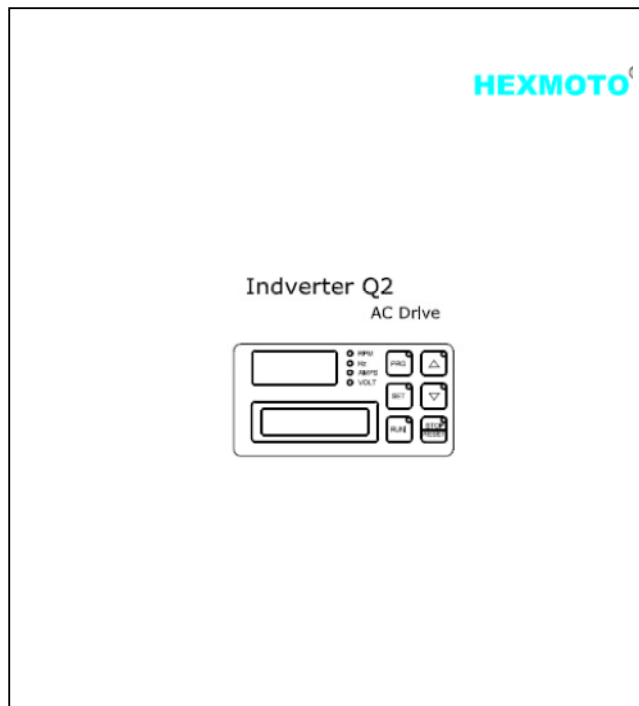


Q2 – General

Ratings: 37kW~75kW

Indverter – Q2

User Manual



Rev 2 2nd August 2014

Rev 0	:	06.03.2014	Initial Release	34.00
Rev1	:	22.04.2014	Software version 34.01 AUTO Run feature introduced	
Rev2	:	02.08.2014	Software version 32.21 Description on AUTO RUN, Multi Speed added	

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Introduction

Dear Customer,

We thank you for buying our “Inverter-Q2” 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 Q2 series controller. Term is used in combination “Drive Module” or separately as “Drive” or “Module” to indicate the Q2 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	37 kW (50 HP)	45 kW (60 HP)	55 kW (75 HP)	75 kW (100 HP)
Applicable Motor output in KW	37.0	45.0	55.0	75.0KW
Inverter Output at 415V in KVA	53.9	69.0	82.7	111.4
Rated Output Current in Amperes	72	96	115.0	155.0
DUTY	HIGH	HIGH	HIGH	LOW
Net Weight (Kg)				
Dimensions (W D H) in mm	335 x 252 x 655	335 x 252 x 655	418 x 338 x 655	418 x 338 x 655

HIGH Duty refers to drive overload rating of 150% for 1 Minute

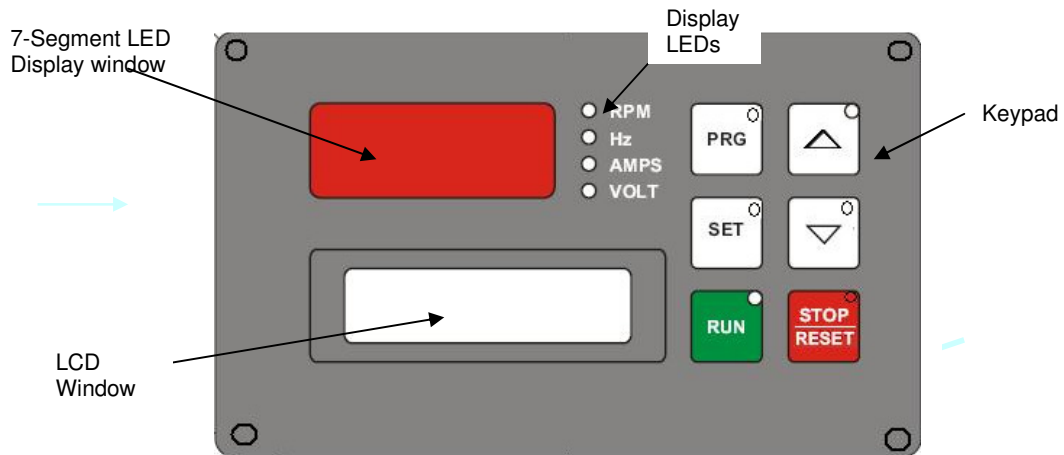
LOW Duty refers to drive overload rating of 110% for 1 Minute









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
	Base Frequency	30 to 400Hz
	Carrier frequency	2kHz to 6kHz (Fixed at 6kHz)
	Frequency setting	Up/Down keys Raise/Lower Switch 0-10V, 0-20mA 4-20mA 8 Preset frequencies with X1, X2 and X3 Serial communication. Programmable digital inputs : X1,2,3,4,5,6(63 possible steps)
	Frequency resolution	Digital: 0.01Hz step up to 100Hz Analog: 0.05Hz step (at Fmax. 50Hz)
	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	(Optionally, braking device will be included in the module, whereas external resistor to be connected)
Indication and Control	Analog output	VOut = 0 → 10V Output (Scalable using software para) IOut = 0 → 20mA Output (Scalable using software para) Programmable for output frequency, Set frequency, RMS Motor current, DC bus voltage and output voltage.
	External output	1No. Fault alarm relay output 2No. Programmable relay output rated for 230V, 2A.
	Display unit	7 segments LED display + 2x16 Line LCD Unit with 6 functions Keypad
	Fault history display	Present fault and up to 9 previous faults.
	Protection	Inverter trip and Error messages
Functions		Stall prevention, Auto restart during power failure
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)
Communication (Optional)	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
	Used as Program Key <ul style="list-style-type: none"> 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 <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 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 <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 ready to run mode. In programming mode, DOWN key is used to decrease Function code or decrease data for a function code.
	Used as RUN Key <ul style="list-style-type: none"> 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
	Used as SET Key <ul style="list-style-type: none"> 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)
	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 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

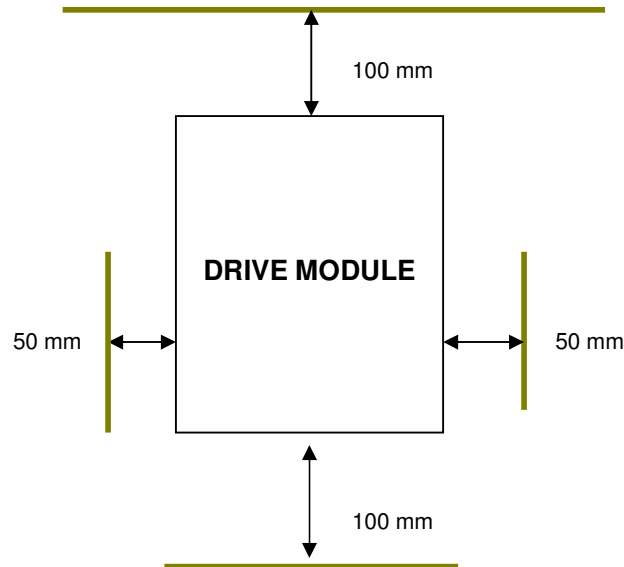
	WARNING
<ul style="list-style-type: none">• Please follow the instructions in the manual before installation and commissioning• Ensure to disconnect all power lines to the drive before handling or commissioning• Input power cable must be connected tightly and the equipment must be grounded securely using 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
<ul style="list-style-type: none">• 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	

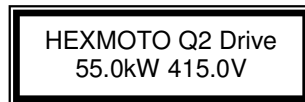
Please follow instructions mentioned below for safe and trouble free installation of Inverter modules.

