invac

Variable Speed AC Drives

USER MANUAL

User Friendly, High- Quality Drive Solutions

INTEGRATED ELECTRIC CO (P) LTD

An ISo 9001 Company (DC Machines, Alternaters)

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PRODUCT RANGE

● DC Machines	Upto 1500 KW
● AC Motors	Upto 18.5 KW
● AC Drives	Upto 100 KW
● AC Generators	UPto 320 KVA

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Chapter 1. Introduction

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Congratulations on your purchase of the **invac** AC drive. **invac** is a user friendly, high quality drive solution AC drive, manufactured with high quality standards.

GETTING STARTED

If you are operating the drive for the first time, the following sequence has to be adhered to for successful installation.

- ☞ Before operating the unit, please read this manual thoroughly and retain it for future reference.
- ☞ Read and follow the safety instructions.
- ☞ Check for proper earthing.
- ☞ Check supply and motor cables.
- ☞ Verify availability and quality of cooling air.
- ☞ Connect the 1 phase mains input (230 V, 1 Ph, 50 Hz – P, N, E) in case of IRACxxM series, and 3 phase mains input (415 V, 3 ph, 50 Hz – R, S, T, E / R, Y, B, E and neutral (ref., table 2.2)) in case of ISACxxM series.
- ☞ Connect the drive output to the motor as per connection diagram table.
- ☞ Turn ON the main power.
- ☞ Check if the display corresponds to any of the modes listed in table 3.5. If not, press RESET key.
- ☞ Check whether the status of the RUN/STOP, FOR/REV & Remote LED's are as required. Press the Mode key until set frequency is displayed. If the display in RPM is required, set the number of poles in the Off-line Programming Mode correctly, press the Mode key and reset again. Set the Speed to the required value.
- ☞ Press the Run key to start the drive. The motor will start rotating. Note that the set speed is reached slowly if the Acceleration time is high. A very small acceleration time may produce an Overload trip.

SAFETY INSTRUCTIONS

- ☑ The DC bus capacitors contain dangerous DC voltages. After disconnecting the supply wait for atleast 60 seconds,and then carry out any work within the Drive. Only a competent Electrician should carry out the electrical installation.
- ☑ When the Drive is connected to the mains, the motor terminals (U, V, W in case of IRAC xx M series & M1, M2, M3 in case of ISAC xx M series) are live even if the motor is not running. Do not make any connections when the Drive is connected to the mains. Disconnect the mains to the Drive before connecting the motor to the drive. Failure to disconnect the mains may cause serious injury.
- ☑ Altering the parameter settings or configuration will affect the function and performance of the Drive.
- ☑ Make sure that the Drive is earthed properly.
- ☑ Static voltage can damage electronic components. Avoid touching any of the components within the Drive.

STORAGE OF AC DRIVES

- ☑ Store in clean and dry location.
- ☑ Store within an ambient temperature range of -25 °c to 70 °C .
- ☑ Store within a relative humidity range of 0 % to 95 %, non-condensing.
- ☑ Do not store the drives in places where it could be exposed to a corrosive atmosphere.

TECHNICAL SPECIFICATIONS

	PARAMETER	IRAC SERIES	ISAC SERIES
INPUT	Voltage	1 Phase AC 230 V (+10 %, -15 %)	3 Phase AC 415 V (+10 %, -15 %)
	Frequency	50 Hz +/- 5 %	50 Hz +/- 5 %
	Fundamental Power Factor	Cos∅ ≅ 1	Cos∅ ≅ 1
OUTPUT	Voltage	3 Phase AC 0 to I/P Voltage	3 Phase AC 0 to I/P Voltage
	Continuous load capacity	1.0* I_o for ambient temp upto 45 °c	1.0 * I_o for ambient temp upto 45 °c
	Over load capacity	1.5* I_o for 60 sec for ambient temp upto 45 °c	1.5* I_o for 60 sec for ambient temp upto 45 °c
	Output frequency	0-200 Hz in steps of 0.01 Hz	0-200 Hz in steps of 0.01 Hz
	Constant torque	0 to Rated Frequency	0 to Rated Frequency
	Constant power	Rated Frequency to 200 Hz	Rated Frequency to 200 Hz
CONTROL	Control Method	Sine-Triangle Modulation	Sine-Triangle Modulation
ENVIRONMENT	Ambient temperature	0 to 45 °c	0 to 45 °c
	Max. chassis temperature	65 °c	65 °c
	Storage temperature	25 °c to 70 °c	25 °c to 70 °c
	Relative humidity	0 to 95 %, no condensation	0 to 95 %, no condensation
	Cooling	Forced Air Circulation	Forced Air Circulation
	Mounting	Vertical	Vertical

TABLE 1.1 TECHNICAL SPECIFICATIONS

FEATURES

invac drives are designed for low loss continuous speed adjustment of 3 - Ø AC motors with shaft output ranging from (0.75 to 45) KW. By utilizing state of the art technology, a compact, easy to use, economical drive unit has been designed. Some key features of the **invac** series drives are as follows :

- IPM / IGBT based inverter.
- Digital control by a 16 bit Microcontroller.
- Sine-triangle modulation.
- High overall efficiency.
- Speed control from 0-200 Hz in steps of 0.01 Hz.
- Programmable acceleration and decelaration times.
- Selectable V/F patterns.
- Two ranges of skip frequencies.
- Programmable rated frequency.
- Jog operation.
- Programmable switching frequency from 1 KHz to 12 KHz in steps of 0.1 KHz.
- Overload capacity of 150 % for 60 seconds.
- Inverse time trip.

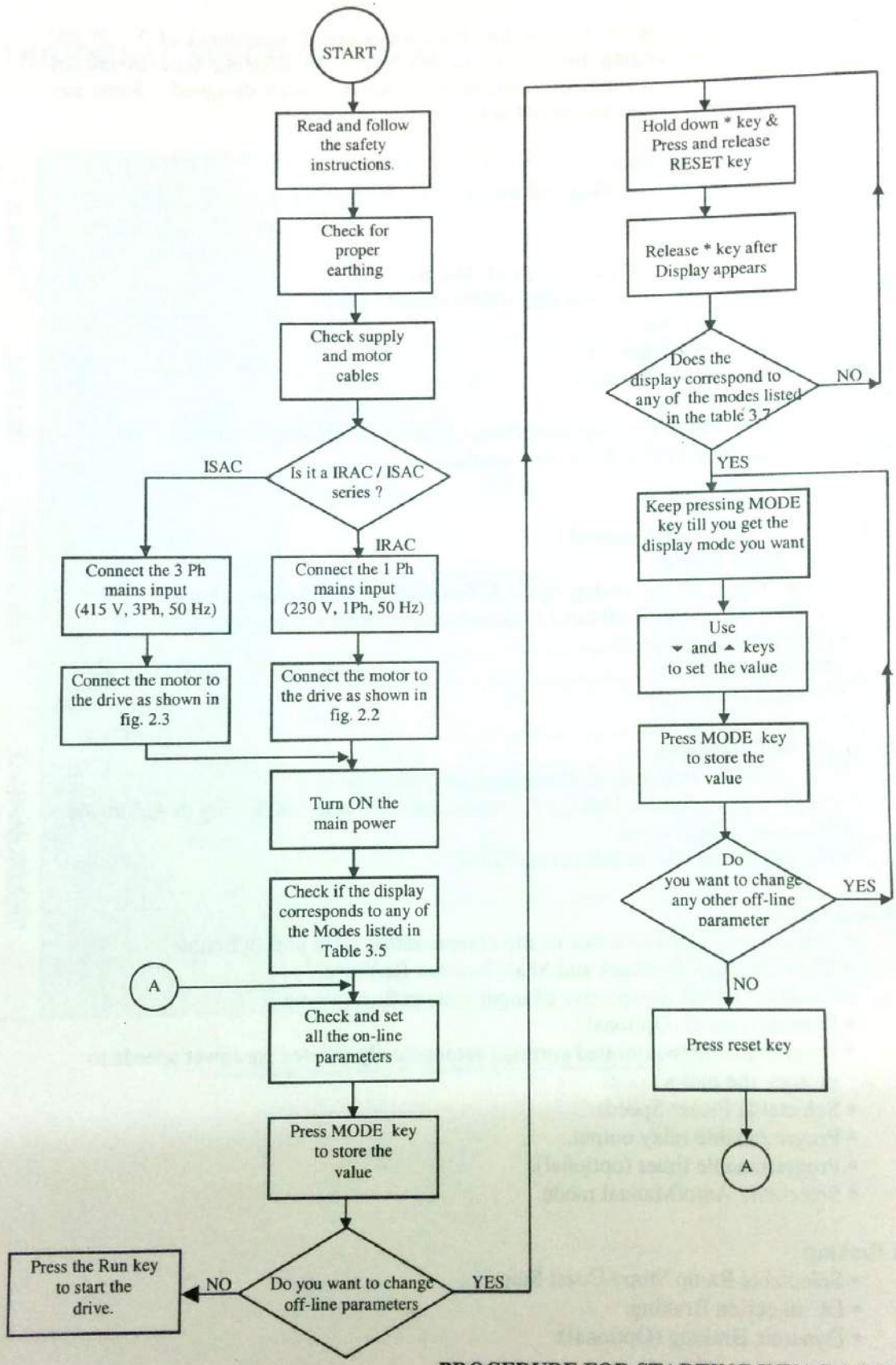
- Features for PLC based control :
  - Six digital inputs.
  - Two programmable analog inputs & one programmable analog output.
  - 0 -10 V / 2 -10 V / 0-20 mA / 4 -20 mA analog input and output signals.
  - One external trip input
  - One trip output.
  - Remote reset.

- Display & Diagnostics
  - Two lines 16 character alphanumeric LCD display.
  - Simultaneous Speed, Voltage & Current and Unit selected display in Automode.
  - Extensive diagnostics.
  - Facility to review the last twenty faults.

- Special Features
  - Better speed regulation due to slip compensation (also user definable).
  - Shaft Encoder Feedback and Shaft Encoder Reference.
  - Constant torque irrespective of input voltage fluctuations.
  - Remote control (Optional).
  - Programmable motor rated current (automatically derated for lower speeds to protect the motor).
  - Selectable Preset Speeds.
  - Programmable relay output.
  - Programmable timer (optional).
  - Selectable Auto/Manual mode.

- Braking
  - Selectable Ramp Stop / Coast Stop.
  - DC injection Braking.
  - Dynamic Braking (Optional).

STARTING THE DRIVE (Follow the flowchart below, if you are operating the drive first time)



PROCEDURE FOR STARTING INVAC AC DRIVES

PROTECTIONS

The controller will stop the drive in case of any of the following faults and the fault condition is indicated by Fault LED and LCD Display. Also the Relay output terminals for fault indication are available at the terminals of the connector J2. Relay is rated for 28 VDC/230 VAC & 6A for resistive load.

❶ Voltage Protection
- Over Voltage (+ 10 %)
- Under Voltage (- 15 %)

❷ Short Circuit Protection
- Phase to Phase
- Phase to Ground

❸ Over Current Protection
- Inverse Time Trip
- Instantaneous Overload Trip (software) above 150 %.
- Instantaneous Overload Trip (hardware) above 160 %.

❹ Thermal Protection
- Heatsink Over Temperature
- Motor Over Temperature

❺ Analog Input out of Range

❻ Feedback Failure trip

Note: 1. For further details refer Chapter 4.
2. For Motor Over Temperature Trip, thermistor input has to be provided by the user.

PRINCIPLE OF OPERATION (IRAC XX M SERIES)

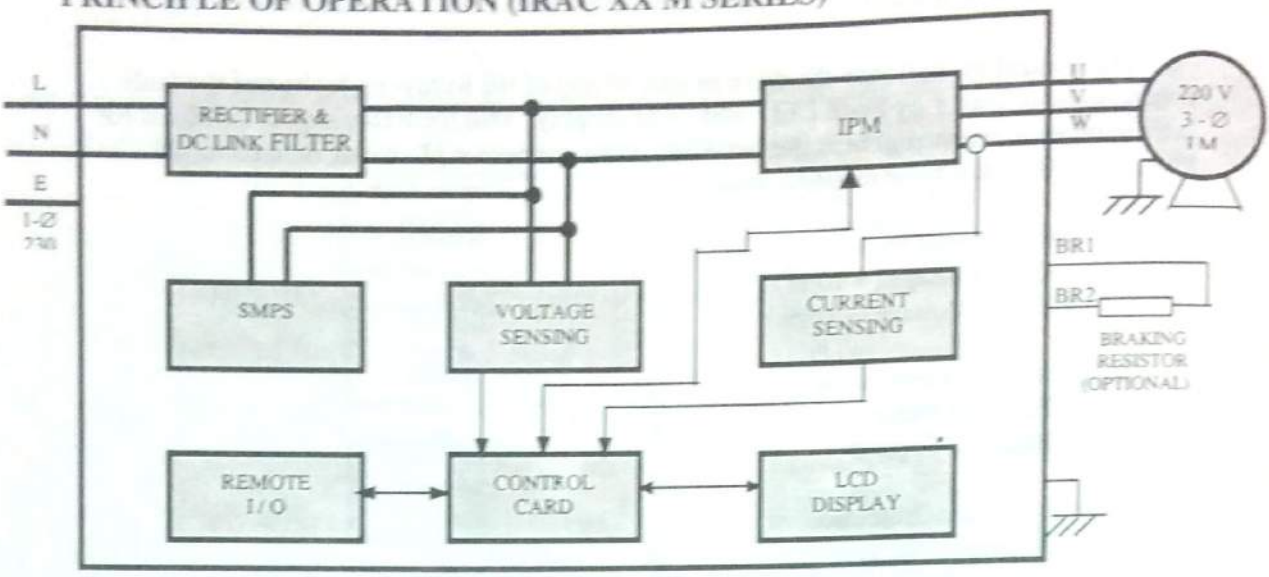


FIG1.1 BLOCK DIAGRAM OF IRAC xx M SERIES AC DRIVES

The **IRAC xx M** series of AC drives allows a standard induction motor to run at variable speed. The block diagram of the **IRAC xx M** series drive is shown in fig. 1.1.

