Hexmoto
Ratings: 30kW~45kW

Indverter - Q1

User Manual

Rev 0 August 26, 2010

HEXMOTO
Controls Pvt.Ltd

Rev 0 : Initial Release

Contents

Introduction

Dear Customer,

We thank you for buying our “Indverter-Q1” series AC Drive.

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

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

1. GLOSSARY OF TERMS USED

Drive Module Refers to Hexmoto make Q1 series controller. Term is used in combination "Drive Module" or separately as "Drive" or "Module" to indicate the Q1 series Controller

Inverter Refers to Drive module

Display 7-Segment + LCD Keypad unit on the drive module

Keypad 6-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 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 Ready to Run 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.**

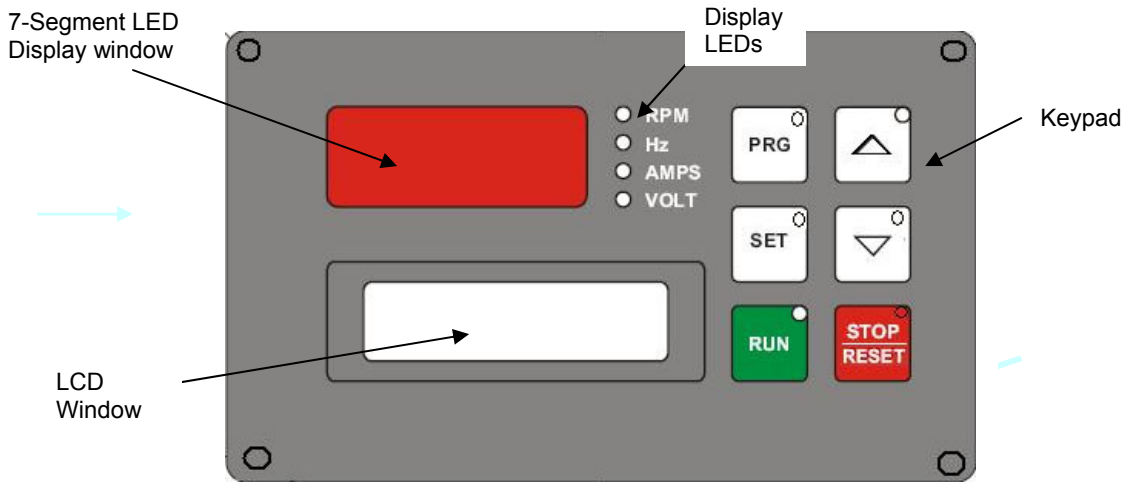
Selection Chart			
Type	**30kW**	**37.5kW**	**45kW**
Applicable Motor output in KW	30.0	37.5	45.0
Inverter Output at 415V in KVA	42.4	51.6	69.0
Rated Output Current in Amperes	59	72	96
Net Weight (Kg)	36	38	40
Dimensions (W D H) in mm	343 x 297 x 690		

3. 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 (Not Programmable by user)
	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)
	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	Acceleration : 1.0 to 999.9 in steps of 0.1 seconds 1000 to 9999 in seconds Deceleration: 0.5 to 999.9 in steps of 0.1 seconds 1000 to 9999 in seconds
	Dynamic Braking	Optional External Dynamic Braking Unit to be connected
	Slip compensation	Available, load current dependent.
	S-curve	Available. Settable in the range of 0.1 to 10.0 Seconds
	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 Voltage output. Output voltage can be scaled. 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 segments LED display + 2x16 Line LCD Unit with 6 function Keypad connected with RS485 serial interface.
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.,	

4. DISPLAY AND KEYPAD



Keys	Description
PRG	Used as **Program** Key • Use 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 on first line of LCD display
▲	Used as **UP** key • When Main speed reference is from Keypad, UP key is used to increase the reference frequency/ speed when the drive is running or in ready to run mode. • In programming mode, UP key is used to increase Function code Or increase data for a function code or Parameter
▼	Used as **DOWN** key • When Main speed reference is from Keypad, DOWN key is used to decrease the reference frequency/ speed when the drive is running or in ready to run mode. • In programming mode, DOWN key is used to decrease Function code or decrease data for a function code.
RUN	Used as **RUN** Key • If the Start command is from Keypad, RUN Key is used to start a drive • LED on RUN Key glows when drive is in RUN Mode
SET	Used as **SET** Key • Used to set the parameter value in Programming mode • In ready mode / RUN mode, used to set the frequency / RPM value If set, the value will be stored in the memory (possible only when Parameter 03 is set to Keypad)
STOP RESET	Used as **STOP or RESET** Key • If the Start command is from Keypad, STOP RESET Key is used to stop a drive • STOP/RESET is also used as return from Menu if in programming mode • In case of fault, STOP RESET 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 Parameter 01.
	LED is ON when display is showing Frequency. This selection of display function is based on function Parameter 01.
	LED is ON when display is showing drive output current. This selection of display function is based on Parameter 01.
	LED is ON when display is showing DC bus voltage of the drive. This selection of display function is based on Parameter 01
LED on PRG	If user enters Programming mode by pressing PRG key, PRG LED is ON. This is to indicate to the user that drive is in programming mode and drive cannot be started 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.
LED on RUN	RUN LED RUN LED is ON when the drive is in RUN Mode.
LED on STOP/RESET	STOP LED STOP LED is ON when the drive is stopped.

- Pressing PRG again in programming mode, user can modify the data. In this mode, first line of LCD starts blinking to indicate data being modified.
- For detailed description on programming refer to “Description of parameters and programming”

5. 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.**

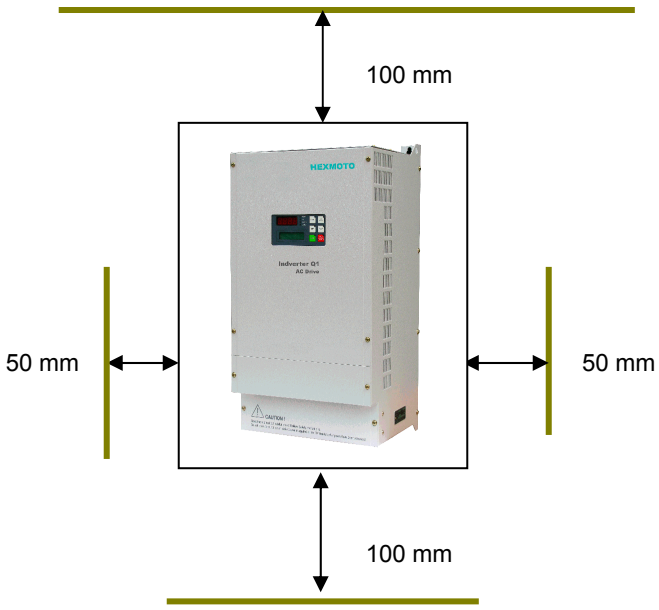
CAUTION

- **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 Module is designed for vertical mounting inside a panel. Always fix the module with vertical alignment.

2 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.



3 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.
4 Use proper lugs, ensure connectivity of the cables to the input, and output terminals on the drive module.
5 Check proper operation of the control logic by referring to description of “Control circuit interface”.
6 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.
7 On start-up, drive module displays rated input voltage and module rating on LED display

HEXMOTO Q1 Drive 30.0kW 415.0V

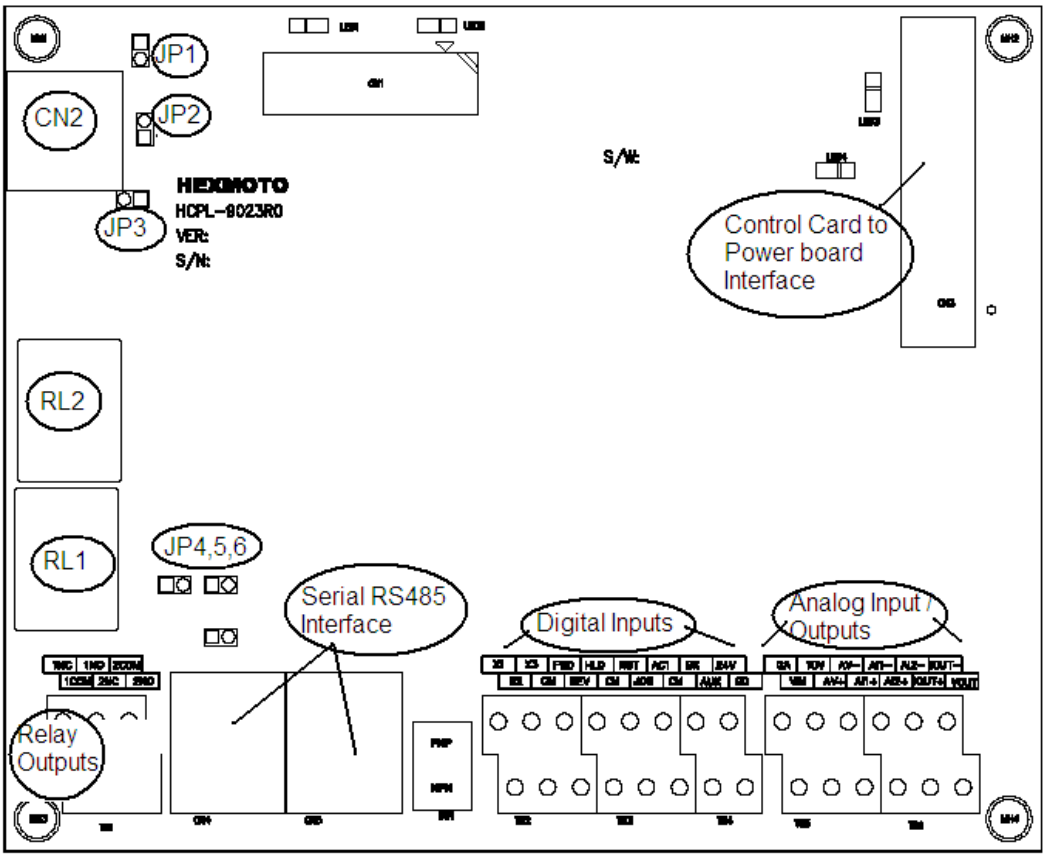
Indicating input rated supply voltage selection is for 3-Ph, 415V +10% -15%, 50-60Hz input Followed by module rating in kW

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

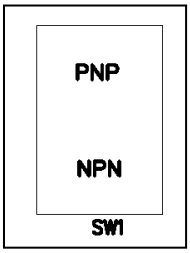
8 Close FOR/REV TB input to CM to start drive controller and run the motor. If start command as per **Para 02** is from Display unit, press RUN key to run the motor. Drive enters RUN mode and motor starts rotating in FOR direction.
9 Refer to “Maintenance and Troubleshooting” for any problem related to controller performance and fault condition.

