Instruction Manual

Axpert-Opti torque

200V System, 15kW (20Hp) ~ 500kW (670Hp)
400V System, 30kW (40Hp) ~ 710kW (950Hp)
500V System, 37kW (50Hp) ~ 800kW (1075Hp)
600V System, 45kW (60Hp) ~ 900kW (1205Hp)

NOTICE

1. Read this manual thoroughly before using the Axpert-Opti torque, and store in a safe place for reference.
2. Make sure that this manual is delivered to the final user.

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PREFACE

THANK YOU for purchasing the "AMTECH ***Axpert-opti torque*** Electronic Soft Starter".

Axpert-opti torque Electronic Soft Starter is a modern Digital Signal Processor based highly functional Soft Starter that is easy to use.

PLEASE READ THIS MANUAL THOROUGHLY before use, and keep the manual at hand for later reference. Also make sure that this manual is delivered to the final users.

The purpose of this Instruction Manual is to provide basic information on Installation, Start-up, Operational and Troubleshooting for the ***Axpert-opti torque*** Electronic Soft Starter.

WARNING

ALWAYS READ THIS MANUAL THOROUGHLY BEFORE USING THE SOFT STARTER.

THIS SOFT STARTER CONTAINS HIGH VOLTAGE CIRCUITS THAT MAY BE FATAL TO HUMANS. USE EXTREME CAUTION DURING INSTALLATION. MAINTENANCE MUST BE PERFORMED BY QUALIFIED TECHNICIANS, AND ALL POWER SOURCES MUST BE DISCONNECTED BEFORE ANY MAINTENANCE. SUFFICIENT NOTICE MUST BE GIVEN TO THE GENERAL OPERATORS AND WORKERS BEFORE STARTING.

• ***ELECTRIC SHOCK MAY OCCUR IF THE FOLLOWING POINTS ARE NOT OBSERVED***.

(1) DO NOT OPEN THE FRONT COVER WHILE THE POWER IS ON.

(2) ALWAYS GROUND THE UNIT CASE. THE GROUNDING METHOD MUST COMPLY WITH THE LAWS OF THE COUNTRY WHERE THE UNIT IS BEING INSTALLED

• ***THE UNIT MAY BE DESTROYED BEYOND REPAIR IF THE FOLLOWING POINTS ARE NOT OBSERVED.***

(1) OPERATION WITHIN THE UNIT SPECIFICATIONS.

(2) PROPER CABLE CONNECTIONS TO INPUT/OUTPUT TERMINALS.

(3) CLEANING AND ENOUGH VENTILATION TO THE UNIT INTAKE/OUTTAKE PORTS.

(4) OBSERVATION OF CAUTIONS LISTED IN THIS INSTRUCTION MANUAL.

• THERE MAY BE SOURCES OF NOISE AROUND THIS UNIT AND MOTOR DRIVEN BY THIS UNIT. CONSIDER THE POWER SUPPLY SYSTEM, INSTALLATION PLACE AND WIRING METHOD BEFORE INSTALLATION

INSTALL THE UNIT AWAY FROM DEVICES THAT HANDLE MINUTE SIGNALS, SUCH AS MEDICAL EQUIPMENT IN PARTICULAR. ALSO SEPARATE THE DEVICES ELECTRICALLY, AND TAKE SUFFICIENT NOISE MEASURES.

• TAKE SUFFICIENT SAFETY MEASURES WHEN USING THIS UNIT FOR PASSENGER TRANSPORTATION, SUCH AS IN LIFTS (ELEVATORS).

Precautions for Safety

Items to be observed to prevent physical damage or property damage and to ensure safe use of this product are noted on the product and in this instruction manual.

❑ Please read this instruction manual and enclosed documents before starting operation to ensure correct usage. Thoroughly understand the device, safety information and precautions before starting operation. After reading, always store this manual where it can be accessed easily.

❑ The safety precautions are ranked as "**DANGER**" and "**CAUTION**" in this instruction manual.

: When a dangerous situation may occur if handling is mistaken, leading to fatal or major injuries.

: When a dangerous situation may occur if handling is mistaken, leading to medium or minor injuries, or physical damage.

Note that some items described as 

may lead to major problems depending on the situation. In any case, important information that must be observed is described.

This instruction manual is written on the presumption that the user has an understanding of the soft starter. A qualified person must do installation, operation, maintenance and inspection of this product. Even qualified persons must undergo periodic training.

Qualified refers to satisfying the following conditions.

✓ The person has thoroughly read and understood this instruction manual.

✓ The person is well versed in the installation, operation, maintenance and inspection of this product, and understands the possible dangers.

✓ The person is informed on matters related to starting, stopping, installation, locks and tag displays, and has been trained in the operation and remedies.

✓ The person has been trained on the maintenance, inspection and repairs of this product.

✓ The person has been trained on protective tools used to ensure safety.

KEEP SAFETY FIRST IN YOUR SYSTEM

AMTECH puts the maximum effort into making products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with soft-starter may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your system, with appropriate measures such as isolating devices, mechanical brakes, prevention against any malfunction or mishap.

CHAPTER-1: DELIVERY, INSPECTION AND STORAGE

⚠ CAUTION

- ✓ Always transport the product with an appropriate method according to the products weight.
  Failure to observe this could lead to injuries.
- ✓ Do not place the product near inflammable items.
  Failure to observe this could lead to fires.
- ✓ Do not hold the product with front cover while transporting the product.
  Failure to observe this could lead to injuries from dropping.
- ✓ Do not let conductive materials such as screws or metal pieces and inflammable materials such as oil enter into the product.
  Failure to observe this could lead to fires.
- ✓ Install the product in a place that can withstand the weight of the product, and follow the instruction manual.
  Failure to do so could lead to injuries from dropping.
- ✓ Do not install and operate the unit that is damaged or that has missing parts.
  Failure to observe this could lead to injuries.
- ✓ Always observe the conditions described in the instruction manual for the installation environment.
  Failure to observe this could lead to faults.

1.1 Delivery, inspection and storage

Axpert-Opti torque Electronic Soft Starter has gone through rigorous quality control tests at the factory before shipment. After receiving the unit, check for the following.

(1) Check to make sure that the package includes unit and User Manual

(2) Remove the unit from packaging, and check the details on the rating nameplate to confirm that the unit is as ordered.

(3) Confirm that the product has not been damaged during shipment.

The ***Axpert-Opti torque*** Electronic Soft Starter should be kept in the shipping carton before installation. In order to retain the warranty coverage, the unit should be stored properly when it is not to be used for an extended period of time. Some storage suggestions are:

(1) Store in a clean, dry location.

(2) Store within an ambient temperature range of -20°C (-4°F) to +60°C (140°F).

(3) If possible, store in an air-conditioned environment where the relative humidity is less than 95%, non-condensing.

(4) Do not store the unit in places where it could be exposed to corrosive gases.

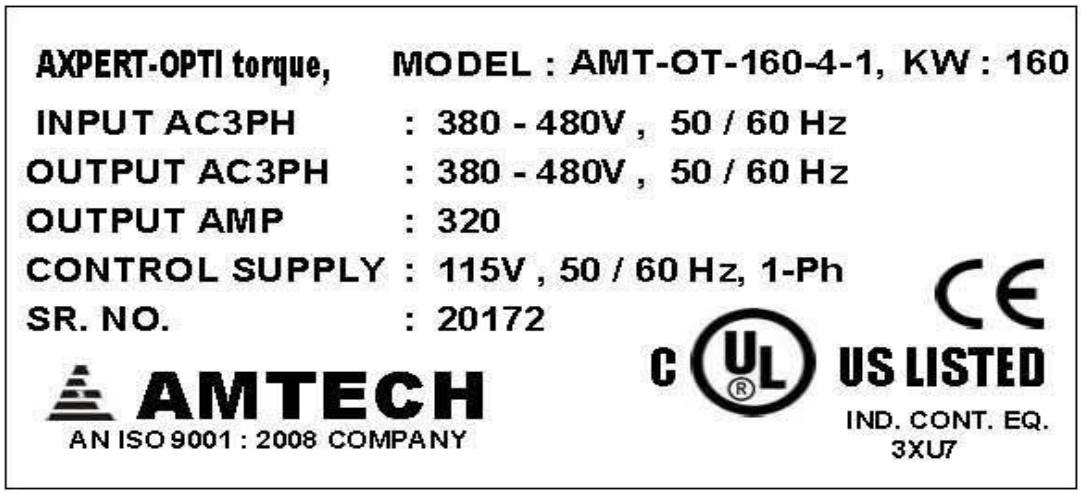
(5) Do not store the unit on a shelf or on an unstable surface.

(6) If the unit is not to be used for a while (more than 2 months) after purchasing, store it in a place with no humidity or vibration in the packaged state.

(7) Always inspect the unit before using after storing for a long period.

1.2 Details of rating nameplate and type display method

The following details are listed on the rating nameplate.



Using the above type as an example, the type is displayed as follows:

AMT - OT - 045 - 4 - 1

***Axpert-opti torque* Series**

-030: For 30 kW Capacity
-037: For 37 kW Capacity
-045: For 45 kW Capacity
-055: For 55 kW Capacity
-075: For 75 kW Capacity
-090: For 90 kW Capacity
-110: For 110 kW Capacity
-132: For 132 kW Capacity
-160: For 160 kW Capacity
-200: For 200 kW Capacity
-250: For 250 kW Capacity
-315: For 315 kW Capacity
-400: For 400 kW Capacity
-450: For 450 kW Capacity
-500: For 500 kW Capacity
-575: For 575 kW Capacity
-630: For 630 kW Capacity
-710: For 710 kW Capacity

-1: For 1- Phase 115V Fan & Control Supply
-2: For 1- Phase 230V Fan & Control Supply

-2: For 3- Phase 200V series, 200Vac ~ 240Vac
-4: For 3- Phase 400V series, 380Vac ~ 480Vac
-5: For 3- Phase 500V series, 500Vac ~ 575Vac
-6: For 3- Phase 600V series, 600Vac ~ 690Vac

CHAPTER-2: INSTALLATION AND WIRING

This chapter provides the information needed to properly **install** and **wire** the unit. Make sure that the unit is wired according to the instructions contained in this chapter. The instructions should be read and understood before the actual installation begins.

⚠ CAUTION

- ✓ Install the unit and other peripheral devices on noncombustible material such as metal.
  Failure to observe this could lead to fires.
- ✓ Do not place the product near inflammable items.
  Failure to observe this could lead to fires.
- ✓ Do not let conductive materials such as screws or metal pieces and inflammable materials such as oil enter the product.
  Failure to observe this could lead to fires.
- ✓ Install the product in a place that can withstand the weight of the product.
  Failure to do so could lead to injuries from dropping.
- ✓ Do not install and operate the unit that is damaged or that is missing parts.
  Failure to observe this could lead to injuries.
- ✓ Always observe the conditions described in the instruction manual for the installation environment.
  Failure to observe this could lead to faults.

2.1 Installation environment

Observe the following points when installing the unit.

(1) Install the unit vertically to provide proper ventilation.

(2) Make sure that the ambient temperature is –10°C (14°F) to 50°C (122°F).

(3) Avoid installation in the following environment.

- Places subject to direct sunlight
- Places with oil mist, dust or cotton lint, or subject to salty winds
- Places with corrosive gas, explosive gas or high humidity levels
- Places near vibration sources such as dollies or press machines
- Places made of in-flammable materials such as wood, or places that are not heat resistant

(4) Ensure ventilation space around the unit as shown in fig. 2-1-1

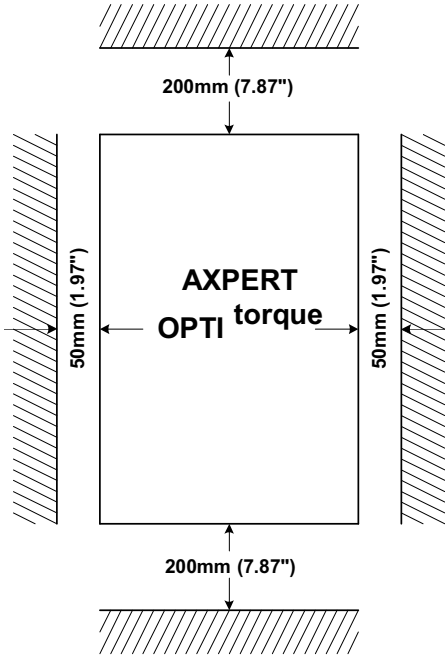


Fig. 2-1-1

2.2 Precautions for power supply and motor wiring

DANGER

- ✓ Always turn the device's input power OFF before starting wiring.
  Failure to do so could lead to electric shocks or fires.
- ✓ Carry out grounding that complies with the standards of the country where the unit is being installed.
  Failure to do so could lead to electric shocks or fires.
- ✓ Wiring must always be done by a qualified electrician
  Failure to observe this could lead to electric shocks or fires.
- ✓ Always install the device before starting wiring.
  Failure to do so could lead to electric shocks or injuries.
- ✓ Use a circuit breaker such as an MCCB or fuses that match with the capacity of the unit power supply.
  Failure to do so could lead to fires.

CAUTION

- ✓ Do not connect an AC power supply to the output terminals (U, V, W).
  Failure to observe this could lead to injuries or fires.
- ✓ Confirm that the product's rated input voltage and frequency match the power supply voltage and frequency.
  Failure to do so could lead to injuries or fires.
- ✓ Tighten the terminal screws with the designated tightening torque.
  Failure to do so could lead to fires.
- ✓ Correctly connect the output (U, V, W) to motor terminals to ensure proper phase sequence.
  Failure to do so could cause the motor to rotate in reverse and the machine to be damaged.
  Failure to observe this could lead to reverse rotation or abnormal acceleration of the motor, and to injuries or machine damage.

2.3 Simplified block diagram of *Axpert-Opti torque* soft starter

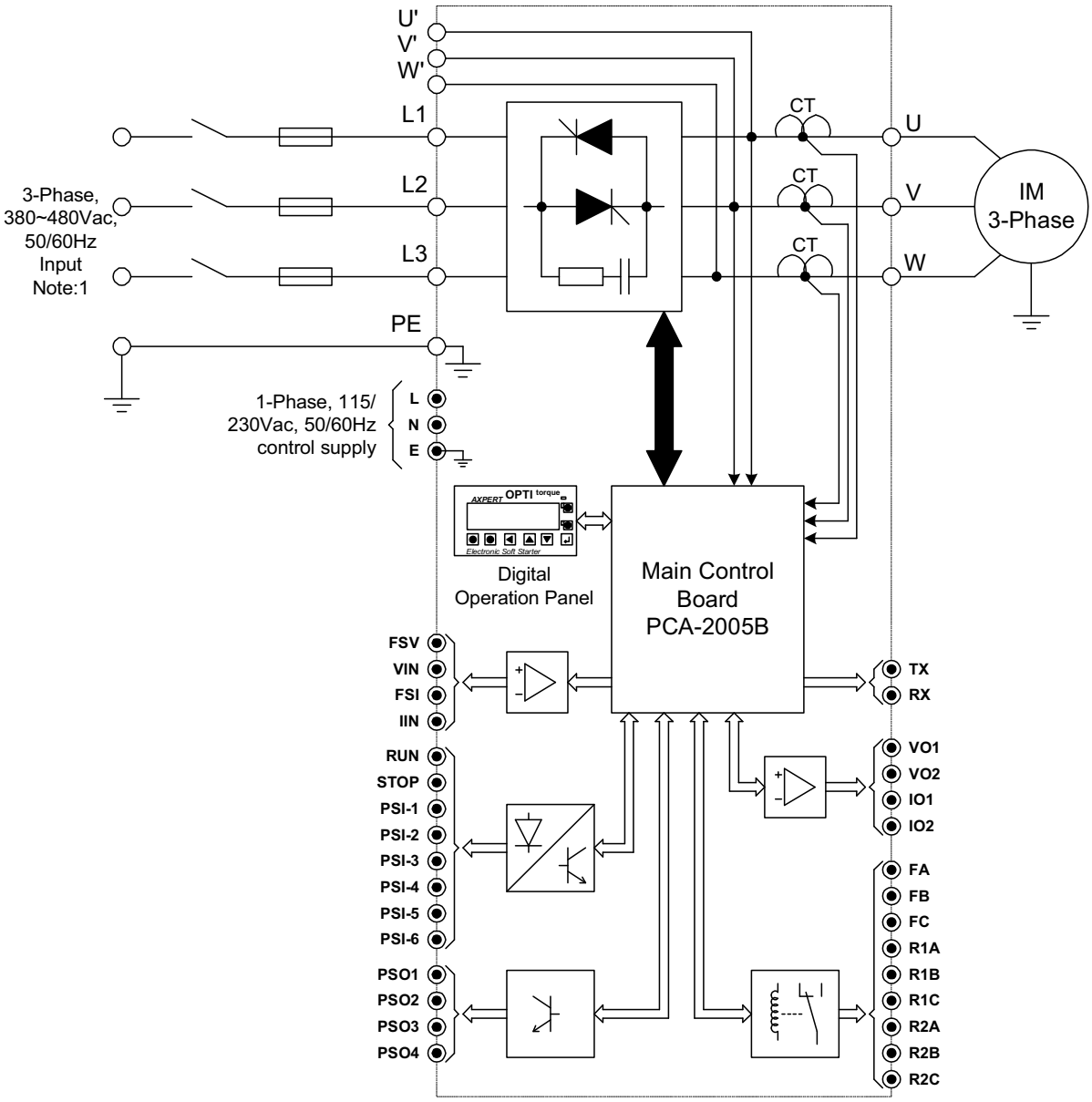


Fig. 2-3-1 - Simplified Block Diagram of *Axpert-Opti torque* Soft starter

(Note 1) Input / Output and Bypass terminals

The input terminals are L1, L2 & L3. The output terminals to the motor are U, V & W. Connect the power supply to input terminals L1, L2 & L3 only. Never connect the power supply to the U, V, and W terminals. Connect bypass contactor between L1, L2, L3 and U', V', W'. Input voltage range is varies according to voltage series for 200V series input voltage ranger 200VAC to 240VAC, for 400V series input voltage range 380VAC to 480VAC, for 500Vsereis input voltage range 500VAC to 575VAC and for 600V series input voltage range 600VAC to 690VAC.

(Note 2) Wire size

Use wires having the size (or larger) shown in the below table for the main circuit wiring shown in the above figure. The applicable wire size range, applicable ring terminal and tightening torque for the main circuit terminals are shown in the Table-2-3-1, for 200V Series, Table-2-3-2 for 400V Series, Table-2-3-3 for 500V Series and Table-2-3-4 for 600V Series.

Table-2-3-1: 200V series Axpert-Opti torque (Terminal and applicable wire/bus bar for Input, Output & Bypass)

AMT-OT-XXX-2-X	Rated Current (A)	wire/bus bar size for Input / Output+		wire size for Grounding terminal		Lug ID mm (inch) #	Lug width mm (inch)	Terminal width (I/P, O/P & Bypass) mm (inch)	Hole diameter mm (inch)	Terminal screw size	Tightening torque N*m (lb-inch)
		mm^2	AWG	mm^2	AWG						
015	60	25	4	10	8	8.4 (0.33)	15 (0.59)	19 (0.75)	9 (0.35)	M8	9 (79.7)
018	72	35	2	10	8	8.4 (0.33)	15.2 (0.60)	19 (0.75)	9 (0.35)	M8	9 (79.7)
022	87	50	1	10	8	8.4 (0.33)	18.5 (0.73)	19 (0.75)	9 (0.35)	M8	9 (79.7)
030	110	50	1/0	16	6	8.4 (0.33)	18.5 (0.73)	19 (0.75)	9 (0.35)	M8	9 (79.7)
037	147	35 x 2p	2 x 2p	16	6	10.5 (0.41)	15.2 (0.60)	32 (1.26)	10.5 (0.41)	M10	22.5 (199)
045	175	50 x 2p	1 x 2p	16	6	10.5 (0.41)	18.5 (0.73)	32 (1.26)	10.5 (0.41)	M10	22.5 (199)
055	215	50 x 2p	1/0 x 2p	25	4	10.5 (0.41)	18.5 (0.73)	32 (1.26)	10.5 (0.41)	M10	22.5 (199)
075	245	70 x 2p	2/0 x 2p	25	4	10.5 (0.41)	21.4 (0.84)	40 (1.58)	11 (0.43)	M10	22.5 (199)
076	245	70 x 2p	2/0 x 2p	25	4			50 (1.97)	13 (0.51)	M12	31.2 (276)
090	320	120 x 2p	4/0 x 2p	-	3	10.5 (0.41)	28.3 (1.11)	40 (1.58)	11 (0.43)	M10	22.5 (199)
091	320	120 x 2p	4/0 x 2p	-	3			50 (1.97)	13 (0.51)	M12	31.2 (276)
110	360	40 x 10 (400)	-	-	3			50 (1.97)	13 (0.51)	M12	31.2 (276)
111											
132	470	40 x 10 (400)	-	50	1			50 (1.97)	13 (0.51)	M12	31.2 (276)
133											
160	590	50 x 10 (500)	-	50	1			50 (1.97)	13 (0.51)	M12	31.2 (276)
161											
200	720	75 x 10 (750)	-	50	1/0			50 (1.97)	13 (0.51)	M12	31.2 (276)
250	800	75 x 10 (750)	-	70	2/0			50 (1.97)	13 (0.51)	M12	31.2 (276)
315	880	100x10 (1000)	-	95	3/0			75 (2.95)	13 (0.51)	M12	31.2 (276)
400	950	100x10 (1000)	-	95	3/0			75 (2.95)	13 (0.51)	M12	31.2 (276)
450	1065	100x10 (1000)	-	95	3/0			75 (2.95)	13 (0.51)	M12	31.2 (276)

+2p = Two parallel
- Listed ZMVV, Lugs shall be used
Wire size for external control supply for cooling fan is 14 AWG (2.5 mm^2).

Table-2-3-2: 400V series Axpert-Opti torque (Terminal and applicable wire/bus bar for Input, Output & Bypass)

AMT-OT-XXX-4-X	Rated Current (A)	wire/bus bar size for Input / Output+		wire size for Grounding terminal		Lug ID mm (inch) #	Lug width mm (inch)	Terminal width (I/P, O/P & Bypass) mm (inch)	Hole diameter mm (inch)	Terminal screw size	Tightening torque N*m (lb-inch)
		mm^2	AWG	mm^2	AWG						
030	60	25	4	10	8	8.4 (0.33)	15 (0.59)	19 (0.75)	9 (0.35)	M8	9 (79.7)
037	72	35	2	10	8	8.4 (0.33)	15.2 (0.60)	19 (0.75)	9 (0.35)	M8	9 (79.7)
045	87	50	1	10	8	8.4 (0.33)	18.5 (0.73)	19 (0.75)	9 (0.35)	M8	9 (79.7)
055	110	50	1/0	16	6	8.4 (0.33)	18.5 (0.73)	19 (0.75)	9 (0.35)	M8	9 (79.7)
075	147	35 x 2p	2 x 2p	16	6	10.5 (0.41)	15.2 (0.60)	32 (1.26)	10.5 (0.41)	M10	22.5 (199)
090	175	50 x 2p	1 x 2p	16	6	10.5 (0.41)	18.5 (0.73)	32 (1.26)	10.5 (0.41)	M10	22.5 (199)
110	215	50 x 2p	1/0 x 2p	25	4	10.5 (0.41)	18.5 (0.73)	32 (1.26)	10.5 (0.41)	M10	22.5 (199)
132	245	70 x 2p	2/0 x 2p	25	4	10.5 (0.41)	21.4 (0.84)	40 (1.58)	11 (0.43)	M10	22.5 (199)
133	245	70 x 2p	2/0 x 2p	25	4			50 (1.97)	13 (0.51)	M12	31.2 (276)
160	320	120 x 2p	4/0 x 2p	-	3	10.5 (0.41)	28.3 (1.11)	40 (1.58)	11 (0.43)	M10	22.5 (199)
161	320	120 x 2p	4/0 x 2p	-	3			50 (1.97)	13 (0.51)	M12	31.2 (276)
200	360	40 x 10 (400)	-	-	3			50 (1.97)	13 (0.51)	M12	31.2 (276)
201											
250	470	40 x 10 (400)	-	50	1			50 (1.97)	13 (0.51)	M12	31.2 (276)
251											
315	590	50 x 10 (500)	-	50	1			50 (1.97)	13 (0.51)	M12	31.2 (276)
316											
400	720	75 x 10 (750)	-	50	1/0			50 (1.97)	13 (0.51)	M12	31.2 (276)
450	800	75 x 10 (750)	-	70	2/0			50 (1.97)	13 (0.51)	M12	31.2 (276)
500	880	100x10 (1000)	-	95	3/0			75 (2.95)	13 (0.51)	M12	31.2 (276)
585	950	100x10 (1000)	-	95	3/0			75 (2.95)	13 (0.51)	M12	31.2 (276)
630	1065	100x10 (1000)	-	95	3/0			75 (2.95)	13 (0.51)	M12	31.2 (276)

+2p = Two parallel
- Listed ZMVV, Lugs shall be used
Wire size for external control supply for cooling fan is 14 AWG (2.5 mm^2).

Table-2-3-3: 500V series Axpert-Opti torque (Terminal and applicable wire/bus bar for Input, Output & Bypass)

AMT-OT-XXX-5-X	Rated Current (A)	wire/bus bar size for Input / Output+		wire size for Grounding terminal		Lug ID mm (inch) #	Lug width mm (inch)	Terminal width (I/P, O/P & Bypass) mm (inch)	Hole diameter mm (inch)	Terminal screw size	Tightening torque N*m (lb-inch)
		mm^2	AWG	mm^2	AWG						
037	60	25	4	10	8	8.4 (0.33)	15 (0.59)	19 (0.75)	9 (0.35)	M8	9 (79.7)
045	72	35	2	10	8	8.4 (0.33)	15.2 (0.60)	19 (0.75)	9 (0.35)	M8	9 (79.7)
055	87	50	1	10	8	8.4 (0.33)	18.5 (0.73)	19 (0.75)	9 (0.35)	M8	9 (79.7)
075	110	50	1/0	16	6	8.4 (0.33)	18.5 (0.73)	19 (0.75)	9 (0.35)	M8	9 (79.7)
090	147	35 x 2p	2 x 2p	16	6	10.5 (0.41)	15.2 (0.60)	32 (1.26)	10.5 (0.41)	M10	22.5 (199)
110	175	50 x 2p	1 x 2p	16	6	10.5 (0.41)	18.5 (0.73)	32 (1.26)	10.5 (0.41)	M10	22.5 (199)
132	215	50 x 2p	1/0 x 2p	25	4	10.5 (0.41)	18.5 (0.73)	32 (1.26)	10.5 (0.41)	M10	22.5 (199)
160	245	70 x 2p	2/0 x 2p	25	4	10.5 (0.41)	21.4 (0.84)	40 (1.58)	11 (0.43)	M10	22.5 (199)
161	245	70 x 2p	2/0 x 2p	25	4			50 (1.97)	13 (0.51)	M12	31.2 (276)
200	320	120 x 2p	4/0 x 2p	-	3	10.5 (0.41)	28.3 (1.11)	40 (1.58)	11 (0.43)	M10	22.5 (199)
201	320	120 x 2p	4/0 x 2p	-	3			50 (1.97)	13 (0.51)	M12	31.2 (276)
250	360	40 x 10 (400)	-	-	3			50 (1.97)	13 (0.51)	M12	31.2 (276)
251	360	40 x 10 (400)	-	-	3			50 (1.97)	13 (0.51)	M12	31.2 (276)
315	470	40 x 10 (400)	-	50	1			50 (1.97)	13 (0.51)	M12	31.2 (276)
316	470	40 x 10 (400)	-	50	1			50 (1.97)	13 (0.51)	M12	31.2 (276)
400	590	50 x 10 (500)	-	50	1			50 (1.97)	13 (0.51)	M12	31.2 (276)
401	590	50 x 10 (500)	-	50	1			50 (1.97)	13 (0.51)	M12	31.2 (276)
450	720	75 x 10 (750)	-	50	1/0			50 (1.97)	13 (0.51)	M12	31.2 (276)
500	800	75 x 10 (750)	-	70	2/0			50 (1.97)	13 (0.51)	M12	31.2 (276)
585	880	100x10 (1000)	-	95	3/0			75 (2.95)	13 (0.51)	M12	31.2 (276)
630	950	100x10 (1000)	-	95	3/0			75 (2.95)	13 (0.51)	M12	31.2 (276)
710	1065	100x10 (1000)	-	95	3/0			75 (2.95)	13 (0.51)	M12	31.2 (276)

+2p = Two parallel
- Listed ZMVV, Lugs shall be used
Wire size for external control supply for cooling fan is 14 AWG (2.5 mm^2).

Table-2-3-4: 600V series Axpert-Opti torque (Terminal and applicable wire/bus bar for Input, Output & Bypass)

AMT-OT-XXX-6-X	Rated Current (A)	wire/bus bar size for Input / Output*		wire size for Grounding terminal		Lug ID mm (inch) #	Lug width mm (inch)	Terminal width (I/P, O/P & Bypass) mm (inch)	Hole diameter mm (inch)	Terminal screw size	Tightening torque N*m (lb-inch)
		mm^2	AWG	mm^2	AWG						
045	60	25	4	10	8	8.4 (0.33)	15 (0.59)	19 (0.75)	9 (0.35)	M8	9 (79.7)
055	72	35	2	10	8	8.4 (0.33)	15.2 (0.60)	19 (0.75)	9 (0.35)	M8	9 (79.7)
075	87	50	1	10	8	8.4 (0.33)	18.5 (0.73)	19 (0.75)	9 (0.35)	M8	9 (79.7)
090	110	50	1/0	16	6	8.4 (0.33)	18.5 (0.73)	19 (0.75)	9 (0.35)	M8	9 (79.7)
110	147	35 x 2p	2 x 2p	16	6	10.5 (0.41)	15.2 (0.60)	32 (1.26)	10.5 (0.41)	M10	22.5 (199)
132	175	50 x 2p	1 x 2p	16	6	10.5 (0.41)	18.5 (0.73)	32 (1.26)	10.5 (0.41)	M10	22.5 (199)
160	215	50 x 2p	1/0 x 2p	25	4	10.5 (0.41)	18.5 (0.73)	32 (1.26)	10.5 (0.41)	M10	22.5 (199)
200	245	70 x 2p	2/0 x 2p	25	4	10.5 (0.41)	21.4 (0.84)	40 (1.58)	11 (0.43)	M10	22.5 (199)
201	245	70 x 2p	2/0 x 2p	25	4			50 (1.97)	13 (0.51)	M12	31.2 (276)
250	320	120 x 2p	4/0 x 2p	-	3	10.5 (0.41)	28.3 (1.11)	40 (1.58)	11 (0.43)	M10	22.5 (199)
251	320	120 x 2p	4/0 x 2p	-	3			50 (1.97)	13 (0.51)	M12	31.2 (276)
315	360	40 x 10 (400)	-	-	3			50 (1.97)	13 (0.51)	M12	31.2 (276)
316	360	40 x 10 (400)	-	-	3			50 (1.97)	13 (0.51)	M12	31.2 (276)
400	470	40 x 10 (400)	-	50	1			50 (1.97)	13 (0.51)	M12	31.2 (276)
401	470	40 x 10 (400)	-	50	1			50 (1.97)	13 (0.51)	M12	31.2 (276)
450	590	50 x 10 (500)	-	50	1			50 (1.97)	13 (0.51)	M12	31.2 (276)
451	590	50 x 10 (500)	-	50	1			50 (1.97)	13 (0.51)	M12	31.2 (276)
500	720	75 x 10 (750)	-	50	1/0			50 (1.97)	13 (0.51)	M12	31.2 (276)
585	800	75 x 10 (750)	-	70	2/0			50 (1.97)	13 (0.51)	M12	31.2 (276)
630	880	100x10 (1000)	-	95	3/0			75 (2.95)	13 (0.51)	M12	31.2 (276)
710	950	100x10 (1000)	-	95	3/0			75 (2.95)	13 (0.51)	M12	31.2 (276)
800	1065	100x10 (1000)	-	95	3/0			75 (2.95)	13 (0.51)	M12	31.2 (276)

[+]2p = Two parallel
- Listed ZMVV, Lugs shall be used
Wire size for external control supply for cooling fan is 14 AWG (2.5 mm^2).

(Note 3) Noise filter

The unit will generate high harmonic electromagnetic noise, so using the following noise measures is recommended.

Insert a noise filter on the input side of the unit. Contact Amtech to select the proper noise filter. Keep the wiring length between the noise filter and unit to 500mm (19.7") or less.

Use a shield cable for the unit and motor wiring and connect the screen to the unit's  terminal.

When using the control circuit wiring and power circuit wiring in parallel, separate the wiring by 300mm (11.8") or more or pass each of the wiring through separate metal conduits. If the control circuit wiring and main circuit wiring intersect, make sure that they intersect at a right angle.

(Note 4) Output

Do not insert a power factor improvement capacitor on the output side of the unit. When inserting a magnetic contactor on the output side of the unit, prepare a sequence control circuit so that the magnetic contactor will not open and close when the unit is running. Directly connect only motor to the unit and do not connect through a transformer etc...without consulting Amtech.

(Note 5) Grounding

Always ground the unit according to the regulations of the country where the unit is being used to ensure personnel safety in all circumstances, and to reduce electromagnetic emission and pickup.

Make sure that grounding conductors are adequately sized as required by safety regulations.

In European CE compliant installations and in other installations where EMC emissions must be minimized, make a 360° high frequency grounding of cable entries in order to suppress electromagnetic disturbances.

In addition, connect the cable shields to protective earth (PE) in order to meet safety regulations.

(Note 6) Surge absorber

Install a surge absorber on the magnetic contactor and relay coils installed near the unit.

(Note 7) External Control & Fan supply

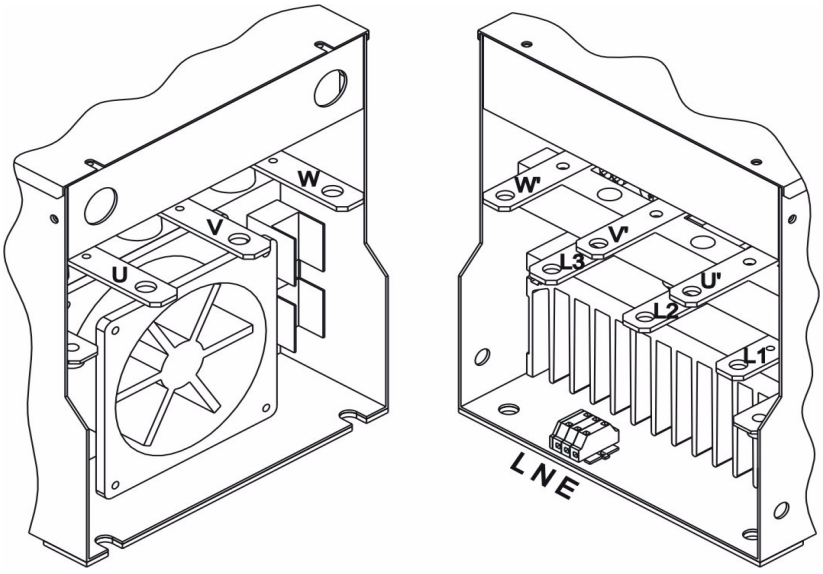
User has to connect external control and fan supply 1-Phase, 50/60Hz; 115VAC/230VAC. Current requirement is defined in below table as per the rating. This supply should be derived from maximum 1kVA transformer. Use of higher rating transformer may damage the power supply unit.

