Installing, Operating and Maintaining the Three-Phase Input Three-Phase Output General Purpose GP2000 A-C V★S Drives

20 to 40 HP at 208 VAC
25 to 50 HP at 230 VAC
50 to 100 HP at 460 VAC
50 to 100 HP at 575 VAC
30 to 55kw at 380/415 VAC

V★S® DRIVES

Instruction Manual D2-3217-2

December, 1993

Price: $25.00

RELIANCE ELECTRIC

Table of Contents

List of Figures

List of Tables

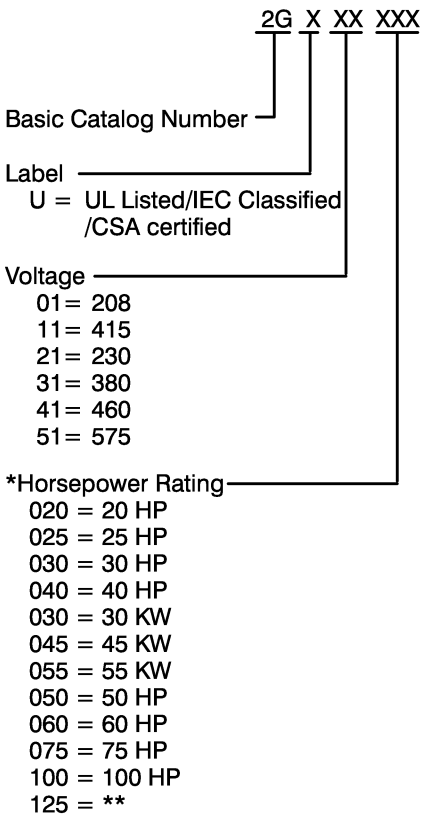
1: Receive and Accept the Controller

The products described in this instruction manual are manufactured by Reliance Electric Industrial Company.

Identify the Controller

Each Reliance Electric GP2000 A-C V★S® Controller can be positively identified by its model number (standard controller) or sales order number (customer specified controller). This number appears on the shipping label and is stamped on the controller nameplate. Refer to this number whenever discussing the equipment with Reliance Electric personnel.

The standard model number describes the controller as follows:



***Note**: Refer to Table 2-2 for HP/KW range for each input voltage.

Receive and Accept the Shipment

Reliance Electric's terms of sale, in all instances, are F.O.B. point of origin. The user is responsible for thoroughly inspecting the equipment before accepting shipment from the transportation company.

If all the items called for on the bill of lading or on the express receipt are not included or if any items are obviously damaged, do not accept the shipment until the freight or express agent makes an appropriate notation on your freight bill or express receipt.

If any concealed loss or damage is discovered later, notify your freight or express agent within 15 days of receipt and request that he make an inspection of the shipment. Keep the entire shipment intact in its original shipping container.

The user is responsible for making claim against the Carrier for any shortage or damage occurring in transit. Claims for loss or damage in shipment must not be deducted from the Reliance Electric invoice, nor should payment of the Reliance® invoice be withheld while awaiting adjustment of such claims since the Carrier guarantees safe delivery.

If considerable damage has been incurred and the situation is urgent, contact the nearest Reliance Electric Sales Office for assistance.

File a Return Request

1. To return equipment, send a written request to Reliance Electric within ten days of receipt.
2. Do not return equipment without a numbered Equipment Return Authorization (ERA) from Reliance Electric.
3. Reliance Electric reserves the right to inspect the equipment on site.

Store the Controller until Installation

After receipt inspection, repack the GP2000 A-C V★S Controller in its shipping container until installation. If a period of storage is expected, store in the original shipping container with its internal packing.

To ensure satisfactory drive operation at startup and to maintain warranty coverage, store the equipment

- in its original shipping container in a clean, dry, safe place.
- within an ambient temperature range of −40ºC to 65ºC (−40ºF to 149ºF).
- within a relative humidity range of 5 to 95% without condensation.
- away from a highly corrosive atmosphere. In harsh environments, cover the shipping/storage container.
- away from construction areas.

If storage will be longer than 5 months, contact Reliance for long-term storage instructions.

****Note**: See Supplement D2-3266 which covers M/N's 2VU41125, 2VU51125, 2VU01050, 2VU31075, and 2VU11075 Variable Torque Ratings only.

2: Know the Controller

Introduction to the Controller

The GP2000 controller is a general purpose, variable speed, A-C controller. It utilizes state-of-the-art microprocessor digital technology. Many diagnostic capabilities are standard. Because of the many configuration adjustments handled in software through the standard keypad/display, this controller is adaptable to many industrial applications.

Configuration adjustments are handled in software through the standard keypad/display. Lower motor noise operation on PWM power is achieved through Full Spectrum Switching techniques, resulting in a controller uniquely suited for constant or variable torque applications.

Controller Operational Theory

An A-C motor is normally a fixed speed machine operating from a constant voltage, constant frequency source, such as 460 VAC and 60 Hz. To vary the speed of the motor, the voltage and frequency of the source to the motor must be variable. A Controller provides this source.

The controller transforms its input (three-phase, constant A-C voltage, constant frequency) into any output compatible with the A-C adjustable speed requirement of the A-C motor (three-phase, variable voltage, variable frequency).

The basic equation to determine motor synchronous speed is:

$$\text{Synchronous RPM} = \frac{\text{Controller Output Frequency} \times 120}{\text{Number of A-C Motor Poles}}$$

The relationship between output voltage and operating frequency is the “Volts per Hertz” ratio (V/Hz). Except at low speed, this ratio is usually a constant determined by this equation:

$$\text{V/HZ} = \frac{\text{Motor Nameplate Voltage}}{\text{Motor Nameplate Frequency}}$$

The two major sections of the controller are the power circuit and the regulator circuit. The power circuit consists of diode bridges that convert A-C to D-C voltage and solid state transistor modules that transform the constant D-C voltage into variable A-C voltage and frequency output power.

The regulator controls the On/Off switching of the transistors in the output power circuit.

Power Circuit Operation

A-C power is supplied to terminals R, S, and T and is full-wave rectified by the diode power module to constant D-C voltage. A leakage current sensor detects line-to-ground leakage. Along with the regulator, it protects against output ground faults while the controller is in operation. Three MOV suppressors (located on the Inverter Multiple Voltage Board) limit voltage transients within the maximum voltage rating of the diodes.

The rectified voltage is then fed into the D-C bus capacitor, which is charged through a precharge resistor to limit the charging current.

Relay DCR is energized and bypasses the precharge resistor when the bus capacitor voltage reaches approximately 90% of the rated bus voltage (See Table 5-1 for rated bus voltages). The negative D-C bus runs through the Hall effect current sensor to detect D-C bus current. The hall effect current sensor detects a line-to-line short circuit within each transistor arm. A D-C bus fuse is also in series with the negative bus. This fuse protects the inverter in case of catastrophic transistor failure.

The filtered D-C bus voltage is fed into the transistor modules, which transforms D-C bus voltage into three-phase A-C variable voltage/variable frequency by switching the transistors. Two of the three output lines on the transistor modules run through the hall transformers to detect A-C output current. The A-C output current feedback protects against an overload or a line-to-line short circuit among the three-phase output lines.

In summary, constant D-C voltage is produced by rectifying and filtering the incoming A-C power line. Variable voltage/variable frequency is produced by six output transistors, inverting the constant D-C voltage to a PWM voltage waveform.

Regulator Circuit

The regulator circuitry is divided into six sections: the Regulator board, the Control Signal Buffer board, the Power Supply board, the Base Driver board and the Inverter Multiple Voltage board.

The regulator uses surface-mount technology and is fully digital with two microprocessors. The PWM signal is produced by software. All adjustments to the software configuration are made by keypad inputs. The regulator is designed

so that the controller can be controlled either locally from the keypad or remotely from a variety of speed reference signals. The regulator also provides an IET relay.

The Control Signal Buffer board contains the following:

Note: If Bypass Option is included, these features control only the Inverter. For Bypass Control features, refer to Section 4 of this manual.

- Provides customer wiring connections for speed reference signals.
- Provides customer wiring connections for Function Loss, Stop/Start, Run/Jog, Fwd/Rev, MS1, MS2, MS3 (via TB11). Refer to Section 6 for Multi-Speed functions. It also provides 40mA load current @ 24VDC for customer wiring to these inputs so that the user can use standard industrial contacts (dry contacts not necessary). It also provides additional noise immunity for these inputs to the regulator.
- Provides customer wiring connections for 110 VAC power supply, 50 VA- TB14 (4 & 3), 289 & 288. This power supply is for user convenience.
- Provides customer wiring connections for 110VAC Start/Stop or optional Purge Control TB14 (1 & 2). A jumper allows the user to select either 110 VAC Start/Stop (J1 position) or J2 position for 110 VAC Purge. The Factory setting is in the J1 position. This Purge feature uses single contact purge control because it not only provides a start command, but also internally activates the Multiple Speed Preset Function 16 (MS1), telling the inverter to go to a preset speed (programmable by user). The 110 VAC is desired by some users.
- Provides customer wiring connections for 24 VDC Purge Control via terminals 1 & 3 on TB13. This Purge feature also uses single contact purge control because it not only provides start command, but also internally activates Multiple Speed Preset Function 16 (MS1), telling the invertor to go to a preset speed (programmable by user). Standard industrial contacts can be used for this input.
- Provides customer wiring connections for Dynamic Braking Optional kits. Up to five (5) dynamic braking units can be controlled from TB11 terminals (9 & 10). Power supply connections for the DB kit are provided at TB15 (1 & 2) 113, 114. Fuse (4FU) protects the 10 VDC power supply from short circuits. See Figure 3-6.

From the Control Signal Buffer board, an external analog signal input for speed is converted to a pulse train adaptive by the microprocessor through the V/F converter. All external signals are optically isolated.

The Power Supply board provides the control power and the interface for high voltage feedback. The Power Supply board is composed of a switching regulator and a high frequency multi-winding transformer.

The Base Driver board provides the isolated base driver for the transistors.

The Inverter Multiple Voltage board provides the following:

- Provides fuse (9FU) protection for the 110 VAC power supply (which is located at TB14 terminals 3 & 4, (288, 289) on the Control Signal Buffer board).

Bypass Operation (Optional)

The optional bypass modification is required in some GP2000 HVAC applications. This option consists of a three-phase multiple voltage primary (208V, 230V, 380V, 415V, 460V, and 575V), control transformer, three-position selector switch for manual operation, interlocking auxiliary contacts, input line fuses, Main Input Disconnect, Inverter Disconnect (optional), line reactor, inverter and bypass contactors, motor overload, and the Bypass Control board. These components are factory-installed.

Bypass allows operation of the motor directly off the user-supplied power line while disconnecting the inverter section of the controller. For applications including BYPASS, STOP/START, (24VDC or 110 VAC), or PURGE, customer interlocks are connected to the Bypass Control board. Function Loss, Customer Convenience 110 VAC (50 VA) power supply, and Customer Convenience 24 VDC power supply, are connected to Terminal Block (TB21) located on the left-hand SIDE WALL. Connect to these locations for “single contact” control of both Inverter (KEYPAD or REMOTE modes) and bypass (depending on which is selected).

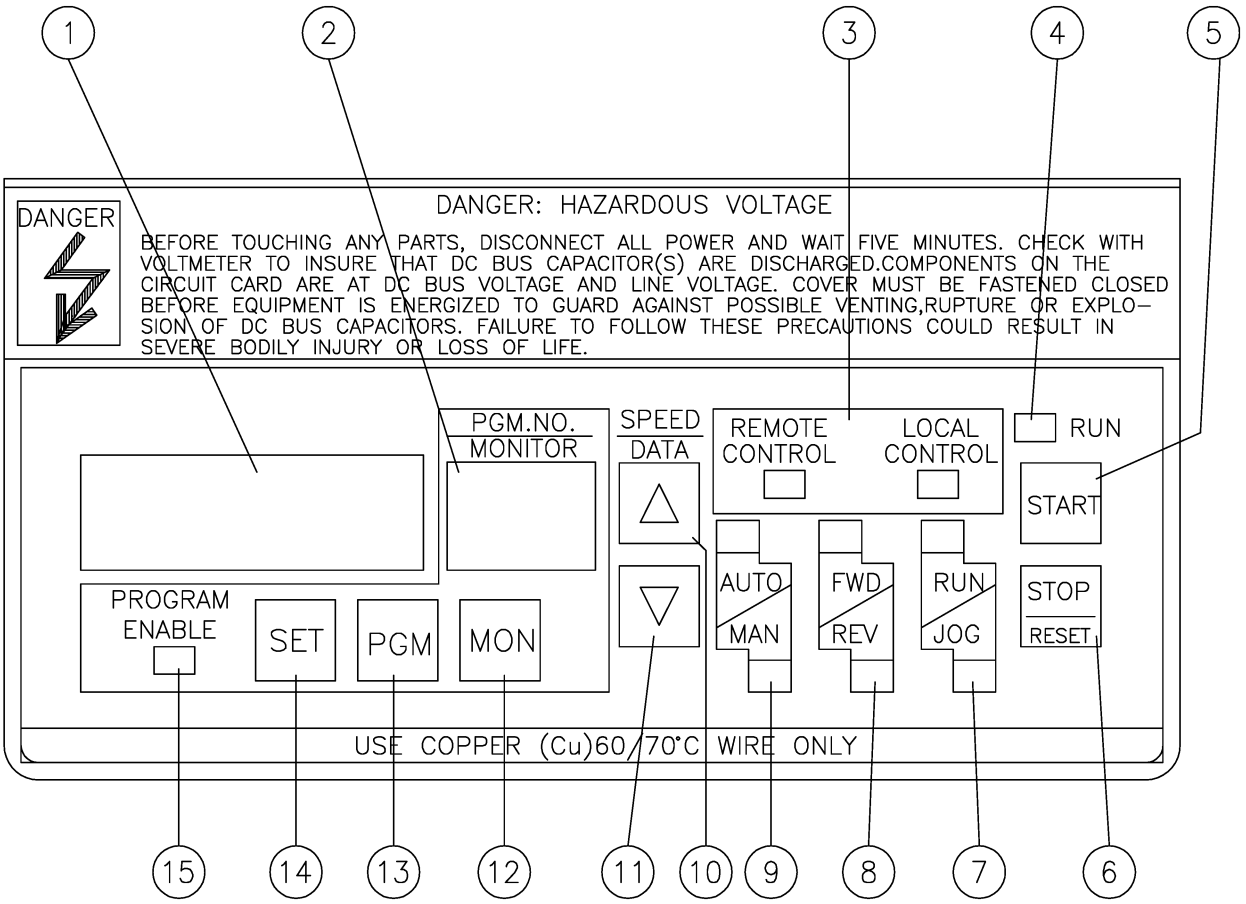
Note: For **inverter control only**, such features such as speed reference, RUN/JOG, FWD/REV, MS2, MS3 and Dynamic Braking signals must still be connected to the Control Signal Buffer (located in the Inverter section). You may need to use the features provided by the Remote Meter Interface Board. The location for wiring to it is located in

the Inverter section. Its outputs reflect only the conditions of the Inverter (NOT BYPASS). The regulator provides IET contacts (via TB2) however, the status of the IET contacts is relevant only to the Inverter status (NOT BYPASS). Refer to Section 4 for more information regarding Bypass.

Keypad and Display

Controller operation and configuration is performed through a keypad/display panel (Figure 2-1). The keypad allows selection of START, STOP, RUN/JOG, FORWARD/REVERSE, and AUTOMATIC/MANUAL. Each of the three dual selection keys (RUN/JOG, for example) has a small red LED above and below it that indicates which condition is selected. Also included on the keypad are an increment (▲) key and a decrement (▼) key that are used to increase or decrease the speed of the motor. The increment and decrement keys can also be used with the PGM key and the SET key to configure the GP2000 controller to many application requirements.

Also located on the keypad are a 4-digit LED display and a 2-digit LED display that show controller running information (output frequency, voltage, and percent of full-load amps and Motor RPM) and error function codes. In addition, these displays are used in configuring the controller.



1. 4—DIGIT DISPLAY OF FUNCTION VALUES/IET CODES
2. 2—DIGIT DISPLAY OF MONITOR SELECTION/FUNCTION NUMBER
3. OPERATOR'S CONTROL LEDS
4. RUN MODE LED (GREEN)
5. START KEY
6. STOP/RESET KEY
7. RUN/JOG KEY WITH INDICATING LEDS
8. FORWARD/REVERSE KEY WITH INDICATING LEDS
9. AUTOMATIC/MANUAL KEY WITH INDICATING LEDS
10. SPEED/DATA INCREMENT KEY
11. SPEED/DATA DECREMENT KEY
12. MONITOR KEY
13. PROGRAM KEY
14. SET KEY
15. PROGRAM ENABLE LED

Figure 2-1. Keypad Layout.

Each key and LED has its own function in configuring the controller. See Figure 2-1 for location of the keys, displays and LEDs.

1. **4 Digit Display**: Displays function values in volts, frequency, percentage of full load amps, or RPM.
2. **2-Digit Display**: Displays what monitor type is selected (U for volts, H for frequency, PA for percentage of full load amps, or SP for RPM monitor), or the function number selected by scrolling through the display with the PGM key.
3. **REMOTE CONTROL and LOCAL CONTROL LED's**: When in Local Mode this indicates whether the controller is receiving a speed reference from a remote location, or locally by the keypad.
4. **RUN Mode LED**: Illuminates green when the controller is in the RUN mode.
5. **START key**: Starts controller and places it in the RUN mode. The Run mode LED will illuminate.
6. **STOP /RESET key**: Stops the controller activity and resets the controller after an IET fault.
7. **RUN/JOG key and LED's**: Activates and indicates RUN or JOG mode.
8. **FORWARD/REVERSE key and LED's**: Actvates and indicates FORWARD and REVERSE mode. (**Note**: Reverse Key is disabled from the factory: see Function 36 in Section 6)
9. **AUTO/MAN keys and LED's**: If the AUTO key is selected, the controller follows speed reference commands from an external process control signal. If MAN key is selected, the controller follows speed reference commands from the ▲ and ▼ keys on the keypad.
10. **SPEED/DATA ▲ key**: Increases the speed reference (if in LOCAL mode) or a function value.
11. **SPEED/DATA ▼ key**: Decreases the speed reference (if in LOCAL mode) or a function value.
12. **MON key**: Activates 2-digit display to indicate which output is being monitored (H, U, PA, or SP), and activates the 4-digit display to indicate the actual value (frequency, volts, percentage of full load amps, or RPM) of the output being monitored.
13. **PGM key**: When pressed, allows the program to be changed. The program jumper must be in the J5 position to allow changes to the configuration. See Figure 3-4.
14. **SET key**: Locks in the new value entered for a particular function.
15. **PROGRAM ENABLE LED**: Indicates that the PGM key is activated and that a function's value can be changed.
16. **COAST-STOP PUSHBUTTON**: (Not shown in Figure 2-1. See Figure 3-1). This mushroom-head, red pushbutton provides a positive interrupt and shuts down the drive in Inverter or Optional Bypass mode of operation.

Terminology Used in This Manual

Definitions and Abbreviations

AUTO: See "Speed Reference."

BYPASS: Method of operating the motor at line voltage and line frequency when not in Inverter mode.

CEC: The abbreviation for the Canadian Electrical Code.

Chassis: The open style of controller.

Configure: The process by which the user selects and adjusts one of the standard 57 programmable functions listed in Table 9-2.

Controller: The term substituted throughout this manual for "GP2000 A-C V*S Drive Controller."; Inverter only; or the combination Inverter and Bypass.

Drive: The reference to the controller and the motor combined as one system.

GP2000 A-C V★S Drive Controller: See "controller."

Hz: The abbreviation for hertz.

IET: The abbreviation for instantaneous electronic trip.

INVERTER: Variable voltage and variable frequency power module and regulator.

MAN: See "Speed Reference."

NEC: The abbreviation for the USA National Electrical Code.

NEMA: The abbreviation for the National Electrical Manufacturers Association.

NEMA 1: The type 1 enclosure defined in NEMA standards which provides protection against accidental or inadvertent body contact with live parts.

Process Control: See "Speed Reference."

Program: See "Configure."

PURGE: The invertor goes to a preset speed (MS1 terminal on the Control Signal Buffer Board) and the drive will start regardless of any external function loss interlocks or Start/Stop commands. This feature is used in ventilation systems as a method to exhaust smoke and fumes to the outside (for example, in the event of fire).

If the bypass option is included with the controller, the purge command will try to start the inverter first, over-riding the status of external function loss and Start/Stop commands. If, however, the inverter does not run, the controller will automatically switch to bypass mode (after a time delay) overriding any overload and circuit interlocks. (This time delay is jumper-selectable on the Bypass Control board.) A coast-stop pushbutton on the door of the invertor section will stop the drive during a Purge or any other condition where a stop is necessary.

Note: When Purge is desired, the user must supply a standard industrial, normally-open contact to the controller and must change programmable Function 16, "Multi-Speed Preset" (MS1) to the desired speed setting.

PWM: The abbreviation for Pulse Width Modulation.

Run Mode: The condition when output frequency (Hz) and voltage are applied to the A-C motor. The green RUN MODE LED will be lit in this mode.

Set Frequency: The speed setting stored in memory to which the controller will accelerate when the Run mode is activated. When not monitoring frequency, voltage, or current from the keypad, the 4-digit display shows the set frequency and the 2-digit display is blank.

Speed Pot: The shortened term for speed potentiometer. The speed pot on this controller is in the form of increment ▲ and decrement ▼ keys on the controller keypad: use the increment ▲ key to increase the speed of the motor (like turning a speed pot CW) and the decrement ▼ key to decrease the speed of the motor (like turning a speed pot CCW).

Speed Reference: The MAN (manual) key or the AUTO (automatic) key on the controller keypad determines whether the controller follows speed reference commands from the keypad ▲ and ▼ keys (MAN selected) or from an external process control signal (AUTO selected). Note: If no process control signal is present when AUTO is selected, the controller will run at minimum Hz. See Figure 3-5 for process control configurations.

Static MOP: An electronic MOP (Motor Operated Potentiometer). The speed can be adjusted remotely by the external contacts. Refer to Function 57 in Section 6.

Stop Mode: The condition when output frequency (Hz) and voltage are ramped down to zero. This condition can be caused by pressing the STOP key, by an external function loss signal, or an internal IET. When an IET occurs, the STOP key also acts as an IET reset.

Dangers, Warnings, and Cautions

Dangers, warnings, and cautions point out potential hazards. All three of these precautions are enclosed in a box to call attention to them.

- A **danger** alerts a person that high voltage is present which could result in severe bodily injury or loss of life.
- A **warning** alerts a person of potential bodily injury if procedures are not followed.
- A **caution** alerts a person that, if procedures are not followed, damage to, or destruction of, equipment could result.

Standard Features

- PWM control with dedicated microprocessor to optimize motor flux
- Microprocessor based regulator
- Full spectrum switching for reduced motor noise
- Surface mount technology
- Large scale integration
- UL/CSA Electronic Motor overload which meets NEC/CEC Requirements
- 57 controller configuration adjustments including
  - Minimum and maximum frequency settings
  - Separate acceleration and deceleration ramps
  - Current limit
  - Automatic flux control
  - Torque boost
  - Up to (3) preset speed selections
  - Frequency Avoidance and bandwidth selections
  - D-C braking
  - Slip compensation
  - Frequency and current level detection
  - Static MOP
  - Settable Electronic Overload
  - Output Voltage Regulation
  - Linear S-Curve acceleration and deceleration
- Keypad and display
  - START/STOP
  - Speed adjustment
  - Automatic or manual speed reference
  - RUN/JOG
  - Complete drive adjustments
  - Monitor and display of either output frequency, voltage, percent current, or RPM
  - Diagnostic fault monitoring
- Ability to follow a 0−20 mA, 4−20 mA, 0−10 VDC, or frequency pulse input signal for automatic speed control
- 0−400 Hz frequency range
- Control Signal Buffer board for industry standard control interface
- UL Listed/CSA Certified/ IEC Classified
- Programmable electronic overload
- Coast-Stop Pushbutton standard
- Brown-Out Proof
- D-C Bus Fuse
- Precharge Contactor
- Line-to-line and line-to-ground output short circuit protection (Limited at 575V)
- Motoring current limit and regenerative voltage limit
- NEMA 1 enclosure

Optional Kits and Modifications

The following kits and modifications are available with select controllers. See Table 2-1 for the complete kit listing.

Field or Factory Installed Kits

- Remote Meter Interface Card
- Remote Digital Meter
- Pressure-to-Electrical Transducer
- Inverter Disconnect
- Dynamic Braking
- Inverter Fuse Kit
- Reference Trim Pot
- Remote Operator Station
- RPM A-C Blower Motor

Modifications (Factory Installed Only)

- Magnetic Bypass
- Line Reactor
- Motor Overload
- Output Contactor
- Remote Reference
- Gain/Bias Reference
- Output Feedback (4−20 mA)

Table 2-1. GP2000 Controller Kits.

Model No.	Volt	HP/KW	Factory/Field	Description	I/M No.
1MI4000	All	All	Both	Remote Meter Interface	D2-3168
1TP3000	All	All	Both	Reference Trim Pot	D2-3213
1RS3000	All	All	Both	Remote Operator Station	D2-3214
3DM4000	All	All	Both	Remote Digital Meter	D2-3169
1CB4100	All	All	Both	Inverter Disconnect	D2-3245
1PE4100	All	All	Both	P-E Transducer	D2-3248
1RR4100	All	All	Factory	Remote Reference Selector	None(6)
1FB4100	All	All	Factory	Output Feedback (4−20 ma)	None(6)
1GB4100	All	All	Factory	Gain/Bias Reference Adjustment	None(6)
1BM4000	All	All	Both	RPM A-C Motor Blower	D2-3254
2FU5050	575	50HP	Both	Inverter Fuse Kit	D2-3249
2FU4100	All	All*	Both	Inverter Fuse Kit	D2-3249
1CN4100(1)	All	All	Factory	Output Contactor	None
1LR4100(1)	All	All	Factory	Line Reactor Kit	None
2DB2010(2)	230	10 HP(4)	Both	Dynamic Braking Kit	D2-3178
2DB2010(2)	208	10 HP(4)	Both	Dynamic Braking Kit	D2-3178
2DC2010(5)	230	10 HP(4)	Both	Dynamic Braking Kit	D2-3178
2DC2010(5)	208	10 HP(4)	Both	Dynamic Braking Kit	D2-3178
2DB4020(2)	460	20 HP(4)	Both	Dynamic Braking Kit	D2-3179
2DB4020(2)	415	20 HP(4)	Both	Dynamic Braking Kit	D2-3179
2DB4020(2)	380	20 HP(4)	Both	Dynamic Braking Kit	D2-3179
2DC4020(5)	460	20 HP(4)	Both	Dynamic Braking Kit	D2-3179
2DC4020(5)	415	20 HP(4)	Both	Dynamic Braking Kit	D2-3179
2DC4020(5)	380	20 HP(4)	Both	Dynamic Braking Kit	D2-3179
2DB5020(2)	575	20 HP(4)	Both	Dynamic Braking Kit	D2-3180
2DC5020(5)	575	20 HP(4)	Both	Dynamic Braking Kit	D2-3180
1ML4100(1)	460 415 380 230 208	100 HP 55 KW 55 KW 50 HP 40 HP	Factory	Motor Overload Kit(3)	None(6)
1ML4075(1)	575 460 415 380 230 208	100 HP 75 HP 45 KW 45 KW 40 HP 30 HP	Factory	Motor Overload Kit(3)	None(6)
1ML4060(1)	575 460 460 230 230 208	75 HP 60 HP 50 HP 30 HP 25 HP 25 HP	Factory	Motor Overload Kit(3)	None(6)

*Except 50 HP 575V; 20 HP, 208V; 30 KW, 415V
(1)Must include Side Cabinet Kit (1KU4100).
(2)U/L
(3)Note: Controller contains internal electronic motor overload, but an electro-mechanical motor overload (such as this kit) may be required by local codes.
(4)Up to (5) Dynamic Braking Kits can be wired together to increase DB capability (see Figure 3-6).
(5)CSA
(6)See Section 7 for more information on these factory installed kit options.

Table 2-1. GP2000 Controller Kits. (Continued)

Model No.	Volt	HP/KW	Factory/Field	Description	I/M No.
1ML5060[1]	575 575 415 380 208	60 HP 50 HP 30 KW 30 KW 20 HP	Factory	Motor Overload Kit[3]	None[6]
1KU4100	All	All	Factory	Side Cabinet Kt	None
1BU4100	460	100 HP	Factory	Bypass Circuit, Cabinet	None
1BU1055	415	55 KW	Factory	Bypass Circuit, Cabinet	None
1BU3055	380	55 KW	Factory	Bypass Circuit, Cabinet	None
1BU2050	230	50 HP	Factory	Bypass Circuit, Cabinet	None
1BU0040	208	40 HP	Factory	Bypass Circuit, Cabinet	None
1BU4075	460	75 HP	Factory	Bypass Circuit, Cabinet	None
1BU5100	575	100 HP	Factory	Bypass Circuit, Cabinet	None
1BU1045	415	45 KW	Factory	Bypass Circuit, Cabinet	None
1BU3045	380	45 KW	Factory	Bypass Circuit, Cabinet	None
1BU2040	230	40 HP	Factory	Bypass Circuit, Cabinet	None
1BU0030	208	30 HP	Factory	Bypass Circuit, Cabinet	None
1BU4060	460	60 HP	Factory	Bypass Circuit, Cabinet	None
1BU4060	460	50 HP	Factory	Bypass Circuit, Cabinet	None
1BU5075	575	75 HP	Factory	Bypass Circuit, Cabinet	None
1BU2030	230	30 HP	Factory	Bypass Circuit, Cabinet	None
1BU2030	230	25 HP	Factory	Bypass Circuit, Cabinet	None
1BU0025	208	25 HP	Factory	Bypass Circuit, Cabinet	None
1BU5060	575	60 HP	Factory	Bypass Circuit, Cabinet	None
1BU5060	575	50 HP	Factory	Bypass Circuit, Cabinet	None
1BU0020	208	20 HP	Factory	Bypass Circuit, Cabinet	None
1SC4000	All	All	Both	Rail Interface Card	D2-3170
1RG2100	All	All	Both	GPI-100 Regulator Upgrade Kit[7]	D2-3269

*Except 50 HP 575V; 20 HP, 208V; 30 KW, 415V

[1] Must include Side Cabinet Kit (1KU4100).

[2] U/L

[3] Note: Controller contains internal electronic motor overload, but an electro-mechanical motor overload (such as this kit) may be required by local codes.

[4] Up to (5) Dynamic Braking Kits can be wired together to increase DB capability (see Figure 3-6).

[5] CSA

[6] See Section 7 for more information on these factory installed kit options.

[7] Upgrade Kit is needed for 1SC4000.

Controller Specifications

Controller Ratings

The controller is intended to operate from a three-phase A-C power source at the rated voltage listed on the controller nameplate. It can operate on 50 or 60 Hz line frequency. The controller provides three-phase variable voltage and variable frequency to the motor. Controller current ratings are listed in Table 2-2.

Table 2-2. Controller Ratings with Three-Phase Input Power.[1]

Controller Model Number	Controller 3-Phase Input Volts	Nominal HP/KW	Controller Input KVA	Input Amps @ Rated[2] Output Amps	Maximum Controller Output Amp
2GU01020	208	20	27	75	65
2GU01025	208	25	32	90	78
2GU01030	208	30	42	116	102
2GU01040	208	40	51	143	125
2GU21025	230	25[1]	30	75	65
2GU21030	230	30[1]	36	90	78
2GU21040	230	40[1]	46	116	102
2GU21050	230	50[1]	57	143	125
2GU31030	380	30 KW	50	75	65
2GU31045	380	45 KW	77	116	102
2GU31055	380	55 KW	94	143	125
2GU11030	415	30 KW	53	75	65
2GU11045	415	45 KW	84	116	102
2GU11055	415	55 KW	103	143	125
2GU41050	460	50	60	75	65
2GU41060	460	60	72	90	78
2GU41075	460	75	93	116	102
2GU41100	460	100	114	143	125
2GU51050	575	50	60	60	52
2GU51060	575	60	75	75	65
2GU51075	575	75	90	90	78
2GU51100	575	100	116	116	102

[1]Some manufacturers motor current ratings may exceed output current rating of controller. If so, size controller to next HP rating.

[2]Controller "Maximum" input amps are given for distribution systems which can supply short circuit current between 25,001 −42,000 amps at the controller's input terminals. For distribution systems below 25,001 amps, see Table 3-5.

Service Conditions

- Ambient temperature: −10ºC to 55ºC (14ºF to 131ºF) for controllers
- Storage temperature: −40ºC to 65ºC (−40ºF to 149ºF)
- Atmosphere: 5 to 95% non-condensing relative humidity
- Elevation: To 3300 feet (1000 meters) above sea level without derating. For every 300 feet (91.4 meters) above 3300 feet, derate the current rating by 1%. Consult your Reliance Electric Sales Office for operation above 10,000 feet.
- Line frequency: 50±2 Hz or 60±2 Hz
- Line voltage variation: −10% to +10%
- A-C line distribution system capacity (maximum): see Table 2-3. Maximum symmetrical fault current capacity must not exceed 42,000 amps. Class J, time delay fuses must be installed internally or upstream in the distribution system.

Table 2-3. A-C Line Distribution System Capacity.

Input Voltage	Max Distribution[1] System Capacity
208	750 KVA
230	840 KVA
380	1400 KVA
415	1500 KVA
460	1700 KVA
575	2100 KVA

[1]Assumes 5% transformer impedance.

Controller Application Data

- Pulse Width Modulation (PWM)
- Service Factor: 1.0
- Displacement Power Factor: 0.96
- Maximum Load: 150% for one minute (based on controller nameplate rating)
- Overcurrent IET: 200% load (based on controller nameplate rating)
- Current Limit Adjustment: 50 to 150% (based on controller nameplate rating)
- Linearity (Speed reference to output frequency): ±1%

WARNING

THIS DRIVE IS INTENDED TO OPERATE AT A PREDETERMINED MINIMUM SPEED UNLESS DISCONNECTED FROM THE POWER SOURCE. IF THE APPLICATION REQUIRES ZERO SPEED OPERATION WITHOUT SUCH DISCONNECTION, THE USER IS RESPONSIBLE FOR ASSURING SAFE CONDITIONS FOR OPERATING PERSONNEL BY PROVIDING SUITABLE GUARDS, AUDIBLE OR VISUAL ALARMS, OR OTHER DEVICES. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN BODILY INJURY.

- Minimum Frequency: 5 to 60 Hz (or 0.5 to 60 Hz programmed with a password)

WARNING

THE USER IS RESPONSIBLE FOR ENSURING THAT DRIVEN MACHINERY, ALL DRIVE-TRAIN MECHANISMS, AND PROCESS LINE MATERIAL ARE CAPABLE OF SAFE OPERATION AT A SPEED EQUIVALENT TO AT LEAST THAT WHICH WOULD RESULT FROM AN APPLIED FREQUENCY OF 20% ABOVE THE OVERFREQUENCY LIMIT (FUNCTION 38: FACTORY PRESET @ 90 HZ; MAXIMUM VALUE 405 HZ). FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

- Maximum Frequency: 15 Hz to overfrequency limit
- Base Frequency (V/Hz): 30 to 400 Hz
- Frequency Stability Long Term: 0.01% of base speed with digital keypad; 0.5% of base speed with optional analog speed pot
- Acceleration Adjustment: 0.1 to 360 seconds (within the capability of current limit)
- Deceleration Adjustment: 0.1 to 360 seconds (within the energy absorbing capability of the controller)
- Torque Boost: 0 to 10% of input voltage

Single-Motor Applications

The controller and motor must be sized for the load and speed requirements of the specific application.

If the motor is overframed, the motor operating current must not exceed the controller's rated output current and the motor horsepower must not be more than one standard rating larger than the controller's horsepower rating.

CAUTION: If the motor will be operated at speeds below one-half base speed, a motor overload relay may not protect the motor. A motor thermostat, internal to the motor, may be required. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Multi-Motor Applications

One controller can run one, two, or more motors. Adhere to the following requirements to assure correct drive operation:

1. When all the motors connected to the output of the controller are to start and stop simultaneously, the sum of the full-load currents of all the motors must be less than the maximum output current rating of the controller.
2. When one or more of the motors connected to the output of the controller are to start independently:
   - Each motor that starts while the controller is running must have a full-load current rating less than 10% of the maximum controller output current rating.
   - The sum of the sine wave currents of all the motors connected to the output of the controller and the locked rotor current of any motor which is to start individually must be less than the maximum controller output current rating.
   - Each motor connected to the controller must have individual overload protection.

CAUTION: If the motor will be operated at speeds below one-half base speed, a motor overload relay may not protect the motor. A motor thermostat, internal to the motor, may be required. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

3: Install the Controller

Note: For Bypass Installation, Refer to Section 4.

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL IT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING TO THE NEC AND ALL OTHER APPLICABLE LOCAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS, AND OVERCURRENT PROTECTION ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

CAUTION: Use of power factor correction capacitors on the output of the controller can result in erratic operation of the motor, nuisance tripping, and/or permanent damage to the controller. Remove power factor capacitors before proceeding. Failure to observe this precaution could result in damage to, or destruction of the equipment.

Plan the Installation

Read and understand this section in its entirety before beginning the actual installation. Follow these guidelines and procedures to minimize both installation and operating problems.

Select Controller Location

1. Verify that the controller can be kept clean, cool, and dry.
2. Check that the controller is away from oil, coolant, and other airborne contaminants.

CAUTION: Salt, chlorine, other corrosive gases and/or liquids must be avoided. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

3. Check that temperatures in the controller vicinity are between −10°C to 55°C (14°F to 131°F).
4. Check that relative humidity is between 5 and 95% (noncondensing).
5. Do not install above 3300 feet (1000 meters) without derating. For every 300 feet (91.4 meters) above 3300 feet, derate the current rating 1%. Consult your Reliance Electric Sales Office for operation above 10,000 feet.

Mount the Controller

1. In the location selected, using the provided lifting holes, mount the enclosed controller vertically. See Figure 3-1.
2. Make sure surrounding components do not hinder service access. See Figure 3-1 for mounting dimensions.
3. Provide adequate clearance for air ventilation:
   - At least 4 inches from the sides and 8 inches from the top and bottom of the controller to adjacent non-heat producing equipment.
   - At least 4 inches from the sides and 10 inches from the top and bottom of adjacent heat producing equipment. For the best air movement with three or more controllers, do not mount the controllers in a vertical stack; offset the controllers.

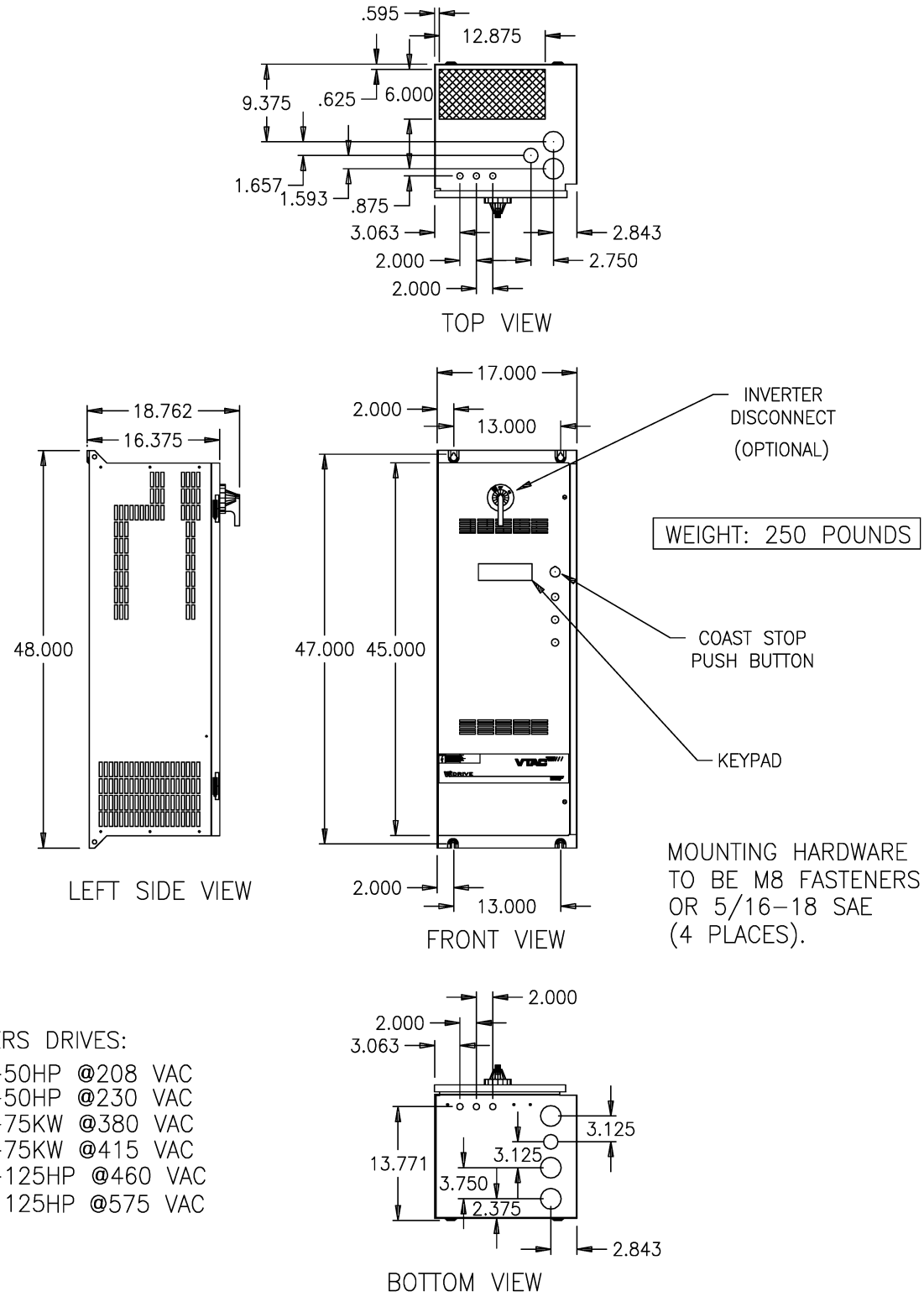


Figure 3-1. Physical Dimensions (Inverter Only).

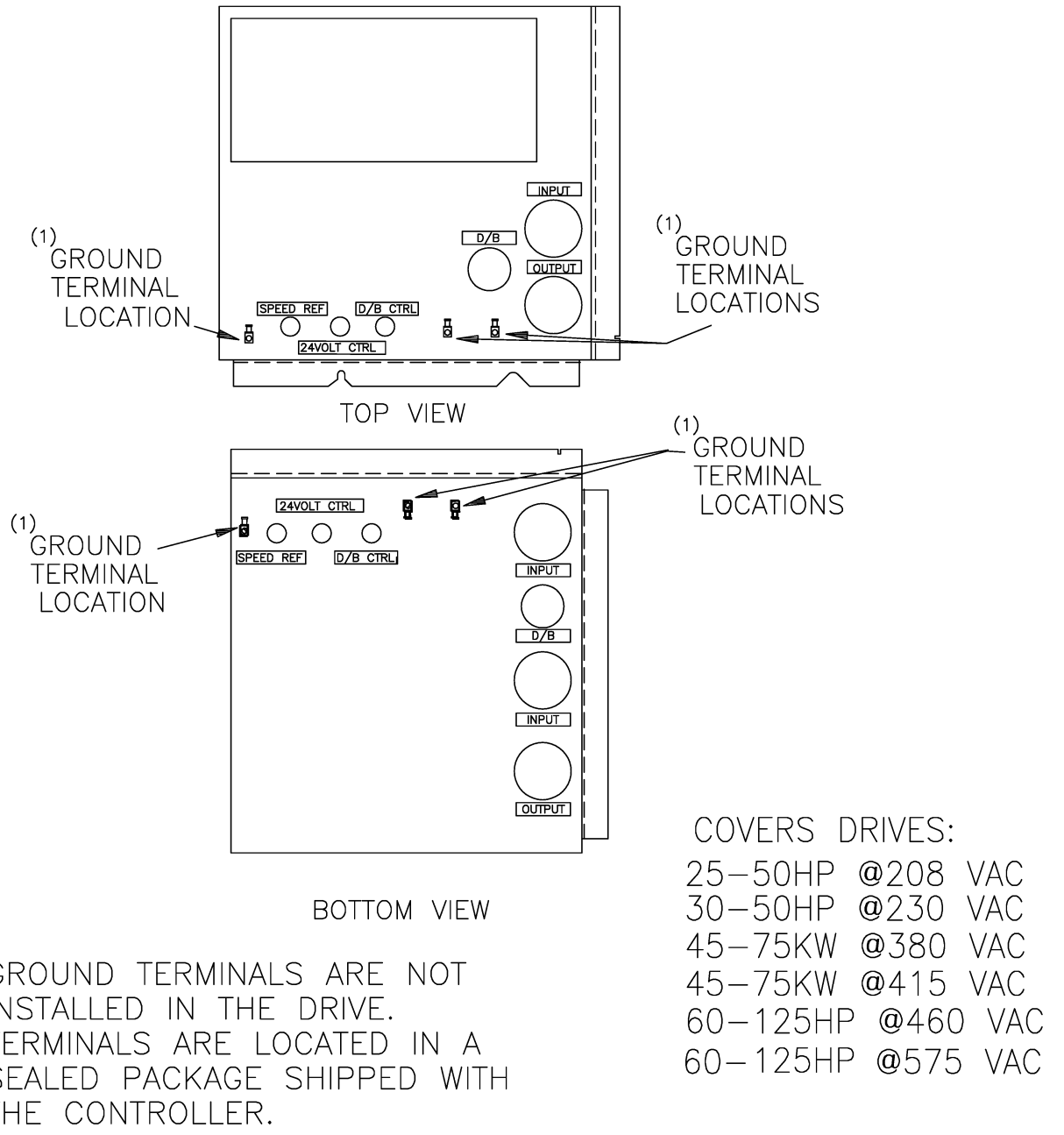


Figure 3-2. Controller Wiring Entrance Locations and Ground Terminals.