- 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 LCD display

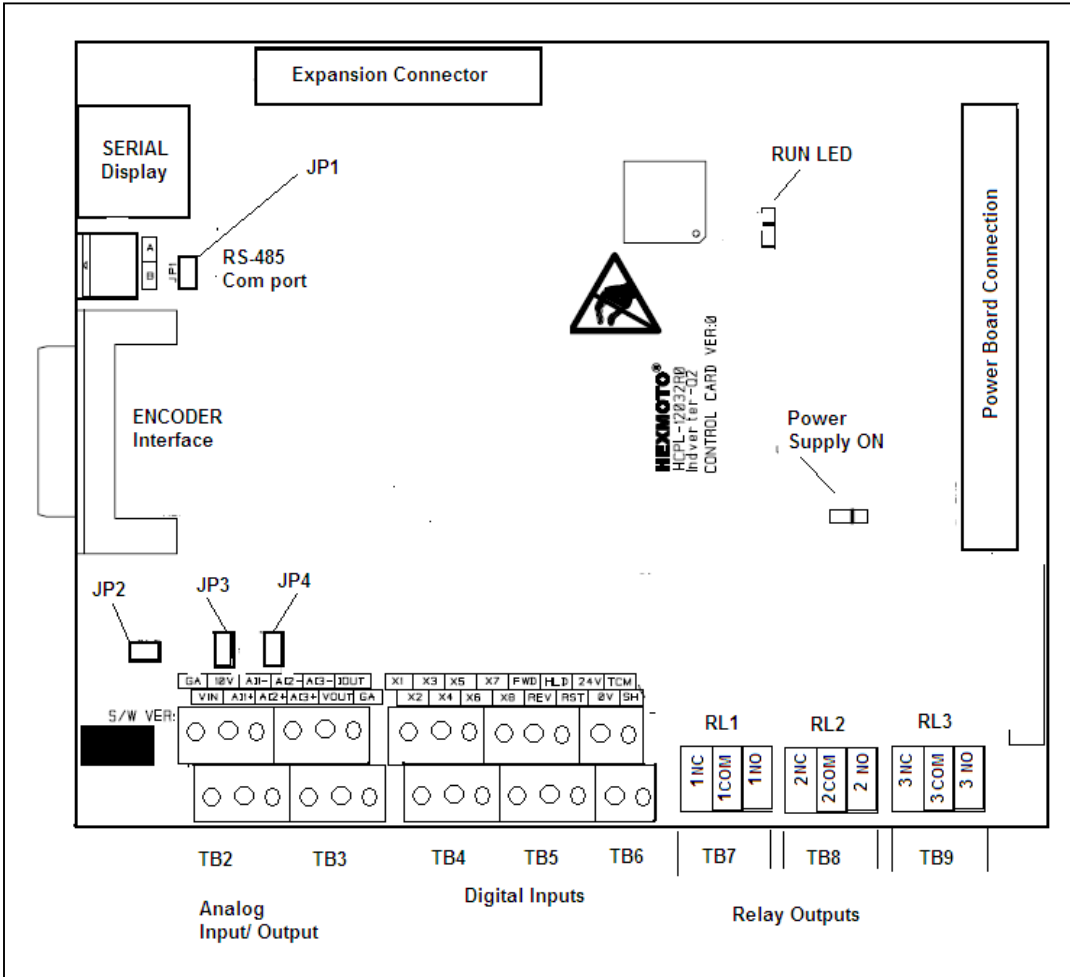


If input voltage is sufficiently high and if there are no faults, drive enters Ready To Run mode.

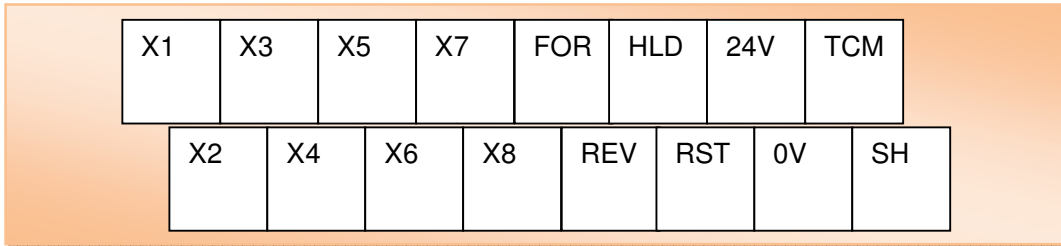
- 8 Close FOR/REV TB input to CM to start drive controller and run the motor. If start command as per **Para 02** is from Display unit, press RUN key to run the motor. Drive enters RUN mode and motor starts rotating in FOR direction.
- 9 Refer to “Maintenance and Troubleshooting” for any problem related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

6. DESCRIPTION OF CONTROL CONNECTIONS

6.1) Overview of the Control card connections



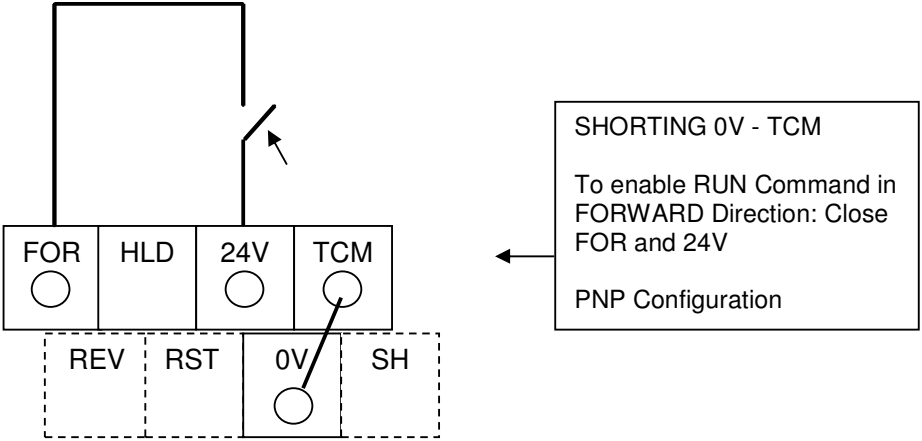
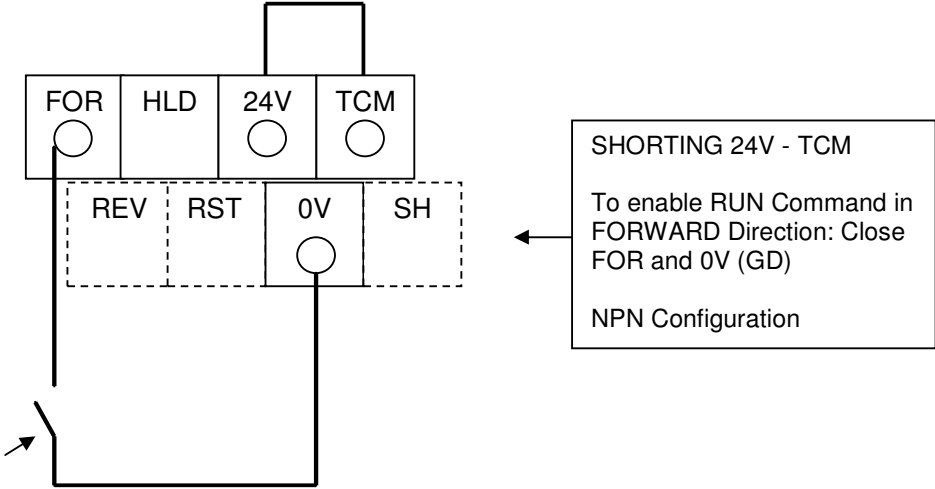
6.2) Digital Inputs on TB 2,3,4



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
X4	X4 / MOTOR THERMAL	Multi-speed Digital Input 4 / MOTOR THERMAL FAULT INPUT. Selection is based on Parameter 34 "THR Input". By default, system works as X4 (Multi Speed). In case this input is selected as MOTOR THERMAL Input, Multi function steps corresponding to X4 are disabled.
X5	X5	Multi-speed Digital Input 5
X6	X6 OR AC1	Multi-speed Digital input OR Selects RAMP values based on Para 29,30. Selection of X6/ AC1 input depends on parameter 154 " X6 TB Func". In case this input is selected as AC1, Multi function steps corresponding to X6 are disabled.
X7	JOG Function	JOG Input, to be operated along with either of FOR/REV inputs.
X8	BX function	BX - Drive output is disabled / stopped as long as this input is ON. On removal of BX input and if START command is present, drive starts again.
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.
24V		Auxiliary voltage source 24V, 100 mA (maximum) with respect to 0V
0V	GND / GD	Common for Auxiliary source
TCM		24V or 0V to be shorted to TCM to select NPN / PNP Configuration for the Digital inputs
SH		Shield Connection

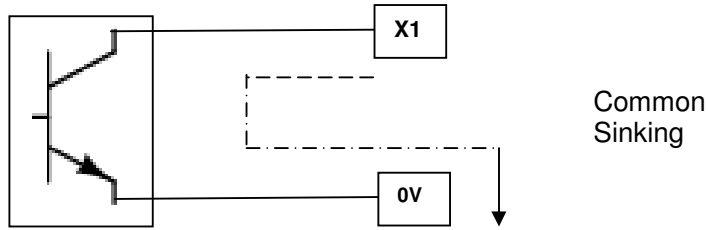
6.3) Input ON/OFF Control

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



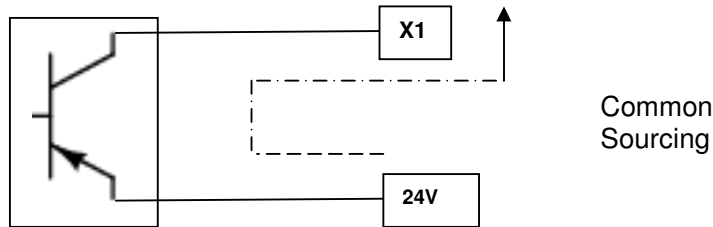
2) External NPN Input from PLC

With 24V and TCM shorted: NPN Connection

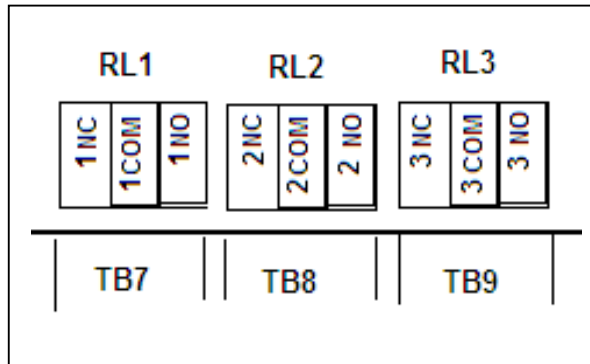


3) External PNP Input from PLC

With 0V and TCM shorted: PNP Connection



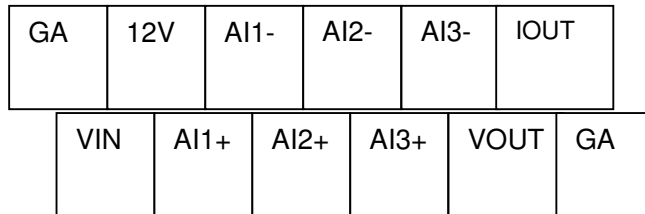
6.4) Relay Outputs on TB7,8,9



	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	Programmable Relay Normally Closed contact (230VAC / 24 VDC, 2A)
	2COM	Programmable Relay Common
	2NO	Programmable Relay Normally Open contact (230VAC / 24 VDC, 2A)
RL3	3NC	Fault Relay Normally Closed contact (230VAC / 24 VDC, 2A)
	3COM	Fault Relay Common
	3NO	Fault Relay Normally Open contact (230VAC / 24 VDC, 2A)