6. DESCRIPTION OF CONTROL CONNECTIONS

6.1) Overview of the Control card connections



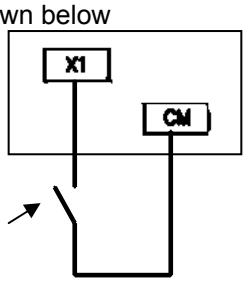
6.2) Digital Inputs on TB 2,3,4



Name	Function	Description
X1	X1 OR Raise	Multi-speed Digital Input 1 or Raise based on Para 03
X2	X2 OR Lower	Multi-speed Digital Input 2 or Lower based on Para 03
X3	X3	Multi-speed Digital Input 3
FOR	FOR	FOR input is used as START in Forward direction
REV	REV	REV input is used as START in Reverse direction
HLD	HLD	HLD input is used for 3-Wire operation as explained in "Control Location" parameter.
RST	Reset Fault	This input is used to reset a latched fault. Short circuit (SC) fault cannot be reset. SC is reset only by switching OFF the drive supply.
JOG	JOG Function	JOG Input, to be operated along with either of FOR/REV inputs.
AC1	Select Ramp-1	Selects RAMP values based on Para 29,30
BX	External	Drive output is disabled as long as this input is ON.
AUX	Auxiliary select	Select Auxiliary speed reference as per Para 20
24V		**Auxiliary voltage source 24V, 100 mA (maximum)w.r.t GD**
GD		**Common for Auxiliary source**

6.3) Input ON/OFF Control

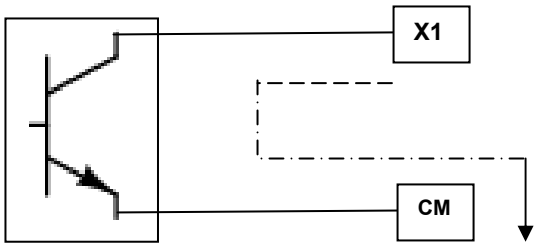
1) In case of Relay logic control, a potential free contact may be used to switch ON/OFF a particular input as shown below



In this case, position of SW1 can be either NPN or PNP

2) External NPN Input from PLC

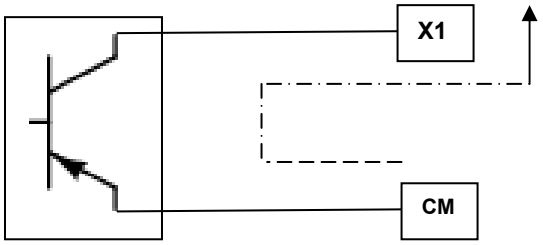
SW1 Position must be put to NPN



Common
Sinking

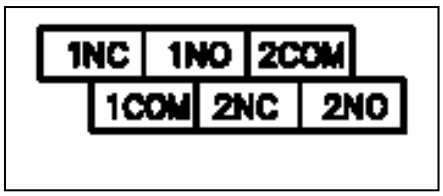
3) External PNP Input from PLC

SW1 Position must be put to PNP



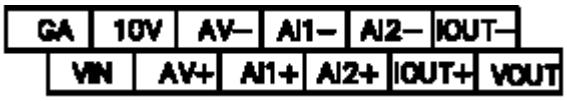
Common
Sourcing

6.4) Relay Outputs on TB1



	Name	Description
RL1	1NC	Programmable Relay Normally Closed contact (230VAC / 24 VDC, 2A)
	1COM	Programmable Relay Common
	1NO	Programmable Relay Normally Open contact (230VAC / 24 VDC, 2A)
RL2	2NC	Fault Relay Normally Closed contact (230VAC / 24 VDC, 2A)
	2COM	Fault Relay Common
	2NO	Fault Relay Normally Open contact (230VAC / 24 VDC, 2A)

6.5) Analog Input/ outputs on TB5,6

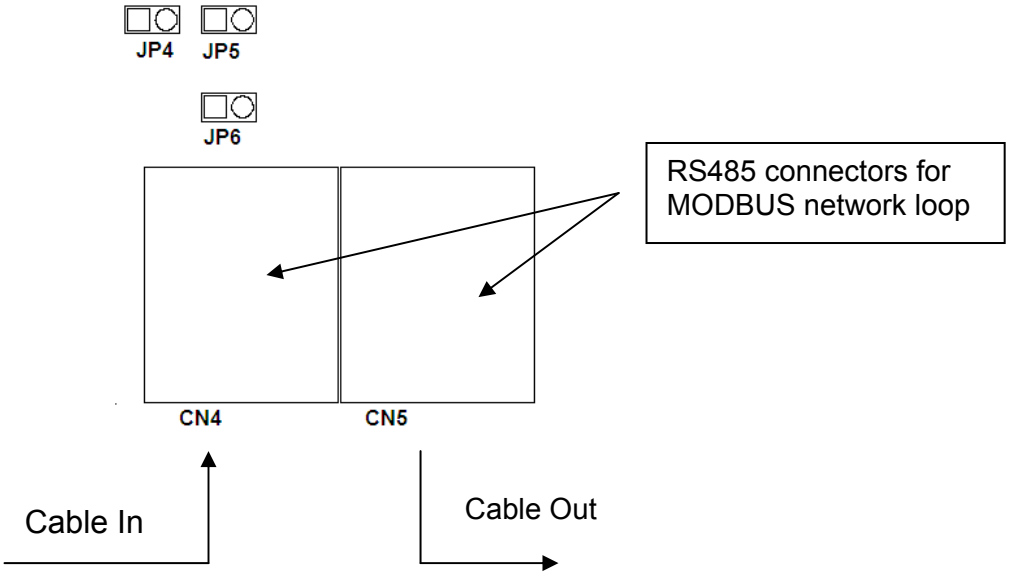


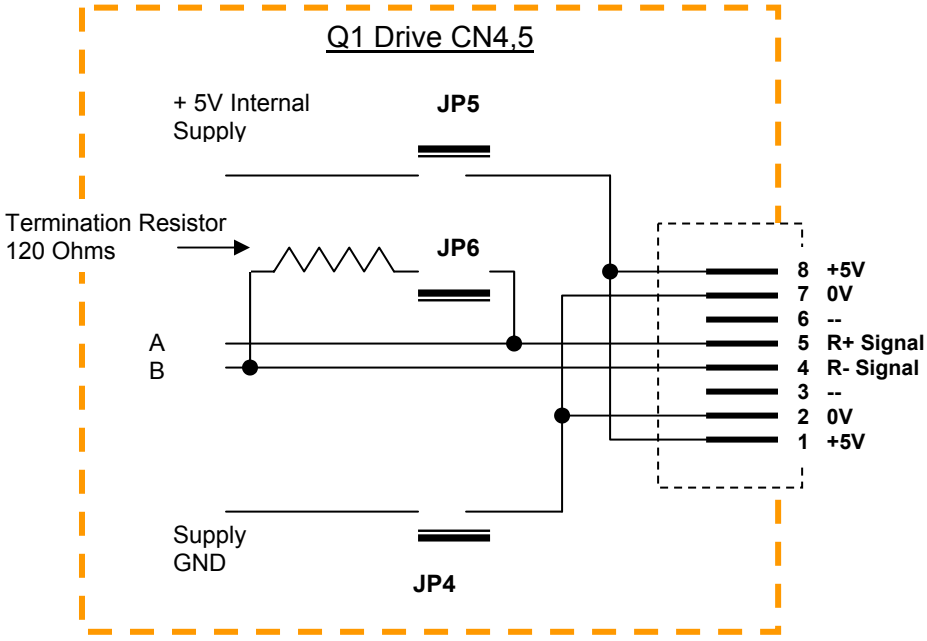
Name	Description
GA	-Potentiometer reference source common -Common for VOUT -If differential analog input AV+ AV- is used with Reference voltage from 10V, connect AV- to GA
10V	10V Potentiometer reference source. (1kΩ ≤ R ≤ 10kΩ)
VIN	Voltage reference input with Potentiometer
VOUT	0-10V analog output corresponding to the selected variable in the program (refer to parameter number 88, 89)
AV+	Differential Analog input positive (Voltage)
AV-	Differential Analog input negative (Voltage)
AI1+	Differential Analog input positive (Current) CHANNEL-1
AI1-	Differential Analog input negative (Current) CHANNEL-1
AI1+	Differential Analog input positive (Current) CHANNEL-2
AI1-	Differential Analog input negative (Current) CHANNEL-2

