$ 25.00

BALDOR®
MOTORS AND DRIVES

# SERIES 11 INVERTER DRIVE

## OPERATING & TECHNICAL MANUAL
## (1 through 5 horsepower, 200-230 VAC)

BEC-905

5/90/2

BALDOR®
MOTORS AND DRIVES

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# INTRODUCTION

This manual contains installation, operation, maintenance, and troubleshooting instructions for the **BALDOR** Series 11 P.W.M. style inverter drives for the range of 1 through 5 horsepower, 200 - 230 VAC. A parts list and illustrations are also included. For more information on how to size these units to particular applications, please refer to the **BALDOR** Inverter Applications Manual.

## GENERAL DESCRIPTION

The **BALDOR** Series 11 adjustable frequency AC drives are designed to provide adjustable speed control of conventional three phase induction motors. The method of control is accomplished by a static conversion of the fixed frequency single or three-phase AC supply into an adjustable frequency adjustable voltage output to the three-phase induction motor. These microcomputer based Pulse Width Modulated (PWM) inverter drives have standard adjustment features that allow tailoring of the motor/inverter system to fit a wide variety of application requirements including variable torque, constant torque, and constant horsepower applications.

## MOTORS

Either one of the following two basic motor categories can be used with the **BALDOR** family of inverter drives:

1. Any standard three-phase AC induction motor designed to operate at standard line frequency and fixed speed operation (speed determined by the load applied to the motor) provided the following natural occurrences are considered:

   a. A slight increase in motor losses will occur when operated on a power source with subharmonics in the output power waveform. All motor controllers that approximate a sinewave by electronic switching of a DC source will have subharmonics present in the output power waveform.

   b. The motor's capability to produce continuous torque (typically NEMA rated torque at rated motor horsepower) must be derated as a function of the minimum continuous operating speed due to the reduced ventilation of the integral motor cooling fan. Where applications require 100% rated motor torque (constant torque application) at speeds below half rated speed, a separately powered constant air flow ventilation blower should be considered. When a separately powered ventilation blower is used, a temperature sensing device should be built into the motor and connected to the control wiring to shut the motor down whenever an over temperature condition exists within the motor.

**CAUTION: An automatic reset device should never be used in cases where an automatic restart of the motor could cause personal injury or harm.**

c. Motors that will be operated above nameplate speed should have special consideration for mechanical suitability of the motor. Special consideration of the bearings, rotor balance, internal cooling fan construction, etc. may be needed. Please consult the motor manufacturer for more specific details on your particular type of motor and application requirements.

d. Motors that will be controlled by a PWM style inverter operating from a 460 VAC RMS power source will require special insulation between adjacent coil windings (phase insulation) within the motor to prevent phase to phase shorts. By the nature of the power conversion within the PWM controller, the motor terminals will see approximately 650 VDC peak. This elevated voltage level will eventually cause phase to phase shorting within the motor if proper precautions are not taken.

2. Any three-phase induction motor specifically designed for adjustable speed operation by an inverter type of motor control.

# MODEL TYPES

The **BALDOR** Series 11 inverter drives are available in horsepower ratings from 1 through 5 HP and various input voltages as shown in Table 1. The controllers are available in open chassis form for mounting into existing control cabinets and OEM use. The enclosed versions carry a NEMA 1 enclosure rating and are equipped with three knockouts suitable for attaching standard 3/4 inch conduit fittings. Optional NEMA 4 and NEMA 12 enclosures are available through your local **BALDOR** stocking distributor.

All **BALDOR** Series 11 inverters are complete functional motor speed controllers requiring only fused input power and a suitably sized three-phase AC induction motor to form an adjustable speed drive system. Remote operation and computer control are available by the addition of external control devices and connection to the onboard control terminal strip.

## TABLE 1 - MODEL MATRIX

| MODEL | INPUT V | MAXIMUM OUTPUT | | | AVAILABLE CONFIGURATIONS | | |
|---|---|---|---|---|---|---|---|
| | | CAPACITY | CURRENT | HORSEPOWER | CHASSIS | NEMA 1 | BRAKE (TORQUE) |
| ID11201 | 200-230 VAC 3-Ø | 750W | 5A | 1 | X | | (100%) X |
| | | | | | | X | (100%) X |
| ID11202 | | 1500W | 7A | 2 | X | | (100%) X |
| | | | | | | X | (100%) X |
| ID11203 | | 2200W | 11A | 3 | X | | (100%) X |
| | | | | | | X | (100%) X |
| ID11205 | | 3700W | 15A | 5 | X | | (70%) X |
| | | | | | | X | (70%) X |

All 230 VAC Series 11 inverter drives are suitable for use on 230 VAC single-phase input power provided that the drives are derated per Table 2.

## TABLE 2 - 230 VAC SINGLE-PHASE DERATE SCHEDULE

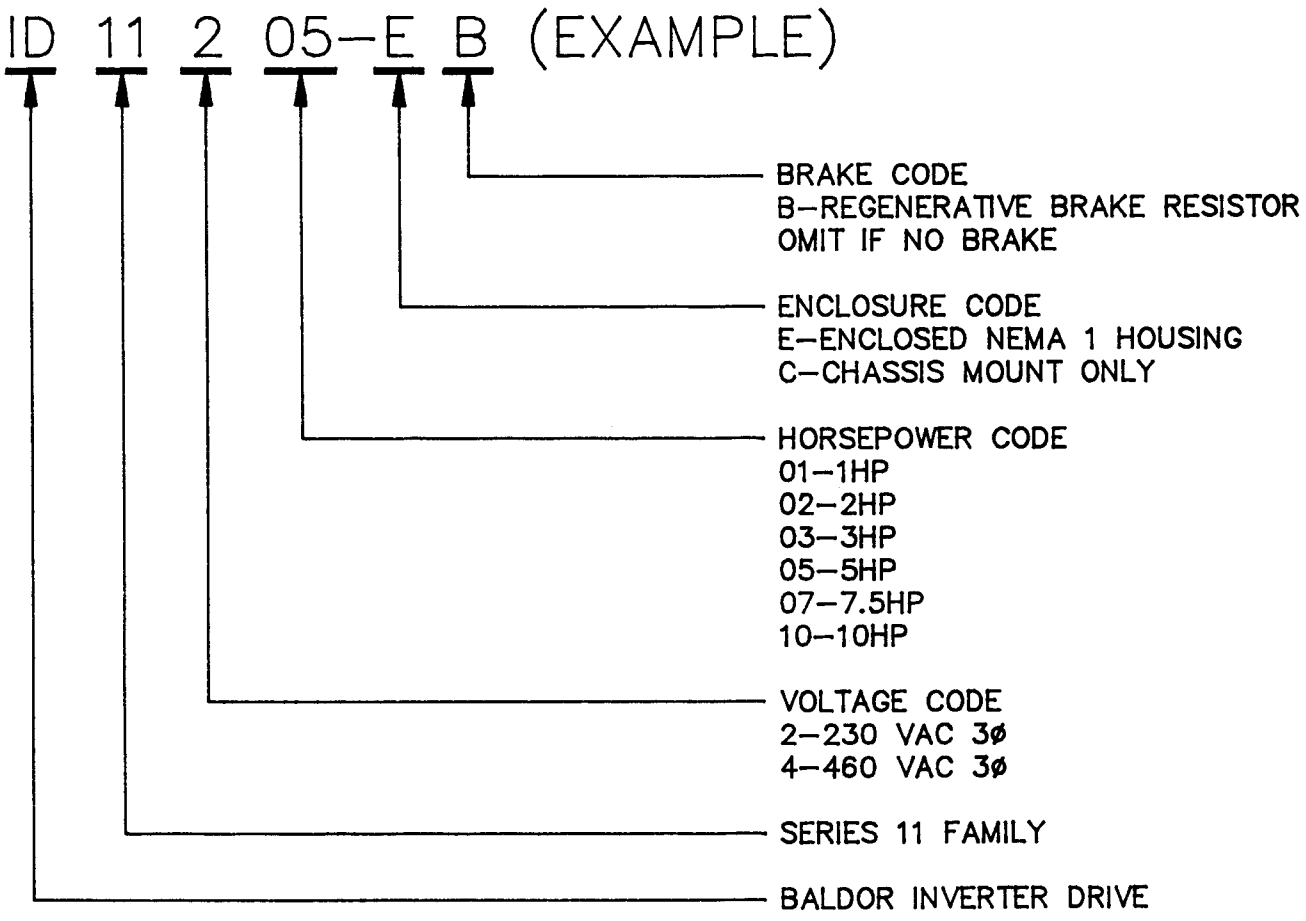
| SINGLE PHASE INPUT | RECOMMENDED 3-PHASE MODEL | |
|---|---|---|
| REQUIRED LOAD HP | LIGHT LOAD | HEAVY LOAD |
| 1/2 HP | 1 HP | 2 HP |
| 1 HP | 2 HP | 3 HP |
| 2 HP | 3 HP | 5 HP |
| 3 HP | 5 HP | 7.5 HP |

Light Load: Fans, Blowers, Centrifugal Pumps, etc.
Heavy Load: Conveyers, Mixers, Agitators, etc.

# CONTROLLER IDENTIFICATION

All Series 11 inverter drives have a nameplate attached to the drive indicating model number, applicable controller ratings, and a manufacturing date code. On enclosed units, the nameplate is located on the left side of the enclosure housing. For bare chassis units the nameplate is located on the transistor heatsink just below the control terminal strip. To determine the controller rating from the inverter model number, please refer to Table 3.

**TABLE 3 - MODEL IDENTIFICATION**



# RATINGS

1. Horsepower . . . . . 1/2 through 5 HP @ 200-230 VAC 1Ø
   . . . . . 1 through 5 HP @ 200-230 VAC 3Ø
2. Input Frequency . . . . . 50 or 60 Hz
3. Output Power (Three Phase)
   A. Voltage . . . . . 0 to Max Input VAC
   B. Frequency (Standard Range) . . . . . 0 to 60 Hz
   (Programmable Option) . . . . . 0 to 120 Hz
4. Service Factor . . . . . 1.0
5. Duty . . . . . Continuous
6. Overload Capacity (Rated Current) . . . . . 150% for 120 Seconds
   . . . . . 200% to Trip on Overcurrent Fault
7. Frequency Setting (Standard Range) . . . . . 0 to +5 VDC
8. Frequency Setting Potentiometer . . . . . 5K, 1/2W

# OPERATING CONDITIONS

1. Input Voltage Variation . . . . . +/- 10%
2. Input Frequency Variation . . . . . +/- 5%
3. Ambient Temperature
   a. NEMA 1 Enclosure . . . . . -10 to +40°C
   b. Open Chassis . . . . . -10 to +50°C
4. Humidity . . . . . 90% Max RH Non-Condensing
5. Altitude . . . . . 3300 Feet Max Without Derate

# SPECIFICATIONS

1. Control Scheme . . . . . Sinewave Carrier Input, PWM Output
2. Frequency Accuracy . . . . . +/- 0.5% @ 25°C +/- 10°C
3. Frequency Resolution . . . . . 0.24Hz @ 60Hz, 0.48Hz @ 120Hz
4. V/F Pattern . . . . . Linear to Squared Reduced in 101 Steps
5. Base Frequency . . . . . 30 to 250Hz in 221 Steps
6. Carrier Frequency . . . . . 868 to 1420Hz in 8 Steps
7. Torque Boost . . . . . 0 to 30% of Input Voltage in 101 Steps
8. Output Voltage . . . . . 0 to Input Voltage in 101 Steps
9. Accel/Decel Time . . . . . 0.1 to 1400 Sec @ 60Hz; 0.1 to 2800 sec @ 120Hz
10. Braking Torque . . . . . 20% Min., 70 to 100% With Braking Resistor
11. Dynamic Braking Time . . . . . 0 to 24.8 Seconds
12. Jog Frequency . . . . . 0 to 30Hz
13. Upper Frequency Limit . . . . . 0 to Max Frequency
14. Lower Frequency Limit . . . . . 0 to Max Frequency
15. Skip Frequency . . . . . 0 to Max Frequency in 2 Independent Zones
16. Operation Modes . . . . . 2 Speed, 4 Speed, External Thermal Trip

# STANDARD FEATURES

**Fault Trip Indication**: Whenever an appropriate internal or external situation exists to cause a fault condition within the inverter, the inverter output will be shut off and an open collector transistor at control terminals 1 and 2 will conduct to give an external indication of the fault occurrence. A visual indication as to the type of fault will be shown via fault codes on the LED display located on the front panel of the inverter. A red LED located on the lower right hand side of the inverter main circuit board will illuminate to indicate a fault condition. The open collector transistor has a maximum input voltage of 24 VDC and a maximum current carrying capacity of 50 maDC. A trip condition can be reset internally by momentarily pushing the reset button or externally by commanding Forward and Reverse movement simultaneously.

**Instantaneous Power Failure Protection (Auto Restart)**: The inverter output will be shut off if the DC bus of the converter section drops below 61% of normal for more than 15 mSec. If input voltage is restored before the end of 15 mSec. the inverter will resume normal operation from the frequency specified by the **Reduced Frequency At Instantaneous Power Failure** parameter. When input voltage is reduced below 61% but still greater than 46% of normal for more than 15 mSec. the fault trip circuit will be activated and the open collector transistor at control terminals 1 and 2 will conduct to give an external trip indication for lack of input voltage.

If the input voltage is reduced below 46% of normal or removed and then reapplied with the RUN/STOP switch in the RUN position and the selection of manual/auto restart parameter is set at "0", the inverter will start the motor as if a run command has been initiated. This command sequence is known as Auto Restart and no external trip indication will be given.

**CAUTION:** **If an automatic restart of the motor could cause personal injury or harm, the Auto Restart function should be defeated.**

**Overcurrent Trip**: The inverter output will be shut off when the output current of the controller exceeds 200% of rated current. The fault trip circuit will be activated and the open collector transistor at control terminals 1 and 2 will conduct to give an external trip indication.

**External Thermal Trip**: The inverter output will be shut off whenever an open circuit condition exists at control terminal 10 with respect to control terminals 5 or 8. Closing this circuit is usually accomplished with an externally mounted normally closed thermostat. The fault trip circuit will be activated whenever an open circuit is sensed, then the open collector transistor at control terminals 1 and 2 will conduct to give an external trip indication. The External Thermal Trip function will only operate when the inverter is in the External Thermal Trip mode of operation.

**Regenerative Overvoltage Trip**: The inverter output will be shut off when the voltage of the DC bus is higher than 23% above normal. The fault trip circuit will be activated whenever an overvoltage condition exists on the DC bus. The open collector transistor at control terminals 1 and 2 will conduct to give an external trip indication. This type of fault condition is usually due to an overhauling load on the motor output shaft during periods of deceleration causing the motor to regenerate energy back into the motor controller. This trip condition can usually be corrected by extending the deceleration time.