6.5) Analog Input/ outputs on TB5,6

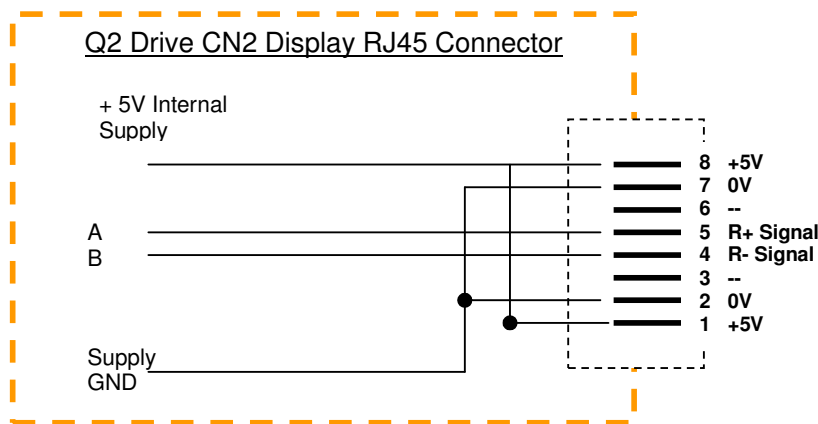


Name	Description
GA	-Potentiometer reference source common -Common for VOOUT -If differential analog inputs AI+ AI- is used with Reference voltage from 12V, connect corresponding AI- to GA
12V	12V Potentiometer reference source. ($1k\Omega \leq R \leq 10k\Omega$)
VIN	Voltage reference input with Potentiometer
VOOUT	0-10V analog output corresponding to the selected variable in the program (refer to parameter number 06, 21)
AI1+	Differential Analog input positive
AI1-	Differential Analog input negative
Jumper JP2 to be inserted to work with 0~20mA Current reference	

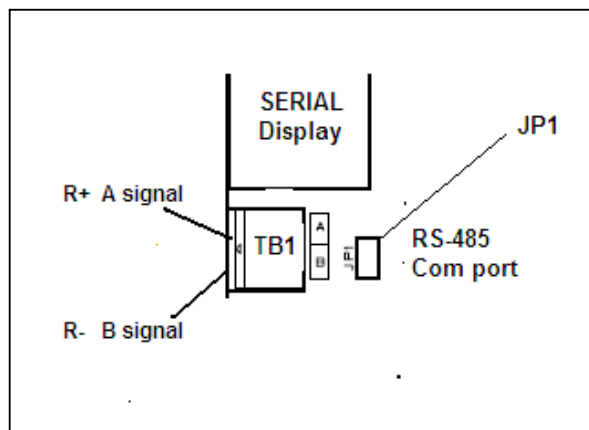
AI2+	Differential Analog input positive 0 – 10V OR 0 ~ 20mA reference
AI2-	Differential Analog input negative Jumper JP3 to be inserted to work with 0~20mA Current reference
AI3+	Differential Analog input positive 0 – 10V OR 0 ~ 20mA reference
AI3-	Differential Analog input negative Jumper JP4 to be inserted to work with 0~20mA Current reference
IOU	0-20mA analog output corresponding to the selected variable in the program (refer to parameter number 07, 24)

6.6) Display and serial interface connections

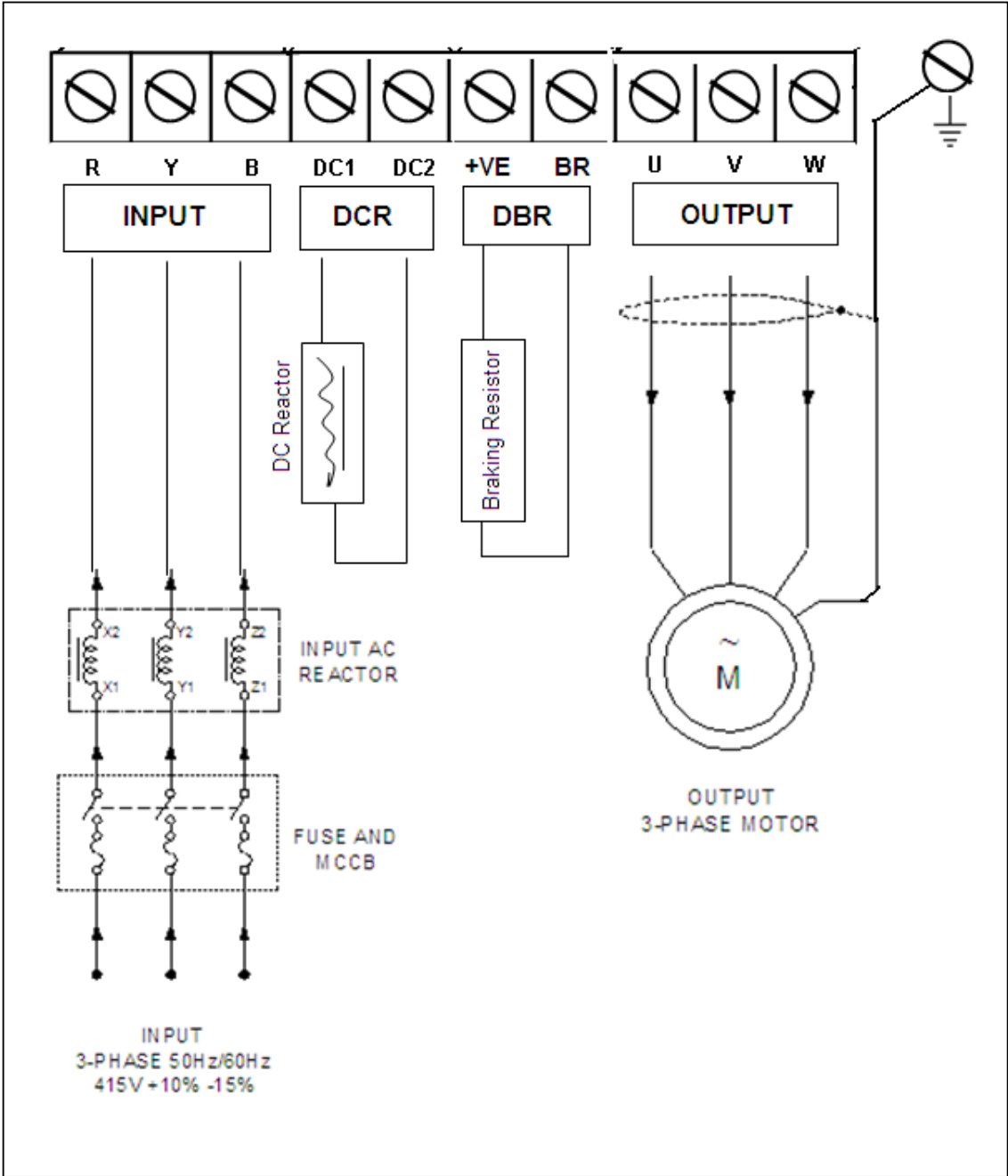
Serial Display Interface



External Serial Communication RS485 MODBUS Interface



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 AI1+/-, AI2+/-, AI3+/- which can work as differential inputs from external source.
- In case 0-20mA or 4-20mA current input is to be used for AI+/- inputs, ensure to put required JUMPER ON THE CONTROL CARD
- Do not short 0V and GA terminals
- Do not short 24V and 0V terminals
- +24V and 0V 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 terminationControl 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

8. LIST OF PARAMETERS

Func Code	Name	Data				
		Selection	Description	Range	Set accuracy	Factory Setting
00	SW version		Shows Software Version used	Read Only		32.21
01	LED display	0000	RPM	0 to 3	0001	0000
		0001	Hz			
		0002	Amps			
		0003	DCBus			
02	Control Location	0000	Keypad Display Unit	0 to 4	0001	0001
		0001	2-Wire TB FOR/REV			
		0002	3-Wire TB FOR/REV + HLD			
		0003	Serial + TB FOR/REV			
03	Main spd Ref	0000	From Keypad Digital	0 to 9	0001	0000
		0001	Analog VIN TB Volts In			
		0002	Analog AI_1+/- TB Ana In Volts/Current			
		0003	Analog AI_2+/- TB Ana In Volts/Current			
		0004	Analog AI_3+/- TB Ana In Volts/Current			
		0005	Serial interface			
		0006	Raise-Lower Stop 0			
		0007	Raise-Lower TB-Norm			
		0008	Raise-Lower App 1			
0009	Raise-Lower App 2					
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	Ana OutSel-V VOUT	0000	Set Frequency	0000 – 0004	0001	0001
		0001	Run Frequency			
		0002	RMS Output Current			
		0003	DC Bus volts			
		0004	RMS O/p Voltage			
07	Ana OutSel-I IOUT	0000	Set Frequency	0000 – 0004	0001	0001
		0001	Run Frequency			
		0002	RMS Output Current			
		0003	DC Bus volts			
		0004	RMS O/p Voltage			
08	Acceln time	Seconds	Acceleration time to reach maximum speed	1.0 to 9999	0.1 1Sec for > 1000	10.0
09	Deceln time	Seconds	Deceleration time to reach zero speed from maximum speed	0.5 to 9999	0.1 1Sec for > 1000	30.0
10	Torque boost	%	Initial torque boost voltage in % of output voltage	0 - 100	0001	0005
11	Freq of Boost	%	% 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	28.80
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	115 Amps
15	Thermal OL	0000	No overload function	0000 - 0002	0001	0001
		0001	Forced Cooled motor			
		0002	Self-cooled motor			