The **input AC supply** (1 Ø 230 V) is rectified and filtered to produce the DC voltage for feeding the inverter. The **filter capacitor** supplies the reactive power requirement of the motor. The **IPM Inverter** produces a variable frequency variable voltage, pulse width modulated 3 Ø output. The speed of the motor is varied by varying the output frequency of the drive. Motor flux is maintained constant by changing the voltage as a dependent variable of the frequency, thereby preserving full torque capability, upto the rated speed. The power supply for the control system is derived from DC bus (**SMPS**).

The electronic control system comprises of a 16 bit **Microcontroller** and digital interface circuits which generates the required PWM output wave forms. The microcontroller generates PWM switching signals which results in sinusoidal motor currents, which ensures,

- Very smooth running even at low speeds
- Minimal noise
- High efficiency

It also performs the inverter protection function based on the feedback signals from the DC link voltage, current monitoring circuits and temperature sensing circuits. **Gate driver circuit** provides the required gate drive signals to the power stage and at the same time provides the isolation between the high voltage power stage and the control circuit.The **keyboard and Display card** connected to the main controller card enables setting of over 45 parameters. These parameters can be adjusted using ▲ and ▼key. MODE key is used to select a particular parameter.

Also the keys on the keyboard and display card are used to control the drive function viz., RUN / STOP, FOR / REV, JOG & REMOTE MODE. The status of the drive can be read through a two lines 16 characters, alphanumeric LCD display. Six digital inputs, two analog inputs & one analog output can be used to control the drive with a PLC rather than the keyboard.

PRINCIPLE OF OPERATION (ISAC XX M SERIES)

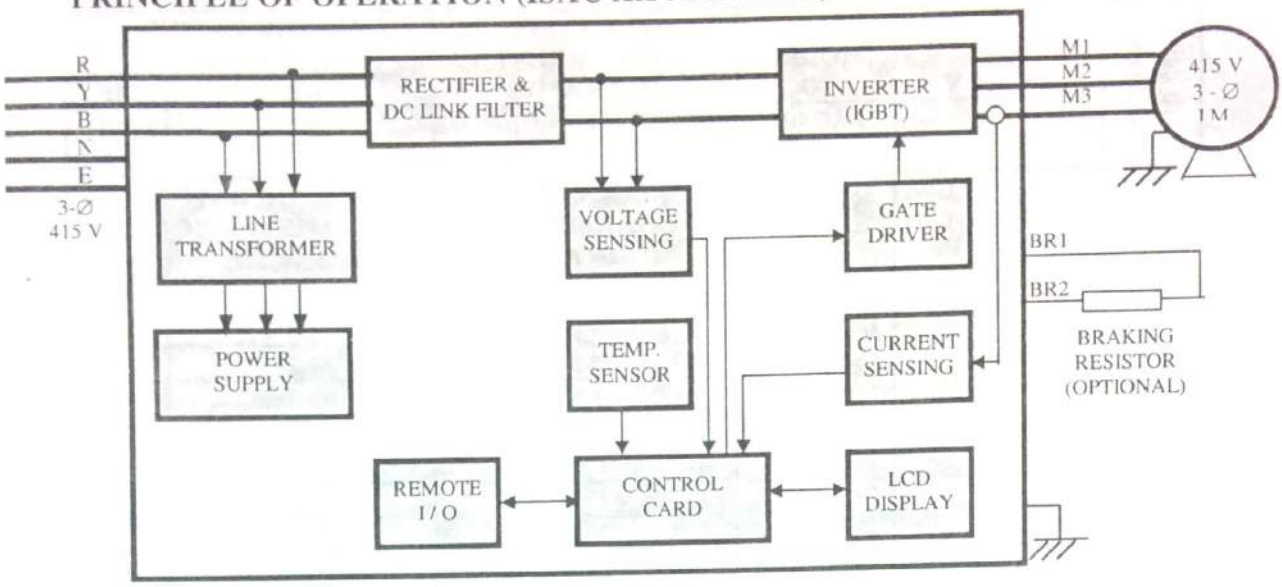


FIG1.2 BLOCK DIAGRAM OF ISAC xx M SERIES AC DRIVES

The **ISAC xx M** series of AC drives allows a standard induction motor to run at variable speed. The block diagram of the **ISAC xx M** series drive is shown in fig. 1.2.

The **input AC supply** (3 ∅ 415 V) is rectified and filtered to produce the DC voltage for feeding the inverter. The **filter capacitor** supplies the reactive power requirement of the motor. The **Inverter** produces a variable frequency variable voltage, pulse width modulated 3 ∅ output. The speed of the motor is varied by varying the output frequency of the drive. Motor flux is maintained constant by changing the voltage as a dependent variable of the frequency, thereby preserving full torque capability, up to the rated speed. The power supply for the control system is derived from a line transformer and a voltage regulator.

The electronic control system comprises of a 16 bit **Microcontroller** and digital interface circuits which generates the required PWM output wave forms. The microcontroller generates PWM switching signals which results in sinusoidal motor currents, which ensures,

- Very smooth running even at low speeds
- Minimal noise
- High efficiency

It also performs the inverter protection function based on the feedback signals from the DC link voltage, current monitoring circuits and temperature sensing circuits. **Gate driver** circuit provides the required gate drive signals to the power stage and at the same time provides the isolation between the high voltage power stage and the control circuit. The keyboard and Display card connected to the main controller card enables setting of over 45 parameters. These parameters can be adjusted using ▲ and ▼ key. MODE key is used to select a particular parameter.

Also the keys on the keyboard and display card are used to control the drive function viz., RUN / STOP, FOR / REV, JOG & REMOTE MODE. The status of the drive can be read through a two lines, 16 characters, alphanumeric LCD display. Six digital inputs, two analog inputs & one analog output can be used to control the drive with a PLC rather than the keyboard.

DRIVE SELECTION

IRAC SERIES	OUTPUT KVA AT 230 V	MODEL NO.	MAX. CONT. O/P CURRENT (I_o IN AMP)	MOTOR RATING (220 V, 3 PH)	
				KW	HP
	1.6	IRAC 01M	4.0	0.75	1.0
	3.0	IRAC 02M	7.5	1.5	2.0
ISAC SERIES	OUTPUT KVA AT 415 V	MODEL NO.	MAX. CONT. O/P CURRENT (I_o IN AMP)	MOTOR RATING (415 V, 3 PH)	
				KW	HP
	1.5	ISAC 01 M	2.0	0.75	1.0
	2.9	ISAC 02 M	4.0	1.5	2.0
	4.0	ISAC 03 M	5.5	2.2	3.0
	6.0	ISAC 05 M	8.5	3.7	5.0
	9.3	ISAC 07 M	13.0	5.5	7.5
	11.5	ISAC 10 M	16.0	7.5	10.0
	12.9	ISAC 12 M	18.0	9.3	12.5
	17.2	ISAC 15 M	24.0	11.0	15.0
	23.0	ISAC 20 M	32.0	15.0	20.0
	27.3	ISAC 25 M	38.0	18.5	25.0
	32.3	ISAC 30 M	45.0	22.0	30.0
	43.1	ISAC 40 M	60.0	30.0	40.0
	51.7	ISAC 50 M	72.0	37.0	50.0
	61.0	ISAC 60 M	85.0	45.0	60.0

TABLE 1.2 DRIVE SELECTION TABLE

NOTE:

1. **IRAC xx M series AC drives are suitable for driving 3 ph, 220 V Squirrel Cage Induction Motor only.**
2. **A standard 415 V AC Star connected motor can be used to work on 220 V supply, with terminals connected in delta.**

MOTOR SELECTION

Note : Imax : Maximum Motor current
In : Rated current of the Motor

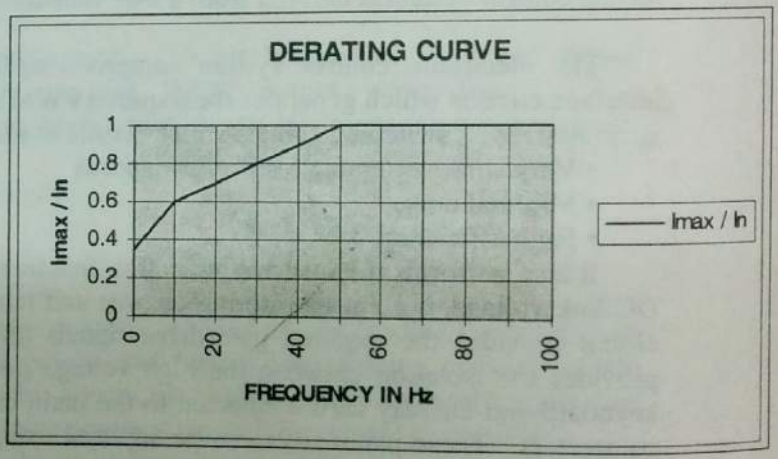


FIG 1.3 DERATING CURVE FOR MOTOR

When an Induction motor is used with an AC drive for variable speed applications, the motor has to be appropriately chosen such that it will not get overheated at low speed. The Induction motor is generally self cooled with a fan mounted on the rotor shaft. When the motor is run at a lower speed, the cooling effect of fan comes down, and hence a derating of the motor becomes necessary to limit the temperature rise. A derating curve that shows the motor loading allowed at different running frequencies is shown in fig 1.3. If the 'Motor protection at lower speed' is enabled, the drive protects the motor for the derated currents. If the Motor is cooled with an external fan or already derated then make sure that the 'Motor protection at lower speed' is disabled in the off-line programming mode.

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INSTALLATION REQUIREMENTS

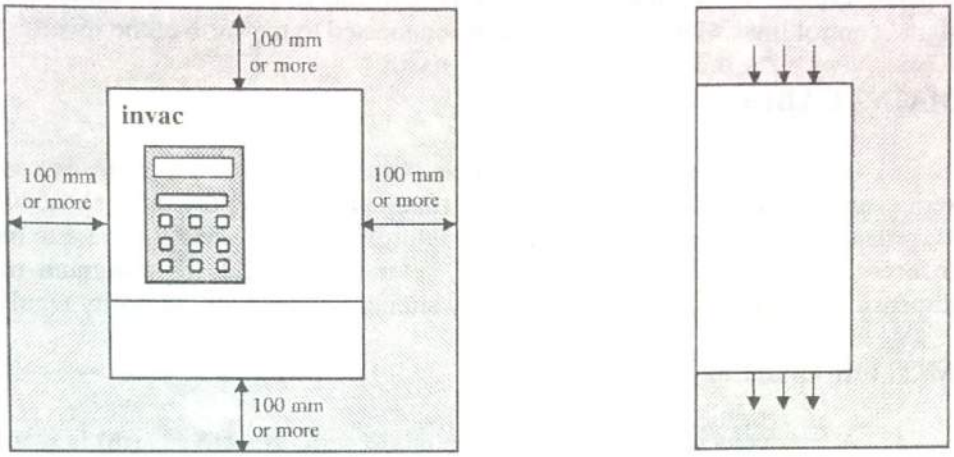


FIG 2.1 COOLING OF THE AC DRIVE

Cooling of the drive is by forced air circulation. Take note of the following before commissioning:

- The cooling air must be clean and free from corrosive materials. If the cooling air contains dust, clean the cooling surfaces of the unit regularly using compressed air and a brush.
- Minimum clearance of 100 mm must be provided above and below the unit.
- Ambient temperature should not exceed 45 °c. For higher ambient temperatures, the drive should be derated.

If the unit is installed in an enclosure (cabinet), then heat arising from dissipation should be removed by means of appropriate ventilation (fig. 2.1). When the unit is mounted inside a cabinet, there should be sufficient clearance around the unit to ensure correct air flow.

INSULATION CHECKS

✱ Insulation checks are to be done before connecting the drive to the mains. Before proceeding with the insulation resistance measurements, make sure that the drive is disconnected from the mains.

- Check that the motor cable is disconnected from the drive output terminals U, V, W in case of IRACxxM series and M1, M2, M3 in case of ISACxxM series.
- Check that the motor cable is disconnected from the motor and remove bridging connections at the motor.
- Measure the insulation resistance of the motor. The voltage range of the insulation resistance meter must be at least equal to the supply voltage, but not exceeding 1000 V. The insulation must be greater than 1 M Ω.
- Measure the insulation resistance of the motor cable between the phases and between each phase and the protective earth. The insulation resistance must be greater than 1M Ω.

WIRING

✱ **This unit contains high voltage condensers. Disconnect the power supply and wait for a period of 60 seconds before making any repairs.**

✱ **Do not connect a voltage higher than 10 % of the rated voltage of the drive.**

✱ **The drive must be earthed through an earthing conductor to the earthing terminal.**

The main supply line, motor supply line and the electronic control lines should be run in separate cables. To avoid interference, it is advisable to use screened cables for the electronic signal control lines. The screen should be connected to the earth at the inverter end only.

MAINS CABLE

A three core screened cable (single phase with protective earth, in case of IRAC xx series) and five conductor screened cable (three phase with protective earth, in case of ISAC xx series) is recommended for the mains cabling. The cables and fuses are to be dimensioned in accordance with the output current. Refer to table 2.1 for minimum ratings. When dimensioning cables and fuses, always pay attention to the local authority regulation.

MOTOR CABLE

A four core screened cable (Three phase with protective earth) is recommended due to rapid voltage changes occurring in variable frequency motor drive systems.

The rapid voltage changes cause capacitive current between the phase conductors, and the cable screen. This phenomenon can cause substantially high current values to be measured by the drive than the actual motor current, and can cause over-current tripping. A maximum cable lengths of 20 meters should not be exceeded. To avoid disturbances, install the motor cable away from other cable routes. Avoid long parallel runs with other cables. The screen of the motor cable should be connected to the earth terminal at the drive and other end to the motor earth inside the motor terminal box. If the length of the cable between the drive and the motor has to be more than 20 meters, appropriate filters should be used at the output terminals of the drive. Contact the nearest INVAC supplier for this.