Mounting the GP2000 Controller in User-Supplied Enclosure

CAUTION: Complete all drilling, cutting, welding, etc., before mounting the controller in a user-supplied metal enclosure. During installation protect the controller from metal chips, weld splatters, and other debris. Failure to observe these precautions could result in damage to, or destruction of, the equipment.

1. Mount the controller in a vertical position directly to the enclosure mounting panel. Stand-off hardware is not necessary. See Figure 3-1 for mounting dimensions.
2. Provide adequate clearance for air ventilation and servicing within the enclosure:
   - At least 4 inches from the sides and 8 inches from the top and bottom of the controller to adjacent non-heat producing equipment, such as a cabinet wall.
   - At least 4 inches from the side and 10 inches from the top and bottom of adjacent heat producing equipment. For the best air movement with three or more controllers, do not mount the controllers in a vertical stack; offset the controllers.

Table 3-1. Heat Generated By GP2000 Power Modules (without kits).

575/460		415/380		230		208	
HP	WATTS	KW	WATTS	HP	WATTS	HP	WATTS
100	2070	–	–	50	1440	40	1350
75	1620	55	1530	40	1260	30	1170
60	1260	45	1260	30	990	25	990
50	1170	30	1080	25	900	20	900

Install the Motor

Note: For multi-motor application requirements, refer to "MultiMotor Applications" in Section 2.

1. Verify the motor is the appropriate size to use with the controller.

   Derate the A-C motor to compensate for additional heating in the motor caused by harmonics.

2. Install the A-C motor according to its instruction manual. Also refer to Figure 3-3 for wiring sizes.

> **CAUTION:** Additional overload and/or overtemperature devices may be required. Refer to the codes that apply to insure that you are in conformance. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

3. Install an overload protection device responsive to motor current in each power line of the motor (motor overload relay). Reliance offers a Motor Overload Kit provided for this purpose. See Section 7.

   If the motor is overframed, verify that the motor operating current does not exceed the controller's output current and the motor horsepower is not more than one size larger than the controller's horsepower rating.

> **CAUTION:** If the motor will be operated at speed below one-half base speed, a motor overload relay may not protect the motor, A motor thermostat, internal to the motor, may be required. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

4. Make sure the motor is properly aligned with the driven machine to minimize unnecessary motor loading from shaft misalignment.

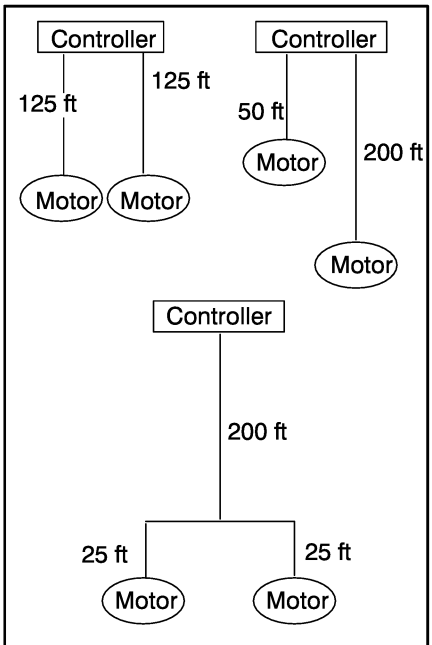
   Note: The controller output has a phase sequence of U, V, W in the forward direction. If the user knows the direction of motor rotation for a particular phase sequence, the direction of motor rotation can be determined prior to power up.

5. If the motor is accessible while it is running, install a protective guard around all exposed rotating parts.

Motor Lead Lengths

For applications using one motor connected to the controller, individual motor lead lengths cannot exceed 250 feet **per phase**. For applications where multiple motors are used, total lead lengths on each phase cannot exceed 250 feet, and each motor connection cannot exceed 250 feet per phase.

For example, the following illustrates correct connections for multiple motor applications:



Note: Each line to the motor represents a 3-phase connection.

If total 3-phase lead length exceeds 250 feet, nuisance tripping may occur. These trips are caused by capacitive current flow to ground and are not an indication of any problem with the controller. If the lead length must be exceeded, output line reactors may be required or other steps must be taken to correct the problem.

Install an Input Disconnect (Inside the Controller Cabinet)

> **DANGER**
>
> **THE NEC REQUIRES THAT AN INPUT DISCONNECT BE PROVIDED IN THE INCOMING POWER LINE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.**

1. Install an input disconnect in the incoming power line according to the NEC.

> **CAUTION:** The disconnect switch does not provide short circuit protection. J-type input fuses must be installed for this purpose. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

2. The controller has provisions for mounting internal to the cabinet, an Inverter Disconnect which can be factory or field installed. An external, through-the-door mechanism is provided. If the Optional Inverter Disconnect Kit is used, see Instruction Sheet D2-3245.

Installing a User Supplied Input Disconnect (External to the Controller)

DANGER

THE NEC REQUIRES THAT AN INPUT DISCONNECT BE PROVIDED IN THE INCOMING POWER LINE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

1. Install an input disconnect in the incoming power line according to the NEC.

CAUTION: The disconnect switch does not provide short circuit protection. J-type input fuses must be installed for this purpose. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

2. If a transformer is used, size the disconnect considering the transformer inrush current as well as any additional loads the disconnect may supply.
3. Wire this disconnect in the controller isolation transformer primary circuit (if used).

Install A-C Input Branch Circuit Protection

CAUTION: The input fuse ratings given in Table 3-2 are applicable for one controller per branch circuit. No other load can be applied to that fused branch circuit. Failure to observe this precaution could result in damage to, or destruction of the equipment.

CAUTION: The NEC requires that upstream branch circuit protection be provided to protect input power wiring. Install the fuses recommended in Table 3-2, for the wire coming to the controller, or install other protection in the form of a customer-supplied circuit breaker, customer-supplied J-type time-delay fuses, or use the optional Inverter Fuse Kit. Do not exceed the maximum allowed rating given in Table 3-2. Failure to observe this precaution could result in damage to, or destruction of the equipment.

1. Install user-supplied branch circuit protection external to the controller in the incoming power wiring. Install and size the branch circuit protection fuses according to the ratings given in Table 3-2.
2. An optional Inverter Fuse Kit (M/N 2FU4100 or 2FU5050) is offered that is installed internal to the controller that will serve as branch circuit protection **for the controller**. This kit includes (3) 200A, Class J fuses that take the place of internal bus bars inside the inverter section. If fuse ratings above 200A, but below the maximum fuse rating given in Table 3-2 are used, they must be installed external from the inverter.

Table 3-2. A-C Input Line Branch Circuit Protection with Three-Phase Input.

Controller Model #	Controller HP/KW Range	Controller Three-Phase Input Volts	Max Input Current Rating (Amps)	Recommended Input Fuse Rating		Max Allowable Input Fuse Rating	
				UL Class	Rating (Amps)	UL Class	Rating (Amps)
2GU01020	20HP	208	75	J	150	J	200
2GU01025	25HP	208	90	J	175	J	225(1)
2GU01030	30HP	208	116	J	200	J	300(1)
2GU01040	40HP	208	143	J	200	J	300(1)
2GU21025	25HP	230	75	J	150	J	200
2GU21030	30HP	230	90	J	175	J	225(1)
2GU21040	40HP	230	116	J	200	J	300(1)
2GU21050	50HP	230	143	J	200	J	300(1)
2GU31030	30KW	380	75	J	150	J	200
2GU31045	45KW	380	116	J	200	J	300(1)
2GU31055	55KW	380	143	J	200	J	300(1)
2GU11030	30KW	415	75	J	150	J	200
2GU11045	45KW	415	116	J	200	J	250(1)
2GU11055	55KW	415	143	J	200	J	300(1)
2GU41050	50HP	460	75	J	150	J	200
2GU41060	60HP	460	90	J	175	J	225(1)
2GU41075	75HP	460	116	J	200	J	300(1)
2GU41100	100HP	460	143	J	200	J	300(1)
2GU51050	50HP	575	60	J	125	J	150(2)
2GU51060	60HP	575	75	J	150	J	175(2)
2GU51075	75HP	575	90	J	175	J	225(1)
2GU51100	100HP	575	116	J	200	J	300(1)

(1)Controller has provisions for mounting up to 200A, J-type time delay fuses internally. Fuses used above 200A must be mounted external from drive cabinet or in 1KU4100 Side Cabinet Kit.

(2)This controller must use 2FU5050 fuse kit only.

Install a Transformer (if needed)

In all applications requiring the use of an output transformer, contact your Reliance Electric Sales Office for assistance.

Input transformers step up or step down input voltage and can be either auto-transformers or isolation transformers. Isolation transformers help eliminate

- Damaging A-C line voltage transients from reaching the controller.
- Line noise from the controller back to the incoming power.
- Damaging currents, which could develop if a point inside the controller becomes grounded.

If an input transformer is installed ahead of the controller, a power disconnecting device must be installed between the power line and the primary of the transformer. If this power disconnecting device is a circuit breaker, the circuit breaker trip rating must be coordinated with the inrush current of the input transformer. An input transformer rated at more than the KVA ratings given in Table 2-3, must NOT be used directly ahead of the controller without additional impedance between the controller reactor and the transformer.

CAUTION: Distribution system capacity above 1700 KVA, 5% impedance for 460 VAC (for other voltages, see Table 2-3) requires an isolation transformer, line reactors, or other means of adding line impedance. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Wire the Drive

Ground the Drive

DANGER

THE USER IS RESPONSIBLE FOR MEETING ALL CODE REQUIREMENTS WITH RESPECT TO GROUNDING ALL EQUIPMENT. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

1. Open the controller door. Install the ground terminals (provided loose with the controller). Tighten to 20 in-lbs.
2. Run a suitable equipment grounding conductor unbroken from the controller ground terminal (see Figure 3-2) to the grounding electrode conductor (earth ground). See Table 3-3 for recommended wire sizes.
3. Connect a suitable equipment grounding conductor to the motor frame, the remote control station (if used), the transformer (if required), and the controller enclosure. Run each conductor **unbroken** to the grounding electrode conductor (earth ground).
4. The 24 VDC and 110 VAC remote Start/Stop circuit is factory grounded. (See Figure 3-2.)

Table 3-3. Recommended Wire Sizes for Controller.

Description	Terminal Designation	Wire Size
Input power Output power	R, S, T U, V, W	#6−250 MCM AWG #8−250 MCM AWG
DB power DB control	147, 45 113, 114(TB15, Pins 1 & 2)	14−22 AWG 14−22 AWG
Inverter Only Function Loss	TB11 (11 & 12)	14−22 AWG
24 VDC Control 24 VDC Control Signal Buffer board	TB 11 (1−19)	14−22 AWG
GND terminal	GND input/output/control	14−1/0 AWG
24VDC Purge (if used) 110VAC, 50VA (288 & 289); 110VAC Purge (if used) or Start/Stop Control wiring.	TB13 (1 & 3); TB14 (4 & 3); TB14 (1 & 2)	14−22 AWG
Inverter Disconnect Kit	L1, L2, L3	#6−250 MCM AWG

Note: Table 3-3 presents a range of acceptable wire sizes for the GP2000. For actual sizes, the user is responsible for following the National Electrical Code and all applicable local codes with respect to wire sizes.

Install Power Wiring

DANGER

EXTERNAL POWER WIRING MAY REMAIN ELECTRICALLY HOT WHEN THE MAIN A-C POWER IS DISCONNECTED. IDENTIFY ALL SUCH EXTERNAL WIRING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

1. Verify that input power to the controller corresponds to the controller nameplate voltage and frequency and that the plant supply is of sufficient capacity to support the input current requirements of the controller.
2. Provide a transformer between the plant power supply and the controller if the correct input line voltage is not available. Refer to "Install a Transformer (if needed)" in this section.
3. Size upstream branch circuit protection (fuses) according to Table 3-2.
4. Size output power wiring, according to applicable codes to handle the rated maximum output current listed in Table 2-2, or marked on the nameplate of the controller. Two, 2-inch conduit openings provided in the top or bottom of the controller permit up to 250 MCM gauge wire. (See Figure 3-2.) The user must add lugs to the ends of the wire and connect securely to studs labeled U, V, W.

   Systems with greater capacity cause fault current to be larger than systems with lower capacity. Fault current ratings given in Table 2-2 are based on distribution systems which have 42,000A short circuit capacity.

   Size input power wiring, according to applicable codes to handle the rated maximum input current as per the fault current listed in Table 2-2, or as marked on the nameplate of the controller, (if you do not know the distribution system capacity or if your system KVA range falls in Group 1 of Table 3-5). If the distribution short circuit current capacity at the controller is known, or the distribution system KVA capacity is known, use Table 3-5 to reduce the incoming wire size. Table 3-5 helps to better predict the actual maximum input current requirements of the controller in the distribution system it is connected to.

   Caution: If the distribution system capacity is increased to a higher KVA capacity, the wire size to the controller may also have to be increased. Failure to observe this precaution could result in damage to or destruction of the equipment.
5. Use only copper wire with a minimum temperature rise of 60/75°C.
6. Use the appropriate tightening torque listed in Table 3-4 for wire connections to input terminals and output terminals in the controller.

   Note: The controller output power has a phase sequence of U, V, W in the forward direction. If the user knows the direction of motor rotation for a particular phase sequence, the direction of motor rotation can be determined prior to power up.
7. Install the power input (R, S, T) and output (U, V, W) wiring. Use Figure 3-3.

Table 3-4. Terminal Tightening Torques (Controller Only).

Terminal	Location	IN. LB
Input Power	R, S, T @ Input Fuse Panel (Standard)	137
	L1, L2, L3 @ Inverter Input Disconnect (Opt)	250
Output Power	U, V, W @ Motor Connection Block (Standard)	137
	147, 45 (For Dynamic Braking, If Required)	137

Table 3-5. Wire Sizing Requirements for System KVA Ranges and Fault Current Availability.

System Short Circuit Capacity at Controller	KVA Range (5% Impedance)	Input Current Requirements for Wire Sizing
25,001−42,000A “Group 1”	451−750 KVA for 208V 501−840 KVA for 230V 826−1400 KVA for 380V 876−1500 KVA for 415V 1001−1700 KVA for 460V 1251−2100 KVA for 575V	Use Table 2-2 Ratings
12,501−25,000A “Group 2”	225−450 KVA for 208V 251−500 KVA for 230V 412−825 KVA for 380V 438−875 KVA for 415V 501−1000 KVA for 460V 626−1250 KVA for 575V	Reduce Controller Current Rating By 5% to Reduce Incoming Wire Size
0−12,500A “Group 3”	* − 225KVA for 208V * − 250KVA for 230V * − 411KVA for 380V * − 437KVA for 415V * − 500KVA for 460V * − 625KVA for 575V	Reduce Controller Current Rating by 10% to Reduce Incoming Wire Size.

*Minimum KVA is the actual nameplate KVA requirement given for the controller in Table 2-2.

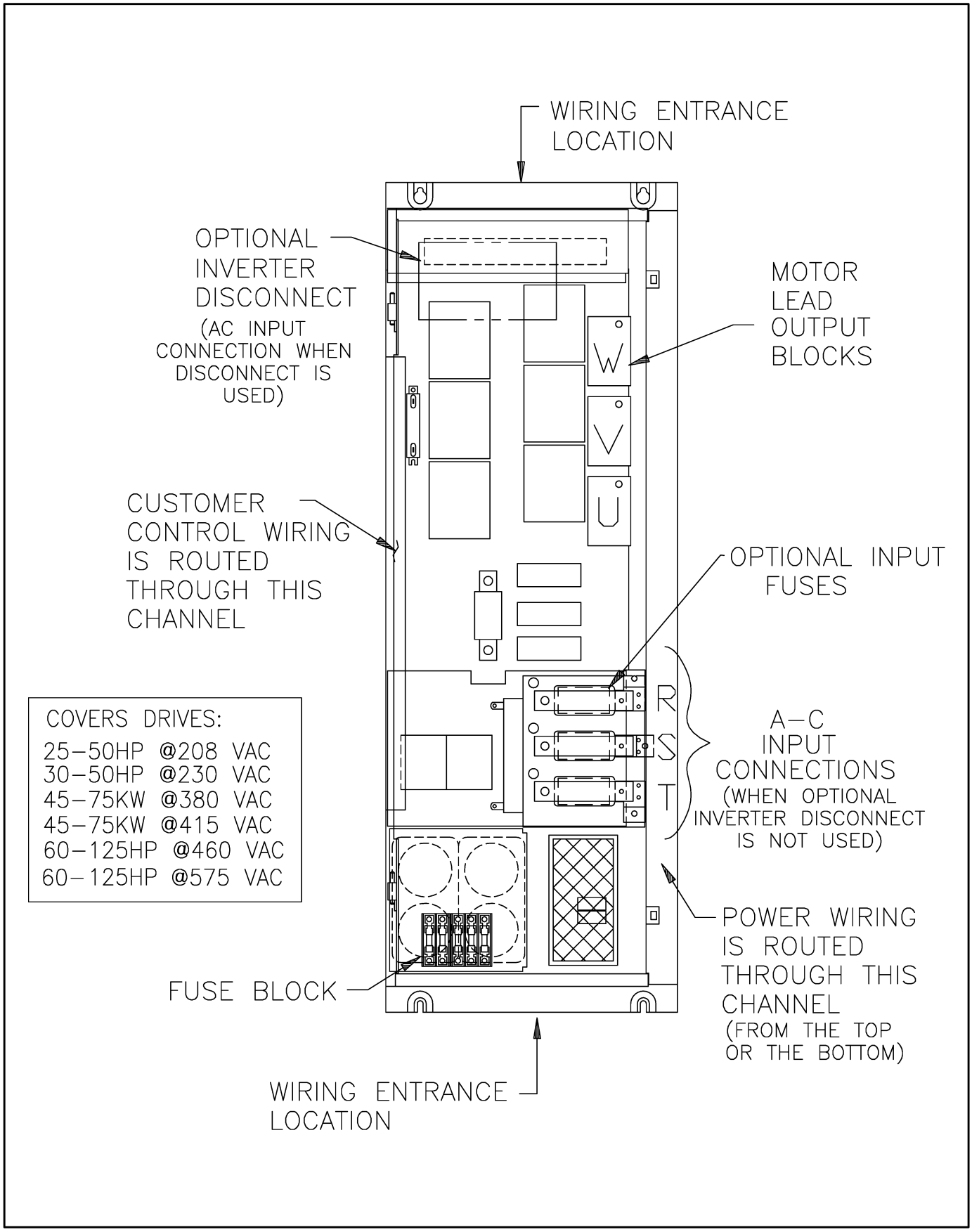


Figure 3-3. Typical Input/Output Power Wiring Locations (Inverter Only).

Install Control and Signal Wiring

Size and install all wiring in conformance with the NEC and all other applicable local codes. See Table 3-3 for recommended wire sizes.

1. For speed reference and 24 VDC signal wiring, use twisted wire having two to three twists per inch. If you use shielded twisted pair wire rather than twisted wire, the shields should not attach to any ground point; they should "float."

   Note: All customer interlocks shall be suitable for operation with 24-volt, 40 milliamp signals (standard industrial 10A contacts).

2. For distances of less than 150 feet, use a minimum of #22 AWG. For distances of more than 150 feet and less than 300 feet, use a minimum of #16 AWG. For distances of more than 300 feet, contact your Reliance Electric Sales Office.

WARNING

THE FACTORY-INSTALLED JUMPER ACROSS TB11 TERMINALS 11 AND 12 ON THE CONTROL SIGNAL BUFFER BOARD IN THE INVERTER MUST BE REMOVED WHEN FUNCTION LOSS INPUT, COAST-STOP PUSHBUTTON, OR INTERLOCKS ARE USED SO THESE CONTACTS WILL OPEN TO STOP THE CONTROLLER. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

3. Route user-supplied interlock and function loss input wiring (if used) through the conduit opening labelled 24 VDC in the bottom of the controller. Remove the factory-installed jumper across terminals 11 and 12. Refer to Figure 3-4.
4. GP2000 controllers have a door-mounted, coast-stop pushbutton as a standard feature. The user may install additional normally-closed, maintained, remote pushbutton. These buttons, installed in series with the coast-stop pushbutton contacts, will function the same as the standard door-mounted pushbutton. It will stop the drive in remote or local mode and override any START command. Wire the pushbuttons in series between TB11 terminals 11 and 12. (Refer to Figure 3-6 for detail.) Route the wiring through the conduit opening labelled 24 VDC in the bottom of the controller. Remove the factory-installed jumper across TB11, terminals 11 and 12.
5. Route external control wiring (if used) through openings indicated on Figure 3-2 in the bottom or top of the controller in separate steel conduit to eliminate electrical noise pick-up. The conduit can be rigid or flexible, armored steel.
6. Do not route any signal wire through junction or terminal boxes that contain power or control wire.
7. Do not route any signal wire in close proximity to devices producing external magnetic fields.
8. The controller can be operated in one of four modes. See Table 3-6.

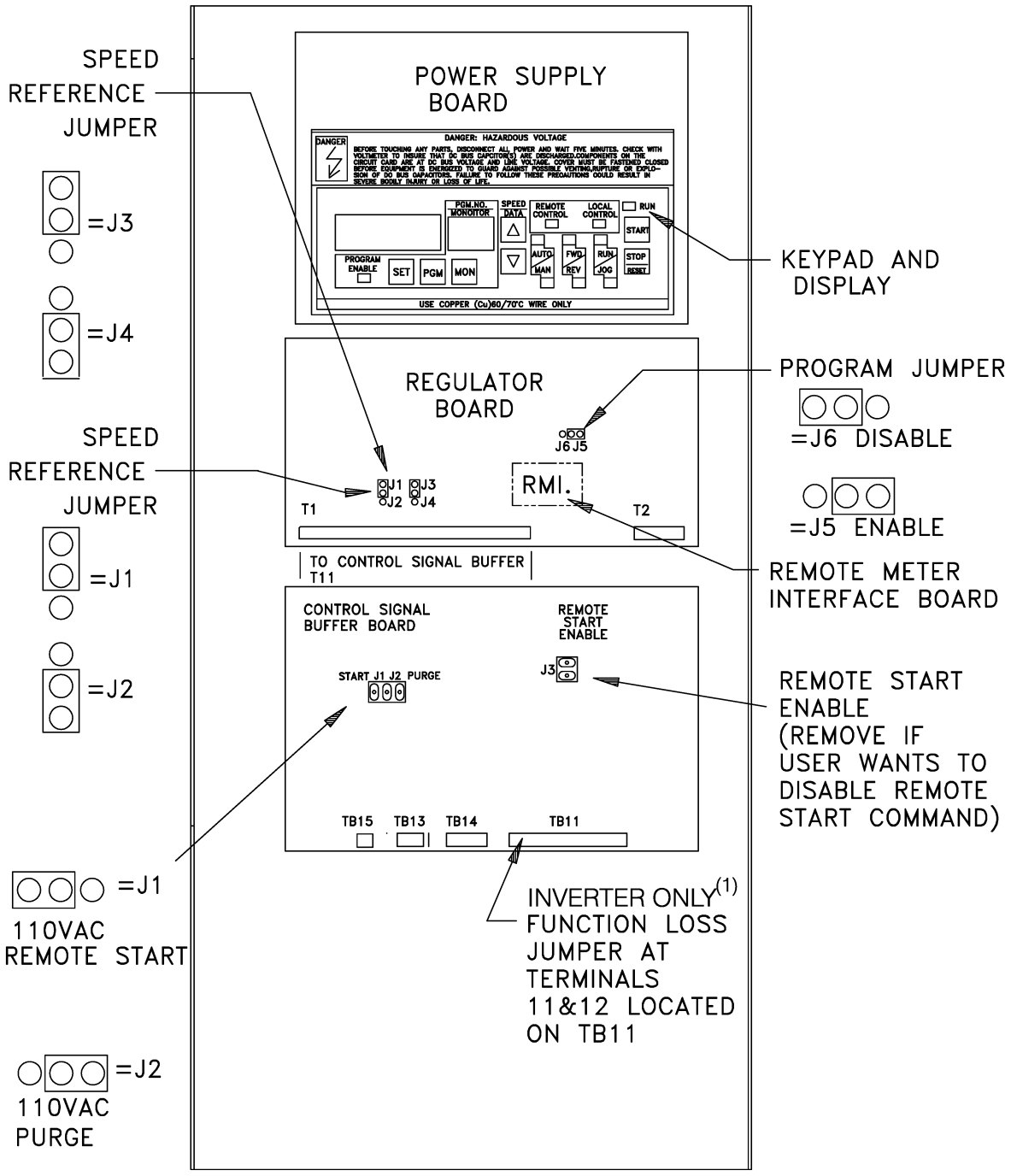
   Install the speed reference external wiring as indicated in Figure 3-5.

   Install the Start/Stop wiring as indicated in the following steps.

Table 3-6. GP2000 Operating Modes.

Mode	Control Interface	Speed Reference Means
Local Manual*	Keypad	Speed increment/decrement keys on Keypad
Local Auto	Keypad	External Speed Reference
Remote Manual	Terminal board	Speed pot connected to terminal board and selected by a remote AUTO/MAN switch
Remote Auto	Terminal board	External Speed Reference

* The controller is shipped with keypad functions selected to operate in LOCAL Manual mode. In the startup procedure, the controller should be tested in this mode first before changing to other modes.



(1) Refer to Section 4 for location of bypass Function loss jumper, if Bypass is installed.

Figure 3-4. Inverter Terminal Block and Jumper Locations (Regulator and Control Signal Buffer Boards).

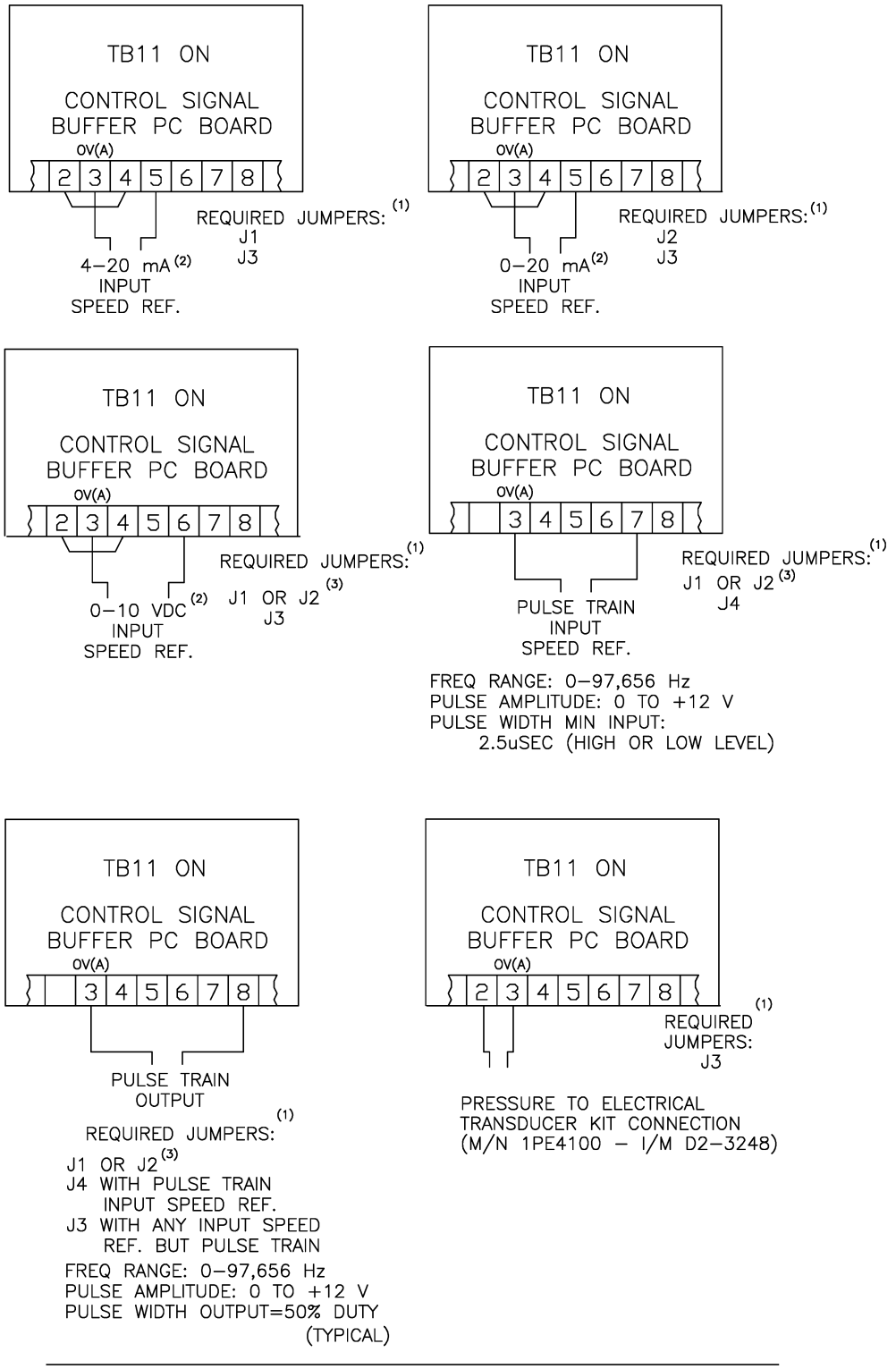


Figure 3-5. Speed Reference Terminal Block Wiring.

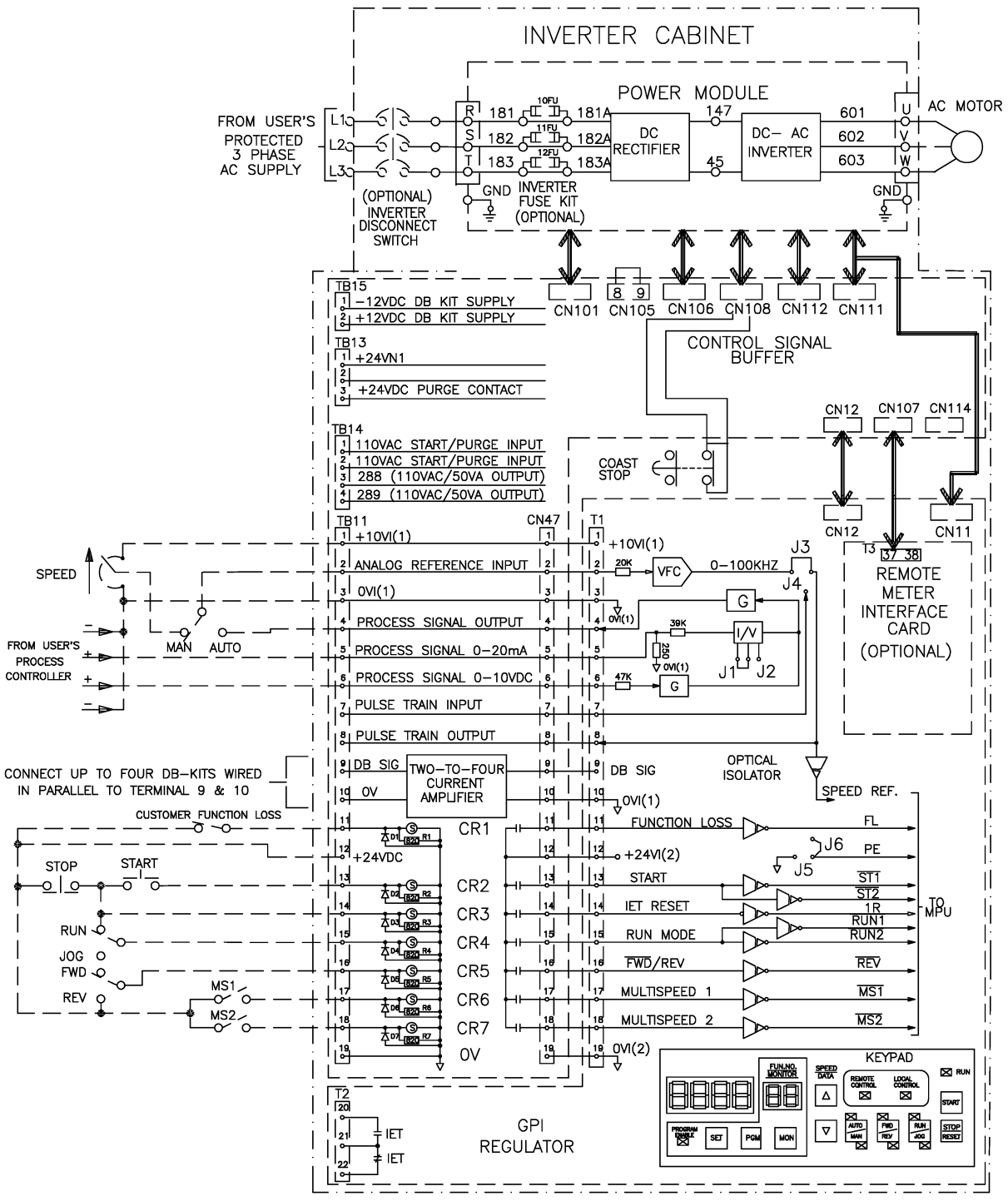


Figure 3-6. Control Signal Buffer Board Functional Block Diagram.

Remote Manual/Auto Modes

9. **110 VAC (Two-Wire, Single Contact) Start/Stop Using Internal Supply**: Install control wiring as shown in Figure 3-7. Use the internal 110 VAC supply at the Control Signal Buffer board TB14, (terminals 3 and 4). Check that the Control Signal Buffer Jumper is in the "J1" position (for 110 VAC remote start). See Figure 3-4.

   Note: TB14, terminal 4 (289) is grounded internally in the controller.

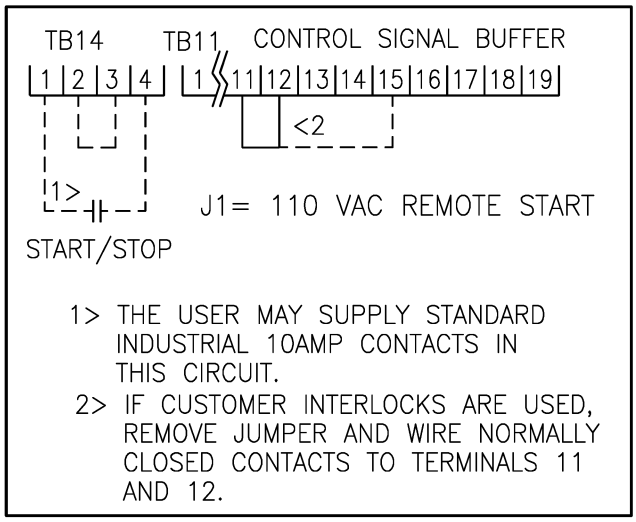


Figure 3-7. 110 VAC (Two-Wire, Single Contact) Start/Stop Wiring Using Internal Supply.

10. **110 VAC (Three-Wire) Start/Stop Using Internal Supply**: Install control wiring as shown in Figure 3-8. Use the internal 110 VAC supply at the Control Signal Buffer Board TB14, (terminals 3 and 4). Check that the Control Signal Buffer Jumper is in the "J1" position (for 110 VAC remote start). See Figure 3-4. Refer to Step 17 for available capacity of this power supply.

    Note: TB14, terminal 4 (289) is grounded internally in the controller.

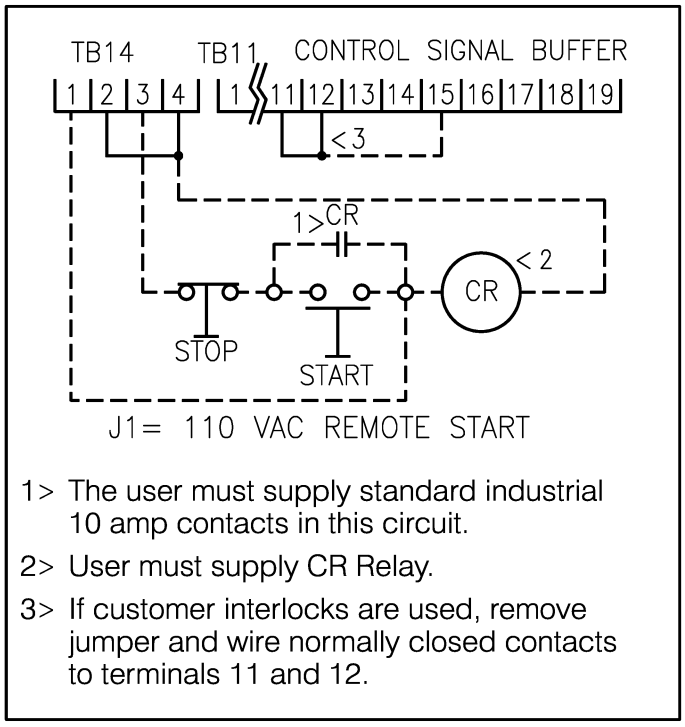


Figure 3-8. 110 VAC (Three-Wire) Start/Stop Wiring Using Internal Supply.

11. **110 VAC (Two-Wire, Single Contact) Start/Stop Using Customer-Supplied 110 VAC**: Install control wiring as shown in Figure 3-9 with customer-supplied 110 VAC. Install control wiring using the Control Signal Buffer board TB14, (terminals 1 and 2) to connect the 110 VAC supply. Check that the Control Signal Buffer Board Jumper is in the "J1" position (for 110 VAC remote start). See Figure 3-4.

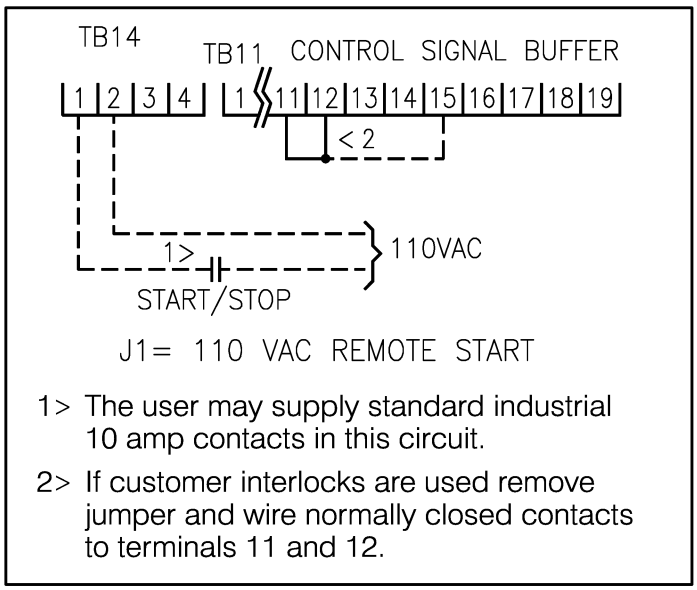


Figure 3-9. Customer-Supplied 110 VAC (Two-Wire, Single Contact) Start/Stop Wiring.

12. **110 VAC (Three-Wire) Start/Stop Using Customer-Supplied 110 VAC**: Install control wiring as shown in Figure 3-10 with customer-supplied 110 VAC. Install control wiring using the Control Signal Buffer board TB14, (terminals 1 and 2) to connect the 110 VAC supply. Check that the Control Signal Buffer Jumper is in the "J1" position (for 110 VAC remote start). See Figure 3-4.

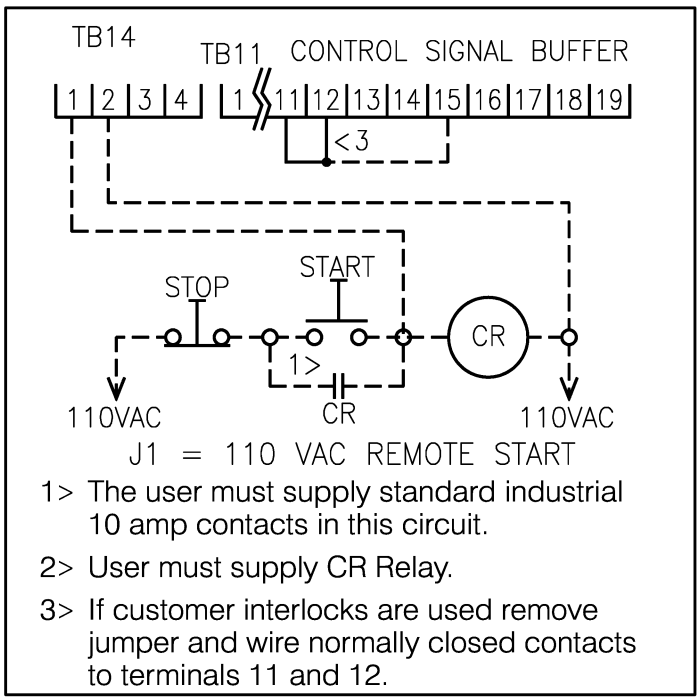


Figure 3-10. Customer-Supplied 110 VAC (Three-Wire) Start/Stop Wiring.

13. **110 VAC Two-Wire Purge**: 110 VAC purge is wired the same as in Steps 9 or 11, Figures 3-7, or 3-9, except when customer uses a “PURGE” contact for control instead of the “START/STOP” contact shown. Purge is typically a two-wire configuration, and can be supplied using either the internal 110VAC supply (288, 289, located at TB14, terminals 3 and 4 on the Control Signal Buffer board), or a customer-supplied 110 VAC supply.

    Change the Control Signal Buffer Jumper to the “J2” position. See Figure 3-4.

14. **24 VDC (Two-Wire, Single Contact) Start/Stop**: Install control wiring as shown in Figure 3-11. Connections are made to the Control Signal Buffer board, TB11. (Also refer to Figure 3-6.)

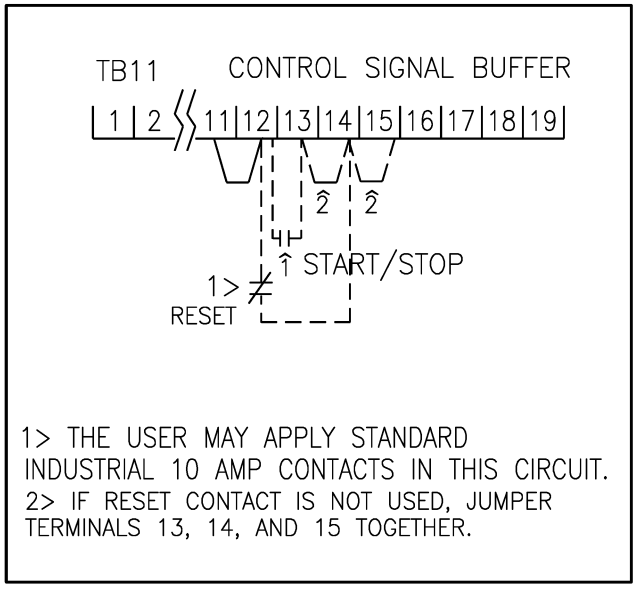


Figure 3-11. 24 VDC (Two-Wire, Single Contact) Start/Stop Wiring.

15. **24 VDC (Three-Wire) Start/Stop**: Install control wiring as shown in Figure 3-12. Connections are made to the Control Signal Buffer Board, TB11. (Also refer to Figure 3-6.)

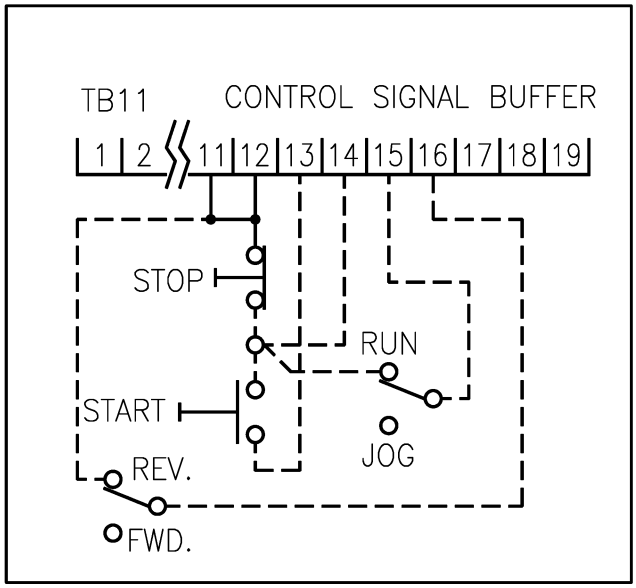


Figure 3-12. 24 VDC (Three-Wire) Start/Stop Wiring.