**Overvoltage Stall Prevention**: During periods of deceleration the decel time will be extended whenever an impending Regenerative Overvoltage trip is sensed. Total decel time will be multiplied by the value set by the **Stall Decel Magnification** parameter whenever an impending Regenerative Overvoltage trip is sensed. The total decel time with Overvoltage Stall Prevention is the product of (Decel Time) X (Decel Magnification) X (Stall Decel Magnification).

**Self Diagnosis Trip**: The inverter output will be shut off and the open collector transistor at control terminals 1 and 2 will conduct to give an external trip indication when any of the following occur:

a. A malfunction of the microcomputer is detected.
b. The inverter will trip for safety whenever the max.output frequency is changed.
c. The inverter will trip for safety whenever a change is made to the operation mode.

**Digital Display**: A digital display is mounted to the front of the inverter to give a visual display of set-up parameters, operation mode, output frequency, and fault diagnostics.

**Controlled Reversing**: The motor shaft rotation can be reversed by shorting control terminal 9 to terminal 5 or 8. The shorting of the control terminals is usually accomplished by an external switch closure. The ability to electronically reverse the motor shaft rotation eliminates the need for external reversing contactors. When a controlled reversal is commanded, the motor will decelerate down the decel ramp to zero speed and then accelerate up the accel ramp in the reverse direction.

**Bus Voltage Present Indicator**: A red LED is located on the lower left hand side of the inverter main control board. This LED is used to give a visual indication that voltage is present on the DC bus. When voltage is present on the DC bus the LED will illuminate.

**CAUTION: Do not rely on the Bus Voltage present indicator to determine when the unit is safe for maintenance or service. Always wait at least 5 minutes after disconnecting input power before beginning any internal servicing of this equipment.**

**Regenerative and DC Dynamic Braking**: Motor braking is available for stopping or short duration holding. The standard braking torque is 20% of the motor's full load torque. Units equipped with a braking resistor have an available braking torque of 70 to 100% of the motor's full load torque.

**Adjustable Skip Frequencies**: Two fully adjustable frequency skip zones are available to minimize mechanical resonance. In some applications certain inverter output frequencies may cause a mechanical resonance to develop in the driven motor load. By skipping these inverter output frequencies the machine mechanical resonance may be avoided. The frequency skip zones are selected by specifying the continue frequency and the jump frequency.

**Selectable 4 Speed Operation**: Two modes of operation available from the **BALDOR** Series 11 is a selectable 4 speed mode. One of 4 independent speeds is selected by appropriate external switch closures connected to the inverter control terminals 10 and 11 with respect to control terminals 5 or 8. Other operation modes include 2 Speed Operation and External Thermal Trip.

**Independent Accel/Decel Rates**: Each selectable speed has an independent accel/decel rate adjustment. The time of accel will equal the time of decel for each selected speed. The rate of decel for a Stop command is independent from all other accel/decel rates. The actual rate of accel/decel is the product of (Accel/Decel Time) X (Accel/Decel Magnification). Actual stopping time may vary depending on the inertia of the driven load.

# ADJUSTMENTS

**Base Frequency**: The **Base Frequency** parameter sets the point on the V/F curve where the voltage output of the inverter becomes a constant value with increasing output frequency. The base frequency is adjustable within the range of 30 to 250 Hz in 221 steps.

**Carrier Frequency**: The PWM carrier frequency input to the internal inverter control scheme is adjustable within the range of 868 to 1420 Hz in 8 steps. The PWM carrier frequency can be adjusted to minimize audible noise.

**Volts/Hertz (V/F) Ratio**: The **BALDOR** Series 11 has a fully adjustable V/F ratio. The V/F ratio is set from the factory to be a linear function for constant torque applications and can be adjusted to a squared reduced relationship for variable torque applications. The **Base Frequency** parameter can be adjusted to give constant horsepower from a properly sized AC induction motor throughout the entire speed range.

**Maximum Output Frequency**: The maximum output frequency is set from the factory at 60 Hz. The maximum output frequency can be set to 120 Hz via a dip switch located on the lower right hand side of the main control board to allow the motor to be driven at twice the motor's rated speed. Please consult the motor manufacturer for suitability to run at a speed higher than the nameplate rating.

**Upper And Lower Frequency Limits**: The upper and lower frequency output of the motor controller can be set to limit the adjustable speed range of the driven motor. This feature is useful in application where a minimum or maximum motor speed is desired regardless of the input command signal.

**Torque (Voltage) Boost**: In applications that require high starting torque, the voltage output of the inverter at low output frequencies can be increased to provide more motor starting torque. The **Torque Boost** is set from the factory at a level that is suitable for most applications. If you find that your application requires more starting torque than is available with the factory setting, then the **Torque Boost** parameter can be adjusted to suit your application requirements. Please use caution when adjusting the boost to ensure that the motor does not overheat at low operating speeds.

**Jog At Preset Speed**: When operating in the 2 speed mode, the second speed is a "Jog" speed. The "Jog" frequency is adjustable from 0 to 30 Hz. This feature is useful in applications where a lower than normal speed is desired for machine setup or for low speed operation.

# OPTIONS

**Enclosures**: NEMA 4 and NEMA 12 enclosures are available for all **BALDOR** Series 11 Inverters. Please consult your local **BALDOR** stocking distributor for more details.

# INSTALLATION

This section covers all instructions for proper mounting and wiring of the **BALDOR** Series 11 Inverter. All tools required for normal installation should be available from any competent electrical service technician. Please thoroughly read Section II and Section III of this manual before applying power to the inverter. If problems arise after installation, please refer to the Troubleshooting section of this manual located in Section IV- Maintenance.

## MOUNTING INSTRUCTIONS

1. Select a mounting surface for the inverter that will allow the controller to be mounted in a vertical position using the four mounting holes provided. The area selected should allow for free air circulation around the controller. Provide for at least two inches of clearance on all sides for maximum cooling efficiency.

   **CAUTION: Avoid locating the inverter immediately above or beside heat generating equipment, or directly below water or steam pipes.**

2. The ambient temperature around the controller should not exceed 40°C. for enclosed versions and 50°C. for open chassis mounting. If the controller is mounted into an existing control cabinet, the ambient temperature limits should not be exceeded or failure of the controller may result. In cases where extreme temperatures are unavoidable, a separate blower fan or cooling system should be considered.

3. The standard ventilated NEMA 1 enclosure should not be used in areas where the controller will be subjected to liquids, chemicals, large amounts of airborne material (ie. dust or lint), or explosive atmospheres. Appropriate protection should be provided for the inverter when used in these environments.

4. If the controller will be subjected to levels of vibration above 0.5G at 10 to 60 Hz, then the inverter should be shock mounted. Excessive vibration within the controller could cause internal connections to loosen and cause component failure or electrical shock hazard.

## WIRING INSTRUCTIONS

1. Interconnection wiring is required between the inverter, AC power source, motor, and any optional operator control stations.

**CAUTION: Separate overcurrent protection is required by the National Electrical Code. The installer of this equipment is responsible for complying with the National Electrical Code and any applicable local codes which govern such practices as wiring protection, grounding, disconnects, and other current protection.**

2. The inverter is self protected from normal AC line transients and surges. Additional external protection may be required if high energy transients are present on the incoming power source. These transients could be caused by sharing a power source with arc welding equipment, large motors being started across the line, or other industrial equipment requiring large surge currents. To prevent inverter damage due to power source disturbances the following should be considered:

   a. Connect the inverter on a feeder line separate from those supplying large inductive loads.

   b. Supply power to the inverter through a suitably sized isolation transformer. When utilizing an isolation transformer to power the inverter, always switch the power off and on between the transformer secondary and the inverter input to avoid spikes due to the collapsing field within the transformer when the power is removed from the primary side.

   **CAUTION: Do not use power factor correction capacitors on the input power lines to the inverter or damage to the controller may result.**

3. All external control wiring to the inverter should be run in a separate conduit from all other wiring. The use of shielded twisted pair wire is recommended for all control wiring. The shield of the control wiring should be connected to control ground of the inverter only. The other end of the shield should be taped to the wire jacket to prevent electrical shorts.

4. Three 3/4 inch conduit openings are provided at the bottom of the inverter housing to facilitate power and control wiring entrance to the controller.

**AC Power Connections**: Connect the fused three-phase AC power lines to the input power terminals L1, L2, and L3, using pre-insulated crimp on terminals. If using single-phase power, connect one of the power leads to input power terminal L2 and the other power lead to either input power terminals L1 or L3. The phase rotation of the input power is not important since the controller is not sensitive to phase rotation of the input power.

Connect an earth ground to the inverter according to any applicable electrical code. The earth ground should be connected to the inverter at terminal G of the input power terminal block.

The use of a power contactor is recommended between the input power and the inverter to provide a fail-safe method to disconnect the controller from the input power. The inverter will remain in a power up condition until all input power is removed from the controller and the internal bus voltage is depleted as indicated by the Bus Voltage Present Indicator.

**CAUTION: Do not attempt to service this equipment while bus voltage is present within the inverter. Remove input power and wait at least 5 minutes for the residual power in the bus capacitors to dissipate.**

**Motor Connections:** Connect the three-phase power leads of the AC induction motor to terminals T1, T2, and T3 of the inverter power terminal block using pre-insulated crimp on terminals. If the motor is supplied with a ground lead, connect this lead to terminal G of the inverter power terminal block.

Do not use a power disconnect contactor between the motor and the inverter or damage may result to the controller. The motor should be connected to the inverter at all times during inverter operation.

If additional motor overload protection is required, the use of suitably sized motor overload heaters and relays is recommended. Motor overload relays should be connected between the motor and the inverter with the relay trip indicator circuit connected into the external inverter control circuitry to power down or trip the inverter in the event of motor overloading. If external control circuitry is not being utilized in your particular application, it is possible to connect the normally closed overload relay contact in series with the external thermal trip device to give a fault trip indication from the controller.

**CAUTION: Overload relays with an automatic reset feature are not recommended in applications where an automatic restart of the motor could cause personal injury or harm. If manual reset relays are not available, then the automatic reset feature should be defeated.**

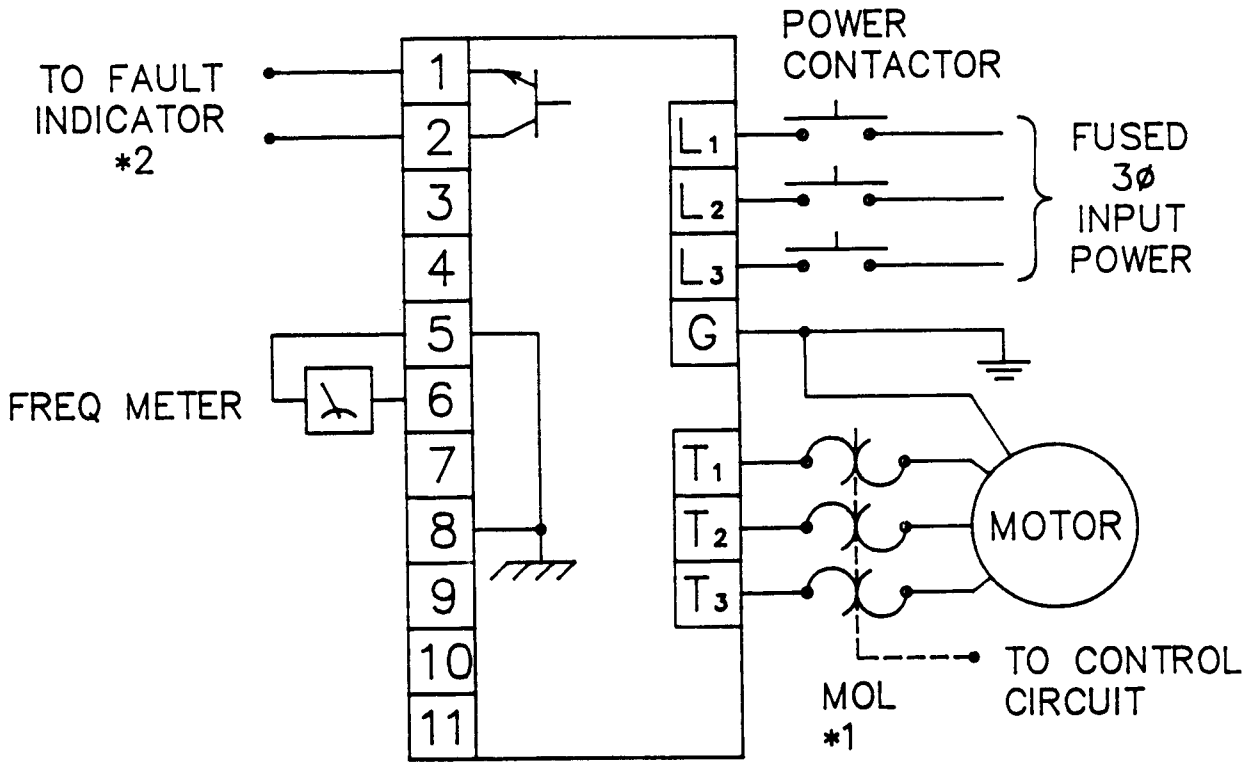
If the motor is equipped with a normally closed thermostat the thermostat should be connected to terminal 10 with respect to terminals 5 or 8 of the inverter control terminal strip. The External Thermal Trip feature of the inverter is only operable when the inverter is in the External Thermal Trip mode of operation. If the External Thermal Trip mode of operation cannot be utilized in your application, then the motor thermostat should be connected into the external inverter control circuitry to power down the inverter when a thermal trip condition exists.

If during initial motor start-up the motor rotation is opposite to that desired, disconnect the input power from the inverter and wait at least 5 minutes for the bus voltage to bleed off. Interchange any two of the three motor leads at the inverter power terminal block T1, T2, T3 to change the shaft rotation of the motor.

**External Control Circuitry**: Before attempting to connect the inverter to external control circuitry or main power, determine which of the following connection diagrams is suitable for your particular application. If you are unsure of your particular connection requirements you may wish to review all of the connection diagrams and choose the diagram which suits your application needs.