TABLE 2.1 CABLE SIZE FOR IRACXXM & ISACXXM SERIES

	MODEL NO.	RECOMENDED INPUT FUSE	RECOMMENDED CABLE [in mm²] (for Copper)	
			MOTOR CABLE	MAINS CABLE
IRAC SERIES	IRAC 01 M	10 A	(3*1.5 +1.5)	(2*1.5 + 1.5)
	IRAC 02 M	16 A	(3*1.5 + 1.5)	(2*2.5 + 2.5)
	MODEL NO.	RECOMENDED INPUT FUSE	RECOMMENDED CABLE [in mm²] (for Copper)	
			MOTOR CABLE	MAINS CABLE
ISAC SERIES	ISAC 01 M	10 A	(3*1.5 + 1.5)	(3*1.5 + 1.5)
	ISAC 02 M	10 A	(3*1.5 + 1.5)	(3*1.5 + 1.5)
	ISAC 03 M	10 A	(3*2 + 2)	(3*2 + 2)
	ISAC 05 M	16 A	(3*2.5 + 2.5)	(3*2.5 + 2.5)
	ISAC 07 M	25 A	(3*5 + 5)	(3*5 + 5)
	ISAC 10 M	30 A	(3*6 + 6)	(3*6 + 6)
	ISAC 12 M	40 A	(3*7 + 7)	(3*7 + 7)
	ISAC 15 M	45 A	(3*9 + 9)	(3*9 + 9)
	ISAC 20 M	60 A	(3*12 + 12)	(3*12 + 12)
	ISAC 25 M	70 A	(3*15 + 15)	(3*15 + 15)
	ISAC 30 M	80 A	(3*18 + 18)	(3*18 + 18)
	ISAC 40 M	100 A	(3*23 + 23)	(3*23 + 23)
	ISAC 50 M	125 A	(3*30 + 30)	(3*30 + 30)
	ISAC 60 M	150 A	(3*36 + 36)	(3*36 + 36)

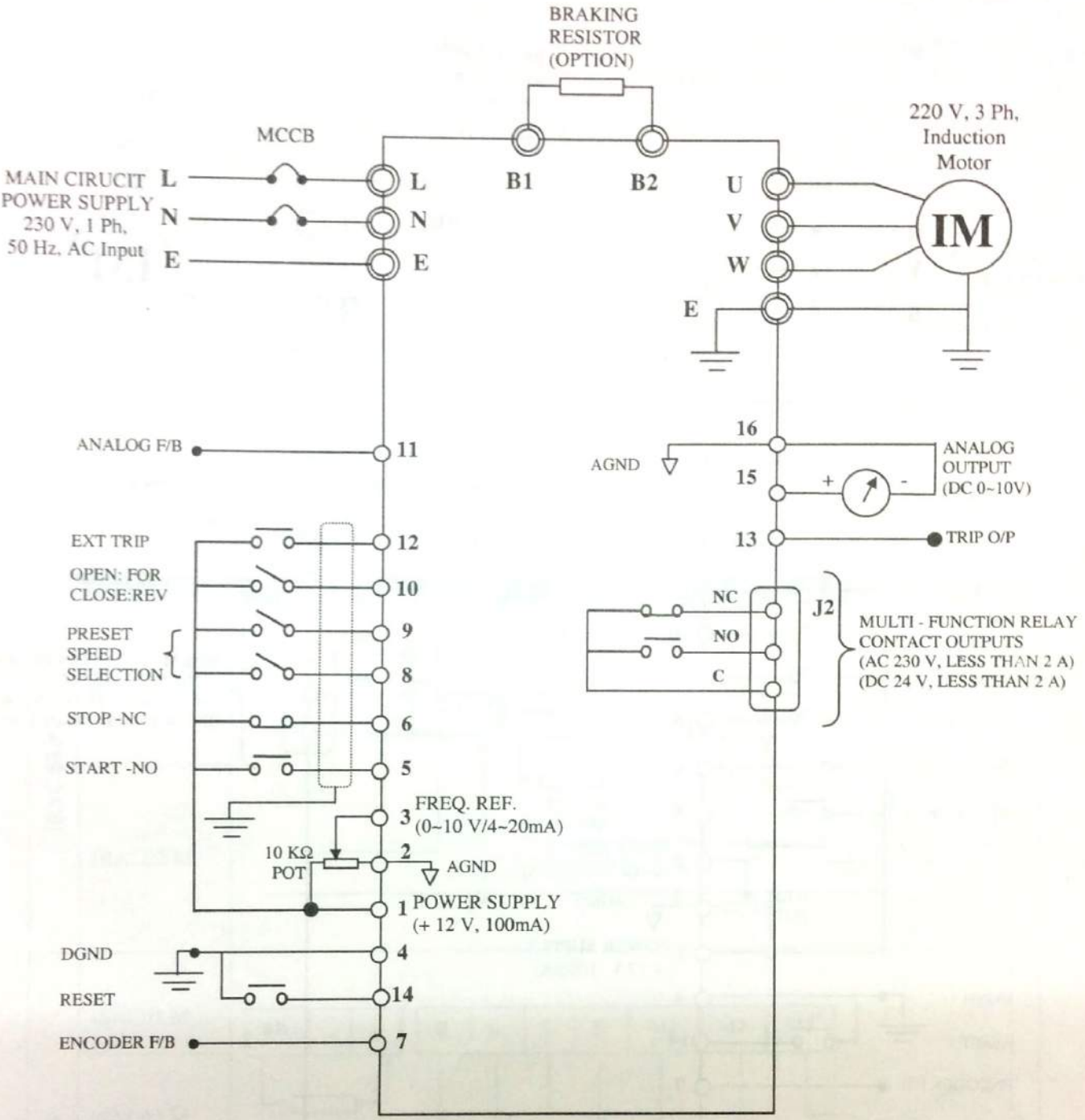


FIG. 2.2 BASIC WIRING DIAGRAM FOR IRAC xx M SERIES AC DRIVE

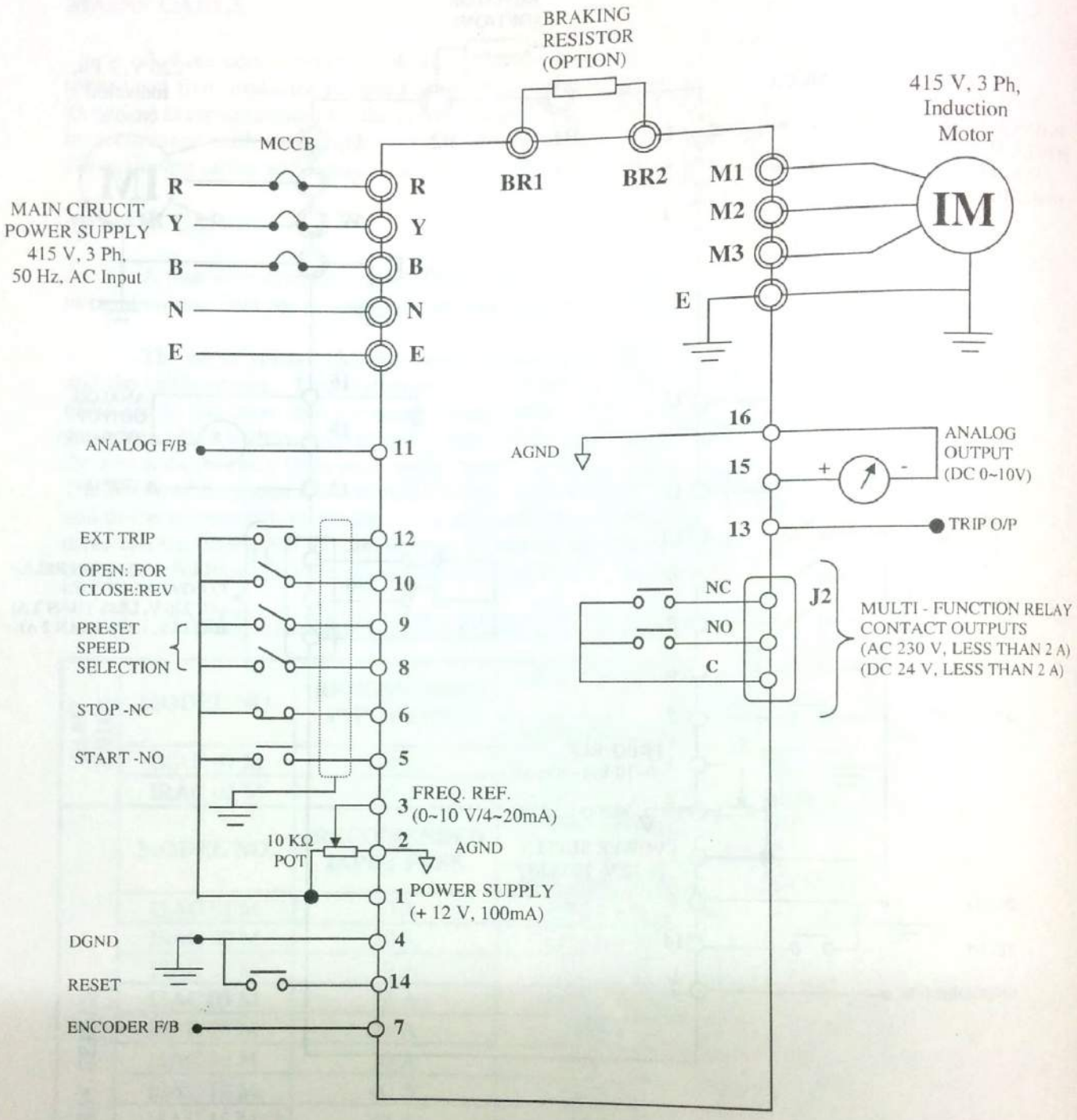


FIG. 2.3 BASIC WIRING DIAGRAM FOR ISAC xx M SERIES AC DRIVE

TERMINAL CONNECTION

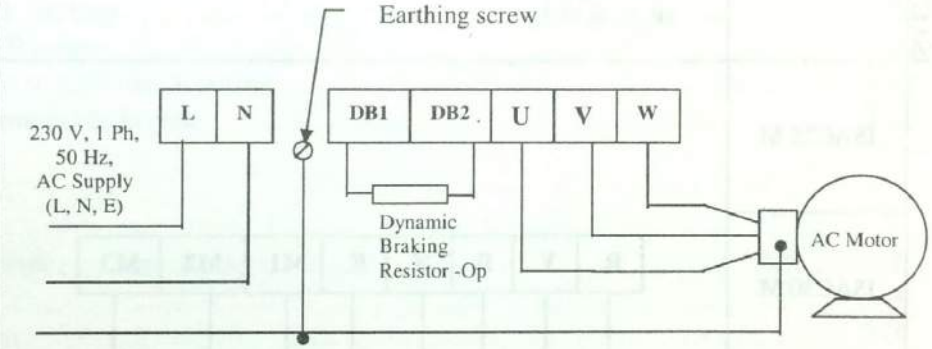
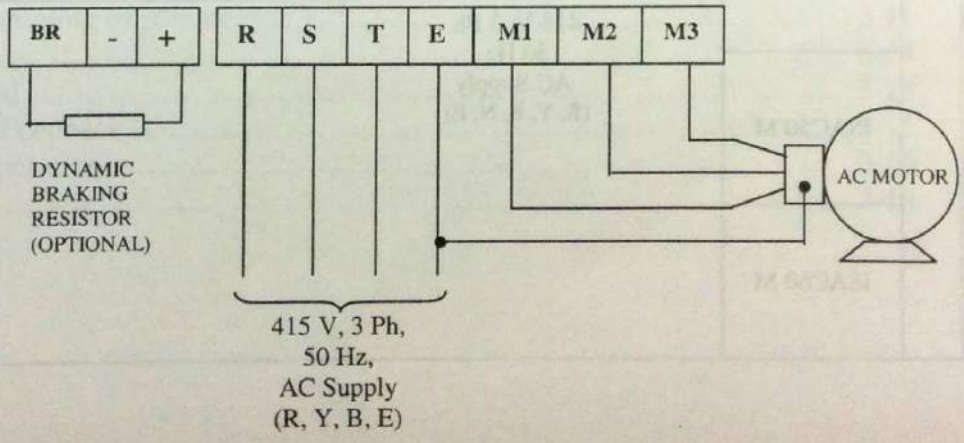
MAINS CONNECTION

- Connection of the AC mains to the drive is made at the terminal block as per table 2.2.
- The drive should be connected to the AC mains via an isolator, contactor or MCB. The motor connected to the drive may be separated by a contactor or motor protection switch for isolation purposes but not for control purposes as the drive may trip.
- All Contactor coils, solenoids and brake coils (if any) should be suppressed with an RC network or equivalent.