Table 2-3-5: External control and fan power supply requirement

AMT-OT-XXX-2-X	AMT-OT-XXX-4-X *	AMT-OT-XXX-5-X	AMT-OT-XXX-6-X	Voltage (VAC)*	Current (A)
015/018/022/030	030/037/045/055	037/045055/075	045/055/075/090	115	0.5
				230	0.25
037/0450/055	075/090/110	090/110/132	110/132/160	115	0.70
				230	0.35
075/076/090/091/ 111/133/161	132/133/160/161/ 201/251/316	160/161/200/201/ 251/316	200/201/250/251/ 316/401/451	115	1.1
				230	0.6
110/132/160	200/250/315	250/315/400	315/400/450	115	1.55
				230	0.95
200/250	400/450	450/500	500/585	115	1.65
				230	0.95
315/400/450	500/585/630	585/630/710	630/710/800	115	1.65
				230	0.95

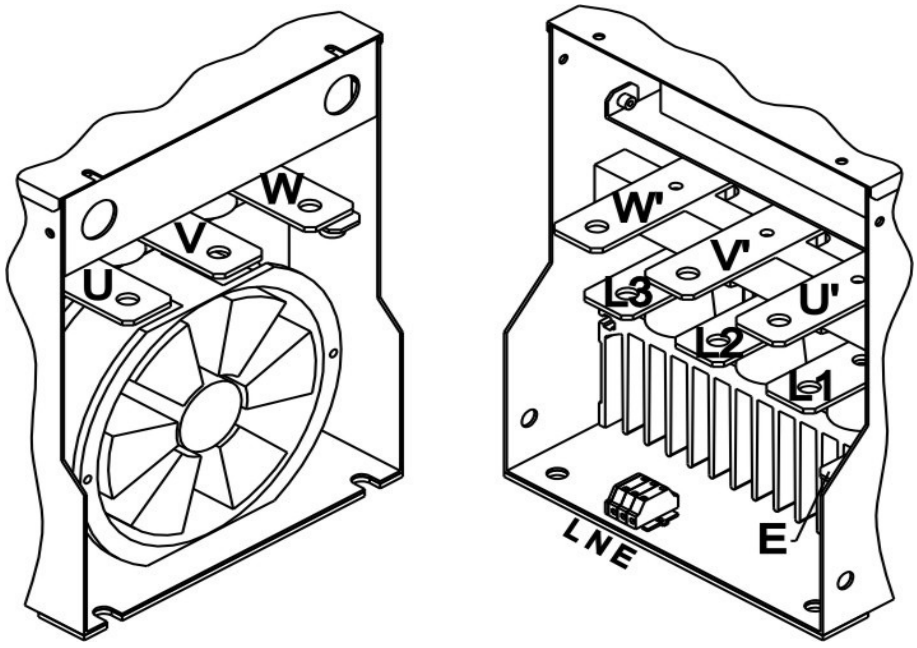
*** AMT-OT-XXX-4-1 series (except 161, 201, 251 and 316) is UL & cUL Listed.**

2.4 Power terminal layout



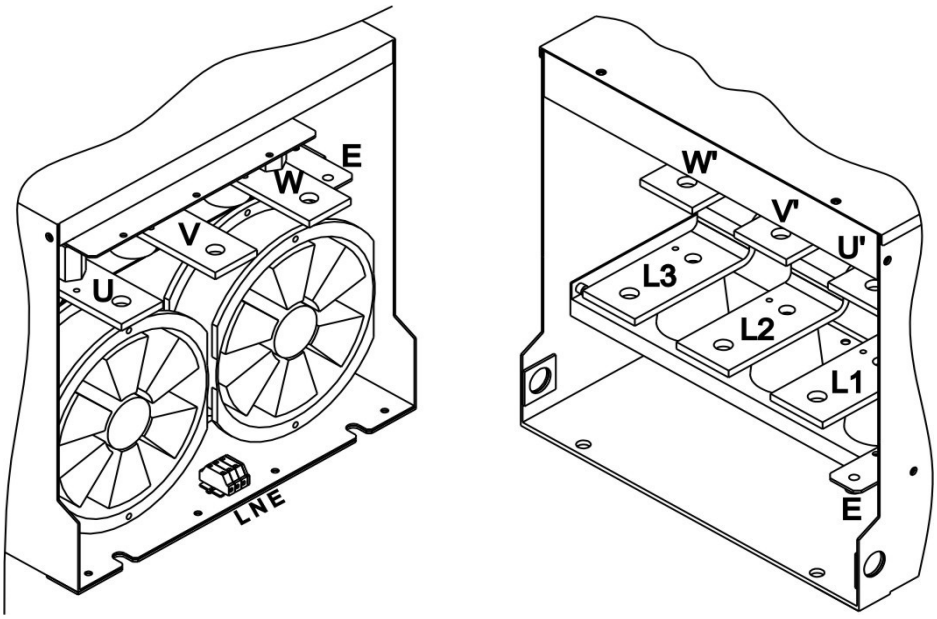
BOTTOM VIEW TOP VIEW

Fig. 2-4-1 - Field Terminal Layout for
200V Series (AMT-OT-015-2-X ~ AMT-OT-030-2-X),
400V Series (AMT-OT-030-4-X ~ AMT-OT-055-4-X),
500V Series (AMT-OT-037-5-X ~ AMT-OT-075-5-X),
600V Series (AMT-OT-045-6-X ~ AMT-OT-090-6-X)



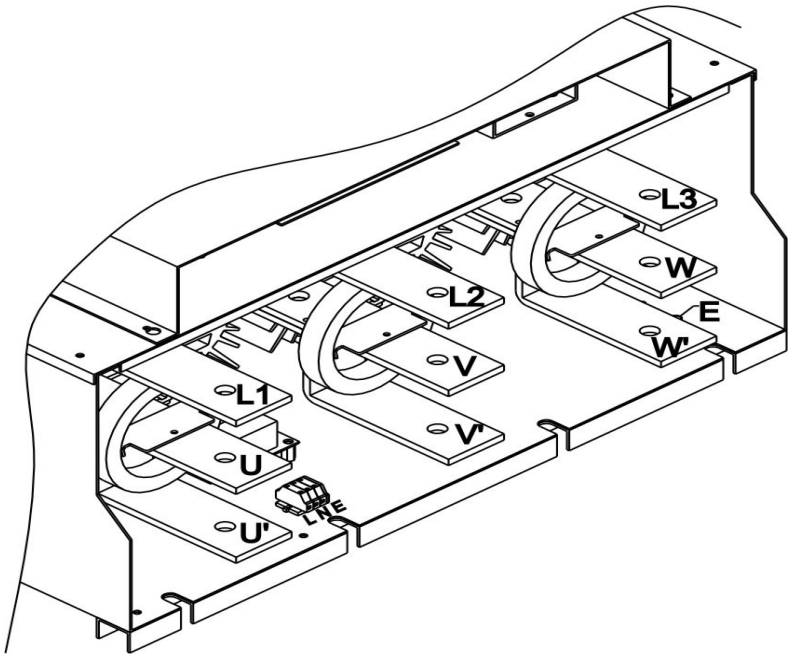
BOTTOM VIEW TOP VIEW

Fig. 2-4-2 - Field Terminal Layout for
200V Series (AMT-OT-037-2-X ~ AMT-OT-055-2-X),
400V Series (AMT-OT-075-4-X ~ AMT-OT-110-4-X),
500V Series (AMT-OT-090-5-X ~ AMT-OT-132-5-X),
600V Series (AMT-OT-110-6-X ~ AMT-OT-160-6-X)



BOTTOM VIEW **TOP VIEW**

Fig. 2-4-3 - Field Terminal Layout for
200V Series (AMT-OT-075, -090),
400V Series (AMT-OT-132, -160),
500V Series (AMT-OT-160, -200),
600V Series (AMT-OT-200, -250)



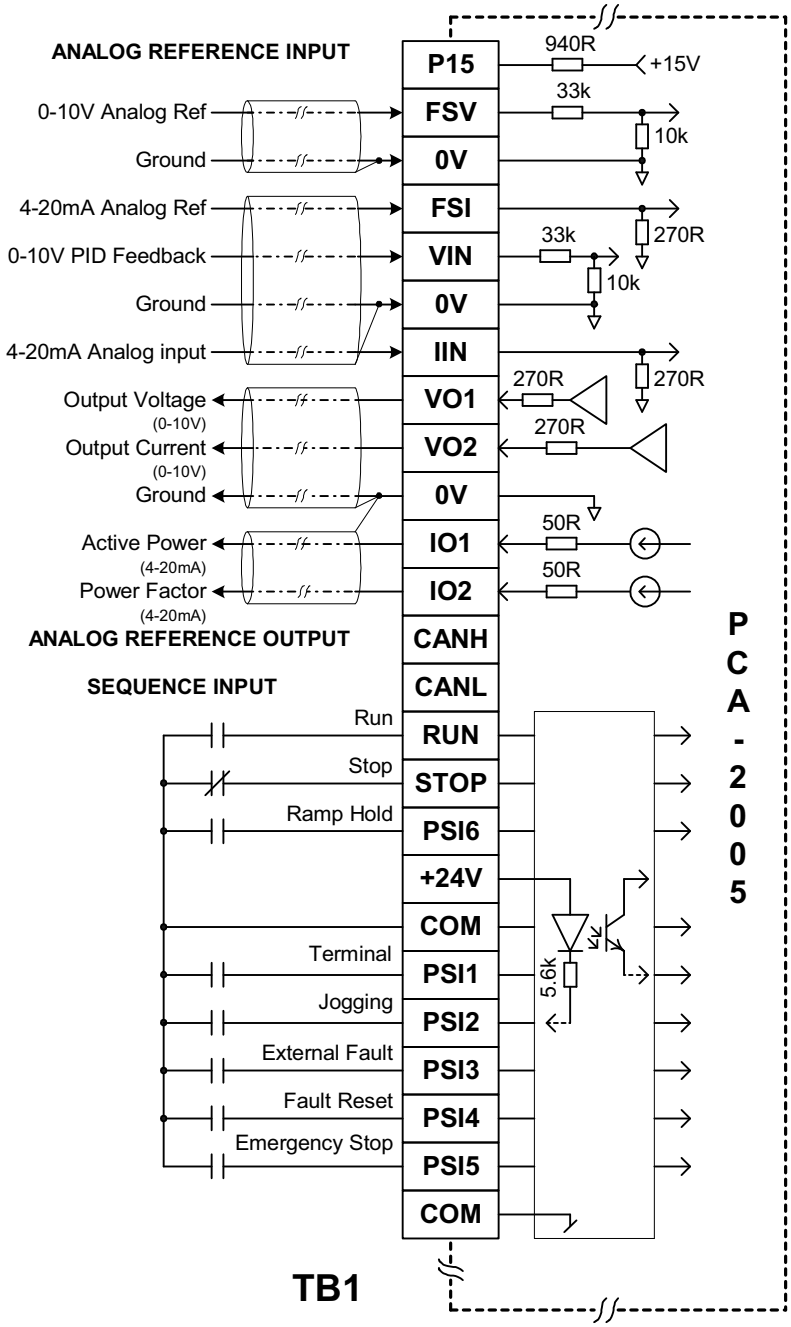
BOTTOM VIEW

Fig. 2-4-4 - Field Terminal Layout for
200V Series (AMT-OT-076, -91, -110, -111 ~ -500),
400V Series (AMT-OT-133, -161, -200 ~ -630),
500V Series (AMT-OT-161, -201, -250 ~ -710),
600V Series (AMT-OT-201, -251, -315 ~ -800)

2.5 Precautions for control signals wiring

- ✓ When wiring (control circuit wiring) to the control terminal block, separate the main circuit wiring (terminals L1, L2, L3, U, V, W, U', V', W') and the other starter wires and power wires.
- ✓ Use a 0.13 (AWG26) to 0.8mm² (AWG18) wire for wiring to the control circuit. The tightening torque must be 0.6N-m (5.3lb-inch).
- ✓ Use a twisted pair wire or twisted pair shield wire for wiring to the analog signal circuit such as the analog references and meters. Connect the shield wire to the 0V terminal of the unit. The wire length must be 30 meters (98.4') or less.
- ✓ The length of the sequence input/output contact wire must be 50 meters (164') or less.
- ✓ Changing the jumper position JP1 in PCA-2005B between "SINK" and "SOURCE" position respectively can change the sequence input between sink logic and source logic. Open cover designated as "Control Unit" to access this jumper.
- ✓ Observe the precautions listed in " **5. Control Input/Output Terminals**"
- ✓ After wiring, always check the mutual wiring.
- ✓ At this time do not carry out a megger check or buzzer check on the control circuit.
  - Are there any wire scraps or foreign matter left around the terminals?
  - Are any screws loose?
  - Is the wiring correct?
  - Is any terminal contacting any other terminal?

  If so, take the necessary corrective measures before proceeding further.



(Sink logic operation is considered in this diagram)

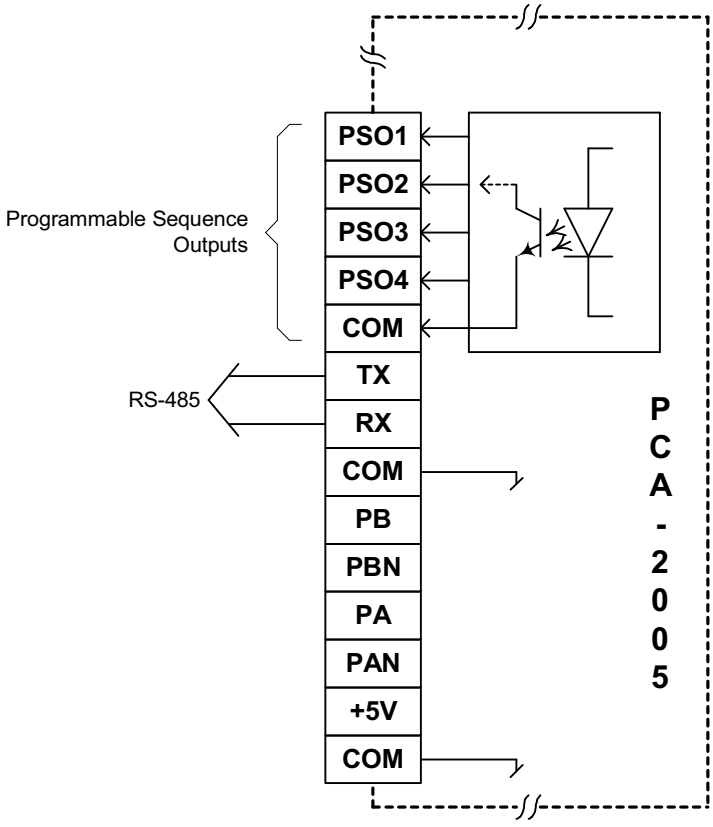
Fig. 2-5-1

Jumper Position

1. The equipment is shipped with sink logic (JP1 is kept on **Sink** position) for the programmable sequence inputs. To change the sink logic to source, change the jumper JP1 position to **Source**.

2. The equipment is shipped with JP3 in **NLD** position. This means the terminating resistors are not in picture. To insert the terminating resistors, keep the jumper to **LD** position.

Refer fig. 5-1-1 for better understanding.


PSO1
PSO2
PSO3
PSO4
COM
TX
RX
COM
PB
PBN
PA
PAN
+5V
COM
Programmable Sequence Outputs
RS-485
PCA-2005
TB1

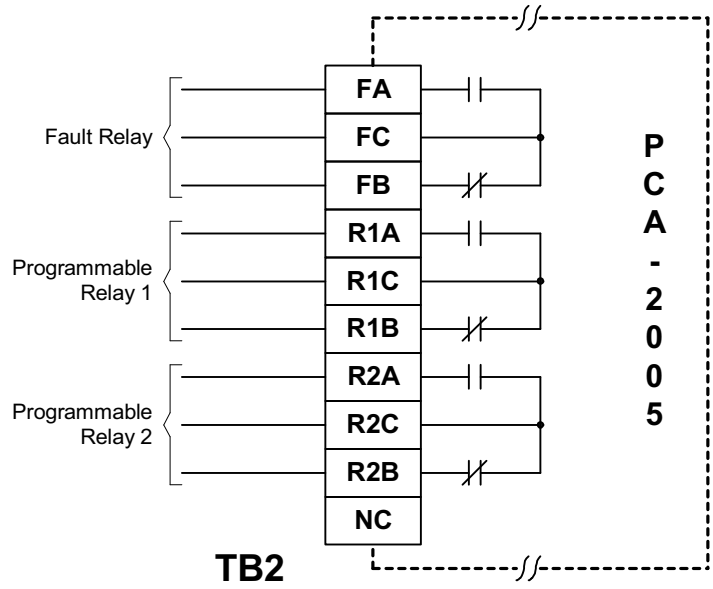
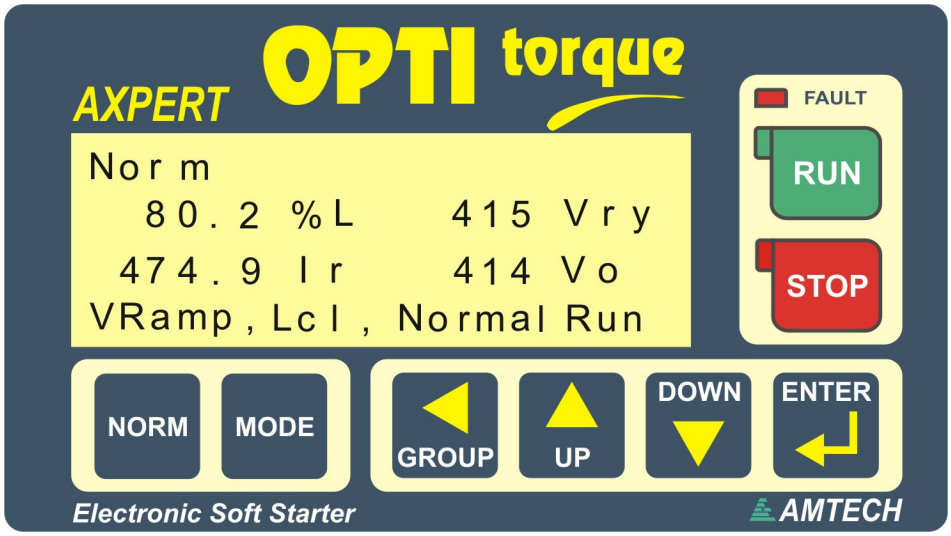

FA
FC
FB
R1A
R1C
R1B
R2A
R2C
R2B
NC
Fault Relay
Programmable Relay 1
Programmable Relay 2
PCA-2005
TB2

Fig. 2-5-2

CHAPTER-3: DIGITAL OPERATION PANEL (LCD KEYPAD MODULE)

The configuration of the Digital Operation Panel is shown in the below picture. The structure of it is as shown below.



The Digital Operation Panel is equipped with 8-keys as shown in the above picture. The function of each key is described below.

This key is utilized to reach to the normal screen of digital operation panel from any parameter, group or mode. The normal screen displays different parameters and status. This is the screen displayed at power on.

This key when pressed passes the control to next successive modes i.e. NORM (Normal), MODE-M (Monitor), MODE-A, MODE-B, MODE-C and so on. After the end of all modes, it will carry the control again to first mode. When changing the mode, the last accessed parameter of last accessed group of successive mode will be displayed.

This key passes the control to next group in the same mode. The groups can be accessed only in the incremental direction. At last it will again come to the first group. If ‘’ENTER’’ key is pressed, this key is used to move the cursor position for parameter value change.

These keys are used to change parameter numbers & parameter value. When ENTER key is pressed, these keys are used to change the parameter value, otherwise it is used to navigate the parameters in upward / downward direction in the group.

This key is used to change and save the parameter value. When pressed first time, it will allow the user to change the parameter value using up / down keys. Once the desired value is set, it is pressed again to save the changed value. Press NORM key instead of ENTER, to discard the change.

This key is used to start the unit when the start control is through Digital Operation Panel. The key is equipped with the status indicating LED. It will glow, when the unit is running.

This key is used to stop the unit irrespective of the start control source. **It is also used to reset the fault.** The stop key is equipped with status indicating LED. It will glow when the unit is off.

The Digital Operation Panel is also equipped with the fault indicating LED. It will flash in the fault condition. It is also equipped with four lines, 80-character, 4-Line LCD display for the user-friendly parameter navigation, monitoring and setting.

In the normal condition the screen will be as below.

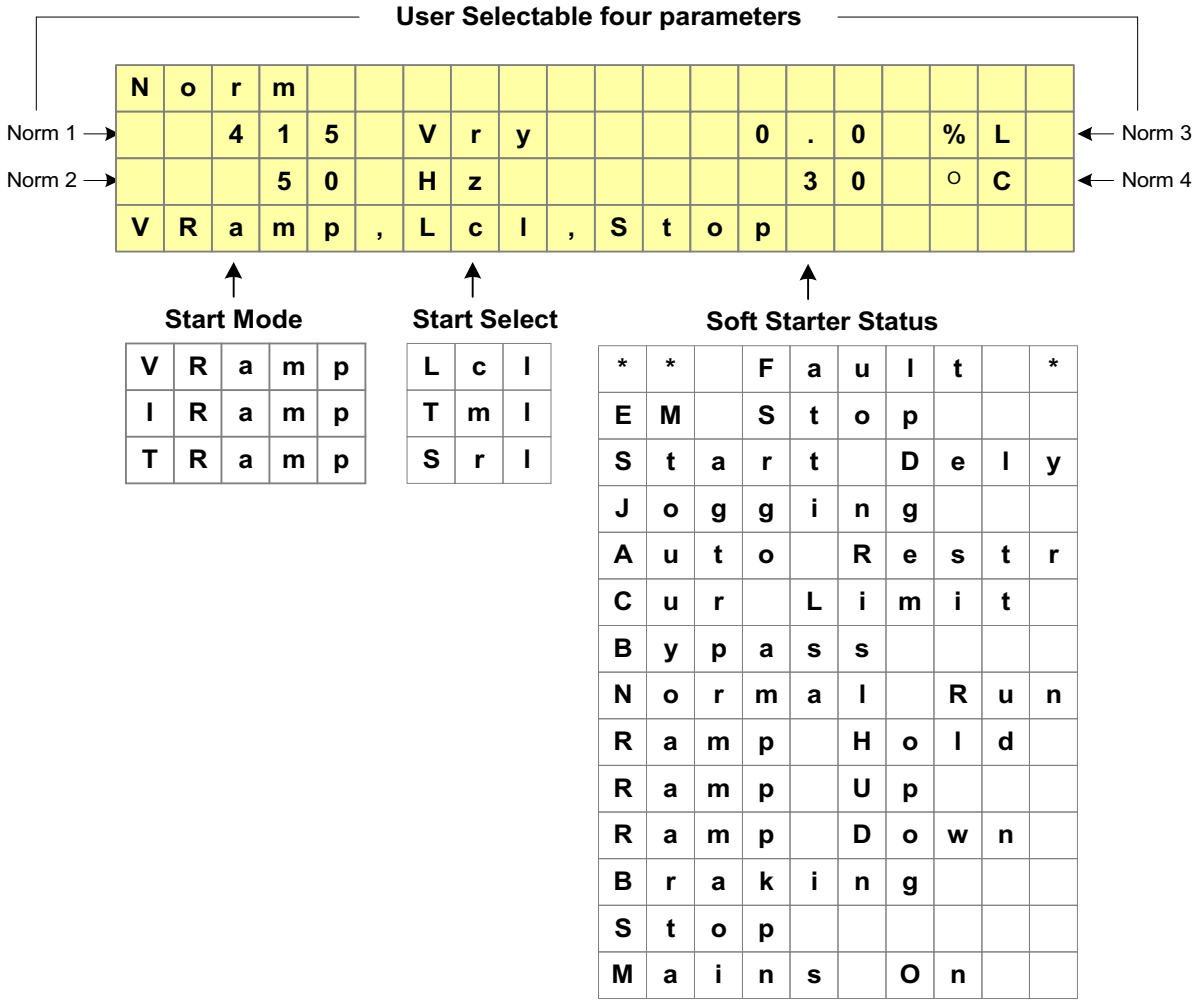


Fig. 3-1

The above figure also indicates the selected start mode, start selection and the status. The four user selectable parameters can be configured using A601 ~ A604.

3.1 Status

The fourth line of the Digital Operation Panel (LCD Keypad Module) is used to display different status of the unit as shown above**.** More than one status can exist at one time. In this case, the status having higher priority will be displayed. The priority is as shown in the figure. Fault has the highest priority and mains on have least priority.

Table-3-1-1

NO	NAME	DESCRIPTION
1	Fault	It indicates that some fault has occurred in the unit.
2	Emergency Stop	It shows that the unit is stopped due to emergency stop command.
3	Start Delay	It shows that the start is delayed by the programmed start Delay.
4	Jogging	It shows that the present operation is jogging.
5	Auto Restart	It shows that auto restart function is in operation.
6	Current Limit	It shows that the current limit function is active.
7	Bypass	It shows that the unit is running in bypass mode.
8	Normal Run	It shows that ramp up action is over and unit is running in normal condition.
9	Ramp Hold	It shows that ramp is hold.
10	Ramp Up	It shows that unit is ramping up.
11	Ramp Down	It shows that unit is ramping down.
12	Braking	It shows that the Breaking is active.
13	Stop	It shows that the unit is in stop condition.
14	Mains On	It shows that the mains power supply is on.

When first time MODE key is pressed, lastly accessed parameter of lastly accessed group of Mode-M will appear with its data. Below figure shows the parameter M101 of Group-1 of Mode-M.

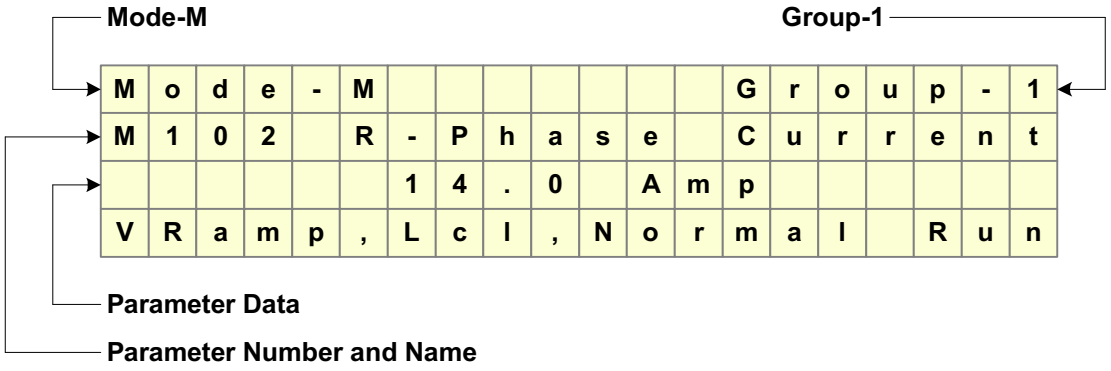


Fig. 3-1-1

The first line indicates the present mode and group. The second line indicates the parameter number with its name and the third line shows its value. The fourth line shows the present status and remains all the time except fault condition, contact information and fault history.

3.2 Modes & parameters

The parameters are grouped into Modes and Groups according to their functions.
The configuration of the parameters is as under.

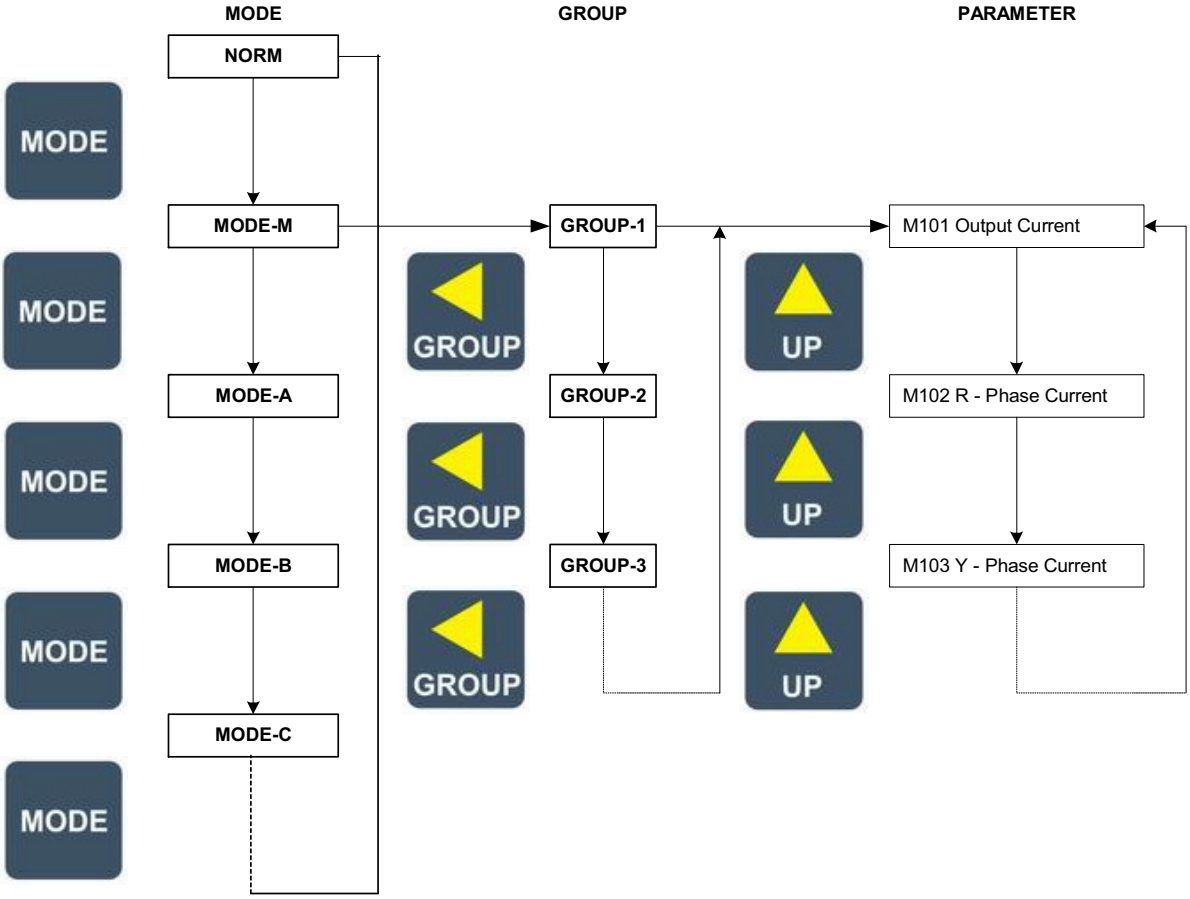


Fig. 3-2-1

3.3 Parameter display & setting

As shown in the above fig, MODE, GROUP, UP & DOWN keys are used to see the parameter value setting. The parameter value (except MODE-M) can be changed using ENTER, GROUP, UP & DOWN keys.

For example, the default V-Remp Up Time1 in A106 is 30 sec. To change the V-Remp Up Time1 to 40 sec, first go to the below screen using the MODE, GROUP, UP and DOWN key.

M	o	d	e	-	A							G	r	o	u	p	-	1
A	1	0	6		V	-	R	a	m	p		U	p		T	i	m	e	1
								3	0			S	e	c					
V	R	a	m	p	,	L	c	l	,	S	t	o	p						

Now, press ENTER key. The least significant digit will start blinking as shown in the below fig.

M	o	d	e	-	A							G	r	o	u	p	-	1
A	1	0	6		V	-	R	a	m	p		U	p		T	i	m	e	1
								3	0			S	e	c					
V	R	a	m	p	,	L	c	l	,	S	t	o	p						

The parameter value now can be set to the desired value using UP, DOWN or GROUP keys. When UP or DOWN is pressed, the value will increment or decrement. If GROUP is pressed, the cursor position will move to the left side as shown in the below fig.

M	o	d	e	-	A							G	r	o	u	p	-	1
A	1	0	6		V	-	R	a	m	p		U	p		T	i	m	e	1
								3	0			S	e	c					
V	R	a	m	p	,	L	c	l	,	S	t	o	p						

Now, press UP key once. The value will be incremented by one.

M	o	d	e	-	A							G	r	o	u	p	-	1
A	1	0	6		V	-	R	a	m	p		U	p		T	i	m	e	1
								4	0			S	e	c					
V	R	a	m	p	,	L	c	l	,	S	t	o	p						

Once the desired value is set, press ENTER key to save the value. The cursor will stop blinking and the parameter value will be saved to the non-volatile memory. If you do not want to save the new value, do not press ENTER key. Press NORM key.

CAUTION

✓ Do not remove or insert the display cable between PCA-2005B (Main Control Card) and PCA-2012 (Display Card) in power-energized condition.

Failure to observe this could lead to component failure and tripping of the unit.

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CHAPTER-4: TEST OPERATION AND ADJUSTMENT

DANGER

- ✓ Never touch the unit terminals while the power is ON even if the operation is stopped.
  Failure to observe this could lead to electric shocks.
- ✓ Selection of the restart function could lead to unexpected restarting when a fault occurs. The machine may start suddenly if the power is turned ON, if the run command is present. Do not go near the machine.
- ✓ The machine may not stop according to the set Soft Stop time when a stop command is issued if the ramp down to stop function is selected and the voltage / current limit function is activated. Prepare a separate emergency stop switch in such cases.
  Failure to do so could lead to injuries.
- ✓ Resetting of a fault while the run signal is input could lead to restarting. Always confirm that the run signal is OFF before resetting the fault.
  Failure to do so could lead to injuries.

CAUTION

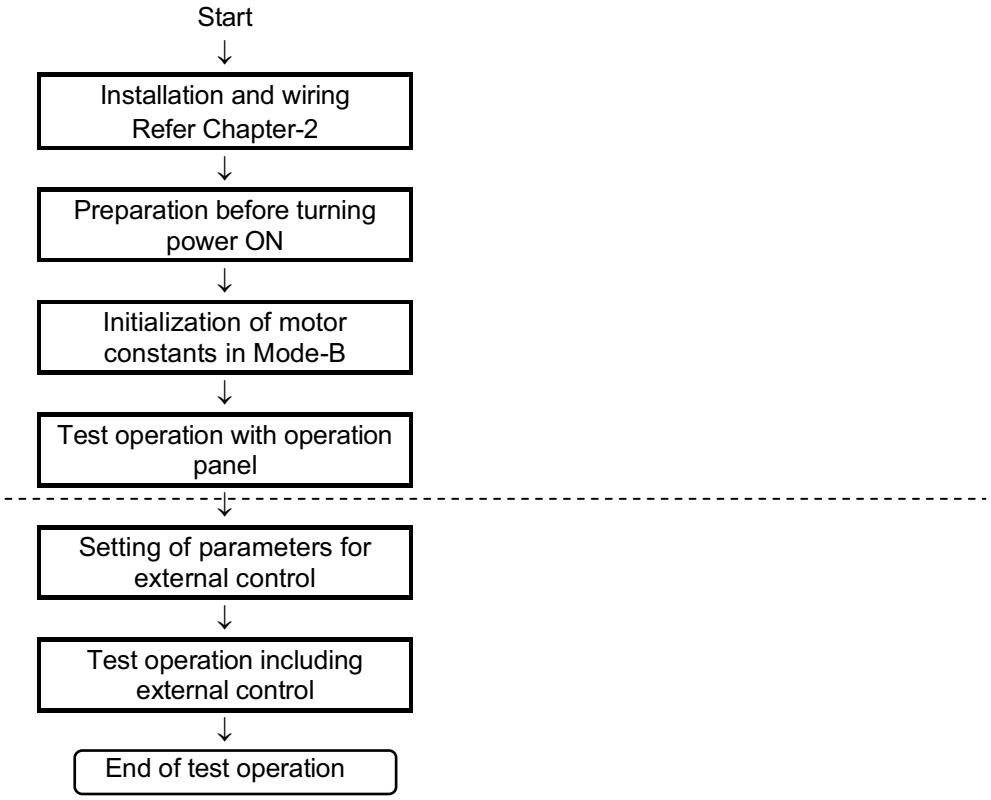
- ✓ The heat sink is heated to high temperatures, so never touch them.
  Failure to observe this could lead to burns.
- ✓ Do not block the unit's ventilation holes.
  Failure to observe this could lead to fires.
- ✓ Confirm the operation of the motor as a single unit before operating the machine.
  Failure to do so could lead to injuries or machine damage due to unforeseen movements.
- ✓ Always prepare a safety backup device so that the machine is not placed in a hazardous situation when an error occurs in the unit.
  Failure to do so could lead to injuries or machine damage or fires.

The ***Axpert-Opti torque*** Series Electronic Soft starter has various setting items. Some of these include settings that must be made according to the power supply and motor before actually starting the operation.

The method of the basic operation is explained in this section.

Carry out test operation according to the flow shown below

The procedures above the dotted line in the below fig are explained in this section.



4-1 Preparation before turning power ON

Always confirm the following points before turning ON the power after completion of wiring.

(1) If problem can occur if the motor runs in reverse direction then remove the coupling and belt coupling the motor and machine, so that the machine can be run as a single unit.

(2) Confirm that the power supply cables are correctly connected to the input terminals (L1, L2, L3).

(3) Make sure that the power voltage and frequency is within the tolerable range.

(4) Refer to Chapter-2: Installation & Wiring and correctly connect the main circuit wiring.

(5) Securely fix the motor with the specified method.

(6) Make sure that none of the terminal section screws are loose.

(7) Make sure that there is no short circuit state in the terminals caused by wire scraps, etc.

(8) Always correctly install the front cover and outer cover before turning the power ON.

Make sure that there is no abnormal noise, smoke or odors at this time. If any abnormality is found, turn the power OFF immediately.

4.1.1 Selection of start / stop modes

With the ***Axpert-Opti torque***, three start modes and four stop modes can be selected. These are set with the parameter ‘A104: Start Mode Selection’ and ‘A105: Stop Mode Selection’.

Normally, V-Ramp is used in almost 90% applications. However, where the load has to reach to the full speed within short time, I-Ramp is the preferred start mode. Where, reduction in the current peak and linear rise of speed is required, use T-Ramp mode. For the test operation, select V-Ramp Start as start mode and Coast-to-stop as stop mode.

A104: Start Mode Selection
=1: V-Ramp Start
=2: I-Ramp Start
=3: T-Ramp Start
A105: Stop Mode Selection
=1: V-Ramp Stop
=2: T-Ramp Stop
=3: Brake Stop
=4: Coast-to-Stop

4.1.2 Selection of start control

The unit can be controlled from various places like Digital Operation Panel (Local), Terminal or from Host computer. Select appropriate start control in A101. Use Digital Operation Panel (Local) during the test operation.

A101: Start Control
=1: Local
=2: Terminal
=3: Serial

4.1.3 Adjusting the ramp time

The ramp time needs to be adjusted according to the applications and start/ stop mode. Do not keep long ramp time when using the V-Ramp and I-Ramp start mode.

For the V-Ramp start / stop adjust the below parameters. For the test operations, you can continue with the default settings and later on change as per the application requirements.

A106: V-Ramp Up Time1
A107: V-Ramp Down Time1
If using the dual ramp function, adjust A204: V-Ramp Up Time2 and A208: Ramp Down Time2

For the I-Ramp start, adjust
A301: I-Ramp Up Time

For T-Ramp start / stop, adjust
A401: T-Ramp Up Time
A406: T-Ramp Down Time

4.2 Initialization of motor constants in Mode-B

Input the motor rating parameters. Set the following parameters in Mode-B.

B101: Rated Input Voltage (V)
B102: Motor Voltage (V)
B103: Motor Current (A)
B104: Motor Frequency (Hz)
B105: Motor Speed (rpm)
B106: Motor Capacity (kW)
B107: Motor Poles
B108: SS Connection Type

Refer Chapter-10 for the power wiring connections for inside delta connections.

4.3 Test operations

When finished with parameter settings, test run the isolated motor, and make sure that there are no tripping.

Use Digital Operation Panel mode to test run the motor. Press “RUN” key to start the motor.

Check

- Did the motor run?

- Is the run direction correct? Check the wiring and operation if abnormal.

- Is the rotation smooth?

- Is motor direction is same as required?

Press the “STOP” key and stop the motor.
If the motor direction is not the desired one, interchange any two motor terminals.

This completes the test operation with the operation panel.

After this, carry out the parameter settings and adjust the load operation to match the user's application.

CHAPTER- 5: CONTROL INPUT / OUTPUT TERMINALS

5.1 Input/output terminal function of PCA-2005B

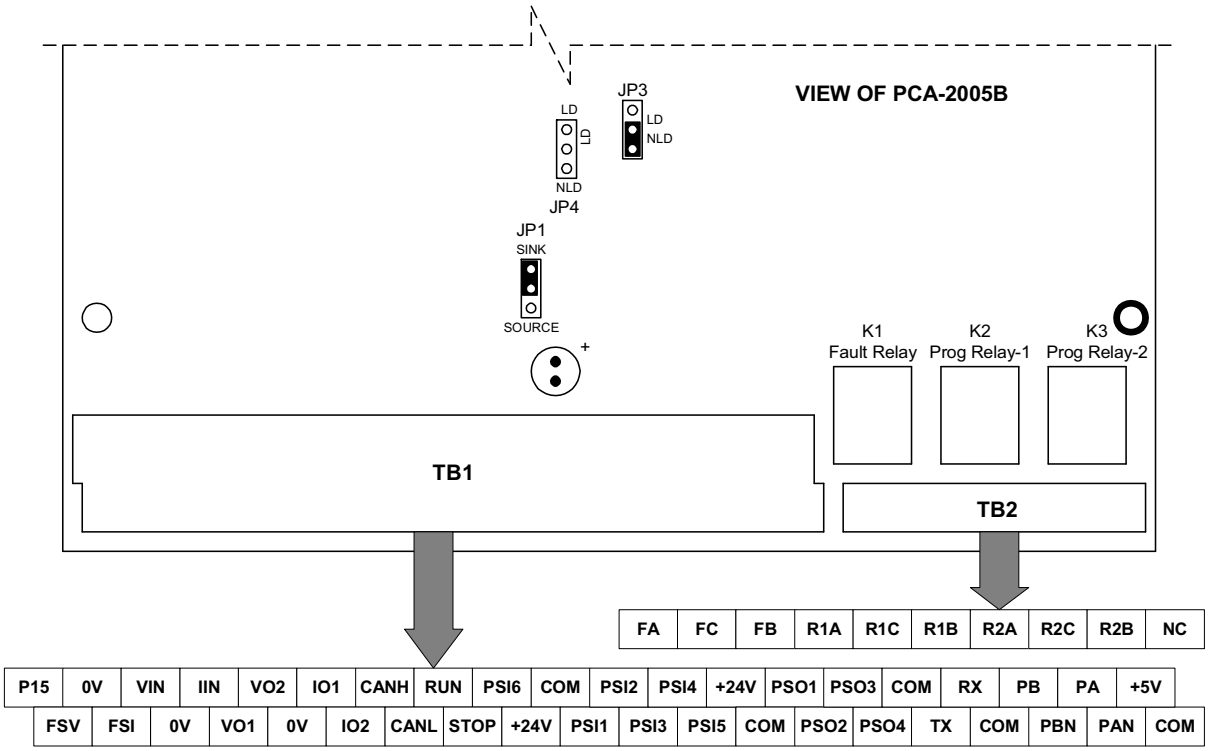


Fig. 5-1-1

Table 5-1-1

SYMBOL	NAME	USE
+24V	+24V source	This source is used for the Programmable Sequence Inputs. The logic for the Programmable Sequence Inputs can be changed to sink or source with the help of JP1 on the control board. ***The unit is shipped with sink logic.***
COM		
RUN	Programmable Sequence Input RUN	These are programmable sequence inputs and can be configured for different 24 functions using *C114.*
STOP	Programmable Sequence Input STOP	These are programmable sequence inputs and can be configured for different 24 functions using *C115.*
PSI1-6	Programmable Sequence Inputs 1 ~ 6	These are programmable sequence inputs and can be configured for different 24 functions using *C101 ~ C106*.
PSO1-4	Programmable Sequence Outputs 1 ~ 4	These are programmable sequence outputs and can be configured for different 20 functions using *C107 ~ C110*.
P15	+15V source	This is a 10V source used when a reference setter is connected to the FSV input circuit. The reference setter to be used should be a variable resistor of 2k and 2W.
0V	Common	This is a common terminal for analog input signals.

FSV	Reference Setting Voltage input	This is mainly used for setting the reference source input. A maximum reference setting is available at 10V input. This setting is valid when *FSV 0-10V* is selected as *PID Reference input (C303)* or *PID Feedback input (C304).*
FSI	Reference Setting Current input	This is mainly used for setting the reference input. A maximum reference setting is available at 20mA input. This setting is valid when *FSI 4-20mA* is selected as *PID Reference input (C303*) or *PID Feedback input (C304).*
VIN	Voltage input	This is analog voltage input 0-10V and can be used for the *PID Reference input (C303)* or *PID Feedback input (C304).*
IIN	Current Input	This is analog current input 4-20mA and can be used for the *PID Reference input (C303)* or *PID Feedback input (C304).*
VO1	Vout-1	These are programmable analog voltage outputs 0-10V. In default condition, output voltage signal is assigned to VO1 and output current signal is assigned to VO2. Different seven internal signals can be assigned to these outputs using *C201 & C202*.
VO2	Vout-2	
IO1	Iout-1	These are programmable analog current outputs 4-20mA. In default condition, active power is assigned to IO1 and power factor signal is assigned to IO2. Different seven internal signals can be assigned to these outputs using *C203 & C204*.
IO2	Iout-2	
TX	DATA+	These two signals are for the two-wire RS-485 serial link. The protocol used is Modbus-RTU
RX	DATA-	
FA	Programmable Fault Relay contacts	This is programmable relay and its function is assigned to “FAULT” condition in default. When a programmed condition occurs, the section FA-FC is closed and the section FB-FC is open. Other internal signals can also be output with the help of *C113*.
FC		
FB		
R1A	Programmable Relay 1 contacts	This is programmable relay and its function is assigned to “Run” condition in default. When a programmed condition occurs, the section R1A-R1C is closed and the section R1B-R1C is open. Other internal signals can also be output with the help of *C111*.
R1C		
R1B		
R2A	Programmable Relay 2 contacts	This is programmable relay and its function is assigned to “Top of Ramp” condition in default. When a programmed condition occurs, the section R2A-R2C is closed and the section R2B-R2C is open. Other internal signals can also be output with the help of *C112*.
R2C		
R2B		

The control circuit wiring is shown as under. The described precautions must be observed during wiring. Changing the jumper position **JP1** in PCA-2005B between “*SINK*” and “*SOURCE*” position can change the sequence input between sink logic and source logic. The unit is shipped with sink logic.