**CAUTION:** **Failure to connect the inverter as shown in the following diagrams may result in damage to the driven load, failure of the controller, or cause personal injury. Care should be exercised to protect persons working in and around equipment that is being controlled from a remote location.**

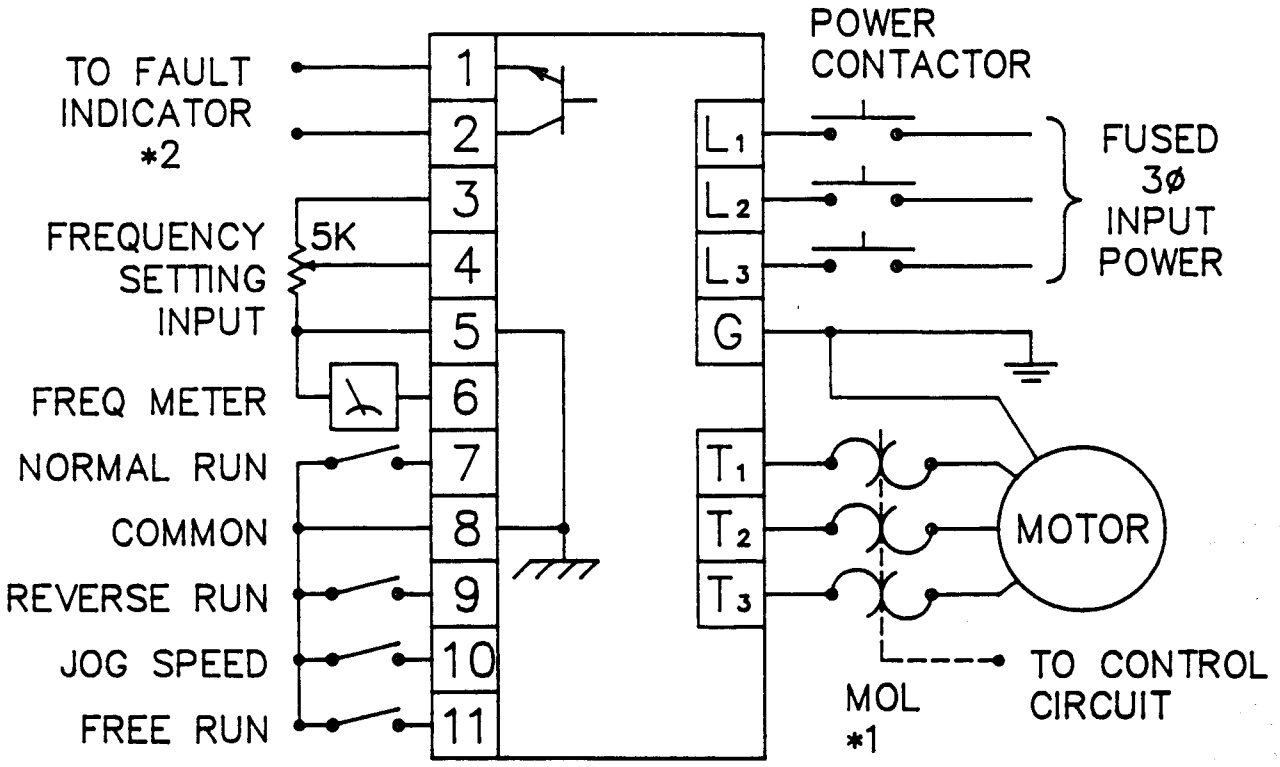
**FIGURE 1. - 2-SPEED OPERATION (JOG)**




*1 THE TRIP INDICATOR OF THE THERMAL RELAY SHOULD BE USED TO DISABLE THE DRIVE OR DISCONNECT THE INPUT POWER TO THE DRIVE IF AN OVERLOAD CONDITION OCCURS.

*2 CIRCUIT RATED AT 50ma DC, 24VDC MAXIMUM. IF THIS CIRCUIT IS USED TO DIRECTLY DRIVE A RELAY, A FLYBACK DIODE RATED FOR 1A, 100V SHOULD BE CONNECTED ACROSS THE RELAY COIL.

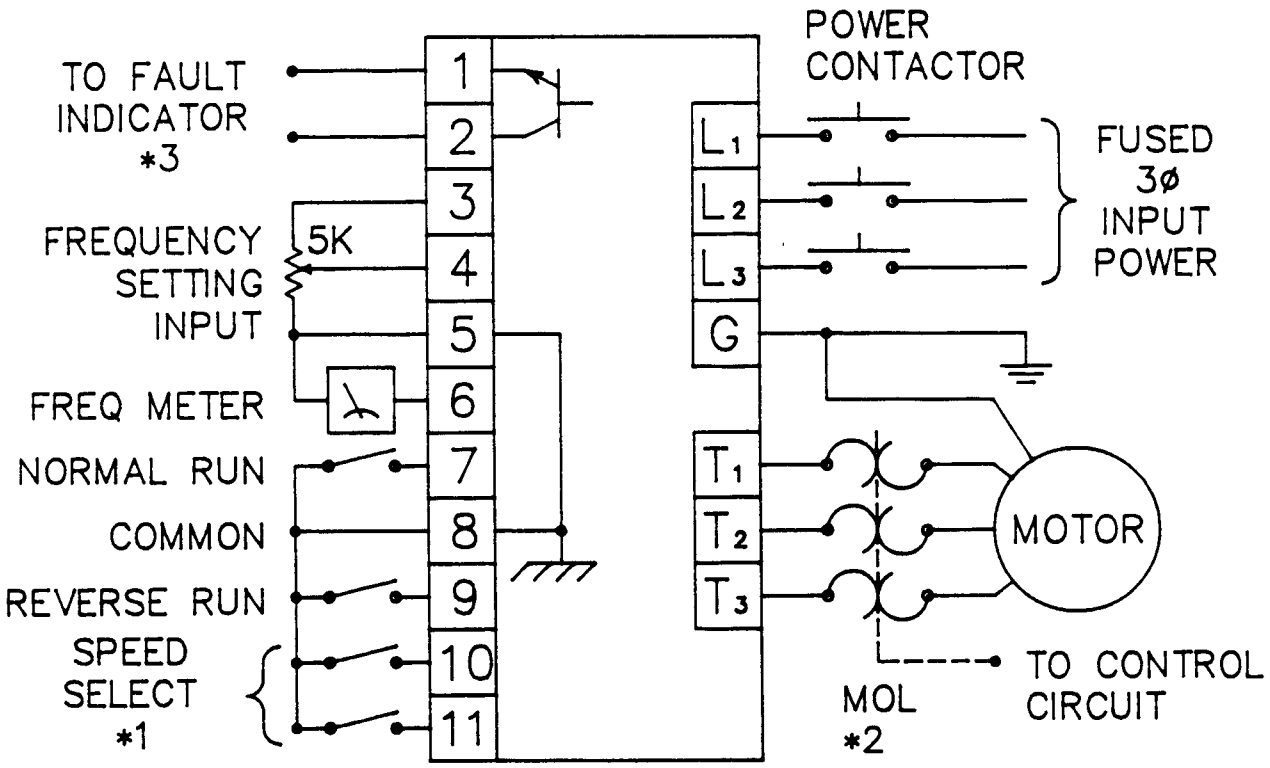
**FIGURE 2. - 2-SPEED OPERATION (JOG) WITH EXTERNAL CONTROL**




*1 THE TRIP INDICATOR OF THE THERMAL RELAY SHOULD BE USED TO DISABLE THE DRIVE OR DISCONNECT THE INPUT POWER TO THE DRIVE IF AN OVERLOAD CONDITION OCCURS.

*2 CIRCUIT RATED AT 50ma DC, 24VDC MAXIMUM. IF THIS CIRCUIT IS USED TO DIRECTLY DRIVE A RELAY, A FLYBACK DIODE RATED FOR 1A, 100V SHOULD BE CONNECTED ACROSS THE RELAY COIL.

**FIGURE 3. - 4-SPEED OPERATION**

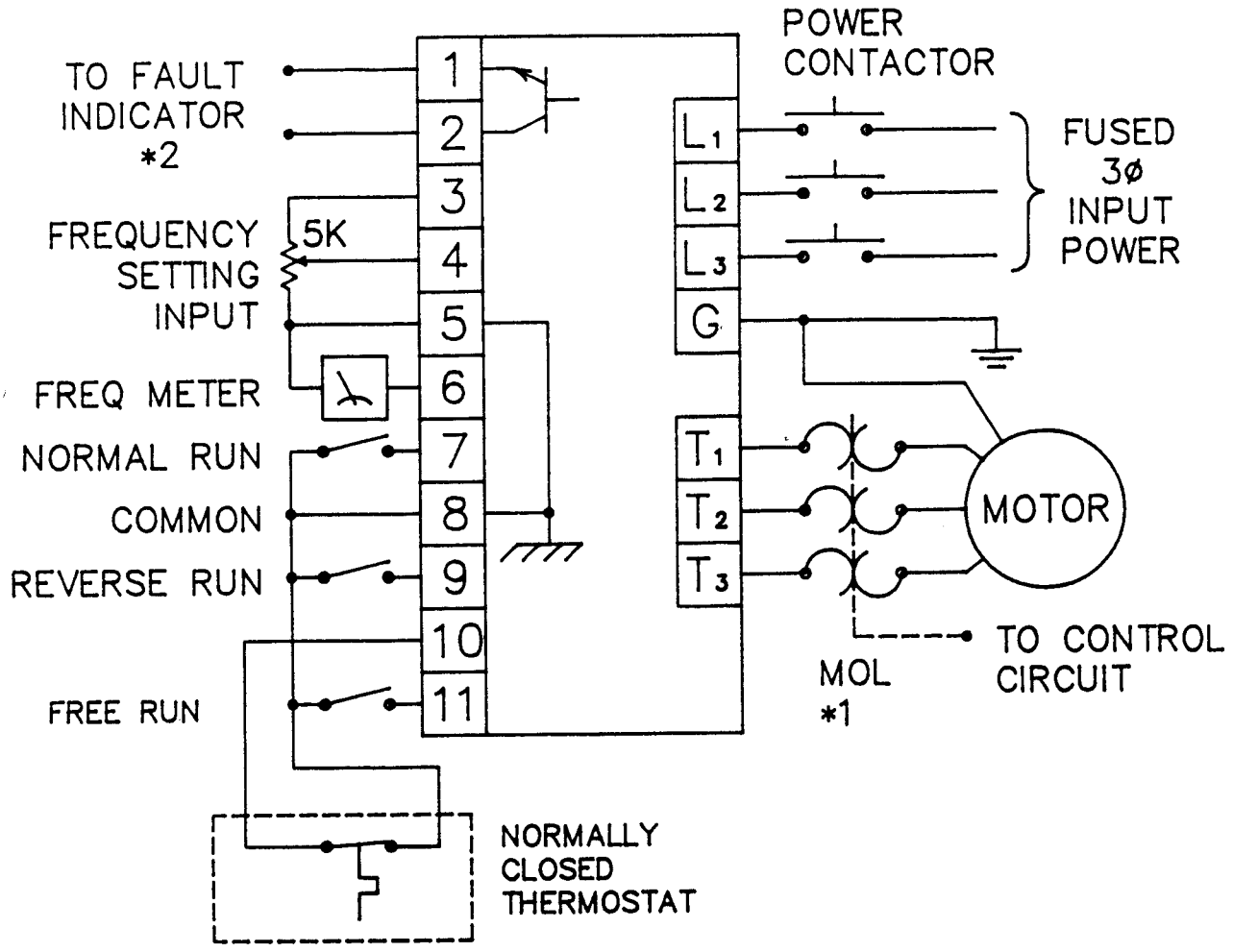



| *1 | SW10 | SW11 |
|---|---|---|
| SPEED 1 | OPEN | OPEN |
| SPEED 2 | SHORT | OPEN |
| SPEED 3 | OPEN | SHORT |
| SPEED 4 | SHORT | SHORT |

*2 THE TRIP INDICATOR OF THE THERMAL RELAY SHOULD BE USED TO DISABLE THE DRIVE OR DISCONNECT THE INPUT POWER TO THE DRIVE IF AN OVERLOAD CONDITION OCCURS.

*3 CIRCUIT RATED AT 50ma DC, 24VDC MAXIMUM. IF THIS CIRCUIT IS USED TO DIRECTLY DRIVE A RELAY, A FLYBACK DIODE RATED FOR 1A, 100V SHOULD BE CONNECTED ACROSS THE RELAY COIL.

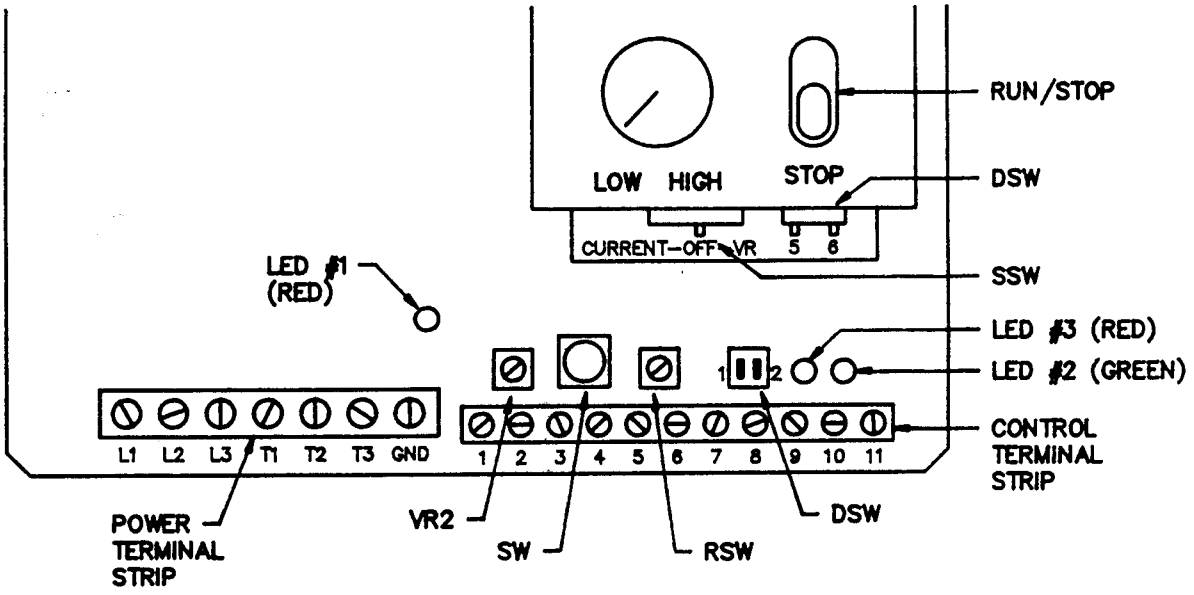
**FIGURE 4. - EXTERNAL THERMAL TRIP**




*1 THE TRIP INDICATOR OF THE THERMAL RELAY SHOULD BE USED TO DISABLE THE DRIVE OR DISCONNECT THE INPUT POWER TO THE DRIVE IF AN OVERLOAD CONDITION OCCURS.

*2 CIRCUIT RATED AT 50ma DC, 24VDC MAXIMUM. IF THIS CIRCUIT IS USED TO DIRECTLY DRIVE A RELAY, A FLYBACK DIODE RATED FOR 1A, 100V SHOULD BE CONNECTED ACROSS THE RELAY COIL.

FIGURE 5. - TERMINAL AND SWITCH LOCATION




# INITIAL START-UP

After the mounting and wiring procedures have been completed check for any dirt or debris that may have collected inside the inverter control cabinet. If necessary use a vacuum cleaner to remove the debris. Do not use compressed air to clean the inside of the inverter as dirt blown beneath and into the circuit components can cause short circuits and/or grounds to form within the controller.

The inverter has been factory tested and adjusted for operation on most applications and should not require many adjustments if any for normal operation. Before energizing the inverter for the first time the persons performing the initial start-up should familiarize themselves with the selected inverter operation mode and the associated external control scheme. The following start-up procedure should be followed for proper operation, system compatibility, and safety.