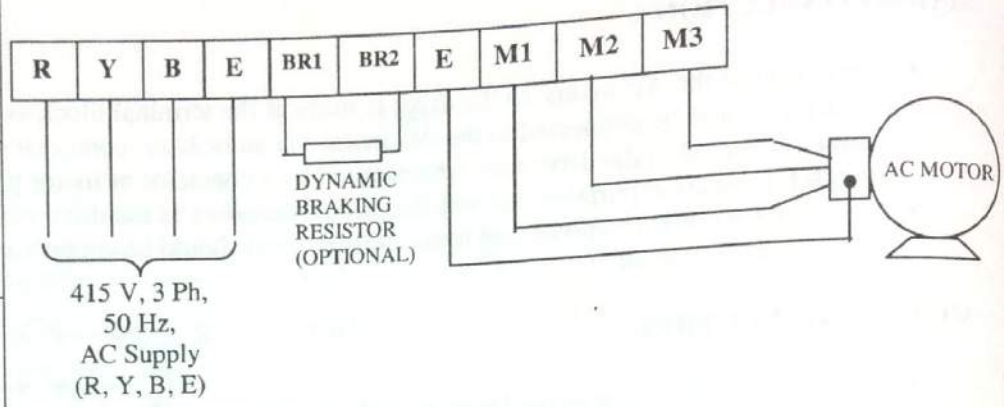
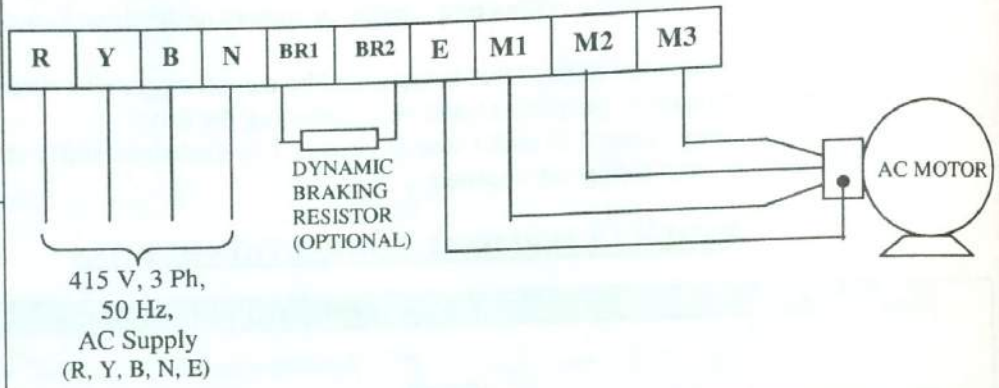
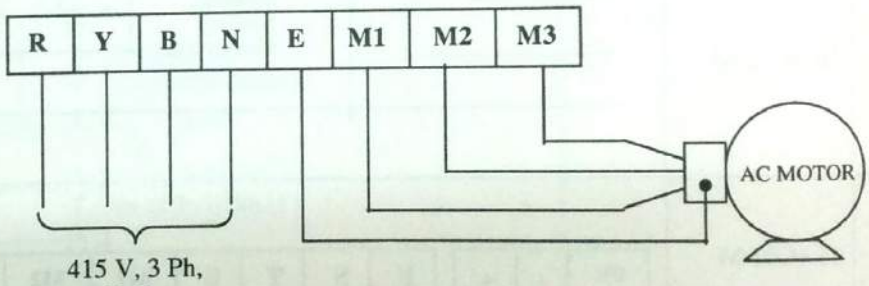
MOTOR CONNECTION

- Connection of the motor to the Drive is made at the terminal block as per table 2.2. The type of load must be resistive or inductive. Capacitive load can lead to a damage of the drive and therefore connecting condenser motors to the drive is not permitted.
- If the motor connected to the drive is separated by a contactor, make sure that the contact of contactor is properly closed before starting the drive.
- Main switch may be used to start / stop the drive. Use electronic start / stop control if more frequent start / stop are required.

TABLE 2.2 TERMINAL CONNECTION DETAILS

	MODEL	CONNECTION DIAGRAM
IRAC SERIES	IRAC01 M IRAC02 M	
ISAC SERIES	ISAC01 M ISAC02 M ISAC03 M ISAC05 M	

ISAC SERIES

MODEL	CONNECTION DIAGRAM
ISAC07 M ISAC10 M ISAC12 M	
ISAC15 M ISAC20 M	
ISAC25 M ISAC30 M ISAC40 M ISAC50 M ISAC60 M	

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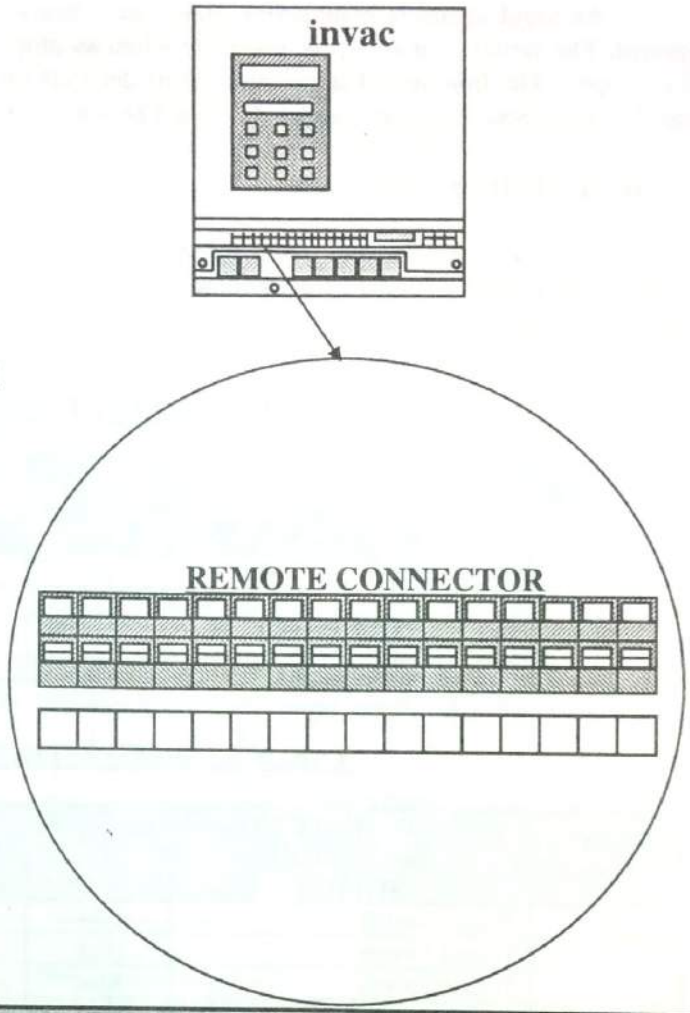
REMOTE CONNECTIONS DETAILS



REMOTE CONNECTOR (J3)

PIN NO.	SIGNAL	DESCRIPTION
1	VPP (+12 V)	Auxiliary power supply O/P (+12 v, 100 mA) can be used to set digital I/P ID1 to ID6.
2	AGND	Analog ground
3	AREF	Analog reference I/P signal of 0 to 20 mA / 4 to 20 mA or 0 to 10 V / 2 to 10 V. Use Analog ground along with Analog signal. Make proper jumper connection to select voltage I/P (0 to 10 V / 2 to 10 V) or current I/P (0 to 20mA / 4 to 20 mA). Ref fig. 3.28
4	DGND	Digital ground. Use for digital inputs ID1 to ID6.
5 to 10	ID1 to ID6	Digital I/P's.
11	AFB	Analog feedback signal of 0 to 20 mA / 4 to 20 mA or 0 to 10 V / 2 to 10V. Use Analog ground along with Analog feedback signal.
12	EXT_TRIP	External -ve edge I/P signal (high to low) can be applied to stop the drive.
13	TRPOP	Trip output from the drive can be used to stop other systems (Active low).
14	RRST	Remote reset to reset the drive externally. Drive gets reset when connected to DGND.
15	AOP	Analog O/P corresponds to frequency or current as programmed in the START MODE. Use the Analog ground along with Analog O/P. Make proper jumper connection to select voltage O/P (0 to 10 V / 2 to 10 V) or current O/P (0 to 20 mA / 4 to 20 mA). Ref fig. 3.28
16	AGND	Analog ground

TABLE 3.1 I/O CONNECTOR DESCRIPTION

DIGITAL INPUTS

An input signal is in an active high state when a voltage between +12 V and 24 V is applied. The signal is in an active low state when an input is grounded (use digital ground) or if it is open. The function of the digital inputs depends on the mode selected. Mode selection and the corresponding functions are described below.

REMOTE MODE SELECTION

Remote mode can be programmed through the keyboard in **Off-line programming mode.** (Please refer Off-line programming). Drive can be used in the selected Remote mode without keyboard. The operation of the drive in the Remote mode is explained below.

TABLE 3.2 START / STOP

REMOTE MODE	START / STOP SWITCH	ID1		ID2		REF.
		START	STOP	START	STOP	
1	Toggle Switch	High	Low	-	-	Fig. 3.1
1	Push Button Switch	High Momentaril y	-	-	Low momentarily	Fig. 3.2

TABLE 3.3 SPEED SELECTION

REMOTE MODE	SPEED / DIRECTION SELECTION SWITCH	ID4	ID5	SPEED SELECTION	REF.
1	Toggle Switch	Low	Low	Normal Speed	Fig. 3.1
1	Toggle Switch	High	Low	Jog Speed	Fig. 3.1
1	Toggle Switch	Low	High	Speed 3	Fig. 3.1
1	Toggle Switch	High	High	Speed 4	Fig. 3.1

TABLE 3.4 DIRECTION / SPEED INCREMENT / DECREMENT THROUGH PUSH BUTTONS

REMOTE MODE	DIRECTION SELECTION SWITCH	ID5	ID4	ID6		REF.
				FOR	REV	
2 & 3	-	Push to decrease speed	Push to increase speed	-	-	Fig. 3.3
1	Toggle Switch	-	-	Low	High	Fig. 3.1

Note : 1. An I/P signal is considered to be High if the voltage is between +11 V to +24 V.
2. An I/P signal is considered to be Low if it is grounded (use digital ground) or open.

REMOTE MODE 1

FIG 3.1 REMOTE TERMINAL CONNECTION

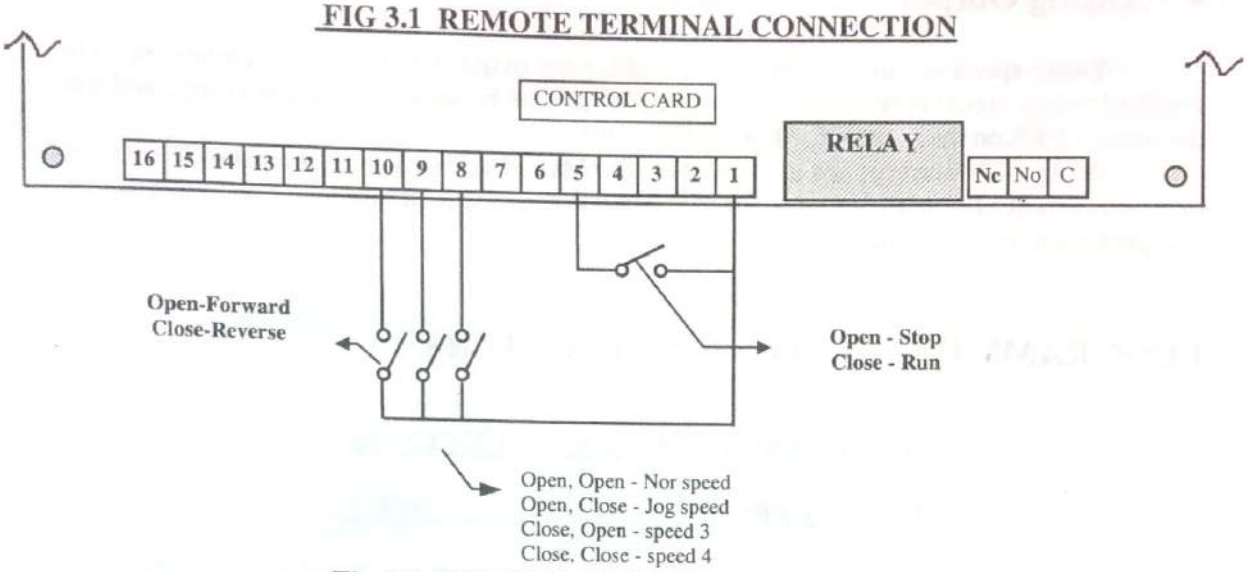
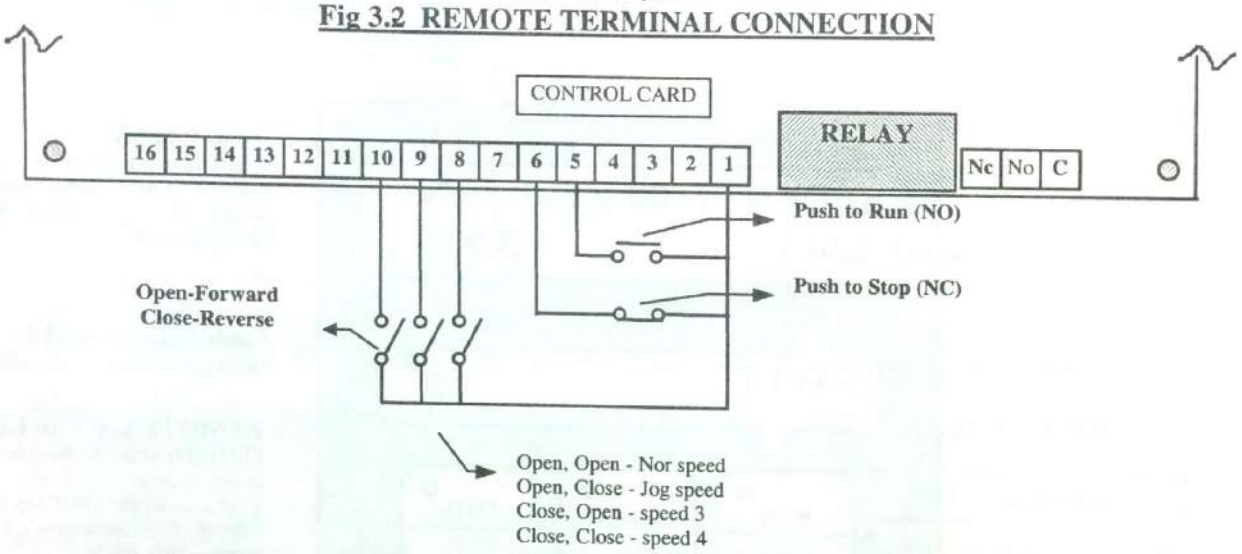
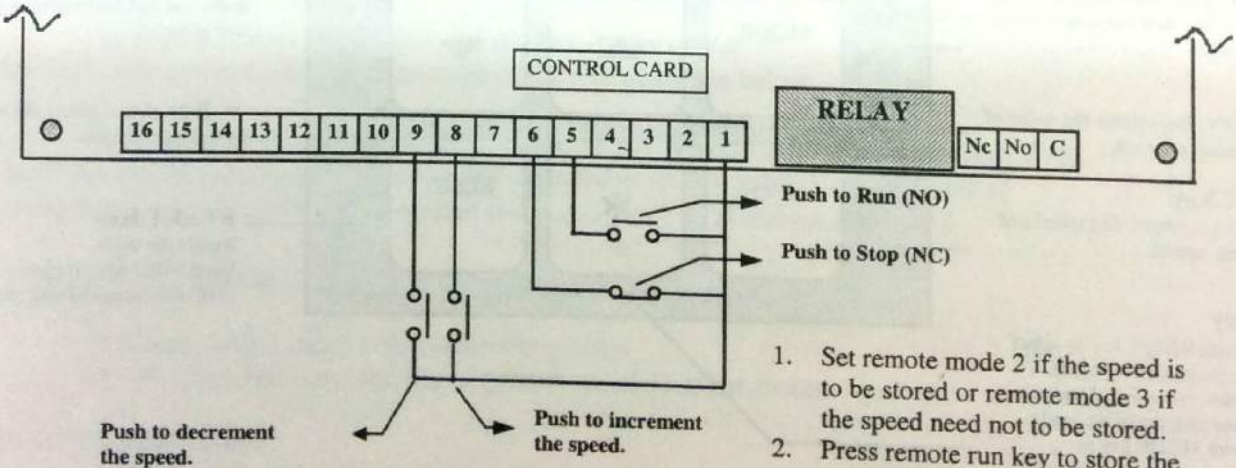


Fig 3.2 REMOTE TERMINAL CONNECTION



REMOTE MODE 2 & 3

FIG 3.3 REMOTE TERMINAL CONNECTION



1. Set remote mode 2 if the speed is to be stored or remote mode 3 if the speed need not to be stored.
2. Press remote run key to store the value in memory.