5.2 Programmable sequence input (PSI) wiring

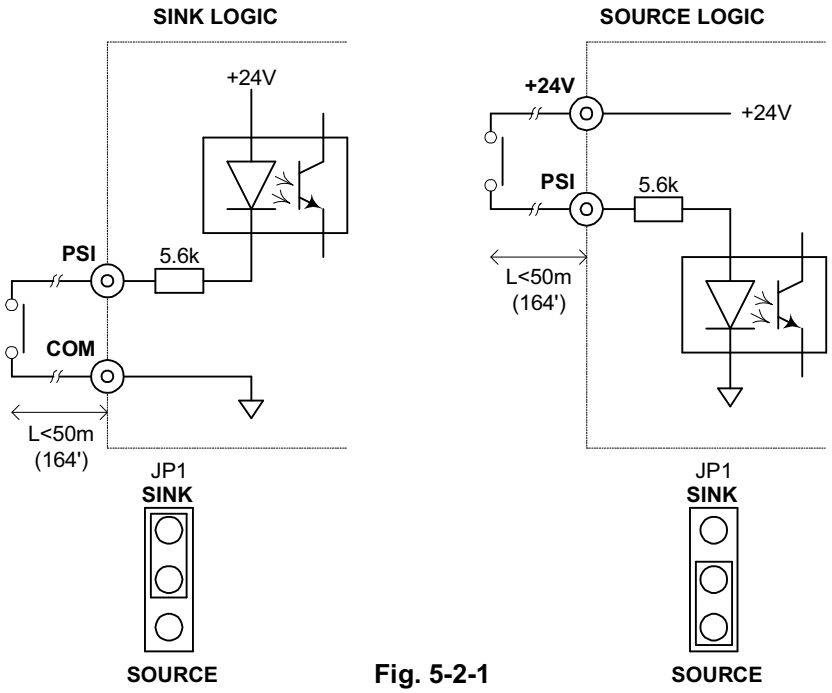


Fig. 5-2-1

Precautions

1. Wiring must not be longer than 50m (164').
2. Use minute current contact.
3. Do not connect to the analog input / output.
4. The sink / source logic can be changed with JP1 as shown in the above figure.

5.3 Programmable analog input (PAI) wiring

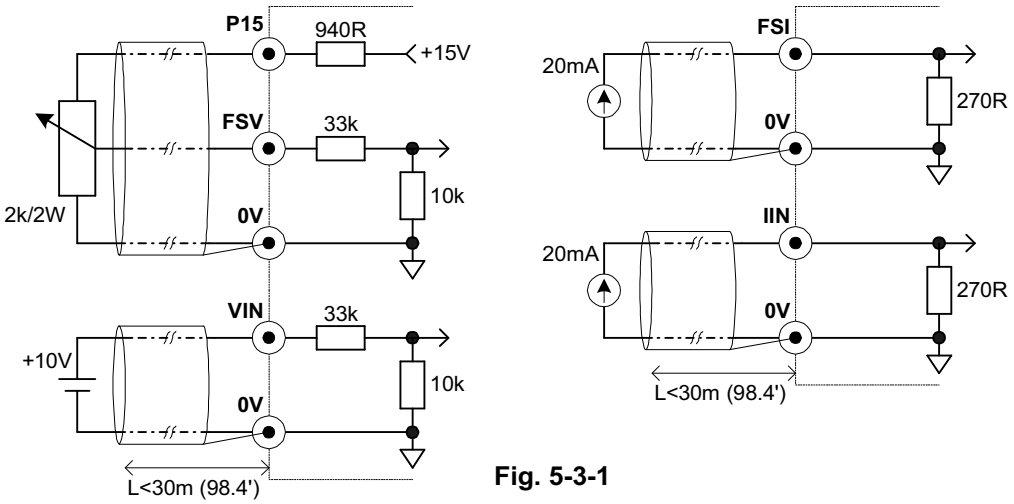


Fig. 5-3-1

Precautions

1. Use 2kΩ / 2W rating potentiometer for the external variable resistor.
2. The maximum input rating of FSV /VIN is 0 to 10.5V
3. Use a shielded wire shorter than 30m (98.4') for the wiring.
4. For the shield connections, open the mate side, and connect to 0V terminal on TB1.
5. The maximum input rating for FSI / IIN is 0 to +21mA or 5.67V.
6. Do not connect to the sequence input.

5.4 Programmable analog output (PAO) wiring

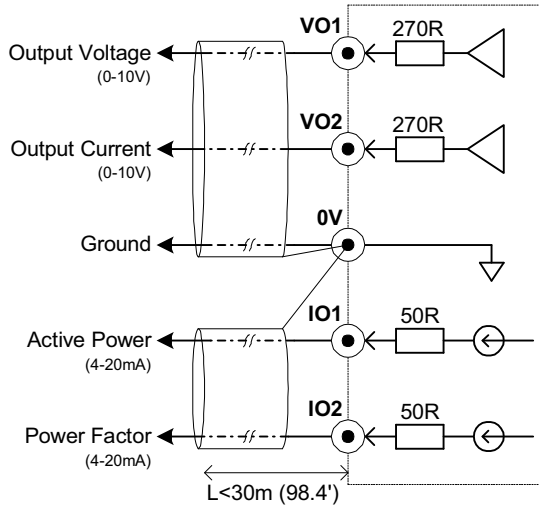


Fig. 5-4-1

Precautions

1. Use 10V full-scale meter (impedance 10k or higher).
2. The maximum output current is 1mA for voltage output.
3. Use a shielded wire shorter than 30m (98.4') for the wiring.
4. For the shield connections, open the mate side, and connect to 0V terminal on TB1.

5.5 Programmable sequence output (PSO) wiring

Open collector type wiring

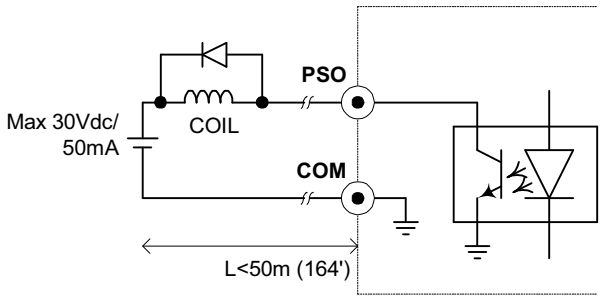
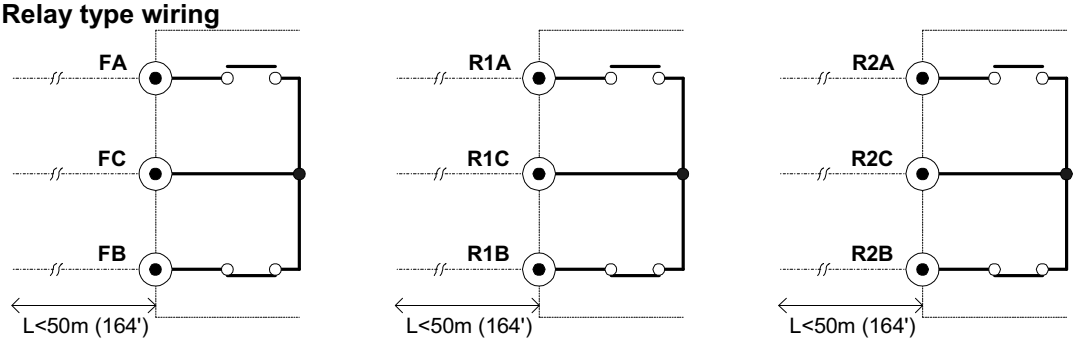


Fig. 5-5-1

Precautions

1. To drive an L load, such as a coil, insert the flywheel diode shown in the drawing.
2. Keep the wiring length to 50m (164') or less.
3. Use within the 30VDC, 50mA ratings range.

Relay type wiring



PROGRAMMABLE FAULT RELAY

PROGRAMMABLE RELAY1

PROGRAMMABLE RELAY2

Fig. 5-5-2

Precautions

1. Use within the rated range shown below.

Rated capacity (resistance load): 250VAC, 1A or 30VDC, 1A
Maximum Voltage: 250VAC
Max. Current: 1A
Switching capacity: 100VA / 100W

2. The wire must be shorter than 50m (164').

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CHAPTER- 6: PARAMETER SETTINGS & FUNCTIONS

6.1 MODE-M: Monitor Parameters

The monitor mode sequentially displays the current, voltage, etc., parameters.

No.	Parameter Name	Unit	Res.	Description
GROUP-1				
M101	Output Current	%	0.1	Displays the average value of three-phase output current as a % of the motor rated current.
M102	R-Phase Current	Amp	0.1	It displays the current of R-Phase in ampere.
M103	Y-Phase Current	Amp	0.1	It displays the current of Y-Phase in ampere.
M104	B -Phase Current	Amp	0.1	It displays the current of B -Phase in ampere.
M105	Output Voltage	Vac	1	It displays the Output Voltage. The display may differ from the actual output voltage.
M106	Input Voltage Vry	Vac	1	It displays the Input Voltage between R & Y phase.
M107	Input Voltage Vyb	Vac	1	It displays the Input Voltage between Y & B phase.
M108	Line Frequency	Hz	0.1	It displays the line frequency.
M109	Active Power	kW	0.1	It displays the active power in kW.
M110	Reactive Power	kVR	0.1	It displays the reactive power in kVAR.
M111	Power Factor		0.01	It displays power factor of the motor.
M112	Energy Meter	kWH	0.1	It displays energy consumed by the system in kWH.
M113	Energy Meter	MWH	1	It displays energy consumed by the system in MWH.
GROUP-2				
M201	Heat sink Temperature	^{o}C	1	Displays actual heat sink temperature of the starter.
M202	PSI-12345678 Status			The ON/OFF state of programmable sequence input will display.
M203	PSO-1234567 Status			The ON/OFF state of programmable sequence output will display.
M204	No Of Start		1	Display the number of start in last one hour.
M205	Total Start		1	Total number of starts after product shipment will be counted and displayed.
M206	Total Conductive Time	Hrs	1	The cumulative power on time after the product shipment will be counted and displayed in hours.
M207	Total Run Time	Hrs	1	The cumulative run time after product shipment will be counted and displayed in Hours.
M208	Motor Torque	N-m	0.1	It displays the motor torque in N-m.
M209	PID Reference		0.1	It displays the value of currently selected PID reference in C303.
M210	PID Feedback		0.1	It displays the value of currently selected PID feedback in C304.
M211	FSV Reference	%	0.1	It displays the value of analog input in % proportional to 0-10V.
M212	FSI Reference	%	0.1	It displays the value of analog input in % proportional to 4-20mA.
M213	Vin Reference	%	0.1	It displays the value of analog input in % proportional to 0-10V.
M214	Iin Reference	%	0.1	It displays the value of analog input in % proportional to 4-20mA.
M215	Peak Current	Amp	0.1	It displays the peak current drawn by the unit.
M216	Heat sink Temperature	^{o}F	1	It displays actual heat sink temperature of the starter in degree Fahrenheit.

No.	Parameter Name	Unit	Res.	Description
GROUP-3				
M301	Rated Current	Amp	0.1	This indicates the rated current of the unit.
M302	Rated Capacity	kW	1	This indicates the rated capacity of the unit in kW.
M303	Control Version		0.01	It displays the selected Control version.
M304	Unit Serial Number		1	It displays the Serial Number of the unit.
M305	Ship Month		1	It displays the Month of the unit shipment.
M306	Ship Year		1	It displays the year of the unit shipment.
M307	Display Version		0.01	It displays the selected Display version.
M308	PLC Display 1		1	It displays the signed 16-bit register value from the in built PLC.
M309	PLC Display 2		1	
M310	PLC Display 3		1	
M311	PLC Display 4		1	
M312	PLC Display 5		1	
M313	PLC Display 6		1	
M314	PLC Display 7		1	
M315	PLC Display 8		1	
M316	PLC Display 9		1	
M317	PLC Display 10		1	
M318	PLC FLG STS 0-7		1	It displays the status of the PLC FLG.
GROUP-4: FAULT HISTORY				
FLT-1	Fault 1			Most recent ten faults with the Input Voltage (Vry), Output Current (%), Total Conductive Time (Hrs) and Heat Sink Temperature (°C) at the time of the fault will be displayed. Fault 1 indicates latest fault while successive faults give past faults in descending order.
FLT-2	Fault 2			
FLT-3	Fault 3			
FLT-4	Fault 4			
FLT-5	Fault 5			
FLT-6	Fault 6			
FLT-7	Fault 7			
FLT-8	Fault 8			
FLT-9	Fault 9			
FLT10	Fault 10			
GROUP-5				
This provides the manufacturers contact information.				

Amtech Electronics (India) Limited. E-6, Electronics Zone GIDC, Gandhinagar Gujarat, INDIA Pin: 382028 Ph: ++9179 23289101 Fax: ++9179 2389111 Info@amtechelectronics.com www.amtechelectronics.com	Amtech Drives, Inc 3852, Oakcliff Industrial Court Doraville, Georgia - 30340, USA Ph: 770 469 5240 Fax: 678 894 4043 www.amtechdrives.com

WP: Indicates that this parameter is Write Protected during RUN condition.

6.2 MODE-A Parameters

No.	Parameter Name	Unit	Def	Min	Max	Res.	Description	WP
GROUP-1: START/STOP PARAMETERS								
A101	Start Control		1	1	3	1	This parameter is used to select start location. =1: Local =2: Terminal =3: Serial	
A102	Maintained Start/Stop		0	0	1	0	When using terminal start/ stop facility, this parameter gives the choice of having maintained or momentary contacts for start or stop. =0: The start control maintained type =1: The start/ stop control momentary type.	
A103	Start Delay	Sec	0.0	0.0	10.0	0.1	The motor start will be delayed from the run command by the set time. This is used for synchronization with peripheral machines such as mechanical brakes.	
A104	Start Mode Selection		1	1	3	1	Select the starting mode. =1: V-Ramp Start =2: I-Ramp Start =3: T-Ramp Start	✓
A105	Stop Mode Selection		4	1	4	1	Select the stop mode. =1: V-Ramp Stop =2: T-Ramp Stop =3: Brake Stop =4: Coast to Stop	✓
A106	V-Ramp Up Time1	Sec	30	1	240	1	Sets the ramp up time for V-Ramp Start and Jogging.	
A107	V-Ramp Down Time1	Sec	30	1	240	1	Sets the ramp down time for V-Ramp Stop.	
A108	Kick Voltage	%	70	A202+1	90	1	Sets the voltage level for the kick-start function, if V-Ramp Start or Jogging is selected.	✓
A109	Kick Time	Sec	0.0	0.0	2.0	0.1	Sets the duration of time the kick-start voltage applied to the motor.	
A110	Jog Reference	%	41	A202+1	90	1	Set the jog voltage as a % of the rated input voltage for the jog I/p.	✓
A111	O/L During Ramp		0	0	1	1	Enable or Disabled the thermal overload during ramp up. =0: Disable. =1: Enable.	
GROUP-2: V-RAMP START/STOP PARAMETERS								
A201	Dual Ramp Selection		0	0	1	1	Select the dual ramp in V-Ramp mode. =0: Disable =1: Enable	✓
A202	Pedestal-1	%	40	25	70	1	Sets the starting voltage for Ramp-1 for V-Ramp start. Cannot be set higher than Pedestal-2 (*A205*) if dual ramp is enabled (*A201=1*).	✓
A203	Target	%	90	25	100	1	This variable item adjusts the destination voltage after ramp up.	✓
A204	V-Ramp Up Time2	Sec	30	1	240	1	This parameter sets the ramp up time from pedestal-2 to target for V-Ramp start. Set this parameter if dual ramp is enabled (*A201=1*).	

No.	Parameter Name	Unit	Def	Min	Max	Res.	Description	WP
A205	Pedestal-2	%	70	A202	90	1	Sets the starting voltage for Ramp-2 for V-Ramp Start, when dual damp start is enabled (*A201=1*). It is adjustable from Pedestal-1 (*A202*) to Target (*A203*).	✓
A206	Initial Voltage-1	%	90	25	100	1	Sets the initial voltage for Ramp-1 for the V-Ramp stop. Cannot be set lower than Initial Voltage-2 (*A209*) if dual ramp is enabled (*A201=1*).	✓
A207	Final Voltage	%	40	25	70	1	This parameter adjusts the destination voltage during V-Ramp stop. Cannot be set higher than Initial Voltage-2 (*A209*) if dual ramp is enabled (*A201=1*).	✓
A208	Ramp Down Time2	Sec	30	1	240	1	This parameter sets the ramp down time from Initial Voltge-2 *(A209)* to Final Voltage *(A207)*. Set this parameter, if dual ramp is enabled (*A201=1*).	
A209	Initial Voltage-2	%	70	25	A206	1	Sets the initial voltage for Ramp-2 for V-Ramp stop, when dual ramp is enabled (*A201=1*). It is adjustable from Initial Voltage-1 (*A206*) to Final Voltage (*A207*).	✓
GROUP-3: I-RAMP START PARAMETERS								
A301	I-Ramp Up Time	Sec	10	1	60	1	Sets the ramp up time for I-Ramp Start.	
A302	Initial Current	%	100	100	300	1	Sets the initial current level for I-Ramp Start.	✓
A303	I-Proportional Gain		0.10	0.01	2.00	0.01	This parameter adjusts the proportional gain for the PI controller, which controls the current during I-Ramp Start.	
A304	I-Integral Time	Sec	0.10	0.01	100.00	0.01	This parameter adjusts the integral time for the PI controller, which controls the current during I-Ramp Start.	
GROUP-4: T-RAMP START/STOP PARAMETERS								
A401	T-Ramp Up Time	Sec	30	1	240	1	Sets the ramp up time for T-Ramp Start.	
A402	Initial Torque	%	20	1	250	1	Sets the initial torque level for T-Ramp Start.	✓
A403	Torque Limit	%	100	1	250	1	Sets the torque limit for T-Ramp Start.	✓
A404	T-Proportional Gain		0.5	0.1	2.0	0.1	This parameter adjusts the proportional gain for the PI controller, which controls the torque during T-Ramp Start.	
A405	T-Integral Time	Sec	0.10	0.01	100.00	0.01	This parameter adjusts the integral time for the PI controller, which controls the current during T-Ramp Start.	
A406	T-Ramp Down Time	Sec	30	1	240	1	Sets the ramp down time for T-Ramp Stop.	
A407	End Torque	%	20	1	100	1	Sets the end torque level at stop as a % of motor nominal torque.	✓
GROUP-5: BRAKE STOP PARAMETERS								
A501	Brake Ramp Up Time	Sec	5.0	0.1	20.0	0.1	Set the ramp time for the voltage to reach to Brake Volt (*A502*) during Brake Stop.	
A502	Brake Voltage	%	25	25	100	1	Set the Brake Voltage for Brake Stop.	✓
A503	Brake Time	Sec	5	1	240	1	This parameter sets the time for the Brake Voltage *(A502)* to be applied to the motor during Brake Stop.	

No.	Parameter Name	Unit	Def	Min	Max	Res.	Description			WP
GROUP-6: PARAMETER SELECTION FOR NORMAL DISPLAY SCREEN										
A601	Norm Parameter 1		1	1	23	1	Select from this to display on normal screen.			
A602	Norm Parameter 2		2	1	23	1	=1: M101 %L	=2: M102 Ir	=3: M103 Iy	
A603	Norm Parameter 3		6	1	23	1	=4: M104 Ib	=5: M105 Vo	=6: M106 Vry	
A604	Norm Parameter 4		5	1	23	1	=7: M107 Vyb	=8: M108 Hz	=9: M109 KW	
A605	Norm Parameter 5		8	1	23	1	=10: M110 kVR	=11: M111 PF	=12: M112 KWH	
A606	Norm Parameter 6		9	1	23	1	=13: M113MWH	=14: M201 ºC	=15: M208 N-m	
A607	Norm Parameter 7		14	1	23	1	=16: M209 PR	=17: M210 Fb	=18:M211 FSV	
A608	Norm Parameter 8		12	1	23	1	=19: M212 FSI	=20: M213 VIN	=21: M214 IIN	
							=22: M215 APk	=23: M216 ºF		

6.3 MODE-B: Parameters

No.	Parameter Name	Unit	Def	Min	Max	Res.	Description	WP
GROUP-1: MOTOR PARAMETER								
B101	Rated Input Voltage	Vac	1	1	1	1	Select suitable rated input voltage from the below selections for 200, 400V, 500V & 600V Series. =1:230V	
			3	1	6	1	=1: 380V =2: 400V =3: 415V =4: 440 V =5: 460V =6:480V	
			3	1	4	1	=1: 500V =2: 525V =3: 550V =4: 575 V	
			3	1	3	1	=1: 600V =2: 660V =3: 690V	
B102	Motor Voltage	Vac	230	230	230	1	This is the Motor rated Voltage. Set the voltage mentioned on the motor nameplate. The setting value depends on the 200V, 400V, 500V or 600V Series model.	
			415	380	480	1		
			550	500	575	1		
			690	600	690	1		
B103	Motor Current	Amp	M301	0.3* M301	M301* 1.73	0.1	Set the motor rated current from the motor nameplate. It can be set to 30% of the unit rated current M301.	
B104	Motor Frequency	Hz	1	1	2	1	Set the motor rated frequency from the motor nameplate. =1: 50Hz =2: 60Hz	
B105	Motor Speed	rpm	1500	750	3600	1	Set the motor rated rpm from the motor nameplate.	
B106	Motor Capacity	kW	M302	30.0	M302	0.1	Set the motor's rated capacity.	✓
B107	Motor Poles		4	2	8	2	Insert the motor poles.	✓
B108	SS Connection Type		1	1	2	1	Select the soft starter connection type. =1: Inline =2: Inside delta	✓
GROUP-2: PROTECTION PARAMETERS – 1								
B201	Under Frequency Protection Delay	Sec	5	0	60	1	Delays tripping on detection of a low supply frequency, when the motor is running. Set to 60 to disable the Under Frequency Fault.	
B202	Over Frequency Protection Delay	Sec	5	0	60	1	Delays tripping on detection of a high supply frequency, when the motor is running. Set to 60 to disable the Over Frequency Fault.	
B203	Low Current Alarm Set Point	%	50	1	100	1	Sets the level at which the low current alarm operates as a percentage of motor current. Programmable Relay output can be used to indicate the state of low current alarm using *C111 ~ C113*.	
B204	High Current Alarm Set Point	%	350	100	800	1	Sets the level at which the high current alarm operates as the percentage of motor current. Programmable Relay output can be used to indicate the state of high current alarm using *C111 ~ C113*.	
B205	I-Unbalance Level	%	30	10	100	1	Sets the I-unbalance level as a % of the motor rated current. Set to 100% to disable the function.	
B206	I-Unbalance Delay	Sec	10	10	120	1	Delays tripping on detection of I-unbalance fault.	

No.	Parameter Name	Unit	Def	Min	Max	Res.	Description	WP
B207	Emergency Stop Mode		1	1	3	1	Set the stopping method for the emergency stop. =1: Coast to Stop =2: Coast to Stop with fault output =3: Stop as per A105	
B208	Number Of Restart		0	0	5	1	Sets maximum numbers of restart attempts for 11 faults.	
B209	Restart Wait Time	Sec	10	1	60	1	Sets the wait time between two starts during auto restart operation.	
B210	Bypass Contactor Delay Time	Sec	1.0	0.0	30.0	0.1	This parameter sets the delay time for the bypass contactor to operate, if the load current has not decreased below 115% after completion of Ramp Up Time & I-Limit Time.	
B211	Test Mode Selection		0	0	1	1	Enable or Disabled the Test Mode. Test Mode is only for factory test purpose. =0: Disable. =1: Enable.	✓
GROUP-3: PROTECTION PARAMETERS – 2								
B301	I-Limit Level	%	300	A302+ 1	600	1	Sets the current limit as a % of motor rated current. Applicable for all modes.	✓
B302	I-Limit Time	Sec	30	10	60	1	Sets the time limit for which the current limit can be active. Unit will trip if the total time of current limit operation exceeds the set time.	
B303	I-Low Level	%	0	0	100	1	This parameter sets the threshold of the under current trip as % of motor rated current. Active only during the running condition.	
B304	I-Low Time	min	0	0	20	1	This parameter allows the time that the current must remain below the set threshold level for the undercurrent before the trip will occur.	
B305	Overload Setting	%	105	50	105	1	Setting of this parameter will decide the service factor for thermal overload curves.	
B306	Overload Curve Selection		3	1	4	1	Choose the curves for the motor 'Thermal Overload Protection'. =1: Class 30 =2: Class 20 =3: Class 10 =4: Class 2	
B307	I-Trip Level	%	500	100	800	1	This parameter sets the threshold of the instantaneous over current trip as % of motor rated current.	
B308	I-Limit Kick		1	0	1	1	This parameter controls the current in the kick-start region. =0: Disable =1: Enable	
B309	Parameter Lock		0	0	9999	1	Set to prevent unintentional parameter changes from the digital operational panel.	
B310	Change Password		0	0	9999	1	User can change the 4-digit password for parameter Lock.	

No.	Parameter Name	Unit	Def	Min	Max	Res.	Description	WP
B311	Default Value Load		0	0	111	1	The current active parameters will be saved to non-volatile memory.	
					222		The saved parameter will be fetched from memory and now the unit will respond to these parameters.	✓
					333		All the user parameters will be set to default (US standard) excluding C205 to C219 & PLC parameters.	✓
					444		All the user parameters will be set to default excluding C205 to C219 & PLC parameters.	✓
					555		When set to 555, the fault history buffer is cleared. No previous fault code and parameter will be available.	✓
					666		All the user parameters will be set to default including C205 to C219 & PLC parameters.	✓
					777		All PLC parameters set to default value.	✓
Note that the value entered in this parameter will not be memorized. If correct value is entered, appropriate action will be taken and “00” will be displayed. If incorrect value is entered, no action will be taken and “00” will be displayed.								
B312	Over Voltage Limit	%	120	100	120	1	Sets the level at which the Over Voltage Fault is detected as a percentage of Rated Input Voltage *(B101)*.	
GROUP-4: FAULT SETTING								
B401	Phase Direction Fault		0	0	1	0	When enabled, the unit will trip if the input phase rotation is reversed. =0: Disable. =1: Enable.	
B402	Firing Fault		0	0	1	0	When enabled, the unit will trip whenever the firing fault occurs. =0: Disable. =1: Enable.	
B403	Ground Fault Level	%	70	0	100	1	Sets ground fault level as a % of motor rated current. Set to 0% to disable the fault. *It will be automatically disabled when using for inside delta type.*	
B404	Ground Fault Selection		1	0	1	1	This parameter provides selection of ground fault. *It will be automatically disabled when using for inside delta type.* =0: Disable during ramp up =1: Enable during ramp up	
B405	Pick Up Function		1	0	1	1	When enabled, the unit will auto-restart during the voltage drop conditions (25% or more of rated input voltage *B101* drop for more than 20msec).	
B406	Temperature Alarm Level	°C	82	0	95	1	This is temperature alarm level set point. Whenever the heat sink temperature exceeds the set value, the Temp Alarm output will be set. Hysteresis of 2°C hysteresis will occur with temperature alarm.	
B407	In-Built PLC Selection		0	0	1	1	By Using this parameter In-Built PLC function can Enable or Disable. =0: Disable =1: Enable	

No.	Parameter Name	Unit	Def	Min	Max	Res.	Description	WP
B408	Copy Para set		0	0	8	1	Copy all user and PLC parameters from control side to the Display EEPROM. User can copy up to 8 sets of all parameters. =0:Ent Copy Set =5:Copy Set 5 =1:Copy Set 1 =6:Copy Set 6 =2:Copy Set 2 =7:Copy Set 7 =3:Copy Set 3 =8:Copy Set 8 =4:Copy Set 4	✓
B409	Paste Para set		0	0	8	1	Paste all user and PLC parameters from Display EEPROM to the control side. User can paste 8 sets of all parameters. =0:Ent Copy Set =5:Paste Set 5 =1:Paste Set 1 =6:Paste Set 6 =2:Paste Set 2 =7:Paste Set 7 =3:Paste Set 3 =8:Paste Set 8 =4:Paste Set 4	✓

6.4 MODE –C: Parameters

No.	Parameter Name	Unit	Def	Min	Max	Res.	Description	WP
GROUP-1: PROGRAMMABLE INPUT/OUTPUT								
C101	PSI-1		2	1	24	1	The different options are as under. =1: Not Used =2: Terminal =3: Jogging =4: External Flt (NO) =5: Fault Reset =6: Bypass Cont Flt =7: Main Cont Flt =8: Emergency Stop (NO) =9: Ramp Hold =10: Rev cont Flt =11: PID Bypass =12: PID Disable =13: Emergency Stop(NC) =14:External Flt (NC) =15: RUN =16: STOP =17: PLC input 1 =18: PLC input 2 =19: PLC input 3 =20: PLC input 4 =21: PLC input 5 =22: PLC input 6 =23: PLC input 7 =24: PLC input 8	
C102	PSI-2		3	1	24	1		
C103	PSI-3		4	1	24	1		
C104	PSI-4		5	1	24	1		
C105	PSI-5		8	1	24	1		
C106	PSI-6		9	1	24	1		
C107	PSO-1		2	1	20	1	The different options are as under. =1: Not Used =2: Ready =3: Run =4: Top Of Ramp =5: Terminal =6: Fault Alarm =7: I-Limit Alarm =8: Low Current Alarm =9: High Current Alarm =10: Temp Alarm =11: Rev Cont =12: PID Up Limit =13: PID Low Limit =14: PLC Output 1 =15: PLC Output 2 =16: PLC Output 3 =17: PLC Output 4 =18: PLC Output 5 =19: PLC Output 6 =20: PLC Output 7	
C108	PSO-2		7	1	20	1		
C109	PSO-3		8	1	20	1		
C110	PSO-4		9	1	20	1		
C111	Programmable Relay1		3	1	20	1		
C112	Programmable Relay2		4	1	20	1		
C113	Programmable Fault Relay		6	1	20	1		
C114	PSI-RUN		15	1	24	1	The different options are same as PSI option.	
C115	PSI-STOP		16	1	24	1		
GROUP-2: ANALOG OUTPUT SELECTION								
C201	VO-1		1	1	12	1	This configures the function of analog output =1: Output Voltage =2: Output Current =3: Active Power =4: Reactive Power =5: Power Factor =6: PID Output =7: Motor Torque =8: Heat Sink Temp =9: PLC A-O/P 1 =10: PLC A-O/P 2 =11: PLC A-O/P 3 =12: PLC A-O/P 4	
C202	VO-2		2	1	12	1		
C203	IO-1		3	1	12	1		
C204	IO-2		5	1	12	1		
C205	Vout-1 Gain		0.865	0.500	1.500	0.001	This is gain setting for the VO1 analog output.	
C206	Vout-2 Gain		0.865	0.500	1.500	0.001	This is gain setting for the VO2 analog output.	
C207	Iout-1 Gain		0.850	0.500	1.500	0.001	This is gain setting for the IO1 analog output.	
C208	Iout-1 Bias		705	500	1000	1	This is bias setting for the IO1 analog output.	
C209	Iout-2 Gain		0.850	0.500	1.500	0.001	This is gain setting for the IO2 analog output.	
C210	Iout-2 Bias		705	500	1000	1	This is bias setting for the IO2 analog output.	
C211	Scaling Current	%	200	50	500	1	This parameter scales the Analog Output Current from 0-10V as a set 50 – 500% of motor rated current.	
C212	FSV Gain		1.260	0.500	1.500	0.001	This is gain setting for the FSV Reference.	
C213	FSV Bias		0	0	500	1	This is bias setting for the FSV Reference.	
C214	FSI Gain		1.350	0	1.500	0.001	This is gain setting for the FSI Reference.	
C215	FSI Bias		760	0	1000	1	This is bias setting for the FSI Reference.	
C216	Vin Gain		1.060	0.500	1.500	0.001	This is gain setting for the Vin Reference.	
C217	Vin Bias		0	0	500	1	This is bias setting for the Vin Reference.	
C218	Iin Gain		1.100	0.500	1.500	0.001	This is gain setting for the Iin Reference.	
C219	Iin Bias		760	0	1000	1	This is bias setting for the Iin Reference.	

No.	Parameter	Unit	Def	Min	Max	Res.	Description	WP
C220	FSV/FSI Time Constant	msec	50	0	1000	1	This parameter set the filter time constant for the FSV and FSI analog inputs.	
C221	VIN/IIN Time Constant	msec	50	0	1000	1	This parameter set the filter time constant for the VIN and IIN analog inputs.	
GROUP-3: PID CONTROL SELECTION								
C301	PID Control Selection		0	0	1	1	Enable or disable the PID control action. =0: Disable. =1: Enable.	
C302	PID Polarity		1	0	1	1	This can be used to invert the PID output. =0: Negative =1: positive	
C303	PID Reference Input		5	1	10	1	Decides the set input point for the PID. =1: FSV 0-10V =2: FSI 4-20mA =3: Vin 0-10V =4: Iin 4-20mA =5: Local =6: Serial =7: PLC A-O/P 1 =8: PLC A-O/P 2 =9: PLC A-O/P 3 =10: PLC A-O/P 4	
C304	PID Feedback Input Selection		3	1	8	1	Decides the feedback input point for the PID. =1: FSV 0-10V =2: FSI 4-20mA =3: Vin 0-10V =4: Iin 4-20mA =5: PLC A-O/P 1 =6: PLC A-O/P 2 =7: PLC A-O/P 3 =8: PLC A-O/P 4	
C305	Proportional Gain		1.0	0.1	10.0	0.1	Sets the proportional gain for PID controller.	
C306	Integral Time	Sec	1.0	0.1	100.0	0.1	Sets the integral time for PID controller.	
C307	Derivative Gain		0.00	0.00	1.00	0.01	Sets the derivative gain for PID controller.	
C308	PID deviation Upper Limit	%	100.0	50.0	100.0	0.1	Sets the PID deviation upper limit.	
C309	PID deviation Lower Limit	%	0.0	0.0	50.0	0.1	Sets the PID deviation lower limit.	
C310	PID Offset Adjustment	%	0.0	-100.0	100.0	0.1	Sets the offset for output after PID control.	
C311	PID Reference Setting	%	50.0	1.0	100.0	0.1	Sets the reference value in % if operation panel option is selected as input in C303.	
C312	PID Display Scale - Max		100.0	1.0	6553.5	0.1	This parameter assigns the full-scale value for the PID input/output.	
C313	PID Display Scale - Min		0.0	0.0	6553.0	0.1	This parameter assigns the min value for the PID input/output.	
C314	PID Display Unit Selection		1	1	8	1	This parameter gives a choice to user to display the unit for the PID parameters. =1: % =2: PSI (Pressure per Square Inch) =3: kg/cm2 =4: °C =5: °F =6: CFM (Cubic Feet per Minute) =7: m3/h (Cubic Meter per Hour) =8: LPM (Liter per Minute)	
GROUP-4: SERIAL COMMUNICATION								
C401	Baud Rate	bps	4	1	5	1	Sets the baud rate for the serial communication. =1: 1200 =2: 2400 =3: 4800 =4: 9600 =5: 19200	

No.	Parameter	Unit	Def	Min	Max	Res.	Description	WP
C402	Station Number		1	1	247	1	Sets the station number (address).	
C403	Parity		1	1	3	1	Setting the parity requirement for the communication. =1: No Parity =2: Odd Parity =3: Even Parity	
C404	Response Time	Sec	0.01	0.00	2.00	0.01	Sets the minimum time from receiving the command to returning an answer.	
C405	Operation Panel Communication Loss Selection		0	0	1	1	Enable or disable the operation panel communication loss fault. If enabled, The Unit will generate fault if it does not receive any response from the operation panel within 5sec. =0: Disable =1: Enable	
GROUP-5: PLC PANEL PARAMETER								
C501	PLC Panel Par1		0	0	32767	1	Plc panel parameter 1 & 2 are used in-built PLC for Timer 1 application or also used in PLC application.	
C502	PLC Panel Par2		0	0	32767	1		
C503	PLC Panel Par3		0	0	32767	1	Plc panel parameter 3 & 4 are used in-built PLC for Timer 2 application or also used in PLC application.	
C504	PLC Panel Par4		0	0	32767	1		
C505	PLC Panel Par5		0	0	32767	1	Plc panel parameter 5 & 6 are used in-built PLC for Timer 3 application or also used in PLC application.	
C506	PLC Panel Par6		0	0	32767	1		
C507	PLC Panel Par7		0	0	32767	1	Plc panel parameter 7 & 8 are used in-built PLC for Timer 4 application or also used in PLC application.	
C508	PLC Panel Par8		0	0	32767	1		
C509	PLC Panel Par9		0	0	32767	1	Plc panel parameter 9 to12 can be used in-built PLC application.	
C510	PLC Panel Par10		0	0	32767	1		
C511	PLC Panel Par11		0	0	32767	1		
C512	PLC Panel Par12		0	0	32767	1		

6.5 MODE-P: IN-BUILT PLC FUNCTIONS

No.	Parameter	Unit	Def	Min	Max	Res	Description	WP
GROUP-1: IN-BUILT PLC COMMAND PARAMETERS								
P101 ~ P110	PLC Inst 1 ~ PLC Inst 10		0	0	-	1	IN-BUILT PLC Command 1 to 10.	
GROUP-2: IN-BUILT PLC COMMAND PARAMETERS								
P201 ~ P210	PLC Inst 11 ~ PLC Inst 20		0	0	-	1	IN-BUILT PLC Command 11 ~ 20.	
GROUP-3: IN-BUILT PLC COMMAND PARAMETERS								
P301 ~ P310	PLC Inst 21 ~ PLC Inst 30		0	0	-	1	IN-BUILT PLC Command 21 ~ 30.	
GROUP-4: IN-BUILT PLC COMMAND PARAMETERS								
P401 ~ P410	PLC Inst 31 ~ PLC Inst 40		0	0	-	1	IN-BUILT PLC Command 31 ~ 40.	
GROUP-5: IN-BUILT PLC COMMAND PARAMETERS								
P501 ~ P510	PLC Inst 41 ~ PLC Inst 50		0	0	-	1	IN-BUILT PLC Command 41 ~ 50.	
GROUP-6: IN-BUILT PLC COMMAND PARAMETERS								
P601 ~ P610	PLC Inst 51 ~ PLC Inst 60		0	0	-	1	IN-BUILT PLC Command 51 ~ 60.	
GROUP-7: IN-BUILT PLC COMMAND PARAMETERS								
P701 ~ P710	PLC Inst 61 ~ PLC Inst 70		0	0	-	1	IN-BUILT PLC Command 61 ~ 70.	
GROUP-8: IN-BUILT PLC COMMAND PARAMETERS								
P801 ~ P810	PLC Inst 71 ~ PLC Inst 80		0	0	-	1	IN-BUILT PLC Command 71 ~ 80.	
GROUP-9: IN-BUILT PLC COMMAND PARAMETERS								
P901 ~ P910	PLC Inst 81 ~ PLC Inst 90		0	0	-	1	IN-BUILT PLC Command 81 ~ 90.	
GROUP-A: IN-BUILT PLC COMMAND PARAMETERS								
PA01 ~ PA10	PLC Inst 91 ~ PLC Inst 100		0	0	-	1	IN-BUILT PLC Command 91 ~ 100.	

6.6 Function explanation

GROUP-1

M101: Output Current (%)

It displays the average value of three-phase output current as a percentage of the rated motor current *B103*.

Output Current (%) = Output Current (*M101*) × 100/ Motor Current (*B103*)

When the unit is stop, it will display zero. When selected for the normal parameter display in *A601~A608*, the value will be displayed with "**%L**" unit.

M102: R-Phase Current (Amp)

This parameter displays the value of current in R-phase (L1) of the unit in Ampere. When selected for the normal parameter display in *A601~A608*, the value will be displayed with "**Ir**" unit.

M103: Y-Phase Current (Amp)

This parameter displays the value of current in Y-phase (L2) of the unit in Ampere. When selected for the normal parameter display in *A601~A608*, the value will be displayed with "**Iy**" unit.

M104: B-Phase Current (Amp)

This parameter displays the value of current in B-phase (L3) of the unit in Ampere. When selected for the normal parameter display in *A601~A608*, the value will be displayed with "**Ib**" unit.