**Pre-power Checkout**: Be sure that all AC input power is turned off and the bus power present LED is not illuminated.

1. Check that all interconnection wiring is correct and all wiring terminations are tightened securely.

2. Visually inspect the inverters internal wiring for loose or open connections, and any damaged components. Any loose or damaged components must be corrected before power is applied.

3. Measure the incoming power to the inverter and be sure it is within the acceptable limits of the controller's rated input power requirements.

4. Couple the motor to the driven load while following the manufacturer's recommendations for proper coupling alignment. Misalignment of the motor to the driven load could cause imbalance of the mechanical system or premature failure of the bearing support system.

**Power-On Checkout**: Before applying power to the inverter place the RUN/STOP switch in the STOP position and turn the speed reference potentiometer completely counter-clockwise to LOW. If using external control circuitry, initiate a stop command and set the speed reference potentiometer to its minimum setting.

1. Check for proper switch settings of switches SSW (three position switch located on the LED display circuit board), DSW #1&2 (two position DIP switch located on the main circuit board), and DSW #5&6 (two position DIP switch located on the LED display circuit board). These switches are set from the factory for 60 Hz maximum output, front mounted speed reference potentiometer and RUN/STOP switch operable. For other types of command signals and/or 120 Hz maximum output, please refer to the operation section of this manual (Table 6) for proper switch settings.

   **CAUTION: DSW 5 is set in the off position from the factory. This switch should always remain in the off position or damage to the inverter may result.**

2. Apply proper input power to the inverter. The LED display located on the front of the inverter should illuminate indicating the output frequency of the controller. The display should read "_ _ 0" if the inverter is receiving a STOP command.

3. With the speed reference signal set to the minimum speed setting, initiate a RUN command.

4. Slowly increase the speed reference signal (turn the front mounted speed dial clockwise) to verify that the motor increases speed with an increase in the speed reference signal.

5. If the motor shaft rotation is opposite to that desired, initiate a STOP command, disconnect the inverter input power and wait for the bus power present indicator to extinguish, then interchange any two of the three motor leads at terminals T1, T2, T3. Be sure to re-tighten the motor terminal connections.

6. Initiate a RUN command and check that the motor speed responds proportionally to the magnitude of the input speed reference command. The front mounted LED display will indicate the output frequency of the inverter. The output frequency of the inverter corresponds to the motor shaft speed by the synchronous speed equation as follows:

$$\text{MAXIMUM MOTOR SPEED} = \frac{120 \times (\text{MOTOR INPUT FREQUENCY})}{\text{NUMBER OF MOTOR POLES}}$$

Where...Inverter Output Frequency = Motor Input Frequency

7. If necessary adjust the rates of acceleration and deceleration as desired. Please refer to the operation section of this manual before attempting to adjust any operating parameters.

   a. When adjusting acceleration, be sure the rate of acceleration is not too rapid and the motor is not overloaded. Too rapid acceleration and/or excessive motor load will cause the inverter to trip from an overcurrent fault.

   b. When adjusting deceleration, be sure the rate of deceleration is not too rapid and the motor with load coasting time is not longer than the desired deceleration time. Too rapid deceleration and/or an overhauling load will cause the inverter to trip from an overvoltage fault. If the motor with load coasting time is longer than the desired deceleration time, then an inverter with a built in braking resistor to provide sufficient braking torque should be considered.

8. Adjust the motor speed potentiometer to its minimum setting and initiate a STOP command.

# OPERATION

All **BALDOR** Series 11 inverters provide the following operation parameters as standard features. The one exception is in the value of the internal braking resistor that provides extra braking torque. All Series 11 inverters will come standard with 20% minimum braking torque available. Please compare your inverter model number with Table 1 - Model Matrix and Table 3 - Model Identification to determine the amount of braking torque available from your controller.

Before attempting to adjust any of the operating parameters please read the parameter adjustment and inverter resetting procedures carefully. Failure to read and understand these procedures may cause undue mental stress or anxiety to the installer of this equipment.

**Parameter Adjustment**: Within the Series 11 inverter, there are four levels of parameter adjustments, levels 0, 1, 2, and 3. These levels could be viewed as pages within a book. On each level (page) there are up to fifteen different parameter adjustments with one common frequency monitoring point, making a total of sixteen parameters. The parameters are system adjustment points. Some parameters are interrelated, some are independent adjustments.

Levels and parameters are chosen using the sixteen position switch RSW located on the lower right hand side of the main control board. The sixteen position switch is marked with characters 0 through F, with position F being the sixteenth position and position 0 being the frequency monitoring point.

When the inverter is powered up or reset, the controller will automatically be set to level 0. To select a different level or change a parameter setting, potentiometer VR2 is utilized.

Potentiometer VR2 is mounted to the main control board just to the left of RSW. To change the value of the selected parameter, VR2 must be rotated clockwise or counter-clockwise to match the present value of the parameter. When the present value of the parameter is reached, the green LED, LED #2, will illuminate. LED #2 is located just to the right of RSW at the lower right hand side of the main control board. Once LED #2 illuminates, the parameter can be changed to a lower value by rotating VR2 counter-clockwise or to a higher value by rotating VR2 clockwise.

Each time a new parameter value is reached, LED #2 will illuminate to indicate the next value point. The front mounted LED display will indicate the current parameter value as it is reached by virtue of rotating VR2. The new parameter value will not be recognized by the microcomputer until RSW is rotated off the selected parameter indicator, 0 through F. Table 4 lists the parameter level (page) locations along with the available parameter adjustment values. A blank column is provided next to the available parameter values in Table 4 to record the parameter values as you adjust them for your application requirements.

## EXAMPLE...PARAMETER ADJUSTMENT

Lets assume that we are operating in the 2-Speed Mode of operation and wish to change the JOG frequency to its maximum value. The JOG frequency parameter is located on level 1 (page 1), parameter 1, and is set from the factory at 7 Hz.

**Step 1...**Find parameter location and possible values.

From Table 4 we see that the JOG frequency parameter is located at level 1, parameter 1. The factory setting is 7 Hz and the maximum value is 30 Hz.

**Step 2...**Adjust controller to parameter level 1.

From Table 4 we see that the parameter level adjustment location is at position F of RSW for all parameter levels. With a small insulated screwdriver rotate RSW to position F. The number shown on the LED display indicates the current parameter level. Rotate VR2 counter-clockwise and/or clock-wise until green LED #2 illuminates. When LED #2 illuminates the value of VR2 is matched to the present level value as indicated on the LED display. Rotate VR2 until the LED display reads "_ _ 1". By rotating RSW off of position F, the new parameter level will be recognized by the microcomputer. Rotate RSW to position 1...this will initialize the new parameter level and we will be ready to adjust the JOG frequency.

**Step 3...**Adjust JOG frequency to 30 Hz.

Rotate RSW to position 1 (this should have been completed in step 2), the number indicated on the LED display is the current value of JOG frequency. Rotate VR2 clockwise and/or counter-clockwise until green LED #2 illuminates. When LED #2 illuminates the value of VR2 is matched to the present JOG frequency value as indicated on the LED display. Rotate VR2 until the LED display reads "30". By rotating RSW off of position 1, the new JOG frequency will be recognized by the microcomputer. Rotate RSW to position 0 to monitor the output frequency of the inverter, or to the next parameter that requires adjustment.

**Step 4...**Record new parameter value.

With a pencil record the new JOG frequency value in Table 4. A blank column is provided next to the factory parameter settings in Table 4 to record customer adjustments. These customer parameter adjustment values will be useful if troubleshooting is required during inverter operation.

## RECAP OF PARAMETER ADJUSTMENT EXAMPLE

1. Choose parameter to be adjusted.
2. Find location of parameter and possible values in Table 4.
3. Select appropriate parameter level.
4. Select and adjust appropriate parameter.
5. Record new parameter value in Table 4.

## TABLE 4 - PARAMETER LOCATION AND POSSIBLE VALUES

| LEVEL | RSW | PARAMETER | ADJUSTABLE RANGE | FACTORY SETTING | USER SETTING |
|---|---|---|---|---|---|
| 0 | 0 | FREQUENCY MONITORING | | | |
| | 1 | OPERATION MODE | 0,1,2,3,4 | 0 | |
| | 2 | 1ST ACCEL TIME | 0,1,2,3,4,5,6,7 | 5 SEC | |
| | 3 | 1ST ACCEL MAGNIFICATION | 0.2,0.5,1,2,10,20,100,200 | 1 | |
| | 4 | STOP DECEL TIME | 0,1,2,3,4,5,6,7 | 5 SEC | |
| | 5 | STOP DECEL MAGNIFICATION | 0.2,0.5,1,2,10,20,100,200 | 1 | |
| | 6 | CARRIER FREQUENCY | 0,1,2,3,4,5,6,7 | 2 | |
| | 7 | TORQUE BOOST | 0 TO 100 | 34 (20) | |
| | 8 | DC DYNAMIC BRAKE TIME | 0 TO 3.1 OR 0 TO 24.8 | 0.5 SEC. | |
| | 9 | DC BRAKE TORQUE | 0 TO 100 | 26 (20) | |
| | A | UPPER LIMIT FREQUENCY | 0 TO MAX FREQUENCY | 0 HZ | |
| | B | LOWER LIMIT FREQUENCY | 0 TO MAX FREQUENCY | 0 HZ | |
| | C | 2ND SPEED FREQUENCY | 0 TO MAX FREQUENCY | 14 HZ | |
| | D | 3RD SPEED FREQUENCY | 0 TO MAX FREQUENCY | 5 HZ | |
| | E | 4TH SPEED FREQUENCY | 0 TO MAX FREQUENCY | 30 HZ | |
| | F | PARAMETER LEVEL | 0,1,2,3 | 0 | |
| 1 | 0 | FREQUENCY MONITORING | | | |
| | 1 | JOG FREQUENCY | 0 TO 30 HZ | 7 HZ | |
| | 2 | SKIP FREQUENCY 1-A | 0 TO MAX FREQUENCY | 0 HZ | |
| | 3 | SKIP FREQUENCY 1-B | 0 TO MAX FREQUENCY | 0 HZ | |
| | 4 | SKIP FREQUENCY 2-A | 0 TO MAX FREQUENCY | 60 HZ | |
| | 5 | SKIP FREQUENCY 2-B | 0 TO MAX FREQUENCY | 60 HZ | |
| | 6 | RED. FREQ. - INST. POWER FAIL | 0 TO MAX FREQUENCY | 3 HZ | |
| | 7 | DC BRAKE START FREQUENCY | 0 TO 30 HZ | 3 HZ | |
| | 8 | DC BRAKE SELECTION | "__P" - POSITIONING<br>"_-P" - SUDDEN STOP | "__P" POSITIONING | |
| | 9 | V/F CURVE | 0 TO 100 (V=F TO V=$F^2$) | 0 | |
| | A | STALL DECEL MAGNIFICATION | 1,2,4,8,16 | 8 | |
| | B | FREQUENCY DISPLAY | "O-F" - OUTPUT FREQ.<br>"S-F" - SET FREQ. | "O-F" OUTPUT FREQ. | |
| | C | MAX OUTPUT VOLTAGE | 0 TO 100 | 100 | |
| | D | BASE FREQUENCY | 30 TO 250 HZ | 60 HZ | |
| | E | FREQ. METER CALIBRATION | | | |
| | F | PARAMETER LEVEL | 0,1,2,3 | 0 | |

( ) - Factory Setting for 3 and 5 HP

## TABLE 4 - PARAMETER LOCATION AND POSSIBLE VALUES - Continued

| LEVEL | RSW | PARAMETER | ADJUSTABLE RANGE | FACTORY SETTING | USER SETTING |
|---|---|---|---|---|---|
| 2 | 0 | FREQUENCY MONITORING | | | |
| | 3 | 2ND ACCEL/DECEL TIME | 0,1,2,3,4,5,6,7 | 5 SEC. | |
| | 4 | 2ND ACCEL/DECEL MAGNIFICATION | 0.2,0.5,1,2,10,20,100,200 | 1 | |
| | 7 | 3RD ACCEL/DECEL TIME | 0,1,2,3,4,5,6,7 | 5 SEC. | |
| | 8 | 3RD ACCEL/DECEL MAGNIFICATION | 0.2,0.5,1,2,10,20,100,200 | 1 | |
| | B | 4TH ACCEL/DECEL TIME | 0,1,2,3,4,5,6,7 | 5 SEC. | |
| | C | 4TH ACCEL/DECEL MAGNIFICATION | 0.2,0.5,1,2,10,20,100,200 | 1 | |
| | F | PARAMETER LEVEL | 0,1,2,3 | 0 | |
| 3 | 0 | FREQUENCY MONITORING | | | |
| | 1 | SWITCHING OF ANALOG SETTING | "0-5" OR "420" | "0-5" | |
| | 2 | SELECTION OF MANUAL/AUTO RESTART (RETRY) | 0,1,2,3,4 | 1 | |
| | 3 | RETRY STARTING TIME | 0,2,4,...122,124 | 4 | |
| | 4 | SELECTION OF STEP CHANGE/LINEAR CHANGE | 0 (STEP),1 (LINEAR) | 0 (STEP) | |
| | A | PARAMETER INITIALIZATION | "YES" OR "_NO" | "_NO" | |
| | B | CAUSE OF 4TH LATEST TRIP | | | |
| | C | CAUSE OF 3RD LATEST TRIP | | | |
| | D | CAUSE OF 2ND LATEST TRIP | | | |
| | E | CAUSE OF LAST TRIP | | | |
| | F | PARAMETER LEVEL | 0,1,2,3 | 0 | |

**( ) - Factory Setting for 3 and 5 HP**

**RESET**: A reset button is provided within the inverter to reset the internal logic of the motor controller. An internal logic control reset will be necessary whenever the following fault situations occur:

1. Lack of input voltage
2. Overcurrent trip
3. External thermal trip
4 Regenerative overvoltage trip
5. Self diagnosis trip

When a fault condition exists within the inverter the red LED #3 will illuminate and a fault code will be shown on the front mounted LED display. LED #3 is located on the lower right hand side of the main control board. The fault codes and corresponding fault conditions are listed in Table 5.

The cause of the last four fault trip conditions will be retained in memory to facilitate system troubleshooting. The corresponding fault codes can be retrieved by viewing the **Cause of Latest Trip** parameters. Please refer to Table 4 - Parameter Location and Possible Values for the location of the **Cause of Latest Trip** parameters.

There are three methods to reset a fault condition within the inverter, one internal method and two external methods. To reset the inverter internally, momentarily push SW. SW is the black push button located at the lower right hand side of the main control board between RSW and VR2. An external reset of the inverter can be accomplished by 1) removing input power from the controller for more than 15 mSec or 2) commanding a forward and reverse motor movement simultaneously after a trip condition occurs. If a forward and reverse command is given without a trip condition, the inverter will treat this command as a stop command. A "CAU" trip cannot be reset by a simultaneous forward and reverse command. Whenever a reset of the inverter is completed, the controller will automatically set the parameter level (page) to level 0.