Note: IOUT+ and IOUT- is not implemented

6.6) Display and serial interface connections

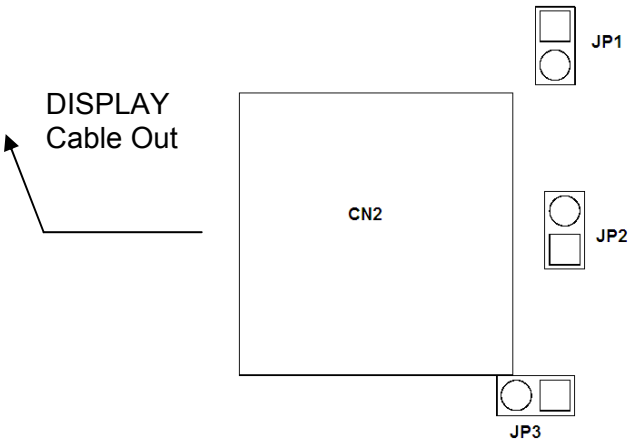
External Serial RS485 interface





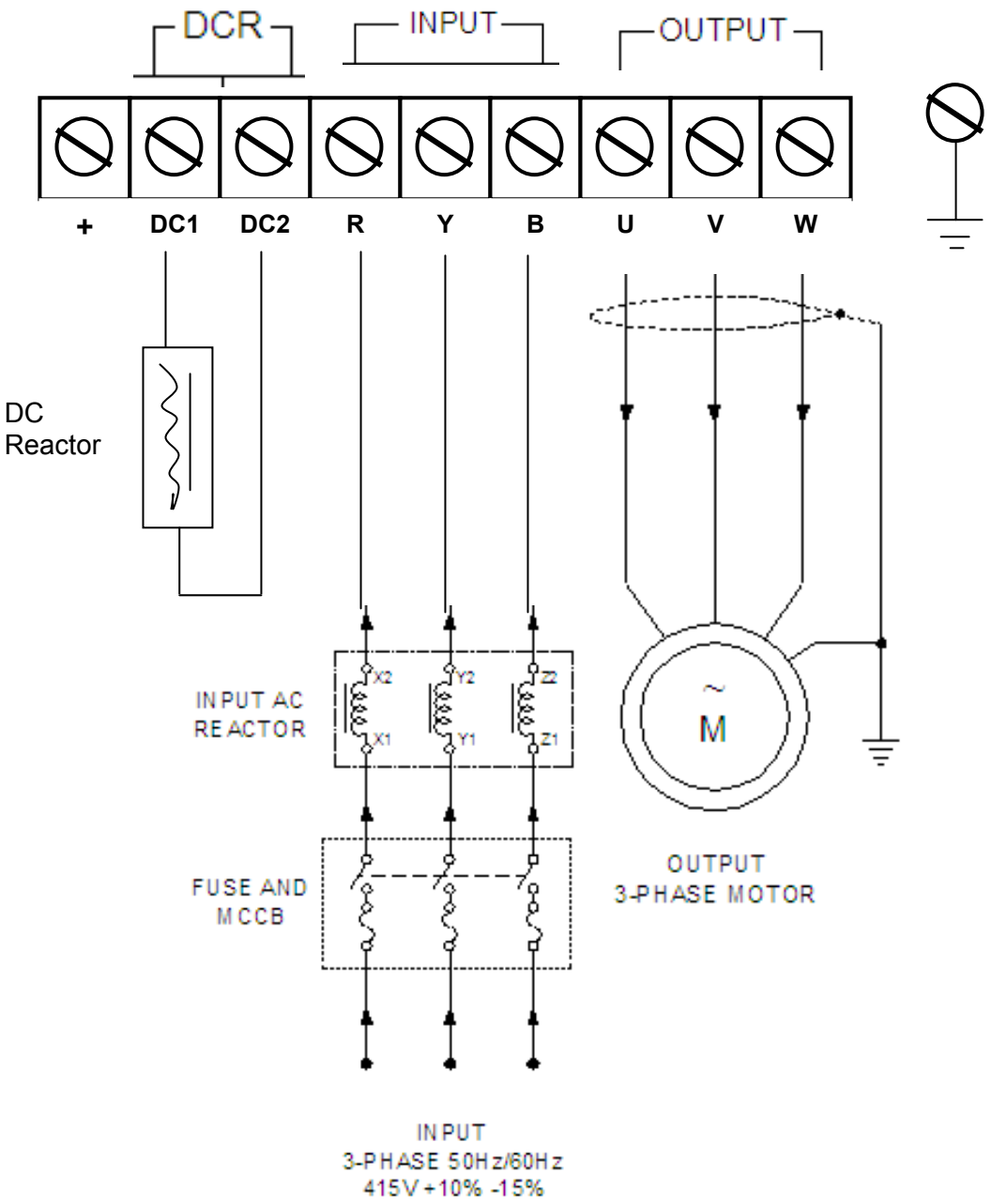
Pin	Signal	Description
1	+5V	Supply available on pin 8,1 if JP5 is closed
2	0V	Supply Gnd for +5V on pins 7,2 if JP4 is closed
3	NC	No connection
4	R-	–ve signal input for RS-485 interface
5	R+	+ve signal input for RS-485 interface
6	NC	No connection
7	0V	
8	+5V	

Internal Display connection



JP1, JP2 and JP3 must be closed for proper operation of Display unit

7. DESCRIPTION OF POWER CONNECTIONS



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 differential inputs such as AV+/AV-, AI-1+/-, AI-2+/-**
- **Do not short CM and GA terminals**
- **Do not short CM and GD terminals**
- **+24V and GD power supply may be used to power up external circuitry. But, the output current should be limited to less than 100mA.**

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 mm^2 to 1.5mm^2 (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 mm2	20	White
61801620	AHI DIN K 0, 75/6	0.75 mm2	20	Grey
61801660	AHI DIN K 1/6	1 mm2	18	Red
61801700	AHI K 1, 5/6	1.5	16	Black

8. LIST OF PARAMETERS

Func Code	Name	Data				
		Selection	**Description**	**Range**	**Set accuracy**	**Factory Setting**
00	Parameter Lock	0000	Enabled	0 to 1	0001	0001
		0001	Disabled			
01	LED display	0000	RPM	0 to 3	0001	0001
		0001	Hz			
		0002	Amps			
		0003	DCBus			
02	Control Location	0000	Keypad Display Unit	0 to 4	0001	0000
		0001	2-Wire TB FOR/REV			
		0002	3-Wire TB FOR/REV + HLD			
		0003	Serial TB FOR/REV			
		0004	*Reserved*			
03	Main speed reference	0000	From Keypad Digital	0 to 7	0001	0000
		0001	Analog VIN TB Volts In			
		0002	Analog AV+/- TB Volts In			
		0003	Analog AI-1 TB Current in			
		0004	Analog AI-2 TB Current in			
		0005	Serial interface			
		0006	Raise-Lower TB- X1/X2			
		0007	Raise-Lower Stop 0			
04	Maximum Freq	Hz	Maximum frequency	0 to 400	00.01	50.00
05	BASE Freq	Hz	Base or Synchronous frequency	30 to 400	00.01	50.00
06	Freq Bias	%	Frequency bias in % of maximum frequency. *Applicable to Analog Inputs ONLY.*	0000	0001	0000
07	Start Freq	Hz	Starting frequency	1.00 to 6.00	00.01	01.00
08	Acceln time	Seconds	Acceleration time	1.0 to 9999	**0.1** 1Sec for > 1000	10.0
09	Deceln time	Seconds	Deceleration time	0.5 to 9999	**0.1** 1Sec for > 1000	10.0
10	Torque boost	%	Initial torque boost voltage in % of output voltage	0 - 100	0001	0005
11	Tq boost cut-off frequency	%	% of Base frequency at which Torque boost becomes zero	0 - 100	0001	0050
12	RPM Multiplier	k	RPM Display = k* Frequency	00.00 – 99.99	00.01	30.00
13	Current Limit	%	Drive Current limit. Percentage of Motor current in Para 14.	0030 - 0200	0001	0150
14	Motor Current	Amps	Rated current of the motor connected. Set by the user.	0 to Module rated current	00.01	Module rated current
15	Thermal OL	0000	No overload function	0000 - 0002	0001	0000
		0001	For separately cooled motor			
		0002	For self-cooled motor			
16	Freq Low Lim	%	Frequency low set	0000 - 0099	0001	0000
17	Freq High Lim	%	Frequency High set	0000 - 0100	0001	0100
18	Jump Start	Hz	Jump start frequency	00.00 - Para 04	00.01	00.00

Func Code	Name	Data				
		Selection	**Description**	**Range**	**Set accuracy**	**Default Setting**
19	Jump End	Hz	Jump End frequency	00.00 - Para 04	00.01	00.00
20	Aux Select	0000	Disable	0000 to 0008	0001	0000
		0001	*Reserved*			
		0002	Analog VIN TB Volts In			
		0003	Analog AV+/- TB Volts In			
		0004	Analog AI-1 TB Current in			
		0005	Analog AI-2 TB Current in			
		0006	Serial interface			
		0007	*Reserved*			
		0008	*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 Cur	Amps	DC Injection current	00.00 – 20.00	00.01	00.00
25	DC Inj Type		*Not Implemented*	0	0	0
26	CatchOnFly	0000 0001	Disable Enable	0000 - 0001	0001	0000
27	CFLY Current	%	% of Motor current in Para 14	0030 - 0200	0001	0100
28		***Reserved***				
29	Acc time-1	Seconds	Acceleration time	1.0 to 9999	**0.1** 1Sec for > 1000	10.0
30	Dec time-1	Seconds	Deceleration time	0.5 to 9999	**0.1** 1Sec for > 1000	10.0
31	JOG Accln time	Seconds	Acceleration time	1.0 to 9999	**0.1** 1Sec for > 1000	10.0
32	JOG Decln time	Seconds	Deceleration time	0.5 to 9999	**0.1** 1Sec for > 1000	10.0
33	JOG Frequency	Hz	When JOG input is enabled in TB	00.00 – Para 04	00.01	05.00
34	Multi Spd-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
35	Multi Spd -2	Hz		00.00 – Para 04	00.01	10.00
36	Multi Spd -3	Hz		00.00 – Para 04	00.01	15.00
37	Multi Spd -4	Hz		00.00 – Para 04	00.01	20.00
38	Multi Spd -5	Hz		00.00 – Para 04	00.01	25.00
39	Multi Spd -6	Hz		00.00 – Para 04	00.01	30.00
40	Multi Spd -7	Hz		00.00 – Para 04	00.01	35.00