Note: *When soft starter is used for inside delta type connection (B108=2), parameters M102, M103 and M104 show the currents in delta branch.*

M105: Output Voltage (Vac)

This parameter displays the output line-to-line voltage. This is calculated voltage based on voltage command. This may differ from actual output voltage. The actual output voltage depends on input supply voltage. When the unit is stop, it will display zero.

When selected for the normal parameter display in *A601~A608*, the value will be displayed with "**Vo**" unit.

M106: Input Voltage Vry (Vac)

This parameter displays the actual input line-to-line voltage between R (L1) & Y (L2) phase. When selected for the normal parameter display in *A601~A608*, the value will be displayed with "**Vry**" unit.

M107: Input Voltage Vyb (Vac)

This parameter displays the actual input line-to-line voltage between Y (L2) & B (L3) phase. When selected for the normal parameter display in *A601~A608*, the value will be displayed with "**Vyb**" unit.

M108: Line Frequency (Hz)

This parameter displays the input supply frequency of the system. When selected for the normal parameter display in *A601~A608*, the value will be displayed with **"Hz"** unit.

M109: Active Power (kW)

This parameter displays the active power drawn by the unit. This may differ from the actual active power. When the unit is stop, it will display zero. When selected for the normal parameter display in *A601~A608*, the value will be displayed with **"kW"** unit.

M110: Reactive Power (kVAR)

This parameter displays the reactive power drawn by the unit. This may differ from the actual output power. When the unit is stop, it will display zero. When selected for the normal parameter display in *A601~A608*, the value will be displayed with **"kVR"** unit.

M111: Power Factor

This parameter displays the power factor of the load. This value may differ from actual power factor. When the unit is stop, it will display zero. When selected for the normal parameter display in *A601~A608*, the value will be displayed with **"PF"** unit.

M112: Energy Meter (kWh)

M113: Energy Meter (MWH)

This parameter displays the total output power consumption per hour basis. This may differ from actually consumed output energy. This is stored in the non-volatile memory.

When selected for the normal parameter display screen in A601-A608, it will appear as **"kWH"** and **"MWH"** unit respectively on display screen.

GROUP-2

M201: Heat Sink Temperature (°C)

This parameter displays the actual heat sink temperature in °C. When selected for the normal parameter display in *A601~A608*, the value will be displayed with "**°C**" unit.

M202: Programmable Sequence Inputs (PSI) Status

This parameter displays the status of various programmable sequence inputs i.e. whether they are OFF (0) or ON (1) for each PSI from 1-8.

M	o	d	e	-	M							G	r	o	u	p	-	2
M	2	0	2		P	S	I	-	1	2	3	4	5	6	7	8		
									0	1	0	0	0	0	0	0		
V	R	a	m	p	,	L	c	l	,	N	o	r	m	a	l		R	u	n

Fig. 6-6-1

As shown above in fig. 6-6-1, line-2 shows the programmable sequence input and line-3 shows the status of respective input. The "0" value indicates that the programmable sequence input is OFF and "1" indicates ON. In the above screen, only PSI-2 is ON and the others are OFF.

M203: Programmable Sequence Outputs (PSO) Status

This parameter displays the status of various programmable sequence outputs. PSO-5 indicates the status of programmable fault relay, PSO-6 & 7 indicates the status of programmable relay 1 and relay 2 respectively.

M	o	d	e	-	M							G	r	o	u	p	-	2
M	2	0	3		P	S	O	-	1	2	3	4	5	6	7			
									0	1	0	0	0	1	0			
V	R	a	m	p	,	L	c	l	,	N	o	r	m	a	l		R	u	n

Fig. 6-6-2

As shown above in fig. 6-6-2, line-2 shows the programmable sequence output and line-3 shows the status of respective output. The "0" value indicates that the programmable sequence output is OFF and "1" indicates ON. In the above screen, only PSO-2 and PSO-6 are ON and the others are OFF.

M204: Number of starts

This parameter displays the number of starts in last one hour.

M205: Total starts

This parameter displays the total number of starts after product shipment.

M206: Total Conductive Time (Hrs)

The total (cumulative) power on time after product shipment is counted and displayed in this parameter.

M207: Total Run Time (Hrs)

The total (cumulative) unit run time after product shipment is counted and displayed in this parameter.

M208: Motor Torque (N-m)

This parameter displays the motor torque in N-m. When selected for the normal parameter display in *A601~A608*, the value will be displayed with "**N-m**" unit.

M209: PID Reference

This parameter displays the value of currently selected PID reference input source in percentage. When local (Digital Operation Panel) option is selected as PID reference input source, it will display the value of *C311*. When selected for the normal parameter display in *A601~A608*, the value will be displayed with **"PR"** unit. Different units can be assigned to this quantity using *C312*.

M210: PID Feedback

This parameter displays the value of currently selected PID feedback input source in percentage. When selected for the normal parameter display in *A601~A608*, the value will be displayed with **"Fb"** unit.

M211: FSV Reference (%)

It displays the full-scale voltage in 0-100% proportional to 0-10V at FSV terminal. When selected for the normal parameter display in *A601~A608*, the value will be displayed with **"FSV"** unit.

M212: FSI Reference (%)

It displays the full-scale current in 0-100% proportional to 4-20mA at FSI terminal. When selected for the normal parameter display in *A601~A608*, the value will be displayed with **"FSI"** unit.

M213: VIN Reference (%)

It displays the full-scale voltage in 0-100% proportional to 0-10V at VIN terminal. When selected for the normal parameter display in *A601~A608*, the value will be displayed with **"VIN"** unit.

M214: IIN Reference (%)

It displays the full-scale current in 0-100% proportional to 4-20mA at IIN terminal. When selected for the normal parameter display in *A601~A608*, the value will be displayed with **"IIN"** unit.

M215: Peak Current (Amp)

This parameter displays the peak current drawn by the unit in Amp. When selected for the normal parameter display in *A601~A608*, the value will be displayed with "**APk**" unit.

M216: Heat sink Temperature (^{0}F)

This parameter displays the actual heat sink temperature in ^{0}F. When selected for the normal parameter display in *A601~A608*, the value will be displayed with **"°F"** unit.

GROUP-3

M301: Rated Current (Amp)

This parameter displays the rated current capacity of unit.

M302: Rated Capacity (kW)

This parameter displays the rated kW capacity of unit.

M303: Control Version

This parameter displays the software version of control board of the unit.

M304: Unit Serial Number

This parameter displays the serial number of the unit.

M305: Ship Month

This parameter displays the month of unit shipment.

M306: Ship Year

This parameter displays the year of unit shipment.

M307: Display Version

This parameter displays the software version of display board of the unit.

M308 to M317: PLC Display 1 ~ 10

For IN-BUILT PLC programming, there are 115 16-bit registers, 10 values of these registers can be displayed in parameter M308 to M317 and that all values will be save in EEPROM during power down. (Related PLC command is DISPLAY_REG (061)).

M318: PLC FLAG Status 0~7

For IN-BUILT PLC programming, there are 100 1-bit flags, 8 of these flag status can be display in parameter M323. (Related PLC command is DISPLAY_FLG (062)).

GROUP-4: FAULT HISTORY

FLT-1~FLT10: Fault 1~10

This parameter displays the most recent ten faults with the values of Input Voltage (Vry), Output Current (%), Total Conductive Time (Hrs) and Heat Sink Temperature (^{o}C) at the time of fault occurrence. Fault-1 indicates latest fault while successive faults gives past faults in descending order.

M	o	d	e	-	M		F	L	T	-	1		G	r	o	u	p	-	4
			E	x	t	e	r	n	a	l		F	a	u	l	t			
		4	1	5		V	r	y			1	5	0	.	0		%	L	
	1	2	7	5		H	r	s						5	0		°	C	

Fig. 6-6-3

As shown in fig. 6-6-3, line-2 shows the fault code, line-3 shows the Input Voltage & Output current and line-4 shows the Total Conductive Time & heat sink temperature. If no fault is detected since shipment, line-2 displays “No previous fault” and the value of different parameters will be read as zero.

Same way FLT-2 ~ FLT10 shows the previous fault codes and parameters at the time of fault occurrence.

MODE-A

GROUP - 1: START/STOP PARAMETERS

A101: Start Control

Select start location.

1: Local
2: Terminal
3: Serial

The unit can be started from *Local* (Digital Operation Panel), *Terminal* or *Serial*.

If in running condition, start control is changed from *Local* to *Terminal*, the operation will continue as per the status of the new selection. For example, present selection is *Local.* Now if in running condition, the selection is changed to *Terminal*. If RUN signal is present in terminal mode, the unit will continue running. If RUN signal is absent, the unit will stop. When the selection is changed from *Terminal* to any other mode (*Local* or *Seria*l), unit will continue its operation as per the status of *Terminal* and not as per the new selection (*Local* or *Serial).*

A102: Maintained Start/Stop

When using *Terminal* as start control (*A101=2*), this parameter gives the choice of having maintained or momentary contacts for start or stop. Here user has to select “15:RUN” option in one of PSI(C101 ~ C106, C114 and C115) for maintained and for momentary, user has to select “15:RUN” option and “16:STOP” in another PSI.

If *A102=0*: The start / stop control is *maintained type* as shown in below fig. 6-6-4.

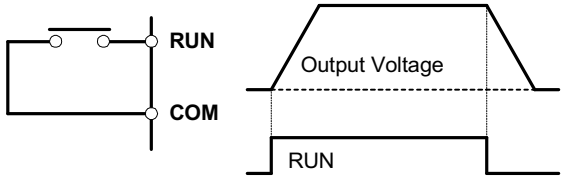


Fig. 6-6-4

If *A102=1*: The start / stop control is *momentary type* as shown in below fig. 6-6-5

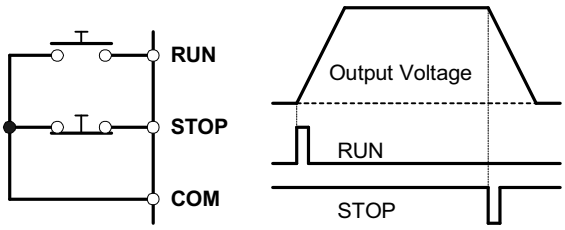


Fig. 6-6-5

A103: Start Delay (Sec)

The motor will be delayed start from the run command by the set time. This is used for synchronization with peripheral machines such as mechanical brakes. The start command can be from *Digital Operation Panel (keypad)*, *Terminal* or *Serial*.

The start delay time is also applicable to *Jog Select* input.

A104: Start Mode Selection

Select the required start mode.

A104=1: The starting mode is *V-Ramp Start*.

A104=2: The starting mode is *I-Ramp Start*.

A104=3: The starting mode is *T-Ramp Start*.

A105: Stop Mode Selection

Select the required stop mode.

A105=1: *V-Ramp Stop*

A105=2: *T-Ramp Stop*

A105=3: *Brake Stop*

A105=4: *Coast to Stop*

A106: V-Ramp Up Time1 (Sec)

This is applicable for V-Ramp Start and Jogging and should be adjusted as per the desired ramp up time.

It controls the ramp up time from *Pedestal-1* to *Target*, when dual ramp (*A201=0)* is not selected. When *A201=1*, it controls the time from *Pedestal-1* to *Pedestal-2*.

Note: Ramp up time is affected by the following condition.

1. Current limit will extend the ramp up time if motor does not reach full speed while in *Current Limit* mode.
2. Ramp up time will extend if *Ramp Hold* function is active.

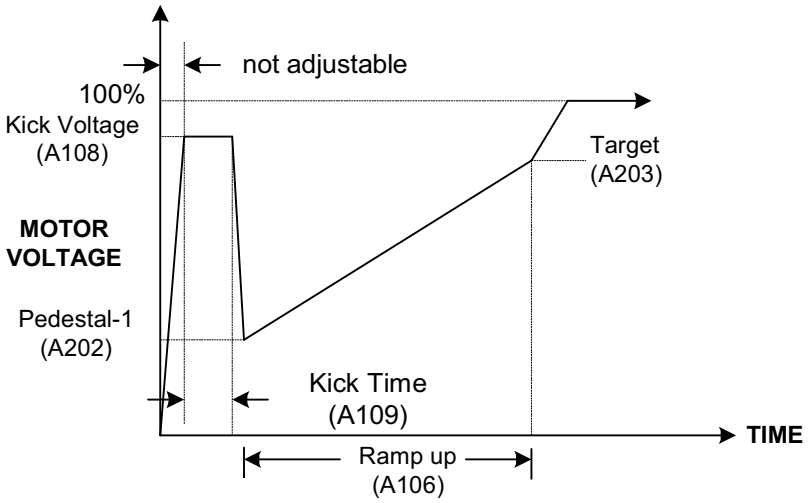


Fig. 6-6-6

A107: V-Ramp Down Time1 (Sec)

This is applicable for V-Ramp Stop or Jogging and should be adjusted as per the desired ramp down time.

This parameter controls the ramp down time from *Initial Voltage-1(A206)* to *Final Voltage (A207),* when dual ramp (*A201=0*) is not selected. When (*A201=1*), it controls the time from *Initial Voltage-1 (A206)* to *Initial Voltage-2 (A209)*.

A108: Kick Voltage (%)

This is applicable only in *V-Ramp Start* or *Jogging* and sets the kick voltage level for the kick-start function.

The setting of this parameter should be higher than the pedestal voltage setting to provide the benefit in the worst starting condition. A kick-start is sometime useful when the load has a high break away torque.

A109: Kick Time (Sec)

This parameter adjusts the duration of kick voltage applied to the motor. When set to '0', disables the kick-start function.

If current feedback is available in the unit, it is possible to limit the current during the kick-start, if *I-Limit kick (B308)* is enabled.

A110: Jog Reference (%)

Set this if *Jogging* is selected as a programmable sequence input command. This is set as a percentage of the rated motor voltage.

This feature is typically used to check rotation, alignment or slowly move load into a position.

The starting profile under *Jogging* will be same as that of a *V-Ramp Start*. The set ramp up time and kick-start feature will be applicable to *Jogging* function. *Dual Ramp start* will not functional in *Jogging*. If the current transformers are connected to the control card, current limit protection is available when motor voltage is ramping up to the jog reference value. The applicable stop mode in Jogging is cost to stop.

However, *RUN* command has the higher priority than *Jogging*, if both the signals are input together.

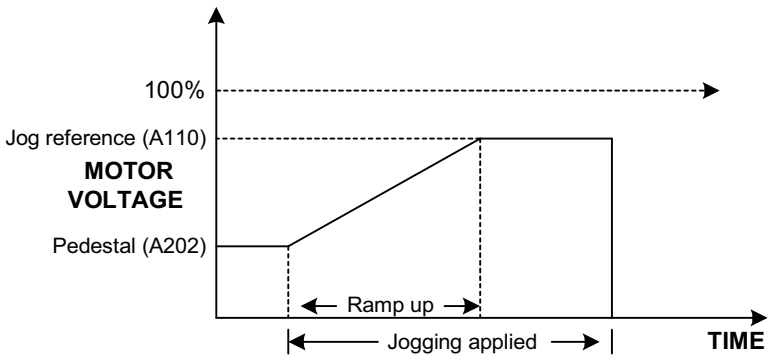


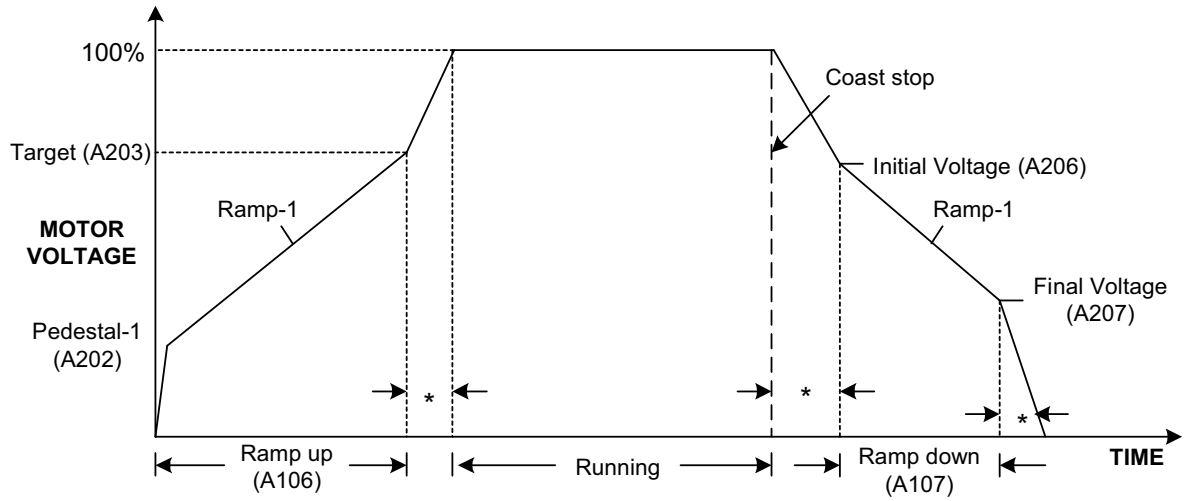
Fig. 6-6-7

A111: O/L during Ramp

Using this facility thermal overload protection can be disabled during ramp up. There are some applications where overload, even with the slowest trip setting, will still trip the unit during ramp up. By disabling this feature, one can eliminate the unnecessary tripping during ramp up.

GROUP-2: V-RAMP START/STOP PARAMETERS

When *V-Ramp Start* is selected in *Start Mode Selection (A104)*, motor voltage ramps up over a predefined time interval. When the unit is run with a *V-Ramp* profile, the connected motor will probably not start turning until the voltage ramps up a little past the standard 40% pedestal value, and will probably reach full speed long before the ramp is finished. Similarly, when the *V-Ramp Stop* is selected in stop mode selection (*A105*), motor voltage is to be ramped down over a predefined time interval. When *V-Ramp Stop* is selected; the motor will slow down less rapidly than it would if power had been removed.



* not adjustable

Fig. 6-6-8

A201: Dual Ramp Selection

This parameter helps to enable the dual ramp setting in *V-Ramp* mode. Generally dual ramp can be used to get even smoother ramps at starting.

A202: Pedestal-1 (%)

This parameter controls the starting voltage of Ramp-1 during a *V-Ramp Start.*

The pedestal should be adjusted so that when the motor is started, the motor just has sufficient torque to start turning the shaft. If the motor doesn't start turning, increase the pedestal in step of 5%. Similarly if motor turns to fast, reduce the pedestal in step of 5%.

If a kick-start is used, set the *Kick Voltage (A108)* and *Kick Time (A109)* prior to setting the pedestal level.

A203: Target (%)

This parameter adjusts the destination voltage after ramp up during *V-Ramp Start*.

The purpose of this adjustment is to control the starting time more accurately. Once the target voltage has been reached, the unit will rapidly increase the motor voltage to 100%. For this reason, it is possible that motor reaches full speed before the target voltage is reached. By shaping the voltage ramp, it is possible to obtain closer approximation to a liner acceleration curve.

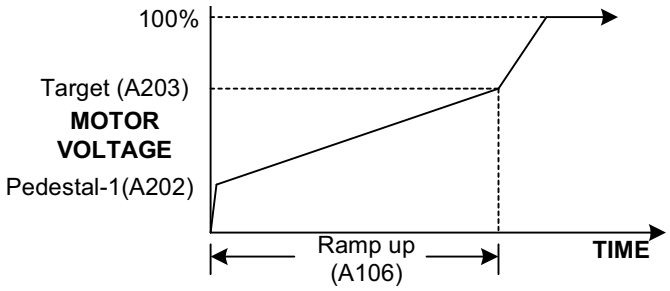


Fig. 6-6-9

As shown in fig. a motor accelerates too rapidly towards the top end of its speed range. To obtain closer to liner acceleration profile, extend the ramp up time to check the acceleration and reduced the target voltage as shown in fig. b. If acceleration profile is unacceptable, again readjust the target voltage until an acceptable acceleration profile is reached as shown in fig. c. But still in fig. c, motor reaches full speed before the target voltage is reached. Now as shown in fig. d, adjust the ramp up time down, so that motor voltage is increased to 100% just after the motor reaches full speed.

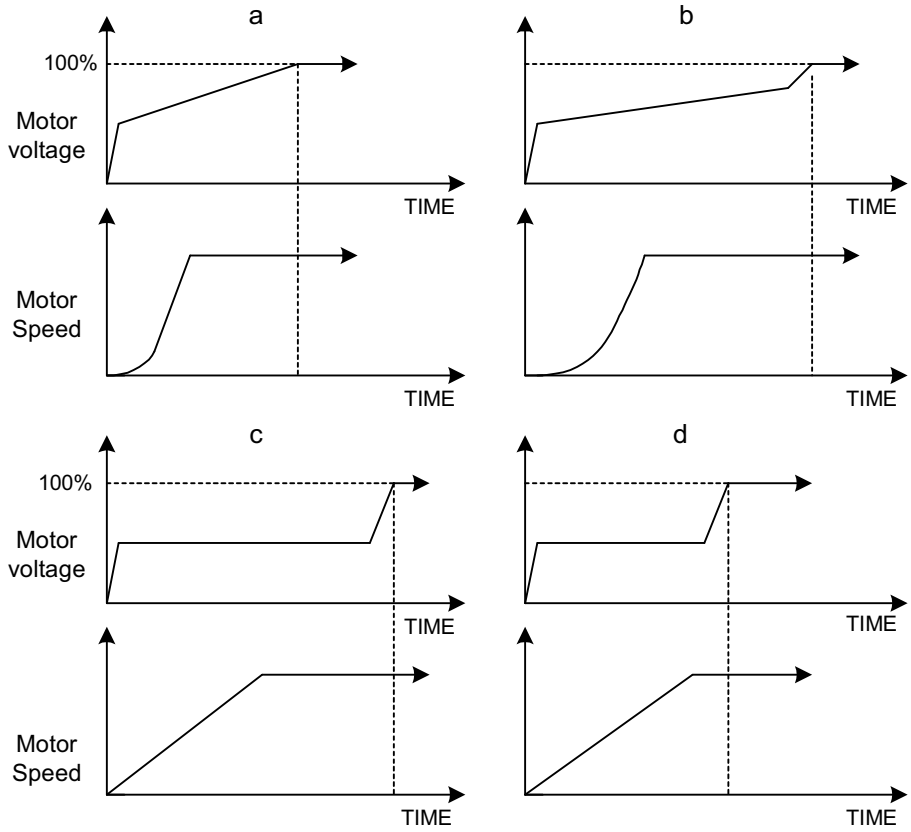


Fig. 6-6-10

A204: V-Ramp Up Time2 (Sec)

This parameter controls the ramp up time from *Pedastal-2* to *Target*. It comes into picture when *Dual Ramp Selection (A201)* is enabled.

A205: Pedestal-2 (%)

This parameter adjusts the starting voltage of Ramp-2. It comes into picture when *Dual Ramp Selection (A201)* is enabled.

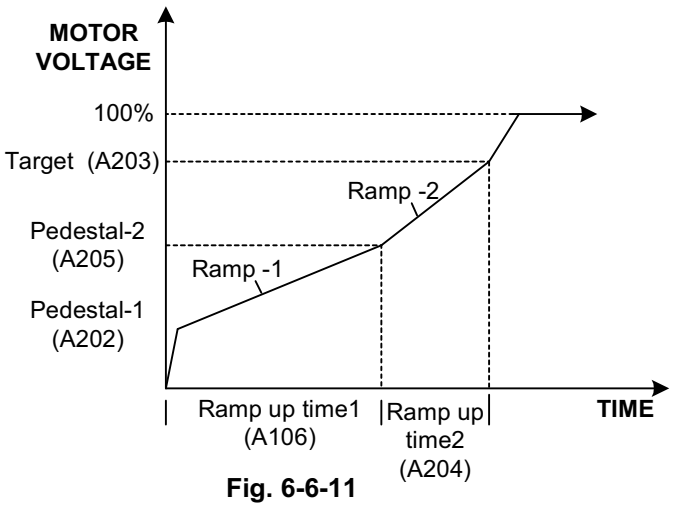


Fig. 6-6-11

A206: Initial Voltage-1 (%)

This parameter adjusts the initial voltage of Ramp-1, which is applied to the motor terminals during a *V-Ramp Stop*.

The purpose of this adjustment is to control the stopping time more accurately. The initial voltage should be adjusted so that when stop button pressed motor starts to decelerate.

If the load speed does not instantly begin to decrease, reduce the value of the initial voltage-1 in step of 5%. Similarly, if the load speed starts to fall off too quickly, increase the initial voltage-1 in step of 5%.

A207: Final Voltage (%)

This parameter adjusts the final voltage that is placed on stator terminal before the power is removed.

If *Dual ramp Selection (A201)* is enabled its value is adjustable between *Initial Voltage-2 (A209)* and 25%. Once the initial value has been adjusted, this value is used to control the way that the motor torque will vary as the motor shaft decelerates.

If the final voltage value is too high, it may happen that the motor shaft is still decelerating when power is removed from the motor. In that case, readjust (reduce) the final voltage value such that the load is stationary at the point power is removed from the motor.

A208: V-Ramp Down Time2 (Sec)

This parameter controls the ramp down time from *Initial Voltage-2 (A209)* to *Final Voltage (A207)*. It comes into picture when *Dual Ramp Selection (A201)* is enabled.

A209: Initial Voltage-2 (%)

This parameter adjusts the initial voltage of Ramp-2, and is adjustable between *Initial Voltage-1* and 25% of rated input voltage. It comes into picture when *Dual Ramp Selection (A201)* is enabled.

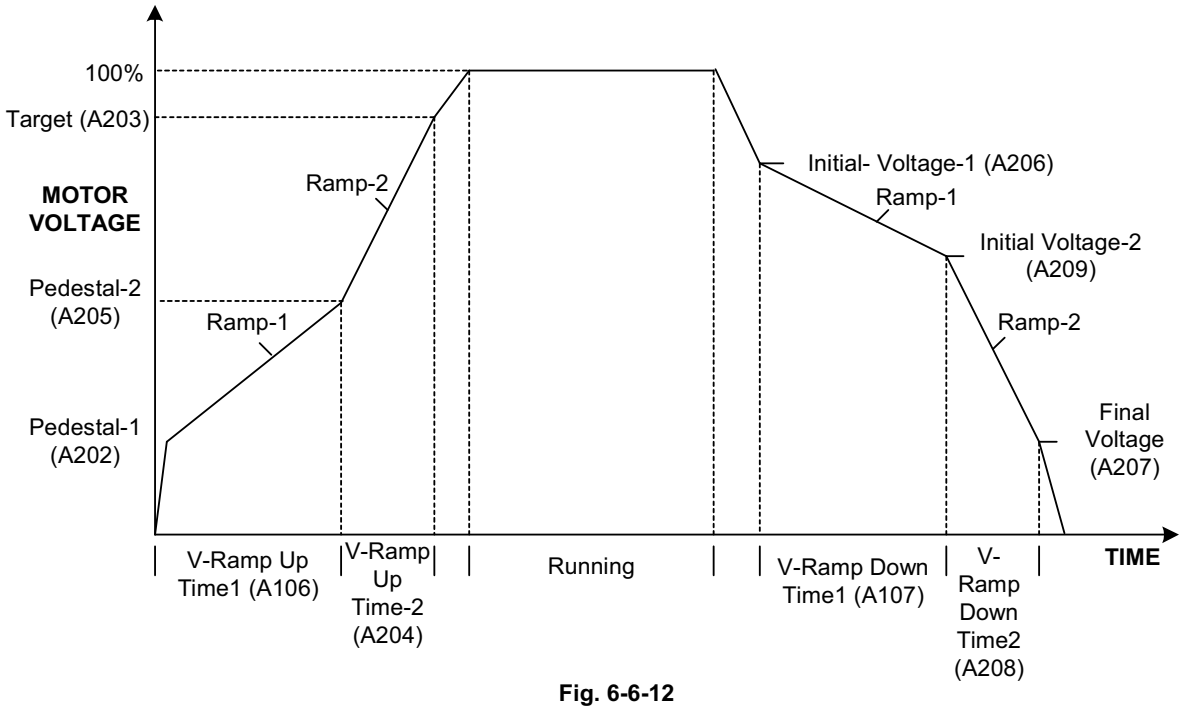

100%
Target (A203)
MOTOR VOLTAGE
Pedestal-2 (A205)
Pedestal-1 (A202)
Ramp-1
Ramp-2
Initial- Voltage-1 (A206)
Ramp-1
Initial Voltage-2 (A209)
Ramp-2
Final Voltage (A207)
V-Ramp Up Time1 (A106)
V-Ramp Up Time-2 (A204)
Running
V-Ramp Down Time1 (A107)
V-Ramp Down Time2 (A208)
TIME

Fig. 6-6-12

GROUP-3: I-RAMP START/STOP PARAMETERS

These parameters will be set if *I-Ramp Start* is selected in *Start Mode Selection (A104)*. It is only possible to have an *I-Ramp Start* if current transformers are properly connected to the control card. Under *I-Ramp Start*, the motor will accelerate at the value set under *I-limit (B301)* and the starting time is not allowed to exceed the time set by *I-limit time (B302)*. An *I-Ramp Start* is used to accelerate the load as rapidly as possible, but with due respect to the rated motor current. The sort of torques relationship exists between a voltage ramp start and a current ramp start is shown in below fig. 6-6-13.

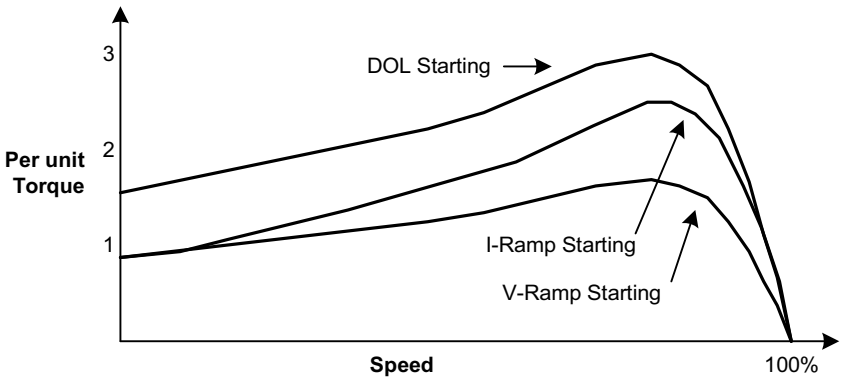


Fig. 6-6-13

The shape of the torque profile under current ramp start has a higher peak than a voltage ramp start, which reinforces the fact that a current ramp start is not an effective torque limiting start mode. The speed profile under such s start, will probably exhibit increasing acceleration as the motor speed increases.

A PI Controller actively controls the motor current during the *I-Ramp Start*.

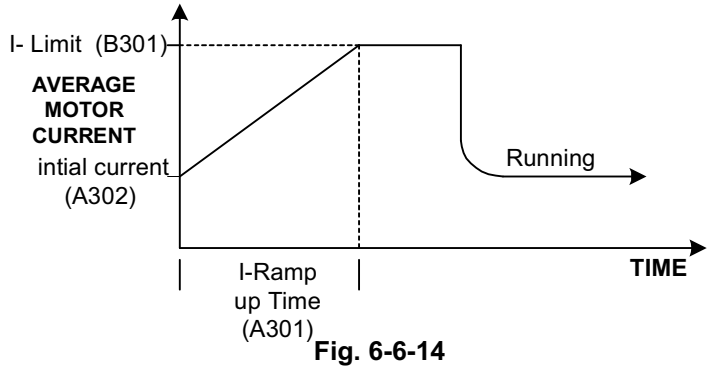


Fig. 6-6-14

A301: I-Ramp Up Time (sec)

This parameter controls the ramp up time during *I-Ramp Start*.

A302: Initial Current (%)

This parameter sets the initial current level for the *I-Ramp Start m*ode.
If *I-Ramp Start* is required, set this such that the motor begins to accelerate immediately a start is initiated.

A303: I-Proportional Gain

This parameter adjusts the value of the proportional gain in the PI Controller, which controls the current during an *I-Ramp Start*.

$$Gc = kp + ki/s$$

The above equation shows the standard PI Controller equation, where
Gc = Controller gain;
kp = proportional gain;
ki = integral gain = kp*Ti;
s = laplacian complex frequency variable.

The value entered under *I-Proportional Gain (A303)* is same as kp in the above equation.

A304: I-Integral Time (Sec)

This parameter adjusts the value of the integral time in the PI Controller, which controls the current during an *I-Ramp Start*.

The value entered under *I-Integral Time (A304)* is same as the Ti in the above equation.

GROUP-4: T-RAMP START/STOP PARAMETERS

Set these parameters if *T-Ramp (Torque Ramp) Start* and *T-Ramp Stop* are selected in *A104* and *A105* respectively. No external motor speed feedback devices are required for *T-Ramp Start* mode. Under a *T-Ramp Start* the motor speed is ramped up linearly over a predefined time frame.

This type of mode is useful in pump application and in high inertia load application.

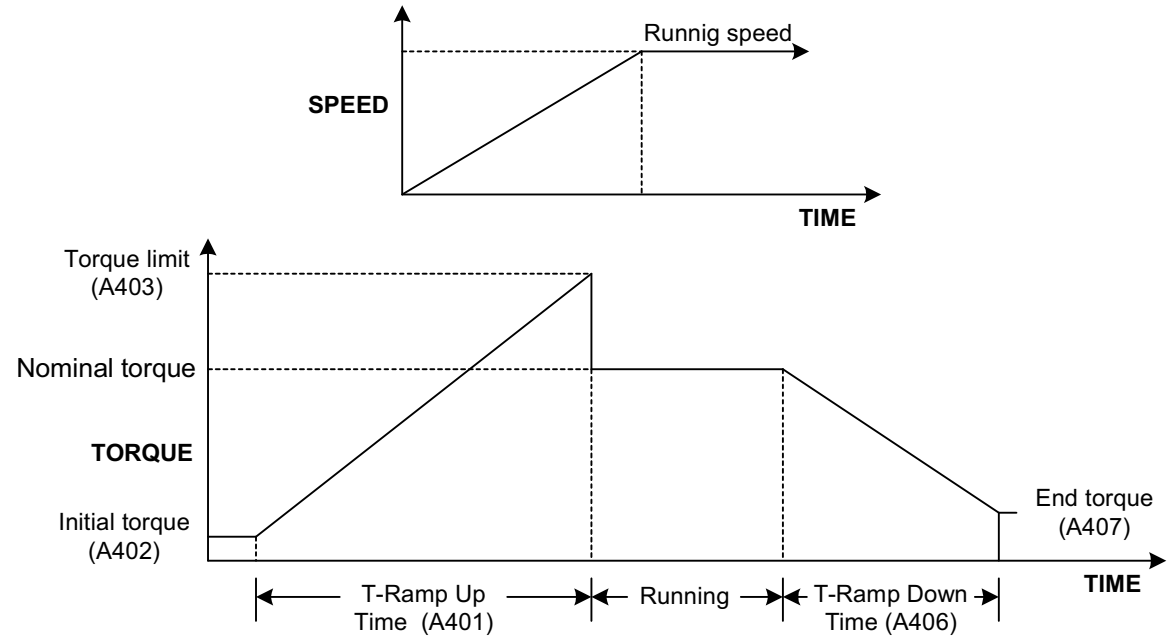


Fig. 6-6-15

A401: T-Ramp Up Time (Sec)

This ramp up time is applicable to torque control mode and is the time taken by the motor speed to ramp up from *Initial Torque (A402)* to *Torque Limit (A403)*.

A402: Initial Torque (%)

Set the initial torque level at start as a percentage of the nominal torque.
Set this value such that when the motor is started, the motor just has sufficient torque to start turning the shaft.

A403: Torque Limit (%)

Set the torque limit for linear acceleration. The torque limit is increased mainly if the application has a high inertia load, like centrifuges, planer and saw. By increasing this level to 150-250%, the current will be more linear and low as shown in below fig.

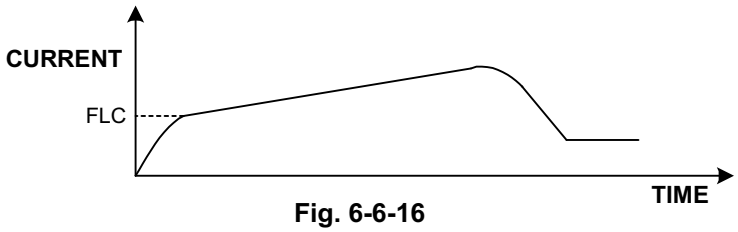


Fig. 6-6-16

A404: T-Proportional Gain

This parameter adjusts the value of the proportional gain in the PI Controller, which controls the speed during a *T-Ramp Start*

$$Gc = kp + ki/s$$

The above equation shows the standard PI Controller equation, where
Gc = Controller gain;
kp = proportional gain;
ki = integral gain = kp*Ti;
s = laplacian complex frequency variable.

The value entered under *T-Proportional Gain* is same as Kp in the above equation.

A405: T-Integral Time (Sec)

This parameter adjusts the value of the integral time in the PI Controller, which controls the speed during a *T-Ramp Start*.
The value entered under *T-Integral Time* is same as Ti in the above equation.

A406: T-Ramp Down Time (Sec)

This ramp down time is applicable to torque control mode and is the time taken by the unit to reduce the nominal torque to end torque. This feature is useful in pump application to prevent hydraulic shock, which may be occurred if the motor decelerates too quickly.

A407: End Torque (%)

Set the end torque level at stop as a percentage of the nominal torque.
This is the threshold at which the controlled stops and the motor freewheel to stop.

GROUP-5: BRAKE STOP PARAMETERS

Set these parameters if *Brake Stop* is selected in *Stop Mode Selection (A105)*. *Brake Stop* is used in applications where the fast braking of high inertia machines is required, i.e. flywheel applications. The brake stop option is of the '*reversing plug'* type and requires phase reversing contactor at front end of the unit. Phase reversal must be confirmed via the auxiliary contacts on the phase reversal contactors.

A501: Brake Ramp Up Time (Sec)

This is the brake ramp time for the motor voltage to reach to the *Brake Voltage (A502)* during brake stop.

A502: Brake Voltage (%)

This is the voltage, which is applied during the brake stop. It is set as % of rated input voltage.

A503: Brake Time (Sec)

This parameter decides the length of time for which brake voltage is applied.

Brake Time and *Brake Voltage* should be set so that the braking stops when the motor has reached standstill but not allow it to go into reverse.

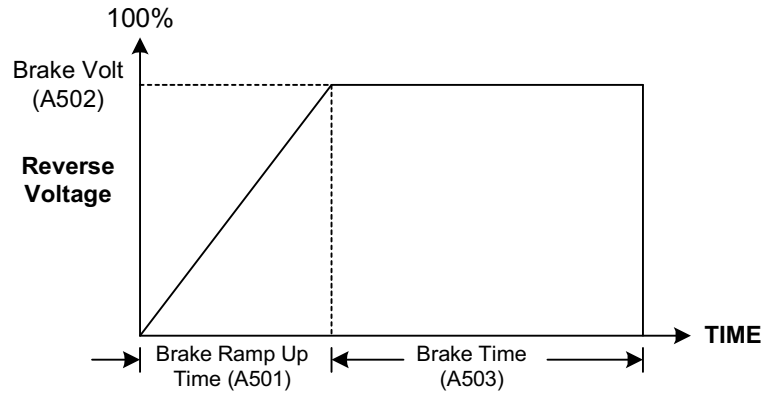


Fig. 6-6-17

GROUP-6: PARAMETER SELECTION FOR NORMAL DISPLAY SCREEN

A601 ~ A608: Normal parameter 1 ~ 8

A601: It selects parameter wishing to display on normal screen position Norm-1 out of *M101~M113*, *M201and M208~M216*, of monitor mode during normal run operation of unit.

Similarly *A602~A608* selects parameters for *Norm-2* to *Norm-8* positions.

The default setting will be as under.

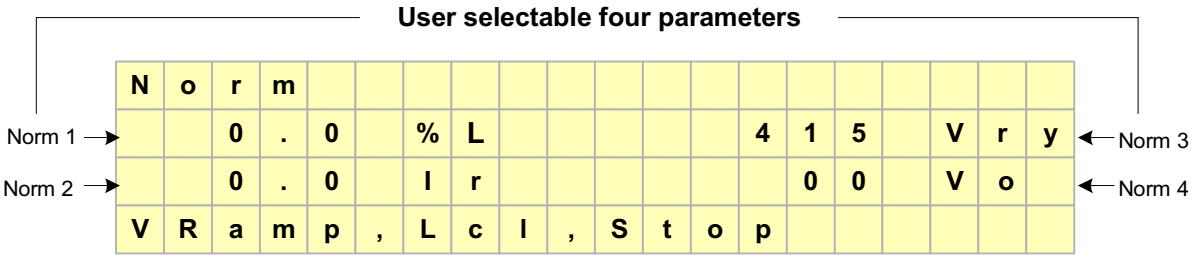


Fig. 6-6-18

To display the *Output Current M101 (%L)* parameter at *Norm 1* position as shown in the above screen, select option-1 (*M101*) in parameter *A601 Norm parameter1*.