Func Code	Name	Data				
		Selection	Description	Range	Set accuracy	Factory Setting
16	JOG Accln time	Seconds	Acceleration time	1.0 to 9999	0.1 1Sec for > 1000	10.0
17	JOG Decln time	Seconds	Deceleration time	0.5 to 9999	0.1 1Sec for > 1000	10.0
18	JOG Frequency	Hz	When JOG input is enabled in TB	00.00 – Para 04	00.01	05.00
19	UV Trip Latch	0000	Trip and Latch	0000 - 0002	0001	0001
		0001	Stop and Start with start frequency			
20	PWM Frequency	kHz	Switching frequency of the power devices for PWM generation	To be modified by authorized service personnel only		0006
21	AnaOut VScale	0 ~ 100%	Analog Voltage output VOut for metering can be scaled to the required value	0 ~ 100	0001	100%
22	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				
		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					
23	Fault Memory	00	Latest Fault information	00 – 09		00
		01-09	Previous faults	<i>This parameter is Read-Only, not modifiable</i>		
24	AnaOut IScale	0 ~ 100%	Analog Current output 0 ~ 20mA, may be scaled to required value by setting this parameter	0 ~ 100	0001	100%
25	Stop Type	0000	Stop with Deceleration		01	00
		0001	Free stop			

26	RL2 Select Conditions for which RL2 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				
		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					
27	DC Bus at Fault	Volts	Shows DC Bus voltage that was measured during last fault condition.		Read Only	000.0
28	Freq at Fault	Hz	Shows Running Frequency during last fault condition.		Read Only	00.00
29	Cur at Fault	Amps	Shows Current that was measured during last fault condition.		Read Only	00.00
30	Detect Frequency	Hz	Frequency Detection level Refer to Para 22	01.00 – Para 04	00.01	10.00
31	Stop Sig Freq	Hz	Frequency at which Stop signal is generated when decelerating. Refer to Para 22	01.00 – Para 04	00.01	01.00
32	Check Dig In		Shows Conditions of Digital inputs for Interfacing.	Read Only		--
33	Reserved					
34	THR Input	Enable / Disable	If Enabled, Motor Thermal NC contact is expected to be connected to X4 and 0V terminals		Disabled	
35	Para Lock	0 or 1	Disable Parameter protection here first, before updating any parameter			0000
36	STALL Dec	0.1 to 20.0 Seconds	If there is increased output current due to Motor stalling, drive controller decelerates motor with this deceleration value.	0.1 to 999.9 Seconds	0.1	10.0
37	OC Trip Level	30 ~ 250 Amps	RMS output current at which drive trips for Over Current	30 ~ 250	1	230
Parameters from 38 ~ 41 are Reserved						
42	Freq Low Limit	0 – 99%	%age of maximum frequency		1	0%
43	Freq High Limit	0 – 100%	%age of maximum frequency		1	100%
44	CatchOnFly	Disable Enable		By default Disabled		
45	CFly Current	%	Set this to 100% Motor current / load current			

Func Code	Name	Data				
		Selection	Description	Range	Set accuracy	Factory Setting
46	Acc time-1	Seconds	Acceleration time selected when AC1 TB is operated	1.0 to 9999	0.1 1Sec for > 1000	10.0
47	Dec time-1	Seconds	Deceleration time selected when AC1 TB is operated	0.5 to 9999	0.1 1Sec for > 1000	10.0
48	Vin-Min	%	Minimum value for Analog input through VIn TB	0~ 99%	1	5%
49	Vin-Max	%	Maximum value for Voltage input through VIn TB	0 ~ 100%	1	95%
50	Vin-Filt	0000	No Filter	0000 – 0006	0001	0002
		0001 to 0006	50Hz to 1 Hz Digital filter cut-off frequency			
51	Vin-Neg	0000	No inversion	0000 – 0001	0001	0000
		0001	Analog input is inverted			
52	AI1- Min	%	Minimum value for Analog input through AI1 TB	0 ~ 99%	1	0
53	AI1- Max	%	Maximum value for Voltage input through AI1+/ AI1- TB	0 ~ 100%	1	100
54	AI1- Filt	0000	No Filter	0000 – 0006	0001	0002
		0001 to 0006	50Hz to 1 Hz Digital filter cut-off frequency			
55	AI1- Neg	0000	No inversion	0000 – 0001	0001	0000
		0001	Analog input is inverted			
56	AI2-Min	%	Minimum value for Current input through AI2+/ AI2- TB	0 ~ 99 %	1	0
57	AI2-Max	%	Maximum value for Current input through AI2+/ AI2- TB	0 ~ 100%	1	100
58	AI2-Filt	0000	No Filter	0000 – 0006	0001	0002
		0001 to 0006	50Hz to 1 Hz Digital filter cut-off frequency			
59	AI2-Neg	0000	No inversion	0000 – 0001	0001	0000
		0001	Analog input is inverted			
60	AI3-Min	%	Minimum value for Current input through AI3+/ AI2- TB	0 ~ 99 %	1	0
61	AI3-Max	%	Maximum value for Current input through AI3+/ AI3- TB	0 ~ 100%	1	100
62	AI3-Filt	0000	No Filter	0000 – 0006	0001	0002
		0001 to 0006	50Hz to 1 Hz Digital filter cut-off frequency			
63	AI3-Neg	0000	No inversion	0000 – 0001	0001	0000
		0001	Analog input is inverted			
64	OL Warn	%	Over load warning level <i>Refer to Para 22</i>	0000 – 0200	0001	0100

Func Code	Name	Data							
		Selection	Description	Range	Set accuracy	Factory Setting			
65	Serial Mode Serial Port at TB1	0000	Disable Serial Communication	0000 – 0033	0001	0002			
		0001	Enable as Master	For serial port at TB1	0001	0002			
		0002 – 0033	Enable as slave with address 1 to 32 Refer to “Serial Communication Interface”						
66	Ser Baud Rate	0000	4800 bps	0000 to 0003	0001	0001			
		0001	9600 bps						
		0002	19200 bps						
		0003	38400 bps						
67	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						
68	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						
69	Ser Flt Act	0000	No Warning			0000			
		0001	Warning						
		0002	Trip for Fault						
70	Serial Bias	0 – 99%	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			
71	Arun Mode	0000	Auto Run Disabled			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						
		0005	Use Reference frequency and Multi-1 set frequency, alternatively. Refer to AUTO Run mode description						
72	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					

73	AutoRun Time-1	Seconds	Time for which drive runs in Multi-1 Speed	0001 to 9999	0001	0000
74	AutoRun Time-2	Seconds	Time for which drive runs in Multi-2 Speed	0001 to 9999	0001	0000
75	AutoRun Time-3	Seconds	Time for which drive runs in Multi-3 Speed	0001 to 9999	0001	0000
76	AutoRun Time-4	Seconds	Time for which drive runs in Multi-4 Speed	0001 to 9999	0001	0000
77 ~ 80	Not implemented					
81	AutoRun Ramp-1	Seconds	Acceleration time for AUTO RUN Step1	1.0 to 9999	0.1	10.0
82	AutoRun Ramp -2	Seconds	Acceleration time for AUTO RUN Step2	1.0 to 9999	0.1	10.0
83	AutoRun Ramp -3	Seconds	Acceleration time for AUTO RUN Step3	1.0 to 9999	0.1	10.0
84	AutoRun Ramp -4	Seconds	Acceleration time for AUTO RUN Step4	1.0 to 9999	0.1	10.0
85 ~ 88	Not implemented					
89	Multi-Spd-Entry	0 or 1	Setting multi speed Entry to 1 will enable viewing of all multi speed entries starting from parameter "90 MultiSpd-1" to "152 MultiSpd-63". Normally with Multi-Spd-Entry set to 0, the above said parameters are not available for viewing / Modification.			0
90 ~ 152	MultiSpd-x	1.0 to 400.0 Hz or the maximum frequency set by Para 3	All multi speed settings from "90 MultiSpd-1" to "152 MultiSpd-63" are based on X1 to X6 TB Inputs. Refer to description of Multi speed parameter for more details			0
153	Reserved					
154	X6 TB Func	0	X6 Multi speed TB input			0
		1	AC-1 input			
155 ~ 157	Reserved					
158	Service Paswd	Enter service password here to proceed to next set of parameters.				0000
Parameters from 159 ~ 168 are for factory use only						

9. DESCRIPTION OF PARAMETERS AND PROGRAMMING

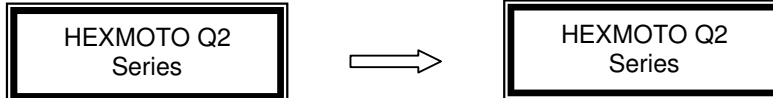
Function codes and data for setting up drive functionality are described below in detail. Understanding different modes of operation of drive controller is essential before setting up the drive parameters.