Func Code	Name	Data							
		Selection	Description				Range	Set accuracy	Factory Setting
41	AutoRun 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** <u>Range</u> 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			
42	AutoRun Mode	0000	Auto Run Disabled				0000 - 0003	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						
43	Arun St-1 time	Seconds	Time for which drive runs in Multi-1 Speed				1 to 9999	1 sec	0000
44	Arun St-2 time	Seconds	Time for which drive runs in Multi-2 Speed				1 to 9999	1 sec	0000
45	Arun St-3 time	Seconds	Time for which drive runs in Multi-3 Speed				1 to 9999	1 sec	0000
46	Arun St-4 time	Seconds	Time for which drive runs in Multi-4 Speed				1 to 9999	1 sec	0000
47-50		***Reserved***							
51	Arun St-1 Acc	Seconds	Acceleration time Step1				1.0 to 9999	**0.1** 1Sec for > 1000	10.0
52	Arun St-2 Acc	Seconds	Acceleration time Step2				1.0 to 9999	**0.1** 1Sec for > 1000	10.0
53	Arun St-3 Acc	Seconds	Acceleration time Step3				1.0 to 9999	**0.1** 1Sec for > 1000	10.0
54	Arun St-4 Acc	Seconds	Acceleration time Step4				1.0 to 9999	**0.1** 1Sec for > 1000	10.0
55-58		***Reserved***							
59	PWM Frequency	kHz	Switching frequency of the power devices for PWM generation				***Not to be Modified***	0001	0006
60	S-Curve	0000	Disable				0000 to 0001	0001	0000
		0001	Enable						
61	S-Time	Seconds	Time duration for which S-Pattern is used during Acc/ Dec . Must be less than Ramp times				0.0 – 10.0	0.1	0.0

Func Code	Name	Data				
		Selection	**Description**	**Range**	**Set accuracy**	**Factory Setting**
62	Vin-Min	Volts	Minimum value for Analog input through VIn TB	0.0 – 9.9	0.1	0.5
63	Vin-Max	Volts	Maximum value for Voltage input through VIn TB	0.0 – 10.0	0.1	9.5
64	Vin-Filt	0000	No Filter	0000 – 0006	0001	0002
		0001 to 0006	50Hz to 1 Hz Digital filter cut-off frequency			
65	Vin-Neg	0000	No inversion	0000 – 0001	0001	0000
		0001	Analog input is inverted			
66	AV+/- V_Min	Volts	Minimum value for Analog input through AV+/- TB	0.0 – 9.9	0.1	0.5
67	AV+/- V_Max	Volts	Maximum value for Voltage input through AV+/- TB	0.0 – 10.0	0.1	9.5
68	AV+/- V_Filt	0000	No Filter	0000 – 0006	0001	0002
		0001 to 0006	50Hz to 1 Hz Digital filter cut-off frequency			
69	AV+/- V_Neg	0000	No inversion	0000 – 0001	0001	0000
		0001	Analog input is inverted			
70	AI 1+/-_Min	mA	Minimum value for Current input through AI1+/ AI1- TB	0.0 – 19.9	0.1	0.0
71	AI 1+/- _Max	mA	Maximum value for Current input through AI1+/ AI1- TB	0.0 – 20.0	0.1	20.0
72	AI 1+/-_Filt	0000	No Filter	0000 – 0006	0001	0000
		0001 to 0006	50Hz to 1 Hz Digital filter cut-off frequency			
73	AI 1+/- _Neg	0000	No inversion	0000 – 0001	0001	0000
		0001	Analog input is inverted			
74	AI 2+/-_Min	mA	Minimum value for Current input through AI2+/ AI2- TB	0.0 – 19.9	0.1	0.0
75	AI 2+/- _Max	mA	Maximum value for Current input through AI2+/ AI2- TB	0.0 – 20.0	0.1	20.0
76	AI 2+/-_Filt	0000	No Filter	0000 – 0006	0001	0000
		0001 to 0006	50Hz to 1 Hz Digital filter cut-off frequency			
77	AI 2+/- _Neg	0000	No inversion	0000 – 0001	0001	0000
		0001	Analog input is inverted			
78	PID-Enable	0000	Disable	0000 – 0001	0001	0000
		0001	Enable			
79	PID-Wait	Seconds	After RUN Command is given, Controller waits for time programmed here before starting PID Control	0.0 – 300.0	0.1	10.0

Func Code	Name	Data				
		Selection	**Description**	**Range**	**Set accuracy**	**Factory Setting**
80	PID P_Gain	kp	PID Proportional Gain	0.000 – 1.000	0.001	0.125
81	PID I_Gain	ki	PID Integral Gain	0.000 – 1.000	0.001	0.010
82	PID D_Gain	kd	PID Differential Gain	0.000 – 1.000	0.001	0.000
83	PID Fback	0000	*Reserved*			
		0001	Analog VIN TB Volts In			
		0002	Analog AV+/- TB Volts In			
		0003	Analog AI-1 TB Current in			
		0004	Analog AI-2 TB Current in			
		0005	*Reserved*			
		0006	*Reserved*			
		0007	*Reserved*			
84	Slip Compnstn	00.00	No slip compensation	00.00 – 10.00	00.00	00.00
		00.01 to 10.00%	Slip percentage considering slip at rated current at base speed			
85~87		***Reserved***				
88	V -Out	0000	Set Frequency	0000 – 0004	0001	0000
		0001	Output Frequency			
		0002	RMS Output Current			
		0003	DC Bus volts			
		0004	RMS O/p Voltage			
89	V -Out Scaling	%	Percentage scaling output of VOut. 100% corresponds to 0-10V, 50% is 0-5V	0000-0100	0001	0100
90	OL Warn	%	Over load warning level *Refer to Para 93*	0000 – 0200	0001	0100
91	Frequency Det	Hz	Frequency Detection level *Refer to Para 93*	01.00 – Para 04	00.01	10.00
92	StSignal Freq	Hz	Frequency for which Stop signal is generated when decelerating.	01.00 – Para 04	00.01	01.00
93	RL1 Select *Conditions for which RL1 Operates*	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			

Func Code	Name	Data				
		Selection	**Description**	**Range**	**Set accuracy**	**Factory Setting**
94	Fault Memory	00	Latest Fault information	00 – 09 *This parameter is Read-Only, not modifiable*	01	00
		01-09	Previous faults			
95	RST TB Select	0000		0000 - 0002	0001	0000
		0001				
		0002				
96	AC1 TB Select	0000		0000 - 0002	0001	0000
		0001				
		0002				
97	AUX TB Select	0000		0000 - 0002	0001	0000
		0001				
		0002				
98	Stop Type	0000	Stop with Deceleration		01	00
		0001	Free stop			
99	Restart Timeout	Seconds	*Refer Para-21* Restart with Set frequency is possible if input voltage returns within this period	00.00 – 05.00	00.01	00.00
100	SW version		*Shows Software Version used*	*Read Only*		20.2
101	Serial Mode	0000	Disable Serial Communication	0000 – 0033	0001	0002
		0001	Enable as Master			
		0002 – 0033	Enable as slave with address 1 to 32 *Refer to "Serial Communication Interface"*			
102	Ser Baud Rate	0000	4800 bps	0000 to 0003	0001	0001
		0001	9600 bps			
		0002	19200 bps			
		0003	38400 bps			
103	Ser 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			
104	Ser 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 105. Communication faults are cleared when a error-free message is received by the master			

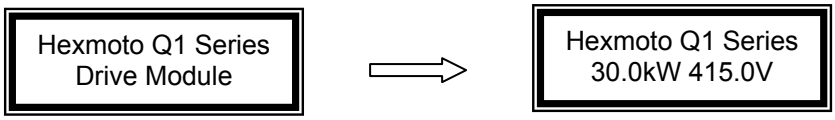
Func Code	Name	Data				
		Selection	**Description**	**Range**	**Set accuracy**	**Factory Setting**
105	Ser Flt Act	0000	No Warning			0000
		0001	Warning			
		0002	Trip for Fault			
106	Serial Bias	0 – 100%	Input bias for AI+/ AI- scaling inputs to get accurate scaling adjustments. Frequency bias in % of maximum frequency. *Refer to **Synchronization of drives** manual for more information*			0000
107 ~ 114		***Reserved***				
115	Service Key		To be used by Authorized service personnel			00.00

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, LCD display will show



Indicating module is rated for 7.5kW and input rated supply voltage selection is for 3-Ph, 415V +10% -15%,50-60Hz input. User must ensure that the selected module rating is correct for the application.

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.

Run Mode
Drive is running in the direction selected by FOR/REV TB input. In this mode, programming of parameters is disabled. Instead, LCD display Line-2 will scroll from Amps→Volts→RPM each time PRG Key is pressed. However, by default Line-2 shows RMS Current output. Sensing of faults is enabled here. If the reference is from keypad, user can increase or decrease the set frequency using UP/DOWN keys.

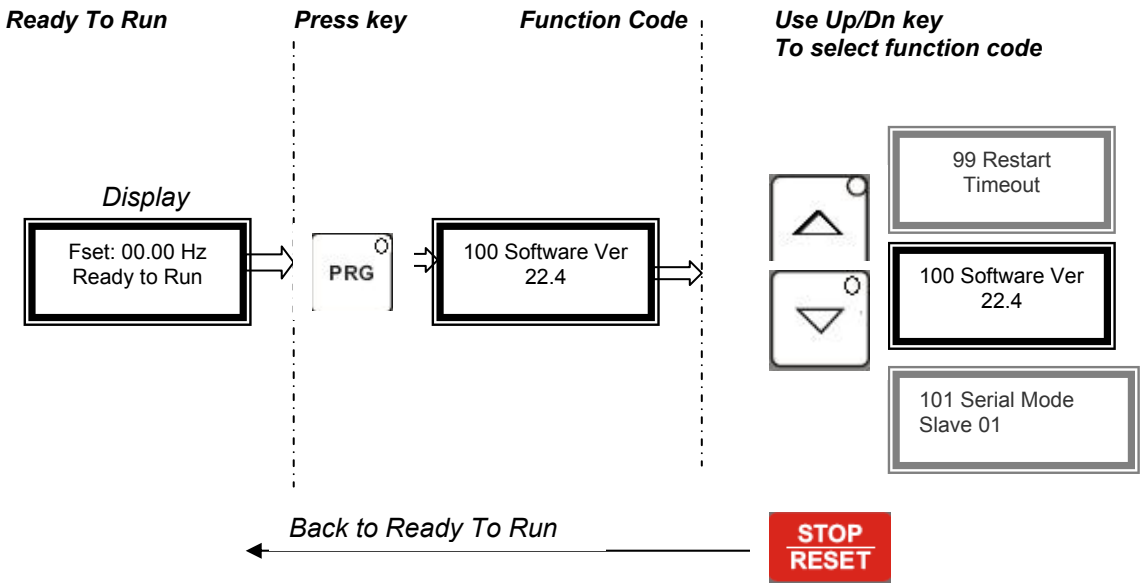
Programming Mode
From Ready To Run mode, pressing PRG key will enable user to enter programming mode where Function codes can be selected. In this mode start commands are not accepted. Pressing PRG key again will enable user to modifv data.