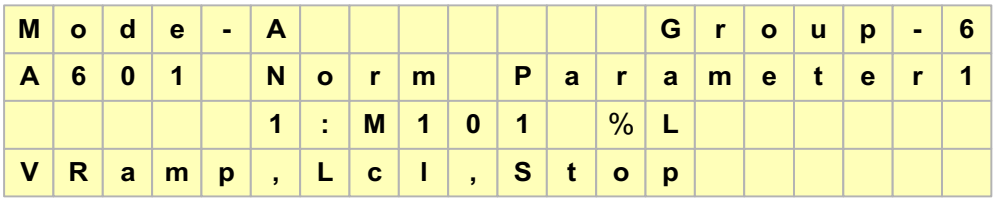


Fig. 6-6-19

Similarly to display the desired parameters at positions *Norm 2, Norm 3,* and *Norm 4*, selects the appropriate option in *A602*, *A603* and *A604* respectively.

Parameters *A605~A608* selects parameters for *Norm-5* to *Norm-8* positions for the meter screen and is not applicable for the normal screen. Below is the meter screen with eight parameters.

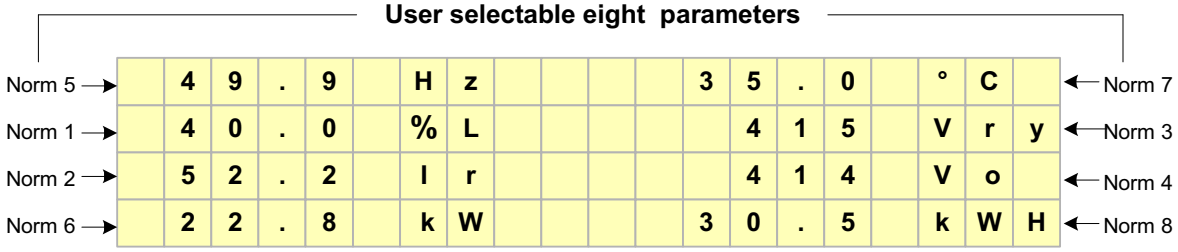


Fig. 6-6-20

MODE-B

GROUP-1: MOTOR PARAMETER

B101: Rated Input Voltage (Vac)

Select suitable rated input voltage for the unit. When the rated input voltage is changed, the motor voltage may change accordingly.

B102: Motor Voltage (Vac)

Enter motor nameplate voltage. This is used as reference voltage for many parameters. This is the motor terminal voltage during full load at the line frequency.

B103: Motor Current (Amp)

Enter motor rated current from the motor nameplate. This is full load motor current at line frequency. The over current and other current related protections are based on this value. This value cannot be set higher than unit rated current *M301* in case of Inline configuration. However, it can be set to 1.73 times the unit rated current for Inside delta configuration.

B104: Motor Frequency (Hz)

Enter motor frequency from the motor nameplate.

B105: Motor Speed (rpm)

Enter motor speed from the motor nameplate.

B106: Motor Capacity (kW)

Enter motor rated capacity from the motor nameplate.

B107: Motor Poles

Enter number of poles from the motor nameplate.

B108: SS Connection Type

Select the soft starter connection type. The unit can be used inline. In this case, only three wires (if bypass option not used) will be coming to the unit.

When the connection is inside delta type, six wires will be coming to the unit. Refer Fig. 10-1-2 for the connection method for inside delta. In this case, the unit can be used to start the motor of the higher current rating (1.73 times) than the unit.

GROUP-2: PROTECTION PARAMETERS – 1

B201: Under Frequency Protection Delay (Sec)

This parameter delays the tripping on detection of a low supply frequency when the motor is running, less than 45Hz for 50Hz supply and less than 55Hz for 60Hz supply.

Set to 60 to disable this function.

B202: Over Frequency Protection Delay (Sec)

This parameter delays the tripping on detection of a high supply frequency when the motor is running, greater than 55Hz for 50Hz supply and greater than 65Hz for 60Hz supply.

Set to 60 to disable this function.

B203: Low Current Alarm Set Point (%)

This parameter sets the current at which the low current alarm operates. Set as a percentage of *Motor Current (B103)*.

Relay output can be programmed in PSO to indicate the state of low current alarm. The relay output change state when motor current is below the set point.

It sets when the *Low Current Alarm* is selected in PSO (Programmable Sequence Output).

Set this parameter higher than the value set in *I-low Level (B303).*

B204: High Current Alarm Set Point (%)

This parameter sets the current at which the high current alarm operates. Set as a percentage of *Motor Current (B103)*.

Relay output can be programmed in PSO to indicate the state of high current alarm. The relay output change state when motor current is above the set point.

It sets when the *High Current Alarm* is selected in PSO (Programmable Sequence Output).

Set this parameter less than the value set in *I-Trip Level (B307)*.

B205: I-Unbalance Level (%)

The maximum current imbalance tolerated will be the value set under the *I-Unbalance Level* from one line to another.

B206: I-Unbalance Delay (Sec)

This parameter delays the tripping on detection of the imbalance current for the set time.
Set 100% to disable this function.

B207: Emergency Stop Mode

Set the stopping method for the emergency stop from the following options.

1: Coast to Stop
2: Coast to Stop with fault output
3: Stop as per A105

B208: Number of Restart

This parameter decides the maximum number of attempts to restart during the fault condition.

B209: Restart Wait Time (Sec)

Restart is function to reset the fault in the unit and start automatically to continue operation if a fault occurs. User can select these parameters to automatically restart the unit in fault condition to provide reliability and continuity of process during fault conditions.

Set to '0' to disables the restart function.

When a fault is detected, the unit output is shut off for the *Restart Wait Time (B209)*. The operation panel displays the fault while the unit output is OFF.

When the restart wait time elapses, a fault is reset automatically and restarts to continue the operation.

When the number of such attempts exceeds the Number of Restart *(B208)*, the faults are not reset automatically and the unit output remains OFF. At this time a fault relay is activated and the fault data will be stored in fault history. The RUN relay will also be deactivated.

The number of restart times is cleared to 0 in the following cases.

1. A fault does not occur for more than 10 minutes.
2. A fault reset signal is applied from the operation panel or terminal.
3. The power supply is turned off and turned ON again.

This function is applicable to the following eleven faults.

1. Over Current Fault.
2. Under Current Fault
3. I-unbalance Fault
4. Over voltage Fault
5. Firing Fault
6. Phase Fault
7. External Fault
8. Ground Fault
9. Over Frequency Fault
10. Under Frequency Fault
11. Temperature Fault

B210: Bypass Contactor Delay Time (Sec)

This parameter sets the delay time for the bypass contactor to operate, if the load current has not decreased below 115% after completion of Ramp Up Time & I-Limit Time.

B211: Test Mode Selection

Enable or Disabled the Test Mode. Test Mode is only for factory test purpose.

=0: Disable.
=1: Enable.

GROUP-3: PROTECTION PARAMETERS – 2

B301: I-Limit Level (%)

B302: I-Limit Time (sec)

I-Limit Level sets the value of the current limit as a percentage of *Motor Current (B103),* and *I-Limit Time (B302)* sets the time in seconds, in which the *I-Limit* condition can exist before a trip will occur. *The current limit feature is active only during the ramp up.*

Whenever the motor current exceeds the *I-Limit*, motor voltage held constant until the current falls to an acceptable level. The current remains higher than the value set under *I-Limit (B301)* for a time set under *I-Limit Time*, the unit will trip in an overload fault. If time frame a + b exceeded the value set by *I-Limit Time (B302)*, the unit will trip.

This feature provides adequate protection for the thyristor stack and sufficient current limiting to the motor.

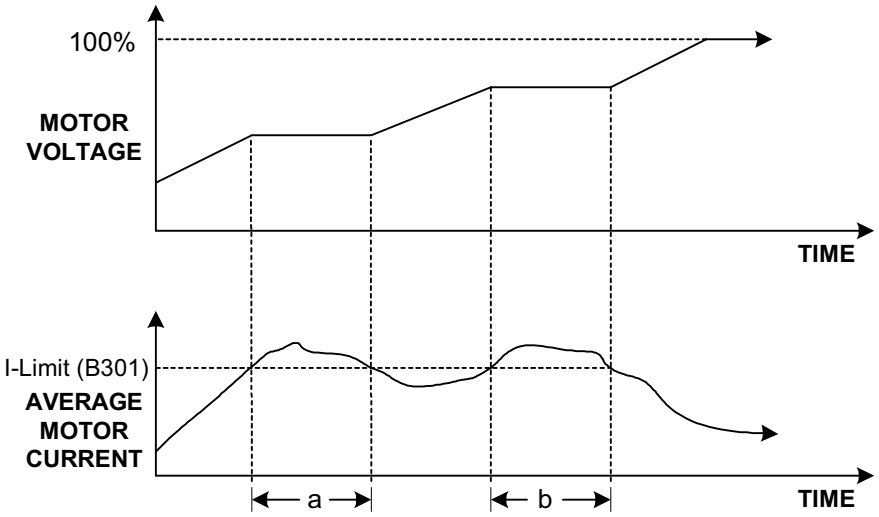


Fig. 6-6-21

B303: I-Low Level (%)

B304: I-Low Time (Sec)

I-Low Level sets the threshold of the under current trip as percentage of the *Motor Current (B103),* and the time for which an under current situation must exist is set by *I-Low Time (B304)* before tripping. *By setting I-Low Level to zero will disable this function*.

The under current trip facility offers an easy way of shutting the device down, when it operates for an extended period without a load. *The under current trip is not active during ramp up and ramp down.*

To set the under current trip, start the motor with no load, and record the current displayed by the unit. Starts it again with normal load, and set the trip point half way between these values. The unit calculates the displayed current, by averaging the current in all three phases and scaling this to an RMS value. There is no guarantee that meter used to measure the current, will operate in the same way, and therefore no guarantee that the value measured will be exactly the same as the displayed value.

Here graph shows the operating characteristics with the I-Low Level set to 50% and I-Low Time set to 3 min.

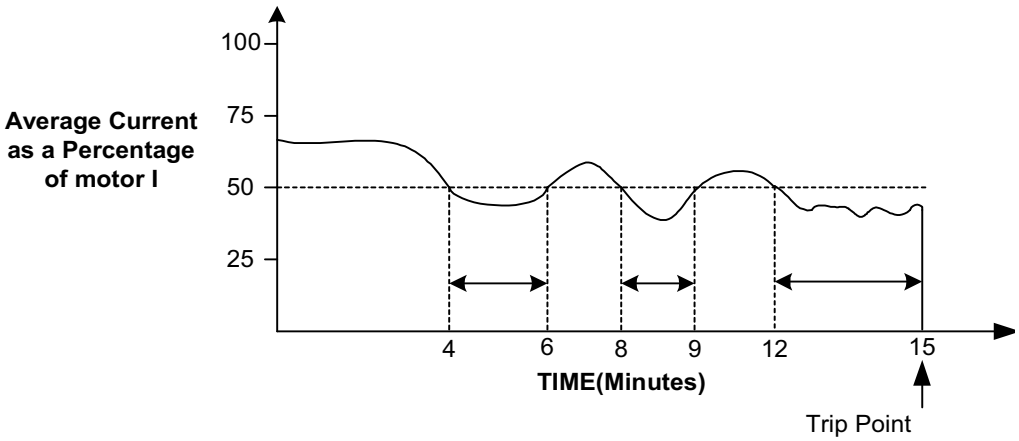


Fig. 6-6-22

B305: Overload Setting (%)

Set this parameter as % of the rated motor current. Changing of this parameter will change the tripping time of the thermal overload curves. For example, at overload setting of 105% - Class 30 curve will trip the unit in 30sec @600% of FLC where as at 52% of overload setting – Class 30 curve will trip the unit in 30sec @300% of FLC.

B306: Overload Curve Selection

Choose the Overload curves for the motor 'Thermal Overload Protection'.
1. Class 30
2. Class 20
3. Class 10
4. Class 2

Program the appropriate class according to the characteristics of the motor and load. These trip curves are based on a common tripping point of 600% of rated motor current. For example Class-20 curve is 20-sec trip at @600% of FLC with overload setting 0f 105%.

Note: These are the cold start curve and every 'start' will reduced the tripping times. Curves are shown at the overload setting of 105% in Fig. 6-6-23.

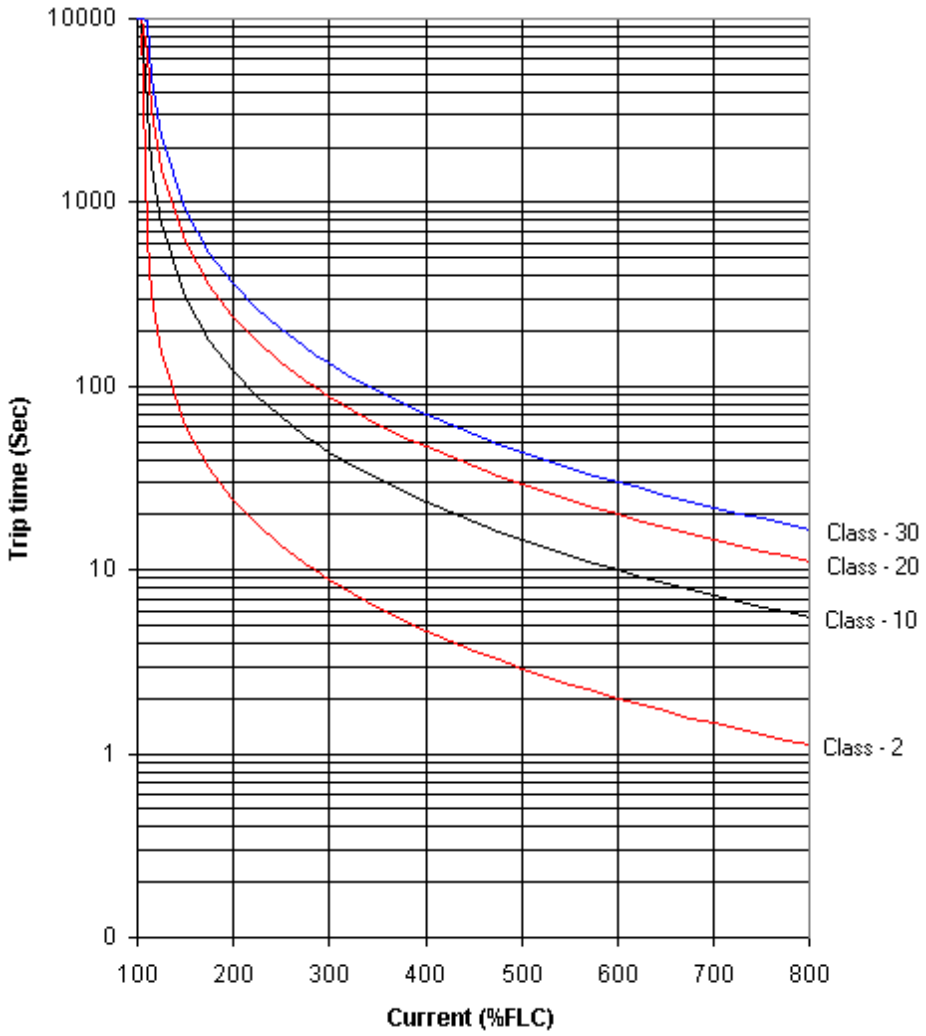


Fig. 6-6-23

B307: I-Trip Level (%)

This parameter sets to give an instantaneous over current trip as a percentage of the *Motor Current (B103)*.

Whenever the output current exceeds the value set by *I-Trip Level*, the unit will trip indicating over current fault. Always set higher side to prevent the unnecessary tripping of the unit during normal operation.

I-Trip Level is entered as a percentage of the motor current, which the RMS value and the processor, which scales the I-Trip value to a peak current and it is the peak current at which the unit will trip. For example, if I-Trip level set to 500% and Motor Current is 40A, unit will trip the instant the current exceeds 282A, i.e. 282 = 40 * 5 * √ 2.

B308: I-Limit Kick (%)

This parameter limits the current in the kick-start region. In some applications it is necessary to limit current in kick-start region. The two main reasons for introducing current limit during the kick-start are: to protect the electrical system, and to limit the torque during the kick-start region.

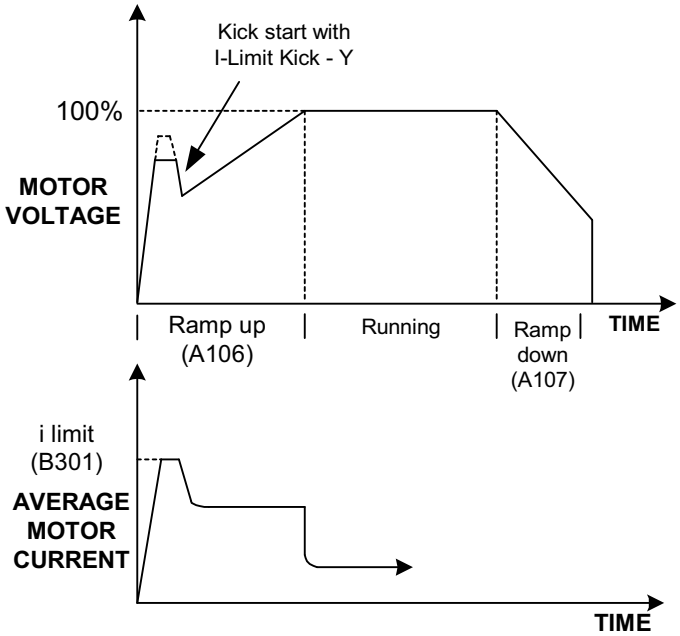


Fig. 6-6-24

B309: Parameter Lock

This is user programmable 4-digit password to prevent unintentional parameter change from the digital operation panel. When programmed, it will not allow the user to change any parameter from digital operation panel or serial link except PID Reference Setting *C311*. ***The unit will be shipped without any password protection.*** To lock the parameters, first enter your selected 4-digit password in *B310* and then enter any value other than your selected password to *B309*. The parameters will be locked and cannot be changed. Now, to open the lock, enter the password to *B309.* If you have entered correct password, you will have the access of all parameters. Now you can change the parameters, even the password. To lock the parameters again follow the same thing.

B310: Change Password

This parameter is used to change the 4-digit user password for parameter locking.

B311: Default Value Load

When set to 111, the current active parameters will be saved to non-volatile memory as customer default setting.

When set to 222, the customer default setting parameters will be fetched from memory and now the unit will respond to these parameters.

When set to 333, all the user parameters will be set to default (US standard) excluding C205 to C219 & PLC parameters.

When set to 444, default value will be loaded in all the parameters excluding C205 to C219 & PLC parameters.

When set to 666, all the user parameters will be set to default including C205 to C219 & PLC parameters.

When set to 777, all PLC related parameters (B407, C501~C512, P101~PA110) set to default value.

However, above settings will not change any factory setting parameters and user password.

Fault History Clear

When set to 555, the fault history buffer is cleared. No previous fault code and parameter will be available.

Note that the value entered in B311 will not be memorized. If correct value is entered, appropriate action will be taken and "00" will be displayed. If incorrect value is entered, no action will be taken and "00" will be displayed.

B312: Over Voltage Limit (%)

Sets the level at which the Over Voltage Fault is detected as a percentage of Rated Input Voltage *(B101).*

GROUP-4: FAULT SETTING

B401: Phase Direction Fault

This Fault displayed when Phase Direction Fault is active. The unit will trip when phase rotation at the input to the unit is reversed. Whenever this fault is disabled, the unit is not phase rotation sensitive. If the fault is activated, the phase rotation to the unit thyristor stack must be positive when the unit is operating in the forward direction.

B402: Firing Fault

This Fault displayed when Firing Fault is active. This fault would normally occur when the firing pulses are sent to the thyristor and thyristor is not conducting.

In bypass mode this fault is not active during the running condition.

B403: Ground Fault Level (%)

This parameter sets as a percentage of the motor rated current (*B103*). The unit will trip if the Ground Level exceeds the set value. *It will be automatically disabled when using for inside delta type.*

B404: Ground Fault Selection

This parameter provides selection of ground fault during ramp up. Sometimes, the unit may be tripping in ground fault during the ramp up due to the unbalance current. In such condition, disable the ground fault condition during the ramp up. *It will be automatically disabled when using for inside delta type.*

B405: Pick up Function

This parameter provides flying start of soft starter during the voltage dip. When enabled, if the line voltage drops below 25% of the rated input voltage B101 for more than 20msec, this function will restart the soft starter automatically with controlled ramp up.

B406: Temperature Alarm Level (°C)

This is temperature alarm level set point. Whenever the heat sink temperature exceeds the set value, the Temp Alarm output will be set. Hysteresis of 2°C hysteresis will occur with temperature alarm.

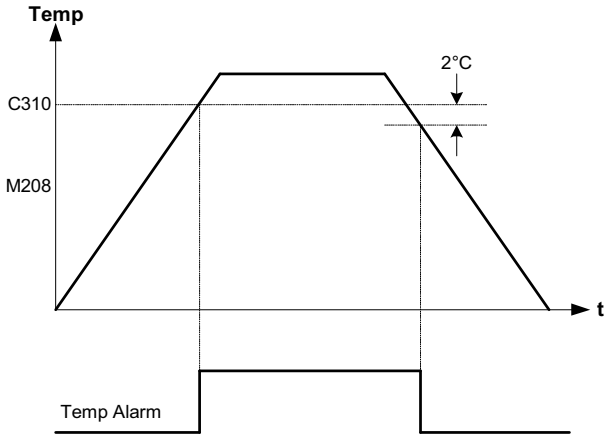


Fig.6-6-25

B407: In-Built PLC Selection

In Built PLC function can be Enable or Disable by using this parameter.

B408: Copy Para set

Copy all user and PLC parameters from control side to the Display EEPROM. User can copy up to 8 sets of all parameters.

=1:Copy Set 1	=5:Copy Set 5
=2:Copy Set 2	=6:Copy Set 6
=3:Copy Set 3	=7:Copy Set 7
=4:Copy Set 4	=8:Copy Set 8

B409: Paste Para set

Paste all user and PLC parameters from Display EEPROM to the control side. User can paste 8 sets of all parameters.

=1:Paste Set 1	=5:Paste Set 5
=2:Paste Set 2	=6:Paste Set 6
=3:Paste Set 3	=7:Paste Set 7
=4:Paste Set 4	=8:Paste Set 8

MODE – C

GROUP-1: PROGRAMMABLE INPUT/OUTPUT SELECTION

C101~ C106: PSI-1 ~ PSI-6

C114 ~ C115: PSI-RUN ~ PSI-STOP

User can configure eight Programmable Sequence Inputs for different functions using parameters *C101 ~ C106 and C114 ~ C115.* The status of the Programmable Sequence Input can be monitored in *M202*. The various options are explained as under.

Table 6-6-1

OPTION	NAME	FUNCTION
1	***Not Used***	Indicates that no function is selected on the PSI.
2	***Terminal***	When this input is selected, the operation control will be switched over to terminal.
3	***Jogging***	This is a jog command. If this signal is ON while RUN is OFF, operation then conforms to the setting of jog reference. The applicable stop mode in Jogging is cost to stop.
4	***External Flt (NO)***	This is used for the external fault function. This is Normally Open type. When the digital input (connected to COM in case of sink logic and to +24V in case of source logic) is close, external fault occurs.
5	***Fault Reset***	This is used for the fault reset. If RUN input is present at the time of fault reset, the unit will not start after fault reset. *Issue fresh RUN command to start the unit after fault reset.*
6	***Bypass Cont Flt***	This input is used for the bypass contactor interlock. The bypass contactor closes once the thyristors are supplying full voltage to the motor.
7	***Main Cont Flt***	This is used when main contactor is fitted to the unit. This input is used for the main contactor interlock.
8	***Emergency Stop (NO)***	This is used as emergency stop. This is Normally Open type. When the digital input (connected to COM in case of sink logic or to +24V in case of source logic) is close, Emergency stop occurs as per the selection in B207.
9	***Ramp Hold***	This input allows to halt the ramp up.
10	***Rev Cont Flt***	This input is used for reverse phase rotation contactor interlock. Select this input if brake stop is selected in A105.
11	***PID Bypass***	This is used to bypass the PID controller. When this input is selected, the PID Reference input will be PID Output and there will not be any effect of PID controller.
12	***PID Disable***	This is used to disable the PID controller. When this input is selected, the PID Output will remain to the last value and there will not be any effect of PID Reference or PID Feedback on the PID Output.
13	***Emergency stop (NC)***	This is used for emergency stop. This is Normally Close type. When the digital input (connected to COM in case of sink logic or to +24V in case of source logic) is open, Emergency stop occurs as per the selection in B207.
14	***External Flt (NC)***	This is used for the external fault function. This is Normally Close type. When the digital input (connected to COM in case of sink logic and to +24V in case of source logic) is open, external fault occurs.

15	***RUN***	This is used to give RUN command from terminal.
16	***STOP***	This is used to give STOP command from terminal.
17	***PLC input 1***	Option 17 ~ 24 are PLC input are use to read PSI status from soft starter to In-Built PLC.
18	***PLC input 2***	
19	***PLC input 3***	
20	***PLC input 4***	
21	***PLC input 5***	
22	***PLC input 6***	
23	***PLC input 7***	
24	***PLC input 8***	

The default selection is as under.

Table 6-6-2

Parameter	Terminal	Option	Name
C101	PSI1	2	***Terminal***
C102	PSI2	3	***Jogging***
C103	PSI3	4	***External Flt (NO)***
C104	PSI4	5	***Fault Reset***
C105	PSI5	8	***Emergency Stop (NO)***
C106	PSI6	9	***Ramp Hold***
C114	PSI-RUN	15	***RUN***
C115	PSI-STOP	16	***STOP***

C107~ C110: PSO-1 ~ PSO-4

User can configure four Programmable Sequence Outputs for different functions using parameters *C107 ~ C110*. The status of the Programmable Sequence Output can be monitored in *M203*. The various options are explained as under.

Table 6-6-3

OPTION	NAME	FUNCTION
1	***Not Used***	No function is selected.
2	***Ready***	This turns ON when supply is given to card, and it indicates unit is ready to start.
3	***Run***	This turns ON during running, jogging or Braking.
4	***Top of Ramp***	This turns ON when the unit is in Top of Ramp condition. Top of ramp implies full voltage is on the motor. This terminal is used for many applications. Most commonly this terminal is used to energies bypass contactor.
5	***Terminal***	This turns ON when the operation mode is Terminal.
6	***Fault Alarm***	This turns ON when Fault is generate
7	***I- Limit Alarm***	This turns ON when motor current exceeds set point (*B301*).
8	***Low Current Alarm***	This turns ON when motor current is below the set point (*B203*).

9	***High Current Alarm***	This turns ON when motor current is above the set point (*B204*).
10	***Temperature Alarm***	This turns ON when the heat sink temperature has rise above the set value.
11	***Rev Cont***	This turns ON to energies a reverse contactor fitted to the unit for a Brake Stop application.
12	***PID Up Limit***	The output will be activated when the PID output reaches to the programmed upper limit value.
13	***PID Lo Limit***	The output will be activated when the PID output reaches to the programmed lower limit value.
14	***PLC Output 1***	Option 14~20 are use to write PSO status from In-Built PLC to soft starter. This is mention in the In-Built PLC Function Explanation.
15	***PLC Output 2***	
16	***PLC Output 3***	
17	***PLC Output 4***	
18	***PLC Output 5***	
19	***PLC Output 6***	
20	***PLC Output 7***	

The default setting of the programmable sequence outputs are as in Table 6-6-4.

Table 6-6-4

Parameter	Terminal	Option	Name
C107	PSO1	2	***Ready***
C108	PSO2	7	***I- Limit Alarm***
C109	PSO3	8	***Low Current Alarm***
C110	PSO4	9	***High Current Alarm***
C111	Programmable Relay1	3	***Run***
C112	Programmable Relay1	4	***Top of Ramp***
C113	Programmable Fault Relay	6	***Fault Alarm***

C111~ C113: Programmable Relay-1~2, Programmable Fault Relay

User can configure three programmable relays for different functions using these parameters. The status of the Programmable Relay can be monitored in *M203*. The options are same as PSO.
The default settings are shown in Table 6-6-4.

GROUP-2: ANALOG OUTPUT SELECTION

C201~ C202: VO1~VO2

User can configure two programmable analog outputs (0~10V) for different functions using parameters *C201 ~ C202*.

Table 6-6-5

OPTION	NAME	FUNCTION
1	***Output Voltage***	The analog output will correspond to the output voltage (*0~100%).*
2	***Output Current***	The analog output will correspond to the output current (*0~500%).*
3	***Active Power***	The analog output will correspond to the active power (*0~B106*).
4	***Reactive Power***	The analog output will correspond to the reactive power (*0~B106*).
5	***Power Factor***	The analog output will correspond to the power factor (*0.00~1.00*).
6	***PID Output***	The analog output will correspond to the PID Output (*0~100%).*
7	***Motor Torque***	The analog output will correspond to the motor torque (*0~250%).*
8	***Heat sink Temperature***	The analog output will correspond to the heat sink temperature (0~100 °C)
9	***PLC A-O/P 1***	The analog output will correspond to the PLC A-O/P 1 (0~100d).
10	***PLC A-O/P 2***	The analog output will correspond to the PLC A-O/P 2 (0~100d).
11	***PLC A-O/P 3***	The analog output will correspond to the PLC A-O/P 3 (0~100d).
12	***PLC A-O/P 4***	The analog output will correspond to the PLC A-O/P 4 (0~100d).

The default setting of the programmable analog outputs are as in Table 6-6-6.

Table 6-6-6

Parameter	Terminal	Option	Name
C201	VO1	1	***Output Voltage***
C202	VO2	2	***Output Current***
C203	IO1	3	***Active Power***
C204	IO2	5	***Power Factor***

C203~ C204: IO1~IO2

User can configure two programmable analog outputs (4~20mA) for different functions using these parameters. The options are same as above.

The default setting of the programmable sequence outputs are as in Table 6-6-6.

C205: Vout-1 Gain

This is gain setting for the VO1 analog output.

C206: Vout-2 Gain

This is gain setting for the VO2 analog output.

C207: Iout-1 Gain

This is gain setting for the IO1 analog output.

C208: Iout-1 Bias

This is bias setting for the IO1 analog output.

C209: Iout-2 Gain

This is gain setting for the IO2 analog output.

C210: Iout-2 Bias

This is bias setting for the IO2 analog output.

C211: Scaling Current (%)

This parameter is allow to scales the Analog Output Current as a set value of 50 - 500% of rated motor current.

C212: FSV Gain

This is gain setting for the FSV reference.

C213: FSV Bias

This is bias setting for the FSV reference.

C214: FSI Gain

This is gain setting for the FSI reference.

C215: FSI Bias

This is bias setting for the FSI reference.

C216: Vin Gain

This is gain setting for the Vin reference.

C217: Vin Bias

This is bias setting for the Vin reference.

C218: Iin Gain

This is gain setting for the Iin reference.

C219: Iin Bias

This is bias setting for the Iin reference.

C220: FSV / FSI Time Constant (mSec)

This parameter sets the filter time constant for the FSV and FSI analog inputs.

C221: VIN / IIN Time Constant (mSec)

This parameter sets the filter time constant for the VIN and IIN analog inputs.

GROUP-3: PID CONTROL SELECTION

C301: PID Control Selection

This parameter is used to enable or disable the PID control action.

C302: PID Polarity

This parameter can be used to invert the output of PID as per the system requirement.

C303: PID Reference Input

The PID Reference Input can be selected from any of the six options. The various options include ***FSV 0-10V, FSI 4-20mA, Vin 0-10V, Iin 4-20mA, Local*** , ***Serial, PLC A-O/P 1, PLC A-O/P 2, PLC A-O/P 3 and PLC A-O/P 4.***

The value of selected PID reference input is displayed in *M209*.

C304: PID Feedback Input Selection

The PID Feedback Input can be selected from any of the four options. The various options include ***FSV 0-10V, FSI 4-20mA, Vin 0-10V*** and ***Iin 4-20mA, PLC A-O/P 1, PLC A-O/P 2, PLC A-O/P 3 and PLC A-O/P 4***. The option selected for the PID reference input cannot be selected for the PID Feedback Input.

The value of selected PID feedback input is displayed in *M210*.

C305: Proportional Gain

This parameter is used to set the proportional gain for the P-Control.

C306: Integral Time (Sec)

This parameter is used to set the integral time for the I-Control. Setting to maximum value does not perform I-Control.

C307: Derivative Gain

This parameter is used to set the derivative gain for the D-Control. Setting to zero does not perform D-Control.

C308: PID Deviation Upper Limit (%)

This is the upper limit for the PID output deviation.

C309: PID Deviation Lower Limit (%)

This is the lower limit for the PID output deviation.

C310: PID Offset Adjustment (%)

Sets offset for the output after PID Control.

C311: PID Reference Setting

When Local is selected as PID reference, this parameter is used to set the PID reference using digital operation panel. This parameter will not have any effect if other options are selected as reference.

C312: PID Display Scale - Max

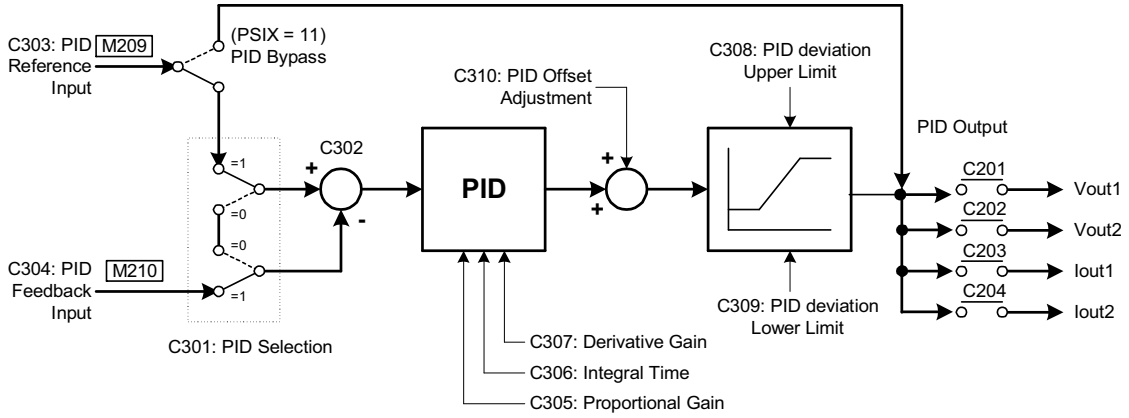
This parameter assigns the full-scale value for the PID input/output.

C313: PID Display Scale - Min

This parameter assigns the min value for the PID input/output.

C314: PID Display Unit Selection

This parameter gives a choice to user to display the unit for the PID parameters. This can be displayed in %, PSI (Pressure per Square Inch), kg/cm2, °C, °F, LPM (Liter per Minute), CFM (Cubic Feet per Minute) and m3/h (Cubic Meter per Hour)



PID Controller

Fig. 6-6-26

GROUP-4: SERIAL COMMUNICATION

C401: Baud Rate

The unit is facilitating with serial communication between the unit and computer terminal. To control or monitor single/ multiple units from single computer terminal, serial link can be used. This parameter defines Baud rate (number of signal transition per second, it can be number of bits per second). The available options are as under. Option-4 is set as default baud rate.

1: 1200	4: 9600
2: 2400	5: 19200
3: 4800	

Refer the detail manual for the ModBus protocol and other information.

C402: Station Number

This parameter defines the address of the unit when connected to the serial network. It supports the ModBus protocol. The station number can be assigned to 1 ~ 247.

C403: Parity

This parameter is used to set the parity. Parity is error-checking code to prevent from erroneous data transformation between the unit and terminal.

C404: Response Time (Sec)

Set the minimum time from receiving the command to returning an answer.

C405: Operation Panel Communication Loss Selection

Enable or disable the operation panel communication loss fault. The unit will trip if it does not receive any response from the operation panel within 5sec. Disable the fault, if operation panel is to be removed.

For detail information on the ModBus protocol and register assignment, please refer "Serial Communication Guide, Version 1.0".

Note: Put jumper JP3 to "LD" position to use terminating resistors. Remove the cover designated as "Control Unit" to access this jumper on PCA-2005B.

GROUP – 5: PLC PANEL PARAMETER

C501 ~ C502: PLC Panel Par 1 ~ 2

This PLC panel parameter 1 & 2 are used In-built PLC for Timer 1 application or can be used in Built in PLC application. Related memory location of this parameter is from 101 to 102.

C503 ~ C504: PLC Panel Par 3 ~ 4

This PLC panel parameter 3 & 4 are used In-built PLC for Timer 2 application or can be used in Built in PLC application. Related memory location from of this parameter is 103 to 104.

C505 ~ C506: PLC Panel Par 5 ~ 6

This PLC panel parameter 5 & 6 are used In-built PLC for Timer 3 application or can be used in Built in PLC application. Related memory location from of this parameter is 105 to 106.

C507 ~ C508: PLC Panel Par 7 ~ 8

This PLC panel parameter 7 & 8 are used In-built PLC for Timer 4 application or can be used in Built in PLC application. Related memory location from of this parameter is 107 to 108.

C509 ~ C512: PLC Panel Par 9 ~ 12

PLC panel parameter 9 to 12 can be input and used In-built PLC application. Related memory location of this parameter is from 109 to 112.

MODE – P: IN-BUILT PLC COMMAND PARAMETERS

GROUP-1: IN-BUILT PLC COMMAND

P101 ~ P110: PLC Inst 1 ~ PLC Inst 10

Input the In-built PLC Commands as per PLC application.

GROUP-2: IN-BUILT PLC COMMAND

P201 ~ P210: PLC Inst 11 ~ PLC Inst 20

Input the In-built PLC Commands as per PLC application.

GROUP-3: IN-BUILT PLC COMMAND

P301 ~ P310: PLC Inst 21 ~ PLC Inst 30

Input the In-built PLC Commands as per PLC application.

GROUP-4: IN-BUILT PLC COMMAND

P401 ~ P410: PLC Inst 31 ~ PLC Inst 40

Input the In-built PLC Commands as per PLC application.

GROUP-5: IN-BUILT PLC COMMAND

P501 ~ P510: PLC Inst 41 ~ PLC Inst 50

Input the In-built PLC Commands as per PLC application.

GROUP-6: IN-BUILT PLC COMMAND

P601 ~ P610: PLC Inst 51 ~ PLC Inst 60

Input the In-built PLC Commands as per PLC application.

GROUP-7: IN-BUILT PLC COMMAND

P701 ~ P710: PLC Inst 61 ~ PLC Inst 70

Input the In-built PLC Commands as per PLC application.

GROUP-8: IN-BUILT PLC COMMAND

P801 ~ P810: PLC Inst 71 ~ PLC Inst 80

Input the In-built PLC Commands as per PLC application.

GROUP-9: IN-BUILT PLC COMMAND

P901 ~ P910: PLC Inst 81 ~ PLC Inst 90

Input the In-built PLC Commands as per PLC application.

GROUP-A: IN-BUILT PLC COMMAND

PA01 ~ PA10: PLC Inst 91 ~ PLC Inst 100

Input the In-built PLC Commands as per PLC application.

6.7 In-built PLC function explanation:

In-built PLC Function is one of the important features of this product, by using which, user can make PLC related application without additional hardware. The In-built PLC function has the following features.

Features:

- The In-built PLC can be used to get the same functionality of Programmable Sequence Inputs (PSI).
- It is possible to assign the signals from the In-built PLC to the Programmable Sequences Output (PSO).
- The In-built PLC can be used to get the same functionality as of programmable analog inputs.
- It is possible to assign the signals from the In-built PLC to the analog outputs.
- Bit status of PSI, PSO, Fault codes, Status codes and Control word can be read into the PLC bit memory location.
- Monitor Parameters can be read in to PLC registers (16-bit memory location).
- User can develop program by using PLC Commands based on the required application.
- PLC Commands can be input from the LCD Display. This allows changes to be made easily at the site.
- PLC Commands can be input with the standard serial interface.
- 115 registers (16-bit memory locations) and 100 Flags (1-bit memory location) for PLC operation.
- PLC program's length up to 100 PLC Commands.
- 4 Timer Command can be set from display.

The In-built PLC function-processing chart is shown in fig. 6.7.1. PLC commands are separate in each parameter and all command (P101 to PA10) execute within 20-millisecond interval.

