 | 0 | Multi speed 1 | Para 32 |
| 0 | 1 | 0 | Multi speed 2 | Para 33 |
| 1 | 1 | 0 | Multi speed 3 | Para 34 |
| 0 | 0 | 1 | Multi speed 4 | Para 35 |
| 1 | 0 | 1 | Multi speed 5 | Para 36 |
| 0 | 1 | 1 | Multi speed 6 | Para 37 |
| 1 | 1 | 1 | Multi speed 7 | Para 38 |

39 Arun Direction

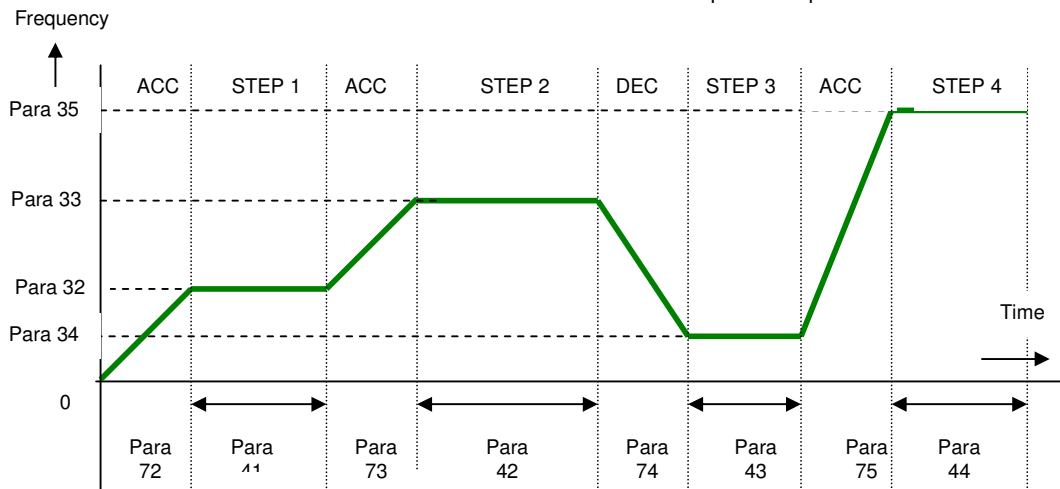
This parameter assigns direction for each step of Auto run operation. Parameter 39 is applicable to all Auto Run modes of operation in **Para 40**. For selection 0000, direction is controlled by FOR/REV TB Input to the drive controller. All other selections override TB direction input and follow programmed direction in this parameter. On completion of Auto run cycle, direction from TB input is followed.

40 Arun Mode

Auto run is enabled using this parameter. **Para 41- 44** determines the motor speed, time duration and ramp value for each step of Auto run operation. If the Inverter Stops and Starts again, it will begin a new Auto Run Cycle. **In case Arun Mode is set to 4, Motor speed is determined by parameter 3.**

41- 44 Arun Step-1 time – Arun Step-4 time

Drive runs for time in seconds programmed here for each step in auto run mode. Setting this as 0000 disables the current and next step in Auto run cycle. **Para 32 to 35** determines frequency reference for Step-1 to Step-4. **Para 72 to 75** determines the Acceleration/ Deceleration times for Step-1 to Step-4.



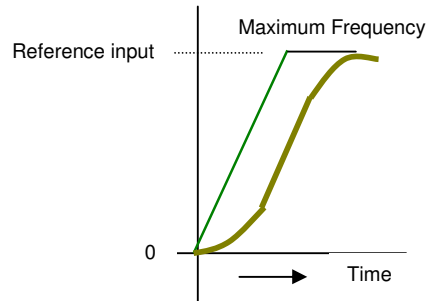
45 PWM Frequency

Certain combination of switching frequencies for particular motor load characteristics can create oscillations in the motor performance due to resonance. User can vary the switching frequency to avoid such oscillations. This is also called as “switching frequency” or “Carrier frequency” in Inverter drives terms. Factory default setting is 4kHz. Reducing the PWM frequency creates more noise that is audible and less loss in the inverter system. Increasing the PWM frequency will reduce audible noise but increases switching losses in the inverter system.