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.




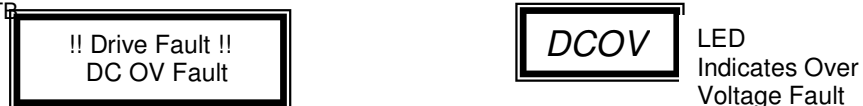
Programming Mode

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 modify data.



Fault Mode

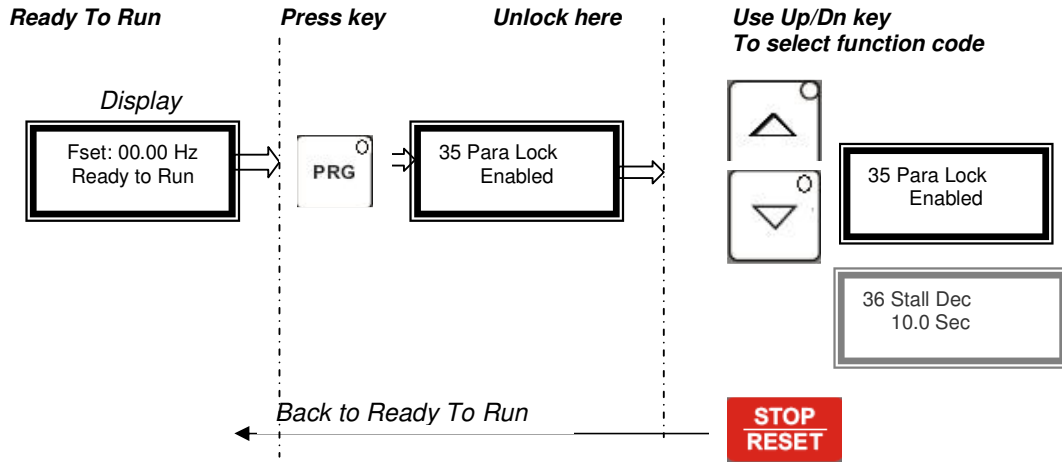
Drive enters fault mode if it encounters any fault when it is running. The fault can be reset only if the system returns to healthy condition. For resetting of faults, use  button on the display Keypad or use RST input from TB



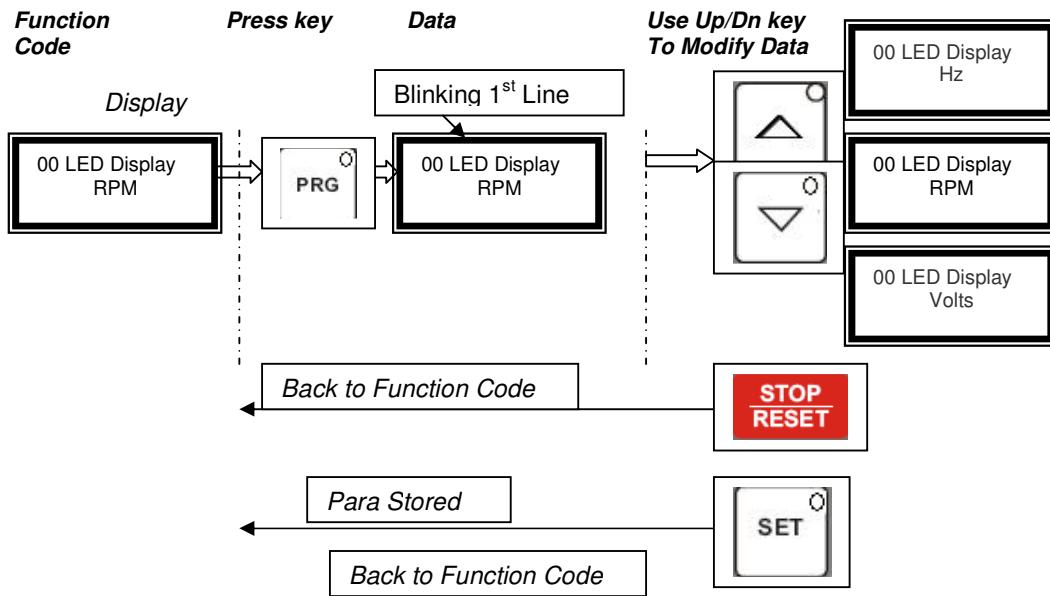
* Refer to "Maintenance and Troubleshooting" Chapter for more details

Programming the Drive Module

Step-1 Parameter LOCK and selecting function code



Step-2 Modify Function data



It is important to set correct Password at Parameter 35 to view/ Modify any other parameter value

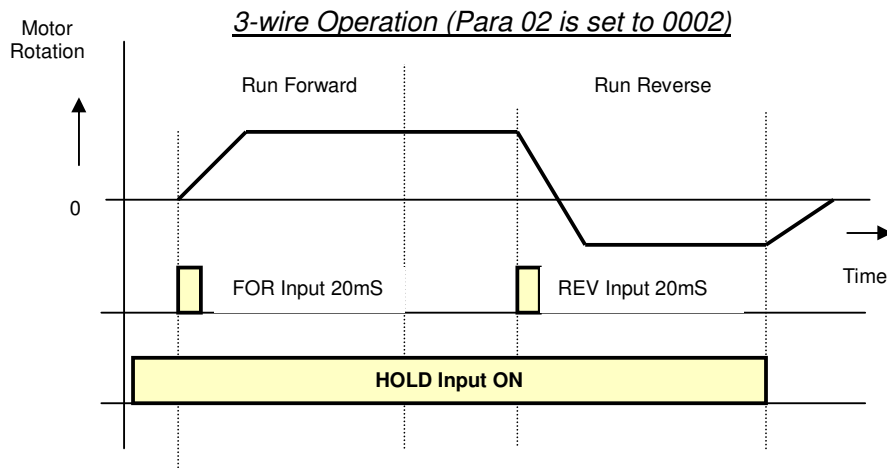
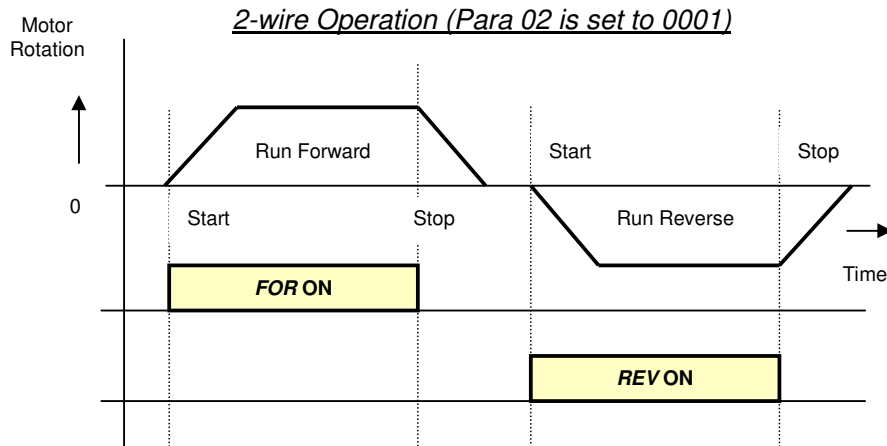
01 LED Display


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*



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

- Setting 0000 → Press  button to start when in Ready To Run mode
- Press  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.

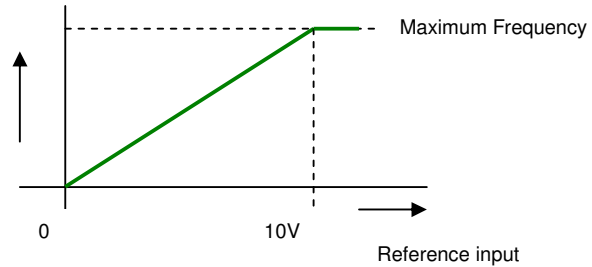
03 Main Speed Reference

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 <i>Para 48-51</i> . |
| 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 <i>Para 52-55</i> |
| 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 <i>Para 56-59</i> |
| 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 <i>Para 60-63</i> |
| 0005 | Reference from Serial communication. If drive is configured as Slave in Para
65, frequency/ speed reference is from Serial communication. |
| 0006 | Function is similar to selection 0007. 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 <i>Run
mode</i> only |
| 0007 | Activating terminal X1 on TB will increase the speed. The digital input X2 will
decrease the speed. If the drive is stopped or switched-OFF, the current
frequency/ RPM are stored in the drive memory. When the start command is
issued, the drive will initially start running at this stored frequency/ RPM. |
| 0008 | Application 1: X2 is not used. Raise frequency when X1 is ON and lower when
X1 is OFF. |
| 0009 | Application 2: Similar to 0007, except that the set frequency returns to
minimum when drive is stopped |

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*

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

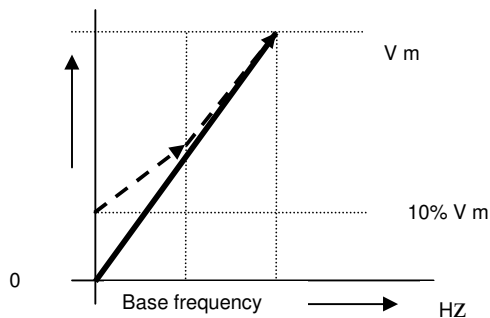
Different motors will have different stator IR drops. This causes drastic torque reduction in some situations at low speed. To overcome this effect, stator voltage is increased at lower speeds and eventually it follows the V/F curve based on the Boost Frequency selection **Para 11**

11 Frequency of Torque boost

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).