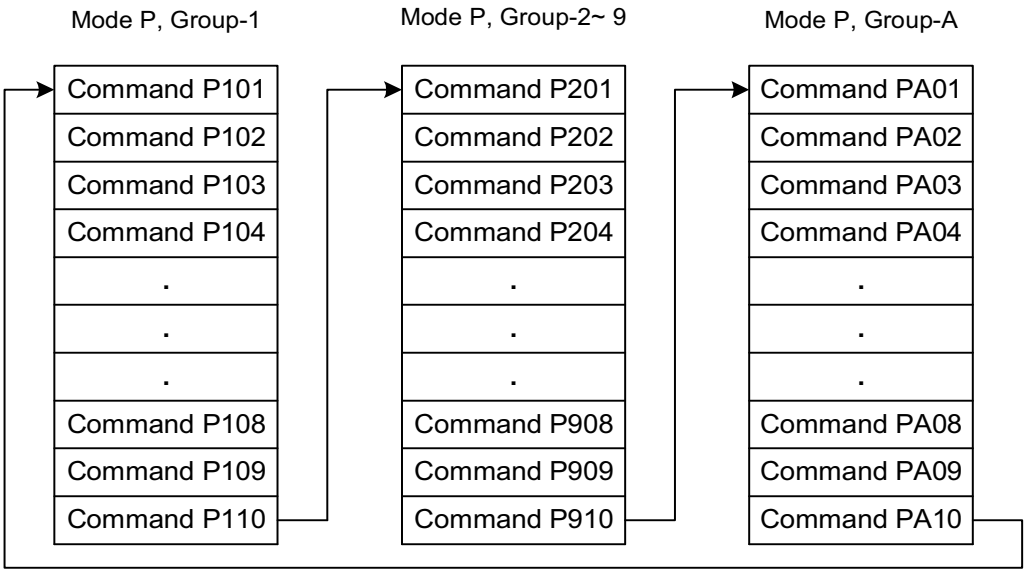


Fig. 6-7-1 In-built PLC processing Chart

The In-built PLC function starts to read command from the Mode P Group-1 parameter (P101) and executes it one-by-one. END (000) Command indicates end of program and after this command; PLC function again executes from 1st command (P101).

IN-BUILT PLC BLOCK

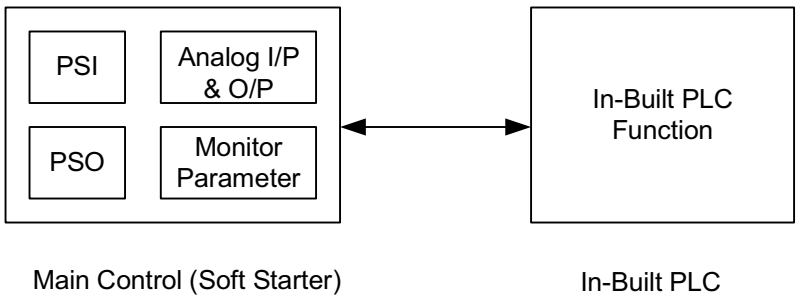


Fig. 6-7-2 Block Diagram Of In-built PLC function with Main Control

Fig. 6.7.2 is a block diagram of main control and In-built PLC function. All Digital Input and Output, Analog Input and output are connected with main control.

Now user can program In-built PLC for his application. User can also take output of the soft starter as PLC Input and output from PLC to the soft starter as an Input.

In-built PLC Function Related Parameters and Command.
The In-Built PLC function related parameters are listed below.

1 **In-built PLC (*B407*):**
Use this parameter to enable the In-built PLC Function.

2 **In-built PLC Command *(P101 to PA10)*:**
Input the PLC commands to be executed with the In-built PLC Function in parameters P101 to PA10.

3 **PLC Display Parameter *(M308 to M318)*: In-built PLC → Display**
For PLC programming, there are 115 numbers of 16-bit register and 100 numbers of 1-bit flag. 10 values of signed 16-bit register can be displayed in parameter M308 to M317 and these values will be saved in EEPROM at the time of power off. (Related PLC command is DISPLAY_REG (061)) and during power of these parameters values will come in register 76 to 85, 8 different flag bit status can be display in parameter M318. (Related PLC command is DISPLAY_FLG (062)).

4 **Digital Input From Soft Starter (PSI Status) to In-built PLC:**
Parameters C101 to C106 and C114 to C115 have 24 selectable options. In these, 17 to 24 are for PLC input options. Now to take PSI status as a PLC input, select one of the PLC input option from these parameter. Use **READ_PSI** (047) command in PLC program for this operation.

5 **Digital Output From In-built PLC to Soft Starter (PSO Status):**
Parameters C107 to C113 have 20 Selectable options. In these, 14 to 20 options are for In-Built PLC output. Now to take In-built PLC's output as Soft Starter's PSO output, select one of the PLC option from these parameters. Use **WRITE_PSO** (049) command in PLC program for this operation.

6 **Digital Input From In-built PLC to Soft Starter (PSI Status):**
Parameters C101 to C106 and C114 to C115 have 24 selectable options.
User can activate one of 1 to 16 options of these parameters, without any external digital signal on PSI by using In-built PLC. Use **WRITE_PSI** (048) command in PLC program for this operation.

7 **Digital Output From Soft Starter (PSO Status) to In-built PLC:**
User can read and use status of PSO from Soft Starter for In-built PLC application.
To read the PSO status In-built in PLC, use **READ_PSO** (046) command in PLC program.

8 **Analog Input From In-built PLC to Soft Starter:**
The signals from In-built PLC can be given as Analog Input.
Parameters C303 & C304 have four PLC A-O/P options.
User has to select one of these options for this operation. Use **WRITE_AN_O/P** (054) command in PLC program for this operation.

9 **Analog Output From In-built PLC to Soft Starter:**
Analog output can be given from In-built PLC.
Parameters C201 to C204 have four PLC A-O/P options. User has to select one of these options for this operation. Use **WRITE_AN_O/P** (054) command in PLC program.

10 **Analog Input From Soft Starter to In-built PLC:**
The Soft Starter's Analog input signals (FSV, FSI, Iin, Vin) can be read to In-built PLC. These Inputs are stored in Register No. 94 to 97.

11 **Analog Output From Soft Starter to In-built PLC**
The Soft Starter's Analog output signal (C201 to C204's 1 to 7 option) can be read to the In-built PLC. These outputs are stored in Register No. 86 to 93.

12 **In-built PLC PANEL Parameter *(C501 to C512)*: Parameter → In-built PLC**
Twelve parameters can be input. Related memory location from 101 to 112.

✓ ***Note:*** *To get proper output from PLC program, make sure to select correct option in PLC parameters state above. It is advisable to set unused PLC parameters to default conditions.*

Memory Description:

There are 115 numbers of 16-bit register or memory locations, 100 numbers of 1-bit flag and one 32-bit register.
16-bit register description has shown below table.

16-bit Register No.	Name	Access Type	Details	Value
0-75	User Memory	Read/Write	User can Read and Write	-32768 to 32767
76	User Memory	Read/Write	User can Read and Write	M308 – M317 (during power on condition) or -32768 to 32767
77	User Memory	Read/Write	User can Read and Write	
78	User Memory	Read/Write	User can Read and Write	
79	User Memory	Read/Write	User can Read and Write	
80	User Memory	Read/Write	User can Read and Write	
81	User Memory	Read/Write	User can Read and Write	
82	User Memory	Read/Write	User can Read and Write	
83	User Memory	Read/Write	User can Read and Write	
84	User Memory	Read/Write	User can Read and Write	
85	User Memory	Read/Write	User can Read and Write	
86	Output Voltage	Read	Read Output Voltage value	M105
87	Output Current	Read	Read Output Current value	M101
88	Active Power	Read	Read Output Power value	M109
89	Reactive Power	Read	Read Output Reactive value	M110
90	Power Factor	Read	Read Power Factor value	M111
91	PID output	Read	Read PID output value	100d = 100%
92	Motor Torque	Read	Read Motor Torque value	M208
93	Heat sink temperature	Read	Read Heat sink temperature value	M201

16-bit Register No.	Name	Access Type	Details	Value
94	FSV Input	Read	Read input value from FSV	100d = 100%
95	FSI Input	Read	Read input value from FSI	100d = 100%
96	Vin Input	Read	Read input value from Vin	100d = 100%
97	Iin Input	Read	Read input value from Iin	100d = 100%
98-100	Reserved			
101	Panel Parameter 1	Read	Read value set with C501	-
102	Panel Parameter 2	Read	Read value set with C502	-
103	Panel Parameter 3	Read	Read value set with C503	-
104	Panel Parameter 4	Read	Read value set with C504	-
105	Panel Parameter 5	Read	Read value set with C505	-
106	Panel Parameter 6	Read	Read value set with C506	-
107	Panel Parameter 7	Read	Read value set with C507	-
108	Panel Parameter 8	Read	Read value set with C508	-
109	Panel Parameter 9	Read	Read value set with C509	-
110	Panel Parameter 10	Read	Read value set with C510	-
111	Panel Parameter 11	Read	Read value set with C511	-
112	Panel Parameter 12	Read	Read value set with C512	-
113-114	Reserved			

All 100 numbers of 1-bit flags are read/Write and one 32-bit register is Read/Write.

In-built PLC Command Format:

The PLC commands used with the In-built PLC are 12- digit value shown in below table. These commands can be input from the P101 to PA10 parameter.

0	0	2	0	0	1	0	2	5	0	0	0
OPCODE			**DATA1**			**DATA2**			**DATA3**		

12-digit In-built PLC Command format

Where, OPCODE = Command no.
DATA1 = Data format 1
DATA2 = Data format 2
DATA3 = Data format 3

✓ ***Note:*** *Range of DATA1, DATA2 and DATA3 are different and it depends on command type. See list of PLC Commands for detail. It is necessary to terminate program with END (000) Command.*

Sr. No.	Command Name	Op-Code	DATA1	DATA2	DATA3	Description
1	END	000	000	000	000	End of the Program.
2	REG_LD	001	Register (n)	Value		Load the 16-bit value in Register (n).
3	REG32_LD	002	Register (n)	000	000	Register (n) as a High 16-bit and Register (n+1) as a Low 16-bit are loaded in Register 32 as 32 bits.
4	REG32_ST	003	Register (n)	000	000	Register 32 is store in Register (n) as a High 16-bit and Register (n+1) as a Low 16-bit as 32 bit.
5	REGDEC	005	Register (n)	000	000	Decrement the value of Register (n) by 1.
6	REGINC	006	Register (n)	000	000	Increment the value of Register (n) by 1.
7	COPY_REG	007	Register (n)	Register (m)	000	Copy Register (m) in Register (n).
8	COPY_FLG	008	Flag (n)	Flag (m)	000	Copy Flag (m) in Flag (n).
9	SET_FLG	009	Flag (n)	000	000	Set the Flag (n).
10	CLEAR_FLG	010	Flag (n)	000	000	Clear the Flag (n).
11	ADI	011	Register (n)	Value		Add immediate value. (Register (n) = Register (n) + Immediate Value (0 to 32767)
12	ADD	012	Register (n)	Register (n1)	Register (n2)	Add operation. (Register (n) = Register (n1) + Register (n2)).
13	ADD32	013	Register (n)	000	000	Register (n) as a High 16-bit and Register (n+1) as a Low 16-bit are added to Register 32 as 32 bits. Register 32 = Register 32 + Register (n).
14	SUB	014	Register (n)	Register (n1)	Register (n2)	Subtraction operator (Register (n) = Register (n1) - Register (n2)).
15	SUB32	015	Register (n)	000	000	Register (n) as a High 16-bit and Register (n+1) as a Low 16-bit are subtracted from Register32 as 32 bits. Register 32 = Register 32 - Register (n).
16	MUL32	016	Register (n)	Register (m)	000	Multiplication operator (Register 32 = Register (n) * Register (m)).
17	DIV	017	Register (n)	Register (n1)	Register (n2)	Division operator (Register (n) = Register (n1) / Register (n2)).
18	DIV32	018	Register (n)	000	000	Division operator (Register 32 = Register 32 / Register (n)).
19	AND	019	Flag (n)	Flag (n1)	Flag (n2)	Logical AND operation between Flags (Flag (n) = Flag (n1) & Flag (n2))
20	NAND	020	Flag (n)	Flag (n1)	Flag (n2)	Logical NAND operation between Flags (Flag (n) = ~(Flag (n1) & Flag (n2)))
21	NOR	021	Flag (n)	Flag (n1)	Flag (n2)	Logical NOR operation between Flags (Flag (n) = ~ (Flag (n1) | Flag (n2)).
22	XOR	022	Flag (n)	Flag (n1)	Flag (n2)	Logical XOR operation between Flags (Flag (n) = Flag (n1) ^ Flag (n2)).
23	XNOR	023	Flag (n)	Flag (n1)	Flag (n2)	Logical XNOR operation between Flags (Flag (n) = ~ (Flag (n1) ^ Flag (n2))).
24	OR	024	Flag (n)	Flag (n1)	Flag (n2)	Logical OR operation between Flags (Flag (n) = Flag (n1) | Flag (n2)).
25	NOT_FLG	025	Flag (n)	Flag (m)	000	Invert the specified Flag (Flag (n) = ~Flag (m)).
26	NOT_REG	026	Register (n)	Register (m)	000	Invert the specified register (Register (n) = ~Register (m))
27	WAND	027	Register (n)	Register (n1)	Register (n2)	Logical Word (16-bit) AND operation between registers (Register (n) = Register (n1) & Register (n2))
28	WOR	028	Register (n)	Register (n1)	Register (n2)	Logical Word (16-bit) OR operation between registers (Register (n) = Register (n1) | Register (n-2))
29	WXOR	029	Register (n)	Register (n1)	Register (n2)	Logical Word (16-bit) XOR operation between registers (Register (n) = Register (n1) ^ Register (n2))

Sr. No.	Command Name	Op-Code	DATA1	DATA2	DATA3	Description
30	NEG	030	Register (n)	000	000	Negative. Register (n) = - Register (n)
31	ABS	031	Register (n)	000	000	Absolute the value of Register (n). Register (n) = ABS (Register (n))
32	CMP_GT	035	Flag (n)	Register (n)	Register (m)	If Register (n) is greater than Register (m) then given Flag (n) is set.
33	CMP_LT	036	Flag (n)	Register (n)	Register (m)	If Register (n) is less than Register (m) then given Flag (n) is set.
34	CMP_GE	037	Flag (n)	Register (n)	Register (m)	If Register (n) is greater than or equal to Register (m) then given Flag (n) is set.
35	CMP_LE	038	Flag (n)	Register (n)	Register (m)	If Register (n) is less than or equal to Register (m) then given Flag (n) is set.
36	CMP_EQ	039	Flag (n)	Register (n)	Register (m)	If Register (n) is equal to Register (m) then given Flag (n) is set.
37	CMP_NE	040	Flag (n)	Register (n)	Register (m)	If Register (n) is not equal to Register (m) then given Flag (n) is set.
38	IF	041	Flag (n)	000	000	If given Flag (n) is set then condition is true and execute IF routine until ELSE or END_IF.
39	ELSE	042	000	000	000	If IF condition is false then ELSE loop will execute until END_IF.
40	END_IF	043	000	000	000	Specify the end of IF and ELSE Loop.
41	JUMP	044	X (1-100)	000	000	JUMP to X command no.
42	READ_PSO	046	Flag (n)	1-7	000	Read the status of selected PSO (1-7) in selected Flag (n).
43	READ_PSI	047	Flag (n)	1-8	000	Read the status of selected PSI (1-8) in selected Flag (n).
44	WRITE_PSI	048	1-16	Flag (n)	000	Assign value of Flag (n) in PSI function (1-16).
45	WRITE_PSO	049	1-7	Flag (n)	000	Assign value of Flag (n) in PSO (1-7).
46	READ_MON_PARA	050	Register (n)	0-115	000	Read the value of monitor parameter (0-115) in Register (n).
47	READ_STA_BIT	051	Flag (n)	1-2	0-15	Read the value of status bit (0-15) of status register (1-2) in Flag (n).
48	READ_FLT_BIT	052	Flag (n)	1-2	0-15	Read the value of fault bit (0-15) of fault register (1-2) in Flag (n).
49	READ_CWORD_BIT	053	Flag (n)	1-2	0-15	Read the value of control bit (0-15) of control word (1-2) in Flag (n).
50	WRITE_AN_O/P	054	1-4	Register (n)	000	Assign the value of Register (n) to selected Analog O/P (1-4). i.e 100D = 10V.
51	TIMER1	057	000	000	000	Input = Flag no 92 Output = Flag no 93 Count = C501 * C502 ms Count in multiple of 1ms. Maximum Timer 298 Hour.
52	TIMER2	058	000	000	000	Input = Flag no 94 Output = Flag no 95 Count = C503 * C504 ms Count in multiple of 1ms. Maximum Timer 298 Hour.
53	TIMER3	059	000	000	000	Input = Flag no 96 Output = Flag no 97 Count = C505 * C506 ms Count in multiple of 1ms. Maximum Timer 298 Hour.
54	TIMER4	060	000	000	000	Input = Flag no 98 Output = Flag no 99 Count = C507 * C508 ms Count in multiple of 1ms. Maximum Timer 298 Hour.
55	DISPLAY_REG	061	X1 (1-10)	Register (n)	000	It will display the value of Register (n) to selected display number. It will be stored in EEPROM on Power off mode.

Sr. No.	Command Name	Op-Code	DATA1	DATA2	DATA3	Description
56	DISPLAY_FLG	062	X1 (0-7)	Flag (n)	000	It will display value of selected Flag (n) on X1 bit location.
57	LPF1	063	Register (n)	Register (m)	Tc (0-100)	Inputs = Register (m) and Tc (in mS) LPF Output = Register (n)
58	LPF2	064	Register (n)	Register (m)	Tc (0-100)	
59	LPF3	065	Register (n)	Register (m)	Tc (0-100)	
60	LPF4	066	Register (n)	Register (m)	Tc (0-100)	
61	JMPC	067	X (1-100)	Flag (n)	000	If Flag (n) = 1, then JUMP to X Command no.
62	JMPNC	068	X (1-100)	Flag (n)	000	If Flag (n)! = 1, then JUMP to X Command no.

- Range of n, n1, n2 and m are 0 to 114 for register and 0 to 99 for flag.
- Register 0 to 85 have Read and Write access. Registers 86 to 114 are Read Only.
- Flag status is single bit locations, which is 0 to 99.
- Memory Locations for Registers and Flag status are different.
- X1 indicate Display parameter (M308 to M318)
- X indicates Command No.

In-built PLC Command Detail Description:

1. END (OPCODE → 000)
This command indicates End of PLC program. Any command after this command (END) will not be executed.
Input Command
000000000000

2. REG_LD (OPCODE → 001)
This command is used to Load 16-bit signed value into selected register.

Example,
REG_LD Rn 32000
Where,
Rn = Register Number (0 to 85)
Input Command
001001032000
001 → indicates Command OPCODE
001 → indicates Register Number 1
032000 → indicate 16-bit value (32000).

3. REG32_LD (OPCODE → 002)
This command is used to load 32-bit value into 32-bit Register.

Example,
REG32_LD Rn
Where,
Rn = Register Number (0 to 113)
32-bit register = value of Register (n) as a high byte and the value of Register (n+1) as a low byte.
Input Command
002001000000
002 → Indicate Command OPCODE
001 → Indicates Register Number 1
000 → Not used
000 → Not used

4. REG32_ST (OPCODE → 003)
This command is used to store 32-bit value into Register.

Example,
REG32_ ST Rn
Where,
Rn = Register Number (0 to 84)
High byte of 32-bit value will be store into selected Rn and Low byte of 32-bit value will be stored into selected R (n+1).
Input Command
003001000000
003 → Indicate Command OPCODE
001 → Indicates Register Number 1
000 → Not used
000 → Not used

5. REGDEC (OPCODE → 005)
This command is used to Decrement the value of selected register by one.

Example,
REGDEC Rn
Where,
Rn = Register Number (0 to 85)

6. REGINC (OPCODE → 006)
This command is used to increment the value of selected register by one.

Example,
REGINC Rn
Where,
Rn = Register Number (0 to 85)

7. COPY_REG (OPCODE → 007)
This command is used to copy the content of one register (Rm) to another register (Rn).

Example,
COPY_REG Rn Rm
Where,
Rn = Register Number (0 to 85)
Rm = Register Number (0 to 114)

8. COPY_FLG (OPCODE → 008)
This command is used to copy the bit status of one Flag (Fm) to another Flag (Fn).

Example,
COPY_ FLG Fn Fm
Where,
Fn and Fm = Flag Number (0 to 99)

9. SET_FLG (OPCODE → 009)
This command is used to set the bit status of selected Flag (Fn).

Example,
SET_FLG Fn
Where,
Fn = Flag Number (0 to 99)

10. CLEAR_FLG (OPCODE → 010)
This command is used to clear the bit status of selected Flag (Fn).

Example,
CLEAR_FLG_FLG Fn
Where,
Fn = Flag Number (0 to 99)

11. ADI (OPCODE → 011)
This command is used for summation of immediate signed 16-bit value and Register.

Example,
ADI Rn 32000
Where,
Rn = Register Number (0 to 85)
Result will be stored in Rn. (Rn = Rn + 32000).

12. ADD (OPCODE → 012)
This command is used for 16-bit summation operation of two registers.

Example,
ADD Rn Rn1 Rn2
Where,
Rn = Register Number (0 to 85)
Rn1, Rn2 = Register Number (0 to 114)
Result will be stored in Rn. (Rn = Rn1 + Rn2)

13. ADD32 (OPCODE → 013)
This command is used for 32-bit summation.

Example,
ADD32 Rn
Where,
Rn = Register Number (0 to 113)
Register Rn as high byte and Rn+1 as low byte and it will be added to 32-bit register. Result will be stored into 32-bit Register.

14. SUB (OPCODE → 014)
This command is used for 16-bit subtraction of two registers.

Example,
SUB Rn Rn1 Rn2
Where,
Rn = Register Number (0 to 85)
Rn1, Rn2 = Register Number (0 to 114)
Result will be stored in Rn. (Rn = Rn1 – Rn2)

15. SUB32 (OPCODE → 015)
This command is used for 32-bit Subtraction.

Example,
SUB32 Rn
Where,
Rn = Register Number (0 to 113)
32bit Register = 32bit Register - Rn
Register Rn as high byte and Rn+1 as low byte and it will be subtracted from 32-bit register. Result will be Stored into 32-bit Register.

16. MUL32 (OPCODE → 016)
This command is used for multiplication operation of two registers.

Example,
MUL32 Rn Rm
Where,
Rn and Rm = Register Number (0 to 114)
32bit Register = Rn * Rm.
Result will be stored in 32-bit Register.
Result should not be exceeding more then 32-bit value.

17. DIV (OPCODE → 017)
This command is used for division of two registers.

Example,
DIV Rn Rn1 Rn2
Where,
Rn = Register Number (0 to 85)
Rn1, Rn2 = Register Number (0 to 114)
Result will be stored in Rn. (Rn = Rn1 / Rn2).

18. DIV32 (OPCODE → 018)
This command is used for division of 32-bit value.

Example,
DIV32 Rn
Where,
Rn = Register Number (0 to 114)
Result will be stored in 32-bit Register. (32bit Register = 32bit Register / Rn.)

19. AND (OPCODE → 019)
This command is used for logical AND operation between two bits of Flags.

Example,
AND Fn Fn1 Fn2
Where,
Fn, Fn1 and Fn2 = Flag Number (0 to 99)
Result will be stored in Fn. (Fn = Fn1 & Fn2)

20. NAND (OPCODE → 020)
This command is used for logical NAND operation between two bits of Flags.

Example,
NAND Fn Fn1 Fn2
Where,
Fn, Fn1 and Fn2 = Flag Number (0 to 99)
Result will be stored in Fn. (Fn = ~(Fn1 & Fn2))

21. NOR (OPCODE → 021)
This command is used for logical NOR operation between two bit Flags.

Example,
NOR Fn Fn1 Fn2
Where,
Fn, Fn1 and Fn2 = Flag Number (0 to 99)
Result will be stored in Fn. (Fn = ~(Fn1 | Fn2))

22. XOR (OPCODE → 022)
This command is used for logical XOR operation between two bit Flags.

Example,
XOR Fn Fn1 Fn2
Where,
Fn, Fn1 and Fn2 = Flag Number (0 to 99)
Result will be stored in Fn. (Fn = Fn1 ^ Fn2)

23. XNOR (OPCODE → 023)
This command is used for logical XNOR operation between two bit Flags.

Example,
XNOR Fn Fn1 Fn2
Where,
Fn, Fn1 and Fn2 = Flag Number (0 to 99)
Result will be stored in Fn. (Fn = ~(Fn1 ^ Fn2))

24. OR (OPCODE → 024)
This command is used for logical OR operation between two bit Flags.

Example,
OR Fn Fn1 Fn2
Where,
Fn, Fn1 and Fn2 = Flag Number (0 to 99)
Result will be stored in Fn. (Fn = Fn1 | Fn2)

25. NOT_FLG (OPCODE → 025)
This command is used for logical NOT operation of selected bit Flag.

Example,
NOT_FLG Fn Fm
Where,

Fn and Fm = Flag Number (0 to 99)
Result will be stored in Fn. (Fn = ~Fm)

26. NOT_REG (OPCODE → 026)
This command is used for logical NOT operation of selected Register.

Example,
NOT_REG Rn Rm
Where,
Rn = Register Number (0 to 85)
Rm = Register Number (0 to 114)
Result will be stored in Rn. (Rn = ~Rm)

27. WAND (OPCODE → 027)
This command is used for 16-bit logical AND operation of selected two Registers.

Example,
WAND Rn Rn1 Rn2
Where,
Rn = Register Number (0 to 85)
Rn1, Rn2 = Register Number (0 to 114)
Result will be stored in Rn (Rn = Rn1 & Rn2).

28. WOR (OPCODE → 028)
This command is used for 16-bit logical OR operation of selected two Registers.

Example,
WOR Rn Rn1 Rn2
Where,
Rn = Register Number (0 to 85)
Rn1, Rn2 = Register Number (0 to 114)
Result will be stored in Rn. (Rn = Rn1 | Rn2)

29. WXOR (OPCODE → 029)
This command is used for 16-bit logical XOR operation of selected two Registers.

Example,
WXOR Rn Rn1 Rn2
Where,
Rn = Register Number (0 to 85)
Rn1, Rn2 = Register Number (0 to 114)
Result will be stored in Rn. (Rn = Rn1 ^ Rn2)

30. NEG (OPCODE → 030)
This command is used for negative operation of selected Register.

Example,
NEG Rn
Where,
Rn = Register Number (0 to 85)
Result will be stored in Rn. (Rn = -Rn)

31. ABS (OPCODE → 031)
This command is used for absolute operation of selected Register.

Example,
ABS Rn
Where,
Rn = Register Number (0 to 85)
Result will be stored in Rn. (Rn = ABS (Rn))

Note: *OPCODE no. 032 to 034 Reserved.*

32. CMP_GT (OPCODE → 035)
This command is used for compare application.

Example,
CMP_GT Fn Rn Rm
Where,
Rn and Rm = Register Number (0 to 114)
Fn = Flag number (0 to 99)
It will compare Rn and Rm, and if Rn is greater than Rm then it will set Fn (bit status) to 1.

33. CMP_LT (OPCODE → 036)
This command is used for compare application.

Example,
CMP_LT Fn Rn Rm
Where,
Rn and Rm = Register Number (0 to 114)
Fn = Flag number (0 to 99)
It will compare Rn and Rm, and if Rn is less than Rm then it will set Fn (bit status) to 1.

34. CMP_GE (OPCODE → 037)
This command is used for compare application.

Example,
CMP_GE Fn Rn Rm
Where,
Rn and Rm = Register Number (0 to 114)
Fn = Flag number (0 to 99)
It will compare Rn and Rm, and if Rn is greater than and equal to Rm then it will set Fn (bit status) to 1.

35. CMP_LE (OPCODE → 038)
This command is used for compare application.

Example,
CMP_LE Fn Rn Rm
Where,
Rn and Rm = Register Number (0 to 114)
Fn = Flag number (0 to 99)
It will compare Rn and Rm, and if Rn is less than and equal to Rm then it will set Fn (bit status) to 1.

36. CMP_EQ (OPCODE → 039)
This command is used for compare application.

Example,
CMP_EQ Fn Rn Rm
Where,
Rn and Rm = Register Number (0 to 114)
Fn = Flag number (0 to 99)
It will compare Rn and Rm, and if Rn is equal to Rm then it will set Fn (bit status) to 1.

37. CMP_NE (OPCODE → 040)
This command is used for compare application.

Example,
CMP_NE Fn Rn Rm
Where,

Rn and Rm = Register Number (0 to 114)
Fn = Flag number (0 to 99)
It will compare Rn and Rm, and if Rn is not equal to Rm then it will set Fn (bit status) to 1.

38. IF (OPCODE → 041)
This command is used for condition application.

Example,
IF Fn
Where,
Fn = Flag number (0 to 99)
If Fn is 1 then it will go into the If loop otherwise it will execute the PLC code written after **ELSE** command.

39. ELSE (OPCODE → 042)
This command is used for condition application.

Example,
ELSE
If **IF** command condition is false then it will go into the ELSE loop. Otherwise it will execute the PLC code written after **END_IF** command.

40. END_IF (OPCODE → 043)
This command indicates end of IF and ELSE condition loop.
NOTE: END_IF command must be used after IF, ELSE command.

Example,

```
IF Fn                          IF Fn
…….          OR                 ……
END_IF                         ELSE
                                   ……
                                   END_IF
```

Note: *Nested IF….ELSE…..END_IF statement is not supported.*

41. JUMP (OPCODE → 044)
This command is used for branch application.

Example,
JUMP Xn
Where,
Xn = Command Number (1 to 100)
It will JUMP to selected Xn Command number and start executing from there.

Note: *OPCODE no. 045 Reserved.*

42. READ_PSO (OPCODE → 046)
This command is used to read PSO status in selected Flag Number.

Example,
READ_PSO Fn PSOm
Where,
Fn = Flag number (0 to 99)
PSOm = PSO number (1 to 7)

43. READ_PSI (OPCODE → 047)
This command is used to read PSI status from Inverter to In-built PLC.
For this, user must have to select below PLC option in Inverter parameters C101 to C106 and C114 to C115.

Example,
READ_ PSI Fn PSIm
Where,
Fn = Flag number (0 to 99)
PSIm = PSI number (1 to 8)

	FLAG NO	PSI SELECTABLE OPTIONS (C101 to C106 and C114 to C115)
READ PSI	BIT STATUS OF FLAG	17: PLC I/P 1
		18: PLC I/P 2
		19: PLC I/P 3
		20: PLC I/P 4
		21: PLC I/P 5
		22: PLC I/P 6
		23: PLC I/P 7
		24: PLC I/P 8

44. WRITE_PSI (OPCODE → 048)
This command is use to Activate PSI terminal function from In-built PLC.
PSI terminal have 16 selectable options.

Example,
WRITE_PSI PSIFunction (m) Fn
Where,
Fn = Flag number (0 to 99)
PSI Function (m) = PSI Selectable option (1 to 16)
It will load bit result of selected flag into PSI selected option.
Note: *User should take care; below selectable options should be use either in In-built PLC or in PSI parameters (C101 to C106 and C114, C115) at one time.*

	Select one of the Options		Flag No
WRITE_PSI	1: Not Used	2: Terminal	Bit Status of Flag
	3: Jogging	4: External Flt (NO)	
	5: Fault Reset	6: Bypass Cont Flt	
	7: Main Cont Flt	8: Emergency Stop (NO)	
	9: Ramp Hold	10: Rev cont Flt	
	11: PID Bypass	12: PID Disable	
	13: Emergency Stop (NC)	14:External Flt (NC)	
	15: RUN	16:STOP	

45. WRITE_PSO (OPCODE → 049)
This command is used to write PSO status from In-built PLC to Inverter.
For this, user must have to select below PLC option in inverter parameters C107 to C113.

Example,
WRITE_PSO PSO (m) Fn
Where,
PSO (m) = PSO no. (1 to 7)
Fn = Flag no. (0 to 99)

	PSI SELECTABLE OPTIONS (C107 to C113)	FLAG NO
WRITE_PSO	26:PLC O/P 1	BIT STATUS OF FLAG
	27:PLC O/P 2	
	28:PLC O/P 3	
	29:PLC O/P 4	
	30:PLC O/P 5	
	31:PLC O/P 6	
	32:PLC O/P 7	

46. READ_MON_PARA (OPCODE → 050)
This command is used to read the monitor parameter value into the selected Register Number.

Example,
READ_MON_PARA Rn ModId
Where,
Rn = Register Number (0 to 85)
ModId = Modbus Id of Monitor Parameter (0 to 115)
Reference: Serial guide Manual
Example,
to read parameter M104: B-Phase Current's Modbus id is 40004. So
ModId = 40004 – 40001 = 3

47. READ_STA_BIT (OPCODE → 051)
This command is used to read bit status of Status Register in selected Flag Number.

Example,
READ_STA_BIT Fn StsRegNo BitNo
Where,
Fn = Flag number (0 to 99)
StsRegNo. = Status Register Number (1 to 2)
BitNo. = Bit Number (0 to 15)

Bit description of *Status Code 1*:

Bit No	Status
0	Emergency Stop
1	Stop
2	Ramp Up
3	Ramp Down
4	Braking
5	Current Limit
6	Power Off
7	Ramp Hold
8-15	Reserved

Bit description of *Status Code 2*:

Bit No	Status
0	Normal Run
1	Jogging
2	Fault
3	Auto Restart
4	Bypass
5	Main Allow
6	Factory Allow
7	Start Delay
8-15	Reserved

48. READ_FLT_BIT (OPCODE → 052)
This command is used to read bit status of Fault Code Register in selected Flag Number.

Example,
READ_FLT_BIT Fn FltRegNo BitNo
Where,
Fn = Flag number (0 to 99)
FltRegNo. = Fault code Register Number (1 to 2)
BitNo. = Bit Number from (0 to 15)

Bit description of *Fault Code 1:*

Bit No.	Fault Type
0	Over Current Fault
1	Under Current Fault
2	I-Unbalance Fault
3	Overload Fault
4	Over Voltage Fault
5	Rev Contactor Flt
6	Firing Fault
7	Phase Loss Fault
8	External Fault
9	Emergency Stop
10-15	Reserved

Bit description of *Fault Code 2:*

Bit No.	Fault Type
0	Eeprom Error
1	Ground Fault
2	Communication Loss
3	Phase Direction Fault
4	Reserved
5	Over Frequency Fault
6	Under Frequency Fault
7	Bypass Contactor Fault
8	Main Contactor Fault

9	Temperature Fault
10-15	Reserved

49. READ_CWORD_BIT (OPCODE → 053)
This command is used to read bit status of Control Word Register in selected Flag Number.

Example,
READ_CWORD_BIT Fn CwordRegNo BitNo
Where,
Fn = Flag number (0 to 99)
CwordRegNo = Control Word Register Number (1 to 2)
BitNo. = Bit Number from (0 to 15)

Bit description of *Control word:*

Bit No	Status	Description
0	Phase Direction Fault	Enable or disable the phase direction fault. = 0: Disable = 1: Enable
1	Firing Fault	Enable or disable the firing fault. = 0: Disable = 1: Enable
2	Pick up function	Enable or disable the pick up function. = 0: Disable = 1: Enable
3	Reserved	
4	Reserved	
5	PID Control selection	Enable or disable the PID control action. = 0: Disable = 1: Enable
6	PID Polarity	This can be used to invert the PID output. = 0: Negative = 1: positive
7	Operation Panel Communication Loss selection	If enabled, SOFT STARTER will generate fault if it does not receive any response from the operation panel within 5sec. =0: Disable =1: Enable
8	Maintained/Momentary Start	When using terminal start/ stop facility, this parameter gives the choice of having maintained or momentary contacts for start or stop. = 0: The start control maintained type = 1: The start/ stop control momentary type.
9	O/L During Ramp	Enable or Disabled the thermal overload during ramp up. = 0: Disable. = 1: Enable.
10-15	Reserved	

50. WRITE_AN_O/P (OPCODE → 054)
This command is used to set Analog Output or Analog Input by the use of selected Register value. Register value should be in the range of 0 to 100d. Where 0d will give 0Volt and 100d will give 10Volt.

Example,
WRITE_AN_O/P PLCAOPn Rn
Where,
PLCAOPn = PLC analog output number (PLCAOP1 to PLCAOP4).
Rn = Register Number (0 to 114).

FOR ANALOG OPUTPUT:
Analog output will come according to selection of **C201** to **C204**.
To get PLC analog output at **VO1** terminal, one of the selectable options from **9:PLC A-O/P 1** to **12:PLC A-O/P 4** should be set at **C201**.

FOR ANALOG INTPUT:
Analog Input can be given to parameters C303 & C304 from In-built PLC by setting one of four PLC A-O/P options and using this command.

51. TIMER1 (OPCODE → 057)
This command is used to set fix timing event for required application.

Example,
TIMER1
1 count = 1 ms
Final count = C501 * C502. (Parameter)
Flag Number **92 is Input** Flag and Flag Number **93 is Output** Flag for Timer1.
TIMER1 is down counter. It will start after Flag number 92 is set to 1. It will only work if 92 Flag number is set otherwise it will stop counting.
When TIMER1 will become zero, Flag number 93 will be set. Maximum Timer is 298 hour.

52. TIMER2 (OPCODE → 058)
Final count = C503 * C504. (Parameter)
Flag Number **94 is Input Flag** and Flag Number **95 is Output** Flag for Timer2.
Same as TIMER1.

53. TIMER3 (OPCODE → 059)
Final count = C505 * C506. (Parameter)
Flag Number **96 is Input** Flag and Flag Number **97 is Output** Flag for Timer3.
Same as TIMER1.

54. TIMER4 (OPCODE → 060)
Final count = C507 * C508. (Parameter)
Flag Number **98 is Input** Flag and Flag Number **99 is Output** Flag for Timer4.
Same as TIMER1.

55. DISPLAY_REG (OPCODE → 061)
This command is used to display the Register value on Display Panel and save it to EEPROM on Power OFF mode.

Example,
DISPLAY_REG X1 Rn
Where,
X1 is the Display Number of Display Panel, which are 1 to 10. (M308 to M317)
Rn = Register Number (0 to 114)
User can also display the value of Read only Register.

56. DISPLAY_FLG (OPCODE → 062)
This command is used to display the bit status of Flag Number on Display Panel and save it to EEPROM on Power OFF mode. Total 8 number of flag bit status can be shown.

Example,
DISPLAY_FLG Bitloc Fn
Where,

Bitloc = bit location (0 to 7) of shown parameter on Display Panel (M318)
Fn = Flag Number (0 to 99)

57. LPF1 (OPCODE → 063)
This command is used for the low pass filter.

Example,
LPF1 Rn Rm Tc
Where,
Rn = Register number (0 to 85)
Rm = Register number (0 to 114)
Tc = Time constant. (0 to 100)
Result will be stored in Rn.

58. LPF2 (OPCODE → 064)
59. LPF3 (OPCODE → 065)
60. LPF4 (OPCODE → 066)
Same as LPF1.

61. JMPC (OPCODE → 067)
This command is used for conditional Branch application.

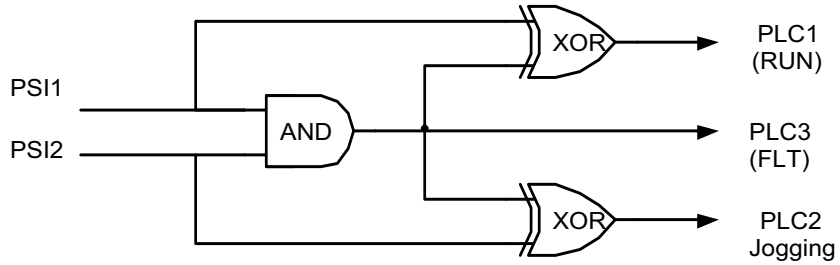
Example,
JMPC Xn Fn
Where,
Xn = Command Number (0 to 100)
Fn = Flag Number (0 to 99)
If Fn (flag no) in equal to 1, then It will JUMP to selected Xn Command number and start executing from there.

62. JMPNC (OPCODE → 068)
This command is used for conditional Branch application.

Example,
JMPC Xn Fn
Where,
Xn = Command Number (0 to 100)
Fn = Flag Number (0 to 99)
If Fn (flag no) in not equal to 1, then It will JUMP to selected Xn Command number and start executing from there.

In-built PLC Applications

Example 1
This example is used to control three signals by the use of two PSI.
As shown here if PSI1 will become Active and PSI2 is Inactive then RUN status will become Active.
If PSI2 will become Active and PSI1 is Inactive then JOGGING status will become Active.
If both are Active at the same time then Fault will generate.



Program Code:

To write PLC program from Display Panel, few things should be known to PLC programmer.