- **Analog Output**

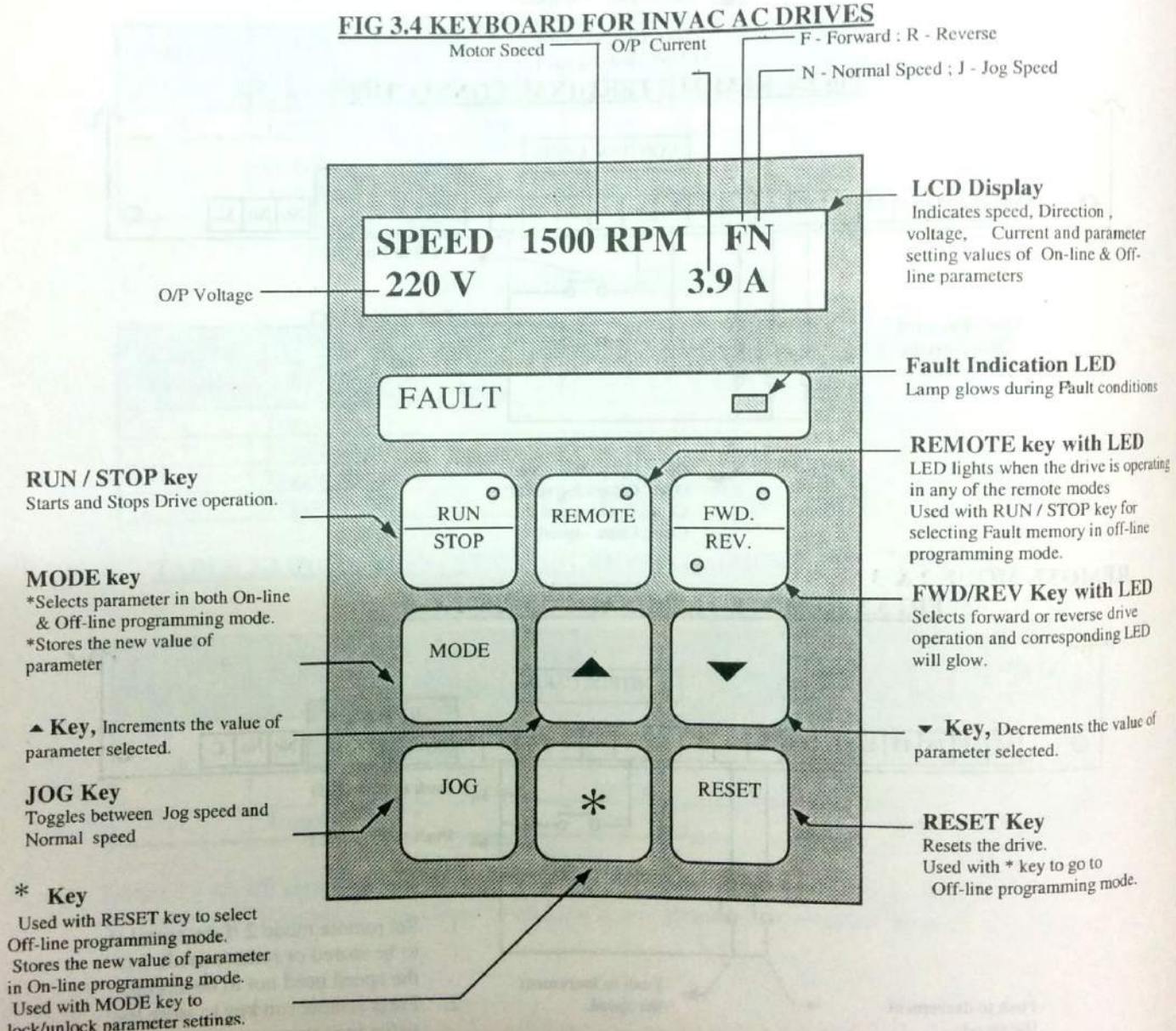
Either speed or current can be selected for the output by Off-line programming. The standard output signal is 0/2 to 10 V. A 0/4 to 20 mA can be selected by connecting 1 and 2 of the jumper LK5 on the control card (refer fig. 3.28).

0/2 to 10 V corresponds to a speed of 0 to Max., frequency, or a current of 0 to 150 % of rated current. If 2 to10 V or 4 to 20 mA signal is required it should be programmed in Off-line programming using start mode.

PROGRAMMING OF DRIVE PARAMETERS

KEYBOARD DETAILS AND FUNCTIONS

FIG 3.4 KEYBOARD FOR INVAC AC DRIVES



ON-LINE PROGRAMMING OF PARAMETERS IN TIMER DISABLE MODE

Press MODE key to access the next parameter. Use ▲ and ▼ keys to increment or decrement the values of the parameter. The value of the parameters listed below in table can be changed while the drive is running. After changing the parameter values, press the MODE key so that the new values are stored in memory permanently.

TABLE 3.5 ON-LINE PROGRAMMING PARAMETERS (TIMER DISABLED)

MODE	PARAMETER	DEFAULT VALUES	RANGE	CUSTOMER SET VALUES
1	Display		Speed, Voltage & Current display	
2	Normal Speed	1500 RPM or 50 Hz	Min., to Max. Speed or Min., to Max. frequency	
3	Acceleration	10 Sec.	Min., to Max., ramp time	
4	Deceleration	10 Sec.	Min., to Max., ramp time	
5	Slip compensation	Slip not compensated	Slip not compensated / Factory set slip compensation/ User defined slip compensation	
6	Jog Speed	300 RPM or 10 Hz	Min to Max. Speed or Min to Max. frequency	
7	Speed 3	600 RPM or 20 Hz	Min to Max. Speed or Min to Max. frequency	
8	Speed 4	900 RPM or 30 Hz	Min to Max. Speed or Min to Max. frequency	
9	Speed Scale	100.00 %	0 to 200.00 %	
10	Auto/Manual mode	Manual mode	Auto mode/Manual mode	
11	Set Value			

DESCRIPTION FOR ON-LINE PARAMETERS IN TIMER DISABLE MODE

1) STATUS DISPLAY

This Parameter displays Speed, Voltage & Current, Percentage of current or feedback value with unit will be displayed simultaneously depending on the mode selected (see parameter 10) when the drive is running.

1500 RPM	5.0 A	FN
100 %		415 V

1500 RPM	5.0 A	FN
500 ° c		415 V

If Manual mode is selected, the display shows speed/ frequency, voltage, current and percentage of current as shown below.

If Auto mode is selected, the display shows speed/frequency, voltage, current & the feedback parameter depending on the unit selected as shown below. For example if temperature in ° c is selected as an unit the display will be as shown above.

2) NORMAL SPEED

- Range: Minimum to Maximum Frequency
- This parameter sets the speed (preset speed 1) of the motor.

3) ACCELERATION

- Range: Minimum Ramp time to Maximum Ramp time
- This parameter specifies the time required to change the speed from 0 to Rated value. If acceleration time is too low, the unit may trip on over current.

4) DECELARATION

- Range : Minimum Ramp time to Maximum Ramp time
- This parameter specifies the time required to change the speed from Rated value to 0. If the deceleration time is low, the unit may trip on over voltage. Make sure that the dynamic braking resistor is connected when fast deceleration is required with high inertia load.

5) SLIP COMPENSATION

- Range: Slip not compensated
  Factory set slip compensation
  User defined slip compensation
- In Squirrel cage induction motor the shaft speed decreases with an increasing load. This can be compensated by increasing the frequency according to the factory set slip values at different load currents. By this method, the slip is reduced to approximately 10 % of the original value.
- For accurate speed control, user defined slip compensation can be used. In this method the values of the slip frequencies at different load currents are entered by user. A high value of slip compensation may cause an instability in the motor operation. The slip compensation feature should not be used when motors are connected in parallel and in case of dynamic loads.

6) JOG SPEED

- Range: Minimum to Maximum frequency
- This parameter is used to set the Jog speed (preset speed 2) of the motor.

7) SPEED 3

- Range : Minimum to Maximum Speed
- This parameter is used to set the preset speed 3 of the motor.

8) SPEED 4

- Range : Minimum to Maximum Speed
- This parameter is used to set the preset speed 4 of the motor.

9) SPEED SCALE

- Range : 0 to 200 %
- This parameter defines the multiplication factor when the reference speed is from analog reference input, error input or from encoder.

10) AUTO AND MANUAL MODE SELECTION

- This can be selected by pressing increment key from manual mode to auto mode & vice-versa.

NOTE: Select Auto mode when feedback is present and manual mode for operation without feedback. If the drive has to display the selected unit in open loop, Auto mode has to be selected.

12) SET VALUE

- This parameter displays the reference speed.

ON-LINE PROGRAMMING OF PARAMETERS IN TIMER ENABLE MODE

Press MODE key to access the next parameter. Use ▲ and ▼ keys to increment or decrement the values of the parameter. The value of the parameters listed below in table can be changed while the drive is running. After changing the parameter values, press MODE key so that the new values are stored in memory permanently.

TABLE 3.6 ON-LINE PROGRAMMING PARAMETERS (TIMER ENABLED)

MODE	PARAMETER	DEFAULT VALUES	RANGE	CUSTOMER SET VALUES
1	Display		Speed, Voltage & Current display	
2	Normal Speed	1500 RPM or 50 Hz	Min., to Max. Speed or Min., to Max. frequency	
3	Acceleration	10 Sec.	Min., to Max., ramp time	
4	Deceleration	10 Sec.	Min., to Max., ramp time	
5	Slip compensation	Slip not compensated	Slip not compensated / Factory set slip compensation/ User defined slip compensation	
6	Jog Speed	300 RPM or 10 Hz	Min to Max. Speed or Min to Max. frequency	
7	Run time		0 to 9999 Min.	
8	Balance time		0 to Run time	
9	Off time		0 to 9999 Min.	
10	No. of cycle	0	0 to 9999	
11	Auto/Manual mode	Manual mode	Auto mode/Manual mode	
12	Display		i) RPM, cycle, Run time and Balance run time while motor is running. ii) Off time and balance off time while motor is not running.	

DESCRIPTION FOR ON-LINE PARAMETERS IN TIMER ENABLE MODE

1) STATUS DISPLAY

This Parameter displays Speed, Voltage & Current simultaneously when the drive is running.

2) NORMAL SPEED

- Range: Minimum to Maximum Frequency
- This parameter sets the speed (preset speed 1) of the motor.

3) ACCELERATION

- Range: Minimum Ramp time to Maximum Ramp time
- This parameter specifies the time required to change the speed from 0 to Rated value. If acceleration time is too low, the unit may trip on over current.

4) DECELARATION

- Range : Minimum Ramp time to Maximum Ramp time
- This parameter specifies the time required to change the speed from Rated value to 0. If the deceleration time is low the unit may trip on over voltage. Make sure that the dynamic braking resistor is connected when fast decelaration is required with high inertia load.

5) SLIP COMPENSATION

- Range: Slip not compensated
  Factory set slip compensation
  User defined slip compensation
- In Squirrel cage induction motors the speed decreases with an increasing load. This can compensated by increasing the frequency according to the factory set slip values at different load currents. By this method, the slip is reduced to approximately 10 % of the original value.
- For accurate speed control user defined slip compensation can be used. In this method the values of the slip frequencies at different load currents are entered by user. A high value of slip compensation may cause an instability in the motor operation. The slip compensation feature should not be used when motors are connected in parallel and in case of dynamic loads.

6) JOG SPEED

- Range: Minimum to Maximum frequency
- This parameter is used to set the Jog speed (preset speed 2) of the motor.

7) RUN TIME

- Range : 0 to 9999 Min
- This determines the total run time set by the customer i.e. , the time for which the motor should run.

8) BALANCE TIME

- Range : 0 to 9999 Min

This shows the remaining run time after the run time is set and the run command is given. This shows only the balance run time and will be decremented after completion of every minute while motor is running. Once the balance run time becomes zero, the drive will come to a stop. The balance time will be reset, after completion of off time. If number of cycles becomes zero, the balance time remains zero. While starting the drive the balance time and number of cycles has to be set by the user.