*** Important Note**
 The factory setting is optimal in most of the cases. Modification may be required in special cases where the mechanical resonance is a problem.

46 S-Curve

S-Curve acceleration/deceleration is used for preventing shock at Start/stop. The curvature time is dependent on time programmed in **Para 47**. Total acceleration / deceleration time is extended due to S-Curve by the time programmed in **Para 47**.



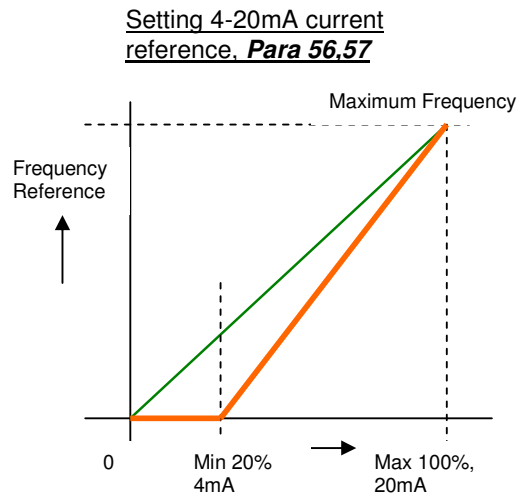
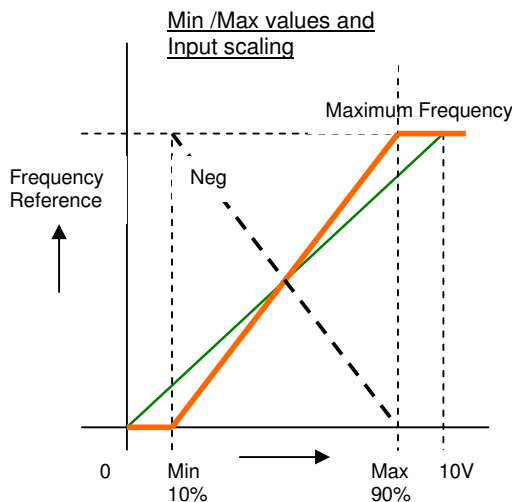
47 S-Time

Time in seconds for which the s-curve shapes the edges. This is applicable if S-Curve **Para 46** is enabled

48 – 59 Analog input scaling parameters

Functionality of these parameters are based on **Para 03**. Refer to description of **Para 03**. Functionality described below applies to analog reference inputs from VIN and AI+/AI- on control TB.

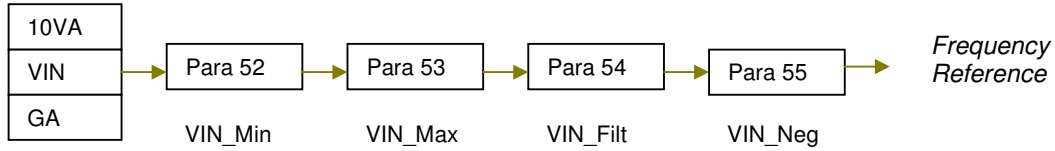
- Min → This is the percentage of analog input voltage/ current, which is considered as zero reference for the drive controller. As shown in the figure below, Analog input is scaled for new values.
- Max → This is the percentage of analog input voltage/ current, which is considered as Maximum reference for the drive controller.
- Filt → This determines the level of filtering or the filter crossover frequency for the analog input.
- Neg → Reference analog voltage/current input from Control TB VIN or AI+/AI- can be negated or reversed by enabling this parameter.