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 STOP RESET button on the display Keypad or use RST input from TB.

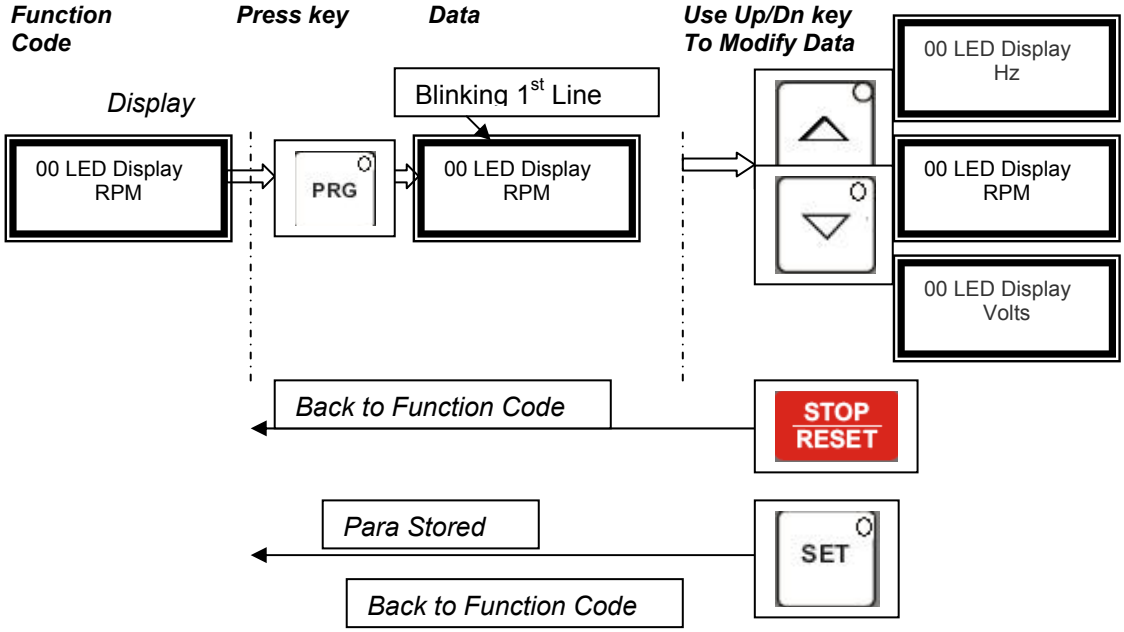
* Refer to "Maintenance and Troubleshooting" Chapter for more details

Programming the Drive Module

Step-1 Selecting a Function code



Step-2 Modify Function data



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.

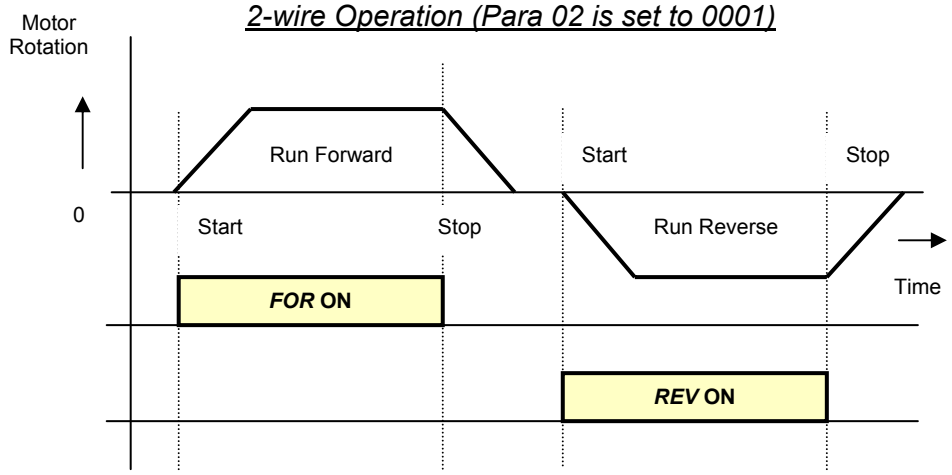
02 Control Location

Operation of FOR, REV and HOLD inputs

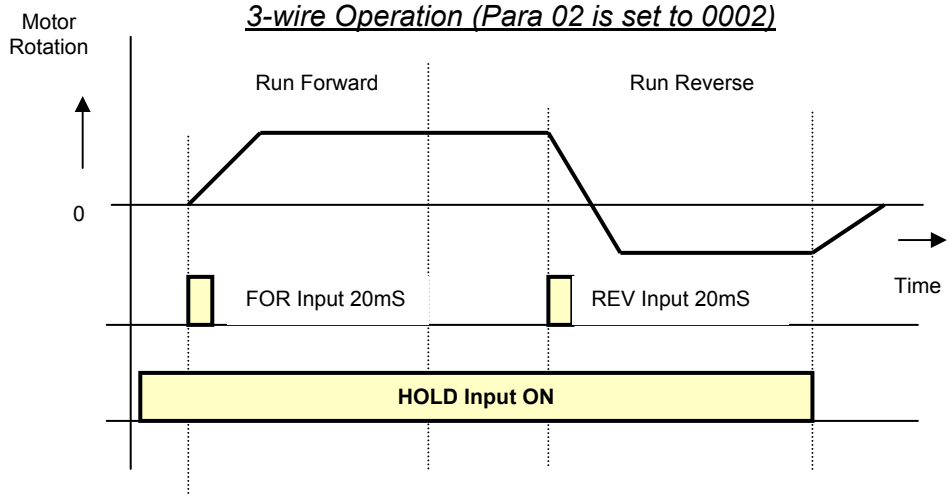
* If programmed command location in Para 02 is Display unit and when RUN key is pressed, Inverter will start provided either of the FOR/REV digital inputs are connected to GD terminal. The direction of rotation depends on the FOR/REV selection on TB.

* 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

2-wire Operation (Para 02 is set to 0001)



3-wire Operation (Para 02 is set to 0002)



By default, drive is configured to be controlled using RUN/SET key and STOP/RESET 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

Setting 0000 → Press RUN/SET button to start when in Ready To Run mode

Press STOP/RESET button to stop drive when in Run mode

Setting 0001 → **TB input FOR/REV (2-Wire Operation)**
Start/Stop operation is from TB FOR/REV terminal

Setting 0002 → Using HLD input 3-wire Operation as shown in the above figure.

Setting 0003 → **Serial START/ STOP Control**
Any of the FOR/REV input must be ON to enable this control.

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 62-65.*

0002 Analog Voltage input from AV+ AV- 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 66--69*

0003 Analog Current input from AI-1+ AI-1- terminals on TB
AI-1+ and AI-1- terminals are used as current inputs. 0-20mA or 4-20mA range can be set using *Para 70-73*

0004 Analog Current input from AI-2+ AI-2- terminals on TB
AI-2+ and AI-2- terminals are used as current inputs. 0-20mA or 4-20mA range can be set using *Para 74-77*

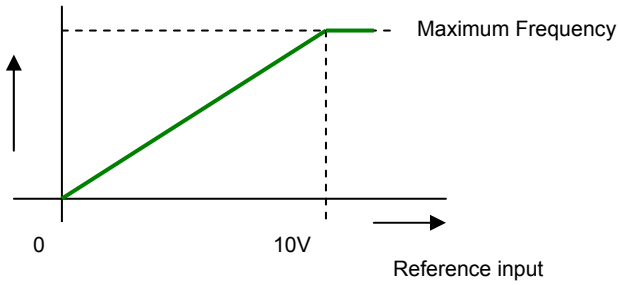
0005 Reference from Serial communication. If drive is configured as Slave in Para 101, frequency/ speed reference is from Serial communication.

0006 Activating terminal X1 on TB will increase the speed with acceleration time in Para 29. The digital input X2 will decrease the speed with a deceleration time in Para 30. 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.

0007 Function is similar to selection 0006. 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.



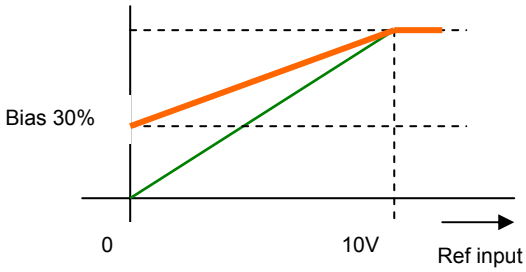
05 Base Frequency

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 set to 0001,0002,0003 or 0004



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 0.1 Sec until 999.9 seconds and 1 Seconds for a maximum value of 9999 seconds. Minimum setting is 1.0 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(Removal of start input as defined by Para 01). The setting resolution is 0.1 Sec until 999.9 seconds and 1 Seconds for a maximum value of 9999 seconds. Minimum setting is 0.5 Seconds

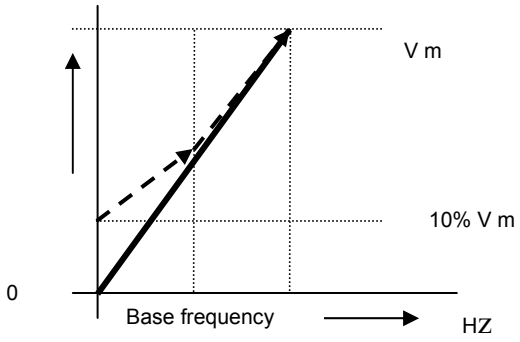
10 Torque boost

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 Boost Frequency selection ***Para 11***

11 Torque boost cut-off frequency

Sets the frequency after which the torque boost component in ***Para 10*** becomes zero.
Using this parameter, it is possible to select required V/F patterns for the application

Example
If the torque boost is 10% at minimum frequency of 1 Hz, 10% of the rated voltage is applied to the motor. As the frequency increases, the amount of boost added is slowly decreased and catches up with the V/F curve at 50% of the base frequency value (25Hz).