16. **24 VDC (Single Contact) Purge Wiring**: Install control wiring as shown in Figure 3-13. Connect the "PURGE" contacts to TB13 (terminals 1 and 3) on the Control Signal Buffer board. Do not use the 110 VAC purge in combination with the 24 VDC purge. (Note that it does not matter what position the J1/J2 jumper is in on the Control Signal Buffer board, as the J1/J2 jumper is only used for the 110 VAC circuit.) No external wiring to TB11 is necessary for purge connections. Refer to Figure 3-6. The "PURGE" speed reference is controlled by programmable Function 16 (MS1) which must be set to the desired purge speed setting. (See Section 6, Function 16.)

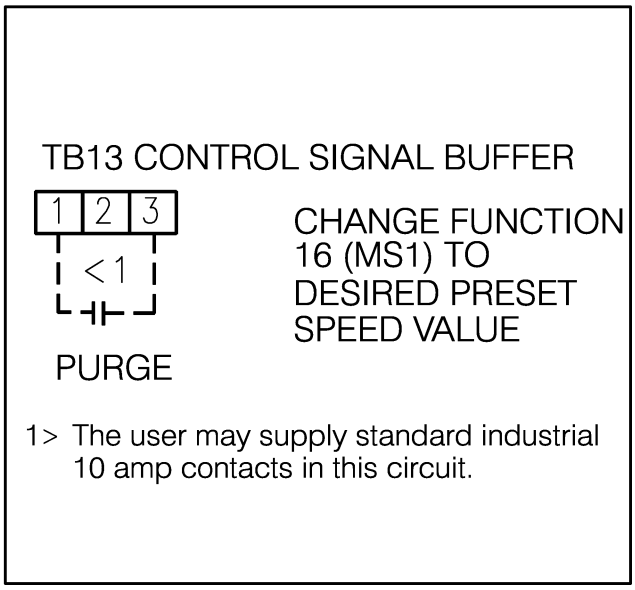


Figure 3-13. 24 VDC (Single Contact) Purge Wiring.

17. **110 VAC (50 VA) Power Supply**: This circuit is located on the Control Signal Buffer board, TB14, terminals 3 and 4 (288 and 289). It has a 50VA rating, and is used to supply the kits (and possibly other factory-installed options) as listed in Table 3-7. Connect all kits to this supply before using the supply for other options. The total circuit capability must be less than 50 VA.

Table 3-7. VA Requirements of Common Factory-Installed Kits Connected to the 110 VAC Power Supply.

M/N	Description	VA Requirement
1PE4100	P-E Transducer(1)	6VA
1RR4100	Remote Reference Selector	3VA
1GB4100	Gain/Bias Adjustment Kit	6VA
1FB4100	Output Feedback (4−20ma)	6VA

(1)This kit is also a field-installable option.

4: Install Optional Bypass

The optional Bypass Unit is contained in a Side Cabinet Kit that houses the bypass and other kit options. Bypass provides a method of operating the motor at rated voltage and frequency when the inverter section is not being used. Bypass contains the following:

- **Main Input Disconnect**: Disconnects all power in the controller. (250A rated).
- **Input Line Fuses**: Provides branch circuit protection for the entire controller (bypass and inverter sections).
- **Input Line Reactor**: A Line Reactor is provided in series with both the inverter and bypass sections. The Input Line Reactor reduces line harmonics during inverter operation and buffers the input supply during across-the-line starts for bypass.
- Separate bolt-on **bypass compartment** (M/N 1KU4100, Side Cabinet Kit) with provided control interface to the inverter section.
- **Bypass Contactor**: NEMA rated contactor for bypass operation.
- **Inverter Contactor**: Disconnects inverter output from motor during bypass.
- **Motor Overload**: Bi-metal overload, with current adjustment capability.
- **Three-Phase Multiple Voltage Transformer Board and Bypass Multiple Voltage Board**: Supplies 24 VDC power for bypass control; permits bypass to run, if possible, during single-phase conditions necessary when using Purge. The Bypass Multiple Voltage Board provides 110 VAC, single-phase power for customer convenience @ TB21 (terminals 5 & 6), wires 188 & 189. (18FU fuse protects the 110 VAC circuit from an overload condition).
- **Inverter Disconnect**: Located in the inverter compartment, disconnects power from the inverter while leaving power on to bypass. This permits troubleshooting in the inverter compartment while bypass remains energized.
- **Inverter On/Inverter Off/Bypass Selector Switch:** Selects the Control Mode of operation, i.e. Inverter or Bypass.

WARNING

THE BYPASS OPTION INCLUDES AN INVERTER/BYPASS CONTROL SWITCH LOCATED ON THE BYPASS CABINET DOOR. DEPENDING ON THE CONTROL MODE SELECTED, THE MOTOR MAY BE ENERGIZED WITH THE SWITCH IN ANY POSITION. WHEN CONTROL MODE "AUTO-SELECT" IS USED, THE "OFF" POSITION OF THE SWITCH WILL PREVENT INVERTER OPERATION, BUT WILL NOT PREVENT THE MOTOR FROM OPERATING IN THE BYPASS MODE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

DANGER

THE INVERTER DISCONNECT AND INVERTER ON/INVERTER OFF/BYPASS SWITCH MAY NOT ISOLATE ALL POWER IN THE CONTROLLER CABINET. REMOVE POWER BEFORE SERVICING THE EQUIPMENT. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

WARNING

THE FACTORY INSTALLED JUMPER ACROSS TERMINALS 3 & 4 ON TB 21 MUST BE REMOVED WHEN FUNCTION LOSS INPUT, COAST STOP PUSHBUTTON, OR INTERLOCKS ARE USED SO THAT THESE CONTACTS WILL OPEN TO STOP THE CONTROLLER. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

- **Inverter and Bypass Function Loss Input:** Interlock for both bypass and inverter (in keypad and remote modes).
- **24 VDC Power Supply:** Convenient customer wiring to +24 VDC power supply via TB 21, terminals 1 & 2.
- **Coast-Stop Pushbutton** is standard on inverter with and without bypass. This mushroom-head pushbutton will stop bypass or inverter operation, even if Purge command is present. Optional remote Coast-Stop pushbuttons with normally closed contacts can also be installed.
- **The Remote Meter Interface Card** (M/N 1MI4000) plugs into the regulator and controls the inverter contactor so that the contactor picks up (only after a

start command is given and the inverter does not have a fault).

- **Bypass Control Board**:
  1. ***Single Remote Contact 110 VAC Start/Stop Capability:*** Start/Stop input controls bypass and inverter depending on which mode of operation is selected. Refer to Figure 4-4.
  2. ***24 VDC Remote Start/Stop Input:*** Standard industrial contacts can be used. Start/stops bypass or inverter depending on which mode of operation is selected. Refer to Figures 4-9 and 4-12.
  3. ***24 VDC Purge Operation:*** With single standard industrial contact (TB16, terminals 1 & 11), selects the MS1 preset speed internally. No other contact is necessary. (User must program MS1 to desired preset speed. Refer to Section 6.) This method operates bypass or inverter. If inverter mode is selected, purge command will try to start inverter. If inverter will not run, it will automatically start bypass. Purge command will ignore overload trip and interlocks except Coast-Stop. Refer to Figure 4-4.
  4. ***Interface with the Remote Meter Interface Card:*** Jumpers J1 & J2 on the Bypass Control board provide the capability to run with or without the Remote Meter Interface card. If the Rail Interface card (M/N 1SC4000) is used in combination with bypass, the Remote Meter Interface Card will need to be removed because both cards plug into the same connector on the regulator board. Placing the jumper in the J2 position permits bypass to operate without the Remote Meter Interface Card. The inverter contactor will not drop out in the inverter stop mode, but remains energized at all times unless bypass is selected. The factory setting is in the J1 jumper position.
  5. ***Auxiliary Contacts Option:*** The Bypass Control board also provides a wiring connection for auxiliary contacts from the bypass contactor (BC), at TB16, terminals 9 & 10, and the inverter contactor (IN) at TB16, terminals 7 & 8. See Figure 4-4.

Installation and Wiring of Bypass

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD INSTALL IT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

DANGER

THE USER IS RESPONSIBLE FOR CONFORMING TO THE NEC/CEC AND ALL OTHER APPLICABLE LOCAL CODES. WIRING PRACTICES, GROUNDING, DISCONNECTS, AND OVERCURRENT ARE OF PARTICULAR IMPORTANCE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Follow the same procedures as given in ***Section 3: Install the Controller for "Planning", "Selecting the Location", "Mounting the Controller", and "Installing the Motor".*** Follow all of the branch circuit protection guidelines as given for the inverter section. Use the physical dimensions given in Figure 4-1 that show the Bypass dimensions including the inverter.

Input Disconnect

When Bypass is included, there can be two internal disconnects provided. There is a Main Input disconnect located in the bypass section which disconnects all incoming power to the bypass and inverter sections of the controller. The Main Input Disconnect is standard with Bypass. The second disconnect is the Inverter Disconnect located in the inverter section of the controller. This disconnect removes power to the inverter section only, and leaves power on to the bypass section. Both disconnects have through-the-door handles, which are interlocked with the door.

A-C Branch Circuit Protection

Bypass Option: If bypass is included as a factory installed option, 200A, Class J time delay fuses are standard and may serve as branch circuit protection for the Inverter and Bypass sections of the controller. In some cases, the application may require the fuse rating to be increased to the Maximum Allowable Fuse Rating (given in Table 3-2) to avoid nuisance fuse blowing. The Bypass section has provisions for installing up to 300A fuses (exception: 400A fuses for 125 HP/460V, 75 KW/415V, 75 KW/380V, and 50 HP/208V).

Wiring Bypass

Grounding

DANGER

THE USER IS RESPONSIBLE FOR MEETING ALL CODE REQUIREMENTS WITH RESPECT TO GROUNDING ALL EQUIPMENT. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Refer to Table 4-1 for Recommended Wire Sizes for bypass.

1. Open the controller door. Install the ground terminals (provided loose with the controller). Tighten to 20 in-lbs.
2. Run a suitable equipment grounding conductor unbroken from both the inverter bypass ground terminals to earth ground. See Figure 4-2. (Ground the Bypass section in addition to the Inverter Section.)
3. Connect a suitable equipment grounding conductor to the motor frame, the remote control station (if used), and the Bypass enclosure. Run each conductor, unbroken to earth ground. The Remote Meter Interface Card is standard with the VTAC V controller.The Remote Meter Interface Card is standard with the VTAC V controller.
4. The remote 24VDC and 110VAC start/stop circuits are factory grounded.

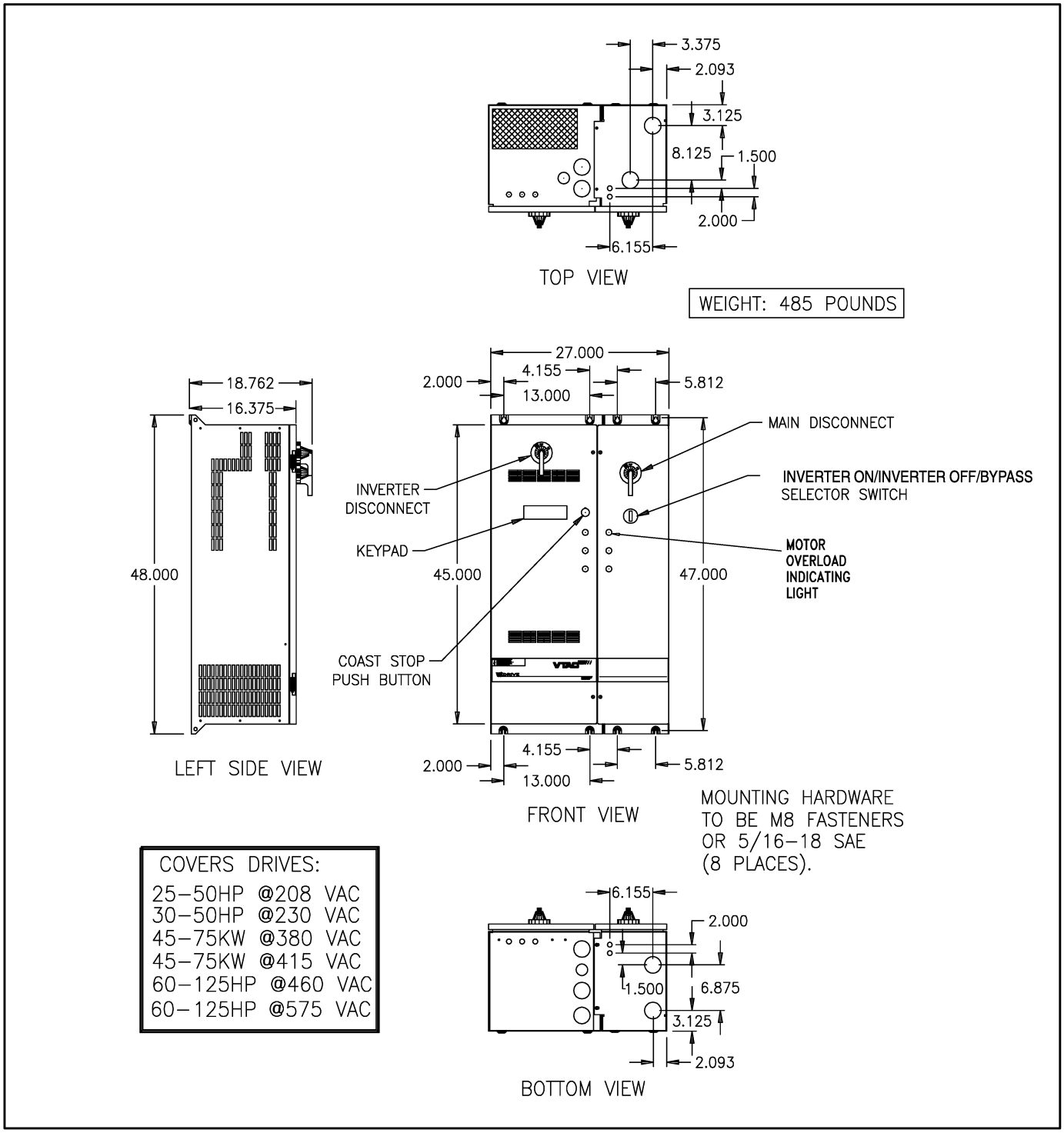
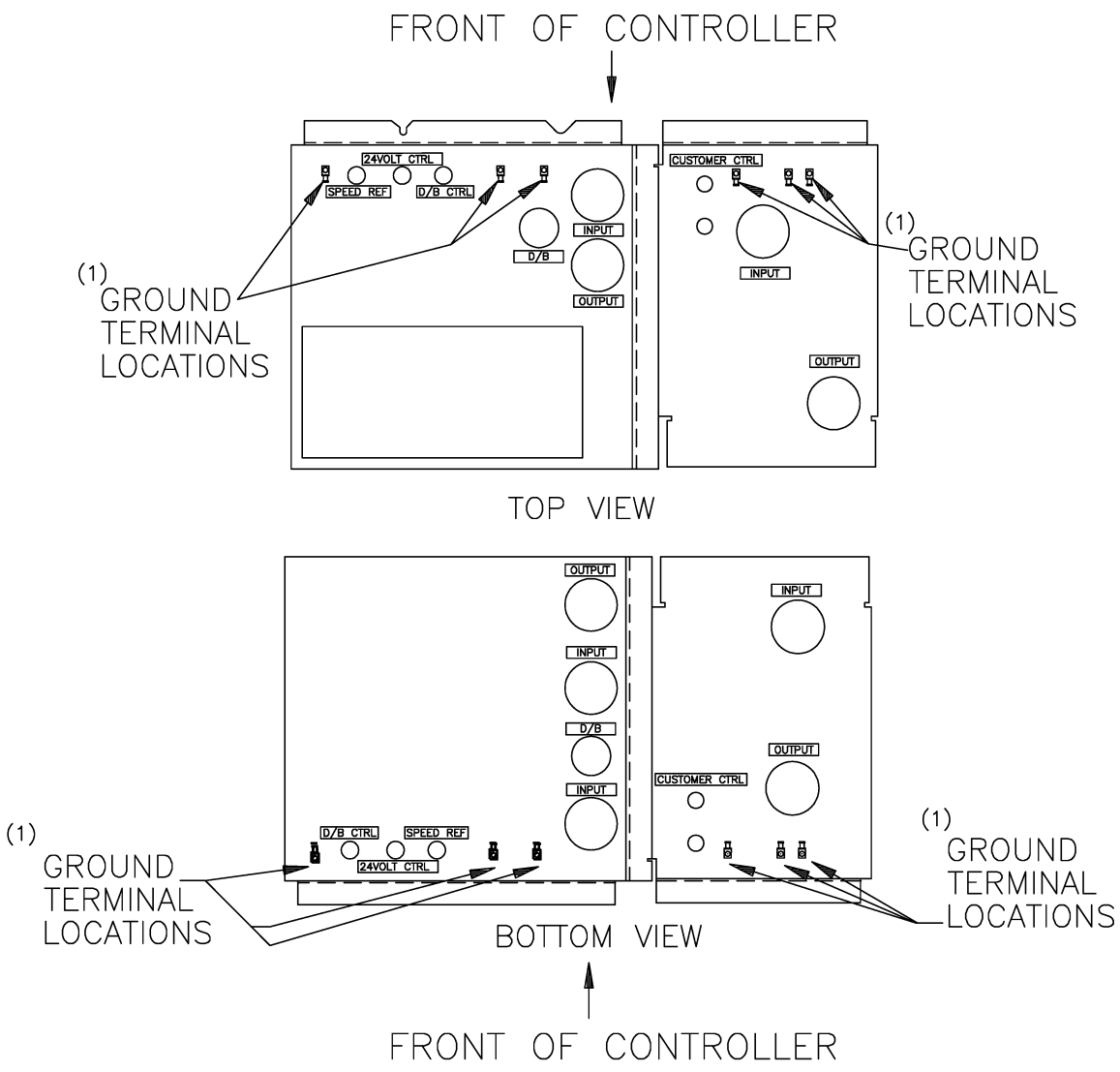


Figure 4-1. Bypass Physical Dimensions (with Inverter Section).



(1) GROUND TERMINALS ARE NOT INSTALLED IN THE DRIVE. TERMINALS ARE LOCATED IN A SEALED PACKAGE SHIPPED WITH THE CONTROLLER.

COVERS DRIVES:
25–50HP @208 VAC
30–50HP @230 VAC
45–75KW @380 VAC
45–75KW @415 VAC
60–125HP @460 VAC
60–125HP @575 VAC

Figure 4-2. Bypass Wiring Entrance Locations and Ground Terminals.

Table 4-1. Recommended Wire Sizes for Bypass.[1]

Description	Terminal	Wire Size
Main Input Disconnect	L1, L2, L3	#6−250MCM AWG
Output Power	U', V', W'	#8−250MCM AWG
Bypass Control Board	TB16 (1−13), TB17 (1−2)	14−22 AWG
110 VAC, 50VA Power Supply	TB21 (5−6)	14−22 AWG
Bypass and Inverter Function Loss	TB21 (3 − 4)	14−22 AWG
24 VDC Power Supply	TB21 (1 − 2)	14−22 AWG
Ground Terminal	GND INPUT/OUTPUT	14−1/0 AWG

[1]For inverter connections, refer to Table 3-3.

Note: Table 4-1 presents a range of acceptable wire sizes for the controller. For actual sizes the user is responsible for following the National Electrical Code/Canadian Electrical Code and all applicable local codes with respect to wire sizes.

Install Power Wiring

DANGER

EXTERNAL POWER WIRING MAY REMAIN ELECTRICALLY HOT WHEN THE MAIN A-C POWER IS DISCONNECTED. IDENTIFY ALL SUCH EXTERNAL WIRING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Size all input and output power wiring in accordance with the controller guidelines given in ***Section 3: Install the Controller*, under "Install Power Wiring"**. See Table 4-1 for recommended wire sizes.

Use only copper wire with a minimum temperature rise of 60/75°C.

Install input power wiring to the bypass A-C input block (through the top of the main input disconnect at L1, L2, and L3). See Figure 4-3, Input and Output Power Wiring Locations for bypass. Use the terminal tightening torques as given in Table 4-2.

Install motor leads to the output block at terminals U', V', and W'. See Figure 4-3. Use the terminal tightening torques as given in Table 4-2.

Table 4-2. Bypass Option Terminal Tightening Torques.

Terminal	Description	In-lb. Torque
Input Power	L1, L2, L3	250
Output Power	U', V', W'	137

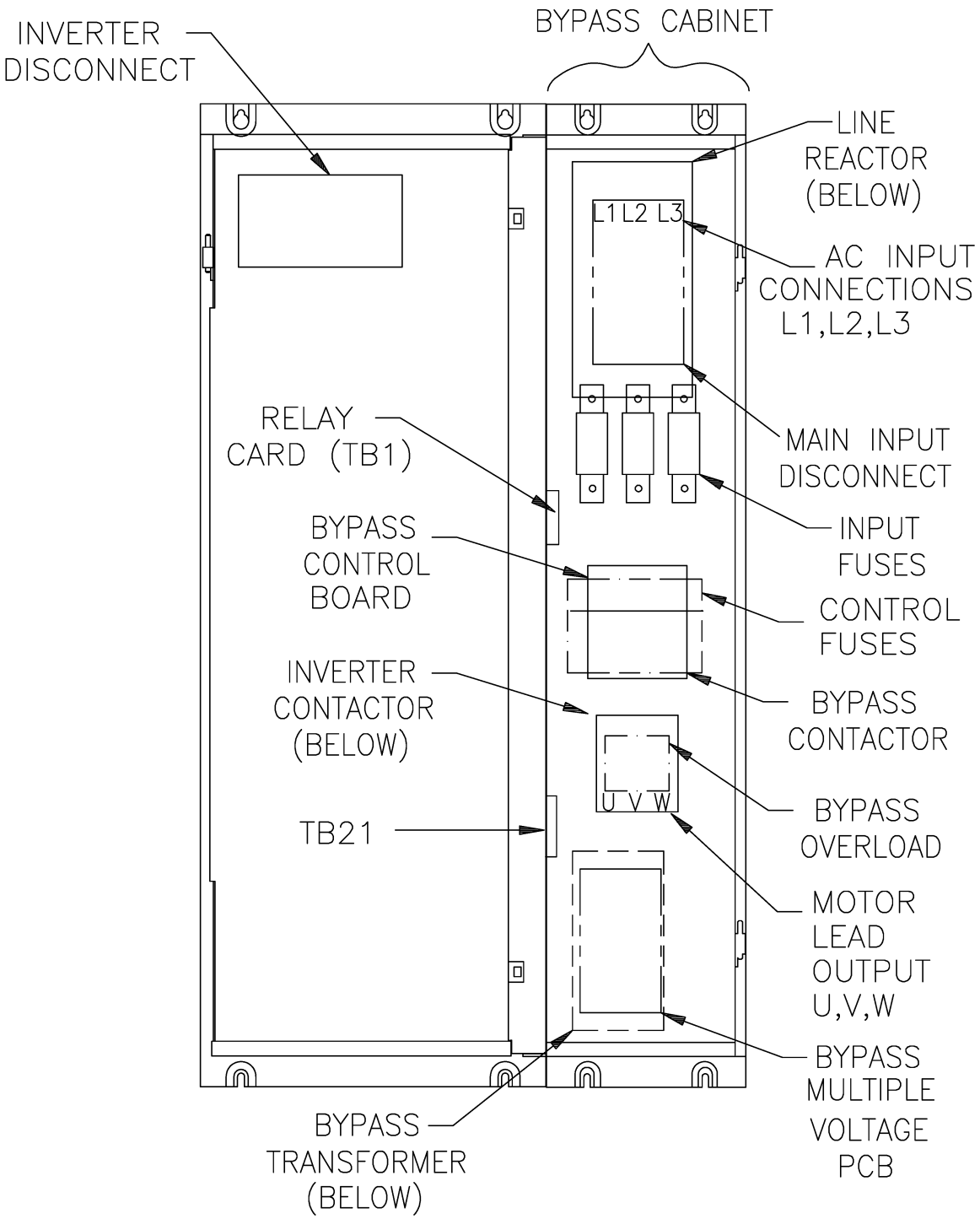


Figure 4-3. Input and Output Power Wiring Locations for Bypass.

Install Bypass Control and Signal Wiring

Size and install all wiring in conformance with the NEC and all other applicable local codes. See Table 4-1 for recommended wire sizes.

Follow all guidelines given in ***Section 3: Install the Controller, Install Control and Signal Wiring,*** except as noted here. Follow the guidelines given in ***Section 3: Install the Controller*** in regards to calculating input requirements (and distribution system capacity) for wire sizing. (See Table 3-5.)

WARNING

THE FACTORY-INSTALLED JUMPER ACROSS TERMINALS 3 AND 4 ON THE REMOTE TERMINAL BOARD (TB21) MUST BE REMOVED WHEN FUNCTION LOSS INPUT, COAST-STOP PUSHBUTTON, OR INTERLOCKS (AS GIVEN IN TABLE 4-4) ARE USED SO THAT THESE CONTACTS WILL OPEN TO STOP THE CONTROLLER. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

1. Route user-supplied interlock and function loss input wiring through the conduit opening labeled 24VDC in the bottom of the controller. See Figure 4-2.
2. VTAC V controllers have door-mounted coast-stop pushbutton as a standard feature. The user may install normally-closed, maintained coast-stop, remote pushbuttons. These buttons, installed in series with the coast-stop pushbutton contacts, will function the same as the standard door-mounted pushbutton. They will stop the drive in REMOTE or LOCAL mode and override any START command. Wire these pushbuttons in series between terminals 3 and 4 on TB21. Remove the factory installed jumper. Refer to Table 4-4 for other Interlock wiring options.
3. Route external control wiring through openings in the top or bottom of the controller as indicated in Figure 4-2. Route the wiring in separate steel conduit to eliminate electrical noise. The conduit can be rigid or flexible, armored steel.

Note: Do not route any signal wire through junction or terminal boxes that contain power or control wire. Do not route in close proximity to devices producing external magnetic fields.

Bypass Option Wiring

When using the Bypass option, there are many wiring options available, depending on the desired application. Either 110VAC or 24VDC wiring can be used in combination with the options presented in Table 4-3. Most connections are made to the Bypass Control board, TB16. (See Figure 4-3 for location of the Bypass Control board, and Figure 4-4 for Bypass Control board wiring.) Other connections on the Bypass Control board are made to TB17, and to the remote terminal board, TB21. (Also refer to Figure 4-3 for location of the remote terminal board, TB21.) **Note:** AUTO select wiring is connected between the Bypass Control Board TB16 (204) & the Relay Card TB1(3).

Control modes based on wiring configurations are given in Tables 4-3 through 4-5. Also refer to the appropriate section on 1) **Purge Wiring**, 2) **Start/Stop Bypass or Inverter Wiring**, 3) **Start/Stop Inverter Only Wiring**, or, 4) **Auto Select, Bypass or Inverter Wiring**.

Table 4-3. Bypass Control Modes and Wiring Options.

Control Mode Wiring (Select One)	Mode of Operation:		Controller Mode (See Table 3-6.)	24 VDC Supply for Control	110 VAC Supply for Control		Single Contact Two-Wire Start/ Stop	Three-Wire Start/ Stop
	Bypass	Inverter			Internal	Customer-Supplied		
Purge Mode(1)	YES	YES	REMOTE ONLY	YES– MUST USE	NO		YES– MUST USE	NO
Start/Stop Bypass or Inverter Mode	YES	YES	REMOTE ONLY	YES	YES		YES	
Start/Stop Inverter Only Mode	N/A	YES	REMOTE OR LOCAL	YES	YES		YES	
Auto Select Mode, Bypass or Inverter(2)	YES	YES(3)	REMOTE ONLY	YES– MUST USE	NO		YES	

(1) Speed during Purge is determined by the setting of MS1 in Function 16.

(2) A time delay (determined by Jumpers J3 and J4 on the Bypass Control Board) will occur when switching from Inverter to Bypass, and vice versa. It is recommended that during Auto Select Mode, that indicator lights are installed so that when running remotely, it can be determined whether you are running in Inverter or Bypass Mode. See Table 4-5.

(3) Operation depends on the position of the INVERTER ON/INVERTER OFF/BYPASS Switch. See the section on Auto Select Mode.

Table 4-4. Interlock Wiring Options.

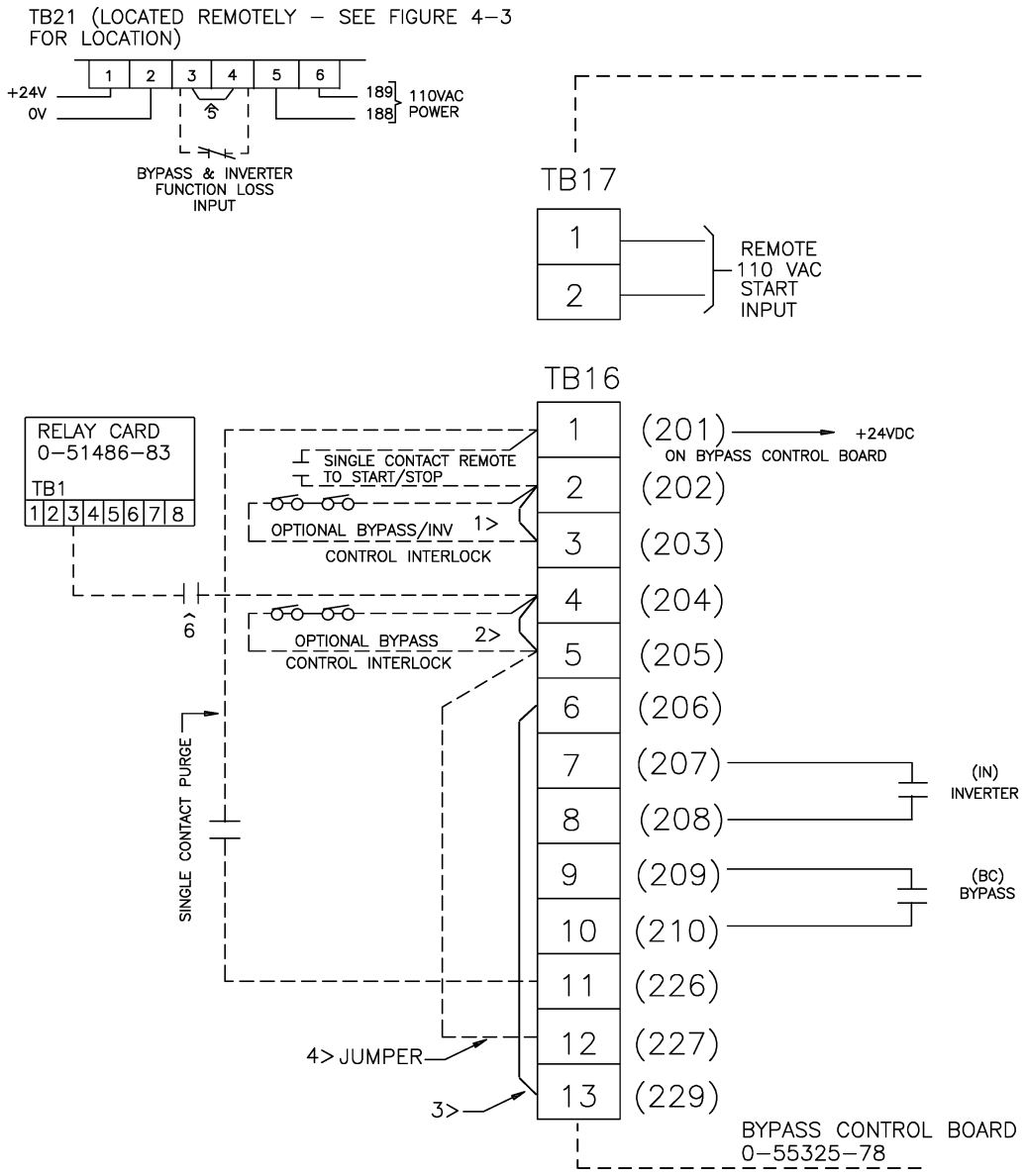
Interlock Option	Bypass Control Board Connection	Stops Controller in Bypass Mode?	Stops Controller in Inverter Mode?	Controller Mode (Remote or Local)
Bypass and Inverter Control Interlock	TB16-2 to TB16-3 (Remove existing factory jumper)	YES	YES	REMOTE ONLY
Bypass Control Interlock	TB16-4 to TB16-5 (Remove existing factory jumper)	YES	NO	REMOTE ONLY
Bypass and Inverter Function Loss Interlock	TB21-3 to TB21-4 (Remove existing factory jumper)	YES	YES	REMOTE OR LOCAL
Inverter Only Interlock (1)	TB11-11 to TB11-12 on the Control Signal Buffer board (Located in inverter section – remove existing factory jumper)	NO	YES	REMOTE OR LOCAL

(1) This interlock option will display a “CS” (if Function 32=1) or a “FL” (if Function 32=0) on the keypad of the drive.

Table 4-5. Bypass Optional Auxiliary Contacts.

Contact	Available Connections on Bypass Control Board	Circuit Rating	Suggested Use
Bypass Contactor[1] Auxiliary Contact (BC)	TB16-9 to TB16-10	2 Amps, 110VAC or, 1 Amp, 24VDC	Indicating light for Remote Auto Select Function. (See Table 4-3.)
Inverter Contactor[1] Auxiliary Contact (IN)	TB16-7 to TB16-8	2 Amps, 110VAC or, 2 Amps, 24VDC	Indicating light for Remote Auto Select Function. (See Table 4-3.)

[1] See Figure 4-4.



NOTES:

1> FACTORY INSTALLED JUMPER. LEAVE IN PLACE UNLESS INSTALLING INTERLOCKS FOR REMOTE START/STOP OF BYPASS AND INVERTER (IN REMOTE MODE ONLY). THIS INTERLOCK WILL NOT START/STOP THE INVERTER IN KEYPAD MODE. OTHERWISE USE FUNCTION LOSS INPUT AT TB21–3 AND TB21–4.

2> FACTORY INSTALLED JUMPER. LEAVE IN PLACE UNLESS INSTALLING INTERLOCKS FOR REMOTE START/STOP OF BYPASS OPERATION ONLY. OTHERWISE USE FUNCTION LOSS INPUT AT TB21–3 AND TB21–4.

3> FACTORY INSTALLED JUMPER. DO NOT REMOVE.

4> CUSTOMER–SUPPLIED JUMPER. BY ADDING A JUMPER, BYPASS CONTROL IS THROUGH THE INVERTER ON/INVERTER OFF/BYPASS SWITCH. INVERTER CONTROL IS STILL THROUGH REMOTE START/STOP OR KEYPAD OPERATION.

5> FACTORY INSTALLED JUMPER FOR BYPASS AND INVERTER FUNCTION LOSS. FUNCTIONAL IN BOTH REMOTE AND KEYPAD MODES. REMOVE JUMPER WHEN INSTALLING FUNCTION LOSS INPUT, COAST–STOP PUSHBUTTON, OR INTERLOCKS SO THAT THE CONTACTS WILL OPEN TO STOP THE CONTROLLER.

6> CUSTOMER–SUPPLIED JUMPER. BY ADDING A JUMPER, REMOTE SELECTION OF BYPASS AND INVERTER IS PROVIDED. SEE TEXT.

Figure 4-4. Bypass Control Board Wiring (TB16, TB17, and Remote Terminal Board TB21.)

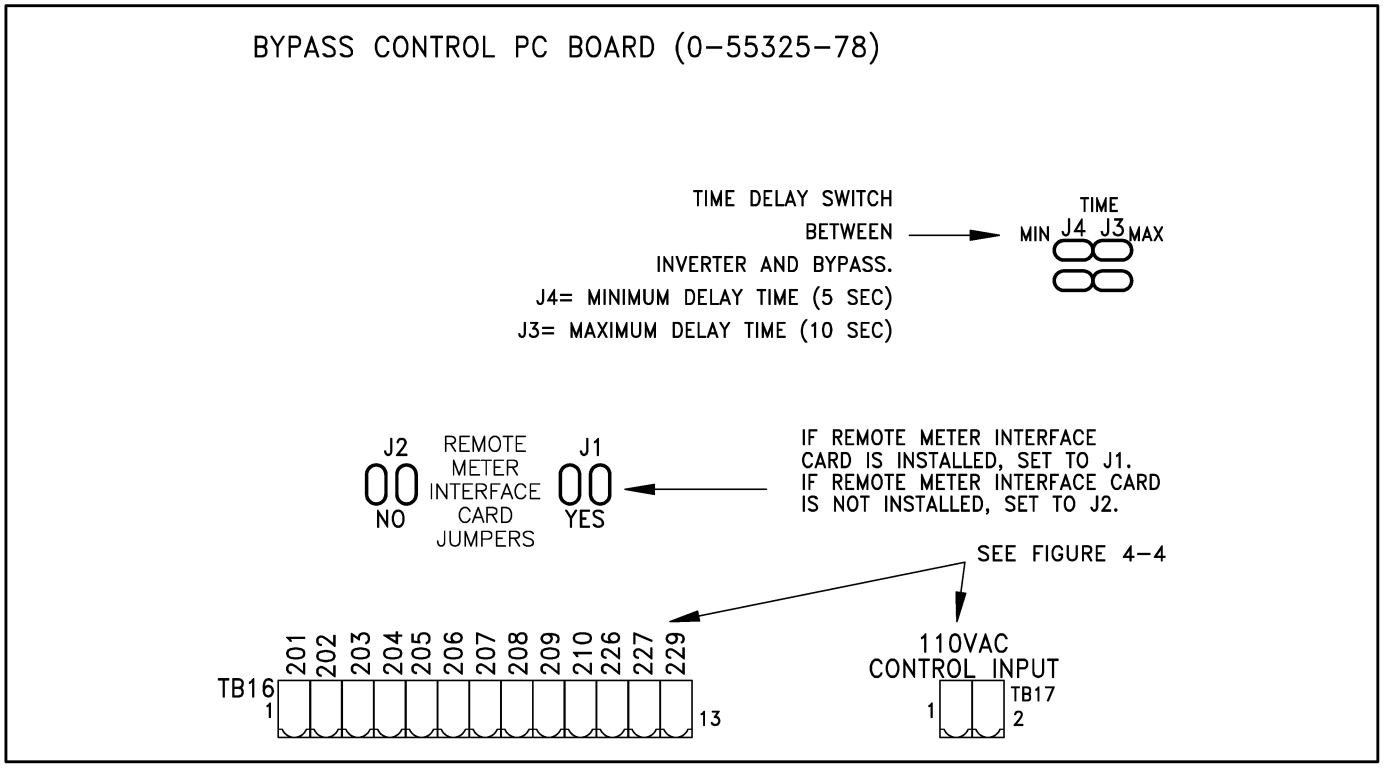


Figure 4-5. Bypass Control Board.

Purge Wiring

(**Note:** There is no 110VAC Purge connection for controllers equipped with Bypass. Do not use the 110VAC Purge in combination with the 24VDC Purge on the Control Signal Buffer board.)

(**Note:** A "CS" warning will appear on the keypad display if a function loss status is present. If this occurs, check that all factory installed jumpers are present, or that, interlocks are installed in their place.)

1. Install a standard industrial contact on the Bypass Control board from terminals 1 to 11 on TB16. See Figure 4-4.

WARNING

THE FACTORY-INSTALLED JUMPER ACROSS TERMINALS 3 AND 4 ON THE REMOTE TERMINAL BOARD (TB21) MUST BE REMOVED WHEN FUNCTION LOSS INPUT, COAST-STOP PUSHBUTTON, OR INTERLOCKS (AS GIVEN IN TABLE 4-4) ARE USED SO THAT THESE CONTACTS WILL OPEN TO STOP THE CONTROLLER. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

2. Remove existing factory jumper at TB21, terminals 3 and 4 and wire normally-closed interlocks in series with the Function Loss input.
3. Check the time delay setting on the Bypass Control board, by checking the setting of Jumpers J3 and J4. See Figure 4-5.
4. Set the purge speed by entering the desired value into Function 16, MS1.

(**Note:** In order to access Function 16, Function 0 must be set to a 1. Additionally, you cannot change the MS1 speed setting while the drive is running. It must be changed in standby.)

5. Depending on the INVERTER ON/INVERTER OFF/BYPASS door switch position (see Figure 4-6), the reference is controlled by either MS1 or the set speed of the inverter. See Table 4-6 for operation.

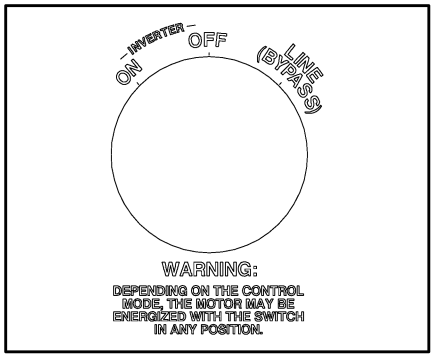


Figure 4-6. INVERTER ON/INVERTER OFF/BYPASS SWITCH (Located on Bypass Door.)

Table 4-6. Purge Operation with INVERTER ON/INVERTER OFF/BYPASS Switch.

INVERTER ON/INVERTER OFF/ BYPASS Switch Position	Inverter is able to run?	Resulting Output Frequency:
INVERTER ON	YES	MS1 (If inverter cannot start, bypass operation is automatic)
INVERTER ON	NO	Bypass operates and runs at 60 Hz
INVERTER OFF	N/A	Time delay, then Bypass runs at 60 Hz
BYPASS	N/A	Time delay, then Bypass runs at 60 Hz

Start/Stop Bypass or Inverter Mode

The INVERTER ON/INVERTER OFF/BYPASS switch determines whether the BYPASS or INVERTER section operates. This method of starting and stopping is available in REMOTE mode only.

1. Install Start/Stop Wiring per the appropriate Figures 4-9 through 4-14.

WARNING

THE FACTORY-INSTALLED JUMPER ACROSS TERMINALS 3 AND 4 ON THE REMOTE TERMINAL BOARD (TB21) MUST BE REMOVED WHEN FUNCTION LOSS INPUT, COAST-STOP PUSHBUTTONS, OR INTERLOCKS (AS GIVEN IN TABLE 4-4) ARE USED SO THAT THESE CONTACTS WILL OPEN TO STOP THE CONTROLLER. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

2. Remove existing factory jumper and wire normally-closed interlocks in series with the Function Loss input at TB21, terminals 3 and 4. (You can optionally leave the factory jumper in place at TB21 terminals 3 and 4, and install an interlock at the Bypass and Inverter Function Loss Input, at TB16, terminals 2 and 3, for remote start/stop of bypass and inverter, however, this does not start/stop the inverter in the keypad mode of operation.)

Start/Stop Inverter Only Mode

The INVERTER ON/INVERTER OFF/BYPASS switch should be positioned in the INVERTER ON position. This method of starting and stopping can be performed in Controller REMOTE mode only.

In LOCAL mode, only the keypad START or STOP pushbuttons can be used.

1. Install Start/Stop Wiring per the appropriate Figures 4-9 through 4-14.

WARNING

THE FACTORY-INSTALLED JUMPER ACROSS TERMINALS 3 AND 4 ON THE REMOTE TERMINAL BOARD (TB21) MUST BE REMOVED WHEN FUNCTION LOSS INPUT, COAST-STOP PUSHBUTTONS, OR INTERLOCKS (AS GIVEN IN TABLE 4-4) ARE USED SO THAT THESE CONTACTS WILL OPEN TO STOP THE CONTROLLER. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

2. Remove existing factory jumper and wire normally-closed interlocks in series with the Function Loss input at TB21, terminals 3 and 4.

Auto Select – Bypass or Inverter Mode

This mode allows selection of bypass or inverter modes from a remote location. The INVERTER ON/INVERTER OFF/BYPASS switch position determines (at the time the remote selection is made and the contact closes) whether the controller operates in Bypass or Inverter Modes. See Figure 4-7 and 4-8.

1. Connect a standard industrial contact between terminal 4 at TB16 on the Bypass Control board and terminal 3 at TB1 on the Relay Card.

WARNING

THE FACTORY-INSTALLED JUMPER ACROSS TERMINALS 3 AND 4 ON THE REMOTE TERMINAL BOARD (TB21) MUST BE REMOVED WHEN FUNCTION LOSS INPUT, COAST-STOP PUSHBUTTON, OR INTERLOCKS (AS GIVEN IN TABLE 4-4) ARE USED TO SO THAT THESE CONTACTS WILL OPEN TO STOP THE CONTROLLER. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

2. Remove existing factory jumper and wire normally-closed interlocks in series with the Function Loss input at TB21, terminals 3 and 4.

3. Check the setting of jumpers J3 and J4 on the Bypass Control board. See Figure 4-5.
4. Set the INVERTER ON/ INVERTER OFF/BYPASS switch in the INVERTER position to run in the INVERTER and subsequently BYPASS mode, if the inverter fails to run, or in the BYPASS position to run only bypass.