Voltage Input from VIN terminal on TB

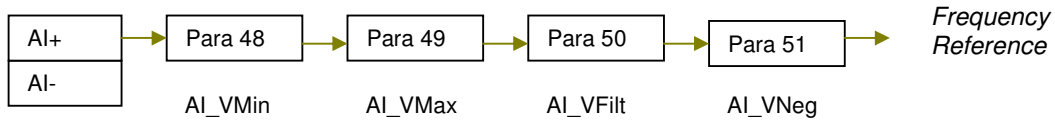
Para 03 set to 0001

TB Analog input



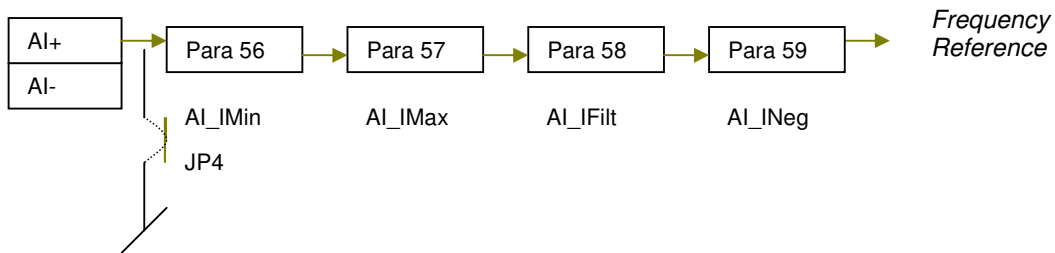
Voltage Input from AI+ / AI-

Para 03 set to 0002



Current Input from AI+ / AI-

Para 03 set to 0003. **Ensure to connect JP4 on Control Card**



60 Slip Compensation

The value entered here is considered as percentage slip of the motor at rated current.

$$\text{Rated percentage slip} = \frac{(\text{Synchronous speed} - \text{Motor actual speed at full load}) \times 100}{\text{Motor Synchronous speed}}$$

Slip compensation will be disabled when this setting is 00.00. In steady state the Drive will compensate the speed drop due load increase. This helps in improving the speed regulation

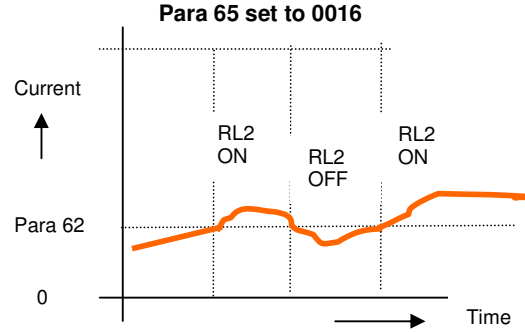
61 VOut

Drive can be configured to output voltage on Vout terminal on control TB with respect to GA (Gnd). Para 61 can be used to choose the parameters to be output from Vout terminals. All parameters are scaled to +10V level on Vout.

| Selection | Parameter | Vout 0 → +10V |
|-----------|------------------|---|
| 0000 | Output frequency | 00.00 Hz to Max.Frequency Para 04 |
| 0001 | Output Current | 00.00 Amps to 100.0 Amps |
| 0002 | Set frequency | 00.00 Hz to Max.Frequency Para 04 |
| 0003 | DC Bus volts | 000.0Volts to 840.0 Volts |
| 0004 | Voltage Output | Voltage output is the RMS line-to-line voltage output to the motor terminals. At 560V DC bus, measuring +10V at Vout terminal indicates voltage output of 395 Volts |

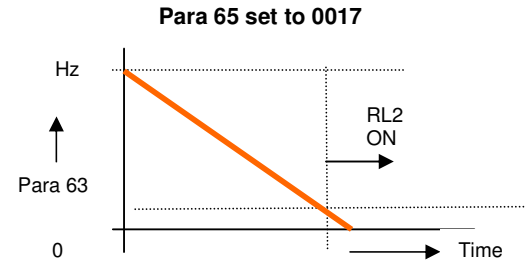
62 OL Warn

Programmable relay RL2 on Control card can be operated for over load warning. OL Warn data set here is the percentage of motor current for which Relay RL2 switches ON. This is based on the selection of RL2 function in **Para 65**.



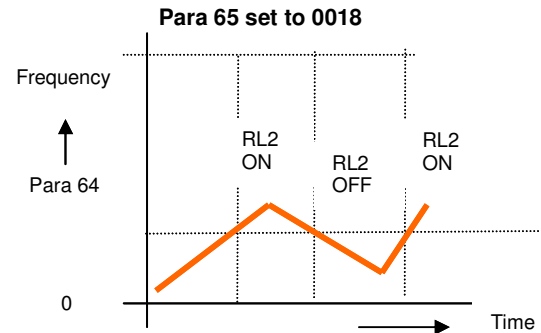
63 Freq Det

Programmable relay RL2 on Control card can be operated for Detecting whether running frequency has crossed the frequency set here. This is based on the selection of RL2 function in **Para 65**.