1. There is a PLC Program mode in Display Panel, which is **Mode-P.**
   In Mode-P there are total **10 groups** from **P101 to PA01**. So user can write up to 100 commands.
2. User has to start PLC programming from **P101,** and then continue to the **P110.**
   After reaching there if user still want to enter commands then he should go to another group **P201** and start writing commands from there, likewise he can write 100 commands.
3. Now before start PLC programming, user should have knowledge of the PLC commands and op-code.
4. If you will come to the **P101** you will find 12-digit value. Here first 3-digit from left is for **OPCODE** of commands you want to use. Second, third and fourth 3-digit depends upon which Command you are using.

Example,

047001001000
047 is opcode of READ_PSI command.
001 is for memory location of Bit number (Flag no.1), which is user memory.
001 is for PSI1 status.
000 is not used.

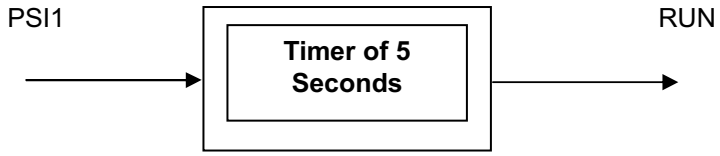
Input from Display Panel into P101 to PA01

Parameter No.	PLC Command	Description
P101	047001001000	Copy the PSI1 status into flag no. 1.
P102	047002002000	Copy the PSI2 status into flag no. 2.
P103	008003001000	Copy the bit status flag no. 1 into flag no. 3.
P104	008004002000	Copy the bit status flag no. 2 into flag no. 4.
P105	019001001002	AND operation between flag 1 and flag 2 and result will be stored in flag no. 1.
P106	022003003001	XOR operation between flag no. 1 and flag no. 3 and result will be stored in flag no. 3.
P107	022004004001	XOR operation between flag no. 1 and flag no. 4 and result will be stored in flag no. 4.
P108	048012001000	Write the Flag no.1's status into the PSI's selectable option no. 12 which is **Ext Flt (NO)**.
P109	048015003000	Write the Flag no. 3's status into the PSI's selectable option no. 15 which is **RUN**.
P110	048003004000	Write the Flag no. 4's status into the PSI's selectable option no. 3 which is **Jog Select**.
P201	000000000000	End of Program.

Note:
User can use 0 to 99 single bit locations for general application.
User has to set following parameter.

1. *Enable PLC function from B407.*
2. *Select option 17 in C101.*
3. *Select option 18 in C102.*
4. *Select option 1 in C114*

Example 2
This application can be used when RUN is required after certain delay.
In this example when Digital input will be applied to PSI1, RUN will be activated after 5 seconds of delay. To keep RUN status active PSI1 should be applied permanently otherwise RUN will become Inactive.



Program Code:
Input from Display Panel into P101 to PA01

Parameter No.	PLC Command	Description
P101	047001001000	Copy the PSI1 status into Flag no. 1.
P102	008092001000	Copy the bit status of Flag no. 1 into Flag no. 92.
P103	057000000000	Here 5000 count (C501*C502) has been loaded to the TIMER1.
P104	048015093000	Write the bit status of Flag to the PSI's selectable option number 15, which is RUN.
P105	000000000000	End of Program.

Note: *User should consider fix format for TIMER COMMAND. There are 4 Timer commands. All are used as same format.*

Example,

057000000000
057 is opcode for TIMER1 command.
Parameter C501 = 1
Parameter C502 = 5000
So, 1 * 5000 = 5000 count will be loaded in to timer1 (1 count = 1ms)
User has to set following parameter.

1. Enable PLC function from B407.
2 Select 15 no. Selectable option in C101.
3. C501 = 1 and C502 = 5000.

1) 4. Select option 1 (Not Used) in C114.

Example 3
This example demonstrate how to use memory location (Register 0 to 114) for 16-bit value.

Program Code:
Input from Display Panel into P101 to PA01

Parameter No.	PLC Command	Description
P101	001002000050	Load 16-bit Immediate value (50) into Register no.2
P102	054001002000	Content of Register no. 2 is copied to PLC A-O/P 1. Here 0d = 0 volt and 100d = 10 volt
P103	001003000010	Load 16-bit Immediate value into Register no.3
P104	035001003002	It will compare two Registers. If Register 3 is greater then 2,than flag no. 1 will be SET (1) otherwise it will reset (0).
P105	049014001000	Write the bit status of Flag no.1 into PLCPSO1.
P106	000000000000	End of Program.

Note: *User should consider fix format for **REG_LD** COMMAND.*

Example,

001002000050
001 is opcode for REG_LD command.
002 Register number 2(Memory location for 16-bit value.)
000050 indicate one signed 16-bit value. (Maximum value is 32767.)

1) User has to set following parameter.
   1. Enable PLC function from C312.
   2. Select 8 no. Selectable option in C201. Output will come on Vo-1 terminal.
   3. Selects 14 no. Selectable option in C107. Output will come on PSO1 terminal.

Note: *User can use 0 to 85 16-bit memory locations for general application. These are read and write memory locations. From 86 to 114 memory location contains analog values of internal parameters, which are given in In-built PLC Function's manual. These memory locations are read only.0 to 114 16-bit memory locations and 0 to 99 bit memory locations both are different.*

Example 4
This example is given to just demonstrate how to use 16-bit memory locations (Register 0 to 114) and 32-bit memory location.

Program Code:
Input from Display Panel into P101 to PA01

Parameter No.	PLC Command	Description
P101	001001001000	Copy 16-bit Immediate value (1000) into Register no.1
P102	001002032000	Copy 16-bit Immediate value (32000) into Register no.2
P103	001003001000	Copy 16-bit Immediate value (1000) into Register no.3
P104	001004030000	Copy 16-bit Immediate value (30000) into Register no.4
P105	002003000000	It will take Register no 3 as high 16-bit and Register no 4 as low 16-bit and save it to 32-bit memory location as 32-bit value.
P106	013001000000	It will take Register no 1 as high 16-bit and Register no 2 as low 16-bit and form 32-bit value, which will be added to the content of 32-bit memory location. Result will be saved to 32-bit memory location.
P107	003005000000	It will take high 16-bit of the content of 32-bit memory location and store it to Register no 5 and low 16 -bit to the Register no 6.
P108	061001005000	It will display the content of Register no 5 on Display Panel. (M308)
P109	061002006000	It will display the content of Register no 6 on Display Panel. (M309)
P110	000000000000	End of Program.

User has to set following parameter.

1. Enable PLC functions from B407.

Note: *There is only one 32-bit memory location is given.*
During 32-bit load and store commands user should use only 0 to 84 16-bit memory locations.

Example 5
This application can be used to monitor feedback of analog voltage input 0-10Vdc by the use of PLC on Display Panel.

Program Code:
Input from Display Panel into P101 to PA01

Parameter No.	PLC Command	Description
P101	016094108000	Multiplication between Register 94 and 108 and result will be stored in 32-bit memory location.
P102	001001000100	Copy 16-bit Immediate value (100) into Register no.1
P104	003010000000	The value of 32-bit memory location is stored in Register 10 as high and register 11 as low 16-bit value.
P105	028012010011	Word OR logic between Register 10 and 11 and result will be store in Register 12.
P106	061001012000	Display Register 12 in PLC Display Number 1.
P107	000000000000	End of Program.

User has to set following parameter.

1. Enable PLC function from B407.
2. Register 94 contains FSV input, which is read only memory location.
3. Register 108 contains value of Panel Para8 **(C508)** which is used for multiplication factor, and that should be change as per input quantity range.

Note: *There is only one 32-bit memory location is given.*
During 32-bit load and store commands user should use only 0 to 84 16-bit memory locations.

Example 6
This application can be used to monitor feedback on FSV and convert it to other quantity by the use of PLC and display on Display Panel to monitor up to certain limit and give trip (External Fault).

Program Code:
Input from Display Panel into P101 to PA01

Parameter No.	PLC Command	Description
P101	016094108000	Multiplication between Register 94 and 108 and result will be stored in 32-bit memory location.
P102	001001000100	Copy 16-bit Immediate value (100) into Register no.1
P103	018001000000	Division between 32-bit memory location and register 1 and result will be stored in 32-bit memory location
P104	003010000000	The value of 32-bit memory location is stored in Register 10 as high and register 11 as low 16-bit value.
P105	028012010011	Word OR logic between Register 10 and 11 and result will be store in Register 12.
P106	061001012000	Display Register 12 in PLC Display Number 1.
P107	035001012102	If Register 12 is greater than Register 102 then Flag number 1 will be set
P108	048004001000	Status of flag 1 will be written to **4:EXT_FLT** option of PSI's selectable options.
P109	000000000000	End of Program.

User has to set following parameter.

1. Enable PLC function from B407.
2. Register 94 contains FSV input, which is read only memory location.
3. Register 108 contains value of Panel Para8 **(C508)** which is used for multiplication factor, and that should be change as per input quantity range.

Note: *There is only one 32-bit memory location is given.*
During 32-bit load and store commands user should use only 0 to 84 16-bit memory locations.

Example 7
This application can be used to monitor feedback on FSV and convert it to other quantity. And to take sample after every 1-second, 1-minute and 1-hour and display them on separate Display Parameters.
Samples of 1-second and 1-minute will be reset but samples of 1-hour will be continuously Increased to measure total input quantity.

Program Code:
Input from Display Panel into P101 to PA01

Parameter No.	PLC Command	Description
P101	016094108000	To find feedback.
P102	001001000100	
P103	018001000000	
P104	003010000000	
P105	028012010011	
P106	061001012000	
P107	057000000000	Set Timer1 of 1 second
P108	009092000000	Start Timer1
P109	041093000000	**1 second routine**-
P110	010093000000	Find summation of 60 samples and store it into register 5
P201	012005005012	
P202	006020000000	
P203	043000000000	
P204	001021000060	
P205	037010020021	To check if 60 samples are taken
P206	041010000000	**1 minute routine** –
P207	010010000000	If 60 samples are taken then find the average value of feedback register 5 and store it to register 6.
P208	017006005021	And again take other 60 samples from register 6 and add it to register 7.
P209	012007007006	
P210	001005000000	
P301	001020000000	
P302	006030000000	
P303	043000000000	
P304	001060000060	
P305	037030030060	To check if 60 samples are taken
P306	041030000000	**1 hour routine**-
P307	010030000000	If 60 samples are taken then add value of register 7 to register 9. And display register 9 on Display Para3 which indicate total input quantity.
P308	001030000000	
P309	012009009007	
P310	061003009000	
P401	043000000000	
P402	001051010000	
P403	037055009051	Whenever register 9 will be greater 10000 it will reset to 0 and register 56 will be increased by one, which indicates that 10000 of total quantity input. (If it is increased to 2 that will indicate 20000 of total quantity input)
P404	041055000000	
P405	006056000000	
P406	001009000000	
P407	010055000000	
P408	043000000000	

P409	047025001000	If PSI is given then it will reset all Registers and total quantity input.
P410	041025000000	
P501	001005000000	
P502	001020000000	
P503	001007000000	
P504	001006000000	
P505	001009000000	
P506	001056000000	
P507	00103000000	
P508	061003009000	
P509	061005056000	
P510	043000000000	
P601	061002007000	To Display values of registers.
P602	061004009000	
P603	061005056000	
P604	061006020000	
P605	061007030000	
P606	000000000000	End of program

User has to set following parameter.

1. Enable PLC function from B407.
2. Register 94 contains FSV input, which is read only memory location.
3. Register 108 contains value of Panel Para8 **(C508)** which is used for multiplication factor, and that should be change as per input quantity range.
4. Select 17 no. Selectable option in C101.
5. C501 = 10 and C502 = 100. (10*100 = 1000 count for Timer1)

Note: *There is only one 32-bit memory location is given.*
During 32-bit load and store commands user should use only 0 to 84 16-bit memory locations.

Example 8
This application is to demonstrate Low Pass filter command.

Program Code:
Input from Display Panel into P101 to PA01

Parameter No.	**PLC Command**	**Description**
P101	063001094030	Input is Register 94(FSV) and Time constant is 030. LPF output will be in Register 1.
P102	061001001000	Output is displayed on Display Para1.
P103	000000000000	End of program

User has to set following parameter.

1. Enable PLC function from B407.
2. Register 94 contains FSV input, which is read only memory location.

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CHAPTER- 7: ELECTRONICS CIRCUIT BOARDS

Axpert-Opti torque Electronics Soft Starter has following electronics circuit boards.

7.1 Main control board PCA-2005B

The Control Board PCA-2005B is a multipurpose board and specifically designed to meet the high-end performance of the power electronics products like Soft Starter, AC Power Controller, and Controlled Rectifier etc…

It uses **32-bit High-Performance Digital Signal Processor TMS320F2811**. The control board generates the necessary Gate pulses for Soft Starter operation. It accepts various inputs from different circuits and Digital Operation Panel (LCD Keypad Module) to generate the necessary control and gate signals.

The TMS320F2811 (U1) is the heart of this board. It handles the user interfaces, core algorithm and generates Thyristor gate signals. The PCA-2005B is connected to PCA-2012, 80 - Character, 4- Line LCD Display Card with RS-485 link. PCA-2012 displays various parameters of the Soft Starter.

7.2 Digital operation panel

The unit is equipped with Digital Operation Panel (LCD Keypad Module) for the user interface. All parameters of Soft Starter can be accessed from Digital Operation Panel. The Digital Operation Panel consists of Display Board and 8-keys keypad. The display board uses 80 - Character, 4- Line Liquid Crystal Display (LCD).

It has 32-bit LPC2368 ARM controller. It interfaced with main control board PCA-2005B, this becomes master and the main control boards works as slave. The master and slave communication is based on RS-485 (Modbus-RTU Protocol).

7.3 Power supply unit

This unit provides the power to all boards in the Soft Starter. The input to the power supply board is 115/230Vac. The different outputs of the power supply board are +15V/2.2A, -15V/0.5A, +5V/1A and +24V/0.5A.

7.4 RC snubber board PCA-82

This is Snubber board for the thyristor. It is a combination of R and C connected across each thyristor to protect the thyristor against the voltage transients.

7.5 MOV board PCA-77

This is connected at the input of the unit. It protects the unit against the surge / voltage transients coming in the power lines.

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CHAPTER- 8: MAINTENANCE, INSPECTION AND PART REPLACEMENT

DANGER

- ✓ Maintenance, inspections and part replacement must be done by a designated person.
  (Remove all metal accessories such as watches, bracelets, etc., before starting the work.)
  (Always use an insulation measure tool.)
  Failure to observe this could lead to electric shocks and injuries.
- ✓ Always turn the power OFF before inspecting the motor or machine. A potential is applied on the motor terminal even when the motor is stopped.
  Failure to do so could lead to electric shocks and injuries.
- ✓ Do not use parts other than those designated for the replacement parts.
  Contact your dealer for replacement parts.
  Failure to observe this could lead to fires.
- ✓ Never modify the product.
  Failure to observe this could lead to electric shocks or injuries or product failure.

CAUTION

- ✓ Vacuum the unit with a vacuum cleaner to clean it. Do not use water or organic solvents.
  Failure to observe this could lead to fires or damage.
- ✓ Do not megger the unit.
  Failure to observe this could lead to damage to semiconductor devices.

8.1 Inspection items

The inspections must be carried out periodically according to the working environment and frequency of use. If there are any abnormalities, the cause must be inspected immediately and countermeasures taken.

Daily inspections

Table 8-1-1

Inspection item	Inspection details and work
Temperature/humidity	Confirm that the ambient temperature is –10 to 50°C, and that the humidity is 95% or less with no dew condensation.
Oil mist and dust	Confirm that there is no oil mist or dust in the unit.
Abnormal noise and vibration	Confirm that there is no abnormal noise or vibration from the installation site or unit.
Input power source	Confirm that the input voltage and frequency are within the specifications range.
Cooling fan	Confirm that the cooling fan rotates normally and that no lint, etc. is stuck on it.
Indicator	Confirm that all lamps on the operation panel light properly.

Periodic Inspections

Table 8-1-2

Inspection item	Inspection details and work
Appearance	Check the state of dirt and dust on the vent or heat sink, and clean if necessary.
Interior	Check the state of dirt and dust on the PCB and inside the equipment, and clean if necessary.
Terminal block	Tighten the terminal block screws if loose.
Cooling fan	Replace the fan every three years.
Insulation resistance inspection	Do not perform a megger test on the unit. When doing a megger test on the external circuit, disconnect all wires connected to the unit.

Inspection of spares

The inspection shown in above table must also be performed for spare unit that are left connected but are not used in normal operation. The operation of the unit must be checked every six months by turning the power on.

8.2 Measuring devices

As the voltage and current on the input and output sides include high harmonics, the measured value will differ according to the measuring device. When measuring with a device for commercial frequencies, measure with the following circuits and noted measuring devices.

Input voltage: Moving iron type voltmeter

Output voltage: Rectifying voltmeter

Input / output power: Electrodynamometer type wattmeter.

CHAPTER- 9: OPTIONS

Besides the standard features available in the ***Axpert-Opti torque*** Electronic Soft Starter, which satisfies most of the industrial applications, *AMTECH* offers its users a spectrum of optional products designed to match their requirement.

The list of optional products offered by *AMTECH* herewith is all developed, field tested and commissioned at various locations in India. A brief description of the option is given. Contact *AMTECH* with relevant data to design one for you.

9.1 Metering

At times there may be need of monitoring the internal unit data. Optional analog or digital metering of unit operating data like various voltages, currents etc can be provided in the panel. For the unit data, which can be monitored, and the extra hardware, contacts *AMTECH* for details.

9.2 Enclosure

Some applications may demand enclosures, which suit the environment where the unit is to be installed. Protection against water or ingress or against some harmful ambient gas can be provided within the scope of the manufacturer. The enclosure can be modified for required degree of protection like IP54/ 55. Occasionally the shape and size of the enclosure can also be discussed for incorporating the unit in some other predefined structure. Contact *AMTECH* for details on *Enclosure options.*

9.3 Remote operator box

Remote box for operation from near the actual driven motor site can be provided for the user with optional controls and displays. We remind you here that our standard keypad control box can be taken up to 1000 feet without any problem. Contact *AMTECH* for details on *Remote Operator Box.*

9.4 Bypass operation

Some applications demand the soft starter with bypass option. All the protective feature and current monitoring functions are provided in Bypass mode. Wiring connection for the Bypass contactor is shown in Fig. 10.1.1, chapter 10. Programmable sequence output, Top of Ramp output is used to control the bypass operation. Contacts *AMTECH* for details.

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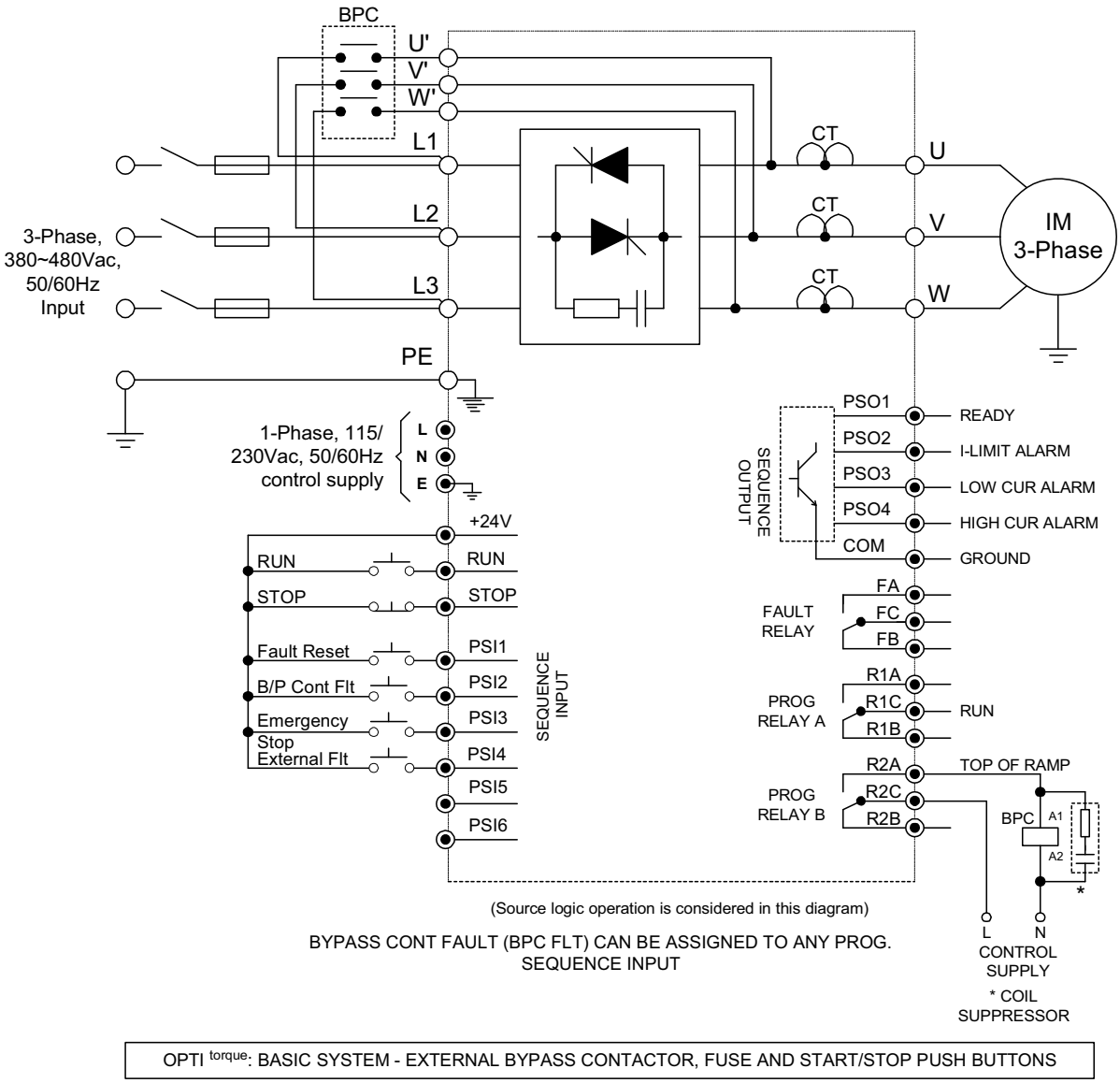
CHAPTER- 10: TYPICAL CONNECTION DIAGRAM

10.1 Bypass contactor connection

It is recommended to use bypass contactor, as after reaching to the full speed, you do not require control of thyristor. The losses in the contactor is very less compare to the thyristor, so you save energy. The connection details are shown in fig. 10-1-1.
Choose contactor having rating equal to 1.15 times the rated motor current. Then choose an AC1 rating closest to, but above that rating.
For example, rated motor current =100A, so required contactor current is 1.15 x 100 = 115A. Then choose the nearest AC1 duty contactor. Suppose, the nearest AC1 contactor rating is 125A, then use 125A AC1 duty contactor.
Here we are selecting AC1 rating of contactor because, the bypass contactor can't energize until the current has dropped to full load current or less.
Although, the bypass contactor is energized and effectively shorting out the thyristor, all protective features such as overload, under load etc are still fully functional.



OPTI torque: BASIC SYSTEM - EXTERNAL BYPASS CONTACTOR, FUSE AND START/STOP PUSH BUTTONS

Fig. 10-1-1

The above diagram shows the soft starter with bypass contactor option. If the bypass contactor is fitted to the soft starter, interlock must be used otherwise unit will trip in "***Bypass Cont Flt***".

Programmable sequence output (***Top of Ramp***) is used to control the bypass contactor and can be assigned to any programmable relay 'A' or 'B'.

10.2 Inside delta connection

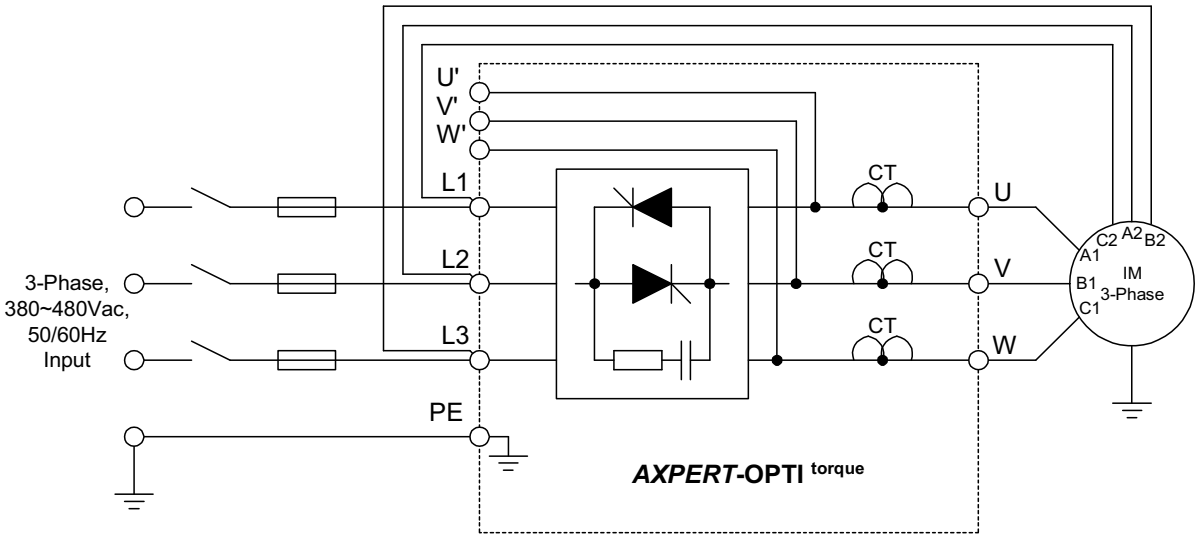


Fig. 10-2-1

The above diagram shows the soft starter power terminal connections when used in inside delta application. The control logic will be same as Inline configuration.

CHAPTER- 11: SERIAL COMMUNICATION SET-UP

The ***Axpert-Opti torque*** Electronics Soft Starter is equipped with a serial communication function using RS485 as a standard. It acts as a ModBus slave in the network. The unit can be controlled with a host computer (master) using this function.

11.1 Connection method

This network is configured of one host computer (master) and 1 to 247 max ***Axpert-Opti torque*** units (slaves). TB1 on main control board is used for the connection.

Refer to Chapter-2 Installation and Wiring for wiring the control signal and for the wiring methods.

The total length of the connected cable must be within 300mt (1000ft).

By using a commercially available RS485-RS232C converter or USB converter unit, the Soft Starter can be connected to a host computer equipped with a serial port or USB, such as a commercially available personal computer.

The details of the TB1 terminal section are shown below.

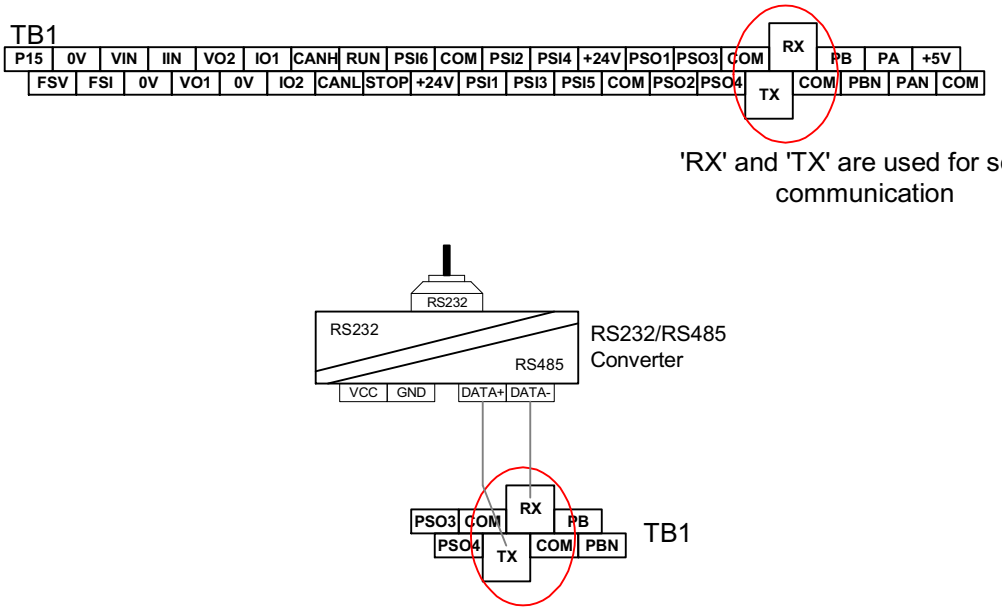


Fig. 11-1-1

11.2 Connecting the host computer and *Axpert-Opti torque* (1-to-1)

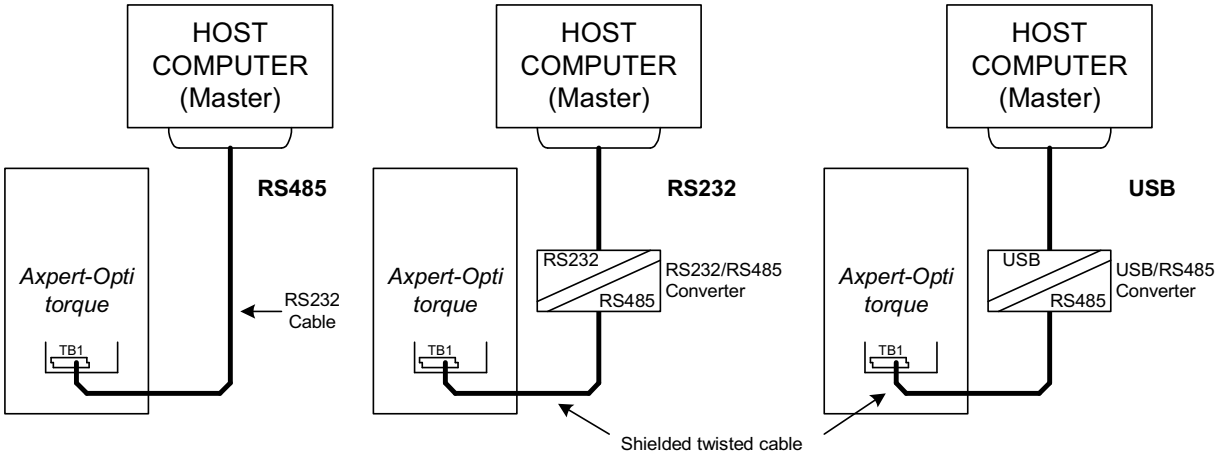


Fig. 11-2-1

CAUTION

- ✓ Separates the communication cable from the main circuit cable and other power cables.
- ✓ A shielded twisted pair cable should be used for connecting TB1 and the host computer. Connect the shielded twisted pair cable's shield to the COM terminal of TB1.
- ✓ When connecting the TB1 and shielded twisted pair cable, do not solder the wires, which are exposed after the sheath is peeled off.
- ✓ If the communication is distorted and not carried out properly because of noise, etc., connect a ferrite core, etc., to the cable, and increase the noise resistance.
- ✓ When connecting several ***Axpert-Opti torque*** units, connect two wires to each TB1 terminal, and couple the ***Axpert-Opti torque*** units. An example of the connection is shown below.

11-3 Connecting the host computer and *Axpert-Opti torque* (1-to-many units)

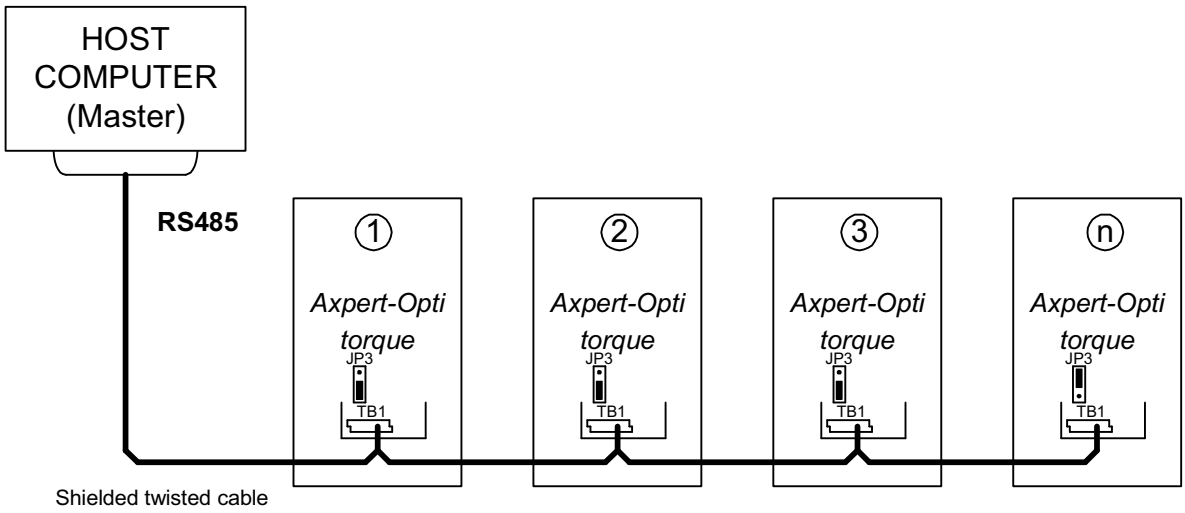


Fig. 11-3-1

The details of the TB1 terminal section are shown below.

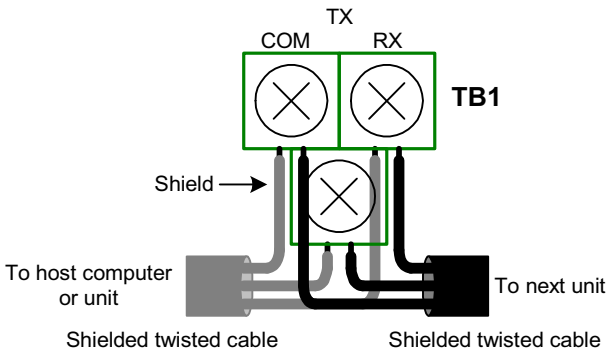


Fig. 11-3-2

CAUTION

- ✓ Separates the communication cable from the main circuit cable and other power cables.
- ✓ A shielded twisted pair wire should be used for connecting TB1 and the host computer. Connect the twisted pair cable's shield to the COM terminal of TB1.
- ✓ When using several slave units, set JP3 of last unit to 'LD' position to connect the terminating resistors as shown in the above fig.
- ✓ When connecting the TB1 and shielded twisted pair cable, do not solder the wires, which are exposed after the sheath is peeled off.
- ✓ If the communication is distorted and not carried out properly because of noise, etc., connect a ferrite core, etc., to the cable, and increase the noise resistance.

11.4 Communication specifications

Table 11-4-1

Connection method	: RS485, 2-wire type
Transmission distance	: Total extension distance less then 300mt (1000ft)
Baud rate	: Select from 1200, 2400, 4800, 9600, 14400, 19200bps
Transmission method	: Start-stop synchronization, half-duplex communication
Frame configuration	: Start - 1 bit Data - 8 bits Stop: 1 bit (with parity) or 2 bits (if no parity) Parity: Select from none, odd or even
Error detection	: Sum check, parity, framing
Communication protocol	: Modbus-RTU communication
Number of stations	: Set between 1 and 247

The default factory settings are shown below.

C401	Baud Rate	bps	=4: 9600
C402	Station Number		1
C403	Parity		=1: No Parity
C404	Response Time	Sec	0.01

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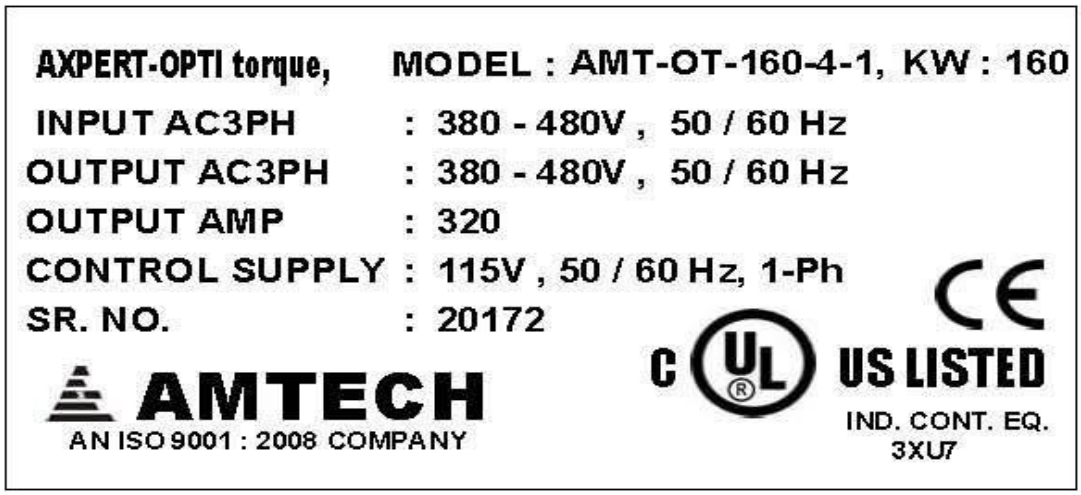
CHAPTER- 12: UL INSTRUCTIONS

The ***Axpert-Opti torque*** Series Electronics Soft-Starter AMT-OT-037-4-1 to AMT-OT-630-4-1 complies with UL508 and CSA C22.2 No.14.
The UL and cUL marks are indicated on the rating nameplate for UL compliant parts.



Observe the following matters when using the soft-starter as an UL/cUL Standard compatible product.

(1) Use the soft-starter in an installation environment, where maximum surrounding air temperature does not exceed 50 Degree C.

(2) For the main circuit connected to the soft-starter, use a "75°C CU" "voltage rating 600V or higher" copper wire.

(3) Use the wire sizes given in Table 2-3-1 for the main circuit wiring. Use a UL/CSA Listed round crimp terminal, which matches the wire diameter for the terminal connection. Crimp the crimp terminal with a crimping tool recommended by the maker.

(4) When wiring the circuit, tighten with the torque given in Table 2-3-1.

(5) Always provide a UL Certified fuse on the input side of the soft-starter. When protected by Class fuse as indicated below, these devices have the following short circuit rating.

Table 12-1

Model AMT-OT-xxx-4-1	Fuse Rating (A rms)	Fuse Class	Short circuit current (A)
037	100A, 600VAC	Class RK5	5000
045	100A, 600VAC	Class RK5	10000
055	150A, 600VAC	Class RK5	10000
075	150A, 600VAC	Class RK5	10000
090	200A, 600VAC	Class RK5	10000
110	300A, 600VAC	Class RK5	10000
132	300A, 600VAC	Class RK5	10000
160	400A, 600VAC	Class RK5	18000
200	400A, 600VAC	Class RK5	18000
250	600A, 600VAC	Class RK5	18000
315	600A, 600VAC	Class RK5	30000
400	800A, 600VAC	Class L	30000
450	1000A, 600VAC	Class L	30000

500	1200A, 600VAC	Class L	42000
585	1200A, 600VAC	Class L	42000
630	1200A, 600VAC	Class L	42000

(6) Install the soft-starter as “open type equipment".

(7) The installation environment must satisfy "pollution degree 2".

(8) The soft-starter has a motor overload protection function. Refer to Chapter 6, and set parameters B301 to B307 correctly.

(9) Integral solid-state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electric Code and any additional local codes or equivalent.

CHAPTER- 13: CE Marking

The ***Axpert-Opti torque*** Series Electronics Soft Starter complies with the EMC directives and Low Voltage directives. Observe the following matters when using the soft starter as an EMC directive compliant product.

This Instruction details how to meet the EMC directives (89/336/EEC) with Opti-Torque and it is important to understand before installation and operation of soft starter. The soft starter is designed to meet the EMC directives and is suitable for use in the Industrial Environments. These soft starters have been tested with the power cables and control leads connected as shown in fig. 13-3-1. If these soft starters are connected with fewer control leads than those specified in fig 13-3-1, it may be possible to reduce installation costs by using ordinary cables rather than screened cables which are recommend in this manual. It is strongly advised however that a compliance test should be performed under the actual operating conditions to certify that the system complies with the relevant EMC requirements. If the soft starters are used with any of the optional cards, in such cases suitable extra measures must be provided and must certify through a test that the product, system or installation complies with the relevant EMC requirements.

WARNING

- ✓ This manual represents Amtech's recommendations based on its understanding of the EMC regulations only and Amtech cannot accept responsibility for any legal problems arising from or in connection with the use of its products.

- ✓ Amtech have made every effort to ensure that their products comply with the directives laid out in the certificate of conformity, which is supplied with each soft starter.

The EMC directives set out immunity requirements for the electrical soft starter (ability to work properly without being affected by external electromagnetic disturbance), in addition to the previously enforced emission requirements (electromagnetic disturbance generated by the electrical soft starter).

In addition to the radiated noise directly generated from the soft starter and its connected cables, the emission requirement includes the conducted noise, which is conducted outside the soft starter through the input cables.

Immunity is the ability of a soft starter to operate properly without being affected by an external disturbance.

The EMC compliance is only achieved when the immunity level of soft starter exceeds its emission level under its operating environment.