While the motor is running, the balance time can be decreased in steps of minutes by pressing ▼ key. If the ▲ key is pressed the balance time will become equal to Run time. This can be used to reset the RUN time. While making the changes, if the Run time alone is changed, the change will become effective only in the next cycle. If you want the change to become effective in the current cycle itself, then the balance time should also be changed as required.

9) OFF TIME

- Range : 0 to 9999 Min
- This determines the time during which the motor is in OFF condition and after the set off time has elapsed, the motor starts again. During the off time period, the motor cannot be run until the set off time has elapsed.

10) AUTO AND MANUAL MODE SELECTION

- This can be selected by pressing increment key from manual mode to auto mode & vice versa.

NOTE: Select Auto mode when feedback is present and manual mode for operation without feedback. If the drive has to display the selected unit in open loop, Auto mode has to be selected.

11) DISPLAY

----RPM Run time-------
----CYCLE Balance time--- ⇒

1500 RPM	100 MIN
5 CYCLE	100 MIN

RPM corresponds to motor speed.
Run time corresponds to set run time.
Cycle corresponds to number of balance cycles.
Balance time corresponds to remaining run balance time.

OFF time-------
Balance time--- ⇒

OFF TIME	30 MIN
BALANCE	30 MIN

This shows the set OFF time and remaining OFF balance time when the motor is in OFF condition.

OFF-LINE PROGRAMMING OF PARAMETERS

TABLE 3.7 OFF-LINE PROGRAMMING PARAMETERS

MODE	PARAMETER	DEFAULT VALUES	RANGE	CUSTOMER SET VALUES
1	Poles	4	0 to 60	
2	IR Range	0	0 to Rated Frequency	
3	IR Comp.,Voltage	0	0 to 60 V	
4	Remote Mode	0	0 to 3	
5	V/F Pattern	0	0 & 1	
6	Start Mode	0	0 to 255	
7	Reference & Feedback mode auto	0	0 to 31	
8	Reference & Feedback mode manual	0	0 to 31	
9	Voltage Selection	100 %	0 to 100 %	
10	Relay Mode	1	0 to 16	
11	Unit Selection	0	0 to 11	
12	Feedback failure trip	60	0 to 30000 S	
13	Switching Frequency	3 KHz	1 to 12 KHz	
14	Skip 1 Range Low	0	0 to 200 Hz	
15	Skip 1 Range High	0	Skip 1 range low to 200 Hz	
16	Skip 2 Range Low	0	0 to 200 Hz	
17	Skip 2 Range High	0	Skip 2 range low to 200 Hz	
18	Rated Current		0 to Maximum	
19	DC Braking Voltage	0	0 to 10 %	
20	DC Braking Time	0	0 to 25 Sec	
21	Min. Ramp Time	1 Sec	0.1 to 3000.0 sec	
22	Max. Ramp Time	100 %	Min. ramp time to 3000.0 Sec	
23	Proportional Constant	1 %	- 800 % to 800 %	
24	Display Factor	1	0 to 5.000	
25	(i)Analog Feedback 10V at (In manual mode) (ii)Analog Feedback 10V at (In auto mode & if display factor is less than 1.000) (iii) Analog Feedback 10V at (In manual mode & if display factor is more than or equal to 1.000)	50 Hz	0 to 200 Hz 0 to 3200.0 (with unit selected in mode 11) 0 to 32000 (with unit selected in mode 11)	
26	Rated Frequency	50 Hz	0 to 200 Hz	
27	Min. Frequency	2 Hz	0 to Max. Frequency	
28	Max. Frequency	50 Hz	PI High limit to 200 Hz	
29	Start Frequency	2 Hz	0 to 5.00 Hz	
30	Integral Time Constant	3 Sec.	0.01 to 327.67 Sec	
31	PI low limit	1 Hz	0 to Max. Frequency	
32	PI high limit	50 Hz	0 to Max. Frequency	
33	User defined Slip Compensation (Only for timer disable mode)	-	-	-

MODE	PARAMETER	DEFAULT VALUES	RANGE	CUSTOMER SET VALUES
34	Enable Function	IT Trip Enabled Timer Disabled Motor Protection Disabled Feedback Failure Trip Disabled DC Injection Braking Disabled Trip Count Disabled Reverse Direction Enabled	IT Trip Enabled / Disabled Timer Enabled / Disabled Motor Protection Enabled / Disabled Feedback Failure Trip Enabled / Disabled DC Injection Braking Enabled / Disabled Trip Count Enabled / Disabled Reverse Direction Enabled / Disabled	
35	PPR Count	0	0 to 600	

To enter into Off-line programming mode, hold * key and press **RESET** key (refer fig.3.21 ro 3.27). Then by pressing **MODE** key, the mode is incremented and the next parameter is displayed. If **JOG** key is pressed the mode is decremented and the previous parameter is displayed. The ▲ and ▼ keys can be used to increment or decrement the values of the parameters. The set values of the parameters are stored in memory when the **MODE** or **JOG** key is pressed. If the **MODE** or **JOG** key is not pressed after setting the parameter values, the changes will be lost if the power is turned off.

If the LCD display after power ON is **'Parameters error check all',** it means that, one or more values of parameters settings might have been corrupted. In this case, enter into programming mode by pressing the * key and enter all the parameters as in the 'Customer set values' column of table. Increment and Decrement once after setting each parameters, finally press **MODE** key to store values.

DESCRIPTION OF OFF-LINE PARAMETERS

1) POLES

- Range: 0 to 60
- This parameter is used to calculate the speed in RPM. Frequency is displayed in Hz when the parameter is set to zero.

2) IR COMP RANGE

- Range: 0 to Rated Frequency
- This parameter defines the frequency up to which IR compensation is required.

Note: IR Compensation is used to get more torque at low speeds. This can be achieved by setting proper values of IR range & IR voltage.

3) IR VOLTAGE

- Range: 0 to 60 V
- This parameter defines the voltage at zero frequency.

Warning: If IR Voltage is too high the drive may trip on **'OVER LOAD'** and also the motor may get heated up if operated continuously at low frequency.

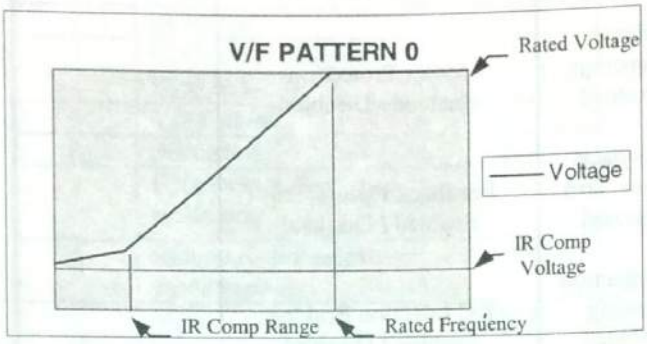


FIG 3.5 IR COMPENSATION

4) REMOTE MODE

- Range: 0 to 3

0 → Control of the drive by keyboard
1 → Control of the drive by Remote terminals
2 → Control of the drive by Remote terminals with Remote increment and decrement of speed with memory.
3 → Control of the drive by Remote terminals with Remote increment and decrement of speed without memory.

5) V/F PATTERN

- **Range :** Linear V/F [0]
  Squared V/F [1]
- **Linear V/F [0]:** In this mode the voltage changes linearly with frequency in the constant flux region. This is used when the load torque characteristics is linear with speed. Ex: Conveyor, Rolling mill etc.
- **Squared V/F [1]:** In this mode the voltage changes square to the frequency. This is used in application where the load torque is proportional to the square of the speed. Ex: Centrifugal pump, fan etc.

6) START MODE

- Range: 0 to 127
- Each bit of the byte is used to configure the drive depending on the type of I/O as explained below.

FIG 3.6 BYTE OF START MODE

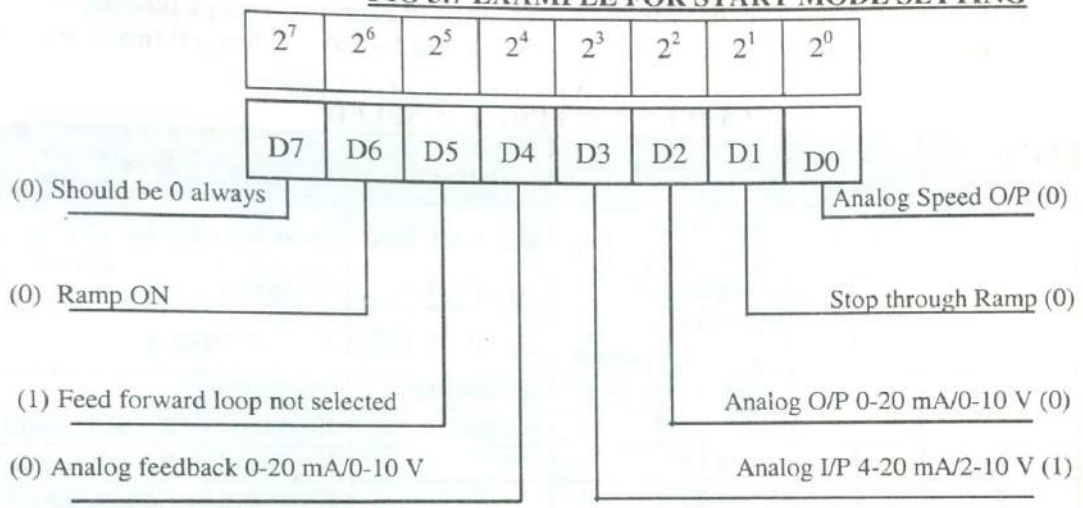
D7	D6	D5	D4	D3	D2	D1	D0

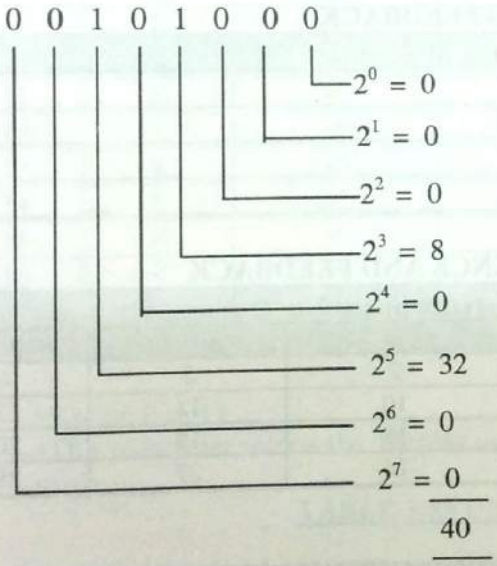
TABLE 3.8 START MODE

BIT	FUNCTION	0	1
D0	Analog O/P Function	Speed O/P	Current O/P
D1	Stop Function	Stop through ramp	Coast to stop
D2	Analog O/P Function	0-20 mA or 0-10 V	4-20 mA or 2-10 V
D3	Analog I/P Function	0-20 mA or 0-10 V	4-20 mA or 2-10 V
D4	Analog Feedback	0-20 mA or 0-10 V	4-20 mA or 2-10 V
D5	Feed Forward loop in PI Controller	Present	Not present
D6	Ramp Function	Ramp ON	Ramp OFF
D7	Not used (should be '0' always)	-	-

Example:

FIG 3.7 EXAMPLE FOR START MODE SETTING

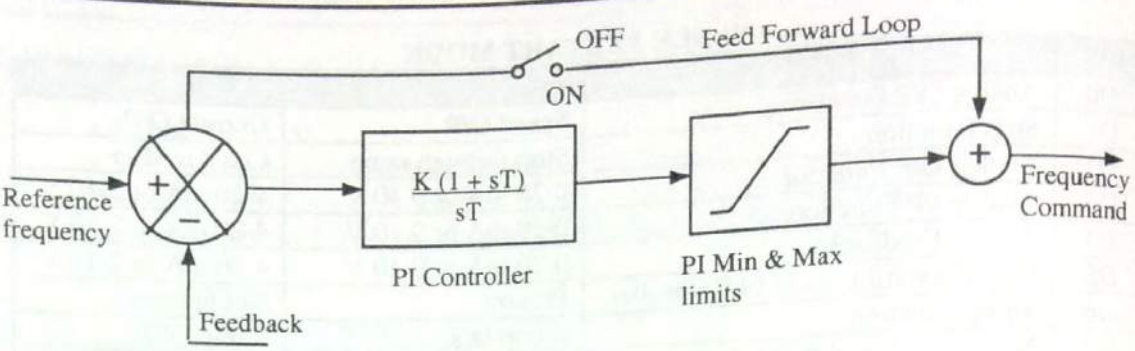




The equivalent decimal value is 40. Hence by using ▲ key a number 40 should be entered.

7) REFERENCE AND FEEDBACK MODE

- Range: 0 to 31
- In feedback mode, the feedback can be from encoder or tachogenerator and the final frequency command is generated from the PI controller as shown in fig. below.



K = Proportional constant
T = Integral time constant

FIG 3.8 PI CONTROLLER

Note: If the ramp is not switched off, the output of the PI controller will go through the ramp. If the ramp is OFF the drive may trip due to over current for too low Integral time constant.