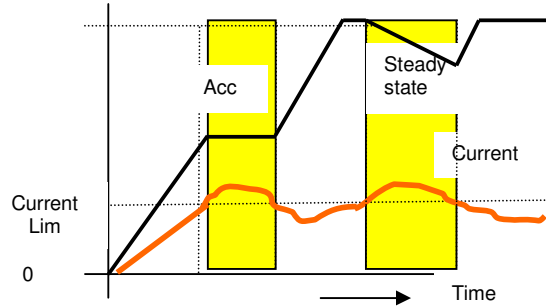
12 RPM Multiplier

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 set to 0001.

Selection 0001

Force Cooled Motor

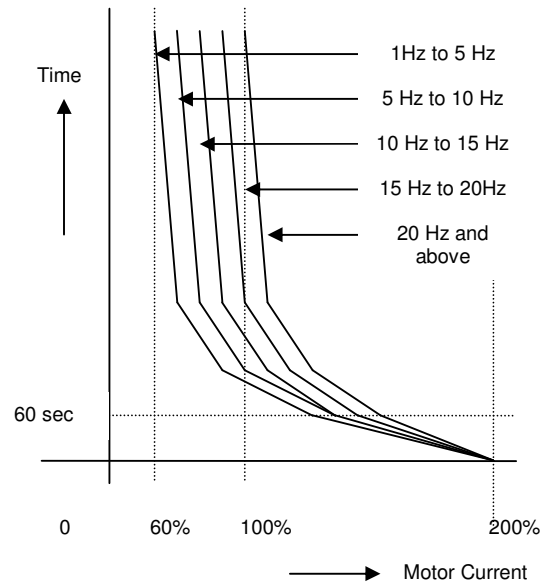
When the motor is cooled from an external fan at fixed speed, the cooling will be same irrespective of the motor speed. Hence the Electronic Thermal Overload Function will act like a standard bimetallic Overload Relay. In the figure, 20Hz and above curve is selected.

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.



16-17 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.

18 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.

19 UV Trip Latch

- 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

20 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.

21 Analog Output

Drive can be configured to output voltage on Vout terminal on control TB with respect to GA (Gnd). Para 21 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 300.0 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

22 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.

23 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 <i>Example: 0201: Recent 2nd fault is of Under voltage</i>
---	--

25 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

27 DC Bus at Fault

This is a Read-only parameter indicating DC bus voltage value at fault condition.

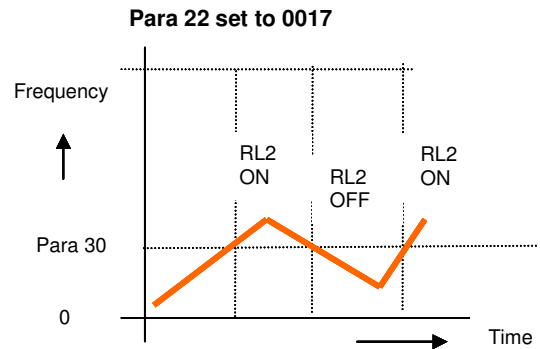
28 Frequency at Fault

This is a Read-only parameter indicating running Frequency value at fault condition.

29 Current at Fault

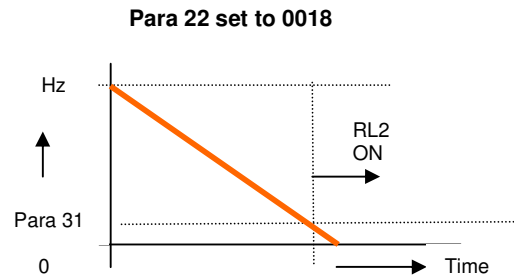
30 Detect Frequency

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 22**.



31 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 22**.



This is a Read-only parameter indicating actual motor current value at fault condition.

32 Check digital Input

This is a read-only parameter to verify whether digital inputs are working as required.
On LCD Display

X1	X2	JOG	BX	FOR	REV	HLD	RST
1	2	J	X	F	R	H	Rs
◆	◆	1	1	◆	◆	◆	◆

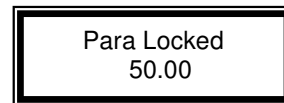
- Input is Open (OFF)
- 1 Input is Closed (ON)

33 Serial Enable

By default, Serial display is always enabled in this version of software.

35 Parameter Lock

To protect un-intentional use of programmable parameters, by default, all parameters are protected against modifications. When this parameter is enabled, LED display shows "Prot" whenever user tries to modify. But user is allowed to view the parameter values on LCD/ LED display. To modify any parameter user must *disable* the Parameter Lock.



- When drive enters RUN Mode, Parameter Lock is enabled automatically.
- By disabling Parameter Lock, user can modify the parameters

38 Service password

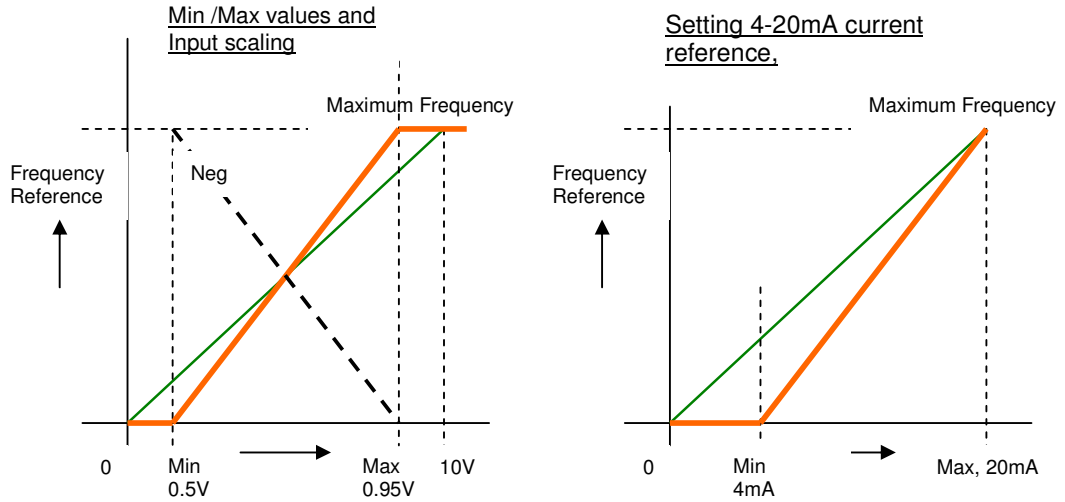
This parameter is for use by authorized service personnel.

46- 47 Acc time-1 -- Dec time-1

Acceleration and deceleration times set here are selected by the drive based on when AC1 TB Digital Input is closed.

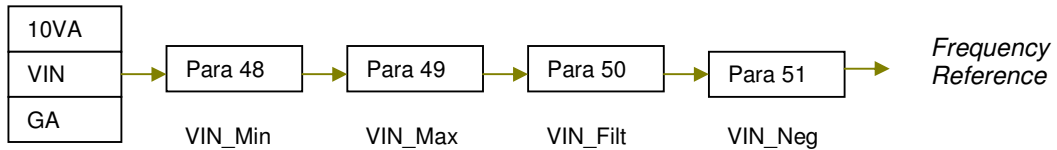
48 – 63 Analog input scaling parameters

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.

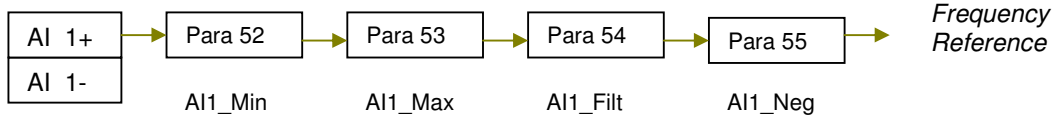


Voltage Input from VIN terminal on TB
 Para 03 set to 0001

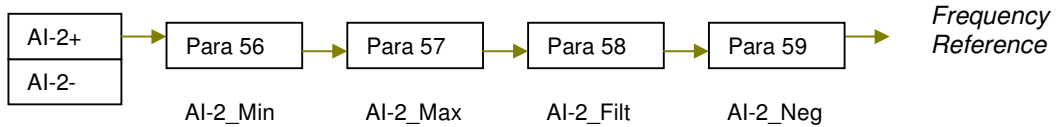
TB Analog input



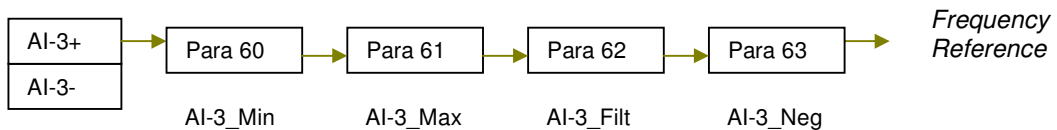
Voltage Input from AI 1+-
 Para 03 set to 0002



Current Input from AI 2+ / AI 2-
 Para 03 set to 0003.