The following charts, as shown in Figures 4-7 and 4-8, detail the operation of the inverter section or bypass section based on the INVERTER ON/INVERTER OFF/BYPASS Switch position:

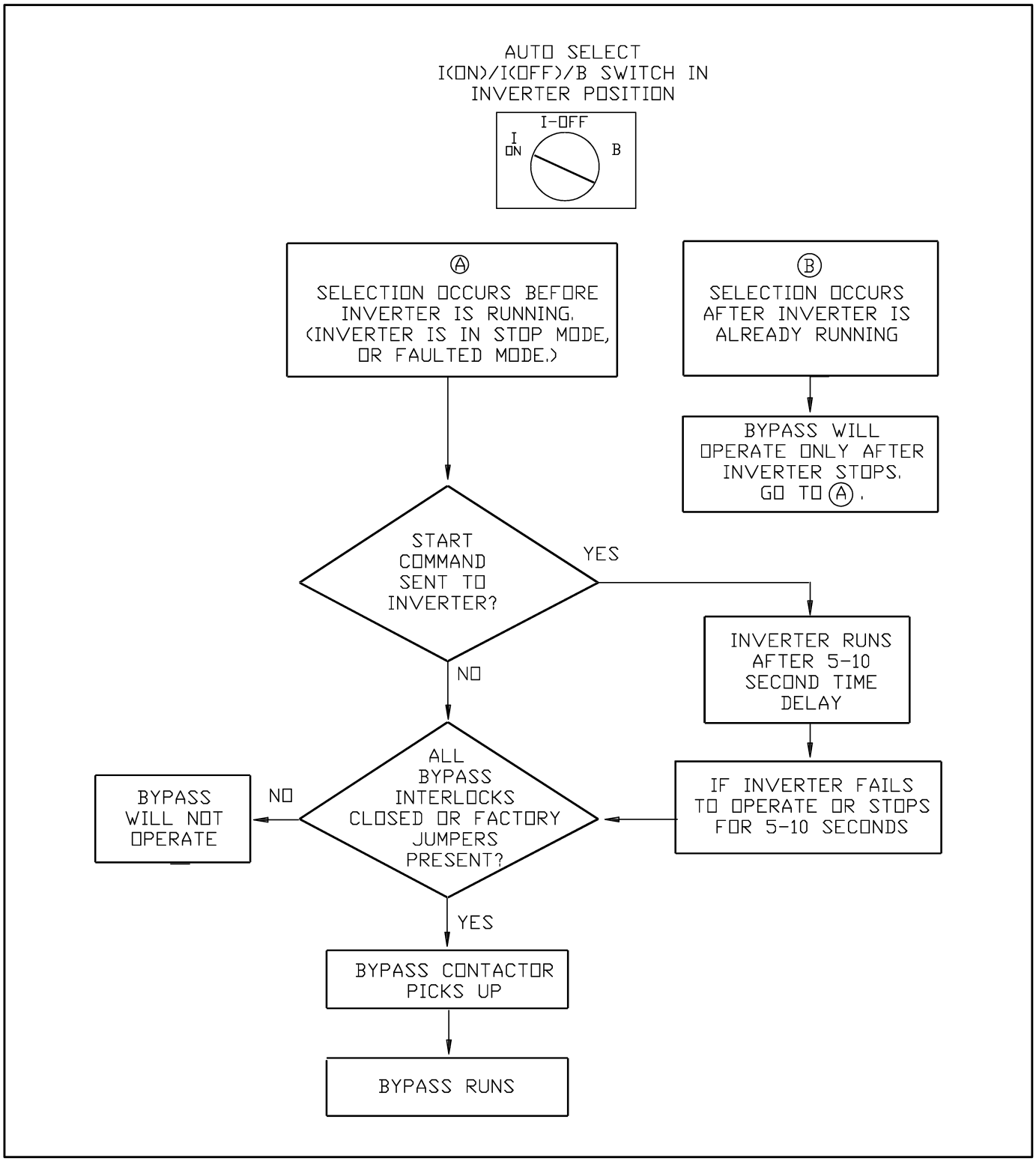


Figure 4-7. Auto Select, INVERTER ON/INVERTER OFF/BYPASS Switch in INVERTER ON Position.

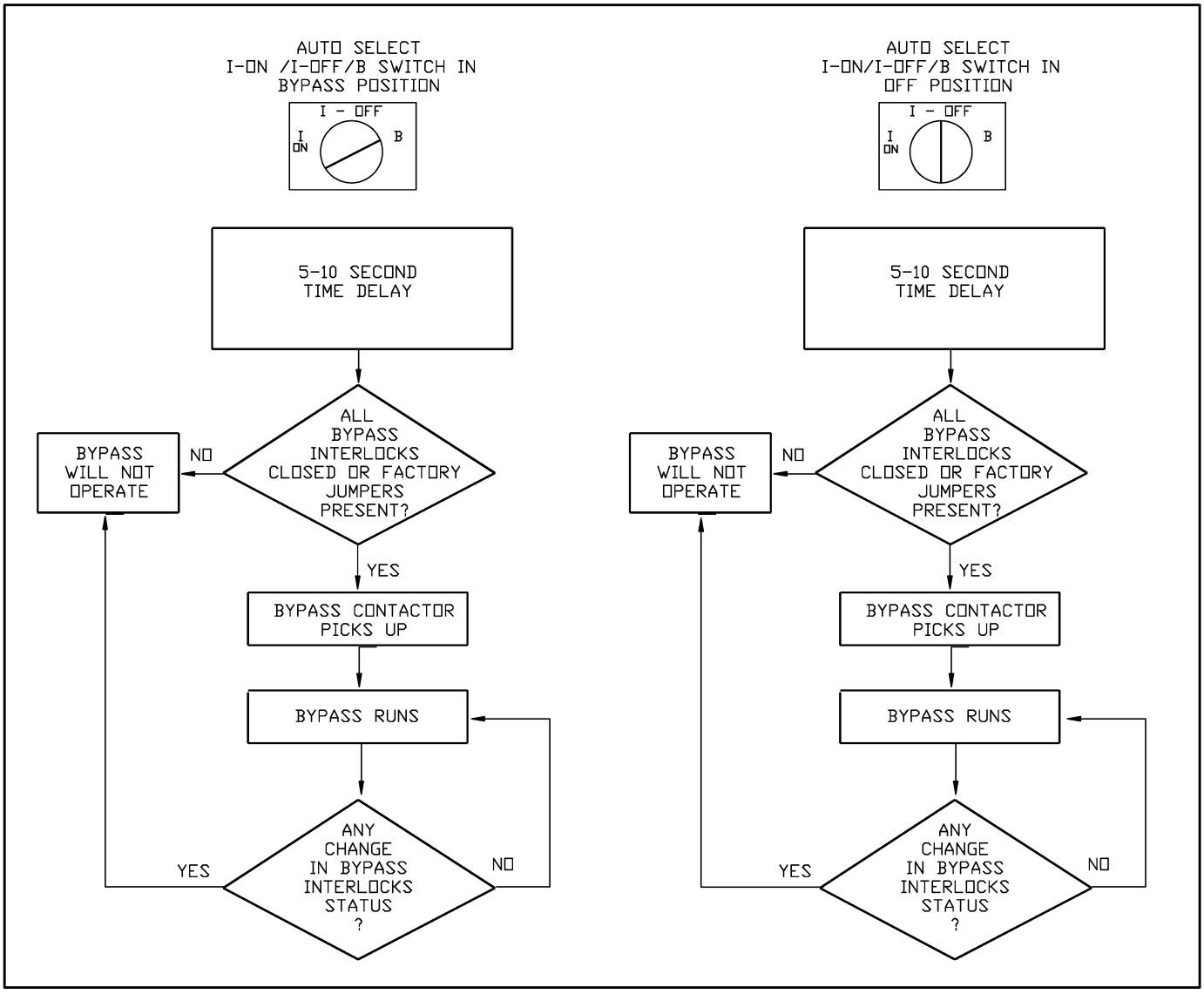


Figure 4-8. Auto Select, INVERTER ON/INVERTER OFF/BYPASS Switch in INVERTER OFF or BYPASS Position.

Start/Stop Wiring

Figures 4-9 through 4-14 show START/STOP wiring for the following wiring options:

1. Figure 4-9: Two-Wire, Single Contact, 24VDC
2. Figure 4-10: Two-Wire, Single Contact, 110VAC Internal Supply
3. Figure 4-11: Two-Wire, Single Contact, 110VAC Customer-Supplied
4. Figure 4-12: Three-Wire, 24VDC
5. Figure 4-13: Three-Wire, 110VAC Internal Supply
6. Figure 4-14: Three-Wire, 110VAC Customer-Supplied

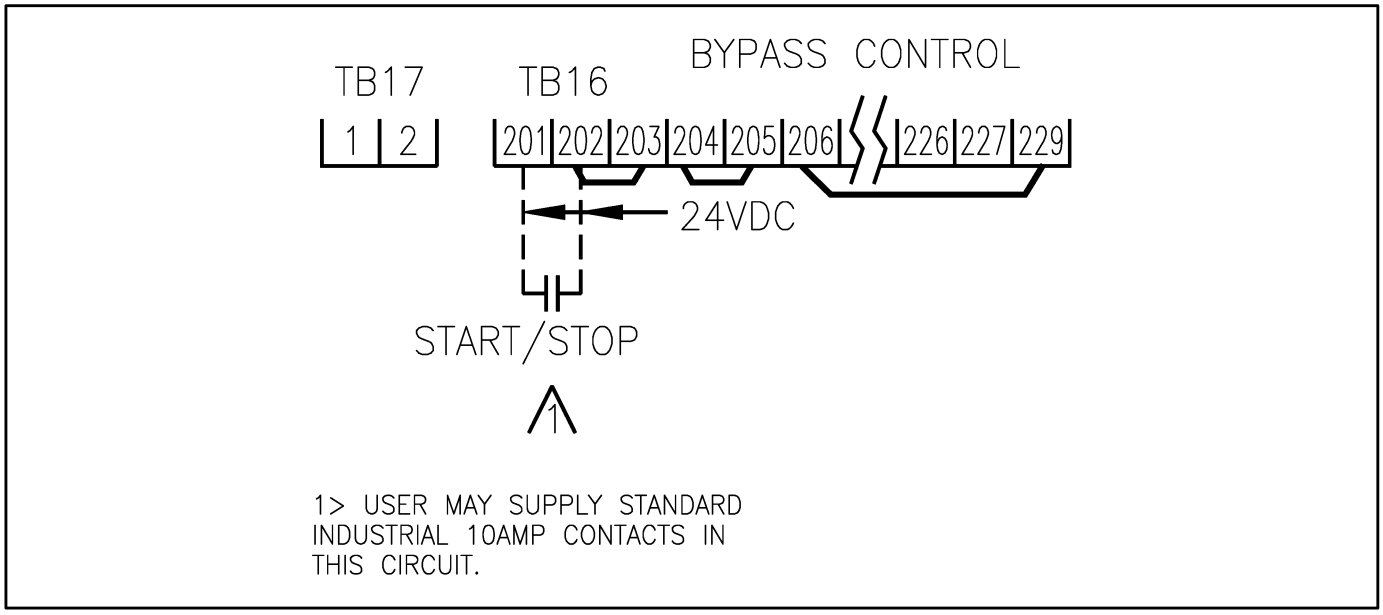


Figure 4-9. Two-Wire, Single-Contact, 24VDC Start/Stop Wiring.

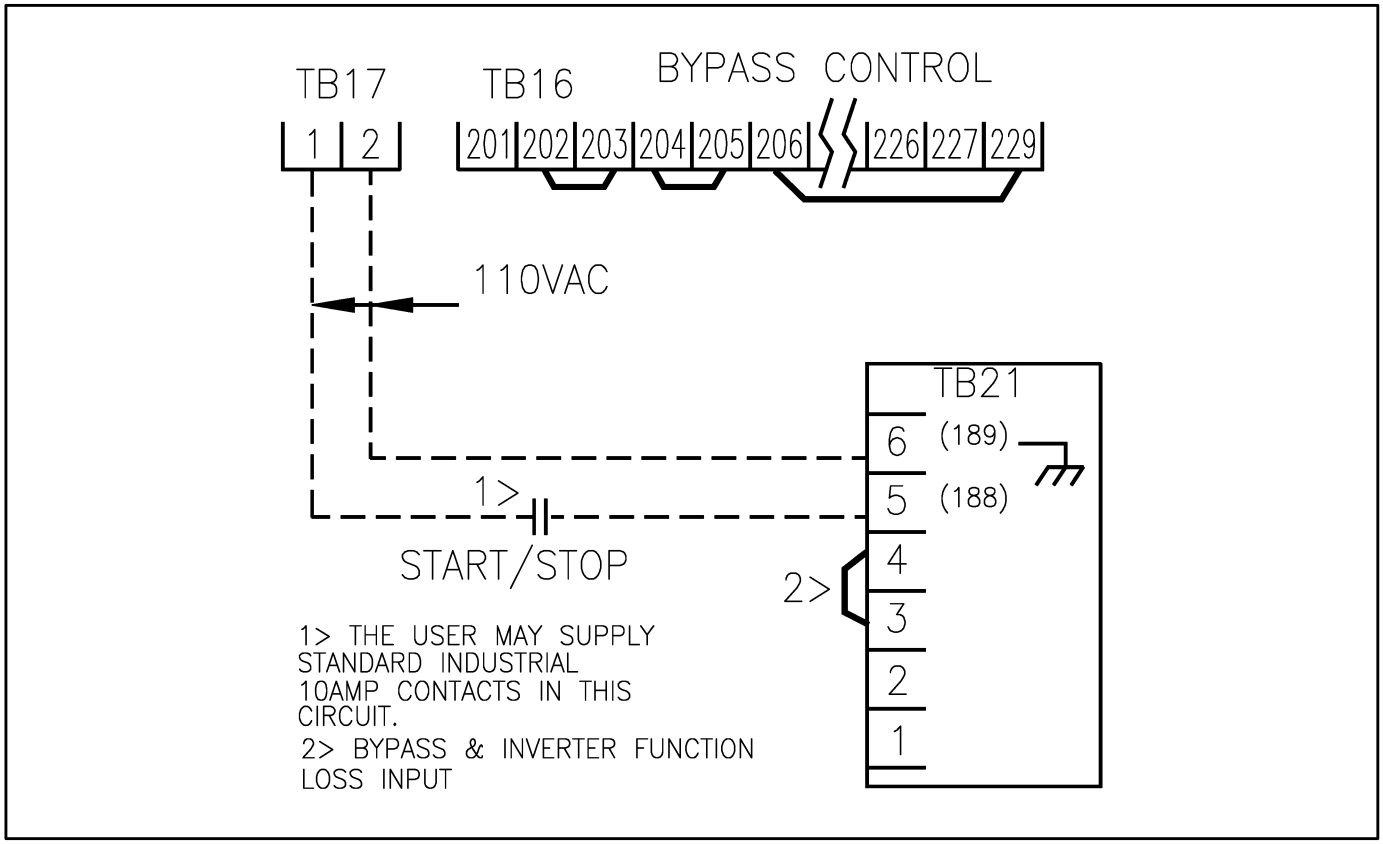


Figure 4-10. Two-Wire, Single-Contact, 110VAC Internal Supply, Start/Stop Wiring.

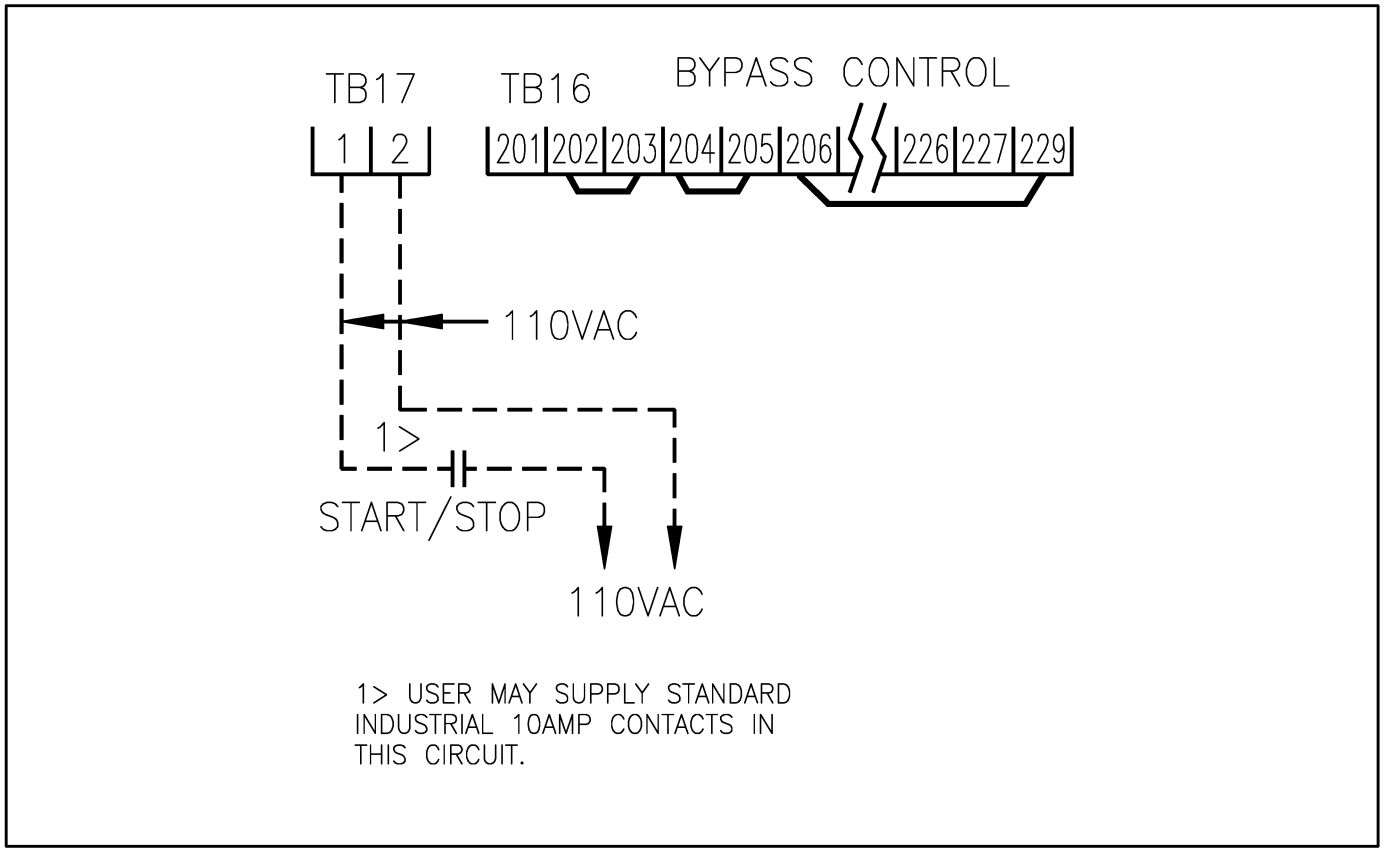


Figure 4-11. Two-Wire, Single-Contact, 110VAC Customer-Supplied, Start/Stop Wiring.

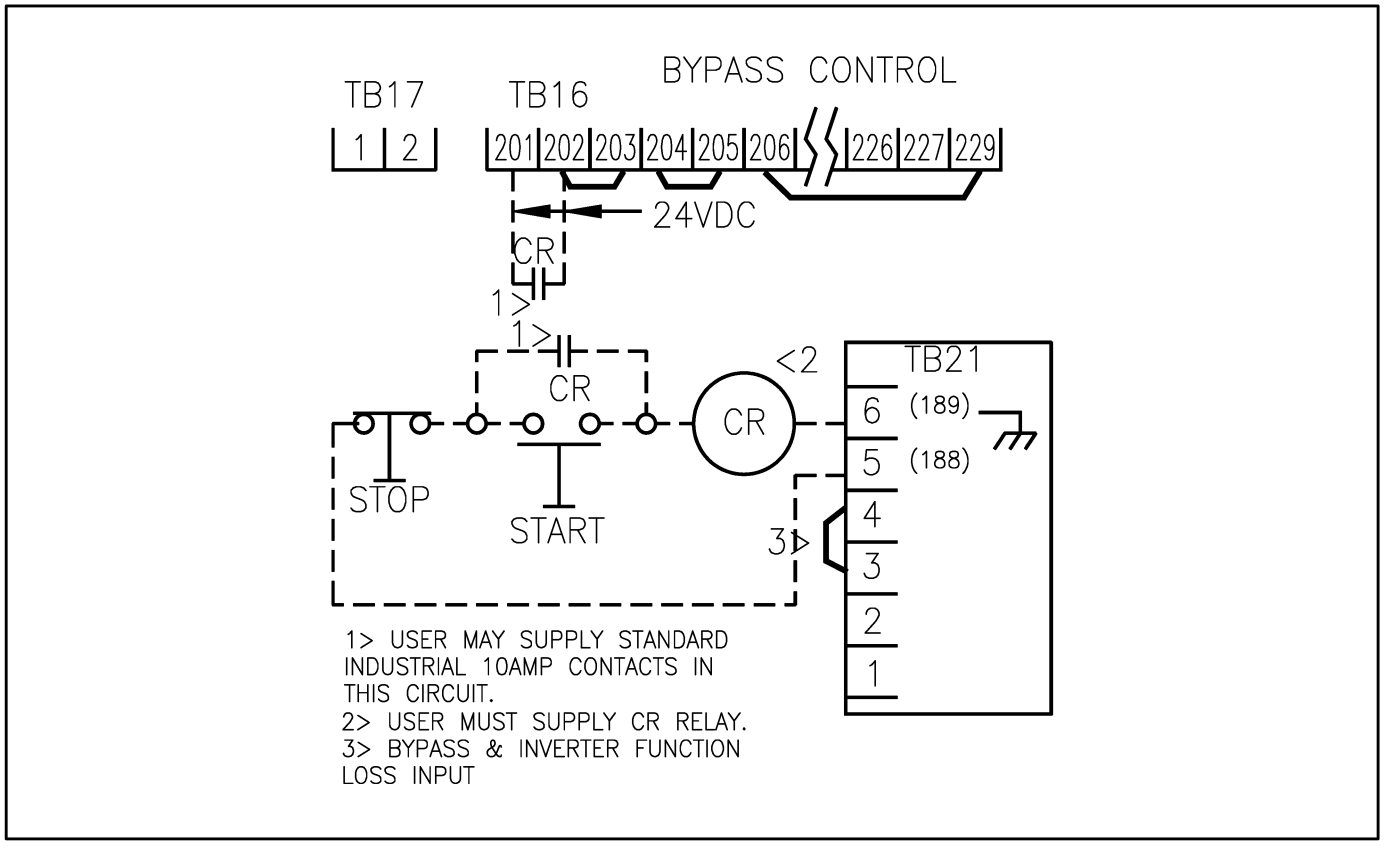


Figure 4-12. Three-Wire, 24VDC Start/Stop Wiring.

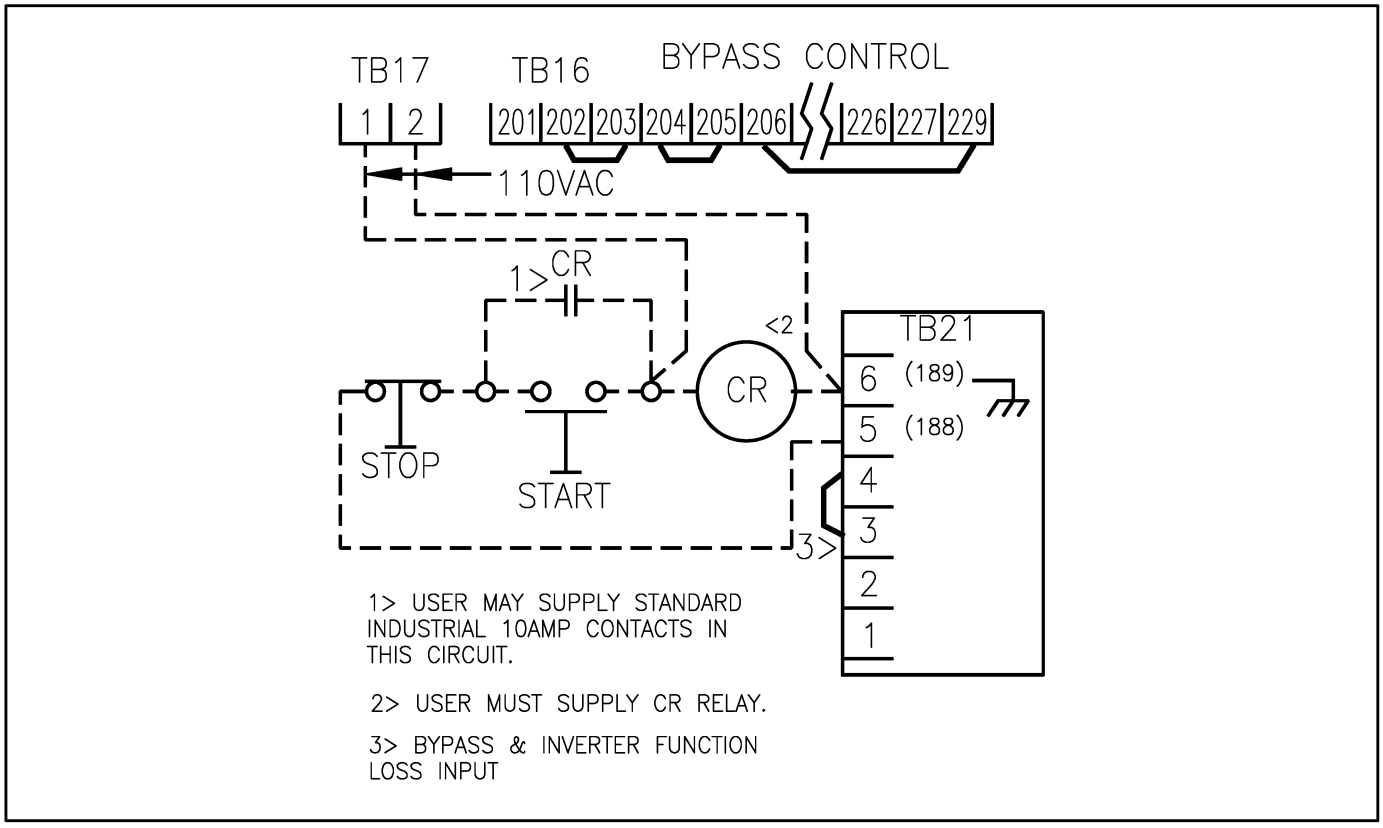


Figure 4-13. Three-Wire, 110VAC Internal Supply, Start/Stop Wiring.

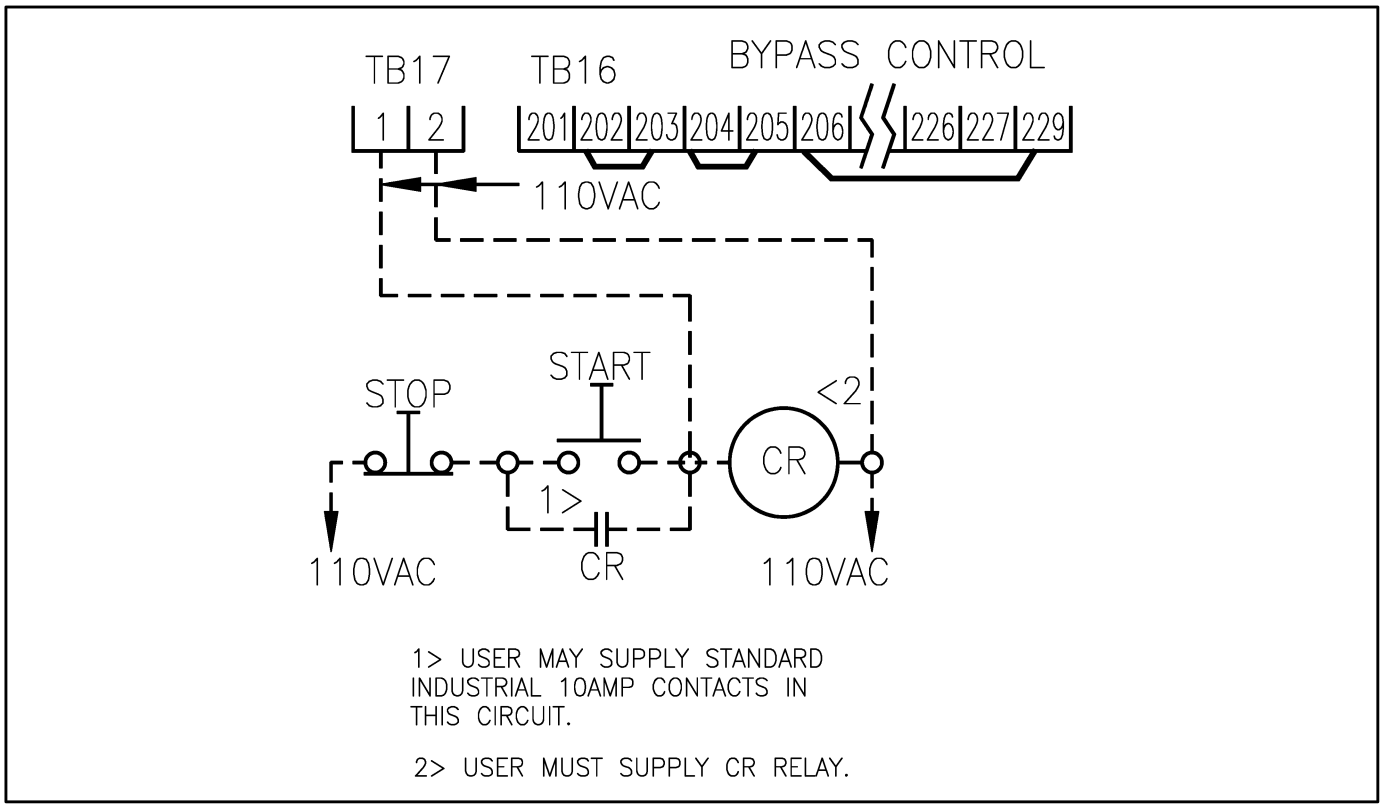


Figure 4-14. Three-Wire, 110VAC Customer-Supplied, Start/Stop Wiring.

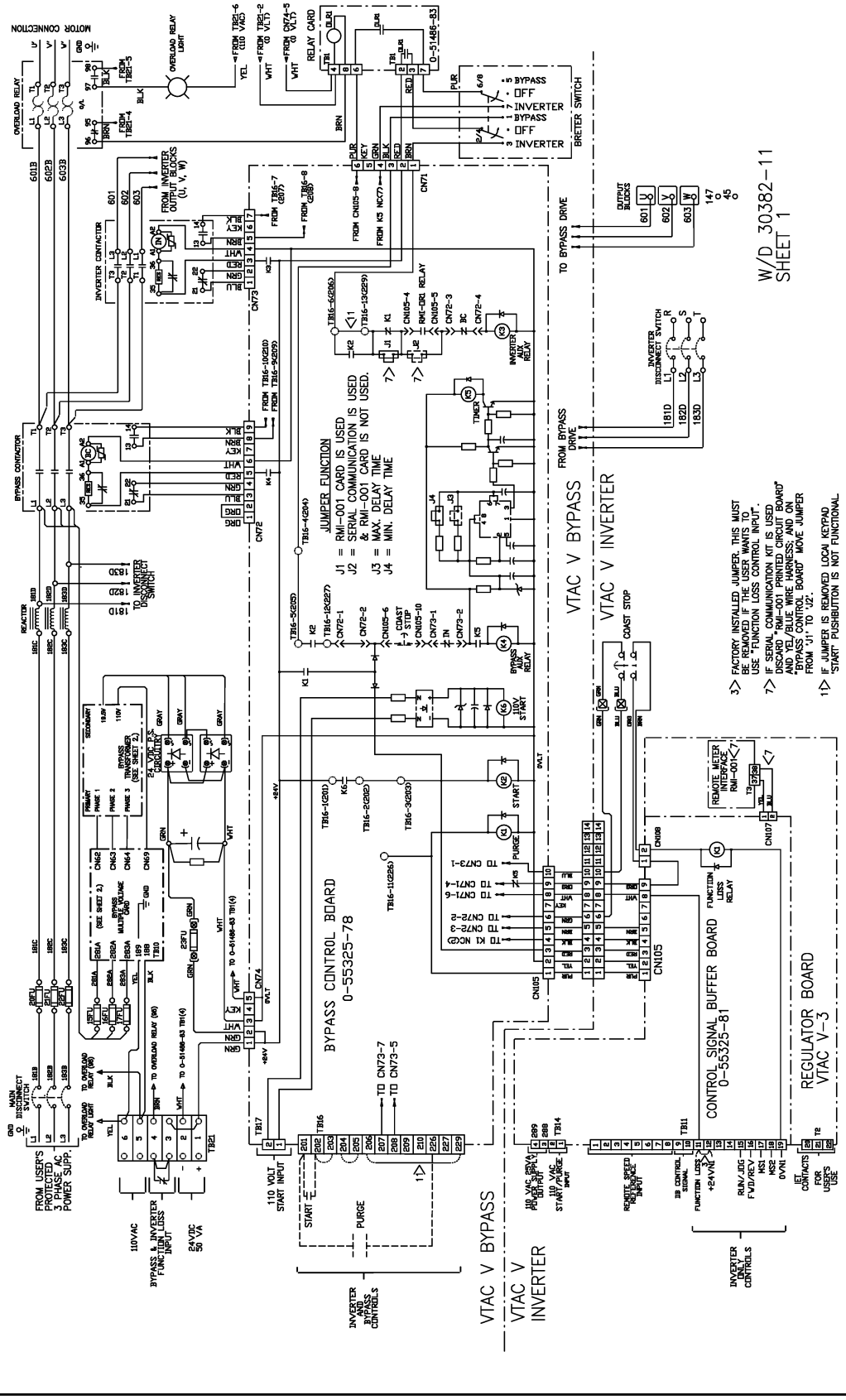


Figure 4-15. Detailed Bypass Control Board Wiring Diagram.

5: Start the Controller

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD START AND ADJUST IT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Test Equipment Needed

CAUTION: Do not use a Megger to perform continuity checks in the drive equipment. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

For controller output measurements of voltage, amperage, and frequency as applied to the motor power leads, the 4-digit display on the controller keypad is satisfactory. For all other voltage, amperage, and ohmic measurements, an analog or digital volt-ohmmeter is required. Make certain the selected volt-ohmmeter is rated for the intended measurement values.

Although not required for controller startup and adjustments, the best method of obtaining actual motor voltage, current, and speed measurements is with a fundamental voltmeter, digital clamp-on ammeter, and a hand-held tachometer, respectively.

Check the Installation

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED TO THE CONTROLLER. DISCONNECT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE FROM THE CONTROLLER. AFTER POWER IS REMOVED, VERIFY WITH A VOLTMETER AT TERMINALS 147(+) AND 45(–) THAT THE D-C BUS CAPACITORS ARE DISCHARGED BEFORE TOUCHING ANY INTERNAL PARTS OF THE CONTROLLER. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

1. Make sure the upstream, external input disconnect is in the OFF position (power OFF).
2. Make sure the drive shutdown interlocks installed around the driven machine are operational. When activated, they should shut down the drive.

CAUTION: Make sure electrical commons are not intermixed in the controller. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Check the Controller and Enclosure

1. Open the controller enclosure door.
2. Look for physical damage, remaining installation debris, wire strands, etc.
3. Use clean, dry, low pressure air (below 25 psi) for removing debris from the controller.
4. Check that there is adequate clearance around the controller for air flow.
5. Check that the controller is wired correctly. Refer to Section 3. Check that the jumpers are in the proper positions:

- Regulator: J1, J2, J3, J4, J5, J6 (see Figure 3-4.)
- Control Signal Buffer: J1, J2, and J3 (see Figure 3-4.)
- Bypass Control Board: J1, J2, J3, J4 (see Figure 4-5.)

WARNING
(APPLIES TO DRIVES *WITHOUT* BYPASS)

THE FACTORY-INSTALLED JUMPER ACROSS TERMINALS 11 AND 12 (ON TB11) MUST BE REMOVED WHEN FUNCTION LOSS INPUT, COAST-STOP PUSHBUTTONS, OR INTERLOCKS ARE USEDS SO THAT THESE CONTACTS WILL OPEN TO STOP THE CONTROLLER. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

WARNING
(APPLIES TO DRIVES *WITH* BYPASS)

THE FACTORY-INSTALLED JUMPER AT TB21 ACROSS TERMINALS 3 AND 4 MUST BE REMOVED WHEN FUNCTION LOSS INPUT COAST-STOP PUSHBUTTONS, OR INTERLOCKS ARE USED SO THAT THESE CONTACTS WILL OPEN TO STOP THE CONTROLLER. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

6. When a motor overload device and/or user-supplied interlocks or function loss devices are installed, make sure the factory-installed jumper across terminals 11 and 12 is removed. See Figure 3-4 and 3-6.

6A. **FOR DRIVES WITHOUT BYPASS:** When a motor overload device, user-supplied interlocks, or function loss devices are installed, make sure the factory-installed jumper across terminals 11 and 12 on TB11 (Control Signal Buffer board) is removed. See Figure 3-10.

6B. **FOR DRIVES WITH BYPASS:** When a motor overload device, user supplied interlocks, or function loss devices are installed, make sure the factory installed jumper across terminals 3 and 4 of TB21 is removed. See Figure 4-4.

7. Check that all control and power terminal connections are tight. (See Table 3-4 for input and output power terminal tightening torques and Table 4-2 for Bypass input and output terminal tightening torques.)

8. Check Branch Circuit Protection:

   A. If user supplied:

      1. Check that branch circuit protection fuses are in place and seated in the fuseholders.
      2. Verify that the fuses are correctly rated for the controller. (Refer to Table 2-2 for controller ratings and Table 3-2 for fuse ratings).

   B. If internal Class J fuses are installed inside controller:

      1. Check that these fuses are properly installed and tightened.

      Note: Controllers with bypass option are equipped with Class J fuses as a standard feature and serve as branch circuit protection for inverter and bypass sections of the controllers. Check that the fuses are correctly rated for the controller. (Refer to Table 3-2). Check that upstream protection for the wiring to the controller is properly installed, if required by NEC or applicable codes.

9. Using a voltmeter, check that rated voltage is available on the incoming line side of the upstream, external input disconnect. Line voltage must correspond to the controller rating.

CAUTION: Line voltage must correspond to controller rating. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

Check the Motor

1. Verify that motor nameplate data corresponds to the controller output ratings:
   - Voltage: Three-phase. Verify that it is connected for the voltage corresponding to the maximum controller output voltage rating.
   - Current: Verify that full-load current does not exceed the controller output current rating. If the motor is overframed, verify that the motor operating current does not exceed the controller's rated current and the motor horsepower rating is not more than one size larger than the controller's horsepower rating.
   - Frequency: 60 or 50 hertz or other frequency consistent with the controller output frequency.

   For synchronous motor applications, consult your Reliance Electric Sales Office.
2. Check that the motor is installed according to the motor instruction manual.
3. Disconnect any power factor correction capacitors connected to the motor.
4. If possible, uncouple the motor from the driven machinery.
5. Manually rotate the motor shaft to check that the motor is free from any binding or mechanical load problem.
6. Check that no loose items, such as shaft keys, couplings, etc., are present.
7. Check all connections for tightness and proper insulation.
8. Check that any motor thermal switch or overload device is wired to the controller correctly.

Motor Overspeed

WARNING

THE USER IS RESPONSIBLE FOR ENSURING THAT DRIVEN MACHINERY IS CAPABLE OF SAFE OPERATION AT AN APPLIED FREQUENCY OF THE OVER-FREQUENCY LIMIT VALUE TO THE A-C MOTOR. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Check the Transformer (if used)

1. Check that the rating of the transformer (if used) matches the controller requirements. Refer to ***"Install a Transformer"*** in Section 3.
2. Check that the transformer is connected for the proper voltages.

Check the Grounding

DANGER

THE USER IS RESPONSIBLE FOR MEETING ALL CODE REQUIREMENTS WITH RESPECT TO GROUNDING ALL EQUIPMENT. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

1. Verify that a properly sized ground wire is installed between the controller ground terminal and a suitable earth ground. Verify the connections are tight.
2. With an ohmmeter, check for and eliminate any grounds between the input power leads to the controller ground terminal and between the output power leads to the controller ground terminal.
3. Verify that a properly sized ground wire is installed between the motor frame and a suitable earth ground and that the connections are tight.
4. With an ohmmeter, check for and eliminate any grounds between the motor frame and the motor power leads.
5. Verify that a properly sized ground wire is installed between the Remote Control Station (if used) and a suitable earth ground and that the connections are tight.
6. Verify that a properly sized ground wire is installed between the transformer (if used) and a suitable earth ground and that the connections are tight.
7. Verify the above ground wires are run **unbroken**.

Start the Controller – *Without* Optional Bypass Modification

In most cases, the following startup procedure will successfully start and run the controller. This procedure requires the controller to be controlled locally from the keypad (LOCAL Control). Reconfiguring the controller programmable functions is not necessary.

1. Follow all ***"Check the Installation"*** procedures if not already performed.
2. Make sure all power is OFF.
3. Set a voltmeter on the 1000 VDC or similar high voltage scale. Connect the voltmeter to terminals 147(+) and 45(–). (See Figure 8-2, Sheet 1 "DB Kit Connections" for location of the D-C Bus. These terminals reside on bus bars near the center of the power unit.) Read this voltmeter every time you turn power OFF to verify that the D-C bus capacitor(s) is fully discharged. Within approximately one minute after power is OFF, the bus voltage should measure 50 VDC or less. The red bus charge LED on the Power Supply Board will gradually fade as the voltage decreases to zero.
4. If the controller has been stored for less than six months, proceed to Step 5. If the controller has been stored for over six months, form the capacitor(s) as follows:

DANGER

THE REMAINING STEPS TO FORM THE CAPACITOR(S) ARE MADE WITH POWER ON. EXERCISE EXTREME CARE BECAUSE HAZARDOUS VOLTAGE EXISTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

- Disconnect the motor leads from the controller, if connected.
- Turn the power ON.

  Note: When the power is turned ON for the first time, the 2-digit display will be blank and the 4-digit display will show SELF for approximately 1 second while the controller performs a self-diagnostic test. At the end of a successful test, the 4-digit display will show 5.0.

  At the end of an unsuccessful test, the 2-digit display will show a hexadecimal number and the 4-digit display will continue to show SELF. Refer to ***"Troubleshooting and Replacement Parts,"*** in Section 8, if this condition exists.
- Observe that the voltmeter reading is the no load D-C bus voltage value with respect to the A-C input voltage. (See Table 5-1.)
- Let the controller sit undisturbed for fifteen minutes while the capacitor(s) form. **Put a tag on the controller that power is ON and hazardous voltage exists.**
- Turn the power OFF. Verify the D-C bus voltage is zero (read the voltmeter).

5. With the power OFF, connect the motor leads to the controller, if disconnected. **Uncouple the driven equipment from the motor, if possible.**

DANGER

THE REMAINING STEPS ARE MADE WITH POWER ON. EXERCISE EXTREME CARE BECAUSE HAZARDOUS VOLTAGE EXISTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

6. Turn the power ON. Observe that the voltmeter reading is the no load D-C bus voltage value listed in Table 5-1.

   Note: When the power is turned ON for the first time, the 2-digit display will be blank and the 4-digit display will show SELF for approximately 1 second while the controller performs a self-diagnostic test.

   At the end of a successful test, the 4-digit display will show 5.0. The following (red) LEDs will light: LOCAL Control, FWD, and MAN.

   At the end of an unsuccessful test, the 2-digit display will show a hexadecimal number and the 4-digit display will continue to show SELF. Refer to ***"Troubleshooting and Replacement Parts,"*** in Section 8, if this condition exists.

7. Verify that the following controls are selected (The red LED of each selected control key will be lit.):
   LOCAL
   FWD
   MAN

Table 5-1. D-C Bus Voltage Value.

A-C Input Line Voltage RMS	Typical D-C Voltage between 147(+) and 45(−)	
	No Load in Stop Mode	Full Load in Run Mode
208 VAC	294 VDC	280 VDC
230 VAC	325 VDC	310 VDC
380 VAC	537 VDC	513 VDC
415 VAC	586 VDC	561 VDC
460 VAC	649 VDC	621 VDC
575 VAC	811 VDC	776 VDC

8. Press the START key. The green RUN LED will light, indicating the controller is in the Run mode. The controller will ramp to the preset output Hz. The 4-digit display will show the output Hz setting (The controller is shipped with minimum Hz factory set at 5 Hz.); the 2-digit display will be blank.

WARNING

THIS DRIVE IS INTENDED TO OPERATE AT A PREDETERMINED MINIMUM SPEED UNLESS DISCONNECTED FROM THE POWER SOURCE. IF THE APPLICATION REQUIRES ZERO SPEED OPERATION WITHOUT SUCH DISCONNECTION, THE USER IS RESPONSIBLE FOR ASSURING SAFE CONDITIONS FOR OPERATING PERSONNEL BY PROVIDING SUITABLE GUARDS, AUDIBLE OR VISUAL ALARMS, OR OTHER DEVICES. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Note: If the motor does not rotate, press the ▲ key to increase the output Hz enough to start motor shaft rotation.

9. While the controller is in the RUN mode, you can monitor the output frequency, the output voltage, and the percentage of full load amps of the controller. Press the MON key and watch the displays. The 2-digit display shows which output is being monitored: H for frequency, U for voltage, and PA for percentage of controller full-load amps. The 4-digit display shows the actual value of output frequency, voltage, or percentage amperage. The display scrolls to the next output reading each time the MON key is pressed. You can also monitor RPM, if required. Refer to Functions 46, 47, and 48.

   Note: To see the set frequency, press the ▲ or ▼ key one time. The 4-digit display will now show the set frequency and the 2-digit display will be blank. If AUTO or Remote Control is selected, the set frequency will be displayed when pressing the ▲ or ▼ key one time. In this case, the display will be showing the set frequency that is equal to the speed reference input.