For more information on the inverter fault trip conditions, please refer to section I of this manual - Standard Features.

**TABLE 5 - FAULT CODES**

| TYPE OF FAULT | LED DISPLAY | LED #2 (GREEN) | LED #3 (RED) ON TIME | LED #3 (RED) OFF TIME |
|---|---|---|---|---|
| LACK OF INPUT VOLTAGE | _L | ON/OFF | | |
| OVERCURRENT TRIP | _OC | | CONTINUOUS | |
| OVERVOLTAGE TRIP | _OU | | 1 SEC. | 1 SEC. |
| EXTERNAL THERMAL TRIP | _OL | | 0.25 SEC. | 0.25 SEC. |
| MALFUNCTION OF MICROCOMPUTER | ERR | | 0.1 SEC. | 0.1 SEC. |
| CHANGE OF MAX FREQ. OR MODE | CAU | | 0.5 SEC. | 0.5 SEC. |
| PARAMETER INITIALIZATION | --- | ON/OFF 2 SEC. INT. | | |
| MANUAL RESTART | _RP | | | |

**Power On/Off**: The inverter is operational whenever sufficient input power is applied to terminals L1, L2, L3. To completely disable the motor controller, all input power must be removed and the bus power present indicator must be extinguished. The input power to the inverter should be switched on and off by a suitably sized power contactor. If the inverter input power is being supplied through an isolation transformer, the power contactor should be connected between the transformer secondary and the motor controller. Do not use a power contactor on the primary side of the transformer to switch the power on and off to the inverter or damage to the controller may result.

**RUN/STOP**: A slide switch is provided on the front of the inverter to command the controller to supply power to the motor. To command motor movement slide the RUN/STOP switch to the RUN position. To command the motor to stop, slide the RUN/STOP switch to the STOP position. The rotation of the motor shaft is determined by the connection of the motor leads to the inverter unless an external reversing switch is being utilized.

External control of the RUN/STOP command can be accomplished by utilizing control terminals 7 and 8. A RUN command will be initiated by connecting control terminal 7 to control terminal 8. A STOP command will be recognized whenever control terminal 7 is disconnected from control terminal 8. A switch connected between control terminals 7 and 8 will satisfy the external RUN/STOP control circuitry.

If external control circuitry is being utilized to accomplish the RUN/STOP commands, the front mounted RUN/STOP slide switch should be disabled. Please refer to Table 6 for proper internal inverter switch settings to disable the front mounted RUN/STOP switch.

**Reversing**: Electronic reversing of the motor shaft rotation is available from the inverter by utilizing control terminals 8 and 9. A REVERSE command will be initiated by connecting control terminal 9 to control terminal 8. A switch connected between control terminals 8 and 9 will satisfy the external REVERSE command control circuitry.

When a REVERSE command is initiated, the motor will decelerate to zero speed at the rate set by decel parameter adjustment and then accelerate in the opposite shaft rotation at the rate set by the accel parameter to the proper set speed. A single pole, double throw, center off switch connected to control terminals 7, 8, and 9 is recommended if the reversing feature is being utilized, to prevent a FORWARD and REVERSE command from being given at the same time. A simultaneous FORWARD and REVERSE command is recognized by the controller as a STOP command under normal operation. If the inverter is receiving a STOP command before the time the REVERSE command is given then the motor will accelerate to the set speed in a direction opposite to the normal shaft rotation.

**Speed Command**: There are four methods to accomplish a Speed Command to the Series 11 inverter, 1) utilize the front mounted LOW/HIGH potentiometer, 2) connect a 5 kilohm, 1/2 watt potentiometer to control terminals 3, 4, and 5, 3) connect a 0 to 10 VDC voltage follower to control terminals 4 and 5, and 4) connect a 4 to 20 maDC current follower to control terminals 4 and 5.

In order to utilize the voltage or current follower inputs to the inverter, appropriate internal switch settings as indicated in Table 6 will need to be changed. The four Speed Command methods are as follows:

1. **LOW/HIGH potentiometer**: The LOW/HIGH potentiometer is located on the front of the LED display board. To command the minimum inverter output frequency the LOW/HIGH potentiometer should be turned completely counter-clockwise. To command the maximum inverter output frequency the LOW/HIGH potentiometer should be turned completely clockwise. There is a linear relationship between the minimum and maximum potentiometer settings with respect to output frequency and the potentiometer knob pointer.

2. **5 Kilohm, 1/2 watt potentiometer**: An external 5 kilohm, 1/2 watt potentiometer can be connected into control terminals 3, 4, and 5 to facilitate a speed reference command. The minimum potentiometer setting will correspond to a minimum inverter output frequency and the maximum potentiometer setting will correspond to a maximum inverter output frequency. The potentiometer high side should be connected to control terminal 3 (5 VDC output), the low side should be connected to control terminal 5 (ground), and the wiper should be connected to control terminal 4 (frequency setting input).

3. **0 to 10 VDC voltage follower**: A 0 to 10 VDC speed reference command can be connected to control terminal 4 with respect to control terminal 5. Zero volts input will correspond to the minimum output frequency and 10 volts input will correspond to the maximum output frequency with a linear relationship of output frequency with input voltage between the two extremes. Please refer to Table 6 for the appropriate internal switch settings to utilize the voltage follower circuit.

4. **4 to 20 maDC current follower**: A 4 to 20 maDC speed reference command can be connected to control terminal 4 with respect to control terminal 5. 4 maDC input will correspond to the minimum output frequency and 20 maDC input will correspond to the maximum output frequency with a linear relationship of output frequency with input current between the two extremes. Please refer to Table 6 for the appropriate internal switch settings to utilize the current follower circuit.

**Inverter Operation Modes**: The **BALDOR** Series 11 has five modes of operation to fit various control schemes and application requirements. The inverter mode of operation is selected just as a normal system parameter is adjusted. The **Operation Mode** parameter is located on level 0, RSW position 1 (see Table 4). The inverter is set from the factory to operate in Mode "0". The five modes of operation are as follows:

1. MODE 0...2-Speed Operation (JOG), Normal speed set by operator
2. MODE 1...2-Speed Operation (JOG), Normal speed set by installer
3. MODE 2...4-Speed Operation, common accel and decel rates
4. MODE 3...4-Speed Operation, separate accel and decel rates
5. MODE 4...External Thermal Trip

**MODE 0 - 2-Speed Operation (JOG)**: This mode of operation can serve many application requirements. The features of operation vary depending upon whether external controls are utilized or the standard on board controls are used. The features available when the on board controls are used are as follows:

Normal speed (speed 1) can be set by utilizing the front mounted frequency dial.

Acceleration rate is set by adjusting the **1st Accel Time** parameter in conjunction with the **1st Accel Magnification** parameter.

Deceleration rate is set by adjusting the **Stop Decel Time** parameter in conjunction with the **Stop Decel Magnification** parameter.

A RUN command can be initiated by sliding the RUN/STOP switch located on the front of the inverter to the RUN position. When a RUN command is given, the motor shaft will accelerate to the set speed in the normal direction (as defined by the motor lead connection).

A STOP command can be initiated by sliding the RUN/STOP switch located on the front on the inverter to the STOP position. The motor shaft will decelerate at the rate set by the **Stop Decel Time** parameter in conjunction with the **Stop Decel Magnification** parameter.

When utilizing external control devices the following features are available:

Normal speed (speed 1) can be set by utilizing the front mounted frequency dial; external potentiometer connected to control terminals 3, 4, and 5; voltage or current follower connected to control terminals 4 and 5.

JOG speed (speed 2) is set by adjusting the **Jogging Frequency** parameter. The JOG speed is selected during operation by connecting control terminal 10 to control terminal 8.

Acceleration rates are common to both the normal speed and the JOG speed. The accel rate is adjusted in the same manner as operation without external control devices.

Deceleration rates are common to both the normal speed and the JOG speed. The decel rate is adjusted in the same manner as operation without external control devices.

A Forward Run command can be initiated, after a speed is selected, by connecting control terminal 7 to control terminal 8. When a Forward Run command is given, the motor shaft will accelerate to the set speed in the normal direction (as defined by the motor lead connection) at a rate and speed set by the selected operating speed.

A Reverse Run command can be initiated, after a speed is selected, by connecting control terminal 9 to control terminal 8. When a Reverse Run command is given the motor shaft will accelerate to the set speed in the opposite to normal direction (as defined by the motor lead connection) at a rate and speed set by the selected operating speed.

A Stop command can be initiated by opening the circuit from control terminals 7 and 9 to control terminal 8 or by commanding a simultaneous forward and reverse command. The motor shaft will decelerate at the rate set by the **Stop Decel Time** parameter in conjunction with the **Stop Decel Magnification** parameter.

Free Run command is available by connecting control terminal 11 to control terminal 8. When a Free Run command is given, the inverter output to the motor will be shut off and the motor will coast to a stop in a time period that is determined by the inertia of the driven load.

**MODE 1 - 2-Speed Operation (JOG)**: MODE 1 operation is useful in applications where it is desirable to have a motor speed that is not readily adjustable by the operator of the motor controller. This mode of operation is similar to MODE 0 with external control devices. The only exception is the method of setting the normal speed (Speed 1). In this mode the normal speed is adjusted by utilizing VR2. To set the normal speed, VR2 should be turned completely counter-clockwise for the minimum output frequency, or turned completely clockwise for the maximum output frequency. There is a linear relationship of output frequency between the two extremes of VR2.

When MODE 1 is used without external control devices, the inverter operation and setup is identical to MODE 0 without external control devices (ie. No JOG Speed).

**MODE 2 - 4-Speed Operation**: MODE 2 operation is useful in applications where multiple preset motor speeds are desirable. External control devices (switches) will need to be utilized when operating in MODE 2.

One of four speeds is selected during operation by virtue of making or breaking a connection between control terminals 10 and 11 and control terminal 8. The connection of the control terminals is usually accomplished by utilizing two single pole , single throw switches connected from control terminal 10 to control terminal 8 and from control terminal 11 to control terminal 8. A rotary switch may be desirable to accomplish the terminal connections, resulting in elimination of simultaneous switch movements.

When operating in MODE 2 the following features are available from the inverter:

Speed 1 is selected by opening the circuits from control terminals 10 and 11 to control terminal 8. The output frequency for Speed 1 can be set by utilizing the front mounted frequency dial; external potentiometer connected to control terminals 3, 4, and 5; voltage or current follower connected to control terminals 4 and 5.

Speed 2 is set by adjusting the **2nd Speed Frequency** parameter. Speed 2 is selected during operation by closing the circuit from control terminal 10 to control terminal 8 and opening the circuit from control terminal 11 to control terminal 8.

Speed 3 is set by adjusting the **3rd Speed Frequency** parameter. Speed 3 is selected during operation by opening the circuit from control terminal 10 to control terminal 8 and closing the circuit from control terminal 11 to control terminal 8.

Speed 4 is set by adjusting the **4th Speed Frequency** parameter. Speed 4 is selected during operation by closing the circuits from control terminals 10 and 11 to control terminal 8.

Acceleration rates are common to all four speeds and is set by adjusting the **1st Accel Time** parameter in conjunction with the **1st Accel Magnification** parameter.

Deceleration rates are common to all four speeds and is set by adjusting the **Stop Decel Time** parameter in conjunction with the **Stop Decel Magnification** parameter.

A Forward Run command can be initiated, after a speed is selected, by connecting control terminal 7 to control terminal 8. When a Forward Run command is given the motor shaft will accelerate to the set speed in the normal direction (as defined by the motor lead connection) at a rate and speed set by the selected operating speed.

A Reverse Run command can be initiated, after a speed is selected, by connecting control terminal 9 to control terminal 8. When a Reverse Run command is given, the motor shaft will accelerate to the set speed in the opposite to normal direction (as defined by the motor lead connection) at a rate and speed set by the selected operating speed.

A Stop command can be initiated by opening the circuit from control terminals 7 and 9 to control terminal 8 or by commanding a simultaneous forward and reverse command. The motor shaft will decelerate at the rate set by the **Stop Decel Time** parameter in conjunction with the **Stop Decel Magnification** parameter.

**MODE 3 - 4-Speed Operation**: MODE 3 operation is useful in applications where multiple set speeds with independent accel/decel rates are desirable. MODE 3 operation is similar to MODE 2 operation with the exception of the independent accel/decel rates for each speed. MODE 3 operation will require the use of external control devices (switches). The following features are available when operating in this mode:

Speed 1 is selected by opening the circuits from control terminals 10 and 11 to control terminal 8. The output frequency for Speed 1 can be set by utilizing the front mounted frequency dial; external potentiometer connected to control terminals 3, 4, and 5; voltage or current follower connected to control terminals 4 and 5. The acceleration rate is set by adjusting the **1st Accel Time** parameter in conjunction with the **1st Accel Magnification** parameter. The deceleration rate is set by adjusting the **Stop Decel Time** parameter in conjunction with the **Stop Decel Magnification** parameter.

Speed 2 is set by adjusting the **2nd Speed Frequency** parameter. Speed 2 is selected during operation by closing the circuit from control terminal 10 to control terminal 8 and opening the circuit from control terminal 11 to control terminal 8. The acceleration rate is equal to the deceleration rate and is set by adjusting the **2nd Accel/Decel Time** parameter in conjunction with the **2nd Accel/Decel Magnification** parameter.

Speed 3 is set by adjusting the **3rd Speed Frequency** parameter. Speed 3 is selected during operation by opening the circuit from control terminal 10 to control terminal 8 and closing the circuit from control terminal 11 to control terminal 8. The acceleration rate is equal to the deceleration rate and is set by adjusting the **3rd Accel/Decel Time** parameter in conjunction with the **3rd Accel/Decel Magnification** parameter.

Speed 4 is set by adjusting the **4th Speed Frequency** parameter. Speed 4 is selected during operation by closing the circuits from control terminals 10 and 11 to control terminal 8. The acceleration rate is equal to the deceleration rate and is set by adjusting the **4th Accel/Decel Time** parameter in conjunction with the **4th Accel/Decel Magnification** parameter.

A Forward Run command can be initiated, after a speed is selected, by connecting control terminal 7 to control terminal 8. When a Forward Run command is given the motor shaft will accelerate to the set speed in the normal direction (as defined by the motor lead connection) at a rate and speed set by the selected operating speed.

A Reverse Run command can be initiated, after a speed is selected, by connecting control terminal 9 to control terminal 8. When a Reverse Run command is given the motor shaft will accelerate to the set speed in the opposite to normal direction (as defined by the motor lead connection) at a rate and speed set by the selected operating speed.

A Stop command can be initiated by opening the circuit from control terminals 7 and 9 to control terminal 8 or by commanding a simultaneous forward and reverse command. The motor shaft will decelerate at the rate set by the **Stop Decel Time** parameter in conjunction with the **Stop Decel Magnification** parameter.

**MODE 4 - External Thermal Trip Operation**: MODE 4 operation should be used in applications where an external normally closed thermostat is to be connected into the inverter to give a fault condition if an over temperature/overload condition should occur.