64 Stop Signal Frequency

Programmable relay RL2 on Control card can be operated for stop detection. Whenever, stop command is issued and frequency drops below this level RL2 is operated. This is based on the selection of RL2 function in **Para 65**.



65 RL2 Select (Programmable relay)

Programmable relay RL2 on Control card can be operated for various conditions of the drive. Select the functionality required using this parameter.

66 Master-Slave Mode

Refer to description on “Serial Communication Interface” .

67 Fault Memory

First two digits will display fault no. The numbers will be 00 to 09. Second two digits will display the fault type. The fault types are shown below. Most recent fault is stored in 00 position.

| | |
|---|--|
| 01: DC Bus Over Voltage 02: Under Voltage 03 :Over current during acceleration 04: Over current during Deceleration 05: Over current during steady state 06: Heat sink Over temperature 07: External trip | 08: Inverse Over load trip 09: Thermal 10 :IGBT short circuit 11: Output phase imbalance. 14: Serial Error Example: 0201: Recent 2 nd fault is of Under voltage |
|---|--|

68 JOG TB Select

By default the selection 0000 corresponds to JOG input. JOG function works with FOR/REV terminals for direction of rotation. JOG input must be activated along with FOR/REV input for JOG operation.

If THR function is chosen, motor thermal NC contact must be connected between JOG and GD inputs.

69 Stop Type

Based on the application, for stopping a motor, user may choose deceleration to stop or coast to stop (Free stop). Whenever free stop is chosen as the stop type, PWM pulses are disabled as soon as the drive gets STOP command and time to stop is dependent on load inertia. DC Injection braking works only with Deceleration stop. In Free stop mode, DC Injection is not operational.

70 Stability

It is observed that in some applications, motor drive system oscillates at certain low frequencies due to various factors affecting sine wave generation. This can be corrected by increasing the stability parameter from the default 0% to 100%.

71 Software version

Displays Software version for reference only.

72- 75 Auto Run Acc and Dec times

Acceleration during Auto run mode is set by these parameters for each step. Drive will consider the same time for deceleration also in auto run mode. On completion of Auto Run cycle, drive controller follows Acceleration and deceleration times set by **Para 08** and **Para 09** respectively.

76- 80 Serial Communication related parameters

For more information, refer to

- 1) Serial communication manual.
- 2) Synchronization of drives manual.

81 Service password

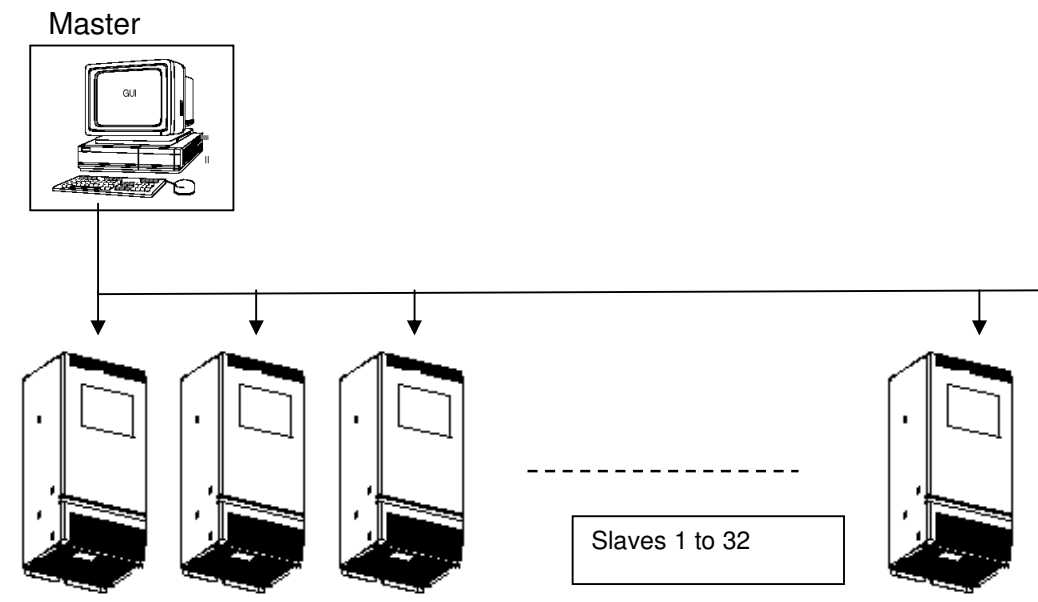
This parameter is for use by authorized service personnel.