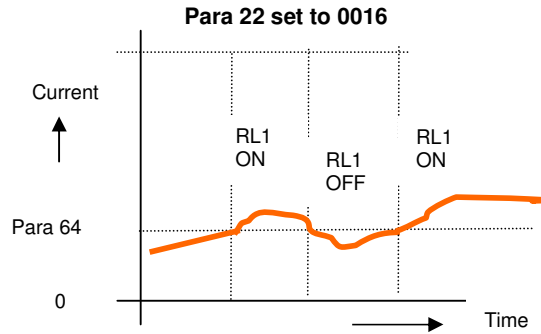


Current Input from AI-3+ / AI-3-
 Para 03 set to 0004.



64 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 22**.



65 Serial Mode

Refer to description on “Serial Communication Interface”.

66- 70 Serial Communication related parameters

For more information, refer to

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

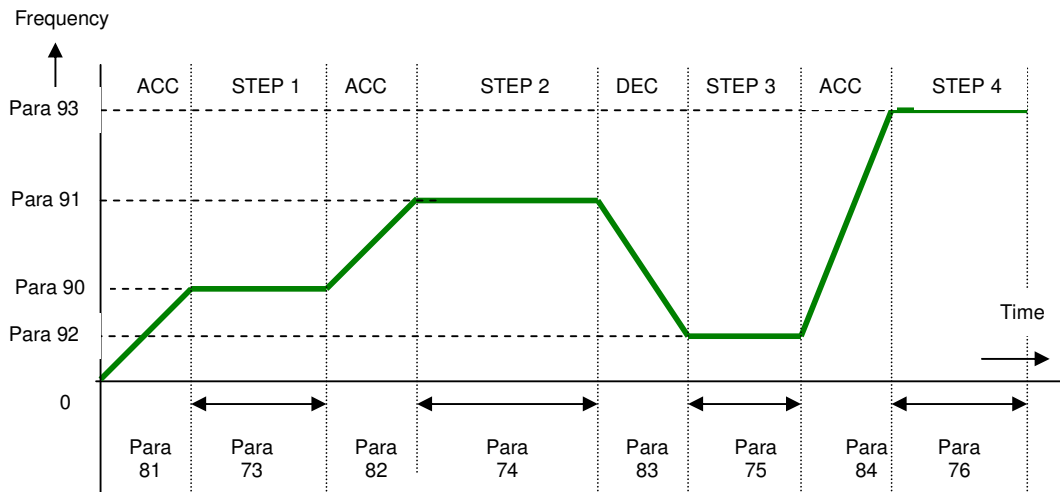
71 AUTORun Mode

Auto run is enabled using this parameter. **Para 90-93** 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 AUTO Run Mode is set to 4, Motor speed is determined by parameter 3.**

73- 76 AUTORun Time

81- 84 AUTORun Ramp

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 90 to 93** determines frequency reference for Step-1 to Step-4. **Para 81 to 84** determines the Acceleration/ Deceleration times for Step-1 to Step-4.



89 Multi-Spd-Entry

User will be able to view / modify the multi-speed frequency references in parameters 90~152 only if Multi Spd Entry parameter is set to 1. If the Multi-spd-Entry parameter is set to 0 (default), controller jumps to parameter 153 after 89.

90 ~ 152 MultiSpd-1 to MultiSpd- 152

Multi speed parameters 90 to 152									
Para	Select		X1	X2	X3	X4	X5	X6	0 = Open 1 = close
			0	0	0	0	0	0	Main Speed Reference in Hz
90	Speed-1		1	0	0	0	0	0	00.80
91	Speed-2		0	1	0	0	0	0	01.60
92	Speed-3		1	1	0	0	0	0	02.40
93	Speed-4		0	0	1	0	0	0	03.20
94	Speed-5		1	0	1	0	0	0	04.00
95	Speed-6		0	1	1	0	0	0	04.80
96	Speed-7		1	1	1	0	0	0	05.60
97	Speed-8		0	0	0	1	0	0	06.40
98	Speed-9		1	0	0	1	0	0	07.20
99	Speed-10		0	1	0	1	0	0	08.00
100	Speed-11		1	1	0	1	0	0	08.80
101	Speed-12		0	0	1	1	0	0	09.60
102	Speed-13		1	0	1	1	0	0	10.40
103	Speed-14		0	1	1	1	0	0	11.20
104	Speed-15		1	1	1	1	0	0	12.00
105	Speed-16		0	0	0	0	1	0	12.80
106	Speed-17		1	0	0	0	1	0	13.60
107	Speed-18		0	1	0	0	1	0	14.40
108	Speed-19		1	1	0	0	1	0	15.20
109	Speed-20		0	0	1	0	1	0	16.00
110	Speed-21		1	0	1	0	1	0	16.80
111	Speed-22		0	1	1	0	1	0	17.60
112	Speed-23		1	1	1	0	1	0	18.40
113	Speed-24		0	0	0	1	1	0	19.20
114	Speed-25		1	0	0	1	1	0	20.00
115	Speed-26		0	1	0	1	1	0	20.80
116	Speed-27		1	1	0	1	1	0	21.60
117	Speed-28		0	0	1	1	1	0	22.40
118	Speed-29		1	0	1	1	1	0	23.20
119	Speed-30		0	1	1	1	1	0	24.00
120	Speed-31		1	1	1	1	1	0	24.80
121	Speed-32		0	0	0	0	0	1	25.60
122	Speed-33		1	0	0	0	0	1	26.40
123	Speed-34		0	1	0	0	0	1	27.20
124	Speed-35		1	1	0	0	0	1	28.00
125	Speed-36		0	0	1	0	0	1	28.80
126	Speed-37		1	0	1	0	0	1	29.60
127	Speed-38		0	1	1	0	0	1	30.40
128	Speed-39		1	1	1	0	0	1	31.20
129	Speed-40		0	0	0	1	0	1	32.00
130	Speed-41		1	0	0	1	0	1	32.80
131	Speed-42		0	1	0	1	0	1	33.60

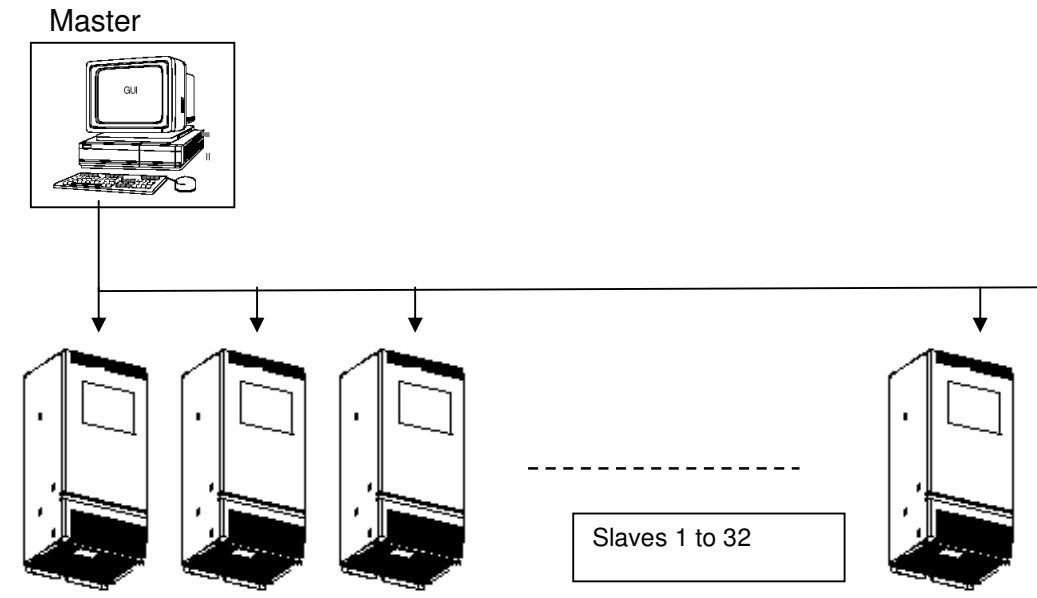
Multi speed parameters									
			X1	X2	X3	X4	X5	X6	0 = Open 1 = close
132	Speed-43		1	1	0	1	0	1	34.40
133	Speed-44		0	0	1	1	0	1	35.20
134	Speed-45		1	0	1	1	0	1	36.00
135	Speed-46		0	1	1	1	0	1	36.80
136	Speed-47		1	1	1	1	0	1	37.60
137	Speed-48		0	0	0	0	1	1	38.40
138	Speed-49		1	0	0	0	1	1	39.20
139	Speed-50		0	1	0	0	1	1	40.00
140	Speed-51		1	1	0	0	1	1	40.80
141	Speed-52		0	0	1	0	1	1	41.60
142	Speed-53		1	0	1	0	1	1	42.40
143	Speed-54		0	1	1	0	1	1	43.20
144	Speed-55		1	1	1	0	1	1	44.00
145	Speed-56		0	0	0	1	1	1	44.80
146	Speed-57		1	0	0	1	1	1	45.60
147	Speed-58		0	1	0	1	1	1	46.40
148	Speed-59		1	1	0	1	1	1	47.20
149	Speed-60		0	0	1	1	1	1	48.00
150	Speed-61		1	0	1	1	1	1	48.80
151	Speed-62		0	1	1	1	1	1	49.60
152	Speed-63		1	1	1	1	1	1	50.40

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 65**, it should be ensured that the Slave address of the controller is unique among the other slaves. Programming 0002 in **Para 65** 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 65**, 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
<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.