This mode of operation has one speed setting available with forward and reverse commands. The features of operation are as follows:

The Speed can be set by utilizing the front mounted frequency dial; external potentiometer connected to control terminals 3, 4, and 5; voltage or current follower connected to control terminals 4 and 5.

Acceleration rate is set by adjusting the **1st Accel Time** parameter in conjunction with the **1st Accel Magnification** parameter.

Deceleration rate is set by adjusting the **Stop Decel Time** parameter in conjunction with the **Stop Decel Magnification** parameter.

A Forward Run command can be initiated by connecting control terminal 7 to control terminal 8. When a Forward Run command is given, the motor shaft will accelerate to the set speed in the normal direction (as defined by the motor lead connection).

A Reverse Run command can be initiated by connecting control terminal 9 to control terminal 8. When a Reverse Run command is given, the motor shaft will accelerate to the set speed in the opposite to normal direction (as defined by the motor lead connection).

A Stop command can be initiated by opening the circuit from control terminals 7 and 9 to control terminal 8 or by commanding a simultaneous forward and reverse command. The motor shaft will decelerate at the rate set by the **Stop Decel Time** parameter in conjunction with the **Stop Decel Magnification** parameter.

Free Run command is available by connecting control terminal 11 to control terminal 8. When a Free Run command is given, the inverter output to the motor will be shut off and the motor will coast to a stop in a time period that is determined by the inertia of the driven load.

**TABLE 6 - INTERNAL INVERTER SWITCH SETTINGS**

| OPERATION | | | INTERNAL SWITCH SETTINGS | | | | |
|---|---|---|---|---|---|---|---|
| FREQ. SETTING | MAX FREQ. | RUN/STOP COMMAND | SSW | DSW#1 | DSW#2 | DSW#5 | DSW#6 |
| DIAL | 60 HZ | FRONT | VR | OFF | ON | OFF | ON |
| DIAL | 60 HZ | TERM | VR | OFF | ON | OFF | OFF |
| DIAL | 120 HZ | FRONT | VR | ON | ON | OFF | ON |
| DIAL | 120 HZ | TERM | VR | ON | ON | OFF | OFF |
| 0-5VDC | 60 HZ | FRONT | OFF | OFF | ON | OFF | ON |
| 0-5VDC | 60 HZ | TERM | OFF | OFF | ON | OFF | OFF |
| 0-5VDC | 120 HZ | FRONT | OFF | ON | ON | OFF | ON |
| 0-5VDC | 120 HZ | TERM | OFF | ON | ON | OFF | OFF |
| 0-10VDC | 60 HZ | FRONT | OFF | OFF | OFF | OFF | ON |
| 0-10VDC | 60 HZ | TERM | OFF | OFF | OFF | OFF | OFF |
| 0-10VDC | 120 HZ | FRONT | OFF | ON | OFF | OFF | ON |
| 0-10VDC | 120 HZ | TERM | OFF | ON | OFF | OFF | OFF |
| 4-20maDC | 60 HZ | FRONT | CUR | OFF | ON | OFF | ON |
| 4-20maDC | 60 HZ | TERM | CUR | OFF | ON | OFF | OFF |
| 4-20maDC | 120 HZ | FRONT | CUR | ON | ON | OFF | ON |
| 4-20maDC | 120 HZ | TERM | CUR | ON | ON | OFF | OFF |

**NOTES: RUN/STOP COMMAND**
FRONT - refers to front mounted **RUN/STOP** switch
TERM - refers to control terminal strip

**Drive Operation Adjustments**: The following Drive Adjustments are available within the Series 11 inverter to allow custom tailoring of the motor control system for the particular application. Table 4 lists the location and possible value of the various system parameter adjustments. The following paragraphs discuss parameter adjustments that have not been adequately covered elsewhere in this manual.

**Accel/Decel Rate Adjustments**: The accel and decel rates are determined by first setting a time parameter and then multiplying the time parameter by a magnification parameter to give a total accel/decel time rate.

The Total Accel Time equals the product of (Accel Time Parameter) X (Accel Magnification Parameter). The minimum Total Accel Time will not be less than 50 mSec.(0.05 Sec.) regardless of the actual product of (Accel Time Parameter) X (Accel Magnification Parameter).

The Total Decel Time equals the product of (Decel Time Parameter) X (Decel Magnification Parameter). The minimum Total Decel Time will not be less than 100 mSec.(0.1 Sec.) regardless of the actual product of (Decel Time Parameter) X (Decel Magnification Parameter).

The various combinations of (Accel/Decel Time Parameter) X (Accel/Decel Magnification Parameter) are shown in Table 7. The accel and decel times shown in Table 7 are for 60Hz maximum operation. When 120 Hz maximum output frequency is selected the times shown in Table 7 should be doubled for the actual time to accel or decel.

**TABLE 7 - AVAILABLE ACCEL AND DECEL RATES**

| ALL TIMES IN SECONDS | | MAGNIFICATION PARAMETER | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 0.2 | 0.5 | 1 | 2 | 10 | 20 | 100 | 200 |
| TIME PARAMETER | 0 | ACCEL RATE = 0.05 SEC.<br>DECEL RATE = 0.1 SEC. | | | | | | | |
| | 1 | 0.2 | 0.5 | 1 | 2 | 10 | 20 | 100 | 200 |
| | 2 | 0.4 | 0.1 | 2 | 4 | 20 | 40 | 200 | 400 |
| | 3 | 0.6 | 1.5 | 3 | 6 | 30 | 60 | 300 | 600 |
| | 4 | 0.8 | 2.0 | 4 | 8 | 40 | 80 | 400 | 800 |
| | 5 | 1.0 | 2.5 | 5 | 10 | 50 | 100 | 500 | 1000 |
| | 6 | 1.2 | 3.0 | 6 | 12 | 60 | 120 | 600 | 1200 |
| | 7 | 1.4 | 3.5 | 7 | 14 | 70 | 140 | 700 | 1400 |

Double all times for 120Hz operation.

**Carrier Frequency**: The carrier frequency of the inverter control scheme can be adjusted to minimize audible noise from the motor/controller system. Before adjusting the **Carrier Frequency** parameter, the motor/controller system should be tested in the operating environment to determine if adjustment is necessary. The **Carrier Frequency** parameter values along with the corresponding carrier frequencies are listed in Table 8.

**TABLE 8 - CARRIER FREQUENCY ADJUSTMENT**

| PARAMETER VALUE | CARRIER FREQUENCY |
|---|---|
| 0 | 868 HZ |
| 1 | 919 HZ |
| 2 | 977 HZ |
| 3 | 1041 HZ |
| 4 | 1116 HZ |
| 5 | 1202 HZ |
| 6 | 1302 HZ |
| 7 | 1420 HZ |

**Torque Boost**: The **Torque Boost** parameter can be adjusted to provide more or less starting torque from the motor than is available with the factory setting. The boost adjustment alters the output voltage of the inverter from the normal value (as defined by the V/F ratio) by increasing or decreasing the output voltage per frequency output at the lower end of the V/F curve.

The boost is set from the factory at a level that is suitable for most applications. Increasing the boost from the factory set level could cause the motor to overheat. Caution should be exercised when adjusting the **Torque Boost** parameter to prevent motor overheating at low operating speeds.

**DC Dynamic Braking**: When the motor is commanded to stop, the inverter will inject a DC current into the motor windings to provide an electronic braking action to the motor. The braking action will begin at the time the output frequency of the inverter equals the frequency set by the **DC Brake Starting Frequency** parameter. The time the electronic braking action is supplied to the motor is determined by the **DC Dynamic Brake Time** parameter. The braking torque supplied to the driven load is determined by the **DC Brake Torque** parameter. The braking action of the motor can be adjusted to stop the motor or to hold the motor shaft stationary for short duration positioning. The type of braking action is determine by the **DC Brake Selection** parameter.

**DC Dynamic Brake Time**: The actual braking time is adjustable from 0 to 3.1 Sec. or 0 to 24.8 Sec. and is set by the **DC Dynamic Brake Time** parameter. The maximum braking time is determined by the setting of the **DC Brake Selection** parameter.

**DC Brake Torque**: The amount of braking torque supplied by the motor to the driven load is determined by the **DC Brake Torque** parameter and is figured in percent of the motor's full load torque. The Series 11 inverters come standard with 20% minimum braking torque available with an optional external braking resistor that can supply up to 100% braking torque depending on the horsepower rating of the inverter. The optional braking resistor must be specified on the inverter at the time of order as the external braking resistor cannot be retrofitted into existing inverter packages. Please review Table 1 - Model Matrix and Table 3 - Model Identification for available braking torques and inverter model numbers.

**DC Brake Starting Frequency**: After a stop command is given, the inverter will inject a DC current into the motor windings to provide an electronic braking action to the motor. The braking action will begin at the time the output frequency of the inverter equals the frequency set by the **Brake Starting Frequency** parameter. The brake starting frequency is adjustable from 0 to 30 Hz.

**DC Brake Selection**: There are two time intervals that the motor can provide braking action to the driven load. The time periods are defined as "sudden stop" and "positioning" and are selected by adjusting the **DC Brake Selection** parameter. When "sudden stop" is selected the braking action will begin immediately after a stop command and the braking time is adjustable from 0 to 24.8 Sec. If "positioning" is selected, the braking time is adjustable from 0 to 3.1 Sec. and the braking action will start at the point where the output frequency reaches the frequency specified by the **DC Brake Starting Frequency** parameter. The actual braking time is set by the **DC Dynamic Brake Time** parameter after the type of braking action is selected.

**Skip Frequency Adjustment**: In some applications certain inverter output frequencies may cause a mechanical resonance to develop in the driven motor load. By skipping over these inverter output frequencies the machine mechanical resonance may be avoided. Two fully adjustable frequency skip zones are available from the Series 11 inverter. The zones are created by setting a jump point and a continue point within the available output frequencies of the inverter. The zones are identified by 1-A & 1-B for zone 1, and 2-A & 2-B for zone 2. The "A" identifier sets the jump frequency point and the "B" identifier sets the continue frequency point.

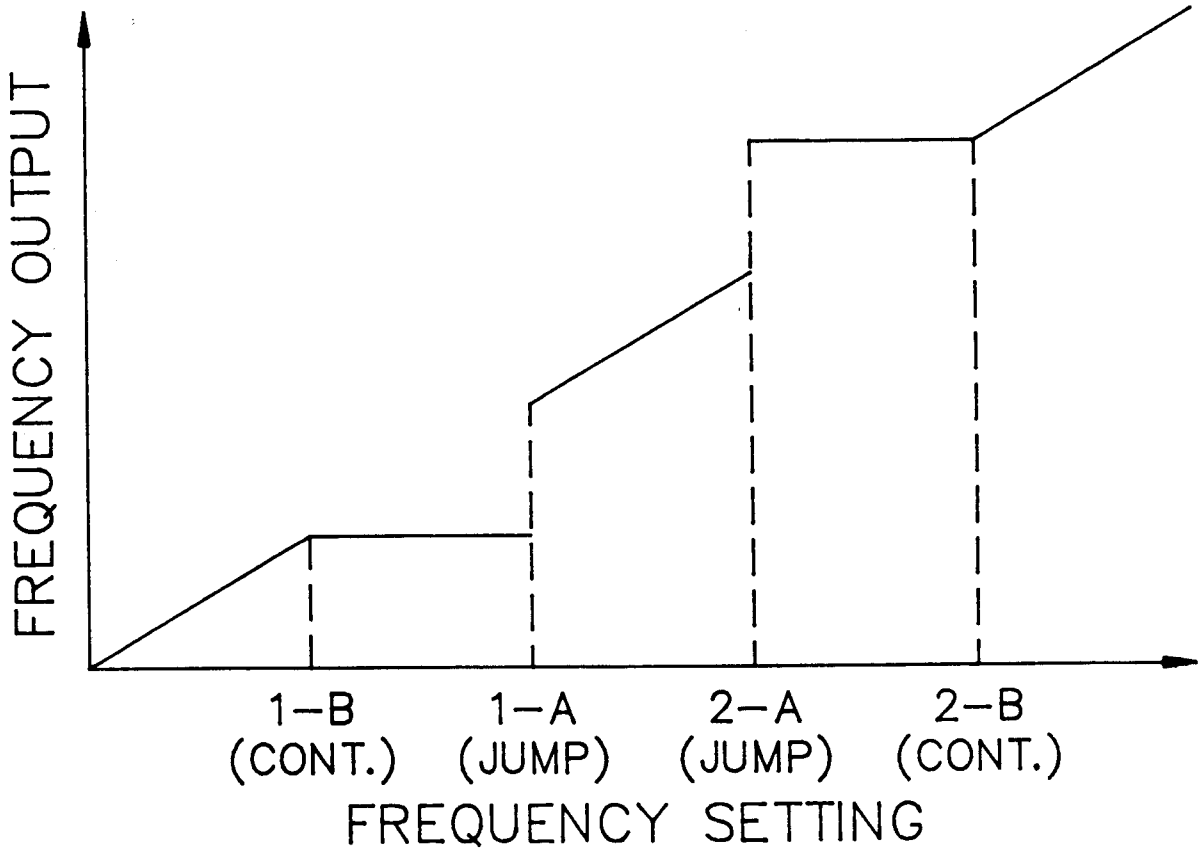
If "A" is set at a greater frequency than "B", the inverter will continue to output the frequency specified by "B" until the output voltage of the inverter is great enough to keep the V/F ratio constant as defined by the normal V/F curve. When the proper V/F ratio is reached the inverter will jump to the output frequency specified by "A" and will continue to vary the output voltage and frequency as indicated by the normal V/F curve.

If "A" is set at a lower frequency than "B", the inverter will jump from the output frequency specified by "A" to the output frequency specified by "B" and continue to output the "B" frequency until the output voltage of the inverter is great enough to keep the V/F ratio constant as defined by the normal V/F curve. When the proper V/F ratio is reached the inverter will continue to vary the output voltage and frequency as indicated by the normal V/F curve.

If "A" is set to equal "B" then the frequency skip zone is defeated, and the inverter will continue to operate on the normal V/F curve.

The skip frequency methods discussed above are illustrated in Figure 6 below.