10. Verify the direction of shaft rotation. Then press the STOP key to initiate the Stop mode. The 4-digit display will show the changing values of the output being monitored at the time the STOP key is pressed.
11. If the direction of shaft rotation is incorrect, change it as follows:
    - Press the STOP key and wait until the motor has completely stopped.
    - Turn the power OFF.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED TO THE CONTROLLER. DISCONNECT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE FROM THE CONTROLLER. AFTER POWER IS REMOVED, VERIFY WITH A VOLTMETER AT TERMINALS 147(+) AND 45(−) THAT THE D-C BUS CAPACITOR(S) IS DISCHARGED BEFORE TOUCHING ANY INTERNAL PARTS OF THE CONTROLLER. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

    - After verifying the D-C bus voltage is zero, reverse any two of the three motor power leads (U, V, or W).
12. Turn the power ON and press the START key.

    The speed of the A-C induction motor shaft varies with the controller output Hz. Changing the output Hz setting is similar to changing the position of a speed pot with analog

controllers. Pressing the ▲ or ▼ keys will change the output Hz settings; then, pressing the SET key will lock in the values. The SET key is needed to lock in the new values. The output Hz setting may be changed while either in the RUN mode or STOP mode using the ▲, ▼, and SET keys.

WARNING

THE USER IS RESPONSIBLE FOR ENSURING THAT DRIVEN MACHINERY, ALL DRIVE-TRAIN MECHANISMS, AND PROCESS LINE MATERIAL ARE CAPABLE OF SAFE OPERATION AT A SPEED EQUIVALENT TO AT LEAST THAT WHICH WOULD RESULT FROM AN APPLIED FREQUENCY OF 20% ABOVE THE OVERFREQUENCY LIMIT (FUNCTION 38/FACTORY PRESET 90 HZ; MAXIMUM VALUE 405 HZ). FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

When changing the speed setting while in the RUN mode, the SET key is not needed as long as power is not removed from the controller. If power is removed from the controller, upon startup the controller will return to the previous set speed. The 4-digit display will show the SET speed in Hz and the 2-digit display will be blank.

Using the ▲ key or ▼ key, change the output Hz settings and run the motor without any load (if possible) across the speed range. (The controller is shipped with the speed range factory set at 5.0 to 60 Hz.)

Note: If the application requires the minimum and maximum Hz settings to be changed, see Functions 3, 4, 38, and 43 in Section 6. In order to set or change any parameters, the drive must be in the STOP mode.

13. If the motor is unloaded and the drive has an IET trip, go to Section 8; otherwise, go to Step 14.
14. Press the STOP key. Wait for the motor to completely stop. Turn the power OFF.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED TO THE CONTROLLER. DISCONNECT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE FROM THE CONTROLLER. AFTER POWER IS REMOVED, VERIFY WITH A VOLTMETER AT TERMINALS 147(+) AND 45(−) THAT THE D-C BUS CAPACITORS ARE DISCHARGED BEFORE TOUCHING ANY INTERNAL PARTS OF THE CONTROLLER. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

15. Couple the driven equipment to the motor, if not already coupled.
16. With the power ON, start the controller by pressing the START key.
17. Run the drive across the speed range under load. If the motor does not rotate at minimum speed, increase manual torque boost until this occurs. (See Section 6, Function 7: Manual Torque Boost.)
18. Press the STOP key. If the controller is intended for use in MANUAL mode only, go to Step 24. If REMOTE mode is to be used, go to Step 19.
19. Turn the power OFF and verify that the D-C bus voltage is zero.
20. Connect a speed reference signal as shown in Figure 3-5. If the optional Pressure-to-Electrical Transducer Kit (1PE4100) is used, install this kit according to Instruction Sheet D2-3248. Install all other customer wiring according to Figures 3-6 through 3-13.
21. Turn the power ON. Set the AUTO/MANUAL switch on the keypad to AUTO.
22. Select Function 0 and change the setting to “1” for “Remote Control, Terminal Strip.” Refer to Section 6, Function 0. When the controller is started by a remote contact, it will now follow a process control signal.

WARNING

THE DRIVE MAY RESTART AUTOMATICALLY WITH THE AUTO-RESET ENABLED (FUNCTION 40, SET TO 1). ATTACH A WARNING TAG TO THE APPROPRIATE DRIVEN EQUIPMENT. BEFORE WORKING ON THIS EQUIPMENT, BE SURE THAT POWER IS REMOVED AND LOCKED OUT FROM THE DRIVE. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN BODILY INJURY.

23. It Auto Restart capability is desired, see Section 6, Function 40. (**Note**: This is not to be confused with the “AUTO SELECT” mode for bypass operation.)
24. Turn the power OFF. After verifying the D-C bus voltage is zero, remove the voltmeter and any other instrumentation connected during startup.

    Note: If bypass is installed, do not set Auto-Restart (Function 40) time interval value below 30 seconds, or Purge feature may not operate properly.

25. Replace and secure the controller enclosure cover.

    If the drive operates satisfactorily, startup is complete.

    If the drive does not operate satisfactorily, go to Section 6. The factory set values of programmable functions, such as the following, may need to be adjusted:

    - local/remote operator control (Function 0)
    - minimum and maximum speed (Functions 3, 4, 38, and 43)
    - current limit (Function 5)
    - manual torque boost (Function 7)
    - base frequency (Function 11)
    - variable torque volts/hz curve selection (Function 23)
    - line-dip-ride-through (Function 27)
    - auto restart (Functions 40, 41, 42)

Start the Controller – *With* Optional Bypass Modification

In most cases, the following startup procedure will successfully start and run the controller. This procedure requires the controller to be controlled locally from the keypad (LOCAL Control). Reconfiguring the controller programmable functions is not necessary.

1. Follow all ***"Check the Installation"*** procedures if not already performed.
2. Make sure all power is OFF.
3. Set a voltmeter on the 1000 VDC or similar high voltage scale. Connect the voltmeter to terminals 147(+) and 45(−). (See Figure 8-2, Sheet 1, "DB Kit Connections", for location of D-C Bus. These terminals reside on bus bars near the center of the power unit.) Read this voltmeter every time you turn power OFF to verify that the D-C bus capacitor(s) is fully discharged. Within one minute after power is OFF, the bus voltage should measure 50 VDC or less. The red Bus Charge LED on the Power Supply board will gradually fade as the voltage decreases to zero.
4. If the controller has been stored for less than six months, proceed to Step 5. If the controller has been stored for over six months, form the capacitor(s) as follows:

DANGER

THE REMAINING STEPS TO FORM THE CAPACITOR(S) ARE MADE WITH POWER ON. EXERCISE EXTREME CARE BECAUSE HAZARDOUS VOLTAGE EXISTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

- Disconnect the motor leads from the controller, if connected.
- Turn the power ON.

  Note: When the power is turned ON for the first time, the 2-digit display will be blank and the 4-digit display will show SELF for approximately 1 second while the controller performs a self-diagnostic test. At the end of a successful test, the 4-digit display will show 5.0.

  At the end of an unsuccessful test, the 2-digit display will show a hexadecimal number and the 4-digit display will continue to show SELF. Refer to ***"Troubleshooting and Replacement Parts"***, in Section 8, if this condition exists.
- Observe that the voltmeter reading is the no load value with respect to the appropriate A-C input voltage listed in Table 5-1.
- Let the controller sit undisturbed for fifteen minutes while the capacitor(s) form. **Put a tag on the controller that power is ON and hazardous voltage exists.**
- Turn the power OFF. Verify the D-C bus voltage is zero (read the voltmeter) and the Bus Charge LED has faded out.

5. With the power OFF, connect the motor leads to the controller, if disconnected. **Uncouple the driven equipment from the motor, if possible.**

DANGER

THE REMAINING STEPS ARE MADE WITH POWER ON. EXERCISE EXTREME CARE BECAUSE HAZARDOUS VOLTAGE EXISTS. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

6. Turn the power ON. Observe that the voltmeter reading is the no load value listed in Table 5-1.

   Note: When the power is turned ON for the first time, the 2-digit display will be blank and the 4-digit display will show SELF for approximately 1 second while the controller performs a self-diagnostic test.

   At the end of a successful test, the 4-digit display will show 5.0. The following (red) LEDs will light: LOCAL Control, FWD, and MAN.

   At the end of an unsuccessful test, the 2-digit display will

show a hexadecimal number and the 4-digit display will continue to show SELF. Refer to ***"Troubleshooting and Replacement Parts"***, in Section 8, if this condition exists.

7. Verify that the following controls are selected (The red LED of each selected control key will be lit.):
   LOCAL
   FWD
   MAN
8. Press the START key. The green RUN LED will light, indicating the controller is in the RUN mode. The controller will ramp to the preset output Hz. The 4-digit display will show the output Hz setting (The controller is shipped with minimum Hz factory set at 5 Hz.); the 2-digit display will be blank.

WARNING

THIS DRIVE IS INTENDED TO OPERATE AT A PREDETERMINED MINIMUM SPEED UNLESS DISCONNECTED FROM THE POWER SOURCE. IF THE APPLICATION REQUIRES ZERO SPEED OPERATION WITHOUT SUCH DISCONNECTION, THE USER IS RESPONSIBLE FOR ASSURING SAFE CONDITIONS FOR OPERATING PERSONNEL BY PROVIDING SUITABLE GUARDS, AUDIBLE OR VISUAL ALARMS, OR OTHER DEVICES. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Note: If the motor does not rotate, press the ▲ key to increase the output Hz enough to start motor shaft rotation.

9. While the controller is in the RUN mode, you can monitor the output frequency, the output voltage, and the percentage of fullload amps of the controller. Press the MON key and watch the displays. The 2-digit display shows which output is being monitored: H for frequency, U for voltage, and PA for percentage of controller full-load amps. The 4-digit display shows the actual value of output frequency, voltage, or percentage amperage. The display scrolls to the next output reading each time the MON key is pressed. You can also monitor RPM if necessary. Refer to Functions 46, 47, and 48.

   Note: To see the set frequency, press the ▲ or ▼ key one time. The 4-digit display will now show the set frequency and the 2-digit display will be blank. If AUTO or REMOTE Control is selected, the set frequency will be displayed when pressing the ▲ or ▼ key one time. In this case, the display will be showing the set frequency that is equal to the speed reference input.
10. Verify the direction of shaft rotation. Then press the STOP key to initiate the STOP mode. The 4-digit display will show the changing values of the output being monitored at the time the STOP key is pressed.
11. If the direction of shaft rotation is incorrect, change it as follows:
    - Press the STOP key and wait until the motor has completely stopped.
    - Turn the power OFF.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED TO THE CONTROLLER. DISCONNECT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE FROM THE CONTROLLER. AFTER POWER IS REMOVED, VERIFY WITH A VOLTMETER AT TERMINALS 147(+) AND 45(−) THAT THE D-C BUS CAPACITOR(S) IS DISCHARGED BEFORE TOUCHING ANY INTERNAL PARTS OF THE CONTROLLER. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

- After verifying the D-C bus voltage is zero, reverse any two of the three motor power leads (U', V', or W').

CAUTION: In order to assure proper motor rotation in inverter and bypass modes, the procedures in **both** Steps 11 and 12 should be followed. Motor rotation in bypass must be the same as the rotation when in inverter forward direction. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

12. Perform the following additional procedure.
    - With the power off, switch to bypass. (The INVERTER ON/ INVERTER OFF/BYPASS Switch located on the Bypass Cabinet door should be in "B" position.)
    - Turn the power ON.

    If the direction of shaft rotation is incorrect, do the following:

- Press the STOP key and wait until the motor has completely stopped.
- Turn the power OFF. Open the incoming power disconnect.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED TO THE CONTROLLER. DISCONNECT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE FROM THE CONTROLLER. AFTER POWER IS REMOVED, VERIFY WITH A VOLTMETER AT TERMINALS 147(+) AND 45(−) THAT THE D-C BUS CAPACITORS ARE DISCHARGED BEFORE TOUCHING ANY INTERNAL PARTS OF THE CONTROLLER. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

DANGER

THE INVERTER DISCONNECT AND INVERTER ON/INVERTER OFF/BYPASS SWITCH MAY NOT ISOLATE ALL POWER IN THE CONTROLLER CABINET. REMOVE POWER BEFORE SERVICING THE EQUIPMENT. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

- After verifying that the D-C bus voltage is zero, reverse any two of the three incoming power leads (L1, L2, L3). Refer to Figure 5-1.

13. Close the incoming power disconnect. Turn the power ON and press the START key.

    The speed of the A-C induction motor shaft varies with the controller output Hz. Changing the output Hz setting is similar to changing the position of a speed pot with analog controllers. Pressing the ▲ or ▼ keys will change the output Hz settings; then, pressing the SET key will lock in the values. As long as power is not removed from the controller, the SET key is not needed to lock in the new values. The output Hz setting may be changed while either in the RUN mode or STOP mode using the ▲, ▼, and SET keys.

WARNING

THE USER IS RESPONSIBLE FOR ENSURING THAT DRIVEN MACHINERY, ALL DRIVE-TRAIN MECHANISMS, AND PROCESS LINE MATERIAL ARE CAPABLE OF SAFE OPERATION AT A SPEED EQUIVALENT TO AT LEAST THAT WHICH WOULD RESULT FROM AN APPLIED FREQUENCY OF 20% ABOVE THE OVERFREQUENCY LIMIT (FUNCTION 38/FACTORY PRESET 90 HZ; MAXIMUM VALUE 405 HZ). FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

    (When changing the speed setting while in the RUN mode, the SET key is not needed as long as power is not removed from the controller.) The 4-digit display will show the set speed in Hz and the 2-digit display will be blank.

    Using the ▲ key or ▼ key, change the output Hz settings and run the motor without any load (if possible) across the speed range. (The controller is shipped with the speed range factory set at 5.0 to 60 Hz.)

    Note: If the application requires the minimum and maximum Hz settings to be changed, see Functions 3, 4, 38, and 43 in Section 6. In order to set or change any parameters, it is necessary to execute this while the drive is in STOP mode.

14. If the motor is unloaded and does not operate satisfactorily, go to Section 8; otherwise, go to Step 15.
15. Press the STOP key. Wait for the motor to completely stop. Turn the power OFF.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED TO THE CONTROLLER. DISCONNECT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE FROM THE CONTROLLER. AFTER POWER IS REMOVED, VERIFY WITH A VOLTMETER AT TERMINALS 147(+) AND 45(−) THAT THE D-C BUS CAPACITORS ARE DISCHARGED BEFORE TOUCHING ANY INTERNAL PARTS OF THE CONTROLLER. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

16. Couple the driven equipment to the motor, if not already coupled.
17. With the power ON, start the controller by pressing the START key.
18. Run the drive across the speed range under load. If the motor does not rotate at minimum speed, increase manual torque boost until this occurs. (See Section 6, Function 7: Manual Torque Boost.)
19. Press the STOP key. If the controller is intended for use in MANUAL mode only, go to Step 25. If REMOTE mode is to be used, go to Step 20.
20. Turn the power OFF and verify that the D-C bus voltage is zero.

21. Connect a speed reference as shown in Figure 3-5. If the optional Pressure-to-Electrical Transducer Kit (1PE4100) is used, install this kit according to Instruction Sheet D2-3248. Install all other customer wiring according to Figures 4-9 through 4-14.
22. Turn the power ON. Set the AUTO/MANUAL switch on the keypad to AUTO.
23. Select Function 0 and change the setting to "1" for "Remote Control, Terminal Strip." Refer to Section 6, Function 0. When the controller is started by a remote contact, it will now follow a remote speed reference signal.
24. If Auto Restart capability is desired, see Section 6, Function 40.
25. Turn the power OFF. After verifying the D-C bus voltage is zero, remove the voltmeter and any other instrumentation connected during startup.
26. Replace and secure the controller enclosure cover.

    If the drive operates satisfactorily, startup is complete.

    If the drive does not operate satisfactorily, refer to Section 8, ***"Troubleshooting and Replacement Parts"***. The factory set values of programmable functions, such as the following, may need to be adjusted:

    - local/remote operator control (Function 0)
    - minimum and maximum speed (Functions 3, 4, 38, and 43)
    - current limit (Function 5)
    - manual torque boost (Function 7)
    - base frequency (Function 11)
    - contant or variable torque volts/hz curve selection (Function 23)
    - line-dip-ride-through (Function 27)
    - auto restart (Functions 40, 41, 42)

WARNING

THE DRIVE MAY RESTART AUTOMATICALLY WITH THE AUTO-RESET ENABLED (FUNCTION 40, SET TO 1). ATTACH A WARNING TAG TO THE APPROPRIATE DRIVEN EQUIPMENT. BEFORE WORKING ON THIS EQUIPMENT, BE SURE THAT POWER IS REMOVED AND LOCKED OUT FROM THE DRIVE. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN BODILY INJURY.

6: Adjust the Controller Functions

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD START AND ADJUST IT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Introduction to Programmable Functions

The controller offers users 57 software functions that are either selectable or adjustable by using the program keys on the keypad. The factory preset values for these functions suit a wide range of standard applications. To configure the controller for a specific application, activate and adjust the values of these functions as necessary.

This section describes how to configure the controller using the keypad and displays. It also gives a complete description of each function by its assigned function number. The functions list is in numerical order by the assigned function numbers. You can scroll through the list in ascending order with the PGM key. A quick reference summary of these functions, also in numerical order by the function number, is given in Table 9-2 at the end of this manual.

Function Menus and Passwords

To simplify the configuration process, the software functions list is divided into two menus. The first menu contains seven functions (0 through 6). Functions 0 through 5 are commonly used to adjust the controller for simple applications. Function 6, which permits access to the second menu, requires a password before it can be changed and allows access to Functions 7 through 57. Until the password is given and the Function 6 parameter is changed, you can only scroll and modify the first six menu functions.

The second menu functions allow you to adjust the controller for more complex applications. Some of these functions cannot be selected without entering a second password. These functions are safety related and should be used only with a thorough understanding of their nature.

Configuring the Controller

1. Turn the power ON if not already on.
2. Press the STOP key to confirm the controller is in the STOP mode.
3. Press the PGM key. The PROGRAM ENABLE LED will light. Note: The controller is shipped from the factory with the Program jumper in the J5 position. This jumper must be in the J5 position in order for the PROGRAM ENABLE LED to light and configuration of the controller to be possible. If this LED does not light, the jumper is in the J6 position. To change its position, perform the following:
   - Turn the power OFF.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED TO THE CONTROLLER. DISCONNECT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE FROM THE CONTROLLER. AFTER POWER IS REMOVED, VERIFY WITH A VOLTMETER AT TERMINALS 147(+) AND 45(−) THAT THE D-C BUS CAPACITOR(S) IS DISCHARGED BEFORE TOUCHING ANY INTERNAL PARTS OF THE CONTROLLER. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

   - Remove the front cover.
   - Verify with a voltmeter at terminals 147(+) and 45(−) that the D-C bus voltage is zero.
   - Locate the Program jumper on the regulator (see Figure 3-4).
   - Change the jumper position.

     In the J5 (Program Enable) position, the PROGRAM ENABLE LED will light when the PGM key is pressed and changing the controller configuration will be possible.

     In the J6 (Program Disable) position, the PROGRAM ENABLE LED will not light and unauthorized data entry will be prevented. Function values can be viewed on the 4-digit display but cannot be changed.
   - Replace the cover.
   - Turn the power ON and wait for the controller to complete its self-diagnostic test.

4. Press the PGM key to scroll through the functions list to the desired function number. The function number will show on the 2-digit display and the function value stored in memory will show on the 4-digit display.
5. To change the value of a particular function, scroll to the function number (2-digit display) using the PGM key. Each function has a range of values that can be entered or selected. Press the ▲ and ▼ keys to increase or decrease the value shown in the 4-digit display. The software will not allow you to make selections outside the function's range.

   Note: The function description included in this section gives the available selections or the value range, as applicable. The value set at the factory (initial factory setting) is also listed.
6. After changing a function value with the ▲ and ▼ keys, press the SET key to lock the new data in the controller memory.

   Depending on the specific application, an IET fault may occur with this new setting when the controller is put in the Run mode. If an IET does occur, the controller will stop and the 4-digit display will indicate the code of the IET causing the failure. Table 8-1 summarizes these codes. The controller cannot run while in an IET state. Reset the controller by pressing the STOP key. Clearing the fault condition may require a new function value to be entered. Note: The controller is shipped with preset values that will not cause IET trips under normal conditions.
7. When selections and changes are complete, press the MON key one time to return to the STOP mode.

   If the MON key is pressed a second time, the 4-digit display will show the code of the last occurring IET. If there have been no IETs, the display will show 0000. To return to the STOP mode, press the STOP key.

   If the PGM key is pressed while in the RUN MODE, the Program Enable is locked out; the PROGRAM ENABLE LED will not light. This program lock out condition can be cleared by pressing the MON key and then the STOP key.

First Menu Functions

0 Local/Remote Operation Control

Parameter Selection

0 = LOCAL Control (Keypad)
1 = REMOTE Control (Terminal Strip)
2 = REMOTE Control (Reliance I/O Port requires optional Rail Interface Card)

Initial Setting

0

Description

When "1" is selected, operational control is through the terminal strip and the REMOTE LED is lit. Most GP2000 applications will require remote operation by selecting 1. When "0" is selected, the controller is operated locally and the LOCAL LED is lit. In the REMOTE mode (1, 2, or 3), the controller deactivates the RUN/JOG, FWD/REV, and AUTO/MAN keys. When in the remote mode, the keypad cannot be used except to stop. These functions must be activated through the terminal strip for proper operation. See Section 3, ***"Install Control and Signal Wiring"*** (or Section 4 if Bypass is installed). The STOP key remains functional.

Note: If in Remote Mode, the keypad STOP key is only functional while the key is pressed. After releasing the STOP key, and if control inputs are correct, the drive will immediately start. The controller will not allow selection of "2" unless the optional Rail Interface Card is installed and wired in the controller.

1 Acceleration Time

Adjustment Range

5.0 – 360.0 seconds

Initial Setting

20.0

Description

Acceleration time is the normal time in which the motor moves from minimum Hz to maximum Hz. The acceleration rate (hertz/second) depends on the minimum Hz and the maximum Hz setting. If an acceleration time faster than 5 seconds is required, see Function 44. If the motor load inertia is high and/or the current limit (Function 5) setting is too low, acceleration time will be longer than the preset time. For Jog Acceleration Time, see Function 51.

Note: With very fast acceleration times, the motor may draw excessive current resulting in an accelerating overcurrent (OC-A) IET. To avoid this condition, reset the acceleration time for a longer period.

2 Deceleration Time

Adjustment Range

5.0 – 360.0 seconds

Initial Setting

20.0

Description

Deceleration time is the normal time in which the motor decreases from maximum Hz to minimum Hz. Therefore, the deceleration rate

(hertz/second) depends on the minimum Hz and the maximum Hz setting. If a deceleration time faster than 5 seconds is required, see Function 45. For Jog Deceleration time, see Function 52.

Note: Motor load inertia and input line conditions can extend the deceleration time to a value greater than the preset time. With very fast deceleration times, either a decelerating overcurrent (OC-d) IET fault, or regenerative motor voltage may charge up the D-C bus voltage causing a high bus voltage (HU) IET fault to occur. To avoid an IET condition, set the deceleration time for a longer period. If a deceleration time faster than the acceptable range is required, install an optional Dynamic Braking Kit.

3 Minimum Hz

Adjustment Range

5.0 – 60.0 Hz

Initial Setting

5.0

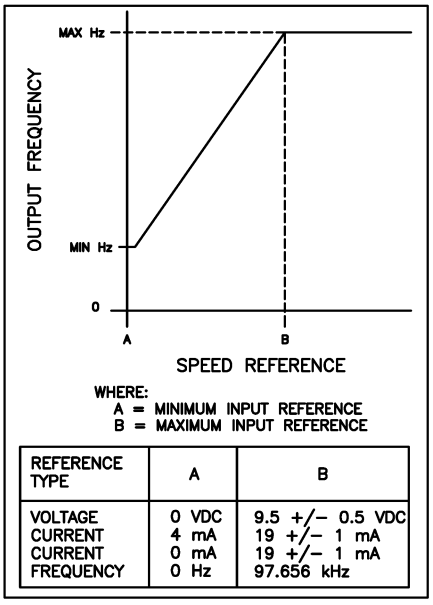
Description

DANGER

THE DRIVE IS INTENDED TO OPERATE AT A PREDETERMINED MINIMUM SPEED UNLESS DISCONNECTED FROM THE POWER SOURCE. IF THE APPLICATION REQUIRES ZERO SPEED OPERATION WITHOUT SUCH DISCONNECTION, THE USER IS RESPONSIBLE FOR ASSURING SAFE CONDITIONS FOR OPERATING PERSONNEL BY PROVIDING SUITABLE GUARDS, AUDIBLE OR VISUAL ALARMS, OR OTHER DEVICES. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Minimum Hz is the minimum output frequency value that can be reached with the ▼ key. Minimum Hz must always be lower than Maximum Hz (Function 4), and the speed setting value must always be within minimum and maximum Hz. When the AUTO key is selected to control speed by an external process control signal, the gain (output frequency/speed reference) can be adjusted with the minimum Hz setting and/or the maximum Hz setting. See Figure 6-1.

If a minimum Hz lower than 5 Hz is required, refer to Function 43, Extended Minimum Hz Range.



REFERENCE TYPE	A	B
VOLTAGE	0 VDC	9.5 +/– 0.5 VDC
CURRENT	4 mA	19 +/– 1 mA
CURRENT	0 mA	19 +/– 1 mA
FREQUENCY	0 Hz	97.656 kHz

Figure 6-1. Relationship of Output Frequency and Speed Reference for Process Control Auto Selection.

4 Maximum Hz

Adjustment Range

15.0 – Overfrequency Limit
Note: Overfrequency Limit (Function 38) is factory set at 90 Hz.

Initial Setting

60.0

Description

WARNING

THE USER IS RESPONSIBLE FOR ENSURING THAT DRIVEN MACHINERY, ALL DRIVE-TRAIN MECHANISMS, AND PROCESS LINE MATERIAL ARE CAPABLE OF SAFE OPERATION AT A SPEED EQUIVALENT TO AT LEAST THAT WHICH WOULD RESULT FROM AN APPLIED FREQUENCY 20% ABOVE THE OVERFREQUENCY LIMIT (FUNCTION 38:FACTORY PRESET @ 90 HZ; MAXIMUM VALUE 405 HZ). FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Maximum frequency is the maximum output frequency value that can be reached with the ▲ key. See Figure 6-1.

Maximum Hz can be programmed between 15 Hz and 90 Hz in the first menu. If a maximum Hz higher than 90 Hz is required, refer to Function 38, Overfrequency Limit.

5 Current Limit

Adjustment Range

50 – 150% of inverter rated current

Initial Setting

150

Description

This feature provides the means to limit motor output torque during run or acceleration. When output current attempts to exceed the preset current limit level, motor speed is decreased. This feature automatically provides an adjustable torque limit for the driven equipment. (See Function 55 if IET tripping occurs under current limit conditions.)

6 Expand to Second Menu

Parameter Selection

0 = Basic (First Menu Only)
1 = Expand to Second Menu

Initial Setting

0

Password

0306 (or 1123 for second password)

Description

Most simple applications will require only the adjustable functions found in the first menu. When you scroll through the functions list with the PGM key, at Function 6 the list will complete its cycle and return to Function 0. Note that the PROGRAM ENABLE LED goes off when you reach Function 6. This indicates that you cannot modify this function without a password.

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD START, ADJUST, OPERATE, AND/OR SERVICE IT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

If your application requires changing any function found in the second menu, complete the following to gain access to the second menu:

- With the PGM key, select Function 6.
- Press and hold in the SET key until 0000 flashes in the 4-digit display (approximately 3 seconds). The 2-digit display will be blank.
- Enter password 0306 (or 1123 for second password) with the ▲ and ▼ keys. When the 4-digit display shows this value, press the SET key.
- The 4-digit display will change to 0 (Function 6 value for Basic – first menu only), and the Program Enable LED will light.
- Change the 0 value to 1 with the key and press the SET key.

Now, when you press the PGM key to scroll the functions list, you will scroll to Function 7 and on through the list. As long as the parameter remains selected at 1, you can proceed to second-level functions. To change Function 6 back to "first menu only," repeat this password process and select 0.

Second Menu Functions

7 Manual Torque Boost

Adjustment Range

0 – 10% voltage

Initial Setting

2

Description

WARNING

THE DRIVE IS INTENDED TO OPERATE AT A PREDETERMINED MINIMUM SPEED UNLESS DISCONNECTED FROM THE POWER SOURCE. TO ENSURE MOTOR ROTATION AT THE MINIMUM SPEED SETTING, TORQUE BOOST MUST BE PROPERLY ADJUSTED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

Torque boost is required to offset the voltage drop of the A-C motor at low speeds. For friction loads and large inertia loads, a high starting torque level may be needed. Manual torque boost is effective only at speeds lower than half of base frequency. Figure 6-2 illustrates the manual torque boost adjustable range and the V/Hz characteristics.

If the torque boost setting is too high or the acceleration ramp is too fast, the motor may draw excessive starting current. This could cause an overcurrent (OC-A or OC) IET. Also, too much torque boost may cause excessive motor heat and motor noise.

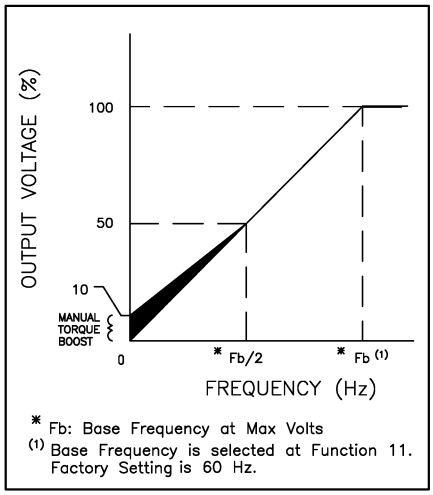


Figure 6-2. Manual Torque Boost Adjustable Range (Constant Torque shown).

8 Jog Frequency

Adjustment Range

0.0 – 60.0 Hz

Initial Setting

5.0

Description

Jogging can be accomplished in either LOCAL Control or REMOTE Control. Jog frequency can be set from 0.0 to 60.0 Hz and is independent of any other set speed. The actual output frequency for jog is automatically limited between minimum and maximum Hz.

Jog speed cannot be changed with the ▲ and ▼ keys while the controller is in the RUN mode. The only way to change JOG speed is to put the controller in the STOP mode, select Function 8 with the PGM key, and reset the jog frequency value.

9 Stop Mode Selection

Parameter Selection

0 = Coast-to-rest
1 = Ramp-to-rest

Initial Setting

0

Description

With parameter “0” selected, pressing the STOP key or giving an external STOP command causes the motor to coast to a rest. With parameter “1” selected, pressing the STOP key or giving an external STOP command causes the motor to ramp to a rest within a time equal to the preset deceleration time (Function 2) unless the inertia of the system in relation to the deceleration rate is such that the stored energy cannot be absorbed.

10 Automatic Flux Control

Adjustment Range

0 – 5% rated voltage

Initial Setting

0

Description

Automatic flux control optimizes the motor magnetic flux and, thus, the motor output torque. It senses the output current and adjusts the corresponding voltage to provide optimum flux for the torque conditions of the motor. This compensated voltage is adjustable from 0 to 5% rated voltage at 100% full load current of the controller.

Figure 6-3 illustrates the automatic flux control adjustable range as well as the V/Hz characteristics with both automatic flux control and manual torque boost. For optimum performance, low torque loads should be set at the low end of the range (≈0%) and high torque loads at the high end (≈5%).

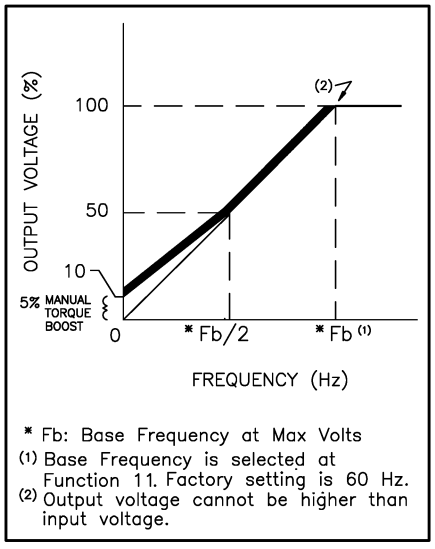


Figure 6-3. Automatic Flux Control Adjustable Range (Constant Torque shown).

11 Base Frequency Selection (Volts/Hz Ratio)

Adjustment Range

30.0 – 120.0 Hz (Variable torque)
30.0 – 400.0 Hz (Constant torque)

Initial Setting

60.0

Description

WARNING

THE USER IS RESPONSIBLE FOR ENSURING THAT DRIVEN MACHINERY, ALL DRIVE-TRAIN MECHANISMS, AND PROCESS LINE MATERIAL ARE CAPABLE OF SAFE OPERATION AT A SPEED EQUIVALENT TO AT LEAST THAT WHICH WOULD RESULT FROM AN APPLIED FREQUENCY 20% ABOVE THE OVERFREQUENCY LIMIT (FUNCTION 38: FACTORY PRESET @ 90 HZ; MAXIMUM VALUE 405 HZ). FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

The base frequency selection is used to adjust the controller output volts/hertz ratio. Base frequency is the frequency at which the output voltage reaches maximum voltage. (Maximum voltage is adjustable, if necessary. See Function 49 and 50.) Below base frequency, output voltage varies with output frequency according to the V/Hz adjustment, and the variable torque V/Hz range. Above base frequency, output voltage is held constant as frequency increases (referred to as the constant horsepower range). Figure 6-4 shows the relationship of output frequency and voltage.

Note: The V/Hz ratio is affected by the settings of automatic flux control (Function 10) and manual torque boost (Function 7).

When the GP2000 is set for the variable torque curve (Function 23), the base frequency selection (Function 11) must be equal to or less than 120 Hz. Figure 6-11 shows the variable torque curve. In normal variable torque applications, base frequency should equal motor nameplate operating frequency.

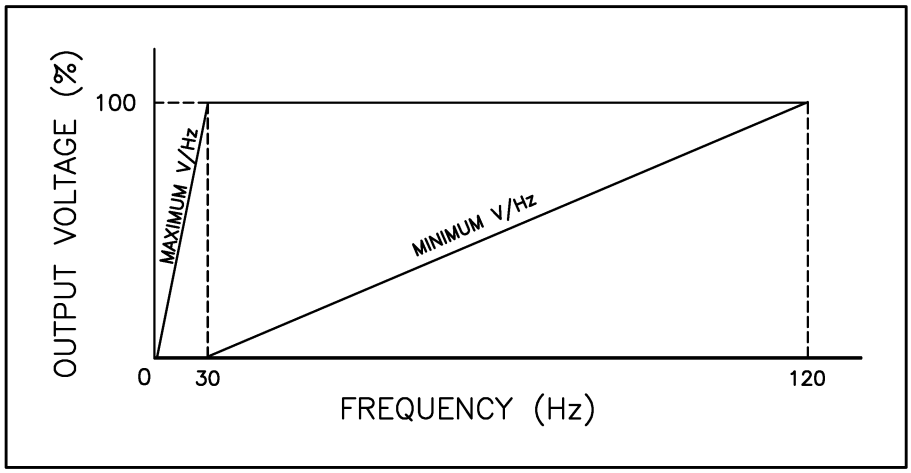


Figure 6-4. Relationship of Base Frequency and V/Hz Selection for Constant Torque Applications.

12 Electronic Thermal Overload Selection

CAUTION: The electronic thermal overload does not provide protection for single motor applications. For multiple motor applications, use separate, properly-sized thermal overload protection for each motor. Failure to observe this precaution could result in damage to, or destruction of the equipment.

Parameter Selection

0 = Normal Motor
1 = Forced Cooled Motor

Initial Setting

0

Description

An electronic thermal overload is useful in applications where motor horsepower rating is less than that of the controller. Function 12 allows selection of an output current profile best suited for the type of motor to be run. Function 13 allows adjustment of the output current value. Note that the electronic thermal overload functions similarly to a motor overload relay and does not measure actual motor temperature. A temperature measuring device is the best way to thermally protect a motor under all conditions.

* If a "1" is selected for this function, contact Reliance Electric for proper electronic thermal overload level adjustment (Function 13).

A Function 12, "0" selection is best suited for motors with cooling fans integral to the motor shaft, such as totally enclosed fan cooled (TEFC) or open dripproof (ODP) motor types. A "1" selection is best suited for motors with cooling that is independent of motor speed, such as motors with constant speed cooling fans or totally enclosed non-ventilated (TENV) motor types.* Figure 6-5 shows the typical continuous current with respect to speed (output Hz) for each selection with Function 13 set at 50% and 100%.

CAUTION: This function is not intended to act as a replacement for a hardwired thermal overload relay. The user is responsible for following the National Electrical code and all other applicable local codes with respect to motor overload protection. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

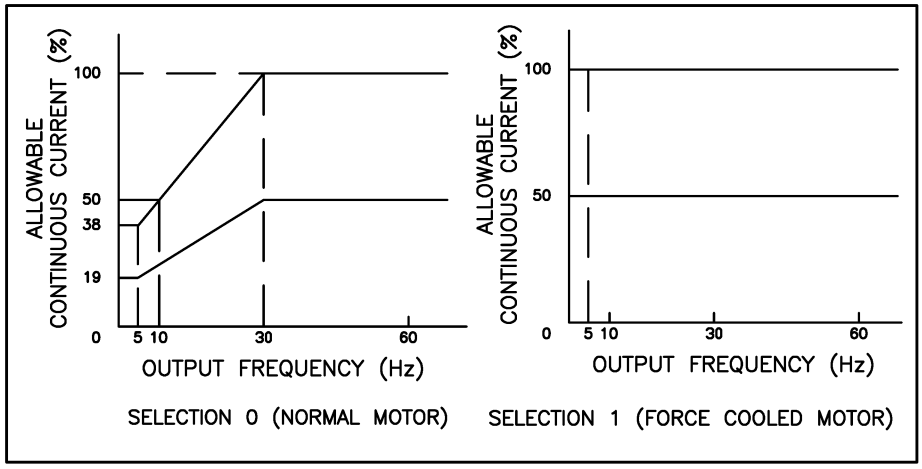


Figure 6-5. Allowable Continuous Current vs Output Hz (with Function 13 at 50% and 100% Settings).

13 Electronic Thermal Overload Level

Adjustment Range

20 – 100% rated current

Initial Setting

100

Description

The adjustment of this function is useful if the motor horsepower rating is less than the controller horsepower size. Using the formula below, calculate the setting level as a percentage of maximum continuous current:

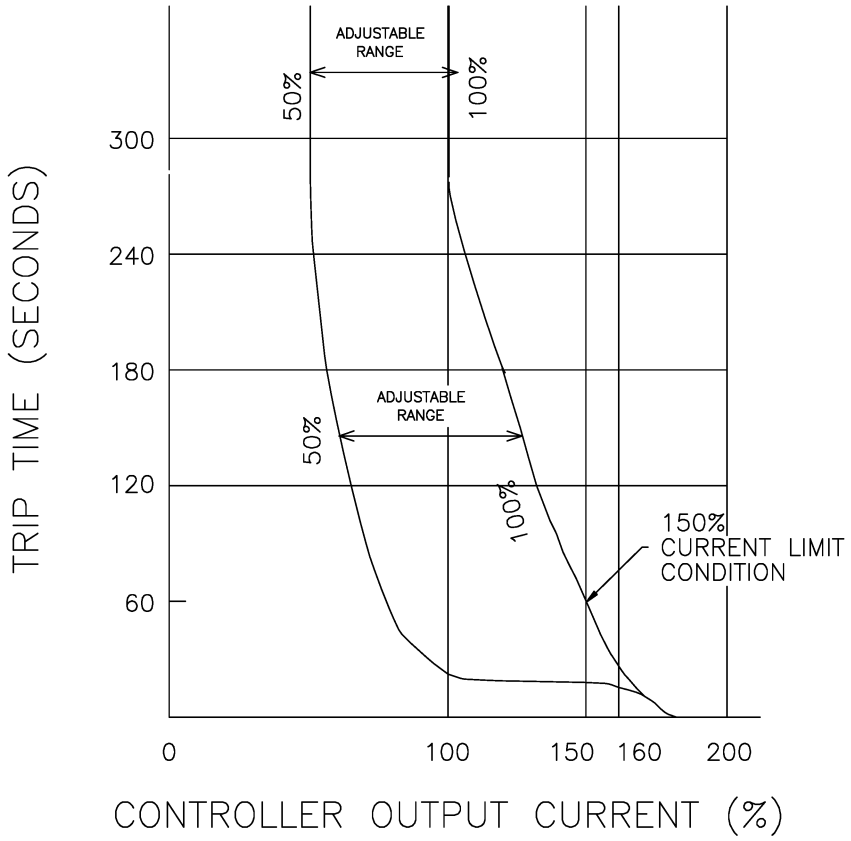
$$\text{Setting Level (\%)} = \frac{\text{Motor Full Load Current}}{\text{Controller Output Rated Current}} \times 100$$

Figure 6-6 illustrates curves for the electronic thermal overload with the forced cooled motor selection at 100% and 50%. Table 6-1 shows the approximate trip time in seconds vs. the output current at various electronic overload levels and frequencies. For example, if the overload setting level is 100%, when a motor runs with 110% load at 60 Hz, an "OL" IET will occur after one minute.

Note: The calculated trip times given in Table 6-1 are based upon one overload trip. If successive trips occur, the trip times are shortened to more closely simulate the operation of a mechanical temperature overload device.

CAUTION: If motors are wired in parallel on the output of the controller do not use the electronic thermal overload function. Use separate motor overload relays on each individual motor. Failure to observe this precaution could result in damage to, or destruction of the equipment.

Note: An optional overload relay must be used. If the controller has bypass, an overload relay trip causes the controller to stop, and "CS" is displayed on the 4-digit display. If the electronic overload trips, the 4-digit display shows "OL" and the controller stops.



Note: The overload relay trip causes a function loss "FL" IET if the controller does not have bypass. If the controller has bypass, the overload relay trip causes the controller to stop, and "CS" is displayed on the 4-digit display. If the electronic overload relay trips, the 4-digit display shows "OL", and the controller stops.

Figure 6-6. Electronic Thermal Overload Curves for Forced Cooled Motor Selection at 50% and 100% Overload Levels.

Table 6-1. Trip Time for Overload Protection Based on First Trip.

Note: Function 12, Electronic Thermal Overload, is set at 0.

Trip Time (second)

Electronic Thermal Overload Level (%)	Rated Output Current (%)	Output Frequency (Hz)					
		60 ~ 30	25	20	15	10	5
100	30	∞	∞	∞	∞	∞	∞
	40	∞	∞	∞	∞	∞	4349
	50	∞	∞	∞	∞	∞	255
	60	∞	∞	∞	∞	361	131
	70	∞	∞	∞	619	155	88
	80	∞	∞	2168	188	98	66
	90	∞	∞	241	111	72	53
	100	∞	334	127	79	57	45
	110	542	149	86	61	47	38
	120	181	96	65	50	40	33
	130	108	71	53	42	35	30
	140	77	56	44	36	31	27
	150	60	46	38	32	29	24
90	90	∞	334	127	79	57	45
	100	443	141	83	59	46	38
	110	157	89	62	48	39	33
	130	69	51	41	34	29	26
	150	44	36	31	27	24	21
80	80	∞	334	127	79	57	45
	90	361	131	80	58	45	37
	100	135	82	58	45	37	32
	110	83	59	46	38	32	28
	130	47	38	32	28	25	22
	150	33	28	25	22	20	18
70	70	∞	334	127	79	57	45
	80	292	121	76	55	44	36
	90	115	74	54	43	35	30
	100	71	53	42	35	30	26
	110	52	41	24	30	26	23
	130	34	29	25	22	20	18
	150	25	22	20	18	17	15
60	60	∞	334	127	79	57	45
	70	232	109	71	53	42	35
	80	96	65	49	40	33	29
	90	60	46	38	32	28	24
	100	44	36	31	27	24	21
	110	35	30	26	23	21	19
	130	25	22	20	18	16	15
	150	19	17	16	15	14	13
50	50	∞	334	127	79	57	45
	60	181	96	65	50	40	33
	70	77	56	44	36	31	27
	80	49	40	33	29	25	22
	90	36	31	27	24	21	19
	100	29	25	22	20	18	17
	110	24	21	19	17	16	15
	130	17	16	15	14	13	12
	150	14	13	12	12	11	10

14 Linear/S-Curve Acceleration

Parameter Selection

0 = Linear Acceleration
1 = S-Curve Acceleration

Initial Setting

0

Description

When S-Curve Acceleration is selected, acceleration will begin and end slowly. The acceleration time set at Function 1 will remain the same. Figure 6-7 illustrates S-Curve acceleration.

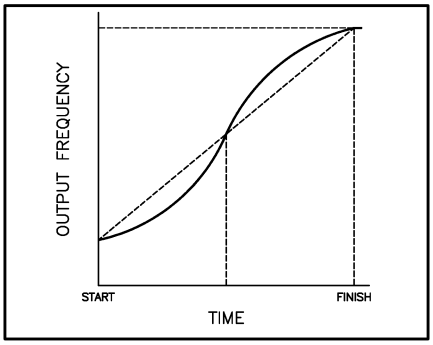


Figure 6-7. S-Curve Acceleration.