10. SERIAL COMMUNICATION INTERFACE

The drive controller can be remotely controlled with RS485 link provided on Connector **CN3**. The communication is implemented using RS485 Serial communication with MODBUS protocol specification version V1.1a RTU.

Usually, the drive controller works as one of the slaves to a Master PC or Host system. When programmed as a slave using **Para 66**, it should be ensured that the Slave address of the controller is unique among the other slaves. Programming 0002 in **Para 66** makes drive controller as a slave with slave address 01.

A special feature of the drive controller allows the drive to work as a master controller to control other similar drives. When configured as master using **Para 66**, the drive controller keeps broadcasting its **Running frequency**. Other slaves can receive this broadcast data. When such system is used for synchronization purposes, it should be ensured that all the slaves are programmed to receive the data by setting parameter 03 accordingly. Control logic for drive starting must be interfaced using Fault relay NC output to ensure that if any one or more of the drives is faulty, all the drives operating in synchronism are disabled.



* When drive controller is configured as slave and Frequency reference to the drive is from serial set by Para 03, AI+/ AI- analog input terminals can be used for ratio adjustments.


For detailed description of Synchronization procedure, refer to Synchronization of Drives manual

11. MAINTENANCE AND TROUBLESHOOTING

Preventive Maintenance

Routine maintenance and inspection are essential for reliable operation of the drive module. Routine maintenance must involve the following activities

1. Inspection of cooling fans and its operation
2. Cleaning of dust accumulated near the cooling fans, Heatsink and other terminals by blowing dry air. This is very important especially in textile mills where the cotton is expected to clog the air passage.
3. Check for tightness of all connections including power and control logic.
4. Connection to motor terminals must also be checked for tightness.

| | |
|--|----------------|
|  | WARNING |
| <p>Do not open the Inverter module with Input Power ON. Inverter should be opened only after the LED display switches off. The internal components or PCBs should be handled/ removed only after the charge LED on the Power board is visibly OFF. Contact with internal components while input power is ON or the charge LED is ON, may cause severe Electric Shock</p> | |
| <p>Do not touch power connection TBs until DC Bus voltage is completely discharged</p> | |
| <p>While plugging in or removing a connector ensure not to put much force on connector housings, which are soldered to the PCB.</p> | |

Maintenance Tests

- ★ When conducting an external circuit megger test, disconnect all inverter terminals. Make sure that high-test voltages are never applied to the Inverter terminals. Authorized personnel must ensure to remove the noise capacitors near the Power input RST terminals.
- ★ Megger test for the Inverter module is not recommended. If need arises, perform the test only on the power wiring after removing all PCBs from the module. Authorized personnel must be present for this test
- ★ For continuity checking on control circuits, use a multimeter in high resistance mode and not a megger or buzzer.

Please note that life of an electrolytic capacitor which is used in the drive system is approximately 5 years. It is recommended that capacitors be replaced after this period for smooth operation of the drive system.