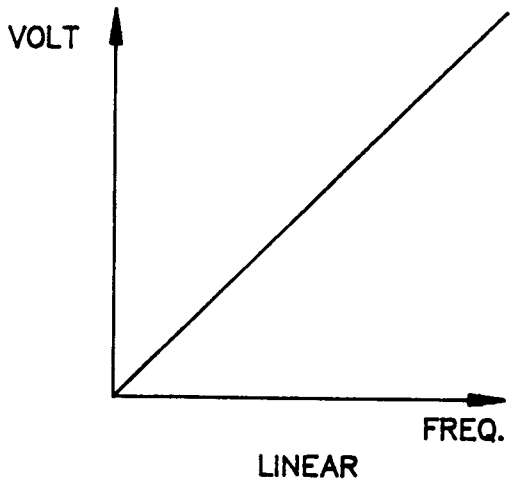
**FIGURE 6 - FREQUENCY SKIPPING**



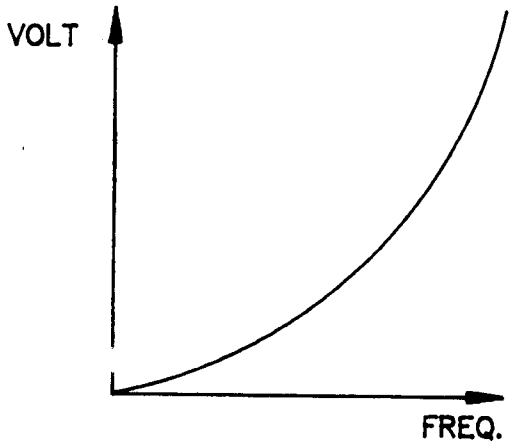

**Reduced Frequency At Instantaneous Power Failure**: The inverter output will be shut off if the DC bus of the converter section drops below 61% of normal for more than 15 mSec. If the input power is restored before the end of 15 mSec. the inverter will resume normal operation from the frequency determined by the **Reduced Frequency At Instantaneous Power Failure** parameter. If an instantaneous power failure occurs, the inverter will resume operation at a frequency that is determined by subtracting the value of the **Reduced Frequency At Instantaneous Power Failure** parameter from the output frequency of the inverter at the time of the power failure.

**Stall Decel Magnification**: During periods of deceleration the decel time will be extended whenever an impending Regenerative Overvoltage Trip is sensed. The total decel time will be multiplied by the value set by the **Stall Decel Magnification** parameter whenever an impending Regenerative Overvoltage trip is sensed. The total decel time with **Overvoltage Stall Prevention** is the product of (Decel Time) X (Decel Magnification) X (Stall Decel Magnification).

**V/F Curve**: The **V/F Curve** parameter sets the output V/F ratio for all values of output voltage versus output frequency. The V/F curve is set from the factory to be a linear function for constant torque applications. The V/F curve can be adjusted to a squared reduced relationship for applications where the load torque requirement increases with increasing speed (variable torque applications). The linear relationship is indicated by a "0" setting and the squared reduced is indicated by a "100" setting. The squared reduced relationship will allow less motor heating when less than the motors full load torque is required during periods of motor starting.



LINEAR



SQUARED REDUCED

**Max Output Voltage**: The maximum output voltage of the inverter can be reduced from the value of the input line voltage to facilitate the use of a motor with an input voltage that is less than the available line voltage. The maximum output voltage of the inverter is set from the factory to equal the input line voltage.

**Base Frequency**: The **Base Frequency** is defined as the point on the V/F curve where the output voltage of the inverter becomes a constant value with increasing output frequency. The **Base Frequency** parameter adjustment is useful in applications where constant motor horsepower output is desired above the motor's nameplate frequency. Special consideration will need to be given to the motor design if constant horsepower is required above the motor's nameplate frequency.

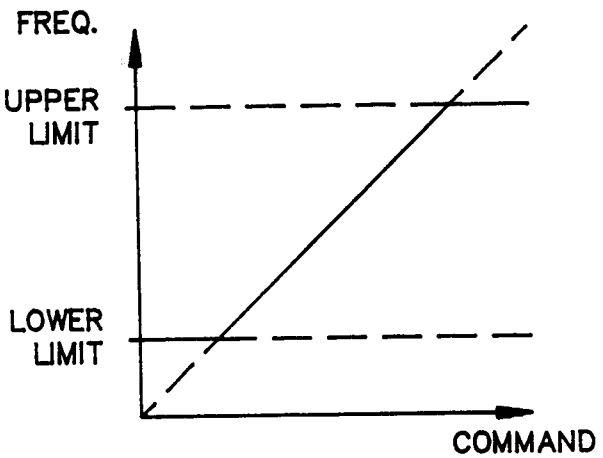
**Upper Frequency Limit**: The output frequency of the inverter can be limited to a value that is less than the maximum output frequency capability. This feature is useful in applications where a maximum frequency is desired that is less than the maximum frequency capability of the inverter to limit the output speed of the motor.

**Lower Frequency Limit**: The minimum output frequency of the inverter can be raised above the minimum output frequency capability. This feature is useful in applications where a minimum frequency is desired that is greater than the minimum frequency capability of the inverter to provide motor rotation with a minimum value of the speed reference command.

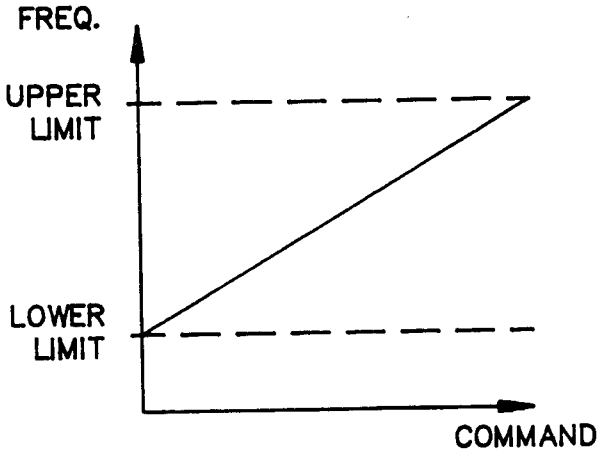
**Selection of Step/Linear Change**: The relationship of input command to output frequency can be set in two forms defined as **Step Change** and **Linear Change**. This parameter is used in conjunction with the upper and lower frequency limit parameters.

If **Step Change** is selected and the lower and upper frequency limits are set higher and lower, respectively, than the inverters capability, then a dead band will exist on the lower and upper regions of the input command versus output frequency. Step change is chosen by setting a value of "0" while the **Selection of Step/Linear Change** parameter is selected.

If **Linear Change** is selected and the lower and upper frequency limits are set higher and lower, respectively, than the inverters capability, then a Linear relationship of input command versus output frequency will exist within the region defined by the lower and upper frequency limit parameters. Linear change is chosen by setting a value of "1" while the **Selection of Step/Linear Change** parameter is selected.

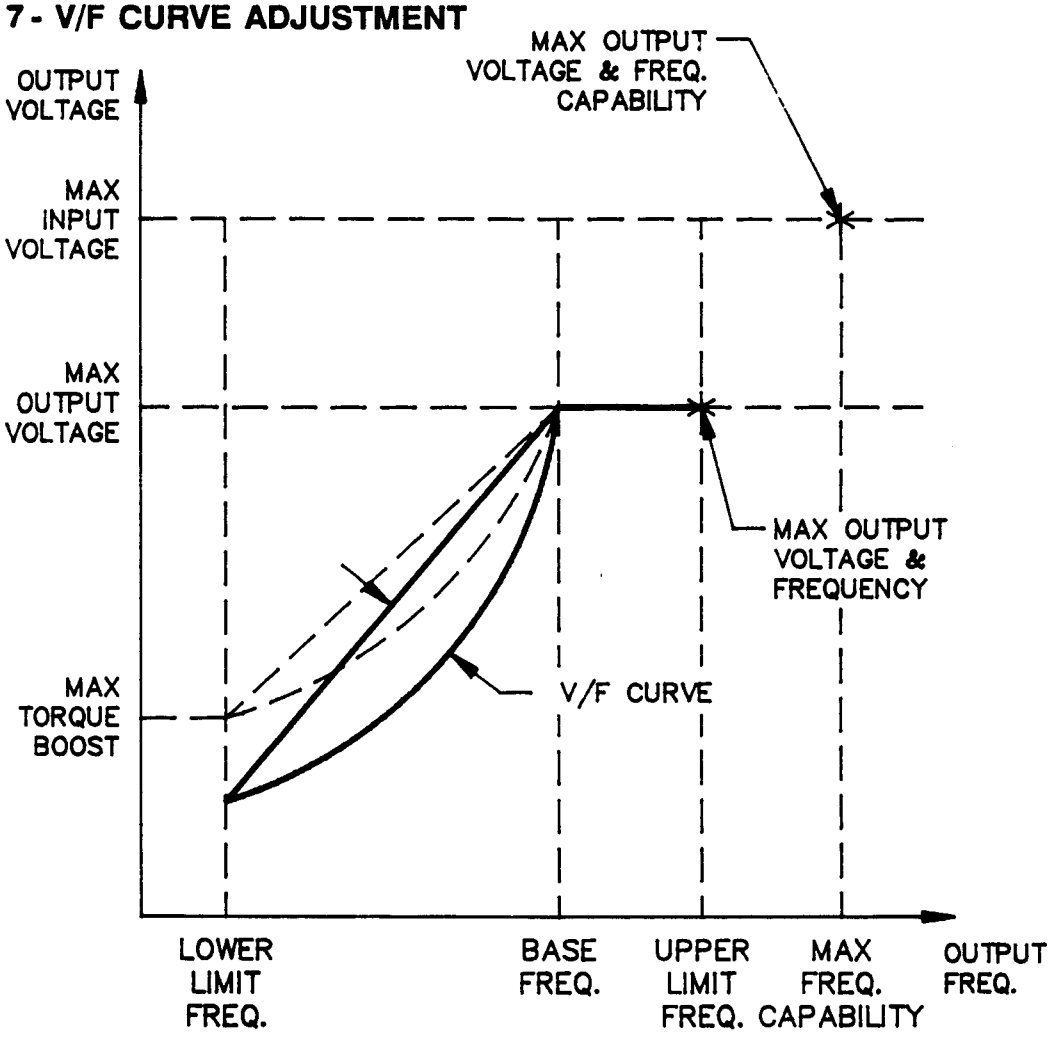


STEP CHANGE



LINEAR CHANGE

**FIGURE 7 - V/F CURVE ADJUSTMENT**




**Frequency Display**: The front mounted LED display can be set to display the output set frequency or the actual output frequency of the inverter. The inverter is adjusted from the factory to display the actual output frequency of the selected operating speed. This feature is useful to display the output set frequency during periods of long programmed acceleration or deceleration.

When the **Frequency Display** parameter is adjusted to display the set frequency, the front mounted LED display will read "S_F" while the **Frequency Display** parameter is selected. If the **Frequency Display** parameter is adjusted to display the actual output frequency, the front mounted LED display will read "O_F" while the **Frequency Display** parameter is selected.

**Frequency Meter Adjustment**: When an external frequency meter is utilized on the Series 11, the external meter will need to be calibrated to the maximum output frequency of the inverter. The external frequency meter should be rated for 100 microamps at full scale and should be connected to control terminal 6 with respect to control terminal 5. The calibration is accomplished by commanding maximum frequency output from the inverter and then adjusting the **Frequency Meter Adjustment** parameter until the external meter reads full scale.

**Analog Frequency Setting**: The **Analog Frequency Setting** parameter is used in conjunction with the internal inverter switch settings. This parameter is used to select a voltage follower speed reference command or a current follower speed reference command. If a current follower (4 to 20 maDC) speed reference command is to be utilized, the **Analog Frequency Setting** parameter will need to be adjusted to read "420" on the front mounted LED display. With this setting, a 4 maDC input will equal zero frequency output. Otherwise, a 4 maDC input will equal approximately 17% of maximum speed.

If a voltage follower speed reference command is to be utilized, the **Analog Frequency Setting** parameter will need to be adjusted to read "0_5" on the front mounted LED display. This is the setting that is provided from the factory and the inverter is expecting to see 0 to 5 VDC as a speed reference command. If a 0 to 10 VDC voltage follower is to be utilized, the internal inverter switch settings will need to be changed. Please refer to Table 6 - Internal Inverter Switch Settings for proper switch adjustments.

**Selection of Manual/Auto Restart (Retry)**: In the event of a power failure, the Series 11 inverter can be adjusted to restart automatically when input power returns. The number of restart attempts after a power failure trip can be set by specifying the allowable number of trips within a 40 minute time period. After 40 minutes has past since the first trip occurrence, the trip counter in the microcomputer will be reset to zero. The number of allowable trips can be set by adjusting the **Selection of Manual/Auto Restart (Retry)** parameter to values 1 through 4. If this parameter value is set to 0, then the inverter will restart automatically. A manual restart is accomplished by initiating a stop command and then a run command to begin normal operation.

**Retry Starting Time**: The time period between a auto restart attempt and trip, can be set by adjusting the **Retry Starting Time** parameter. The retry starting time is adjustable from 0 to 124 seconds.

**Parameter Initialization**: If during system start-up or operation you find that the inverter operating parameters have been adjusted to the point of erratic or abnormal motor operation, the operating parameters can be reset to the settings provided from the factory by utilizing the **Parameter Initialization** parameter. To reset the parameter settings select and adjust the **Parameter Initialization** parameter until the front mounted LED display reads "YES". Turn off the input power to the inverter without rotating RSW off of the selected parameter. When the input power is restored to the inverter, the inverter operating parameters will be initialized to the factory set values and the front mounted LED display will read "---". The inverter will not operate while the display reads "---". The internal reset button (SW) must be pushed or the input power must be removed and then reapplied to reset the inverter for normal operation, after the display reads "---". The inverter is now ready for adjustment just as if the controller were fresh out of the shipping container.

Please note that the **Torque Boost** parameter and **Brake Torque** parameter settings of the 3 and 5 HP units will be reset to the factory settings of the 1 and 2 HP units after completion of a parameter initialization operation.

# MAINTENANCE

## GENERAL

The **BALDOR** Series 11 inverters require very little maintenance, if any, and should provide years of trouble free operation when installed and applied correctly to your application requirements. Occasional visual inspection should be considered to insure tight wiring connections and to avoid the build up of any dust, dirt, or foreign debris. The controller should be physically located in such a manner as to protect the internal circuits and associated external wiring from any accumulation of moisture or other types of liquid contaminants.

Before attempting to service this equipment, all input power should be removed from the inverter to avoid the possibility of electrical shock. The servicing of this equipment should be handled by a qualified electrical service technician experienced in the area of high power electronics.

### VISUAL INSPECTION

1. Be sure all wires are tightened securely and all terminal connectors are mated properly.

2. Check all circuit components for signs of damage or loose connections. Any damaged or loose components must be corrected for satisfactory operation.

3. Use a vacuum cleaner to remove any signs of foreign debris from and around the motor controller. Do not use forced air to remove debris from the inverter as dirt can be forced under circuit components causing failure of the controller.