15 Linear/S-Curve Deceleration

Parameter Selection

0 = Linear Deceleration
1 = S-Curve Deceleration

Initial Setting

0

Description

When S-Curve Deceleration is selected, deceleration will begin and end slowly. The acceleration time set at Function 1 will remain the same. Figure 6-8 illustrates S-Curve deceleration.

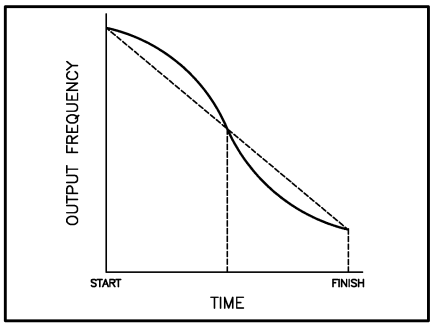


Figure 6-8. S-Curve Deceleration.

16, 17, 18 Multi-Speed Preset (MS1, MS2, MS3)

Note: The Multi-Speed Preset Functions 16, 17 and 18 cannot be seen in the LOCAL Mode, (Function 0, set to 0.)

Adjustment Range

0.0 – 400.0 Hz

Initial Setting

5.0

Description

When the controller is controlled remotely (Function 0, set to a 1, 2, or 3), the controller can be configured to run at three different preset speeds. The frequency of each preset speed is limited between minimum and maximum Hz. If the preset speed is greater than Max. Hz (or less than MIn. Hz) and the function is enabled, (via TB11 terminals 17 and 18), the output will go to Max. Hz (or Min. Hz.)

Note: The Multi-Speed Preset is enabled when parameter 0 is selected in Function 57. When parameter 1 is selected in Function 57, the same terminals 17 and 18 will become inputs for the Static MOP. Controller must be in REMOTE mode, Function 0 set to = 1.

To select 1 to 3 preset speed values,

- Set the frequency level for each desired speed level (Functions 16, 17, and 18) using the ▲, ▼, and SET keys.
- Enable the desired speed level by wiring to the appropriate terminals according to Table 6-2. See Figure 3-6.

When the circuit is closed, the Multi-Speed Preset function overrides the external speed reference, causing the output frequency to accelerate or decelerate to the preset level (MS1, MS2, or MS3). When the circuit is open, control is returned to the external speed reference signal. The frequency of each preset speed overrides the avoidance frequency of Functions 19, 20, 21 and 22. Figure 6-9 shows a typical multi-speed preset application.

Note: When the Purge feature is used, the MS1 Speed Selection is used for preset speed selection. No external wiring is necessary to terminals 12 & 17 on TB11 in this case.

Table 6-2. Terminal Connections for Multi-Speed Preset.

Function Number	Preset Speed	Terminal (TB11) Connection
16	MS1	17 to 12
17	MS2	18 to 12
18	MS3	17 and 18 to 12

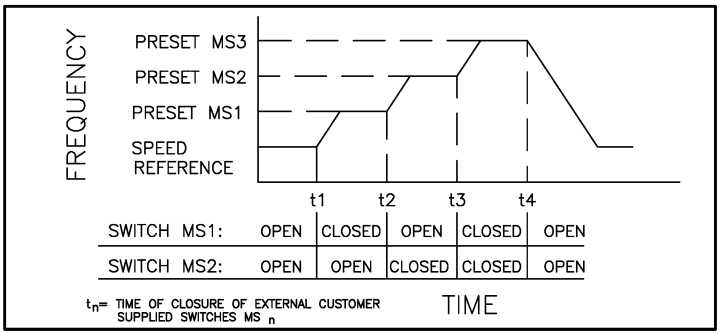


Figure 6-9. Typical Multi-Speed Preset Application.

19, 20, 21 Avoidance Frequency (AF1, AF2, AF3)

Adjustment Range

0.0 – 400.0 Hz

Initial Setting

0.0

Description

Operating a motor continuously at a particular frequency may cause vibrations within the driven machinery. Three independent avoidance frequencies can be programmed to prevent motor vibration at these critical frequencies. See Figure 6-10.

The setting of each avoidance frequency is limited between minimum and maximum Hz. This function (19, 20, or 21) is used with Function 22, Avoidance Frequency Band.

Select from 1 to 3 avoidance frequency bands by using the ▲, ▼, and SET keys. Set each avoidance frequency value (AF1, AF2, and AF3 at Function 19, 20, and 21, respectively) as needed.

The avoidance frequency function is effective in both LOCAL and REMOTE modes. Normal acceleration and deceleration through these bands is unaffected by this function.

22 Avoidance Frequency Band (AFB)

Adjustment Range

0.2 – 10.0 Hz

Initial Setting

0.2

Description

This function is applicable with Functions 19, 20, and 21 (Avoidance Frequency). The avoidance frequency band selection will apply to each of the three avoidance frequencies set in Functions 19, 20, and 21. The actual range of avoidance frequency is calculated by the following formula:

$$AF - \frac{AFB}{2} < F_R < AF + \frac{AFB}{2}$$

where:

AF = Avoidance Frequency (set with Functions 19, 20, and 21)
AFB = Avoidance Frequency Band (set with Function 22)
F_R = Avoidance Range

To select 1 to 3 avoidance frequency bands:

Using the ▲, ▼, and SET keys while at Function 22, select the desired avoidance frequency band that will be applied to each avoidance frequency value.

The following example illustrates how avoidance frequency works. Assume the following:

- Minimum Hz is set at 10.0.
- Maximum Hz is set at 60.0.
- Output speed follows a 0–10 VDC process signal.
- Desired avoidance frequency (AF1) is 40 Hz.
- Desired avoidance frequency bandwidth (AFB) is 10 Hz.

$$40 - \frac{10}{2} < F_R < 40 + \frac{10}{2}$$

$$35\ Hz < F_R < 45\ Hz$$

Before applying avoidance frequency values, the process signal voltage produces output frequency as follows:

0 VDC = 10.0 Hz
5.0 VDC = 35.0 Hz
5.8 VDC = 39.0 Hz
5.9 VDC = 39.5 Hz
6.6 VDC = 43.0 Hz
7.0 VDC = 45.0 Hz
7.1 VDC = 45.5 Hz
10.0 VDC = 60.0 Hz

After applying avoidance frequency values, the output frequency will be:

0 VDC = 10.0 Hz
5.0 VDC = 35.0 Hz
5.8 VDC = 35.0 Hz
5.9 VDC = 35.0 Hz
6.6 VDC = 35.0 Hz
7.0 VDC = 35.0 Hz
7.1 VDC = 45.5 Hz
10.0 VDC = 60.0 Hz

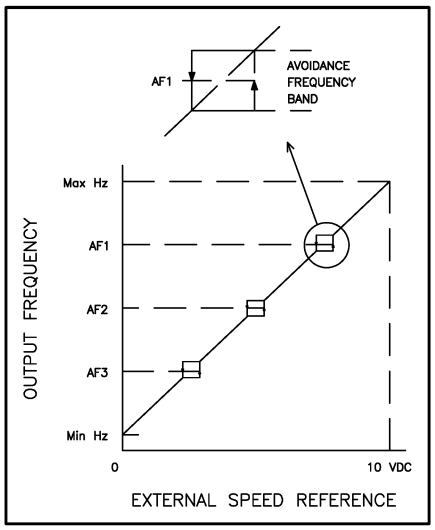


Figure 6-10. Avoidance Frequency Operation.

23 Variable Torque Volts/Hz Curve Selection

Parameter Selection

0 = Constant Torque Curve
1 = Variable Torque Curve

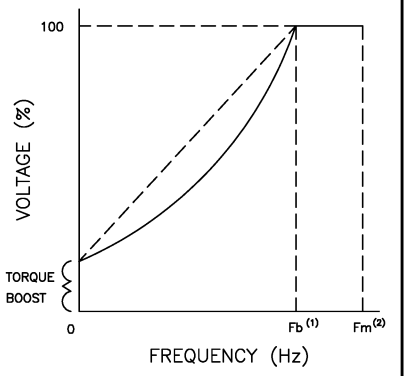
Initial Setting

0

Description

WARNING
THE DRIVE IS INTENDED TO OPERATE AT A PREDETERMINED MINIMUM SPEED UNLESS DISCONNECTED FROM THE POWER SOURCE. TO ENSURE MOTOR ROTATION AT THE MINIMUM SPEED SETTING, TORQUE BOOST (FUNCTION 7) MUST BE PROPERLY ADJUSTED. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

When the GP2000 is set for the variable torque curve, the base frequency selection (Function 11) must be equal to or less than 120 Hz. Figure 6-11 shows the variable torque curve.



Fb: Base Frequency (<=120Hz)
Fm: Maximum Hz (<=120 Hz)

(1) Base frequency is selected at Function 11. Factory setting is 60 Hz.

(2) Maximum Hz is selected at Function 4. Factory setting is 60 Hz.

Figure 6-11. Variable Torque Curve

24, 25, 26 D-C Braking

Adjustment Range

24 Operation Time: 0.0 – 10.0 seconds
25 Voltage: 0–20% voltage
26 Frequency: 0.5 – 10.0 Hz

Initial Setting

24 Operation Time: 0.0
25 Voltage: 0
26 Frequency: 1.0

Note: D-C braking operation requires that Function 9 be set to "Ramp-to-rest."

Description

D-C braking is used to provide additional motor braking at speeds of 10 Hz or lower. If D-C braking is required, all three D-C braking functions (24, 25, and 26) must be adjusted. When the motor decelerates to the preset start frequency (Function 26), the preset constant D-C voltage (Function 25) is momentarily applied to the motor for the preset time (Function 24). See Figure 6-12. This function will not provide the holding torque of a mechanical brake.

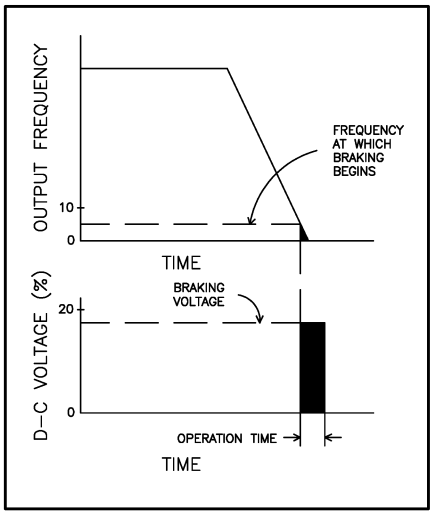


Figure 6-12. D-C Braking Operation.

27 Line-Dip-Ride-Through

Adjustment Range

15 – 500 milliseconds

Initial Setting

15

Description

If the line power supply is interrupted or line voltage dips for longer than the preset time, an IET (Ldip) will occur. The line-dip-ride-through time can be adjusted from 15 milliseconds to 500 milliseconds. The available adjustment range may not be usable. It is determined in conjunction with other drives on the same line and the load characteristics of the application. Also, this function must be used only when drive frequency is less than 100 Hz.

During a line voltage dip, the standard controller may have enough capacitance to keep the regulator active for 500 milliseconds. However, the load will determine how long the D-C bus voltage will remain above the minimum voltage at which the controller will IET. For example, if the load deceleration is slow (high inertia, low frictional loss), the controller may be able to maintain enough D-C bus voltage to ride through a line dip for 500 milliseconds. If the load deceleration is fast (low inertia, high frictional loss), the controller may only be able to remain above the minimum D-C bus voltage limit for the preset time.

28, 29 Output Relay (1 and 2)

Parameter Selection

0 = Not Used
1 = Zero Speed Detect
2 = Input Contactor
3 = Output Contactor
4 = Frequency Level Detection 1
5 = Frequency Level Detection 2
6 = Current Level Detection
7 = Reverse Rotation
8 = D-C Braking Operation
9 = Reserved

Initial Setting

0

Description

These functions use the Remote Meter Interface Card, which includes two relays. Each relay operates according to the parameter (0−9) selected. Function 28 configures output relay 1, and Function 29 configures output relay 2. Output relay 1 provides a form C contact (1NO and 1NC), and output relay 2 provides a form A contact (1NO). The response time of each relay is typically 8 milliseconds.

The ten parameters are described as follows:

0: The relay does not operate.
1: The relay is energized while output frequency is equal to or higher than 0.5 Hz.
2: This provides the control signal for an input contactor. The relay energizes when the controller is put into the Run mode.
3: This provides the control signal for an output contactor. The relay energizes when the controller is put into the Run mode.
4: The relay energizes when the output frequency is equal to or higher than the frequency level set in Function 33.
5: The relay energizes when the output frequency level is equal to or higher than the frequency set in Function 34.
6: The relay energizes when the output current level is equal to or higher than the current set in Function 35.
7: The relay energizes when the phase sequence of the output frequency is in reverse rotation.
8: The relay energizes when the D-C braking voltage is applied to the motor. This relay is not required for D-C braking to be operational.
9: Reserved.

Bypass Option: If Bypass Option is included with the controller, Function 28 is set for #3 (Output Contactor). Factory wiring to terminals 37 and 38 is provided.

30 Slip Compensation

Adjustment Range

0.0 − 5.0 Hz

Initial Setting

0.0

Description

Actual motor shaft speed is determined by two factors: the applied Hz and the slip of the motor. The slip of the motor, however, is fully determined by the type of induction motor and varies with the driven load.

Slip compensation senses motor slip and adjusts the applied Hz automatically. Because of changes in the load, the actual speed regulation of the motor is greatly improved with this function properly adjusted.

High efficiency motors have less slip and, therefore, have improved speed regulation capability. See Table 6-3 for slip adjustment values to achieve 1% speed regulation with Reliance XE™ high efficiency motors.

Note: Slip compensation improves speed regulation by automatically adjusting the output Hz to the motor. This can be viewed on the 4-digit display when monitoring frequency (Hz).

Table 6-3.
Slip Compensation Adjustment.(1)

HP	Slip Adjustment
50	0.5 Hz
60	0.5 Hz
75	0.5 Hz
100	0.5 Hz

(1) Based on Reliance TEFC XE high efficiency motors to obtain 1% speed regulation:

$$\text{Speed Regulation} = \frac{\text{No Load RPM} - \text{Full Load RPM}}{\text{Full Load RPM}}$$

31 Inverse Reference

Parameter Selection

0 = Normal
1 = Inverse

Initial Setting

0

Password

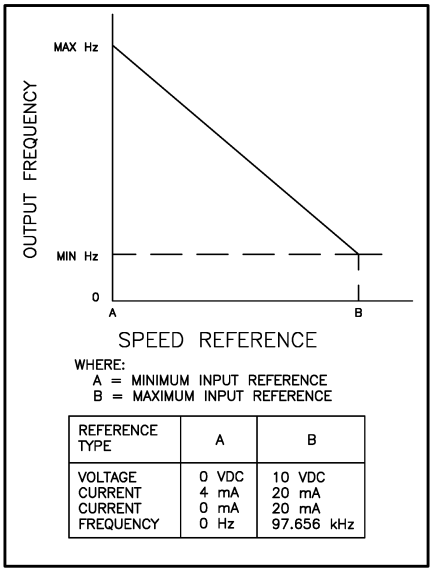
Second Password: Enter 1123 (See Function 6, except enter 1123.)

Description

WARNING

WITH THE INVERSE REFERENCE FUNCTION ENABLED, LOSS OF THE EXTERNAL SPEED REFERENCE SIGNAL WILL CAUSE THE DRIVE TO GO TO MAXIMUM FREQUENCY. EXERCISE EXTREME CARE WHEN USING THIS FUNCTION. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

This function will invert the signal of an external speed reference, causing the GP2000 to run at maximum output frequency when there is loss of or minimum control signal (0 volts or 4 mA) and at minimum output frequency when there is maximum control signal (10 volts or 20 mA). This function may be used when the reference signal supplied by an external device is inverse to desired speed control. Refer to Figure 6-13.



REFERENCE TYPE	A	B
VOLTAGE	0 VDC	10 VDC
CURRENT	4 mA	20 mA
CURRENT	0 mA	20 mA
FREQUENCY	0 Hz	97.656 kHz

Figure 6-13. Inverse Relationship of Speed Reference and Output Frequency.

32 Function Loss Selection

Parameter Selection

0 = IET at Function Loss
1 = Coast-to-rest without an IET Output at Function Loss

Initial Setting

0 (without optional bypass modification)
1 (with optional bypass modification)

Password

Second Password: Enter 1123
(See Function 6; except enter 1123 instead.)

Description

Controllers without bypass option:

Parameter set at “0” from the factory. A function loss signal causes the controller to stop, resulting in the following:

- The motor will coast to rest.
- The 4-digit display will show “FL” (function loss).
- The internal speed reference will be reset to zero.
- The IET relay will be latched on.
- The IET can be reset with the STOP key after the cause of the function loss is removed.
- The controller will restart with the START key after the IET is reset.

Controllers with bypass option:

Parameter set at “1” from the factory. A function loss signal causes the controller to stop, resulting in the following:

- The motor will coast to rest.
- The 4-digit display will indicate “CS” (coast stop).
- The internal speed reference will be reset to zero.
- The controller will restart with the START key after the cause of the function loss is removed.

33, 34 Frequency Level Detection (1 and 2)

Adjustment Range

0.5 – 405.0 Hz

Initial Setting

0.5

Description

This function is effective and displayed, only when parameter 4 or 5 is selected at Function 28 or 29. When the output frequency is equal to or higher than the set detection level, the selected output relay located on the Remote Meter Interface Card will energize as shown in Figure 6-14.

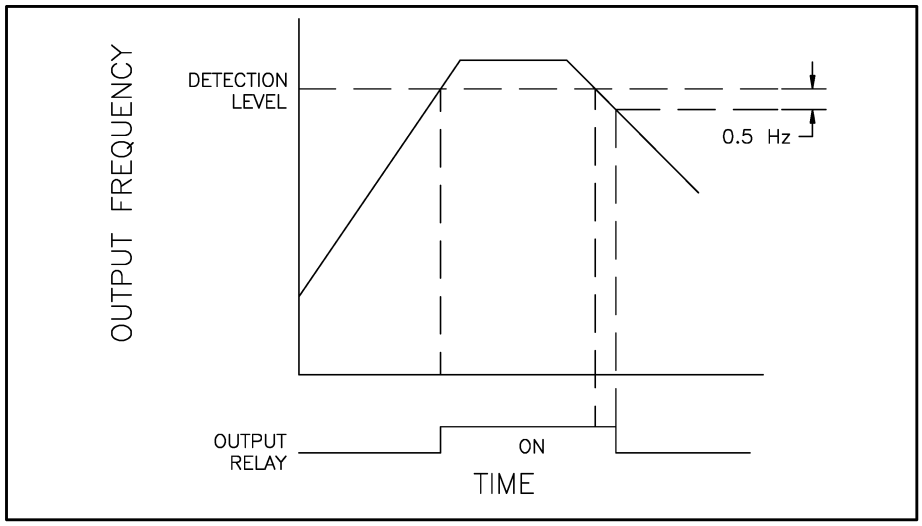


Figure 6-14. Frequency Level Detection Operation.

35 Current Level Detection

Adjustment Range

30 – 110% Rated Current

Initial Setting

100

Description

This function is effective and displayed, only when parameter 6 is selected at Function 28 or 29. When the output current is equal to or higher than the set detection level, the selected output relay located on the Remote Meter Interface Card will energize as shown in Figure 6-15.

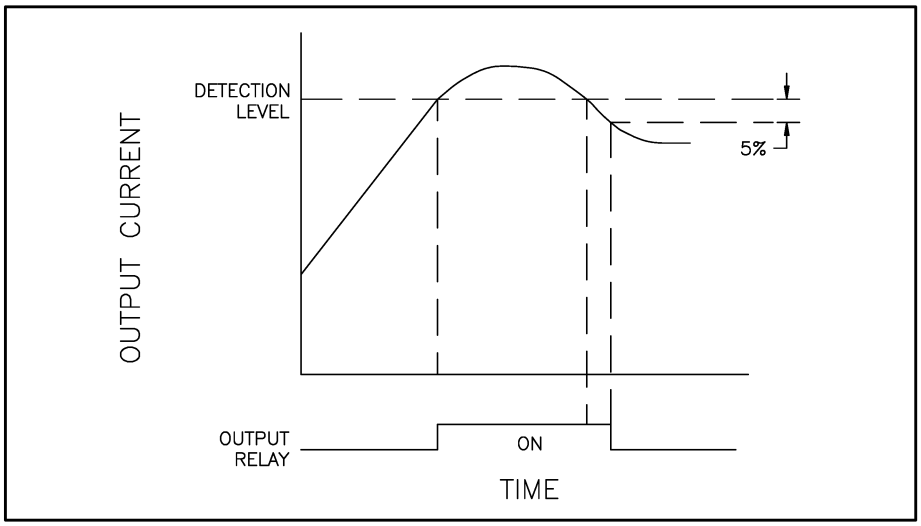


Figure 6-15. Current Level Detection Operation.

36 Reverse Disable

Parameter Selection

0 = Forward/Reverse Enable
1 = Reverse Disable on Keypad

Initial Setting

0

Description

This function is effective only when the controller is controlled locally (Function 0, parameter 0). If parameter 1 is selected, the FWD/REV key is locked in the forward position, preventing the motor from rotating in the reverse direction.

37 Automatic (Process Control) Disable on Local Control

Parameter Selection

0 = AUTO/MAN Key Enable
1 = AUTO Disable on Keypad

Initial Setting

0

Description

This function is effective only when the controller is controlled locally (Function 0, parameter 0). If parameter 1 is selected, the AUTO/MAN key is locked in the manual position, preventing the motor from responding to any external speed command.

38 Overfrequency Limit

Adjustment Range

50.0 – 405.0 Hz

Initial Setting

90.0

Password

Second Password: Enter 1123
(See Function 6; except enter 1123 instead.)

Description

WARNING

THE USER IS RESPONSIBLE FOR ENSURING THAT DRIVEN MACHINERY, ALL DRIVE-TRAIN MECHANISMS, AND PROCESS LINE MATERIAL ARE CAPABLE OF SAFE OPERATION AT A SPEED EQUIVALENT TO AT LEAST THAT WHICH WOULD RESULT FROM AN APPLIED FREQUENCY 20% ABOVE THE OVERFREQUENCY LIMIT (FUNCTION 38: FACTORY PRESET @ 90 HZ; MAXIMUM VALUE 405 HZ). FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

The overfrequency limit is factory set at 90 Hz. The Maximum Hz setting (Function 4) is limited by the setting of this function.

39 D-C Offset Enable

Parameter Selection

0 = Offset Disable
1 = Offset Enable

Initial Setting

0

Password

Second Password: Enter 1123
(See Function 6; except enter 1123 instead.)

Description

When parameter 0 is selected, D-C offset is disabled for normal operation of an induction motor. When this function is enabled (selection 1), the D-C offset function allows some D-C voltage to be output to the motor terminals at 0 Hz. The magnitude of this voltage is equal to the manual torque boost setting at Function 7. This may be required to synchronize the rotor of a permanent magnet synchronous motor to avoid high starting currents.

40, 41, 42 Auto-Restart

Parameter Selection

40 Enable
0 = Auto-restart Disable
1 = Auto-restart Enable

Adjustment Range

41 Restart Attempts: 0 − 10 times
42 Interval Time: 1 − 60 seconds(1)

Initial Setting

40 Enable: 0
41 Time: 0
42 Interval Time: 1 second

(1)**Note**: Do not set Auto-Restart time interval below 30 seconds when Bypass option is used.If setting is below 30 seconds, the Purge feature may not function properly.

Password

40 Enable: Second Password: Enter 1123
(See Function 6; except enter 1123 instead.)

Description

WARNING

THE DRIVE MAY RESTART AUTOMATICALLY WITH THE AUTO-RESTART ENABLED (FUNCTION 40, PARAMETER 1). ATTACH A WARNING TAG TO THE APPROPRIATE DRIVEN EQUIPMENT. BEFORE WORKING ON THIS EQUIPMENT, BE SURE THAT POWER IS REMOVED AND LOCKED OUT FROM THE DRIVE. FAILURE TO OBSERVE THIS PRECAUTION MAY RESULT IN BODILY INJURY.

Select Auto-restart Enable (Function 40, Parameter 1) to automatically restart the controller when one of the following IETs occur: overcurrent (OC, OC-A, OC-d, OC-G), high bus voltage, low bus voltage, or a line dip. (See Table 8-1.) The auto-restart operation can be repeated the number of times set in Function 41 (0 − 10 times) within the time interval set in Function 42 (1 − 60 seconds). The repeat number is returned to zero when the controller restarts successfully.

Note: Customer wiring must be as shown in Figure 3-6 through 3-13 to permit proper restart operations.

43 Extended Minimum Hz Range

Parameter Selection

0 = Disable (5 − 60 Hz)
1 = Enable (0 − 60 Hz)

Initial Setting

0

Password

Second Password: Enter 1123
(See Function 6; except enter 1123 instead.)

Description

DANGER

THE DRIVE IS INTENDED TO OPERATE AT A PREDETERMINED MINIMUM SPEED UNLESS DISCONNECTED FROM THE POWER SOURCE. IF THE APPLICATION REQUIRES ZERO SPEED OPERATION WITHOUT SUCH DISCONNECTION, THE USER IS RESPONSIBLE FOR ASSURING SAFE CONDITIONS FOR OPERATING PERSONNEL BY PROVIDING SUITABLE GUARDS, AUDIBLE OR VISUAL ALARMS, OR OTHER DEVICES. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

If a minimum Hz lower than 5 Hz is required, select parameter 1. Return to Function 3 and set the desired minimum Hz.

44 Extended Acceleration Time Range

Parameter Selection

0 = Disable (5.0 − 360.0 seconds)
1 = Enable (0.1 − 360.0 seconds)

Initial Setting

0

Description

When an acceleration time shorter than 5 seconds is required, select parameter 1. Return to Function 1 and set the desired acceleration time.

Note: With very fast acceleration and/or high manual torque boost settings, the motor may draw excessive current resulting in an OC-A IET.

45 Extended Deceleration Time Range

Parameter Selection

0 = Disable (5.0 – 360.0 seconds)
1 = Enable (0.1 – 360.0 seconds)

Initial Setting

0

Description

When a deceleration time shorter than 5 seconds is required, select parameter 1. Return to Function 2 and set the desired deceleration time.

Note: With very fast deceleration, the regenerative motor voltage may raise the D-C bus voltage too high, causing an HU IET. To avoid such an IET, increase the deceleration time or install a Dynamic Braking Kit (option).

46, 47, 48 RPM Monitor

Parameter Selection

46 Display Enable

0 = Disable
1 = Enable

47 Range Selection

0 = 150 – 9999 RPM
1 = 0 – 9999 RPM

Adjustment Range

WARNING

SETTING THE VALUE OF FUNCTION 48 WILL GIVE A DECEPTIVELY LOW INDICATION EVEN IF THE MACHINE IS RUNNING AT MAXIMUM SPEED. DO NOT SET FUNCTION 48 TO ZERO OR A LOW VALUE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

48 Base Frequency Selection

150 – 9999 RPM

Initial Settings

46 Display Enable: 0

47 Range Selection: 0

48 Base Frequency Selection: 1750

Password

47 Range Selection: Second Password (Enter 1123.) (See Function 6; except enter 1123 instead.)

Description

When parameter 0 is selected in Function 46, output frequency, output voltage, and percentage of full-load amps of the controller can be monitored. When parameter 1 is selected in Function 46, RPM can also be monitored. The display can be scrolled by pressing the MON key. The 2-digit display shows "SP" when monitoring RPM.

Functions 46, 47 , and 48 can also be used to scale the 4-digit display differently. This can be done by entering a value for "Base Frequency" selection (Function 11) that is different than the actual motor speed, but represents some other engineering unit unique to the application. When Base Frequency selection of Function 48 is programmed, use the following formula:

Base Frequency Selection (Function 48) =

$$\frac{\text{Motor Rated RPM}^{(1)}}{\text{Motor Rated Hz}^{(2)}} \times \text{Base Frequency Hz}^{(3)}$$

Where,

(1) = "Motor Rated RPM" equals the RPM of the motor under full load and motor rated frequency conditions. This value for RPM can be found on the motor nameplate.

(2) = "Motor Rated Hz" equals the base frequency of the motor. This value can be found on the motor nameplate.

(3) = "Base Frequency" equals the setting of Function 11.

Example

"Motor Rated RPM" (Motor nameplate) = 1750 RPM
"Motor Rated Hz" = 60 Hz
"Base Frequency" (or number entered into Function 48) = 60 Hz

Function 48 would be equal to the following using the above equation:

$$\frac{1750}{60} \times 60 = 1750$$

Upon entering 1750 for Function 48, the 4-digit display would indicate "1750" at 60 Hz controller output, or full speed. In this case 1750 would be a good approximation of the actual motor speed. If it is desired that the display show the approximate speed of something other than motor RPM, enter a different number in Function 48 that is scaled to the needed application. Table 6-4 shows how Function 48 can be used.

Table 6-4. Two Typical Examples of Relationship between Output Hz and RPM Monitor.

Output Hz to Motor	Actual Motor Speed in RPM	Function 11 Enter:	Function 48 Enter:	4-digit Display reads:
60.0 Hz	1750	60.0	1750	1750
30.0 Hz	850	60.0	1400	700

WARNING

SETTING THE VALUE OF FUNCTION 48 WILL GIVE A DECEPTIVELY LOW INDICATION EVEN IF THE MACHINE IS RUNNING AT MAXIMUM SPEED. DO NOT SET FUNCTION 48 TO ZERO OR A LOW VALUE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN BODILY INJURY.

When setting RPM to a value smaller than 150, select parameter 1 in Function 47. This requires the second password.

Note:The RPM monitor display ignores the slip compensation frequency if Slip Compensation (Function 30) is programmed.

49 Output Voltage Regulation Mode Selection

Parameter Selection

0 = Proportional to Input
1 = Fixed to Maximum Voltage
(See Function 50)

Initial Setting

0

Description

When parameter 0 is selected, the maximum output voltage will be proportional to the input voltage. When parameter 1 is selected, the maximum output voltage will be equal to the set value of Function 50. The output voltage or the V/Hz will be fixed even if the input voltage varies.

50 Maximum Voltage

Parameter Selection

190.0 – 230.0 Volts
380.0 – 460.0 Volts
475 – 575 Volts

Initial Setting

Controller Nameplate Voltage

Description

When the output frequency reaches the Base Frequency of Function 11, the output voltage will be equal to the Maximum voltage of Function 50. The regulator board automatically discriminates between the three types of controllers mentioned above, by sensing the Power Supply board.

51 Jog Acceleration Value

Parameter Selection

0.1 – 360.0 Seconds

Initial Setting

20.0

Description

When parameter “0” (Linear Acceleration) is selected in Function 53, use the following formula to determine the jog acceleration value set in this function:

Jog Accel Value =

$$\frac{(\text{Max Hz})}{(\text{Jog Hz})} \times (\text{Jog Accel Time})$$

Where:

Jog Accel = Setting of Function 51

Max Hz = Setting of Function 4
Jog Hz= Setting of Function 8
Jog Accel Time= Time to accelerate from zero Hz to jog Hz

Example:

If 2 seconds for Jog Acceleration Time is required, and 60 Hz is set into Function 4 (Max Hz), and 10 Hz is set into Function 8 (Jog Hz), Function 51 will be set at 12 seconds (60/10 x 2).

When Parameter “1” (S-Curve Acceleration) is selected in Function 53, use the following formula:

Jog Accel Value =

$$\sqrt{\frac{\text{Max Hz}}{\text{Jog Hz}}} \times \text{(Jog Accel Time)}$$

52 Jog Deceleration Value

Parameter Selection

0.1 – 360.0 Seconds

Initial Setting

20.0

Description

When parameter “0” is selected in Function 54, use the following formula to determine the jog deceleration value set in this function:

Jog Decel Value =

$$\frac{(\text{Max Hz})}{(\text{Jog Hz})} \times \text{(Jog Decel Time)}$$

Where:

Jog Decel =	Setting of Function 52
Max Hz =	Setting of Function 4
Jog Hz=	Setting of Function 8
Jog Decel Time=	Time to decelerate from jog Hz to zero Hz

Example:

If 4 seconds for Jog Deceleration Time is required, and 60 Hz is set into Function 4 (Max Hz), and 20 Hz is set into Function 8 (Jog Hz), Function 52 will be set at 12 seconds (60/20 x 4).

When Parameter “1” (S-Curve Deceleration) is selected in Function 54, use the following formula:

Jog Decel Value =

$$\sqrt{\frac{\text{Max Hz}}{\text{Jog Hz}}} \times \text{(Jog Decel Time)}$$

53 Jog Acceleration Selection

Parameter Selection

0 = Linear Acceleration
1 = S-Curve Acceleration

Initial Setting

0

Description

When the S-Curve Jog Acceleration is selected, acceleration will begin and end slowly. Refer to Function 14.

54 Jog Deceleration Selection

Parameter Selection

0 = Linear Acceleration
1 = S-Curve Acceleration

Initial Setting

0

Description

When the S-Curve Jog Deceleration is selected, deceleration will begin and end slowly. Refer to Function 14.

55 Current Limit Deceleration Rate

Parameter Selection

0 – 100 Hz/Seconds

Initial Setting

90

Description

When the output current attempts to exceed the preset current limit (Function 5), the motor speed will decrease at a predefined, adjustable rate. Adjustment of this function can suppress instability of current that could cause an IET trip during a current limit condition. The amount of adjustment lower or higher than the initial setting will depend on all application parameters (such as, motor, controller HP, application load, line voltage, etc.) If adjusting Function 55 will not correct the condition, Function 1 (Accel Time) and Function 5 (Preset Current Limit) should be adjusted.

56 Start into a Rotating Motor

Parameter Selection

0 = Enable
1 = Disable (Quick Start)

Initial Setting

0

Description

When parameter 0 is selected, the controller can start into a rotating motor without causing an IET trip. When the motor speed is zero or very low, it takes approximately 0.5 seconds to measure the speed before the controller can go into a start condition. The delay can be avoided by disabling this feature by setting it to a “1”.

57 MS Terminals Selection

Parameter Selection

0 = Multi-Speed Preset
1 = Static MOP

Initial Setting

0

Password

Enter Second Password: 1123
(See Function 6, except enter 1123 instead).

Description

When REMOTE Control “1” is selected in Function 0, Function 57 can be changed. (When parameter “0” is selected, TB11 terminals 17 and 18 of the Control Signal Buffer board can be used for the Multi-Speed Preset Selection. Refer to Functions 16, 17, and 18). When parameter “1” of Function 57 is selected, TB11 terminals 17 and 18 of the Control Signal Buffer board can be used for the Static MOP. When terminal 17 is connected to terminal 12, the output frequency will increase with the same acceleration rate as Function 1. When terminal 18 is connected to terminal 12, the output frequency will decrease with the same deceleration rate as Function 2. When both terminals 17 and 18 are opened or closed simultaneously, the output frequency will not change and is held constant.

99 Initial Factory Setting

Parameter Indication

0010 = No changes to factory settings

FF10 = Changes made to factory settings

Description

When changes have been made to the original factory settings, the 4-digit display will read FF10 when Function 99 is selected. This function provides a quick means of indicating if program changes have been made.

7: GP2000 Kit Options

The GP2000 controller is designed to accept kits as field or factory-installed options. Table 2-1 shows all field-installable options and their respective model numbers and instruction manuals. All of the field-installable kits can also be installed at the factory. Some of the factory-installed only options do not have instruction manuals and are therefore described in this section. The following is a list of options that are factory-installed only:

- Remote Meter Interface Card (although this can be field-installable, it is standard and factory-installed with the Bypass Option).
- Bypass Option
- Motor Overload Kit
- Remote Reference Kit
- Gain/Bias Reference Kit
- Line Reactor Kit
- Side Cabinet Kit
- Output Contactor Kit

Each kit is described below. Refer to Figures 7-4 through 7-8 for wiring diagrams.

Remote Meter Interface Card (Model Number 1MI4000)

The optional Remote Meter Interface Card (RMI) has three isolated analog interface circuits for monitoring the controller frequency, voltage, and current. Each interface circuit is composed of an opto-coupler and an active filter. The output capacity of each interface circuit is 1 mA at 10 VDC.

The monitor signals for the controller output frequency and voltage are generated through calculation without actual measuring. The signal for the controller output current is generated through actual measurement. These three signals are always provided, regardless of the keypad monitor display.

When the controller output frequency reaches the overfrequency limit, the output at terminal 31 is 10 VDC.

When the controller output voltage is 229, 253, 418, 506, or 632 VAC, the output at terminal 32 is 10 VDC for the controller input ratings of 208, 230, 380, 415, 460 and 575 VAC, respectively. When the controller output current is 200% rated current, the output at terminal 33 is 10 VDC. See Figure 7-1. Terminal 34 is the common (OVI1) for these signals. See Figure 7-2 for the location of terminal board T3 and other card components.

These monitor signals are normally used for remote analog meters or the Remote Digital Meter kit (Model 3DM4000), which has an analog to digital converter, or to provide feedback to a user's controller

The Remote Meter Interface Card also has three output contacts: Run Relay, Output Relay 1, and Output Relay 2. The Run Relay is energized while the controller is in the RUN mode. Output Relay 1 is energized depending on the selection of Function 28, and Output Relay 2 is energized depending on the selection of Function 29. Functions 28, 29, 33, 34, and 35 are available only when the Remote Meter Interface Card is installed. See Section 6 of this instruction manual for detailed descriptions of these functions.

The Run Relay and Output Relay 2 have normally open contacts. Output Relay 1 has a Form C contact (1NO/1NC). The contact ratings are 1 ampere at 250 VDC and 2 amperes at 30 VDC. Figure 7-3 is a circuit diagram of the Remote Meter Interface Card.

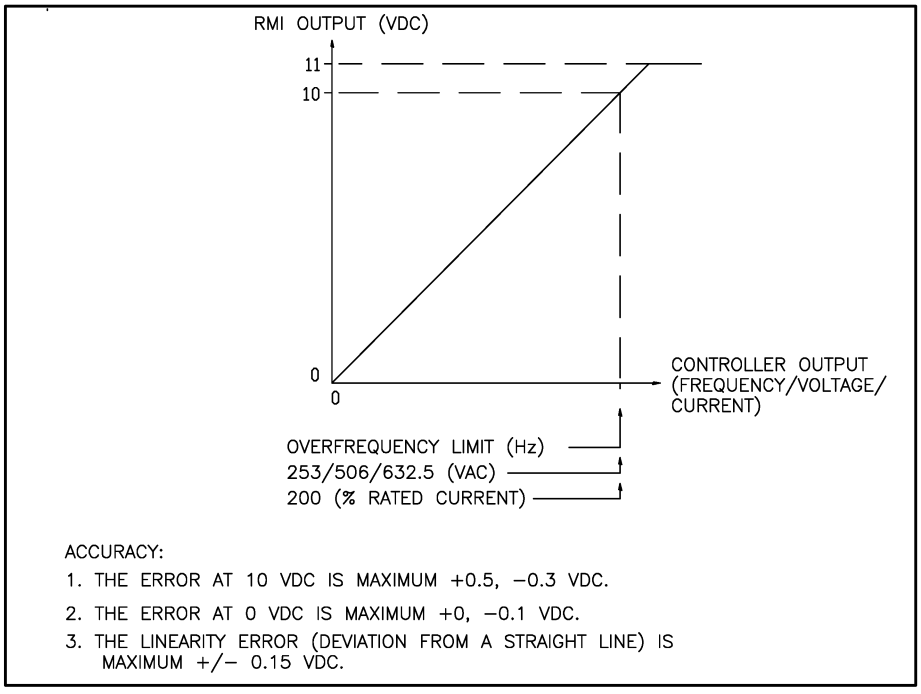
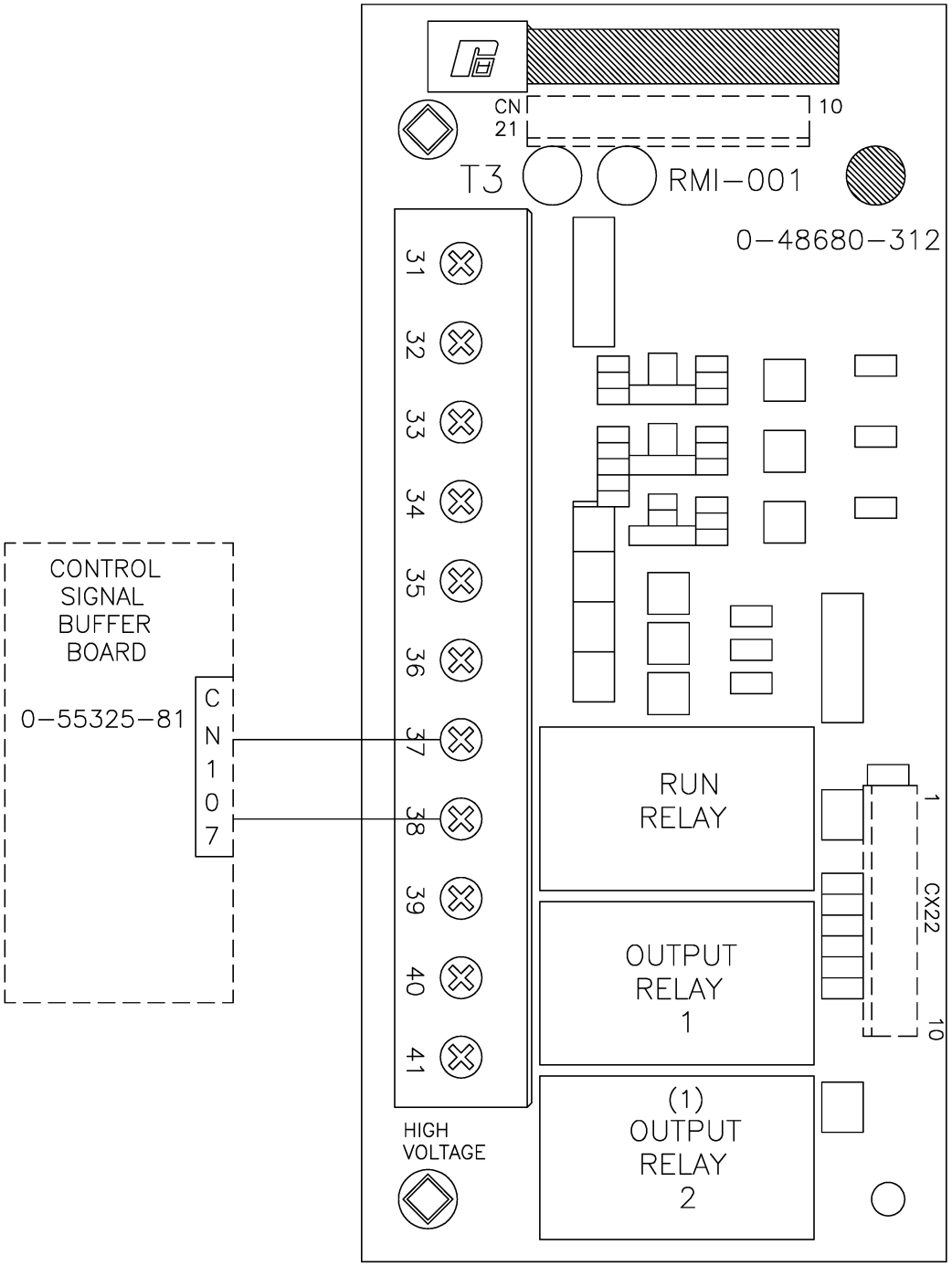


Figure 7-1. Optional Remote Meter Interface Card Output Characteristics.



(1) Output relays 1 and 2 are programmed using Functions 28 and 29. See Section 6 of this manual for details.

Figure 7-2. Remote Meter Interface Card Components.