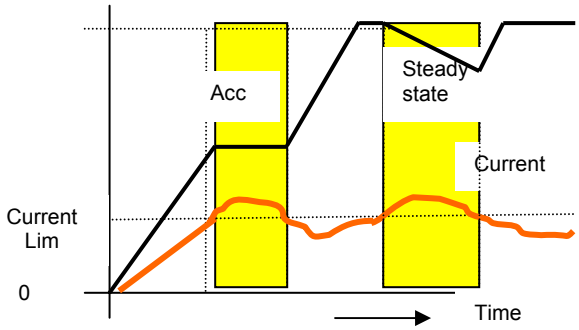
12 RPM Multiplier

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.



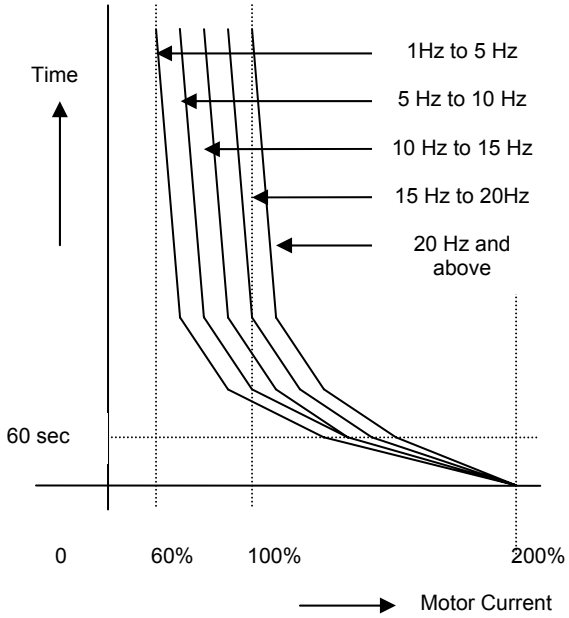
14 Motor Current

Rated Current of the motor to be entered by the user. By default motor current is selected for the rating of the inverter such as for 45kW drive rating, 96 Amps is selected. User can reduce the motor current value based on the motor selected for the drive system. *Maximum current entered here is limited by the Inverter rating.*

15 Electronic Thermal Overload

By default Thermal overload function is disabled.

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.



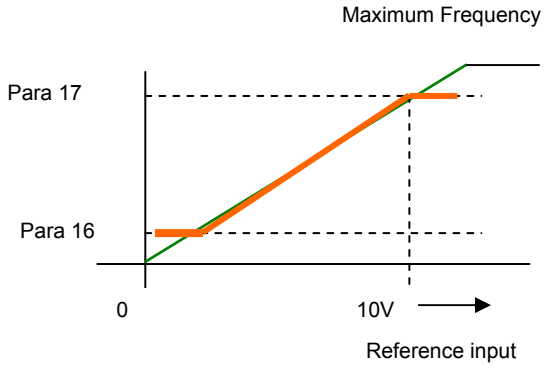
Selection 0002
Self-Cooled Motor
When the motor is cooled from shaft-mounted fan at variable speed, the effect of cooling depends on shaft speed. This is taken into account here and Electronic Thermal Overload function works accordingly. In the figure, 1 Hz to 20 Hz curves are selected when the motor 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

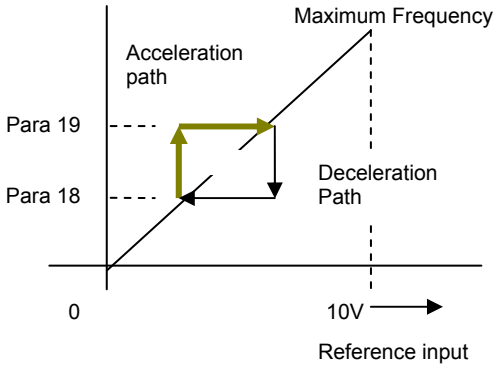
Increase in speed reference beyond this has no effect on output frequency of the Inverter. The parameter should be always more than ***Para 16***

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 a particular speed. The vibration due to resonance will be destructive and so it has to be avoided.

19 Jump End

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



20 Aux Select

With this parameter, Auxiliary reference channel may be selected. Refer to description of Parameter 03 for options available as references. Setting this value to 0 will disable the auxiliary reference feature. Auxiliary

reference cannot be same as Main speed reference. Also, Keypad input, Raise/low inputs are not allowed in this mode. Once after any of the suitable auxiliary channels is selected, closing AUX TB digital input will enable the selected channel value as the reference for the controller.

21 Restart after UV

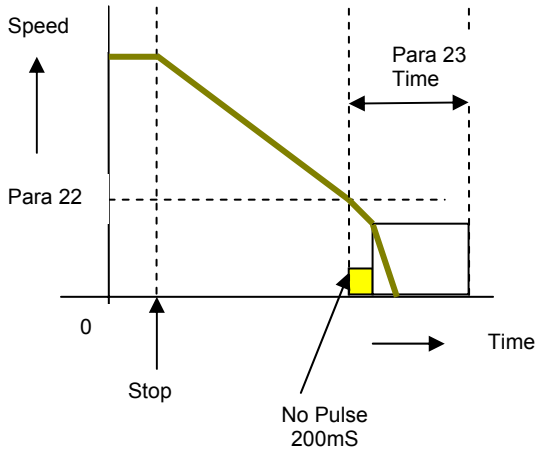
Setting → 0000 **Trip and Latch**
When the DC bus voltage goes below the Under voltage, the Inverter will coast to stop. Under voltage trip will be indicated and latched. Upon return to normalcy user has to RESET the fault.

0001 **Stop and start with starting frequency**
No Latching of fault
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

0002 **Stop and start with Set frequency with Catch On Fly**
No Latching of fault
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 catch up with the running motor and start running in set frequency.

22 DC Inj Freq

When drive is decelerating to stop, Inverter will apply Dc current 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 Current

0 – 20% of the motor current
When installing drive system with DC injection braking, use this parameter to adjust the DC current that is to be applied to motor for safe operation.
DC Injection braking is not functional in Free stop mode.

25 DC Inj Type

To be implemented.

26 CatchOnFly

If this parameter is enabled,Catch On Fly feature is enabled every time the drive starts. Drive controller stops as “Free stop” whenever this parameter is enabled.

27 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.

29- 30 Acc time-1 -- Dec time-1

Acceleration and deceleration times set here are selected by the drive based on

1) When AC1 TB Digital Input is closed.
2) When Reference input in parameter 03 is chosen as Raise/Low

31-32 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.

33 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.

34 -- 40 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 42*** 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 34***
0	1	0	Multi speed 2	***Para 35***
1	1	0	Multi speed 3	***Para 36***
0	0	1	Multi speed 4	***Para 37***
1	0	1	Multi speed 5	***Para 38***
0	1	1	Multi speed 6	***Para 39***
1	1	1	Multi speed 7	***Para 40***

41 Arun Direction

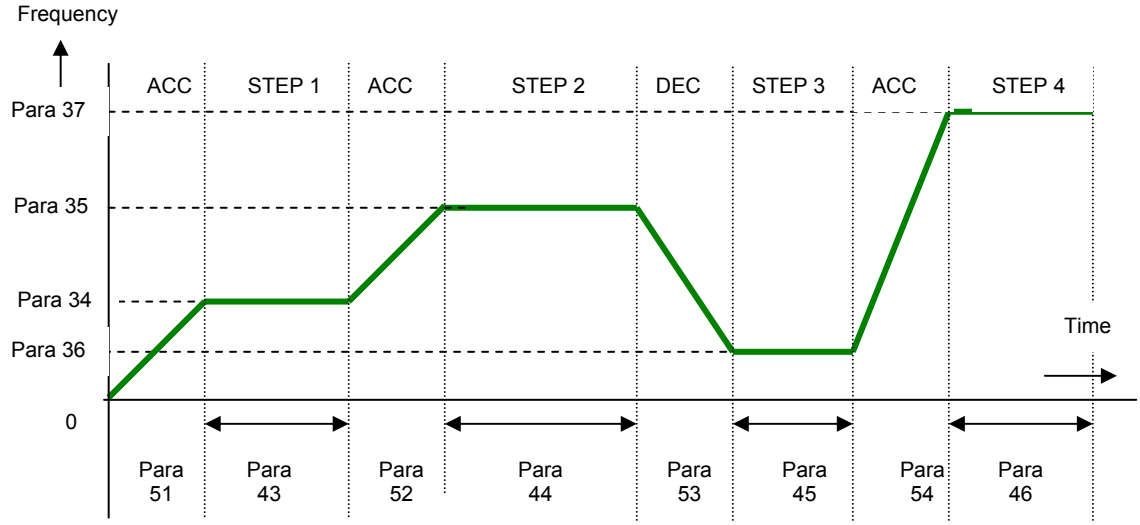
This parameter assigns direction for each step of Auto run operation. Parameter 41 is applicable to all Auto Run modes of operation in ***Para 42.*** For selection 0000, direction is controlled by FOR/REV TB Input to the drive controller. All other selections override TB direction input and follow programmed direction in this parameter. On completion of Auto run cycle, direction from TB input is followed.