Measurement of output voltage and Current

Inverter output voltages are generated using PWM technology. It is a sine waveform constructed using Pulse width modulation. Precision measurements of voltages using standard digital multimeters are not possible. It is recommended to use Rectifier type analog voltmeters to measure the output voltages. Drive input currents are again non-sinusoidal and clamp-on meters does not provide correct values. It is recommended to use Moving-iron type Ammeter for precision measurements. In case of measurements related to input power to the drive system, Electro-dynamometer type watt meter in 2-wattmeter configuration is preferred.

| |
|---|
| <p>★ Important Notes on Measurement of voltages</p> |
| <p>Measurement of DC Voltage can be done between Power terminals POS and NEG. For 415 V 3-Phase AC inputs, the DC voltage expected is around 550V Average</p> |
| <p>Measurement of Input AC voltages can be done at INPUT terminals between R-Y,Y-B and B-R. The line-to-line voltages must be in the range of 415V +10% -15%.</p> |

Trouble shooting

| Display | Description | Check |
|--|--|---|
| <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">dCLo</div> | <ul style="list-style-type: none"> Displayed when input 3-Phase power supply voltage is less. During start-up DC Bus voltage is expected to be at least 400V DC. Otherwise, system will wait for input voltage to build-up before entering <u>Ready To Run</u> Mode. After Power-up, if the drive input voltage falls and goes below UV setting in Para 20, display shows dCLo. If Re-start parameter Para 21 is set as 0000, drive will trip for UV | <p>Measure input AC RMS voltage at R, Y, and B terminals. Line – Line AC voltage must be > 300V and DC Bus measured between Pos and Neg Terminals on Power TB must be > 400V DC.</p> <p>Check for proper 3-Phase connection at the input terminals</p> |
| <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">dCOv</div> | <ul style="list-style-type: none"> Displayed when DC Bus measured by the controller is more than 760 V DC | <p>If this fault appears before Run command is given, verify the input AC RMS voltage.</p> <p>If fault appears when drive is decelerating, Deceleration time is very short for the load inertia. Increase the deceleration time.</p> <p>If optional brake unit is used, check brake terminal connections and Braking resistor value</p> |
| <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">dCUv</div> | <ul style="list-style-type: none"> Displayed when DC Bus measured by the controller is less than UV setting in Para 20. This is applicable only in Run mode of operation and when Para 21 is set as 0000 | <p>Check for proper 3-Phase connection at the input terminals.</p> <p>If the fault persists even when input voltage is OK, DC bus capacitor/ balancing resistor or the IGBT device may be faulty.</p> |
| <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;">OCA</div> | <ul style="list-style-type: none"> Over current during acceleration is displayed when the load current crosses more than 200% of the motor current during acceleration. | <p>Acceleration time is to be increased.</p> <p>Check whether drive rating is sufficient for motor connected.</p> <p>If the fault persists even when Acceleration time is high, problem may be due to wrong</p> |

| | | |
|-------------|---|--|
| | | output connection. |
| OCD | <ul style="list-style-type: none"> Over current during deceleration is displayed when the load current crosses more than 200% of the motor current during deceleration. | This can happen due to large oscillations/ Resonance at a particular speed of the motor. Use jump speed feature or increase/ decrease deceleration time |
| OC | <ul style="list-style-type: none"> Over current during steady state operation of the drive. | This can happen due to sudden application of load or load oscillations. |
| HSOT | <ul style="list-style-type: none"> Heat sink over temperature | <p>Check whether DC cooling fan on top of the drive is working.</p> <p>If fault persists even after cooling fan is working OK, reduce the switching frequency to 2kHz.</p> <p>Measure the output current using a clamp-on meter and check whether load current is within the range of drive capacity</p> |
| IOL | <ul style="list-style-type: none"> Inverse over load fault. This is applicable when Para 15 is enabled. | Measure the output current using a clamp-on meter and check whether load current is within the range of drive capacity |
| thr | <ul style="list-style-type: none"> Motor thermal trip. This is applicable if Para 68 is set to 0002 | If Para 68 is set as 0002, JOG terminal must be connected to GD if motor thermal switch is not used. If motor thermal switch is used, check for proper connection of the motor thermal circuit OR whether motor is overheating |
| SC | <ul style="list-style-type: none"> Output short circuit trip | There is short circuit at the output terminals. Check for connections from drive output to motor terminals. |
| SEr | <ul style="list-style-type: none"> Serial communication Error Drive configured as slave in RS485 network is not getting Messages from Master within time-out period set by Para 78 | <p>Check Serial Cable interface</p> <p>Check whether master is configured to send messages within time-out period</p> <p>If required, increase the time-out period</p> |

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