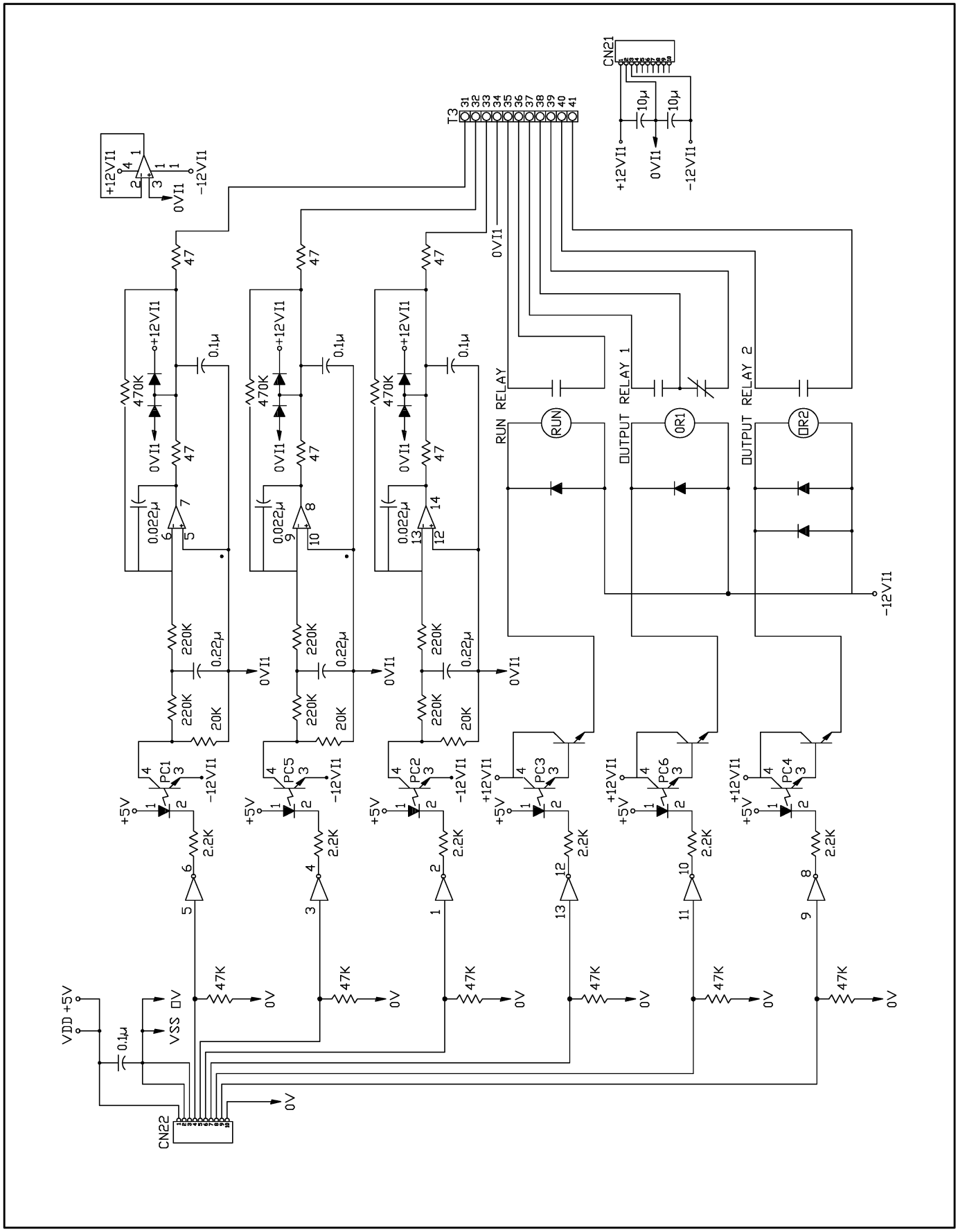


Figure 7-3. Remote Meter Interface Card Circuit Diagram.

When installing wiring for remote meters or customer sequence circuits, route the wiring through either of the control or signal conduit openings in the bottom or top of the controller. Do not allow the wires to come in contact with uninsulated components.

Bypass Option: When bypass is provided with the inverter, Function 28 is programmed for Parameter 3 (output contactor). Wiring is provided between terminals 37 and 38 (T3) to the Control Signal Buffer board via connector CN107. The output Relay 1 contact controls the inverter contactor so that in the STOP Mode of operation, the inverter contactor drops out.

The Rail Interface Card kit plugs into the same connector (CN21 and CN22) on the Regulator board as the Remote Meter Interface Card. Therefore, if Bypass and Rail Interface options are present, a jumper "J2" is provided on the Bypass control Board which allows the Bypass circuit to operate without the Remote Meter Interface Card. (See Figures 4-5 and 5-1)

Note: The inverter contactor will remain picked up in a STOP condition.

Bypass Option

Refer to ***Section 4: Install Optional Bypass*** for information on the bypass option. Throughout this manual specific references to bypass are made when the bypass option is installed. Wiring diagrams for bypass are also included in Section 4.

Motor Overload Kit

Motor overload protection external to the controller can be provided by the user, or internal motor overload protection can be provided as a factory-installed option.

> **CAUTION:** Additional overload and/or overtemperature devices may be required. Refer to the codes that apply to insure that you are in conformance. Failure to observe this precaution could result in damage to, or destruction of the equipment.

When the motor overload is provided as a factory-installed option, it is mounted in the Side Cabinet Kit (M/N 1KU4100). Refer to Figure 8-1, "Typical Component Identification, Inverter and Bypass."

Table 7-1 lists the factory model numbers and controller ratings as applicable to each controller.

Table 7-1. Motor Overload Factory Model Numbers.(1)

Model Number	Input Voltage	Controller Rating
1ML4100	460 415 380 230 208	100 HP 55 KW 55 KW 50 HP 40 HP
1ML4075	575 460 415 380 230 208	100 HP 75 HP 45 KW 45 KW 40 HP 30 HP
1ML4060	575 460 230 208	75 HP 50-60 HP 25-30 HP 25 HP
1ML5060	575 415 380 208	50-60 HP 30 KW 30 KW 20 HP

(1)Note: The Motor Overload Kit is not available as a field-installed item. These model numbers are factory model numbers only.

Refer to Figure 7-4 for the Motor Overload Kit connection diagram, Figure 8-3 (sheet 1) for a wiring diagram, and Figure 8-1 that shows where the motor overload is located in the side cabinet.

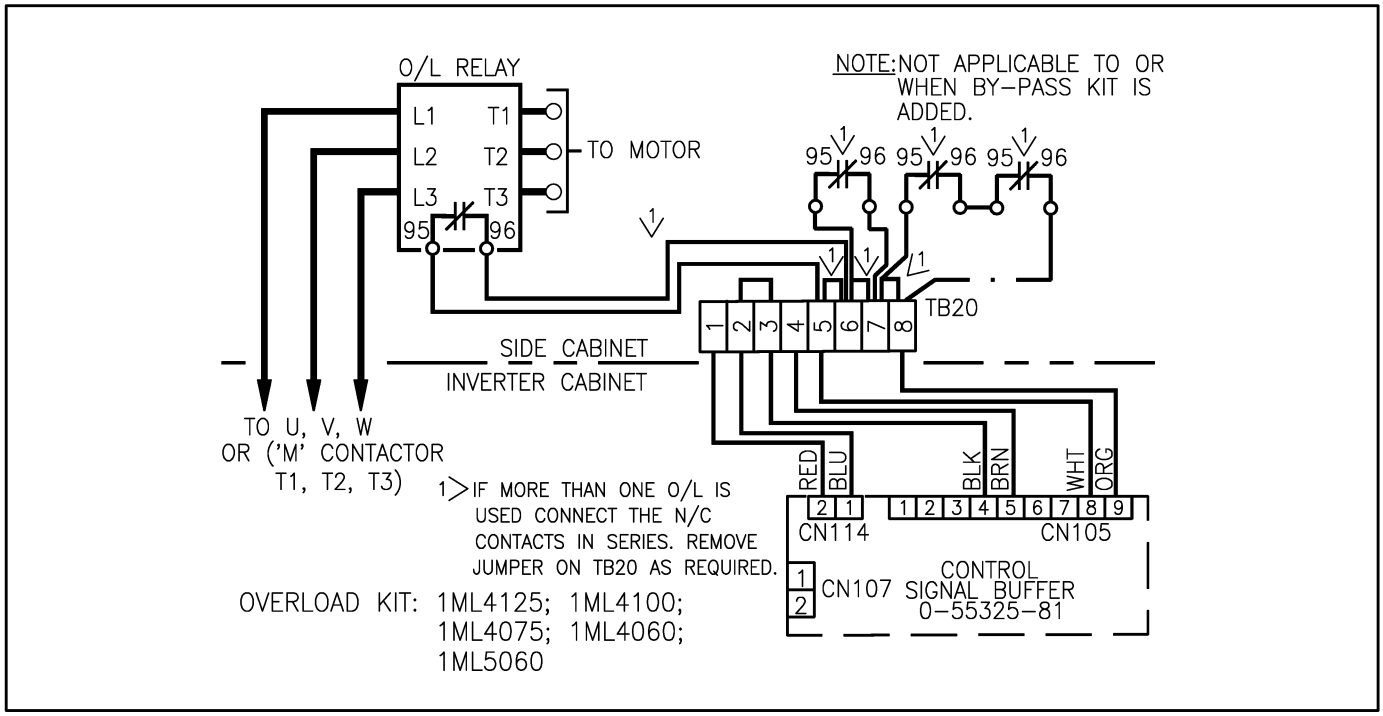


Figure 7-4. Motor Overload Kit Wiring.

Remote Reference Selector Kit - The Remote Reference Selector Kit provides the ability to switch between a manual speed reference potentiometer (0−10VDC) and a remote auto (4−20mA or 0−10 VDC) speed reference. An auto/manual switch is included for this operation. An optional auxiliary contact can be installed on the selector switch. Refer to Figure 7-5 for wiring.

The Remote Reference Selector Kit consists of a PC board (P/N 0-51486-17), two (2) wiring harnesses, mounting hardware, and a selector switch. The PC board mounts on a sheet metal panel, located above the D-C Bus Capacitor Bank. (Refer to Figure 8-1.) The Auto/Manual selector switch mounts on the inverter door.

A harness connects the PC board (terminals 4 and 8) to the Control Signal Buffer card at TB14 (terminals 4 and 3) and to the auto/manual switch. Another harness connects from the PC board to the Control Signal Buffer board at TB11, terminals 2 and 4. Terminals 3, and 5 are jumpered.

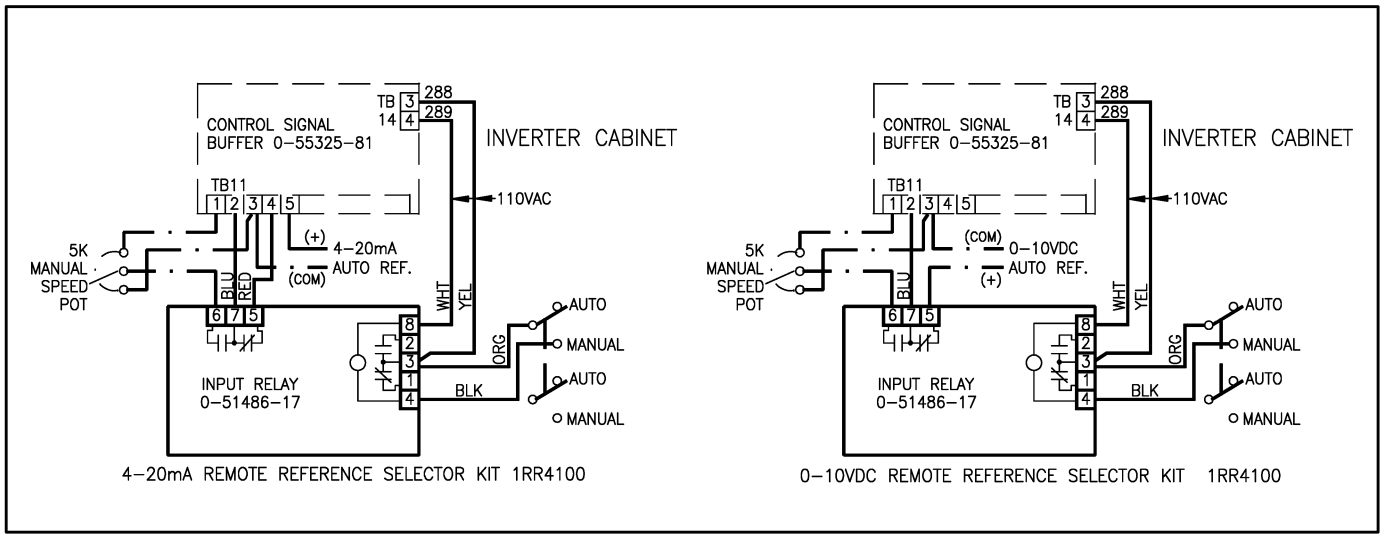


Figure 7-5. Remote Reference Selector Kit Wiring.

Gain/Bias Reference Adjustment Kit - This modification provides the ability to adjust the signal level from a remote customer input speed reference, so that it is properly scaled to the drive input speed reference signal level (of either 0−10VDC or 4−20mA). Refer to Figure 7-6.

The Gain/Bias reference adjustment kit consists of a Current Voltage PC Board (P/N 0-55325-8), two (2) wiring harnesses, a 400 ohm, 1/4 watt resistor (across terminals 1 and 2 on the Current Voltage PC Board), and mounting hardware. Connections are made from the Current Voltage PC Board, terminals 6 and 5 to the Control Signal Buffer Card TB14, at terminals 4 and 3. A second harness connects the Current Voltage PC Board, terminals 3 and 4 to the Control Signal Buffer Board, TB11, at terminals 2 and 3. The user wires the speed reference input (either 4−20mA or 0−10VDC) directly to terminals 1 and 2 on the Current Voltage PC Board.

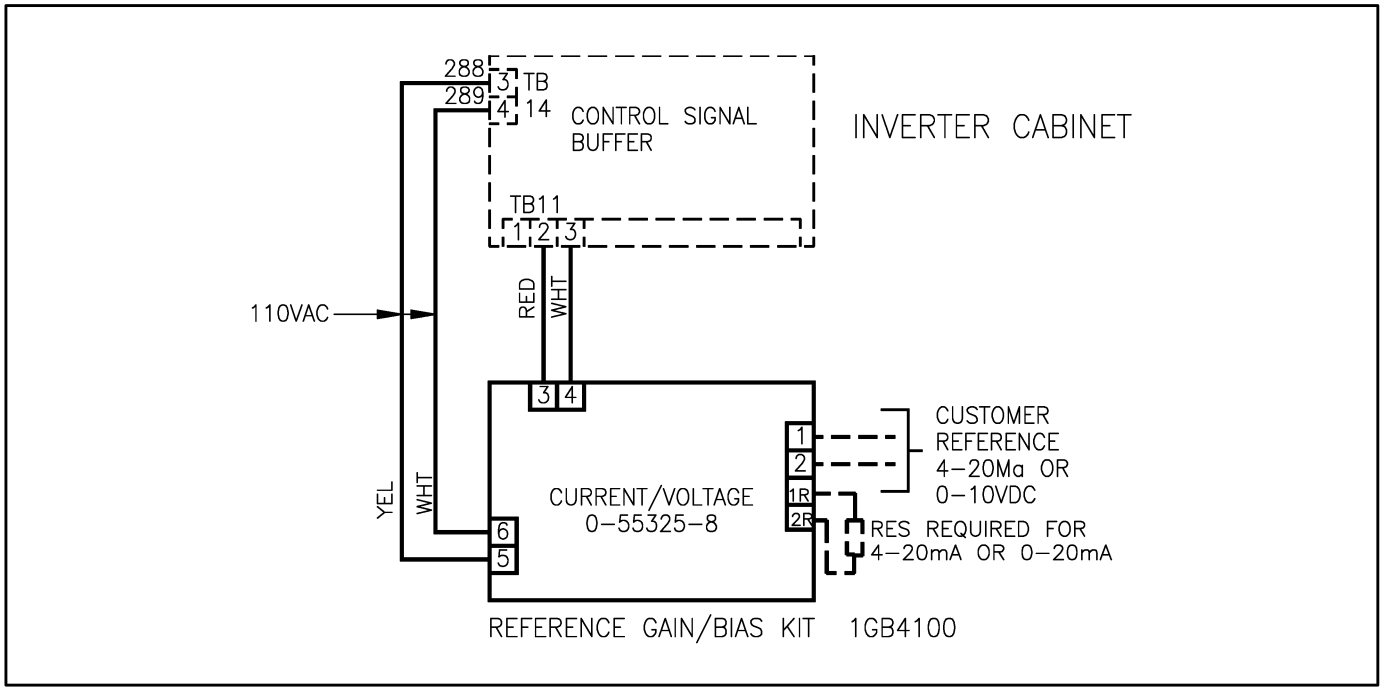


Figure 7-6. Gain/Bias Reference Adjustment Kit Wiring.

Line Reactor Kit – The 1LR4100 Line Reactor Kit is for all models except for 125 HP/460, 75 KW/415, 75 KW/380, and 50 HP/208 (which use 1LF4125 Line Reactor and Input Fuse Kit).

The 1LR4100 consists of an input line reactor (rated >160A), input disconnect and input fuse block panel (Input fuses not provided. If desired, Input Fuse Kit, M/N 2FU4100 must be included). See Figure 7-7.

The 1LF4125 consists of an input line reactor (rated > 190A), input disconnect, input fuse block panel, and three 200A, J type input fuses.

Both kits are factory installed only and require 5KU4100 (U/L) or 5KC4100 (CSA) Side Cabinet Kit for mounting.

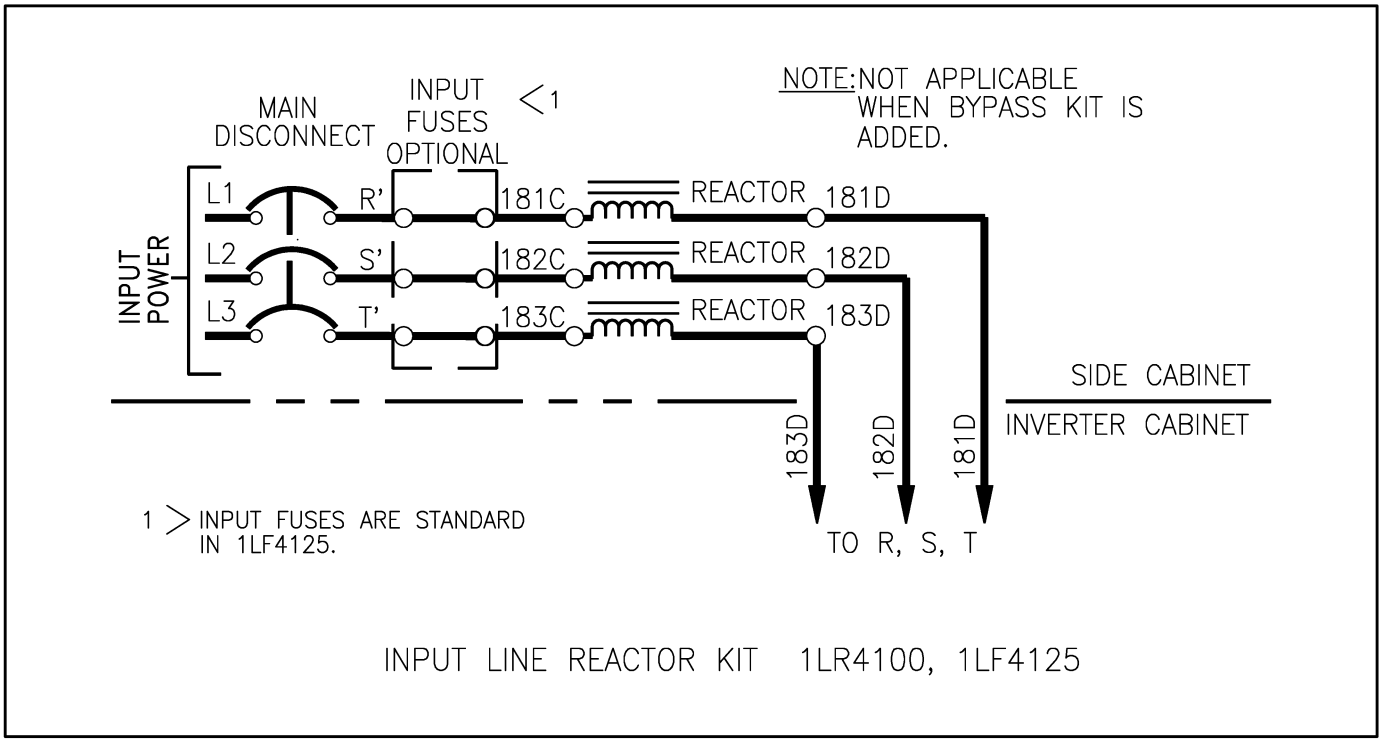


Figure 7-7. Input Line Reactor Kit 1LR4100, 1LF4125.

Output Contactor Kit – The 1CN4100 Output Contactor Kit is for all models except for 125 HP/460, 75 KW/415, 75 KW/380, and 50 HP/208 (which use 1CN4125 Output Contactor Kit).

The 1CN4100 consists of an output contactor (rated > 125A) wire harnesses, and terminal block TB20.

The 1CN4125 consists of an output contactor (rated > 170A) wire harnesses and terminal block TB20.

Both kits are wired the same. Contactor coils are powered from the Inverter transformer 24 VDC power supply. Both are interlocked with the 1MI4000 Remote Meter Interface Kit (TB3, 36 and 37) so that the contactor will normally open and close at zero speed/reference. Function 28 needs to be programmed for 3", which is the output contactor selection. TB20 provides easy troubleshooting and factory wiring modification.

These kits are factory installed only, and require 5KU4100 (U/L) or 5KC4100 (CSA) Side Cabinet Kit for mounting.

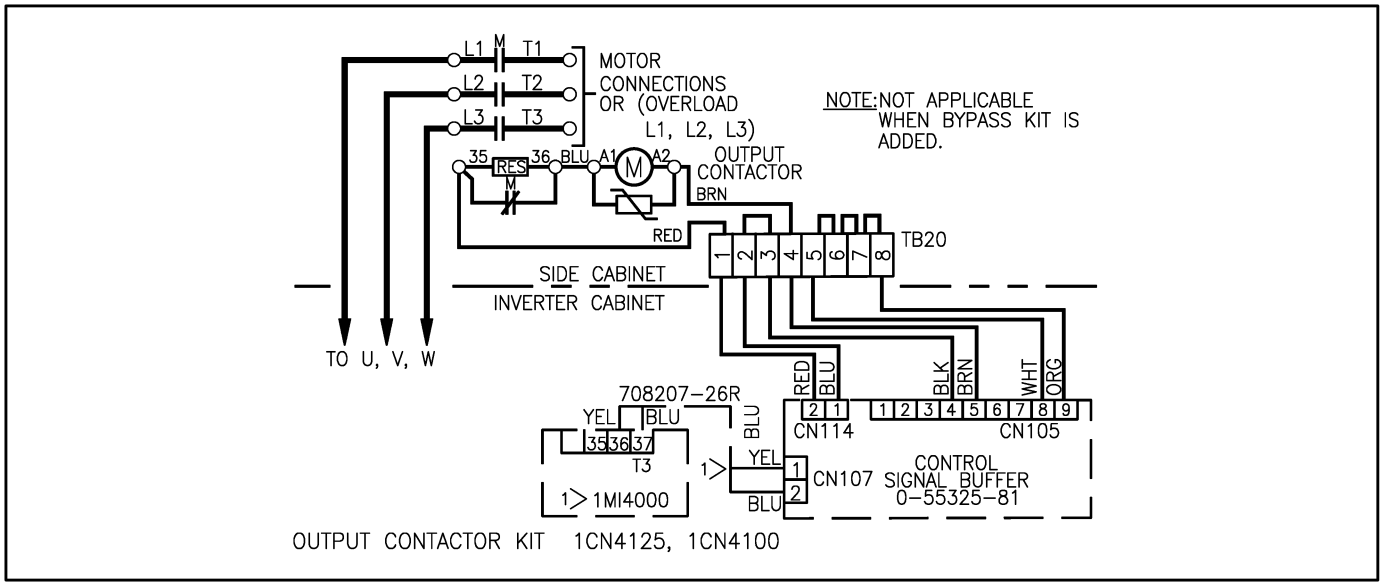


Figure 7-8. Output Contactor Kit 1CN4125, 1CN4100.

Side Cabinet Kit –

Note: If Bypass is required, this kit is not necessary.

The 5KU4100 (U/L) or 5KC4100 (CSA) Side Cabinet Kit is for all models and consists of an enclosure which permits installation of the following kits:

1CN4100 1CN4125	Output Contactor Kit
1ML4125 1ML4100 1ML4075 1ML4060 1ML5060	Motor O/L Kit
1LR4100	Line Reactor Kit
1LF4125	Line Reactor and Input Fuse Kit

The enclosure attaches to the right hand side of the inverter. The right hand side panel of the inverter must be removed. The dimensions of the inverter with the Side Cabinet Kit are the same as an inverter with bypass (See Figure 4-1).

8: Troubleshooting and Replacement Parts

DANGER

ONLY QUALIFIED ELECTRICAL PERSONNEL FAMILIAR WITH THE CONSTRUCTION AND OPERATION OF THIS EQUIPMENT AND THE HAZARDS INVOLVED SHOULD SERVICE IT. READ AND UNDERSTAND THIS MANUAL IN ITS ENTIRETY BEFORE PROCEEDING. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

Test Equipment Needed

CAUTION: Do not use a Megger to perform continuity checks in the drive equipment. Failure to observe this precaution could result in damage to, or destruction of, the equipment.

For controller output measurements of voltage, amperage, and frequency, the 4-digit display on the controller keypad is satisfactory. For all other voltage, amperage, and ohmic measurements, an analog or digital volt-ohmmeter is satisfactory. Make certain the selected volt-ohmmeter is rated for the intended measurement values.

Although not required for controller startup and adjustments, the best method of obtaining actual motor voltage, current, and speed measurements is with a fundamental voltmeter, digital clamp-on ammeter, and a hand-held tachometer, respectively.

Troubleshooting Aids

Several aids are provided for assisting with the troubleshooting procedure: a controller self-diagnostic test, an IET troubleshooting table, component identification figures, and wiring diagrams.

1. Whenever power is turned ON, the controller will perform a self-diagnostic test that takes approximately 2 seconds. If the test fails, a hexadecimal number will show in the 2-digit display and SELF will show in the 4-digit display. Should this “failed” condition occur, the Regulator board may be defective.
2. Table 8-1 lists the possible cause of an IET and gives the recommended action to eliminate the problem. If a code appears on the 2-digit and/or the 4-digit display that is not listed in Table 8-1, the Regulator Board is most likely defective and should be replaced.
3. Figure 8-1 identifies typical electrical components mounted behind the Regulator carrier section. Refer to Tables 8-2 through 8-9 for the replacement part numbers of these components.
4. Refer to the wiring diagram as necessary (Figures 8-2 and 8-3).

Helpful Reminders:

1. When an IET occurs, the IET relay energizes and the motor coasts to rest. The 4-digit display simultaneously will show the IET code of the first fault causing the IET.
2. To view the last three causes of an IET, make sure the controller is in the STOP mode; then press the MON key. Use the ▲ and ▼ keys to scroll through the last three IET causes.
3. The controller cannot start until the fault is cleared and the controller is reset. Press the STOP/RESET key to reset the controller.
4. To clear any stored IET fault history from controller memory:
   - An IET code must be showing on the 4-digit display.
   - Press and hold in the STOP key until “0000” shows on the 4-digit display (approximately 3 seconds).
5. The controller cannot be configured unless the Program jumper is in the J5 position. See Figure 3-4.

Troubleshooting Procedure

1. Check the 4-digit display for the following:
   - If an IET code displays, proceed to Table 8-1 for the possible IET cause and the action to take.
   - Clear the fault.
   - Reset the controller by pressing the STOP/RESET key.
   - Restart the controller. If the controller does not start, proceed to Step 2.
2. Turn the power OFF.

DANGER

THIS EQUIPMENT IS AT LINE VOLTAGE WHEN A-C POWER IS CONNECTED TO THE CONTROLLER. DISCONNECT ALL UNGROUNDED CONDUCTORS OF THE A-C POWER LINE FROM THE CONTROLLER. AFTER POWER IS REMOVED, VERIFY WITH A VOLTMETER AT TERMINALS 147(+) AND 45(−) THAT THE D-C BUS CAPACITOR(S) IS DISCHARGED BEFORE TOUCHING ANY INTERNAL PARTS OF THE CONTROLLER. FAILURE TO OBSERVE THESE PRECAUTIONS COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

3. Verify that the input voltage is within 10% of the controller nameplate rating. If voltage is not within this range, apply the correct input voltage or add a transformer.
4. Make a complete physical inspection of all control and motor wiring. Check that connections are tight. Using Figures 8-2 (and 8-3 if bypass is installed), verify that the drive is wired correctly.
5. Verify that wiring was installed according to the NEC and all local codes.
6. Check for ground faults and shorts.
7. Verify that service conditions are met. See ***Section 2 "Service Conditions"***.
8. Individually check that nearby relays, solenoids, brake coils, etc., are not causing electrical noise. Suppress any device that is inducing noise in the equipment.
9. With the motor connected to the controller and the motor uncoupled from the load if possible, verify that the motor will run.

DANGER

SUBSEQUENT STEPS MAY REQUIRE ROTATING PARTS AND/OR ELECTRICAL CIRCUITS TO BE EXPOSED. STAY CLEAR IF UNIT MUST BE RUNNING OR DISCONNECT AND LOCKOUT OR TAG POWER SOURCE IF CONTACT MUST BE MADE. FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN SEVERE BODILY INJURY OR LOSS OF LIFE.

- If the motor runs, the problem could be the wrong controller for the application. Contact Reliance Electric.
- If the motor does not run, disconnect the motor from the controller. Reconnect the motor to an external line and start the motor. If the motor still does not run, the motor may be defective and should be checked.

10. With the motor connected to the controller, verify that the controller will operate under LOCAL Control. Place the controller under LOCAL Control (Function 0, Set to "0") and press the START key.
    - If the controller operates correctly, the problem could be a faulty process control signal or Remote Control Station, if used.
    - If the controller does not operate correctly, the problem could be misadjusted controller functions.
11. Verify the controller is adjusted properly. Record the adjustment settings and then return the controller to the initial factory settings. See Table 9-2. If possible, disconnect the motor from the controller. With the controller in LOCAL Control, press the START key.
    - If the controller operates correctly with the initial settings, your controller was misadjusted. Readjust the controller as necessary.

Table 8-1. Troubleshooting IETs.

IET Code	Type of IET	Possible Cause	Action
HU	High Bus Voltage	Input voltage too high Deceleration time too short	• Check input voltage. If incorrect, add transformer (see Section 3). • Increase deceleration time. • Install DB kit.
LU	Low Bus Voltage	Input voltage too low	• Check input voltage. If incorrect, add transformer (see Section 3). • Check D-C bus voltage. (See Table 5-1) If incorrect, possible diode cube problem.
OC-A	Overcurrent−A	Acceleration time too short Momentary overload Torque boost or V/Hz too high	• Increase acceleration time. • Check for motor overload; reduce load on motor. • Adjust torque boost (Function 7) or V/Hz (Function 11).
OC-d	Overcurrent−D	Deceleration time too short	• Increase deceleration time.
OC-G	Overcurrent−G	Output line-to-ground	• Check isolation between ground and output terminals. Remove any grounds. • Possible leakage current sensor problem.
OC	Overcurrent	Output line-to-line Bus voltage line-to-line Momentary overload Torque boost or V/Hz too high	• Check isolation among each output line. Correct as necessary. • Check the transistor module for correct output. If incorrect, possible PS&BD board problem. • Possible Hall Effect current sensor problem. • Check for motor overload; reduce load on motor. • Adjust torque boost (Function 7) or V/Hz (Function 11).
OL	Overload	Internal thermal overload	• Reduce load on motor. • Reduce torque boost (Function 7).
OH	Overheat	Cooling fan fault	• Check cooling fan; correct as necessary. • Check the precharge relay.
LdlP	Line dip	A-C power supply interrupt	• Check input voltage. If incorrect, install appropriate A-C reactor in input line.
CPU	CPU error	Microprocessor logic error	• Turn power OFF for about 10 seconds, then turn power ON. • If not corrected, possible Regulator board problem.
Err1	Error 1	Memory error	• Turn power OFF for about 10 seconds, then turn power ON. • If error not corrected, scroll function list for incorrect parameter (− − − − in 4-digit display); readjust parameter. • If no parameter shows − − − −, possible Regulator board problem.
Err2	Error 2	Start/Stop or Run regulator circuit fault (during Remote Control operation only).	• Possible Regulator board problem.
FL	Function Loss	Function loss input is open (0VDC) (Function 32, parameter 0)	• Check external interlocks connected at terminals 11−12 (TB11); correct as necessary. • Check for external short circuit between terminals 11−19 (TB11); correct as necessary. For Bypass, check TB21, 3 & 4.
CS	Coast Stop	Function loss input is open (0VDC) (Function 32, parameter 1)	• Check external interlocks connected at terminals 11−12; correct as necessary. (Note: Controller will start with START key after cause of function loss is removed.) • Check for external short circuit between terminals 11−19; correct as necessary. • Check inverter/bypass selector switch position if bypass option is included. • Check that inverter contactor is picked up. • Check overload relay. For Bypass, check TB21, 3 & 4.
OP CF	1SC4000 Fault	Rail Interface Card Fault	• Refer to 1SC4000 Instruction Sheet (D2-3170).

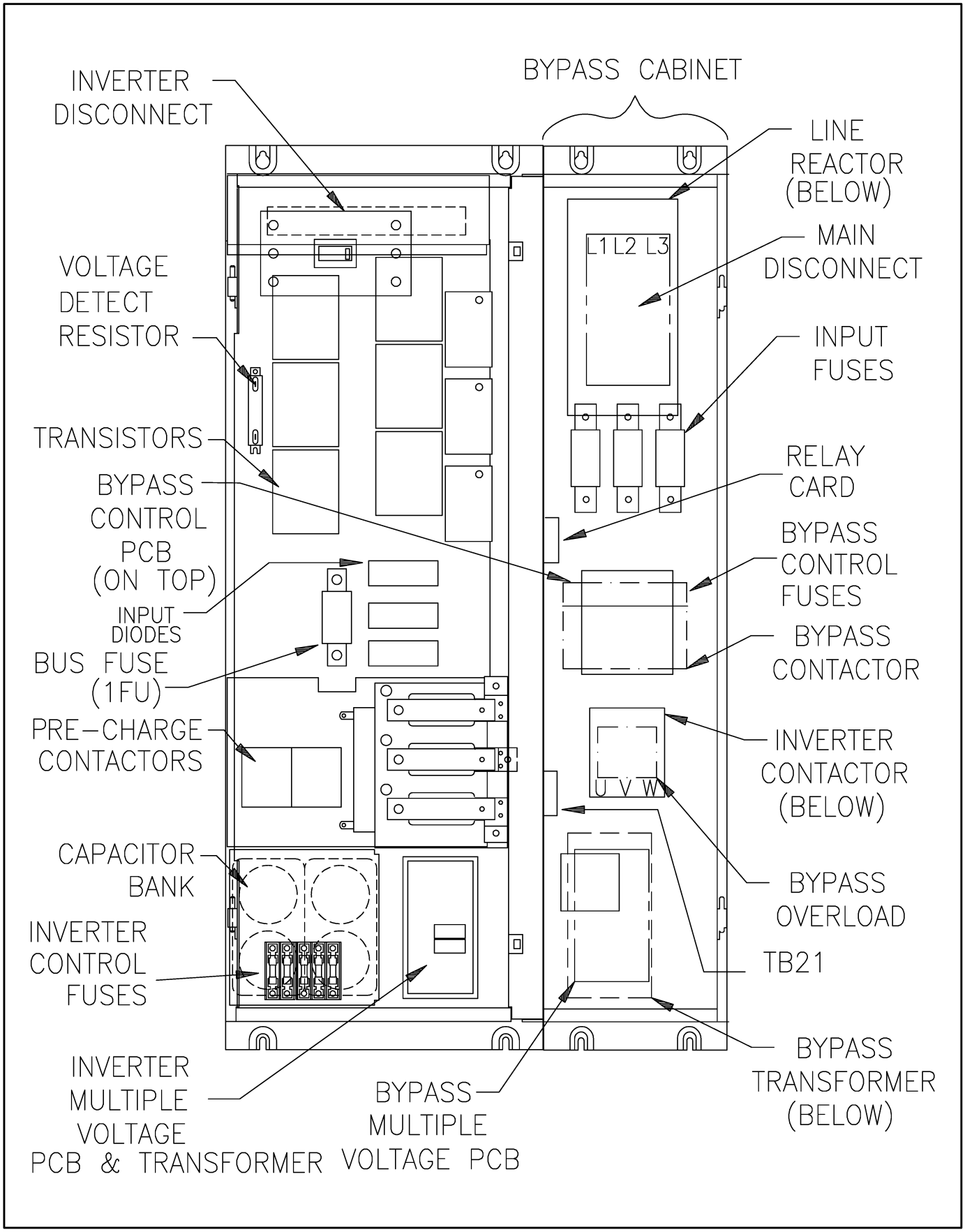


Figure 8-1. Typical Component Identification, Inverter and Bypass (50–100 HP, 208–575 VAC).

Table 8-2. Replacement Parts List, 208 VAC.

Description	Quantity	Part Number
Input Diode Module	3	701819-109AY
Transistor Module	6	602909-125AW
D-C Bus Capacitor	4	600442-26SV
Precharge Relay	2	705310-32M
Precharge Resistor	1	63481-11S
Voltage Detect Resistor	1	63481-102TFB
D-C Bus Fuse	1	64676-130AZX(1)
Regulator Board	1	0-48680-117
Fan	2	69739-9S
Ground Fault Sensor	1	64670-35R
Bus Clamp Assembly	3	0-55325-85
Transistor-Plug In Diode Assembly	6	611899-82S
Transistor-Plug in Capacitor Assembly	6	612182-27R
Base Driver	1	0-55325-84
Keypad Assembly	1	612180-801R
Discharge Resistor	2	63481-6AY
Maps Power Supply	1	0-48680-215
Inverter Multiple Voltage Board	1	0-55325-82
Control Fuses (2FU,3FU)	2	64676-64G(2)
Control Fuses (6FU,7FU,8FU)	3	64676-64K(3)
Control Fuse 4FU, 5FU	2	64676-71E(4)
Control Fuse 9FU	1	64676-71Q(5)
Hall Current Sensors	3	600595-16BC (For 208V, 40HP Drives)
Hall Current Sensors	3	600595-16BB (For 208V, 30HP Drives)
Hall Current Sensors	3	600595-13BA (For 208V, 25HP Drives)
Hall Current Sensors	3	600595-13AD (For 208V, 20HP Drives)
Inverter Thermostat	2	66012-11H
Diode Assembly	1	611899-5S
Precharge Capacitor Assembly	1	612182-1R
Transformer Assembly	1	411027-123R
Control Signal Buffer Board	1	0-55325-81
Coast-Stop Switch	1	610281-12R

(1) 700V, 300A (Brush Semiconductor Fuse)
(2) 600V, 2A (Littelfuse, Type KLDR Class CC, Rejection)
(3) 600V, 4A (Littelfuse, Type KLDR Class CC, Rejection)
(4) 250/125V, 0.5A (Littelfuse Type 239, or Bussman Type GMC, Slow Blow, 5 x 20 mm glass fuse)
(5) 250/125V, 3A (Littelfuse Type 239 or Bussman Type GMC, Slow Blow, 5 x 20 mm glass fuse)

Table 8-3. Replacement Parts List, 230 VAC.

Description	Quantity	Part Number
Input Diode Module	3	701819-109AY
Transistor Module	6	602909-125AW
D-C Bus Capacitor	4	600442-26SV
Precharge Relay	2	705310-32M
Precharge Resistor	1	63481-11S
Voltage Detect Resistor	1	63481-102TFB
D-C Bus Fuse	1	64676-130AZX(1)
Regulator Board	1	0-48680-117
Fan	2	69739-9S
Ground Fault Sensor	1	64670-35R
Bus Clamp Assembly	3	0-55325-85
Transistor-Plug In Diode Assembly	6	611899-82S
Transistor-Plug in Capacitor Assembly	6	612182-27R
Base Driver	1	0-55325-84
Keypad Assembly	1	612180-801R
Discharge Resistor	2	63481-6AY
Maps Power Supply	1	0-48680-215
Inverter Multiple Voltage Board	1	0-55325-82
Control Fuses (2FU,3FU)	2	64676-64G(2)
Control Fuses (6FU,7FU,8FU)	3	64676-64K(3)
Control Fuse 4FU, 5FU	2	64676-71E(4)
Control Fuse 9FU	1	64676-71Q(5)
Hall Current Sensors	3	600595-16BB (For 230V, 40HP Drives)
Hall Current Sensors	3	600595-16BA (For 230V, 30HP Drives)
Hall Current Sensors	3	600595-13AD (For 230V, 25HP Drives)
Inverter Thermostat	2	66012-11H
Diode Assembly	1	611899-5S
Precharge Capacitor Assembly	1	612182-1R
Transformer Assembly	1	411027-123R
Control Signal Buffer Board	1	0-55325-81
Coast-Stop Switch	1	610281-12R

(1) 700V, 300A (Brush Semiconductor Fuse)
(2) 600V, 2A (Littelfuse, Type KLDR Class CC, Rejection)
(3) 600V, 4A (Littelfuse, Type KLDR Class CC, Rejection)
(4) 250/125V, 0.5A (Littelfuse Type 239, or Bussman Type GMC, Slow Blow, 5 x 20 mm glass fuse)
(5) 250/125V, 3A (Littelfuse Type 239 or Bussman Type GMC, Slow Blow, 5 x 20 mm glass fuse)

Table 8-4. Replacement Parts List, 380 VAC.

Description	Quantity	Part Number
Input Diode Module	3	701819-109AY
Transistor Module	6	602909-125AW
D-C Bus Capacitor	4	600442-26SV
Precharge Relay	2	705310-32M
Precharge Resistor	1	63481-11S
Voltage Detect Resistor	1	63481-102TFB
D-C Bus Fuse	1	64676-130AZX(1)
Regulator Board	1	0-48680-117
Fan	2	69739-9S
Ground Fault Sensor	1	64670-35R
Bus Clamp Assembly	3	0-55325-85
Transistor-Plug In Diode Assembly	6	611899-82S
Transistor-Plug in Capacitor Assembly	6	612182-27R
Base Driver	1	0-55325-84
Keypad Assembly	1	612180-801R
Discharge Resistor	2	63481-6AY
Maps Power Supply	1	0-48680-213
Inverter Multiple Voltage Board	1	0-55325-80
Control Fuses (2FU,3FU)	2	64676-64G(2)
Control Fuses (6FU,7FU,8FU)	3	64676-64G(3)
Control Fuse 4FU, 5FU	2	64676-71E(4)
Control Fuse 9FU	1	64676-71Q(5)
Hall Current Sensors	3	600595-16BC (For 380V, 55KW Drives)
Hall Current Sensors	3	600595-16BB (For 380V, 45KW Drives)
Hall Current Sensors	3	600595-13AD (For 380V, 30KW Drives)
Inverter Thermostat	2	66012-11H
Diode Assembly	1	611899-5S
Precharge Capacitor Assembly	1	612182-1R
Transformer Assembly	1	411027-123S
Control Signal Buffer Board	1	0-55325-81
Coast-Stop Switch	1	610281-12R

(1) 700V, 300A (Brush Semiconductor Fuse)
(2) 600V, 2A (Littelfuse, Type KLDR Class CC, Rejection)
(3) 600V, 4A (Littelfuse, Type KLDR Class CC, Rejection)
(4) 250/125V, 0.5A (Littelfuse Type 239, or Bussman Type GMC, Slow Blow, 5 x 20 mm glass fuse)
(5) 250/125V, 3A (Littelfuse Type 239 or Bussman Type GMC, Slow Blow, 5 x 20 mm glass fuse)

Table 8-5. Replacement Parts List, 415 VAC.

Description	Quantity	Part Number
Input Diode Module	3	701819-109AY
Transistor Module	6	602909-125AW
D-C Bus Capacitor	4	600442-26SV
Precharge Relay	2	705310-32M
Precharge Resistor	1	63481-11S
Voltage Detect Resistor	1	63481-102TFB
D-C Bus Fuse	1	64676-130AZX(1)
Regulator Board	1	0-48680-117
Fan	2	69739-9S
Ground Fault Sensor	1	64670-35R
Bus Clamp Assembly	3	0-55325-85
Transistor-Plug In Diode Assembly	6	611899-82S
Transistor-Plug in Capacitor Assembly	6	612182-27R
Base Driver	1	0-55325-84
Keypad Assembly	1	612180-801R
Discharge Resistor	2	63481-6AY
Maps Power Supply	1	0-48680-213
Inverter Multiple Voltage Board	1	0-55325-80
Control Fuses (2FU,3FU)	2	64676-64G(2)
Control Fuses (6FU,7FU,8FU)	3	64676-64G(3)
Control Fuse 4FU, 5FU	2	64676-71E(4)
Control Fuse 9FU	1	64676-71Q(5)
Hall Current Sensors	3	600595-16BC (For 415V, 55KW Drives)
Hall Current Sensors	3	600595-16BB (For 415V, 45KW Drives)
Hall Current Sensors	3	600595-13AD (For 415V, 30KW Drives)
Inverter Thermostat	2	66012-11H
Diode Assembly	1	611899-5S
Precharge Capacitor Assembly	1	612182-1R
Transformer Assembly	1	411027-123S
Control Signal Buffer Board	1	0-55325-81
Coast-Stop Switch	1	610281-12R

(1) 700V, 300A (Brush Semiconductor Fuse)
(2) 600V, 2A (Littelfuse, Type KLDR Class CC, Rejection)
(3) 600V, 4A (Littelfuse, Type KLDR Class CC, Rejection)
(4) 250/125V, 0.5A (Littelfuse Type 239, or Bussman Type GMC, Slow Blow, 5 x 20 mm glass fuse)
(5) 250/125V, 3A (Littelfuse Type 239 or Bussman Type GMC, Slow Blow, 5 x 20 mm glass fuse)

Table 8-6. Replacement Parts List, 460 VAC.