42 Arun Mode

Auto run is enabled using this parameter. ***Para 34- 37*** determines the motor speed,***Para 43-46,*** time duration and ***Para 51-54*** ramp values for each step of Auto run operation. If the Inverter Stops and Starts again, it will begin a new Auto Run Cycle.

43- 46 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 34 to 37*** determines frequency reference for Step-1 to Step-4. ***Para 51 to 54*** determines the Acceleration/ Deceleration times for Step-1 to Step-4.



51- 54 Auto Run Acc and Dec times

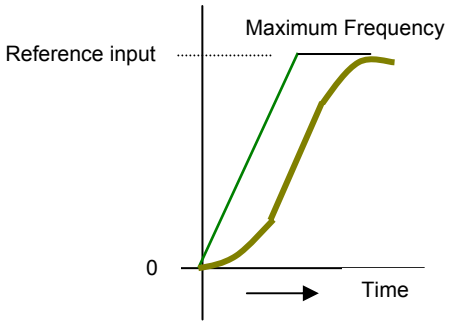
Acceleration during Auto run mode is set by these parameters for each step. Drive will consider the same time for deceleration also in auto run mode. On completion of Auto Run cycle, drive controller follows Acceleration and deceleration times set by **Para 08** and **Para 09** respectively.

59 PWM Frequency

PWM Frequency for the drive control is fixed internally by the controller for optimum performance. User is not allowed to change this parameter.

60 S-Curve

S-Curve acceleration/deceleration is used for preventing shock at Start/stop. The curvature time is dependent on time programmed in ***Para 61***. Total acceleration / deceleration time is extended due to S-Curve by the time programmed in ***Para 61.***



61 S-Time

Time in seconds for which the s-curve shapes the edges. This is applicable if S-Curve ***Para 60*** is enabled

62 – 77 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, AV+/- .AI-1+/- and AI-2+/- on control TB.

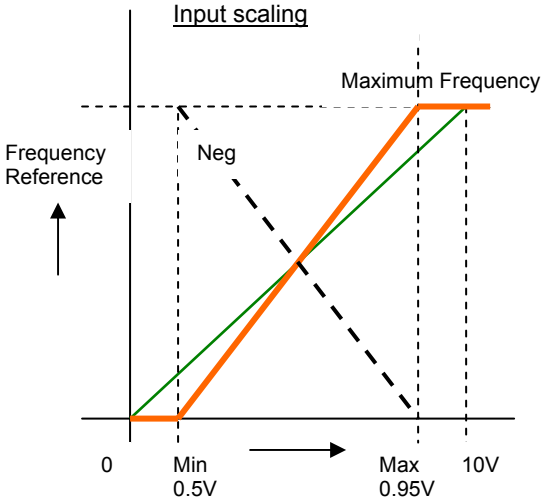
Min → This is the analog input voltage/ current, which is considered as zero reference for the drive controller. As shown in the figure below, Analog input is scaled for new values.

Max→ This is the analog input voltage/ current, which is considered as Maximum reference for the drive controller.

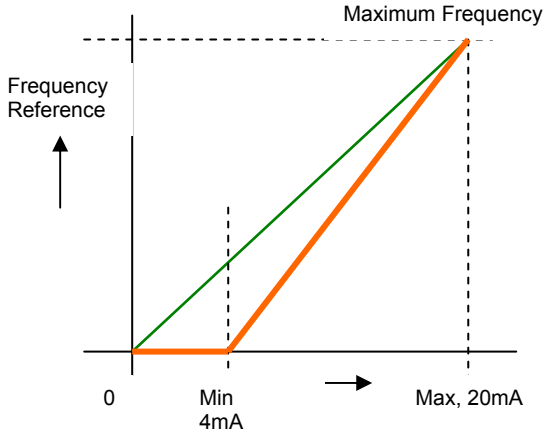
Filt→ This determines the level of filtering or the filter crossover frequency for the analog input.

Neg→ Reference analog voltage/current input from Control TB can be negated or inverted by enabling this parameter.

Min /Max values and Input scaling

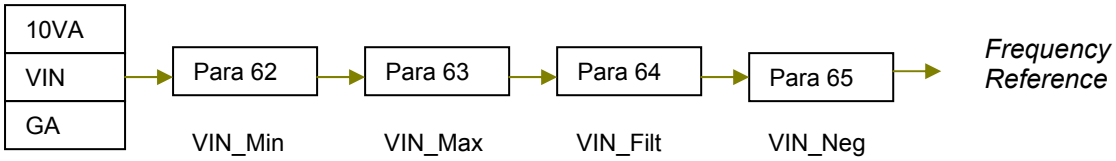


Setting 4-20mA current reference,

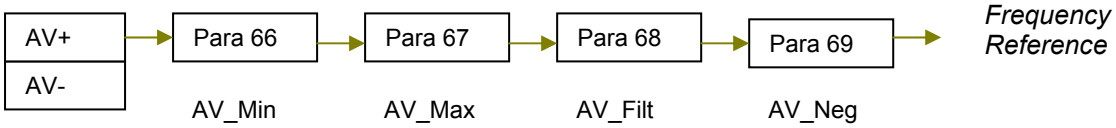


Voltage Input from VIN terminal on TB
Para 03 set to 0001

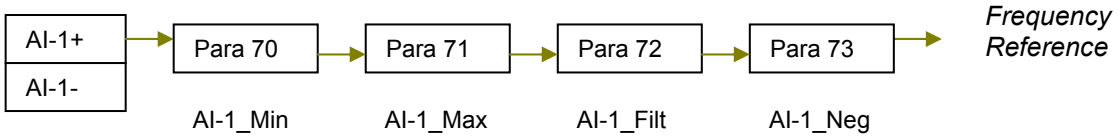
TB Analog input



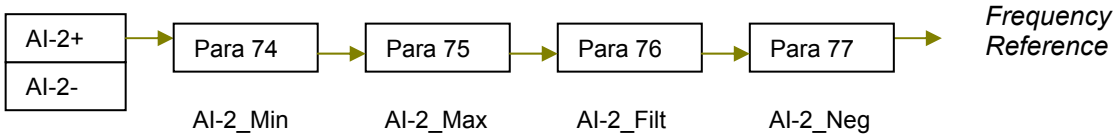
Voltage Input from AV+ / AV-
Para 03 set to 0002



Current Input from AI-1+ / AI-1-
Para 03 set to 0003.



Current Input from AI-2+ / AI-2-
Para 03 set to 0004.



78 PID Enable

PID Controller is enabled with feedback as selected by Parameter 83. The reference will be from Main speed reference parameter 03. The actual control starts after a time delay of PID_time as set by Parameter 79.

79 PID Wait

If PID Control is enabled in Parameter 78, and the start command is given, actual control starts only after the time delay set by this parameter.

80 PID P-Gain

Proportional gain for the PID Loop.

81 PID I-Gain

Integral gain parameter for the PID Loop.

82 PID D-Gain

Differential gain for the PID Loop

83 PID FBack

PID feedback channel selection is to be done using this parameter. Refer to description of Parameter 03 for options available as feedbacks. Main speed reference and PID Feedback chosen must not be from the same input channel. Also, PID Feedback options are limited to Analog inputs only.

84 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.

88 VOut

Drive can be configured to output voltage on Vout terminal on control TB with respect to GA (Gnd). Para 88 can be used to choose the parameters to be output from Vout terminals. All parameters are scaled to +10V level on Vout.

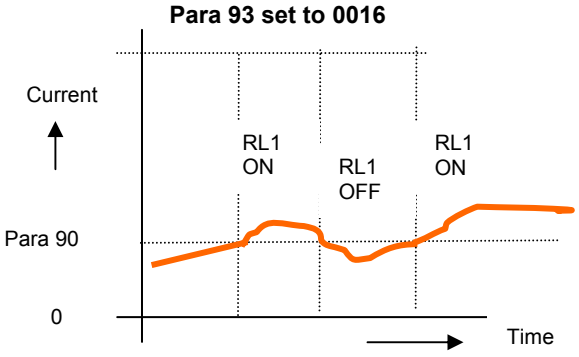
Selection	Parameter	Vout 0 → +10V
0000	Output frequency	00.00 Hz to Max.Frequency ***Para 04***
0001	Output Current	00.00 Amps to 100.0 Amps
0002	Set frequency	00.00 Hz to Max.Frequency ***Para 04***
0003	DC Bus volts	000.0Volts to 840.0 Volts
0004	Voltage Output	Voltage output is the RMS line-to-line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

89 VOut Scaling

The analog output at VOUT TB terminal as selected by Parameter number 88, is scaled from 0 → 100% based on this parameter. For example, if the Frequency set is the output selected for VOUT, at 50 Hz maximum frequency, VOUT will output +10V at 100% VOut_Scaling, whereas, at 50% VOut_Scaling, output will be +5V. This helps in calibration of the analog output.

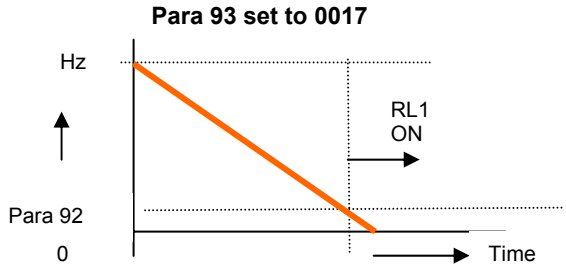
90 OL Warn

Programmable relay RL1 on Control card can be operated for over load warning. OL Warn data set here is the percentage of motor current for which Relay RL1 switches ON. This is based on the selection of RL1 function in ***Para 93.***



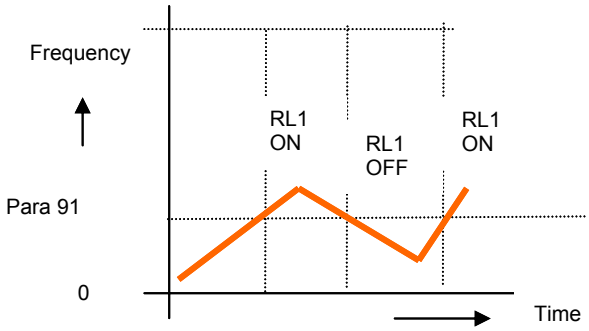
91 Freq Det

Programmable relay RL1 on Control card can be operated for Detecting whether running frequency has crossed the frequency set here. This is based on the selection of RL1 function in ***Para 93.***



92 Stop Signal Frequency

Programmable relay RL1 on Control card can be operated for stop detection. Whenever, stop command is issued and frequency drops below this level RL1 is operated. This is based on the selection of RL1 function in ***Para 93.***



93 RL1 Select *(Programmable relay)*

Programmable relay RL1 on Control card can be operated for various conditions of the drive. Select the functionality required using this parameter.