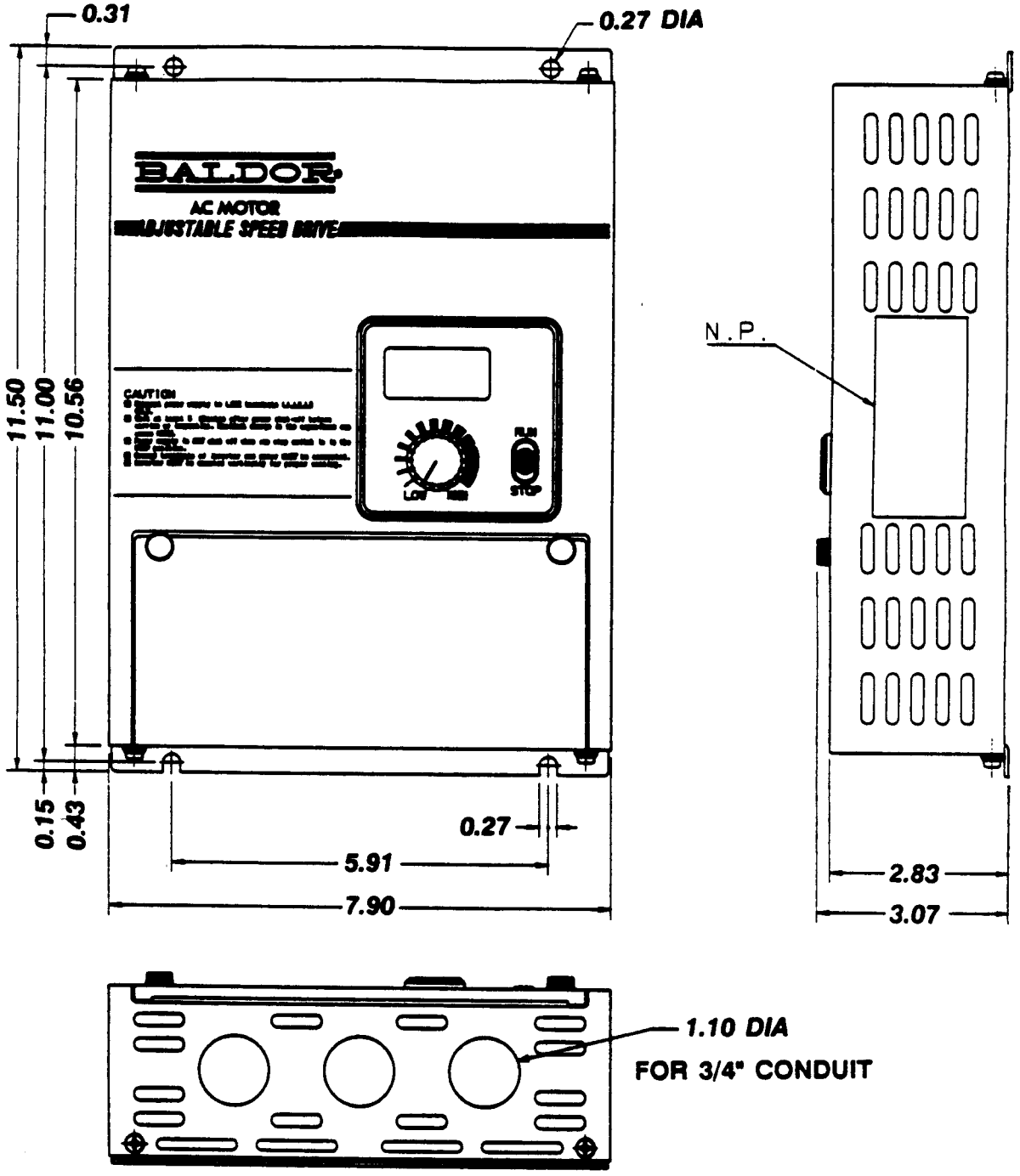
4. Check the controller for any signs of moisture or liquid contaminants.

**TABLE 9 - TROUBLESHOOTING**

| INDICATION | POSSIBLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| NO LED INDICATION | LACK OF INPUT VOLTAGE<br>LOOSE CONNECTIONS | CHECK INPUT POWER<br>CHECK INPUT POWER TERMINATION<br>VERIFY CONNECTION OF LED DISPLAY WIRING |
| MOTOR WILL NOT START | NOT ENOUGH STARTING TORQUE<br>MOTOR OVERLOADED | INCREASE TORQUE BOOST PARAMETER SETTING<br>CORRECT MOTOR LOADING<br>RESIZE MOTOR/INVERTER SYSTEM |
| MOTOR WILL NOT REACH MAXIMUM SPEED | MAXIMUM FREQUENCY LIMIT ADJUSTED TOO LOW<br>MOTOR OVERLOADED<br>SPEED POTENTIOMETER FAILURE | ADJUST MAXIMUM FREQUENCY LIMIT PARAMETER SETTING<br>CHECK FOR MECHANICAL OVERLOAD. IF UNLOADED MOTOR SHAFT DOES NOT ROTATE FREELY--REPLACE MOTOR BEARINGS<br>REPLACE POTENTIOMETER |
| MOTOR WILL NOT STOP ROTATION | MINIMUM FREQUENCY LIMIT ADJUSTED TOO HIGH<br>SPEED POTENTIOMETER FAILURE | ADJUST MINIMUM FREQUENCY LIMIT PARAMETER SETTING<br>REPLACE POTENTIOMETER |
| UNSTABLE SPEED | OSCILLATING LOAD CONNECTED TO MOTOR<br>UNSTABLE INPUT POWER | CORRECT MOTOR LOADING<br>CORRECT INPUT POWER |
| MOTOR RUNS ROUGH AT LOW SPEEDS | TORQUE BOOST SET TOO HIGH<br>MISALIGNMENT OF MOTOR/ LOAD COUPLING<br>FAULTY MOTOR | ADJUST TORQUE BOOST PARAMETER SETTING<br>REALIGN COUPLING<br>REPLACE MOTOR |

**TABLE 9 - TROUBLESHOOTING - Continued**

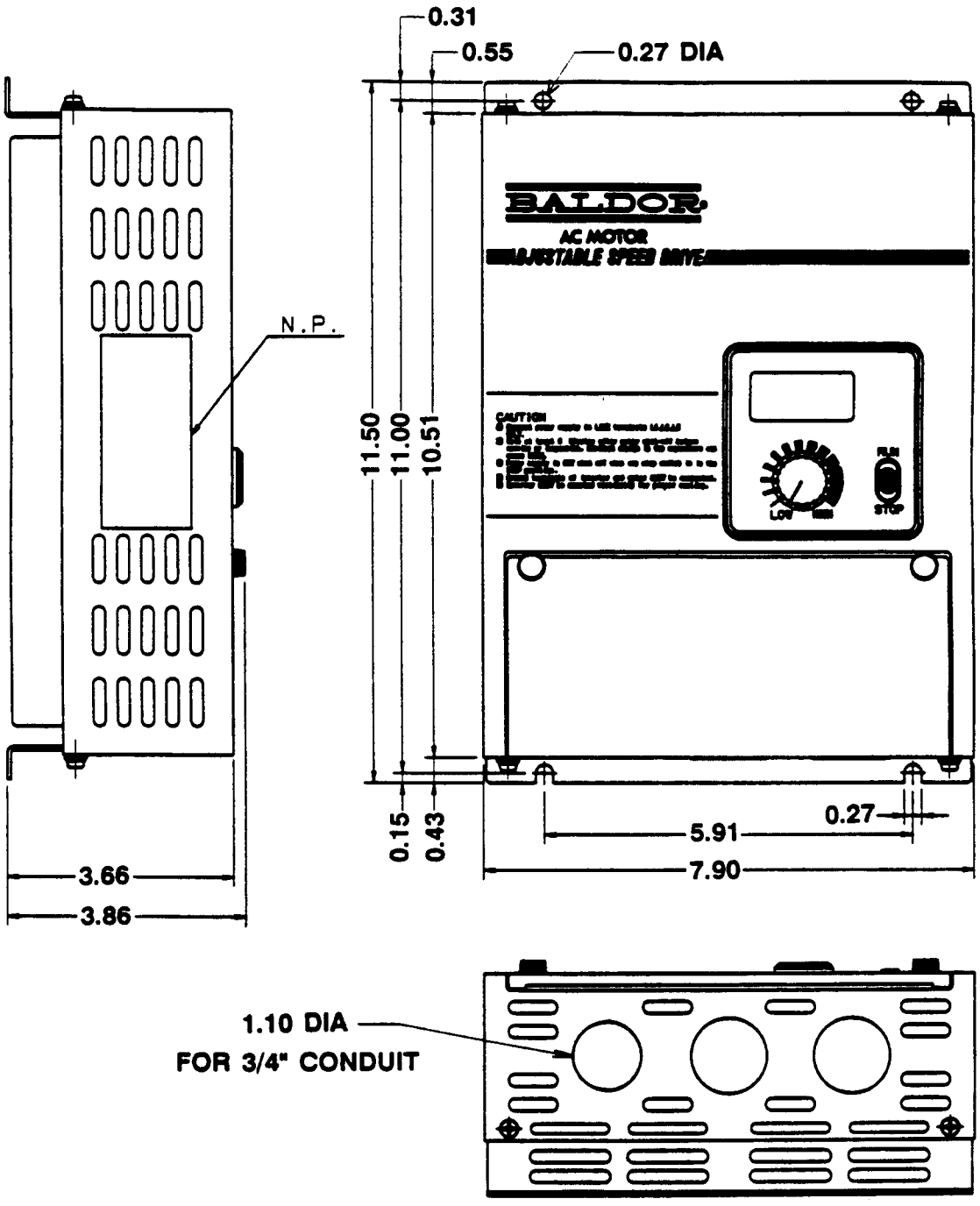
| INDICATION | POSSIBLE CAUSE | CORRECTIVE ACTION |
|---|---|---|
| EXTERNAL THERMAL TRIP (IF USED) | MOTOR VENTILATION INSUFFICIENT | CLEAN MOTOR AIR INTAKE AND EXHAUST |
| | MOTOR DRAWING EXCESSIVE CURRENT | CHECK FOR OVERLOADED MOTOR |
| | | VERIFY PROPER MOTOR AND INVERTER RATING |
| | V/F RATIO MISADJUSTED | ADJUST V/F CURVE PARAMETER SETTING |
| OVERCURRENT TRIP | ACCEL/DECEL RATE SET TOO RAPID | EXTEND ACCEL/DECEL TIME |
| | MOTOR OVERLOADED | VERIFY SIZING OF MOTOR/ INVERTER SYSTEM |
| | | CORRECT MOTOR LOADING |
| OVERVOLTAGE TRIP | INCORRECT INPUT VOLTAGE | CHECK INPUT VOLTAGE |
| | DECEL RATE SET TOO RAPID | EXTEND DECEL TIME |
| | OVERHAULING MOTOR LOAD | CORRECT MOTOR LOAD |
| | | EXTEND DECEL TIME |
| SELF DIAGNOSIS | INVERTER TRIPS FOR SAFETY AFTER CHANGING MAXIMUM FREQUENCY CAPABILITY OR OPERATION MODE | RESET INVERTERS INTERNAL LOGIC |
| | MALFUNCTION OF MICROCOMPUTER | REPLACE/REPAIR MAIN CONTROL BOARD |
| LACK OF VOLTAGE WARNING | INSUFFICIENT INPUT VOLTAGE | VERIFY PROPER INPUT VOLTAGE |
| MANUAL RESTART | INPUT POWER FAILURE | COMMAND STOP THEN COMMAND RUN |




# 1 HP - 230 VAC

** ALL DIMENSIONS ARE IN INCHES*

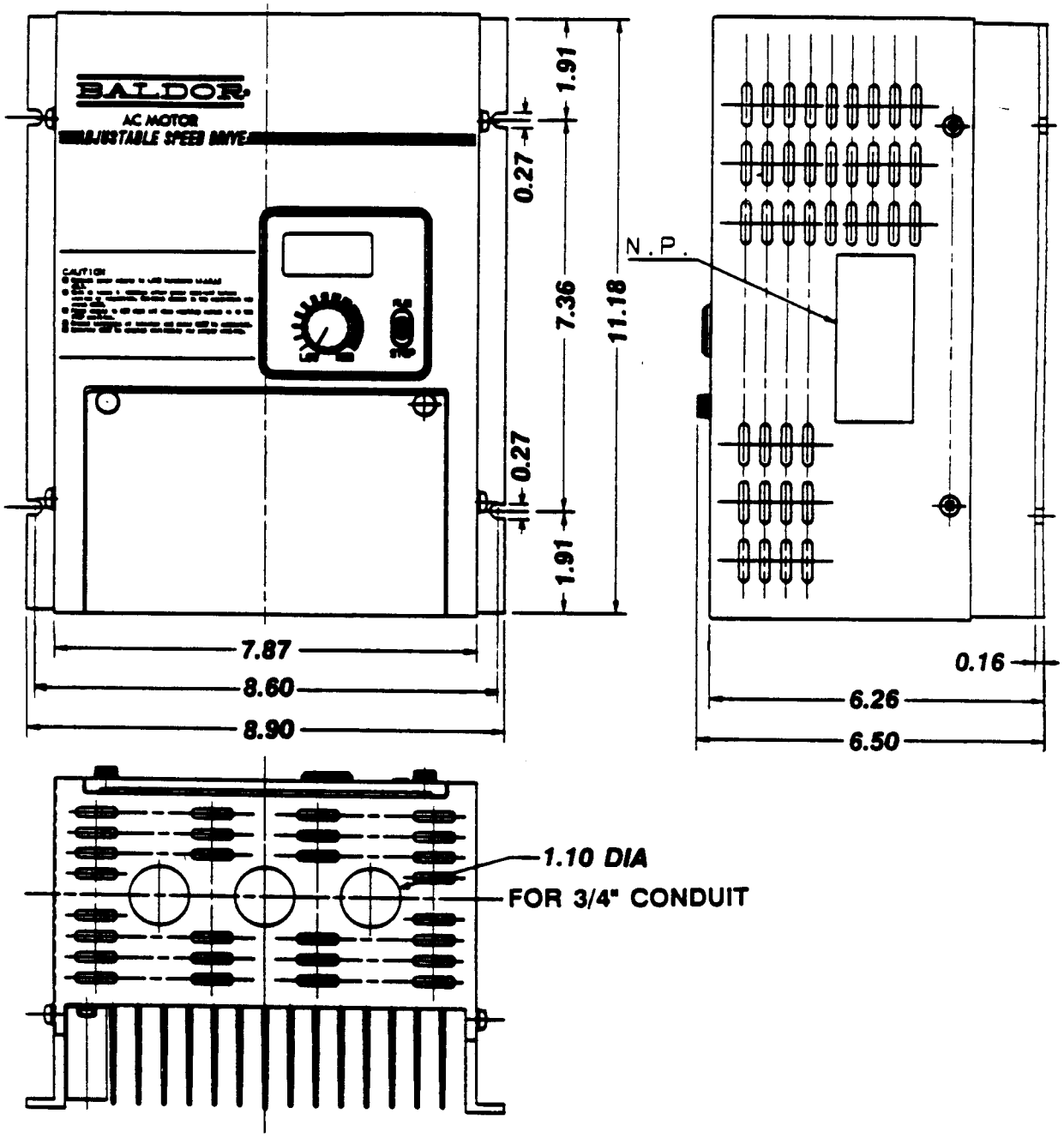
*12/89*




# 2 HP - 230 VAC

* ALL DIMENSIONS ARE IN INCHES

4/90




# 3 & 5 HP - 230 VAC

** ALL DIMENSIONS ARE IN INCHES*

*12/89*