Description	Quantity	Part Number
Input Diode Module	3	701819-109AY
Transistor Module	6	602909-125AW
D-C Bus Capacitor	4	600442-26SV
Precharge Relay	2	705310-32M
Precharge Resistor	1	63481-11S
Voltage Detect Resistor	1	63481-102TFB
D-C Bus Fuse	1	64676-130AZX(1)
Regulator Board	1	0-48680-117
Fan	2	69739-9S
Ground Fault Sensor	1	64670-35R
Bus Clamp Assembly	3	0-55325-85
Transistor-Plug In Diode Assembly	6	611899-82S
Transistor-Plug in Capacitor Assembly	6	612182-27R
Base Driver	1	0-55325-84
Keypad Assembly	1	612180-801R
Discharge Resistor	2	63481-6AY
Maps Power Supply	1	0-48680-213
Inverter Multiple Voltage Board	1	0-55325-80
Control Fuses (2FU,3FU)	2	64676-64G(2)
Control Fuses (6FU,7FU,8FU)	3	64676-64G(3)
Control Fuse 4FU, 5FU	2	64676-71E(4)
Control Fuse 9FU	1	64676-71Q(5)
Hall Current Sensors	3	600595-16BC (For 460V, 100HP Drives)
Hall Current Sensors	3	600595-16BB (For 460V, 75HP Drives)
Hall Current Sensors	3	600595-13BA (For 460V, 60HP Drives)
Hall Current Sensors	3	600595-13AD (For 460V, 50HP Drives)
Inverter Thermostat	2	66012-11H
Diode Assembly	1	611899-5S
Precharge Capacitor Assembly	1	612182-1R
Transformer Assembly	1	411027-123S
Control Signal Buffer Board	1	0-55325-81
Coast-Stop Switch	1	610281-12R

(1) 700V, 300A (Brush Semiconductor Fuse)
(2) 600V, 2A (Littelfuse, Type KLDR Class CC, Rejection)
(3) 600V, 4A (Littelfuse, Type KLDR Class CC, Rejection)
(4) 250/125V, 0.5A (Littelfuse Type 239, or Bussman Type GMC, Slow Blow, 5 x 20 mm glass fuse)
(5) 250/125V, 3A (Littelfuse Type 239 or Bussman Type GMC, Slow Blow, 5 x 20 mm glass fuse)

Table 8-7. Replacement Parts List, 575 VAC.

Description	Quantity	Part Number
Input Diode Module	3	701819-109AY
Transistor Module	6	602909-125AW
D-C Bus Capacitor	4	600442-28SV
Precharge Relay	2	705310-32M
Precharge Resistor	1	63481-11S
Voltage Detect Resistor	1	63481-102TFB
D-C Bus Fuse	1	64676-140AZX(1)
Regulator Board	1	0-48680-117
Fan	2	69739-9S
Fan Resistor	1	63481-6Q
Ground Fault Sensor	1	64670-35R
Bus Clamp Assembly	3	0-55325-85
Transistor-Plug In Diode Assembly	6	611899-82S
Transistor-Plug in Capacitor Assembly	6	612182-27S
Base Driver	1	0-55325-84
Keypad Assembly	1	612180-801R
Discharge Resistor	2	63481-6BB
Maps Power Supply	1	0-48680-216
Inverter Multiple Voltage Board	1	0-55325-83
Control Fuses (2FU,3FU, 6FU, 7FU, 8FU)	5	64676-64G(2)
Control Fuse 4FU, 5FU	2	64676-71E(3)
Control Fuse 9FU	1	64676-71Q(4)
Hall Current Sensors	3	600595-16BB (For 575V, 100HP Drives)
Hall Current Sensors	3	600595-13BA (For 575V, 75HP Drives)
Hall Current Sensors	3	600595-13AD (For 575V, 60HP Drives)
Hall Current Sensors	3	600595-13AC (For 575V, 50HP Drives)
Inverter Thermostat	2	66012-11H
Diode Assembly	1	611899-5S
Precharge Capacitor Assembly	1	612182-1R
Transformer Assembly	1	411027-123T
Control Signal Buffer Board	1	0-55325-81
Coast-Stop Switch	1	610281-12R

(1) 1000V, 300A (Brush Semiconductor Fuse)
(2) 600V, 2A (Littelfuse, Type KLDR Class CC, Rejection)
(3) 250/125V, 0.5A (Littelfuse Type 239, or Bussman Type GMC, Slow Blow, 5 x 20 mm glass fuse)
(4) 250/125V, 3A (Littelfuse Type 239 or Bussman Type GMC, Slow Blow, 5 x 20 mm glass fuse)

Table 8-8. Bypass Replacement Parts List (208 VAC – 575 VAC).

Input Voltage/HP	Description	Quantity per Controller	Part Number
ALL	Transformer Assembly	1	411027-124R
ALL	Main Input Disconnect (Bypass Section)	1	65242-200ZSX
ALL	Inverter Disconnect (Inverter Section)	1	65242-200ZSX
ALL	Input Reactor	1	608895-55J
ALL*	Input Fuses (20FU, 21FU, 22FU)	3	64676-75BC
575/50/60 HP	Input Fuses	3	64676-75AZ
ALL	Bypass Control Board	1	0-55325-78
ALL	Multiple Voltage Board	1	0-55325-79
ALL	Fuse (18FU)	1	64676-71E
ALL	Fuse (15FU, 16FU, 17FU)	3	64676-64G
ALL	Inverter Contactor	1	705310-57AD
ALL	Fuse (23FU)	1	64676-54W
ALL	Bypass Contactor	1	705310-58BD
575/60HP only	Overload Relay (1) See Table	1	64427-19CB
ALL/60HP	Overload Relay (2) See Table	1	64427-19DB
ALL/75HP	Overload Relay (3) See Table	1	64427-20B
ALL/100HP	Overload Relay (4) See Table	1	64427-20C
ALL	Diode Bridge	2	701819-12AD
ALL	Capacitor	1	600442-17A
ALL	Resistor Assembly	1	612182-29R
ALL	Breter Switch	1	65242-7B

(1)	(2)
575V/50–60HP 415V/30KW 380V/30KW 208V/20HP	575V/75–75HP 460V/50–60HP 230V/25–30HP 208V/25HP
(3)	**(4)**
575V/100HP 460V/75HP 415V/45KW 380V/45KW 230V/40HP 208V/30HP	460V/100HP 415V/55 KW 380V/55KW 230V/50HP 208V/40HP

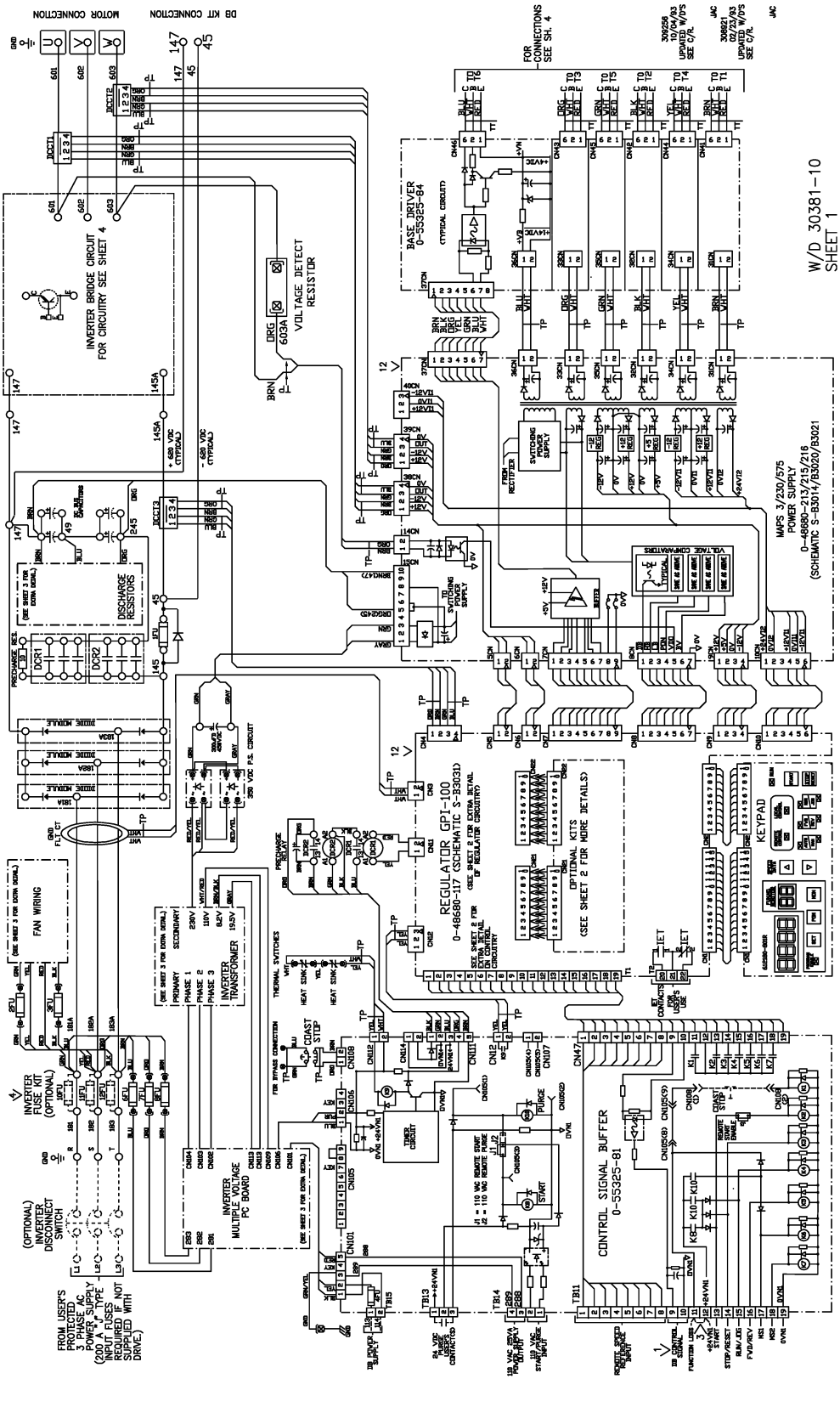


Figure 8-2. Typical Wiring Diagram (50−125 HP, 208−575 VAC). Sheet 1 of 5.

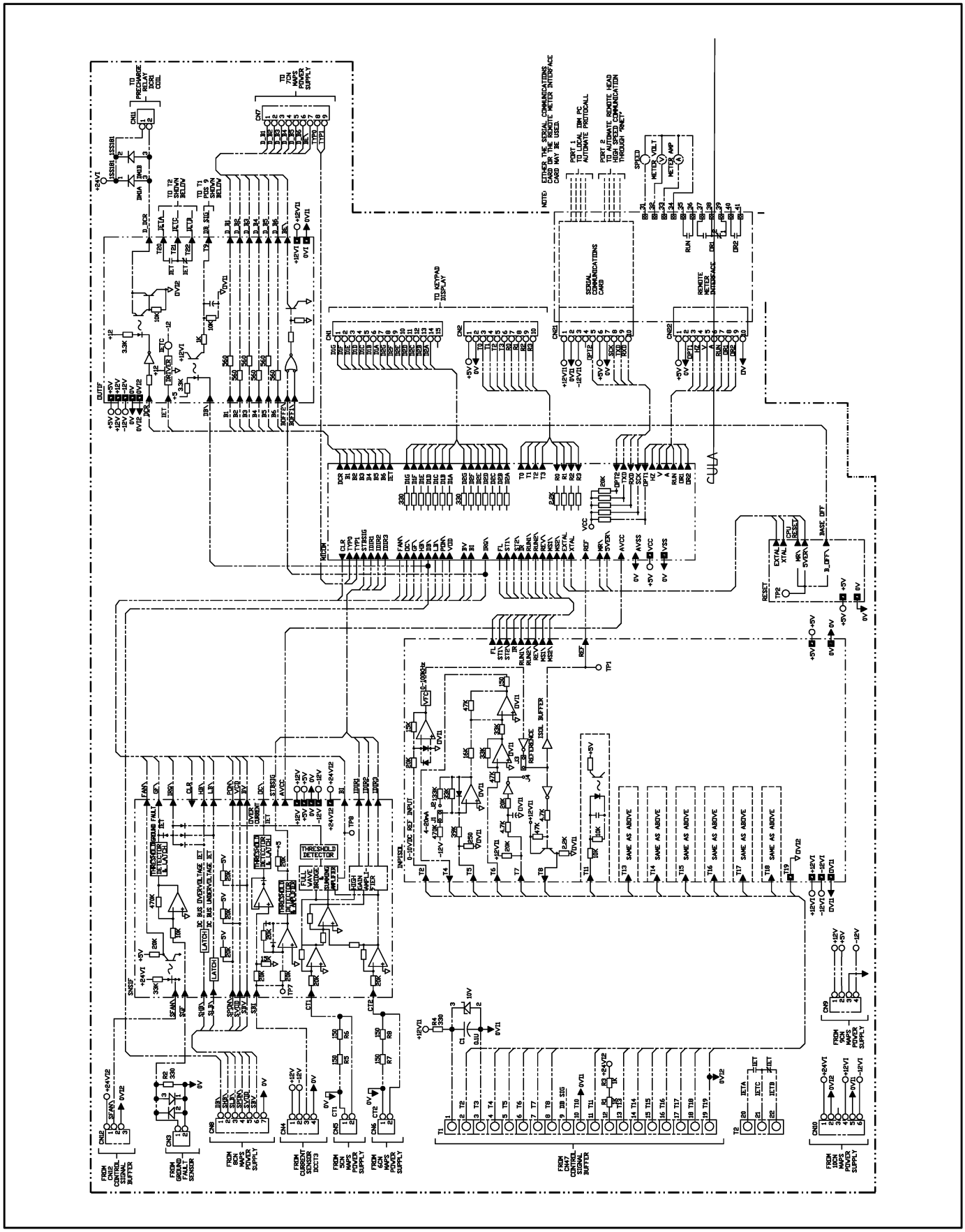


Figure 8-2. Typical Wiring Diagram (50−100 HP, 208−575 VAC). Sheet 2 of 5.

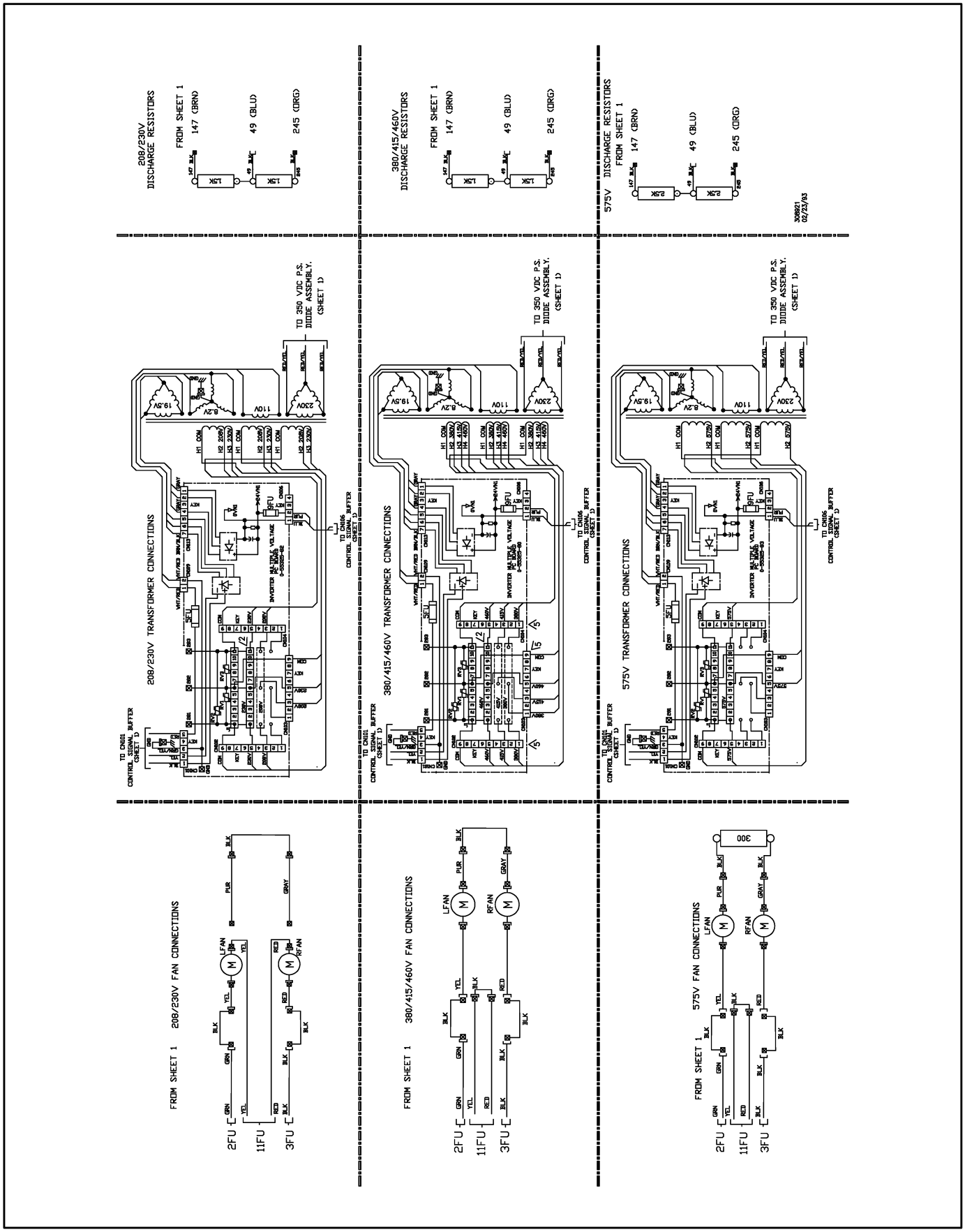


Figure 8-2. Typical Wiring Diagram (50−125 HP, 208−575 VAC). Sheet 3 of 5.

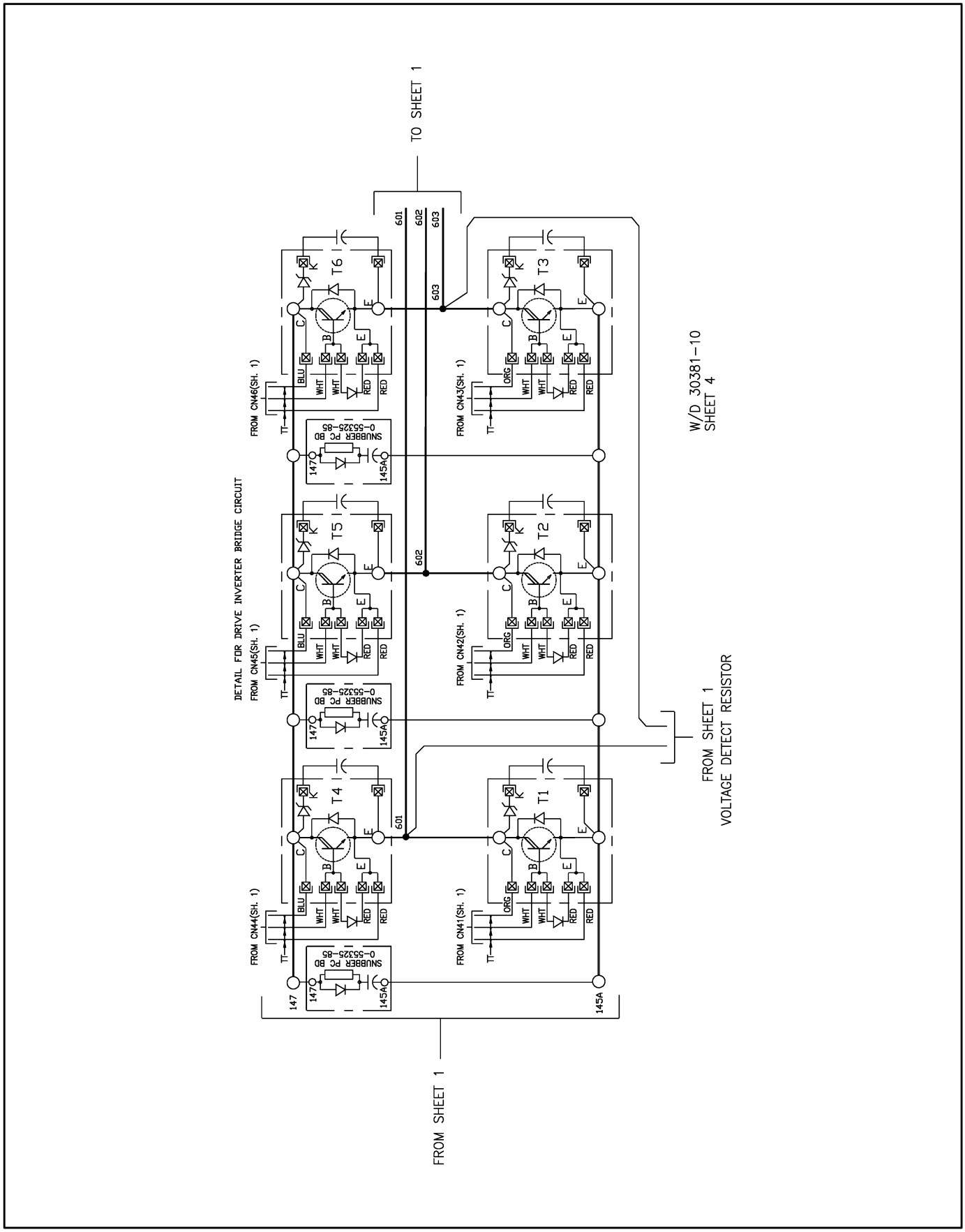


Figure 8-2. Typical Wiring Diagram (50−125 HP, 208−575 VAC). Sheet 4 of 5.

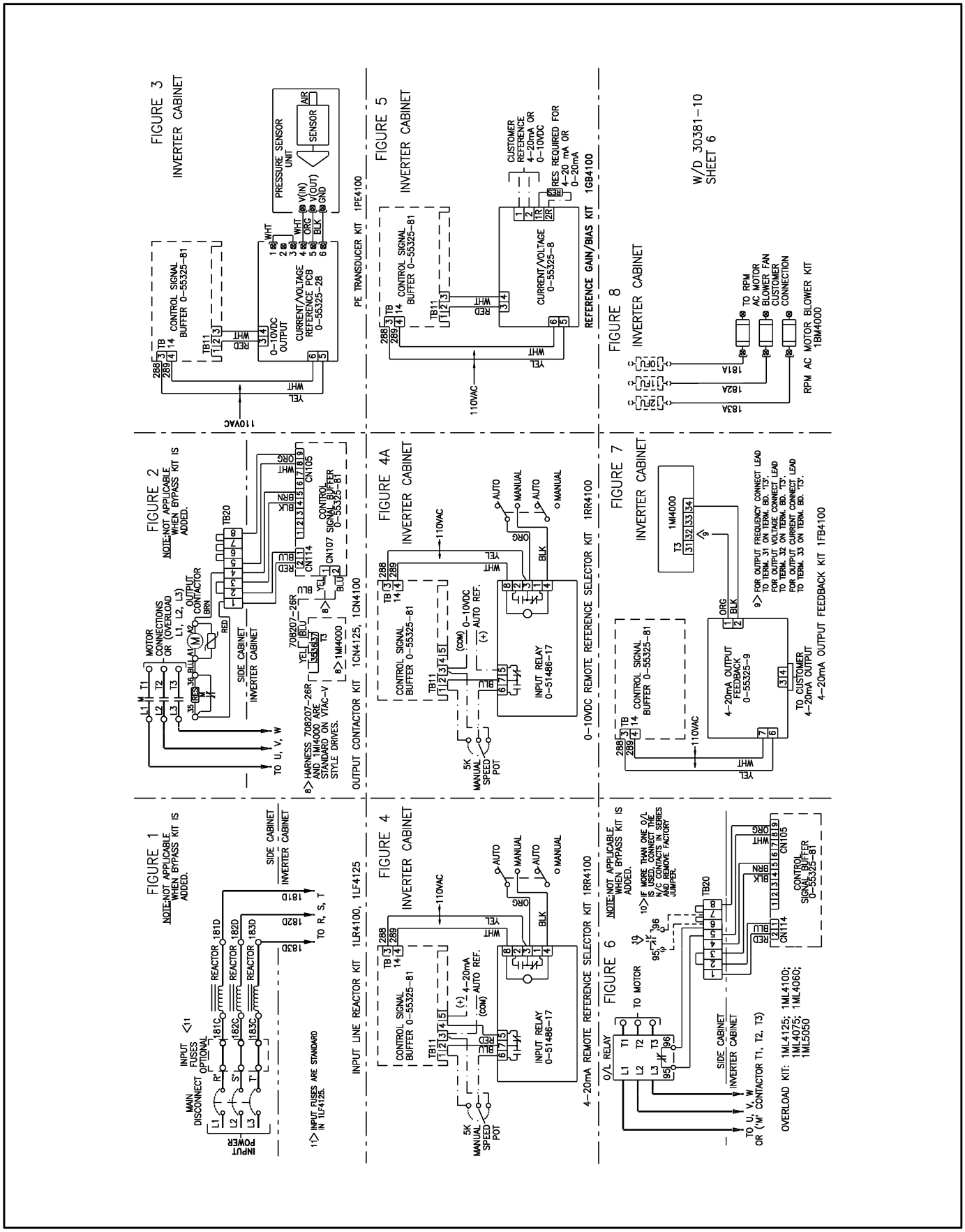


Figure 8-2. Typical Wiring Diagram (50−125 HP, 208−575 VAC). Sheet 5 of 5.

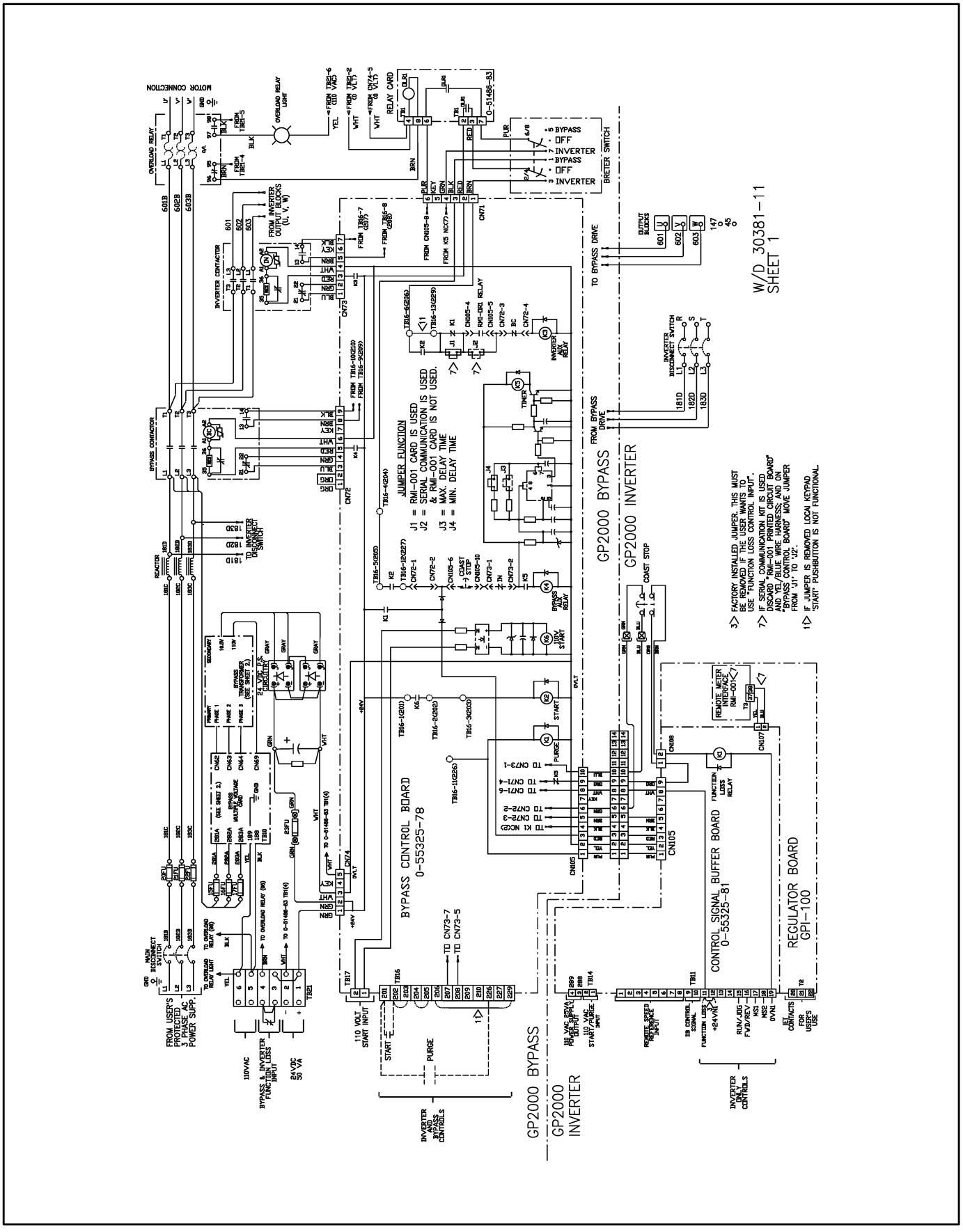


Figure 8-3. Typical Bypass Wiring Diagram, Sheet 1 of 2.

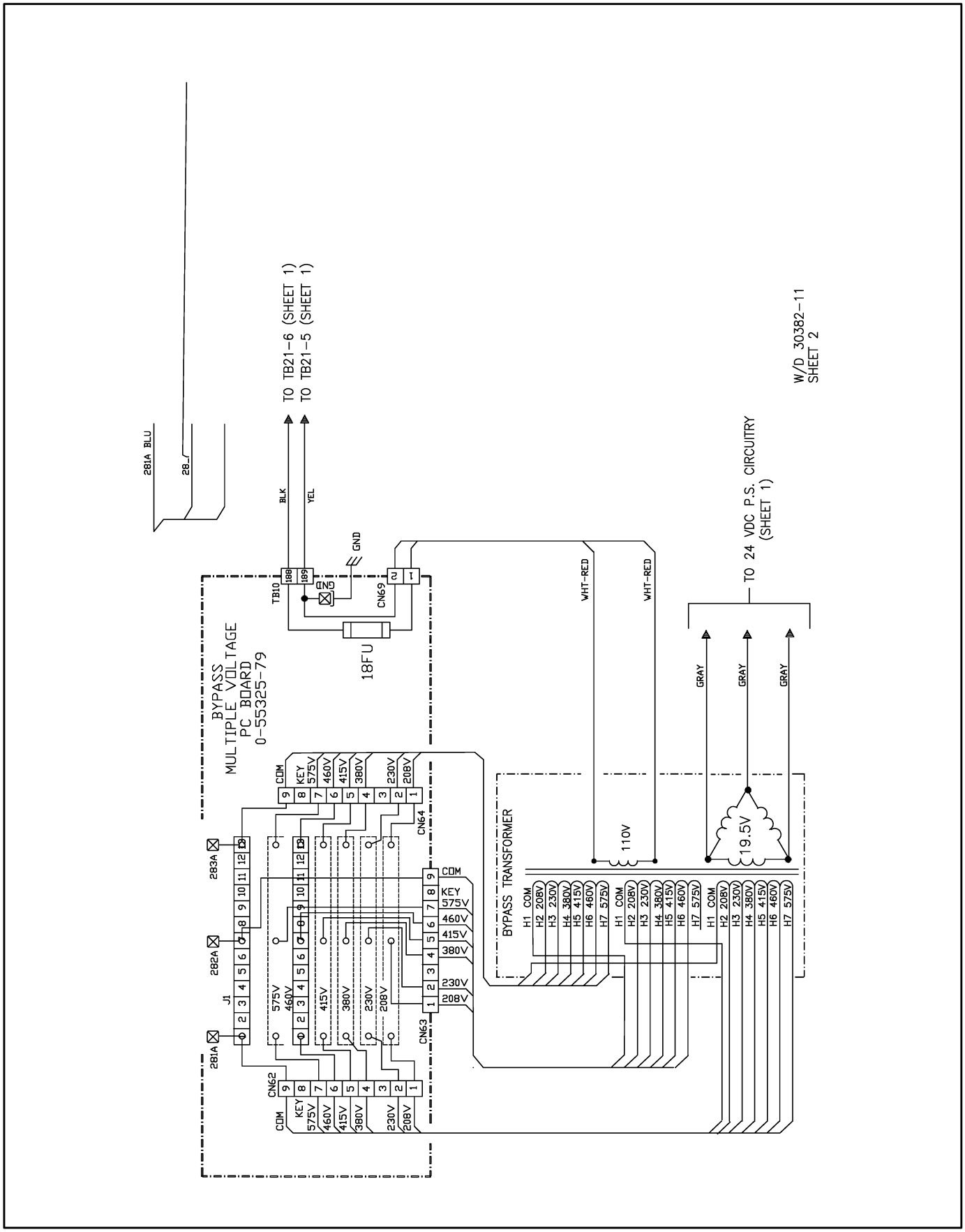


Figure 8-3. Typical Bypass Wiring Diagram, Sheet 2 of 2.

9: Quick Reference Guide

Controller Specifications

Table 9-1. Controller Ratings with Three-Phase Input Power.[1]

Controller Model Number	Controller 3-Phase Input Volts	Nominal HP/KW	Controller Input KVA	Input Amps @ Rated[2] Output Amps	Maximum Controller Output Amp
2GU01020	208	20	27	75	65
2GU01025	208	25	32	90	78
2GU01030	208	30	42	116	102
2GU01040	208	40	51	143	125
2GU21025	230	25[1]	30	75	65
2GU21030	230	30[1]	36	90	78
2GU21040	230	40[1]	46	116	102
2GU21050	230	50[1]	57	143	125
2GU31030	380	30 KW	50	75	65
2GU31045	380	45 KW	77	116	102
2GU31055	380	55 KW	94	143	125
2GU11030	415	30 KW	53	76	65
2GU11045	415	45 KW	84	116	102
2GU11055	415	55 KW	103	143	125
2GU41050	460	50	60	75	65
2GU41060	460	60	72	90	78
2GU41075	460	75	93	116	102
2GU41100	460	100	114	143	125
2GU51050	575	50	60	60	52
2GU51060	575	60	75	75	65
2GU51075	575	75	90	90	78
2GU51100	575	100	116	116	102

[1]Some manufacturers motor current ratings may exceed output current rating of controller. If so, size controller to next HP rating.

[2]Controller “Maximum” input amps are given for distribution systems which can supply short circuit current between 25,001 – 42,000 amps at the controller’s input terminals. For distribution systems below 25,001 amps, see Table 3-5.

Table 9-2. Record of User's Parameter Selections/Adjustments.

Function Number		Functional Descriptions	Parameter Selection/ Adjustment Range	Initial Factory Setting	User Data	
					Date	Setting
First Menu	0	Local/Remote Operation Control (Note: The Rail Interface Card is required with selection 2.)	0 = Local Control 1 = Remote Control/Terminal Strip 2 = Remote Control/I/O Port	0		
	1	Accel. Time (See Function 44)	5.0 – 360.0 Seconds	20.0		
	2	Decel. Time (See Function 45)	5.0 – 360.0 Seconds	20.0		
	3	Minimum Hz (See Function 43)	5.0 – 60 Hz	5.0		
	4	Maximum Hz (See Function 38)	15 – Overfrequency Limit	60.0		
	5	Current Limit	50 – 150% Current	150		
	6	Expand to Second Menu (First or Second Password Necessary)	0 = Basic (First Menu Only) 1 = Expand to Second Menu(16)	0		
Second Menu	7	Manual Torque Boost	0 – 10% Voltage	2		
	8	Jog Frequency	0.0 – 60.0 Hz (Note: The actual jog frequency automatically is limited between minimum Hz and maximum Hz.)	5.0		
	9	Stop Mode Selection	0 = Coast-to-rest 1 = Ramp-to-rest	0		
	10	Automatic Flux Control	0 – 5% Rated Voltage	0		
	11	Base Frequency Selection (Volts/Hz Ratio)	30.0 – 120.0 Hz	60.0		
	12	Electronic Thermal Overload Selection	0 = Normal Motor 1 = Forced Cooled Motor	0		
	13	Electronic Thermal Overload Level	20 – 100% Current	100		
	14	Linear/S-Curve Acceleration	0 = Linear Acceleration 1 = S-Curve Acceleration	0		
	15	Linear/S-Curve Deceleration	0 = Linear Deceleration 1 = S-Curve Deceleration	0		
	16	Multi-Speed Preset 1 MS1(3)	0.0 – 400.0 Hz (Note: The actual preset frequency automatically is limited between minimum Hz and maximum Hz.)	5.0		
	17	Multi-Speed Preset 2 MS2(3)		5.0		
	18	Multi-Speed Preset 3 MS3(3)		5.0		
	19	Avoidance Frequency 1 AF1	0.0 – 400.0 Hz (Note: The actual preset frequency automatically is limited between minimum Hz and maximum Hz.)	0.0		
	20	Avoidance Frequency 2 AF2		0.0		
	21	Avoidance Frequency 3 AF3		0.0		
	22	Avoidance Frequency Band AFB	0.2 – 10.0 Hz	0.2		
	23	Variable Torque Volts/Hz Curve Selection	0 = Constant Torque Curve 1 = Variable Torque Curve	0		
	24	D-C Braking Operation Time(4)	0.0 – 10.0 Seconds	0.0		
	25	D-C Braking Voltage(5)	0 – 20% Voltage	0		
	26	D-C Braking Start Frequency(5)	0.5 – 10.0 Hz	1.0		
	27	Line-Dip-Ride-Through	15 – 500 milliseconds	15		

Table 9-2. Record of User's Parameter Selections/Adjustments (Continued).

Function Number		Functional Descriptions	Parameter Selection/ Adjustment Range	Initial Factory Setting	User Data	
					Date	Setting
Second Menu (Cont.)	28	Output Relay 1 (Form C Contact) (Note: Requires the Remote Meter Interface Card.)	0 = Not Used 1 = Zero Speed Detect 2 = Input Contactor 3 = Output Contactor 4 = Frequency Level Detection 1	0		
	29	Output Relay 2 (Form A Contact) (Note: Requires the Remote Meter Interface Card.)	5 = Frequency Level Detection 2 6 = Current Level Detection 7 = Reverse Rotation 8 = D-C Braking Operation 9 = Reserved	0		
	30	Slip Compensation(6)	0.0 – 5.0 Hz	0.0		
	31	Inverse Reference(7) (Second Password Necessary)	0 = Normal 1 = Inverse	0		
	32	Function Loss Selection (Second Password Necessary)	0 = IET at Function Loss 1 = Coast-to-rest without an IET output at Function Loss	0(2) 1		
	33	Freq. Level Detection 1(8)	0.5 – 405.0 Hz	0.5		
	34	Freq. Level Detection 2(9)	0.5 – 405.0 Hz	0.5		
	35	Current Level Detection(10)	30 – 110% Current	100		
	36	Reverse Disable(11)	0 = Forward/Reverse Enable 1 = Reverse Disable on Keypad	0		
	37	Automatic (Process Control)(12) Disable on Local Control	0 = AUTO/MAN Key Enable 1 = AUTO Disable on Keypad	0		
	38	Overfrequency Limit (Second Password Necessary)	50.0 – 405.0 Hz	90.0		
	39	D-C Offset Enable(1) (Second Password Necessary)	0 = Offset Disable 1 = Offset Enable	0		
	40	Auto-restart Enable (Second Password Necessary)	0 = Auto-reset Disable 1 = Auto-reset Enable	0		
	41	Auto-restart Time(13)	0 – 10 Times	0		
	42	Auto-restart Interval Time(14)	1 – 60 Seconds	1		
	43	Extended Minimum Hz Range(1) (Second Password Necessary)	0 = Disable (5 – 60 Hz) 1 = Enable (0 – 60 Hz)	0		
	44	Extended Acceleration Time Range(1)	0 = 5.0 – 360.0 Seconds 1 = 0.1 – 360.0 Seconds	0		
	45	Extended Deceleration Time Range(1)	0 = 5.0 – 360.0 Seconds 1 = 0.1 – 360.0 Seconds	0		
	46	RPM Monitor Display Enable	0 = Disable 1 = Enable	0		
	47	RPM Monitor Range Selection (Second Password Necessary)	0 = 150 – 9999 RPM 1 = 0 – 9999 RPM	0		
	48	RPM Monitor Base Frequency Selection (See Function 47)	150 – 9999 RPM	1750		

(1) This function is settable in software to 500 ms, however, should not be changed for this controller.

(2) Parameter 32 is programmed with "1" when bypass option is added.

(3) Requires the Remote Meter Interface Card.

Table 9-2. Record of User's Parameter Selections/Adjustments (Continued).

Function Number	Functional Descriptions	Parameter Selection/ Adjustment Range	Initial Factory Setting	User Data	
				Date	Setting
Second Menu (Cont.) 49	Output Voltage Regulation Mode Selection (See Function 50)	0 = Proportional to input 1 = Fixed to Max Voltage	0		
50	Maximum Voltage	190.0 – 230.0(13) 380.0 – 460.0(14) 475 – 575(15)	230.0(13) 460.0(14) 575(15)		
51	Jog Acceleration Value	0.1 – 360.0 Seconds	20.0		
52	Jog Deceleration Value	0.1 – 360.0 Seconds	20.0		
53	Jog Acceleration Selection	0 = Linear Acceleration 1 = S-Curve Acceleration	0		
54	Jog Deceleration Selection	0 = Linear Deceleration 1 = S-Curve Deceleration	0		
55	Current Limit Deceleration Rate	0 – 100 Hz/Seconds	90		
56	Start into a Rotating Motor	0 = Enable 1 = Disable (Quick Start)	0		
57	MS Terminals Selection(15)	0 = Multi-Speed Preset 1 = Static MOP	0		

(3) Effective when "1" is selected in Function 0 and "1" is selected in Function 57.

(4) Effective when "1" is selected in Function 9.

(5) Ineffective when 0.0 is set in Function 24.

(6) Effective when "0" is selected in Function 39.

(7) Effective when "1" is selected in Function 0, or when "0" is selected in Function 0 while AUTO mode on keypad is selected.

(8) Effective when "4" is selected in Function 28 or 29.

(9) Effective when "5" is selected in Function 28 or 29.

(10) Effective when "6" is selected in Function 28 or 29.

(11) Effective when "0" is selected in Function 0.

(12) Effective when "0" is selected in Function 0.

(13) Effective when "1" is selected in Function 40.

(14) Ineffective when 0 is set in Function 41.

(15) Effective when "1" is selected in Function 0.

(16) First Password = 0306
Second Password = 1123

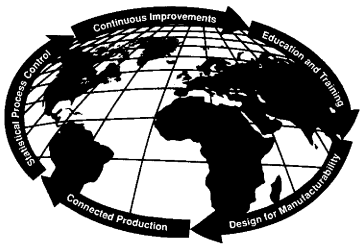
Index

T

V

W

Forward To: Reliance Electric – RGA
Technical Publications
25001 Tungsten Road
Cleveland, OH 44117



Technical Writing Internal Use:

DIF # _____

V★S DRIVES & INDUSTRIAL CONTROLS DOCUMENTATION IMPROVEMENT FORM

Document Number: _____

Page Number(s): _____

Comments: (Please give chapters, page numbers or specific paragraphs that the change will affect. Include markups from the document or attach additional pages if necessary.)

What will this improvement suggestion provide? _____

Originator: _____ City: _____ State: _____ ZIP: _____

Company: _____ Phone: (_____) _____

Address: _____ Date: _____

Technical Writing Internal Use:

Follow-Up Action:

Writer: _____ Date: _____

Thank you for your comments . . .

RELIANCE ELECTRIC

RE 1857LC1 Printed in U.S.A.

A-C DRIVES
TRAINING AND AUDIO/VISUAL PRODUCTS

Reliance Electric offers a wide variety of Industrial Training courses for electricians, electronic technicians and engineers who are responsible for the installation, repair and maintenance of production equipment and systems.

Professional quality A/V Programs are also available. These programs have been designed to provide years of efficient in-house training. Available for playback at the user's convenience, these videotape programs allow individual or groups to learn or review subjects at any time.

Printed reference materials come with all diagnostic and troubleshooting programs.

Training Courses

No.	Title
	A-C DRIVE COURSES
2-1	Maintenance and Troubleshooting of VVI Style Variable-Speed A-C Drives
2-5	Maintenance and Troubleshooting of PWM Style Variable-Speed A-C Drives
2-4	VVI/PWM A-C Drives Hands-On Troubleshooting Lab
2-7	Maintenance and Troubleshooting VCI A-C Inverters
2-8	Maintenance and Troubleshooting VGI A-C Inverters

Audio/Visual Products

Order No.	Title	Format	Price
	A-C DRIVES PROGRAMS		
TM2241	Introduction to the VVI	Videotape	**$725**
TM2242	Troubleshooting the VVI Regulator	Videotape	**995**
TM2367	Troubleshooting the 6-Transistor Power Module	Videotape	**725**
	VIDEO TRAINING PROGRAMS		
VMBA001	Fundamentals of A-C Motors	Videotape	**$495**
VMBV001	Concepts of Digital Controls	Videotape	**495**
VWVS001	GP2000 Video Training	Videotape	**495**
VWVS002	HR2000 Video Training	Videotape	**495**
VWVS005	Basics of A-C Drives	Videotape	**495**

For details and prices on these courses, audio/visual products and FREE Training Schedule Brochure, HD-405, contact:

Industrial Training Department
Reliance Electric
35000 Curtis Boulevard
Eastlake, Ohio 44095

Call Toll Free:

800-RELIANCE
(800-735-4262)

ZA-225b

Data or Prices subject to change without notice.

RELIANCE ELECTRIC

Reliance Electric / 24703 Euclid Avenue / Cleveland, Ohio 44117 / 216-266-7000

Printed in U.S.A. Instruction Manual D2-3217-2 December, 1993