In addition to the immunity against a radiated and conducted disturbance, the EMC directives also require of the soft starter the immunity against static electricity discharges and fast transients.

CAUTION

- ✓ A human body can easily be charged with static electricity by merely walking on carpet and with a mere touch on the soft starter, this static electricity will be discharged through it. A discharging spark can be at such a magnitude that it can damage the soft starter.

A soft starter which is installed near cables connected to a switching inductive load can often operate incorrectly due to a fast transient induced on its control leads at a switching of the inductive load.

These are just a few examples of disturbance to which the soft starter is exposed and the soft starter is now required to operate correctly without being affected by such disturbance.

13-1 Installation environments

The ***Axpert-Opti torque*** conforms to the EN 60947-4-2: 2000 + A2:2006 With stand-alone installation of ***Axpert-Opti torque***, it is recommended to ensure that no device or equipment is installed adjacent to the soft starter that is intended for the Residential, Commercial and Light Industrial Environments only, as interference with such equipment may occur.

13-2 Wiring & Earthing

- ✓ Select the input cables from those specified in the manual.
- ✓ The output cable from the soft starter must be screened or armored and the screen or armor must be connected to the earth as shown in fig. 13-3-1.
- ✓ Ensure that the input and output cable are not installed in parallel to each other. Keep them apart from each other by at least 0.5 meter (20”).
- ✓ Ensure that the screen of the output cable is earthed at both ends with one end connected to the earth terminal of soft starter and the other end to the motor earth.
- ✓ Arrange the termination at the soft starter end inside the enclosure. If it is not possible to terminate the cables inside the enclosure then terminate them as closely to the conduit hole of soft starter as possible (preferably within 0.1 meter (4”)).
- ✓ Use a 0.13mm^2 (AWG 26) to 0.8mm² (AWG 18) wire for wiring to the control circuit and should be screened if they are used for a speed setting circuitry, analogue signal circuitry for metering, or relay signal circuitry. The screen should be connected to the earth terminal of soft starter or COM terminal only (refer to Fig. 13-3-1).
- ✓ Control cables should be selected in accordance with the instructions in the manual of soft starter. The control leads should be wired away from the power cables. If it is not possible, cross them at the right angle, and if they are laid down alongside each other, ensure to separate them by at least 0.5 meter (20”).
- ✓ When the section, which runs along the power cables, exceeds 10 meter (33.3’), separate them further more. The control cables should not share the same conduit hole of the soft starter with the power cables. Separate analogue control leads from relay control leads.
- ✓ To reduce emission and to increase immunity, ensure that no control cables are connected that is not used. Also, wire them in such manner that they are as short as possible.
- ✓ Put the relay signal controller and analog speed-setting controller, analog signal meters in a metal box.
- ✓ Keep the earthing cable of soft starter and motor as short as possible and is installed in accordance with the local requirements. Use low impedance earthing cables.
- ✓ If the motor does not share the same earth post with the soft starter, do not connect the screen / earth cable of the soft starter’s output cable to the motor.

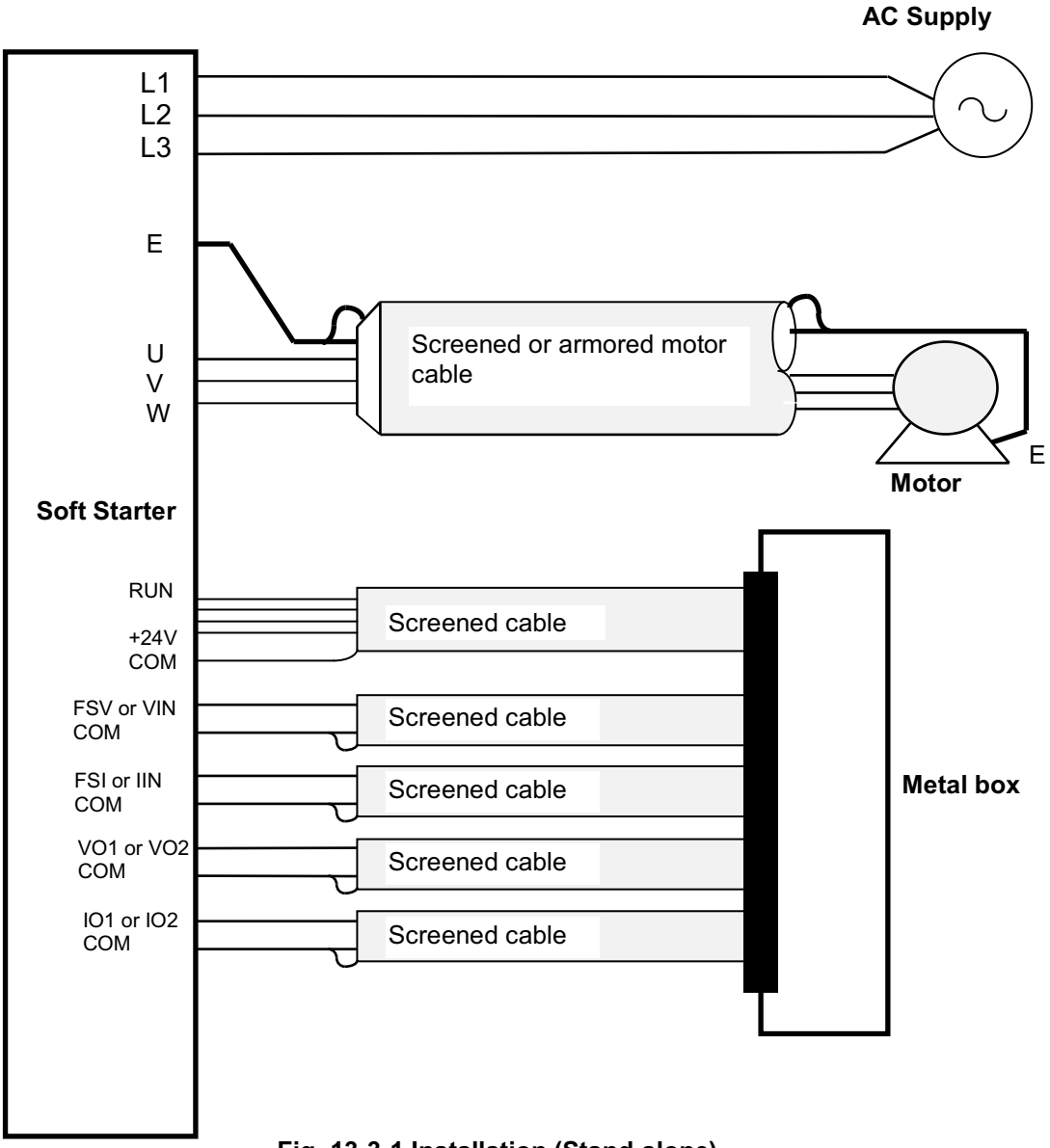


Fig. 13-3-1 Installation (Stand-alone)

13-3 Considerations to measuring devices

All the cables and leads connected to the soft starter should be regarded as active sources of electrical noise. For inspection or service, use measuring devices or equipment that are CE marked. If they require an external power supply, use one, which is separate or well insulated from that of the soft starter.

Even for a system that comprises CE marked equipment and devices only, an EMC compliance test may be required if the whole system is exported from one country to another. Ask the local government for details.

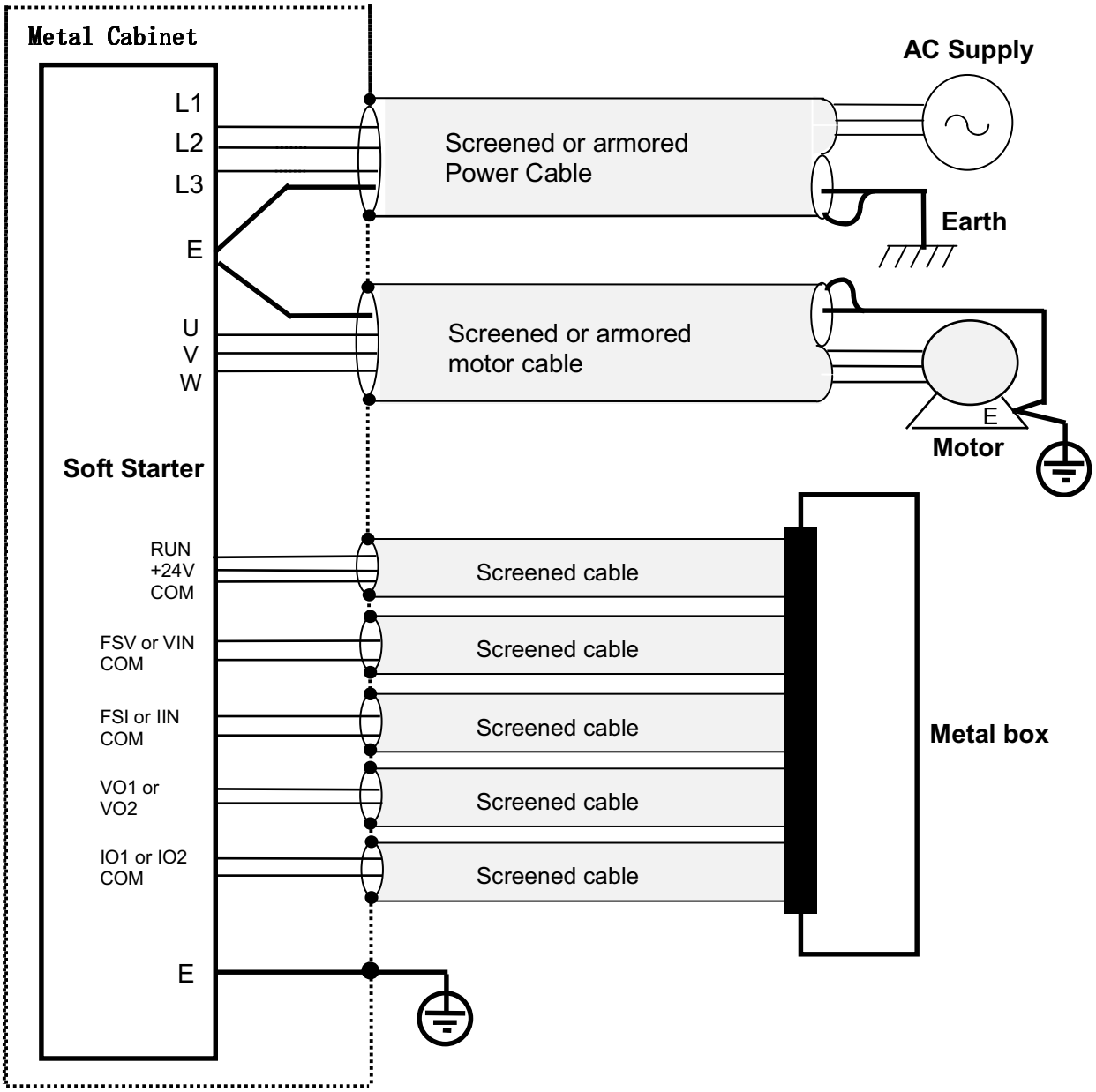


Fig. 13-3-2 (Installation in metal box)

13-4 Insulation test

CAUTION

✓ Perform the test at the maximum voltage of 1960 VAC.

Appendix-A: Standard Specifications for 200V, 400V, 500V and 600V Series

200V series													
Power Source		200 ~ 240 VAC, 3-Phase, 3-Wire, 50/ 60 Hz											
Tolerance		Voltage tolerance: ±10%, Frequency tolerance: ±5%											
AMT-OT-XXX-2-X		**015**	**018**	**022**	**030**	**037**	**045**	**055**	**075**	**076**	**090**	**091**	**110**
Inline Rating	Max applicable motor (kW)	015	018	022	30	37	45	55	75	75	90	90	110
	Max applicable motor line current (A)	60	72	87	110	147	175	215	245	245	320	320	360
Inside Delta	Max applicable motor (kW)	22	30	37	45	55	75	90	132	132	132	132	200
	Max applicable motor line current (A)	104	124	150	190	254	303	372	424	424	554	554	623
AMT-OT-XXX-2-X		**111**	**132**	**133**	**160**	**161**	**200**	**250**	**315**	**400**	**450**	**500**	
Inline Rating	Max applicable motor (kW)	110	132	132	160	160	200	250	315	400	450	500	
	Max applicable motor line current (A)	360	470	470	590	590	720	800	880	950	1065	1200	
Inside Delta	Max applicable motor (kW)	200	200	200	250	250	315	450	585	710	800	875	
	Max applicable motor line current (A)	623	814	814	1021	1021	1247	1385	1524	1645	1844	2078	
400V series													
Power Source		380 ~ 480 VAC, 3-Phase, 3-Wire, 50/ 60 Hz											
Tolerance		Voltage tolerance: ±10%, Frequency tolerance: ±5%											
AMT-OT-XXX-4-X		**030**	**037**	**045**	**055**	**075**	**090**	**110**	**132**	**133**	**160**	**161**	**200**
Inline Rating	Max applicable motor (kW)	30	37	45	55	75	90	110	132	132	160	160	200
	Max applicable motor line current (A)	60	72	87	110	147	175	215	245	245	320	320	360
Inside Delta	Max applicable motor (kW)	45	55	75	90	132	132	200	200	200	250	250	315
	Max applicable motor line current (A)	104	124	150	190	254	303	372	424	424	554	554	653
AMT-OT-XXX-4-X		**201**	**250**	**251**	**315**	**316**	**400**	**450**	**500**	**585**	**630**	**710**	
Inline Rating	Max applicable motor (kW)	200	250	250	315	315	400	450	500	585	630	710	
	Max applicable motor line current (A)	360	470	470	590	590	720	800	880	950	1065	1200	
Inside Delta	Max applicable motor (kW)	315	450	450	585	585	710	800	875	940	1060	1190	
	Max applicable motor line current (A)	653	814	814	1021	1021	1247	1385	1524	1645	1844	2078	

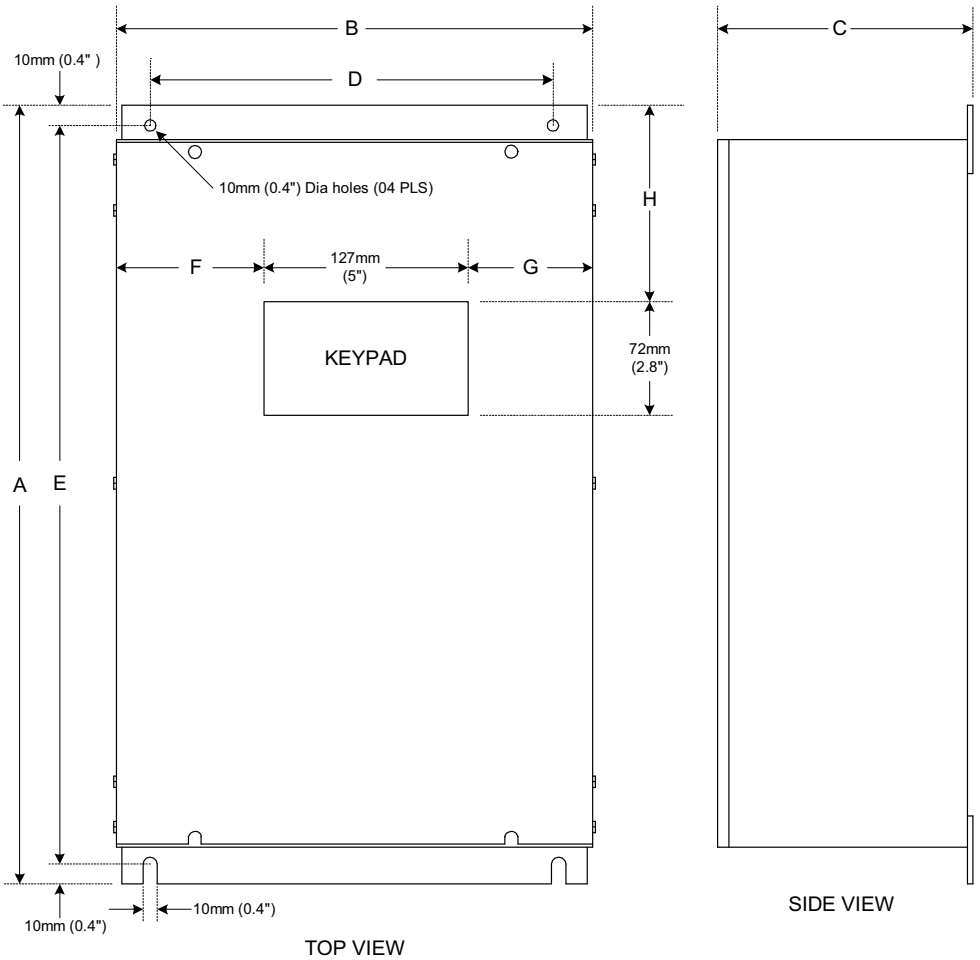
500V series												
Power Source		500 ~ 575 VAC, 3-Phase, 3-Wire, 50/ 60 Hz										
Tolerance		Voltage tolerance: ±10%, Frequency tolerance: ±5%										
AMT-OT-XXX-5-X		**037**	**045**	**055**	**075**	**090**	**110**	**132**	**160**	**161**	**200**	**201**	**250**
Inline Rating	Max applicable motor (kW)	37	45	55	75	90	110	132	160	160	200	200	250
	Max applicable motor line current (A)	60	72	87	110	147	175	215	245	245	320	320	360
Inside Delta	Max applicable motor (kW)	55	75	90	132	132	200	200	250	250	315	315	450
	Max applicable motor line current (A)	104	124	150	190	254	303	372	424	424	554	554	623
AMT-OT-XXX-5-X		**251**	**315**	**316**	**400**	**401**	**450**	**500**	**585**	**630**	**710**	**800**	
Inline Rating	Max applicable motor (kW)	250	315	315	400	400	450	500	585	630	710	800	
	Max applicable motor line current (A)	360	470	470	590	590	720	800	880	950	1065	1200	
Inside Delta	Max applicable motor (kW)	450	585	585	710	710	800	875	940	1060	1190	1400	
	Max applicable motor line current (A)	623	814	814	1021	1021	1247	1385	1524	1645	1844	2078	

600V series												
Power Source		600 ~ 690 VAC, 3-Phase, 3-Wire, 50/ 60 Hz										
Tolerance		Voltage tolerance: ±10%, Frequency tolerance: ±5%										
AMT-OT-XXX-6-X		**045**	**055**	**075**	**090**	**110**	**132**	**160**	**200**	**201**	**250**	**251**	**315**
Inline Rating	Max applicable motor (kW)	45	55	75	90	110	132	160	200	200	250	250	315
	Max applicable motor line current (A)	60	72	87	110	147	175	215	245	245	320	320	360
Inside Delta	Max applicable motor (kW)	75	90	132	132	200	200	250	315	315	450	450	585
	Max applicable motor line current (A)	104	124	150	190	254	303	372	424	424	554	554	623
AMT-OT-XXX-6-X		**316**	**400**	**401**	**450**	**451**	**500**	**585**	**630**	**710**	**800**	**900**	
Inline Rating	Max applicable motor (kW)	315	400	400	450	450	500	585	630	710	800	900	
	Max applicable motor line current (A)	360	470	470	590	590	720	800	880	950	1065	1200	
Inside Delta	Max applicable motor (kW)	585	710	710	800	800	875	940	1060	1190	1400	1700	
	Max applicable motor line current (A)	623	814	814	1021	1021	1247	1385	1524	1645	1844	2078	

Control	Control system	Digital 32-bit Digital Signal Processor	
	+24V supply	Max. Total current drain from terminal = 100 mA	
	Serial port	Supports RS 485	
	External supply for control & cooling fan	External 230/115 VAC, 1-phase supplies to be provided by the user. Capacity varies as per the rating. Refer Instruction Manual Chapter-2 for more detail.	
Operation Specifications	Current feed back & Thermal OLR	Motor current: Adjustable up to 0.3 x Unit Current Rating	
		I-Low Level: 0 ~ 100% of full load motor current	
		I-Limit Level: 100 ~ 500% of full load motor current	
		I-Trip Level: 100 ~ 550% of full load motor current	
		I-Low Time: 0 ~ 20 minutes	
		I-Limit Time: 10 ~ 60 seconds	
	Digital Inputs	8-Programmable Sequence Inputs, Sink / Source changeable, max 5 mA each	
		Programmable between 24 different options: Not Used, Terminal, Jogging, External Flt (NO), Fault Reset, Bypass Cont Flt, Main Cont Flt, Emergency Stop (NO), Ramp Hold, Rev cont Flt, PID Bypass, PID Disable, Emergency Stop (NC), External Flt (NC), RUN, STOP, PLC input 1 ~ 8	
	Digital Outputs	4 Programmable digital outputs, Open collector type, max 30V, 50mA	
		Programmable between 20 different options: Not Used, Ready, Run, Top Of Ramp, Terminal, Fault Alarm, I-Limit Alarm, Low Current Alarm, High Current Alarm, Temp Alarm, Rev Cont, PID Up Limit, PID Low Limit, PLC Output 1 ~ 7	
	Potential Free Contacts	3-Programmable relays:	1-NO, 1-NC for 2A @ 240 VAC
		Programmable between 20 different options same as digital outputs	
	Programmable Analog Outputs	2-Programmable analog voltage outputs VO1 & VO2: 0~10 VDC, 12-bit	
		2-Programmable analog current outputs IO1 & IO2: 4~20 mA, 12-bit	
		Programmable between 12 different options: Output Voltage, Output Current, Active Power, Reactive Power, Power factor, PID Output, Motor torque, Heat sink temperature, PLC Analog output 1 ~ 4	
	Start Mode	V-Ramp Start	Dual Ramp Selection
			V-Ramp Up Time1: 1 ~ 240 sec
			Pedestal-1: 25 ~ 90%
			Kick Time: 0 ~ 2.0 sec
			Kick Voltage: 0 ~ 90%
			Target: 25 ~ 100%
		I-Ramp Start	I-Ramp Up Time: 1 ~ 60 sec
			Initial Current: 100 ~ 300%
			I-Proportional Gain: 0.01 ~ 2.00
			I-Integral Time: 0.01 ~ 100.00
		T-Ramp Start	T-Ramp Up Time: 1 ~ 240 sec
			Initial Torque: 1 ~ 250%
			Torque Limit: 1 ~ 250%
			T-Proportional Gain: 0.1 ~ 2.0
			T-Integral Time: 0.01 ~ 100.00

Operation Specifications	Stop Mode	V-Ramp Stop	V-Ramp Down Time: 1 ~ 240 sec
			Initial Voltage: 100 ~ 25%
			Final voltage: 70 ~ 25%
		Brake Stop	Brake Ramp Time: 0.1 ~ 20.0 sec
			Brake Voltage: 25 ~ 100%
			Brake Time: 1 ~ 240 sec
		T-Ramp stop	T- Ramp Down Time: 1 ~ 240 sec
			End Torque: 1 ~ 100%
		Coast to stop	
	Control Mode	Local (Digital Operation Panel)	
		Terminal	
		Serial	
	PID Controller	Inbuilt PID can be used as stand alone PID Controller	
Display	Display and Keypad module	80-Character, 4-Line LCD panel, 8-Key keypad, 3-Status indicating LED for Run, Stop and Fault	
Start Duty	Ten equally spaced starts per hour at 300% current, each of 30 seconds duration, separated by periods of 100% current, or one start at 300% current of 60 seconds duration, followed by 100% current indefinitely (In 200V series for models 200~500 kW, 6 equal starts, in 400V series for models 400~710 kW, 6 equal starts, in 500V series for models 450~800 kW, 6 equal starts, in 600V for series models 500~900 kW, 6 equal starts)		
Protection	Transient Protection	RC Snubber across thyristor	
		MOV across input power supply	
	Last ten faults with status and four operational parameters like Input voltage (Vry), Output current (%), Total conductive time (Hrs) and Heat sink temperature (^{o}C).		
	* Over current fault	* Temperature fault	
	* Over load fault	* Phase direction fault	
	* Ground fault	* I-Unbalance fault	
	* Phase Loss fault	* Firing fault	
	* Over voltage fault	* Over frequency fault	
	* Under voltage fault	* Under frequency fault	
Environment	Installation Location	Indoor	
	Ambient Temperature	0°C (32°F) ~ 50°C (122°F)	
	Storage Temperature	-20°C (-4°F) ~70°C (158°F)	
	Altitude (above sea level)	1000m (3300 ft) without derating, above this derate 5% per 305m (1000 ft)	
	Humidity	0~95% max non condensing	
	Enclosure	IP00	

Appendix-B: Outline Dimensions



Model	Dimensions in mm (inch)								Weight in kg (lb)
	A	B	C	D	E	F	G	H	
AMT-OT-015-2-X , AMT-OT-018-2-X , AMT-OT-022-2-X , AMT-OT-030-2-X AMT-OT-030-4-X , AMT-OT-037-4-X , AMT-OT-045-4-X , AMT-OT-055-4-X AMT-OT-037-5-X , AMT-OT-045-5-X , AMT-OT-055-5-X , AMT-OT-075-5-X AMT-OT-045-6-X , AMT-OT-055-6-X , AMT-OT-075-6-X , AMT-OT-090-6-X									
	445 (17.5)	213 (8.4)	260 (10.2)	170 (6.7)	423 (16.7)	43 (1.7)	43 (1.7)	77 3.0	13 (28.7)
AMT-OT-037-2-X , AMT-OT-045-2-X , AMT-OT-055-2-X AMT-OT-075-4-X , AMT-OT-090-4-X , AMT-OT-110-4-X AMT-OT-090-5-X , AMT-OT-110-5-X , AMT-OT-132-5-X AMT-OT-110-6-X , AMT-OT-132-6-X , AMT-OT-160-6-X									
	460 (18.1)	213 (8.4)	277 (10.9)	170 (6.7)	438 (17.2)	43 (1.7)	43 (1.7)	92 (3.6)	20 (44.1)
AMT-OT-075-2-X , AMT-OT-090-2-X AMT-OT-132-4-X , AMT-OT-160-4-X AMT-OT-160-5-X , AMT-OT-200-5-X AMT-OT-250-6-X , AMT-OT-315-6-X									
	420 (16.5)	328 (12.9)	315 (12.4)	224 (8.8)	400 (15.8)	102 (4.0)	98 (3.9)	227 (8.9)	29 (64)

Model	Dimensions in mm (inch)								Weight in kg (lb)
	A	B	C	D	E	F	G	H	
AMT-OT-110-2-X, AMT-OT-132-2-X, AMT-OT-160-2-X AMT-OT-200-4-X, AMT-OT-250-4-X, AMT-OT-315-4-X AMT-OT-250-5-X, AMT-OT-315-5-X, AMT-OT-400-5-X AMT-OT-315-6-X, AMT-OT-400-6-X, AMT-OT-450-6-X									
	600 (23.6)	547 (21.5)	326 (12.8)	442 (17.4)	570 (22.4)	210 (8.27)	210 (8.27)	385 (15.2)	60 (132.3)
AMT-OT-200-2-X, AMT-OT-250-2-X, AMT-OT-315-2-X, AMT-OT-400-2-X, AMT-OT-450-2-X AMT-OT-400-4-X, AMT-OT-450-4-X, AMT-OT-500-4-X, AMT-OT-585-4-X, AMT-OT-630-4-X AMT-OT-450-5-X, AMT-OT-500-5-X, AMT-OT-585-5-X, AMT-OT-630-5-X, AMT-OT-710-5-X AMT-OT-500-6-X, AMT-OT-585-6-X, AMT-OT-630-6-X, AMT-OT-710-6-X, AMT-OT-800-6-X									
	740 (29.1)	597 (23.5)	326 (12.8)	492 (19.4)	710 (28)	235 (9.3)	235 (9.3)	525 (20.7)	78 (172)
AMT-OT-076-2-X, AMT-OT-091-2-X, AMT-OT-111-2-X, AMT-OT-133-2-X, AMT-OT-161-2-X AMT-OT-133-4-X, AMT-OT-161-4-X, AMT-OT-201-4-X, AMT-OT-251-4-X, AMT-OT-316-4-X AMT-OT-161-5-X, AMT-OT-201-5-X, AMT-OT-251-5-X, AMT-OT-316-5-X, AMT-OT-401-5-X AMT-OT-201-6-X, AMT-OT-251-6-X, AMT-OT-316-6-X, AMT-OT-401-6-X, AMT-OT-451-6-X									
	600 (23.6)	453 (17.8)	326 (12.8)	398 (15.7)	570 (22.4)	163 (6.4)	163 (6.4)	385 (15.2)	49 (108)
AMT-OT-500-2-X AMT-OT-710-4-X AMT-OT-800-5-X AMT-OT-900-6-X									
	Consult factory for the dimensions								

Appendix-C: Fault Codes

No.	Fault Name	Fault Description
1	**Over Current Fault**	This fault indicates that the unit has tripped due to excessive over current. (550% of the rated current). This fault occurs when the load current exceed the value set under *I-Trip Level (B307)*. This fault gives the instantaneous Over Current trip. A short circuit condition on the output will also cause the unit to display this fault.
2	**Under Current Fault**	This fault occurs when the load current falls below the set value under *I-Low Level (B303)* for a set time in *I-Low Time (B304)*. This active only during the running condition.
3	**I-Unbalance Fault**	This fault occurs when the current between any two phases differ by the value set under the *I-Unbalance Level (B205)* for a set time in *I Unbalance Delay (B206)*.
4	**Overload Fault**	The fault active whenever motor current exceeds the value set under the *Over Load Setting (B305)* and the unit will trip as per the selected overload curve. This fault also occurs whenever the load current exceeds the value set under *I- Limit (B301)* for a set time in *I-Limit Time (B302).*
5	**Firing Fault**	A firing fault means that after the firing pulses are sent to the thyristor is not conducting. This would normally occur only if the thyristor has a faulty gate or if the thyristor is open circuit or, one or more thyristors are short-circuited or if the thyristor firing circuit is faulty, or one or more motor windings are open circuited.
6	**Over Voltage Fault**	This fault occurs whenever the input voltage to the unit exceeds +20% of the value set under the *Rated Input Voltage (B101)*. If this fault occurs, this fault is instantaneous in order to protect the unit.
7	**Phase Loss Fault**	This fault will occur when one or more input phases are lost or the input voltage falls below the 30% of the value set under the *Rated Input Voltage (B101)*.
8	**External Fault**	This fault occurs if the external fault input selected at the terminal is missing. This comes from the user.
9	**Emergency Stop**	This fault indicates that the unit has shut down due to the emergency stop command. This also comes from the user.
10	**EEPROM Fault**	This fault indicates that the data received from the EEPROM is incorrect. After reset, it will store default values in the EEPROM memory.
11	**Ground Fault**	This fault indicates that the unit has shut down due to ground fault. Before reset, check that any output is not shorted with the ground.
12	**Communication Loss**	If the slave (main control unit) is not responding to the master (Digital Operation Panel), this fault will occur. It is auto reset type. If the communication resumes, this will be cleared.
13	**Phase Direction Fault**	This fault indicates that the phase sequence at the input to the Soft Starter is reversed.
14	**Over Frequency Fault**	This fault occurs when the line frequency exceeds the +10% of the motor frequency.
15	**Under Frequency Fault**	This fault occurs when the line frequency below the -10% of the motor frequency.
16	**Bypass Cont Fault**	This fault indicates that bypass contactor unable to energies when power is applied, or fails to drop out when power is removed.

17	**Main Cont Fault**	This fault indicates that main contactor unable to energies when power is applied, or fails to drop out when power is removed. (Note: If the main contactor fault is not selected in PSI and main contactor is fitted then card will display the phase fault).
18	**Reverse cont Fault**	This fault indicates that reverse contactor unable to energies when power is applied, or fails to drop out when power is removed.
19	**Temperature Fault**	This fault indicates that the heatsink temperature has rise above the set value (87˚C).

Appendix-D: Trouble Shooting Guidelines

In case of fault condition, first ensure that the mains voltage applied at L1, L2 and L3 are ok.
Then check the control supply voltage in PCA-2005B.

Sr. No.	Measure @		Expected Voltage
1	**1,J6**	**4,J6**	**+20V ~ 25.5V**
2	**2,J6**	**4,J6**	**+14.9 ~ 15.1VDC**
3	**3,J6**	**4,J6**	**+4.5 ~ 5.5VDC**
4	**5,J6**	**4,J6**	**-13.5 ~ 16.5VDC**
5	**3.3VD**	**DGND**	**+3 ~ 3.6VDC**
6	**1.9VD**	**DGND**	**+1.86 ~ 1.94**

If the above voltages are correct, check the following jumper positions.

Jumper Position

1. The equipment is shipped with sink logic (JP1 is kept on **Sink** position) for the programmable sequence inputs. To change the sink logic to source, change the jumper JP1 position to **Source**.

2. The equipment is shipped with JP3 in **NLD** position. This means the terminating resistors are not in picture. To insert the terminating resistors, keep the jumper to **LD** position.

If the above jumper positions are correct, check the following as per the fault displayed on the Operation Panel (LCD Display)

No.	Fault Name	Causes & Countermeasures
1	**Over Current Fault**	1. Current transformer may have loose connection. Switch off the power supply and repair the loose connection. Check again. 2. The value set under *I-Trip Level (B306)* is too close to the value set in *I-Limit Level (B301)*. Increase the value set in *I-Trip Level*. The setting should be at least 100% above the *I-Limit Level (B301)* setting. 3. The bypass contactor has jammed in. If the bypass contactor has jammed in, the starter attempts direct on line start when the start commend is given. Switch off the power supply and change or repair the bypass contactor. 4. If the motor is stalling, causing the current to reach the *I-Trip Level*. Check the load and free if necessary. 5. If over current comes during ramp up, set it high enough to avoid problems during ramp up or increase the ramp up time. 6. If fault comes during stop, The power module in the main circuit may be damaged. Switch off the power supply and check the power module(s). 7. Starter has a genuine over current fault. Disconnect the motor from the soft starter and megger the motor to ensure there is no ground fault. Otherwise contact your supplier.
2	**Under Current Fault**	1. *I-Low Level (B303)* is set too high. Decrease the set value. 2. Motor is overhauling, Short duration overhauls can be filtered by adjusting *I-Low Time* in (*B304*). 3. Disable the feature by setting 0% in *B303*.

No.	Fault Name	Causes & Countermeasures
3	**I Unbalance Fault**	1. The current transformer may have incorrect polarity. Reconnect the current transformer correctly 2. If one of the current transformers is open circuit. Replace the current transformer. 3. If the current is truly unbalanced, check it with a current meter. Rectify this problem with the motor. Otherwise contact your supplier. 4. One or more load conductors are open (without shorting) or have a high resistance connection. Check wiring and connections for breaks, corrosion or loose devices.
4	**Overload Fault**	1. The value entered under *Motor Current (B103)* in the set menu has not been correct. Enter the correct value under *Motor Current (B103)* in the set up menu. 2. The motor current value measured with meter is close to the rated current of the unit. Reduce motor load. 3. The current transformer polarity is not correct. Reconnect the current transformer correctly. 4. Overload setting has not been correct. Enter the correct value in *Overload setting (B305)*. 5. Overload curve has not been chosen correctly. Select the appropriate curve. 6. The motor is drawing more than 105% of the value entered under motor current in the set up menu. Rectify the problem with the motor or load. 7. The value entered under the *I-Limit Level (B301)* has not been correct. Enter the correct value 8. Inadequate ramp up time setting. Increase the I-Limit value or shorten ramp up time. 9. The start duty cycle is too high. Result in an overload fault. Check the No. Of starts per hour. Otherwise contact your supplier
5	**Firing Fault**	1. If any of the thyristor gate terminals has loose connection or broken. Repair the loose connection 2. The impedance between RG & R, UG & U, YG & Y, VG & V, BG & B and WG & W should be lie between 4 ohms & 100 ohms. If any of the gate impedance is wrong, Replace the thyristor with faulty gate. 3. One or more of the thyristor in the unit is short circuit. Impedance between the R & U, Y & V and B & W should not be below 1kohms. Replace faulty thyristor. 4. One or more motor windings is open circuit. Repair the motor. 5. If the one or more cables connecting the motor to the unit are open circuit. Repair the cables. 6. There are any loose power connections on the input or output of the unit main control card. Repair the loose connection. 7. If the motor is undersized for the unit, the motor impedance could be so large that the thyristor never come into conduction. Sized the unit and motor properly. Otherwise contact your supplier.

No.	Fault Name	Causes & Countermeasures
6	**Over Voltage Fault**	1. The input supply voltage may have risen above 20% of rated input voltage. Check mains supply voltage.
7	**Phase Loss Fault**	1. The unit has lost one or more input phases. Restore the power to the input of the unit. 2. There is a loose connection on the input side of the unit. Repair the loose connection. Otherwise contact your supplier. 3. The rated input voltage may have falls below the 30% of *Rated Input Voltage (B101)*. Check mains supply voltage.
8	**External Fault**	1. The signal for the external fault is present at the PSI. Check and correct it. 2. If the signal is not present, remove the selection of the external fault with the help of Mode-C parameters. 3. There may be a problem in PCA-2005B. Remove the main control board PCA-2005B.
9	**Emergency Stop**	1. The signal for the emergency stop input is present at the PSI. Check and correct it. 2. If the signal is not present, remove the selection for emergency stop with the help of Mode-C parameters. 3. There may be a problem in PCA-2005B. Remove the control board PCA-2005B.
10	**EEPROM Fault**	1. Data received from the EEPROM is incorrect or out of range. On fault reset, default values will be stored in the EEPROM. 2. If again fault occurs after power recycling, replace PCA-2005B.
11	**Ground Fault**	1. A ground fault may have occurred in the output line or motor. Check that any output is not shorted with the ground. 2. One or more current transformer may have problem. Remove the current transformer feedback and check. 3. If still fault persists, replace PCA-2005B; otherwise replace the problematic current transformer.
12	**Communication Loss**	1. Check the communication cable between master (LCD Display unit) and slave (Main control unit). 2. Disable the fault using C*405*. 3. There may be problem in display board PCA-2012. Replace the display board PCA-2012 and check again. 4. There may be problem in control board PCA-2005B. Replace the display board PCA-2005B and check again.
13	**Phase Dirn Fault**	1. Check the phase sequence of the mains power supply, if the phase sequence is reverse, change any two phases. Disable the fault using *B401*.
14	**Under Freq Fault**	1. If this fault occurs, it will cause the fluctuation in speed. Switch off the main supply.
15	**Over Freq Fault**	1. If this fault occurs, it will cause the fluctuation in speed. Switch off the main supply.
16	**Bypass cont Fault**	1. The bypass contactor does not energies when power is applied or fails to drop out after the power is removed. Replace the faulty bypass contactor. 2. Bypass contactor may have loose connection. Repair the loose connection.

No.	Fault Name	Causes & Countermeasures
17	**Main cont Fault**	1. This fault is enabled and main contactor is not energies it will display main cont fault. Replace the faulty contactor. 2. Main contactor may have loose connection. Repair the loose connection.
18	**Reverse cont Fault**	1. This fault is enabled and reverse contactor is not energies it will display Reverse cont fault. Replace the faulty contactor. 2. Reverse contactor may have loose connection. Repair the loose connection.
19	**Temperature Fault**	1. A trouble may have occurred in the cooling blower. Replace it if necessary. 2. The ambient temperature may have risen. Lower the ambient temperature (less than 50 °C). 3. The thermostat is not connected or may have problem. 4. The start duty cycle is too high. Result in an overload fault. Check the No. Of starts per hour.

Appendix-E: Software Revision history

Sr. No.	Control Version	Changes	Compatible Display Version	Effective Date (dd/mm/yyyy)
1	6.01	- The soft starter was not working ok with reverse phase sequence of the input power supply in inside delta configuration. The same is corrected in the new version. - The “RUN” digital output does not turn off in case of emergency stop condition; if the control mode is TERMINAL and start command is maintained type. The same is corrected in the new version.	6.01	10/05/2009
2	6.03	- Add PSI option like External Fault (NC) and Emergency Fault (NC)	6.03	03/02/2010
3	6.04	- Add In-Built PLC Function - Make RUN and STOP PSI as programmable PSI - Make Fault Relay as programmable Relay - Add PSI option like External Fault (NC), Emergency Stop (NC) - Add 200V, 500V, 600V series option - Add option in rated kW Rating - Add parameter for set level of Over Voltage Fault (B312) - Add Test Mode parameter (B211), which is use only for factory test purpose.	6.04	28/05/2010
4	6.05	- Increased maximum limit of B204 to 800%, B301 to 600% & B307 to 800%.	6.05	02/02/2012

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Contact Us

AMTECH ELECTRONICS (INDIA) LTD.

E-6, GIDC Electronics Zone, Gandhinagar-382 028, Gujarat, India.
Phone : +91-79-23289101, 23289102, 23289103
Fax : +91-79-23289111
E-mail : info@amtechelectronics.com
Website : www.amtechelectronics.com

Rep/Distributor Address:

AMTECH