TABLE 3.9 REFERENCE SPEED

Reference Speed No.	No. of Speed	Speed	Selection	Mode
0	4	Normal, Jog, Speed 3, Speed 4	By ID5 & ID4	Remote mode 1
0	2	Normal, Jog	By JOG key	Keyboard
1	4	Aref (POT), Jog, Speed 3, Speed 4	By ID5 & ID4	Remote mode 1
1	2	Aref (POT), Jog	By JOG key	Keyboard
2	1	Aref (POT)	Ainput	Keyboard or Remote mode 1
3	1	Error I/P		Keyboard or Remote mode 1
4	1	Encoder		Keyboard or Remote mode 1

TABLE 3.10 FEEDBACK

F/B No.	Type of Feedback
0	No Feedback
1	No Feedback
2	Encoder Feedback
3	Analog Feedback (Tacho)

TABLE 3.11 REFERENCE AND FEEDBACK

F/B No.	Reference Speed No.				
	0	1	2	3	4
0	0	1	2	3	4
1	8	9	10	11	12
2	16	17	18	19	20
3	24	25	26	27	28

NOTE:
Aref (POT) Speed = (MAX_FREQ*SPEED SCALE*A_{REF} *120) / (100*10*P)
Error I/P speed = (Reference Speed No.) + 1/100[(MAX_FREQ*SCALE in %*{(2/10*A_{ip}) – 1}]

Example:

If Reference Speed No. is 2 and Feedback No. is 0, then the Reference and Feedback has to set to 2 as given in the table 3.9

8) VOLTAGE SELECTION

- Range: 0 to 100 %
- This parameter defines the % of maximum voltage at rated frequency. At light loads it can be to below 100 % to save the energy.

9) RELAY MODE

- Range : 0 to 16
- This parameter sets the required conditions to operate the Relay. All the conditions are OR'ed to activate the relay.

TABLE 3.12 RELAY MODE OPEARATION

RELAY MODE	RELAY OPERATES DURING				
	POWER ON	FORWARD DIRECTION	DRIVE IS RUNNING	OVERLOAD I > 100 %	DRIVE TRIP
0	X	X	X	X	X
1	X	X	X	X	✓
2	X	X	X	✓	X
3	X	X	X	✓	✓
4	X	X	✓	X	X
5	X	X	✓	X	✓
6	X	X	✓	✓	X
7	X	X	✓	✓	✓
8	X	✓	X	X	X
9	X	✓	X	X	✓
10	X	✓	X	✓	X
11	X	✓	X	✓	✓
12	X	✓	✓	X	X
13	X	✓	✓	X	✓
14	X	✓	✓	✓	X
15	X	✓	✓	✓	✓
16	✓	✓	✓	✓	✓

10) UNIT SELECTION

- Range: 0 to 11
- This parameter selects the 'Display units' for speed in on line, while selecting Auto mode.

TABLE 3.13 UNIT SELECTION

Selection	0	1	2	3	4	5
Unit	RPM	%	M/HR	M/MIN	M/SEC	MM/HR
Selection	6	7	8	9	10	11
Unit	MM/MIN	MM/SEC	BAR	KG/CM2	° C	° F

11) FEEDBACK FAILURE TRIP

▪Range: 1 to 30000S

When the drive is working in closed loop condition with feedback, it will try to match the feedback value to set value depending on proportional & integral time constants.

If the feed back is not proper the drive speed will reach to PI maximum value. It will wait for a time equal to feedback failure trip. If that time is crossed, the drive will trip as 'feedback failure trip'.

12) SWITCHING FREQUENCY

▪ Range: 1 to 12 KHz

▪ This parameter is used to reduce the motor noise. As the switching frequency increases noise in the motor decreases but losses in the drive and motor will increases. The drive should be derated when the switching frequency is set beyond 3 KHz.

13 –16) SKIP FREQUENCIES

▪ Range: 0 to 200 Hz

▪The motor and load may produce a lot of vibration and noise at certain frequencies due to resonance. The Skip frequency facility can be used to avoid running the drive at these resonant frequencies. The drive will set the running frequency at the next higher frequency if the set frequency lie inside the skip frequency range.

For example if Skip 1 frequency low is 10 Hz and Skip 1 frequency high is 12 Hz and if the drive is set to run at a frequency in between 10 and 12 Hz it will run at 12 Hz. If the set frequency is not in the skip range, then the drive will run at the set frequency.

17) RATED CURRENT

▪ Range: 0 to Max. Current

▪ This setting is used for Overload and Inverse time trip. At the factory, it is set for the maximum power the drive can handle. If any motor of lower power is to be run with the higher rating drive then the rated current should be set accordingly to protect the motor.

18) DC BRAKING VOLTAGE

▪ Range: 0 to 10 % of DC bus voltage

▪ This parameter defines the % of DC bus voltage to be injected in the motor during DC injection braking.

Note: DC Braking stops the motor by applying DC voltage to the stator windings. By using DC braking, the motor can be stopped in the shortest possible time without dynamic braking unit. Appropriate braking voltage and braking time can be selected depending on the application.

19) DC BRAKE TIME

▪ Range: 0 to 25.5 Secs

▪ This parameter sets the DC injection time in Secs.

Warning : A high Brake time may cause heating in the motor.

20) MINIMUM RAMP TIME

- Range : 0.1 to 3000.0 secs.
- It is the minimum time the Acceleration & Decelaration can be set in "On-line programming mode".

Ex: If Minimum ramp time is 3 Secs, the minimum time for Acceleration & Decelartion can be set in "On-line programming` mode" as 3 secs.

21) MAXIMUM RAMP TIME

- Range: Minimum Ramp Time to 3000.0 Sec
- It is the maximum time the Acceleration & Decelaration can be set in "On-line programming mode".

Ex: The maximum time for Acceleration & Deceleration can be set in On-line programming mode as 60 Secs.

22) PROPORTIONAL CONSTANT

- Range: -800 to +800
- This parameter indicates the number of times the error [reference & feedback] is to be amplified. The process may become unstable when the set value is too high. But higher the value, faster the response.

23) DISPLAY FACTOR

- Range: 0.000 to 5.000
- This parameter defines the multiplication factor to speed display.

E.g.: 1500 RPM can be displayed as 3000 RPM by setting display factor to 2.000 and 750 RPM by setting display factor to 0.500

24) ANALOG FEEDBACK RATED AT 10 V

- Range: (i) 0 to 200Hz (for manual mode)
  (ii) 0 to 3200.00 (with unit in auto mode and if display factor is less than 1.000)
  (iii) 0 to 32000 (with unit in auto mode and if display factor is more than or equal to 1.000)
- This parameter specifies the frequency that corresponds to10 volts analog feedback.

E.g:4 pole tachogenerator gives O/P of 10 volts at 1500 RPM, then set the above parameter to 50 Hz . When the Analog Feedback is selected in Auto mode, the drive will display the running speed & the unit which is selected corresponding to the feedback.

25) RATED FREQUENCY

- Range: 0 to 200 Hz
- This parameter sets the frequency at which 100 % voltage is applied.

26) MINIMUM FREQUENCY

- Range: 0 to Max. frequency
- This parameter sets the minimum frequency at which the drive operates. The minimum frequency should be less than the maximum frequency and more than the start frequency.

27) MAXIMUM FREQUENCY

- Range: PI high limit to 200 Hz.
- This parameter sets the maximum frequency at which the drive operates. If the maximum frequency exceeds the rated frequency of the motor, the motor operates in the constant power region.

28) START FREQUENCY

- Range: 0 to 5 Hz
- This parameter defines the ramp start frequency to get maximum starting torque. It is recommended that this value is set around 2 Hz.

29) INTEGRAL TIME CONSTANT

- Range: 0.01 to 327.67 Secs
- This parameter indicates the time required to regulate the signal. The process may become unstable when the time constant is too low. At higher values, the response may be slow.

30) PI LOW LIMIT

- Range: 0 to max. frequency
- This parameter specifies the minimum value of the PI controller O/P.

31) PI HIGH LIMIT

- Range: 0 to max. frequency
- This parameter specifies the maximum value of the PI controller O/P.

32) USER DEFINED SLIP COMPENSATION

- Frequency range : 0 to 5 Hz
- Current range : 0 to rated current
- In this mode, the user can set the slip frequencies Vs. current for an accurate speed control without feedback. Use FWD and REMOTE keys to increment or decrement the current and set the slip frequency using ▲ and ▼ keys.

33) ENABLE FUNCTION

- Range:

IT Trip	Enable/Disable
Motor Protection	Enable/Disable
DC Injection Braking	Enable/Disable
Reverse Direction	Enable/Disable
Timer	Enable/Disable
Feedback failure trip	Enable/Disable
Trip count	Enable/Disable

- This mode is used to enable or disable the above. Use FWD key to scroll up the parameter and ▲ key to enable or disable.

34) PPR COUNT

- Range: 1 to 600
- This defines the number of pulses per revolution from encoder used to calculate motor speed in encoder feedback mode.

PARAMETER LOCK SETTING

- **Drive Status** : On line programming mode.
- **Note** : The shadow key indicates the "key pressed" in the key pad.

- Follow the procedure to set the **Parameter Lock / Unlock.**

  - ☞ Hold down * key. (fig. 3.9)
  - ☞ Press **MODE** key till get the display '**PARAMETER LOCK ENABLED**' or '**PARAMETER LOCK DISABLED**'. (fig. 3.10)
  - ☞ Release **MODE** key.(fig.3.11)
  - ☞ Release * key. (fig. 3.12)
  - ☞ Use ▲ key to change between parameter enable and disable. (fig. 3.13)
  - ☞ Press **MODE** key to come back to normal display. (fig. 3.14)

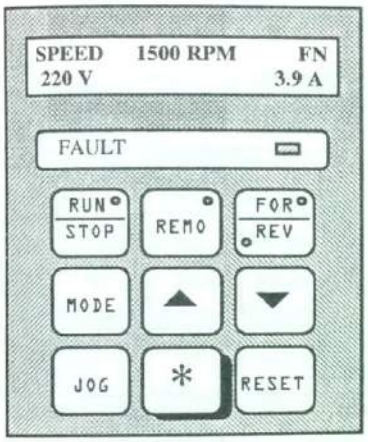


FIG 3.9

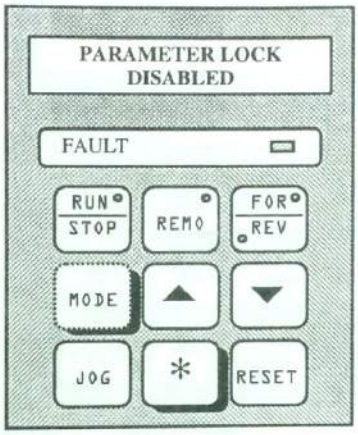


FIG 3.10

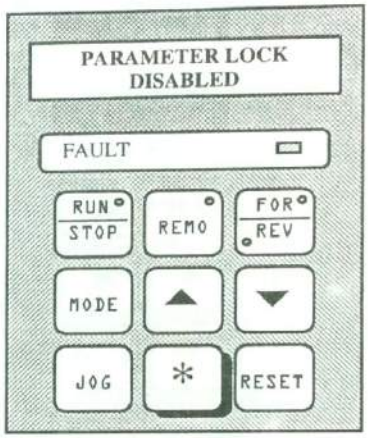


FIG.3.11

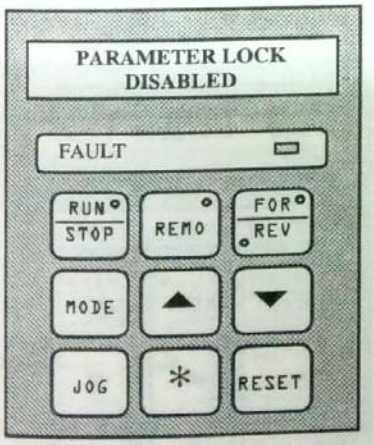


FIG. 3.12

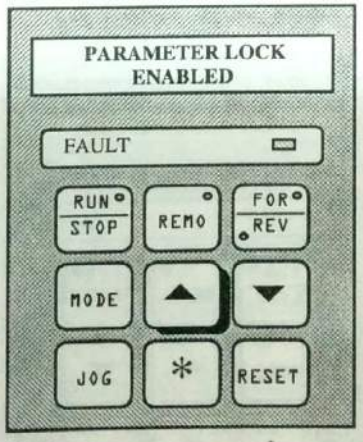


FIG.3.13

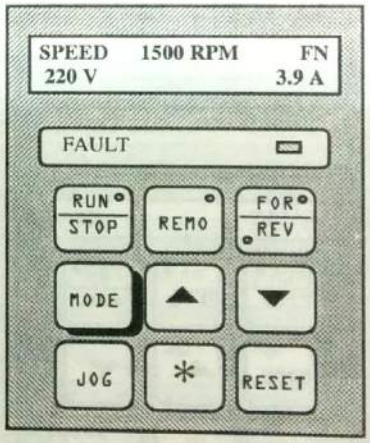


FIG.3.14

FAULT MEMORY REVIEW

▪ When a fault is detected, it is stored in EEPROM. The last 20 faults can be reviewed for fault diagnosis.

▪ **Drive Status** : Off line programming mode.
▪ **Note** : The shadow key indicates the "key pressed" in the key pad.