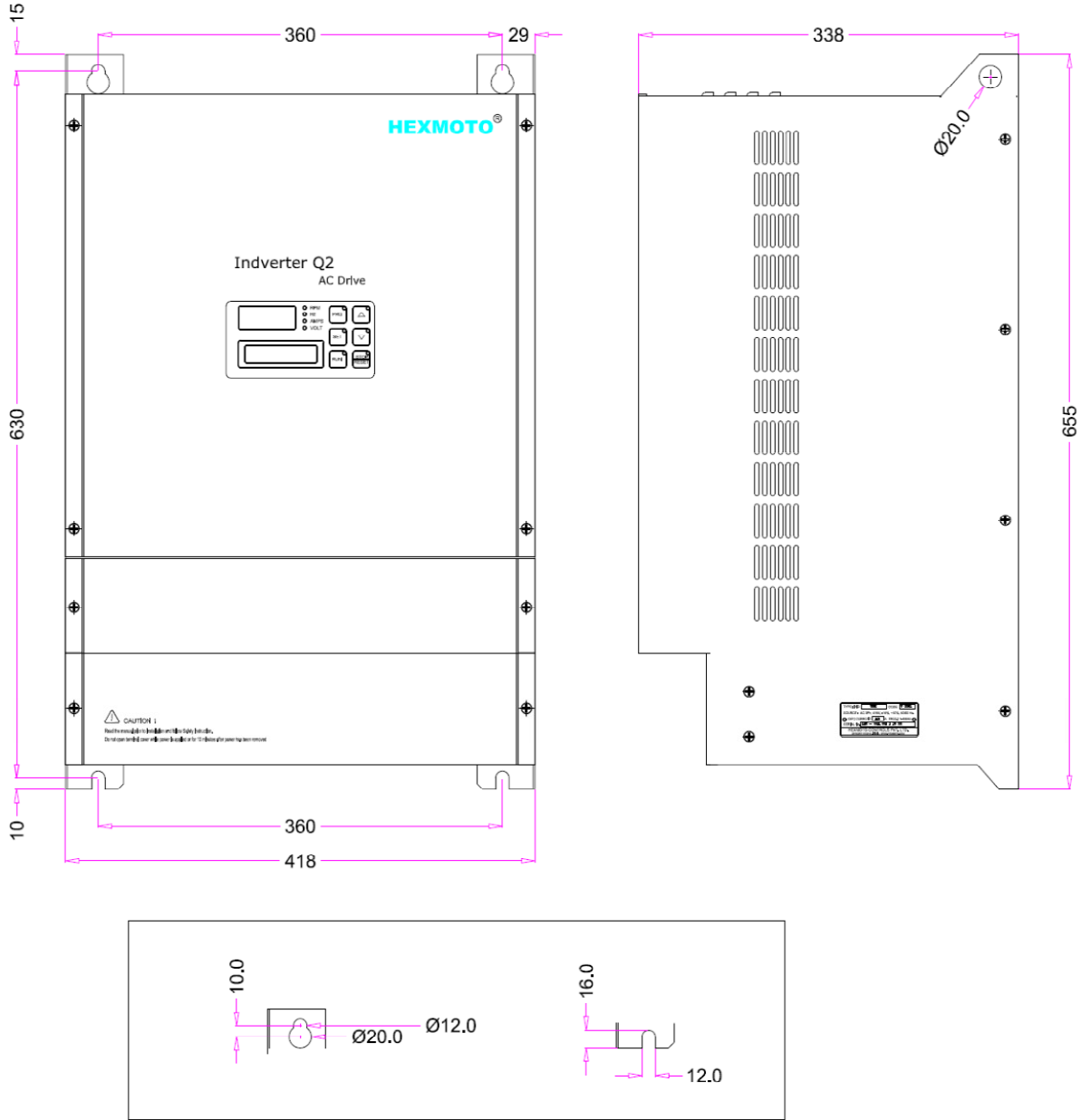
<p>★ Important Notes on Measurement of voltages</p>
<p>Measurement of DC Voltage can be done between Power terminals POS and NEG. For 415 V 3-Phase AC inputs, the DC voltage expected is around 550V Average</p> <p>Measurement of Input AC voltages can be done at INPUT terminals between R-Y,Y-B and B-R.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

Trouble shooting

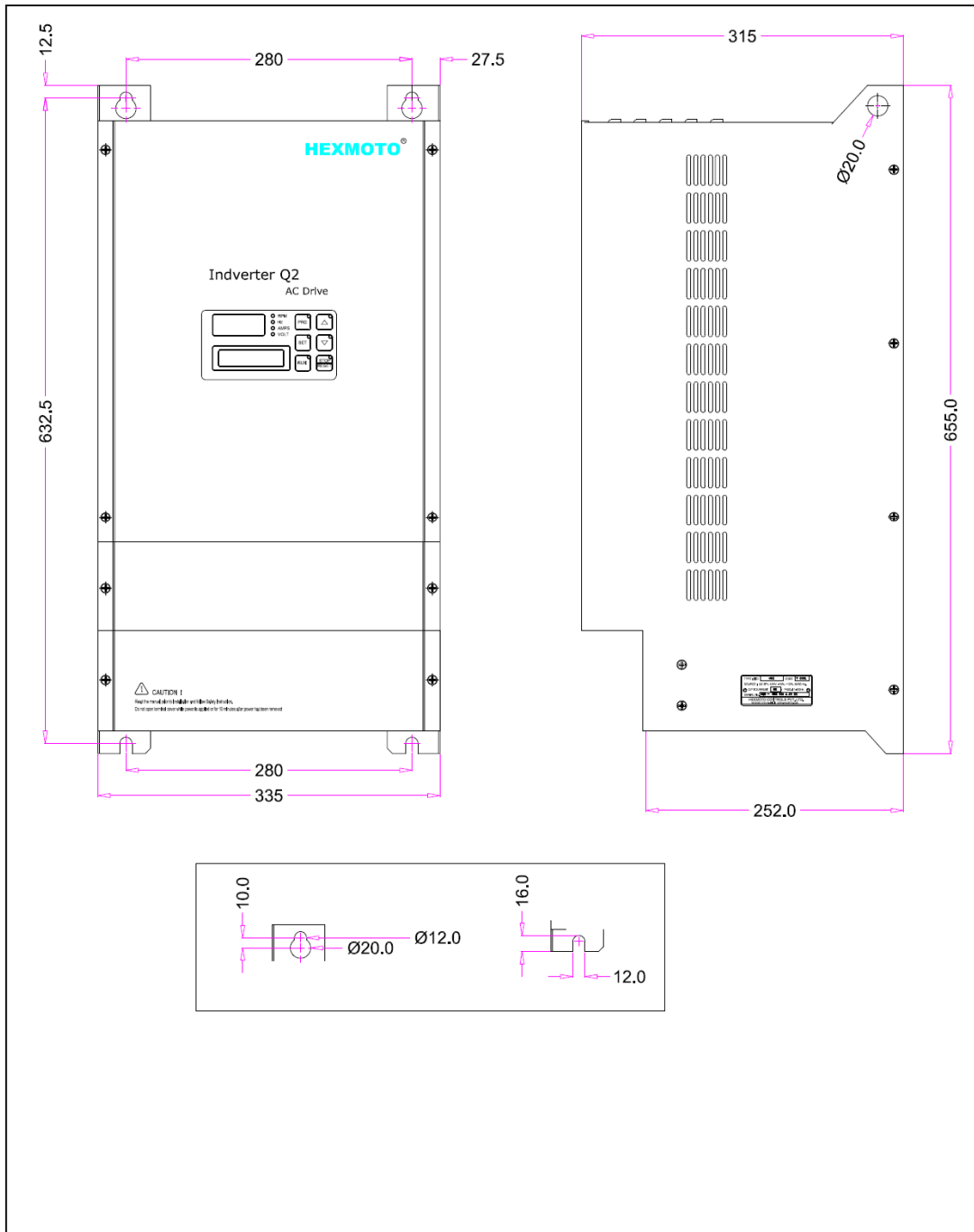
Display	Description	Check
<div style="border: 2px solid black; padding: 5px; width: fit-content; margin: auto;">dCLO</div>	<ul style="list-style-type: none"> Displayed when input 3-Phase power supply voltage is less. During start-up DC Bus voltage is expected to be at least 400V DC. Otherwise, system will wait for input voltage to build-up before entering 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 	<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: 2px solid black; padding: 5px; width: fit-content; margin: 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: 2px solid black; padding: 5px; width: fit-content; margin: auto;">dCUv</div>		<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: 2px solid black; padding: 5px; width: fit-content; margin: 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>

		If the fault persists even when Acceleration time is high, problem may be due to wrong 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>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 	
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 	<p>Check Serial Cable interface Check whether master is configured to send messages within time-out period If required, increase the time-out period</p>
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
nTC	"! NTC Open !" If there is a connectivity problem with the NTC connection to the PS&GD. NTC Open fault is sensed.	Check for NTC Harness connection from PS&GD board to the NTC on the heatsink

12. MOUNTING DIMENSIONS



55kW / 75kW module mounting dimensions



37kW / 45kW Module mounting dimensions

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