94 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 positions.

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 2nd fault is of Under voltage*

98 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

99 Restart Timeout

When Restart with Set frequency is enabled using parameter 21, if the DC Bus voltage regains within the time period set here, the drive starts with Set frequency or otherwise, drive starts with starting frequency(of 1 Hz).

100 Software version

Displays **Software version** (for reference only).

101 Master-Slave Mode

Refer to description on “Serial Communication Interface” .

102- 106 Serial Communication related parameters

For more information, refer to

1) Serial communication manual.

2) Synchronization of drives manual.

115 Service Key

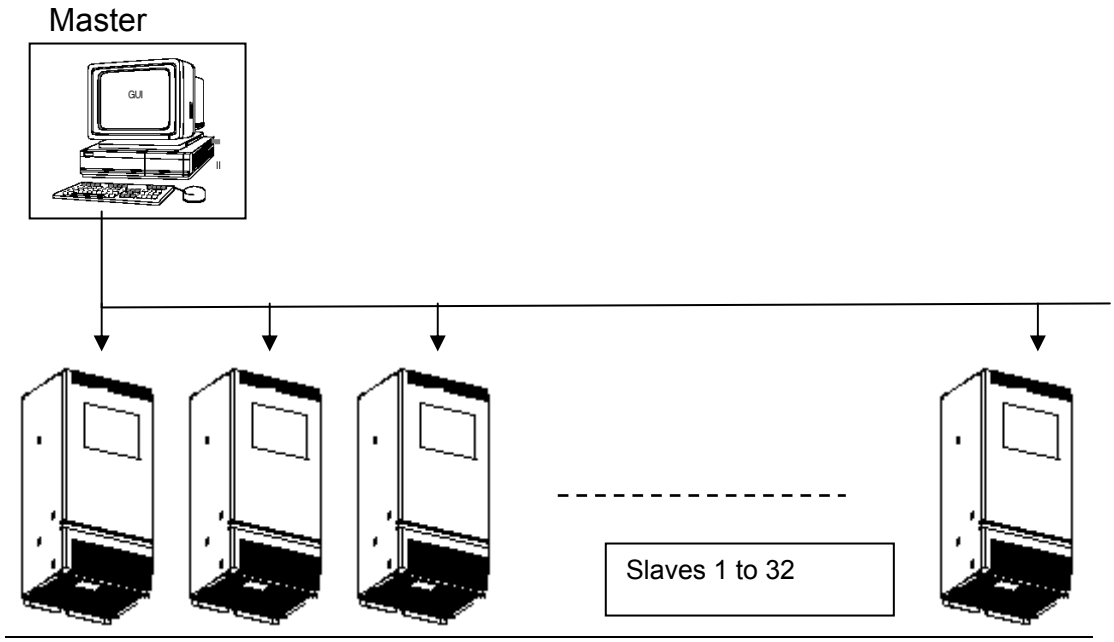
This parameter is for use by authorized service personnel.

10. SERIAL COMMUNICATION INTERFACE

The drive controller can be remotely controlled with RS485 link provided on Connector CN4,5.
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 101**, it should be ensured that the Slave address of the controller is unique among the other slaves. Programming 0002 in **Para 101** 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 101**, 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, AV+/ AV- 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, Heat sink 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

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 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

Do not touch power connection TBs until DC Bus voltage is completely discharged

While plugging in or removing a connector ensure not to put much force on connector housings, which are soldered to the PCB.

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.

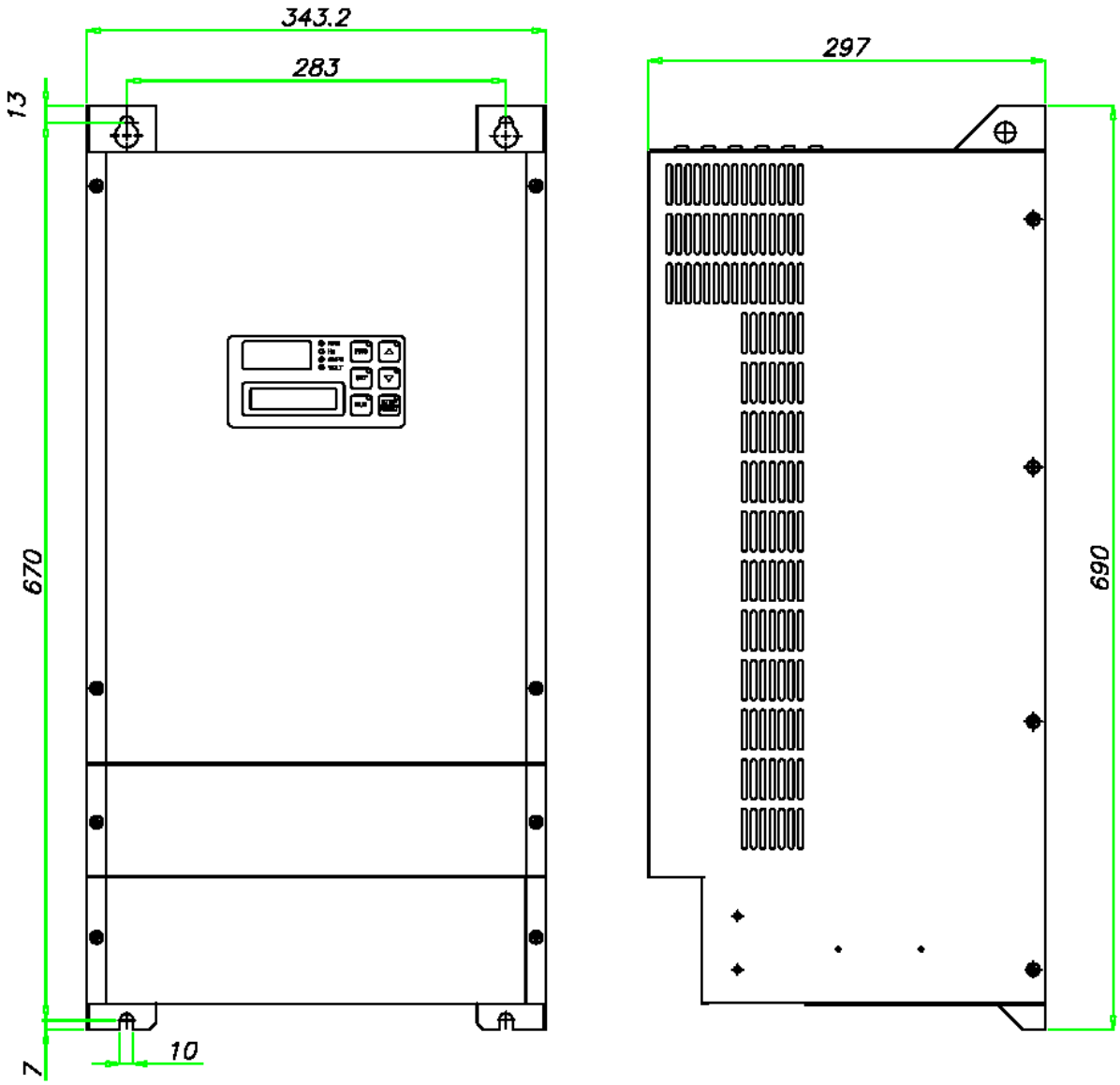
★ **Important Notes on Measurement of voltages**
Measurement of DC Voltage can be done between Power terminals POS and NEG. For 415 V 3-Phase AC inputs, the DC voltage expected is around 550V Average Measurement of Input AC voltages can be done at INPUT terminals between R-Y,Y-B and B-R. The line-to-line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

Trouble shooting

Display	Description	Check
dCLo	• 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 Ready To Run Mode. • After Power-up, if the drive input voltage falls and goes below UV level of 380V DC, display shows dCLo. If Re-start parameter Para 21 is set as 0000, drive will trip for UV	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. Check for proper 3-Phase connection at the input terminals
dCOv	• Displayed when DC Bus measured by the controller is more than 760 V DC	If this fault appears before Run command is given, verify the input AC RMS voltage. If fault appears when drive is decelerating, Deceleration time is very short for the load inertia. Increase the deceleration time. If optional brake unit is used, check brake terminal connections and Braking resistor value
dCUv		Check for proper 3-Phase connection at the input terminals. If the fault persists even when input voltage is OK, DC bus capacitor/ balancing resistor or the IGBT device may be faulty.

OCA	• Over current during acceleration is displayed when the load current crosses more than 200% of the motor current during acceleration.	Acceleration time is to be increased. Check whether drive rating is sufficient for motor connected. If the fault persists even when Acceleration time is high, problem may be due to wrong output connection.
OCD	• 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	• Over current during steady state operation of the drive.	This can happen due to sudden application of load or load oscillations.
HSOT	• Heat sink over temperature	Check whether DC cooling fan on top of the drive is working. Measure the output current using a clamp-on meter and check whether load current is within the range of drive capacity
IOL	• 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	• Motor thermal trip	
SC	• Output short circuit trip	There is short circuit at the output terminals. Check for connections from drive output to motor terminals.
SEr	• Serial communication Error Drive configured as slave in RS485 network is not getting Messages	Check Serial Cable interface Check whether master is configured to send messages within time-out period If required, increase the time-out period
uBAL	Output current from drive to the motor has unbalance.	Check for connections from drive output to motor terminals. OR Problem with Motor winding in case of Re-wound motors

12. MOUNTING DIMENSIONS



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