▪ Follow the procedure to **Review the Fault memory.**

☞ Hold down **RUN** key. (fig. 3.15)
☞ Press **REMOTE** key till it displays any of the fault listed in table 4.1 (fig. 3.16).
☞ Release **REMOTE** key.(fig. 3.17)
☞ Release **RUN** key. (fig. 3.18)
☞ Use **RUN** key to view next fault which is stored in memory. (fig. 3.19)
☞ Press **RESET** key to come back to normal display (i.e., On-line programming mode, fig. 3.20)

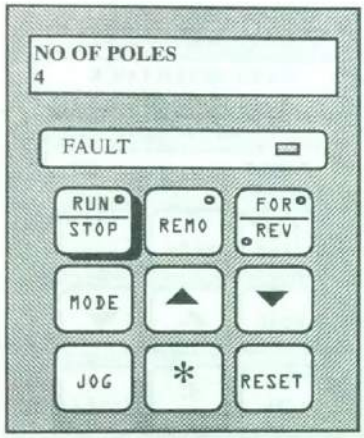


FIG. 3.15

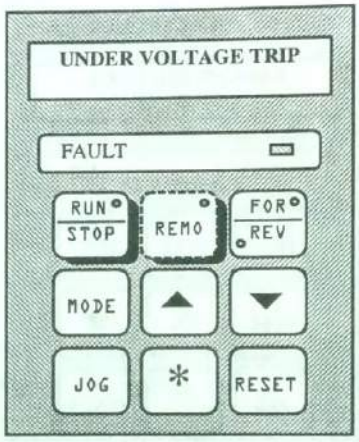


FIG.3.16

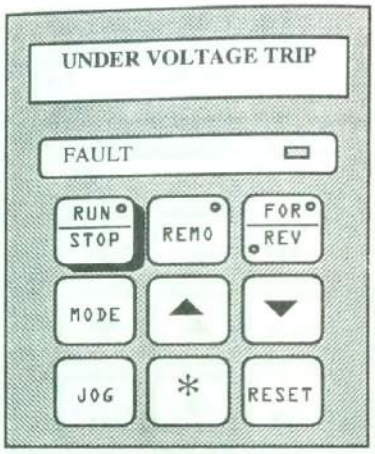


FIG.3.17

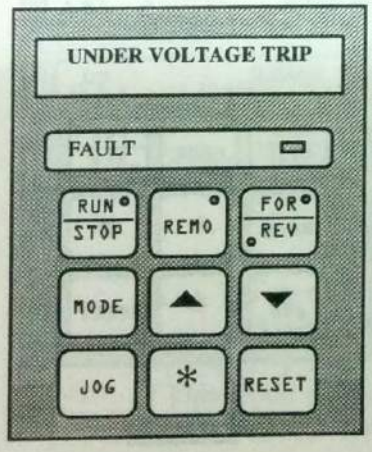


FIG. 3.18

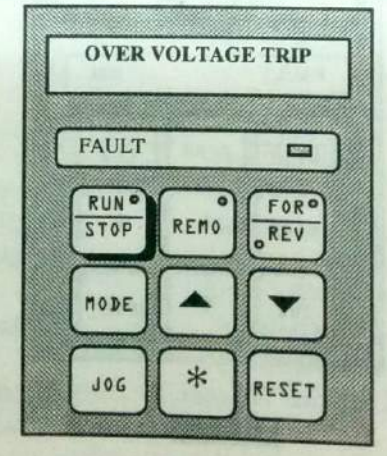


FIG.3.19

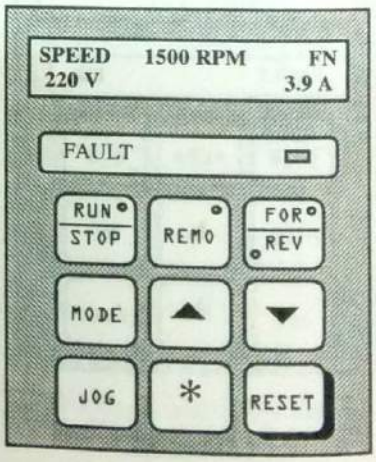


FIG.3.20

PROCEDURE TO GO TO OFF LINE PROGRAMMING MODE

- **Drive Status** : On line programming mode.
- **Note** : The shadow key indicates the "key pressed" in the key pad.
- Follow the procedure to go to Off line programming mode .

☞ Hold down * key. (fig. 3.21)
☞ Press **RESET** key until any one of the off-line parameters is displayed. (fig. 3.22)
☞ Release **RESET &** * key.(fig. 3.23)
☞ Press **MODE** key to access different parameters. (fig. 3.24)
☞ Use ▲ or ▼ key to change the parameters value. (fig. 3.25)
☞ Press **MODE** key to store the new value. (fig. 3.26)
☞ Press **RESET** key to come back to On-line (fig. 3.27)

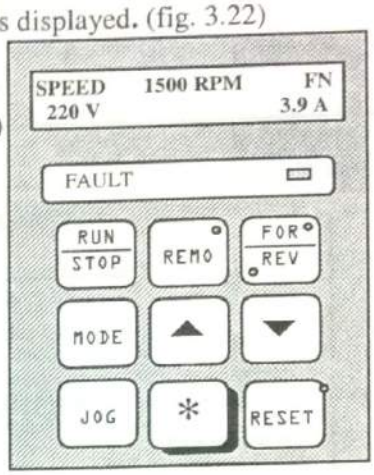


FIG. 3.21

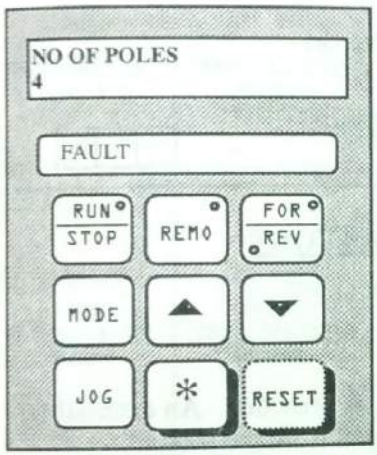


FIG.3.22

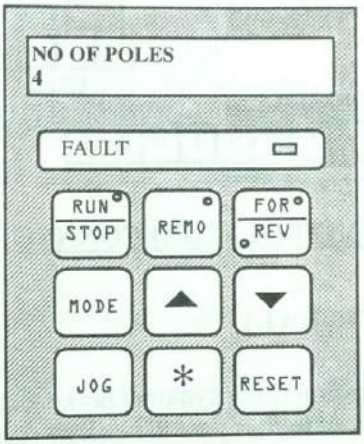


FIG.3.23

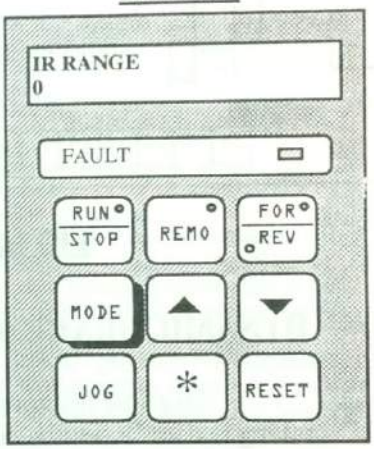


FIG. 3.24

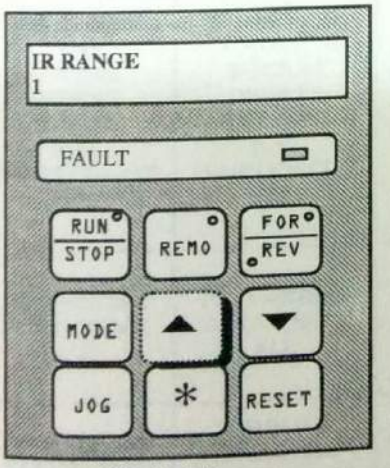


FIG.3.25

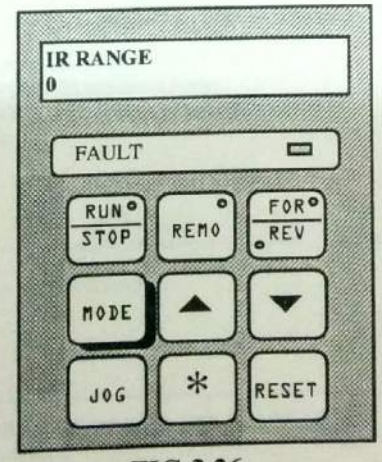


FIG.3.26

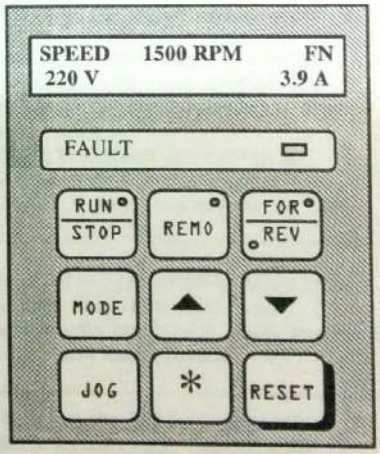


FIG.3.27

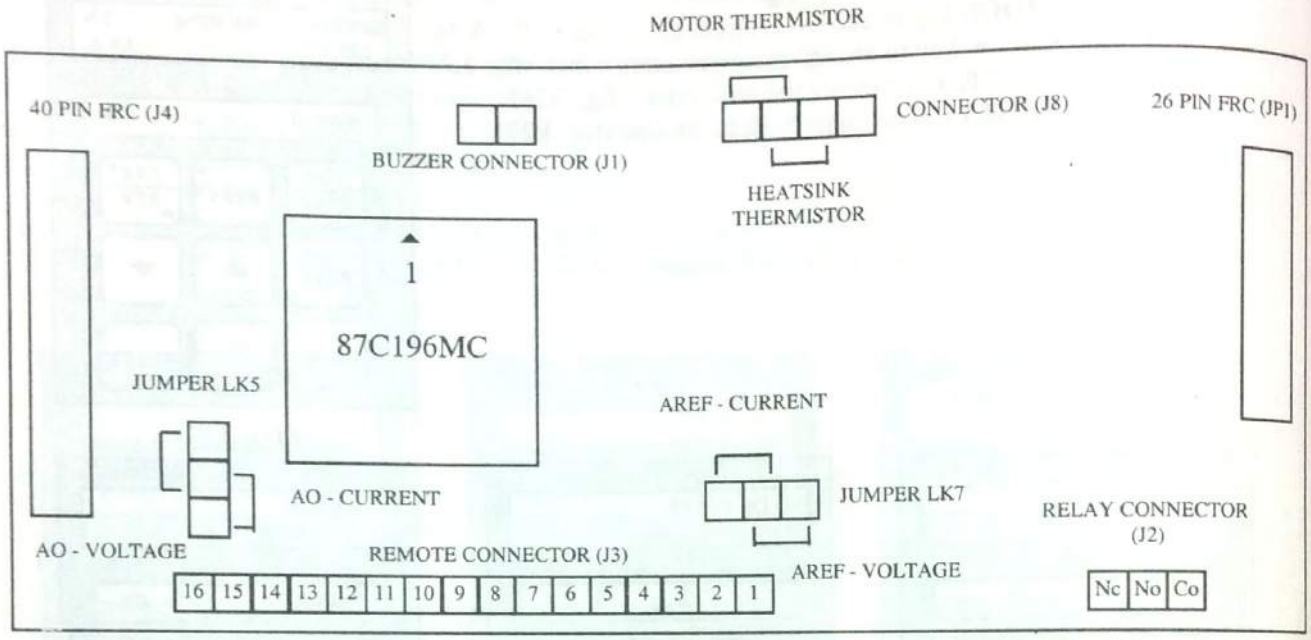


FIG 3.28 CONTROL CARD CONNECTOR LAYOUT

DYNAMIC BRAKE (OPTIONAL)

To allow faster deceleration time, dynamic braking feature is provided. An external braking resistor has to be connected to dissipate the energy regenerated from the motor. Braking torque upto 100 % is allowed.

TABLE 4.1 FAULT ANALYSIS

DISPLAY INDICATION	FAULT NAME	POSSIBLE CAUSE	CORRECTIVE ACTION
OVER VOLTAGE TRIP	OVER VOLTAGE TRIP	▪DC Bus voltage has exceeded 110 % nominal voltage. Over voltage is generally caused when the motor runs as a generator in drives where the load inertia is extremely high & deceleration time is set low, or I/P AC voltage is high.	☛In case of temporary supply voltage peak, reset and restart. ☛Use longer deceleration time.
UNDER VOTLAGE TRIP	UNDER VOLTAGE TRIP	▪DC Bus voltage has gone below 85 % of the nominal voltage. Most common reason for under voltage trip is failure in the mains supply, loss of phase.	☛In case of temporary supply voltage drop, reset and restart. ☛Check the input connection.
IT TRIP	OVER CURRENT INVERSE TIME TRIP	▪**invac** drive has determined that motor is operating in the over current region. The motor is not running because of increased load torque. ▪Ramp time may be too low. ▪Load current settings may be set at lower value. ▪Motor may be too small for the application.	☛Remove mechanical problem causing increased load torque. ☛Increase the Ramp time. ☛Increase the load current settings. ☛Use large drive and motor if necessary & set the parameter a accordingly.
INPUT OUT OF RANGE	INPUT OUT OF RANGE	▪The analog I/P is not within the specified range i.e., 2-10 V or 4-20 mA. ▪Improper connections, Wire cut or loose contact in the connectors. ▪Analog I/P not matched to the drive setting	☛Check the Analog I/P connection. ☛Choose proper I/P type 0-20 Ma/4-20 mA or 0-10 V/2-10 V
HEATSINK OVER TEMPERATURE TRIP	HEATSINK OVER TEMPERATURE TRIP	▪Heat sink temperature is high.	Heat sink dissipation ☛Dust and dirt: Clean the Heat sink. Arrange clean ambient air and regular inspection. ☛Air flow: Remove obstacles. Ensure free cooling air flow. If Ambient temperature is, > 45 °C - Rearrange cooling. <45 °C - Check the over load condition. 150 % of nominal for 60 seconds in every 10 min., allowed at this temperature. Reset and start the drive.
TOP DEVICES (OR) BOTTOM DEVICES FAULT (OR) SHORT CIRCUIT TRIP	TOP DEVICES (OR) BOTTOM DEVICES FAULT (OR) SHORT CIRCUIT TRIP	▪Improper Cabling. ▪Earth faults or short circuits. ▪Sudden over voltage or sudden application of load	☛Check for loose connections in motor wiring ☛Terminals: check that terminals in frequency inverter end are not defective or damaged. ☛Motor: Check the motor terminals and measure earth fault or short circuits., in the motor. ☛Cables: Disconnect motor cables and measure earth fault or short circuits in cables. ☛Correct the fault, reset and start the Drive.
PARAMETERS ERROR CHECK ALL	PARAMETERS ERROR CHECK ALL	▪Stored Date corrupted	☛Go to Off-line programming mode, press mode key and enter the value of each parameter according to table. Then increment and decrement each parameter.
FEEDBACK FAILURE TRIP	FEEDBACK FAILURE TRIP	Feedback is not coming even after the set time has elapsed.	☛Check whether corresponding analog feedback present or not. Increase time.

NOTE: If the fault persists even after you have tried the suggested remedy, please contact the nearest **invac** supplier.