



Installation, Operation and Maintenance Manual

Adjustable Frequency Drive

2001 and IPM 2001 Series

6/95

For parts, service and technical assistance during
normal working hours, call 414-355-8800
For technical assistance only after hours, call 414-964-5782

23-6090-00



Box 23880 / 8800 W. Bradley Road
Milwaukee, Wisconsin 53223-0880
Phone: 414/355-8800 Fax: 414/355-6117

DANGER

Rotating shafts and electrical equipment can be hazardous. Therefore, it is strongly recommended that all electrical work conform to the National Electrical Code and all local regulations. Installation, start-up and maintenance should be performed only by qualified personnel.

Factory recommended procedures, included in this manual, should be followed. Always disconnect electrical power before working on the unit.

Although shaft couplings or belt drives are generally not furnished by the manufacturer, rotating shafts, couplings and belts must be protected with securely mounted metal guards that are of sufficient thickness to provide protection against flying particles such as keys, bolts and coupling parts. Refer to OSHA Rules and Regulations paragraph 1910.219 for guards on mechanical power transmission apparatus. Even when the motor is stopped, it should be considered "alive" as long as its controller is energized. Keep hands away from the output shaft until the motor has completely stopped and power is disconnected from the controller.

Motor control equipment and electronic controls are connected to hazardous line voltages. When servicing drives and electronic controls, there will be exposed components at or above line potential. Extreme care should be taken to protect against shock. Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case of an emergency. Disconnect power whenever possible to check controls or to perform maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electronic control or rotating equipment.

Since improvements are continually being made, the enclosed data is subject to change without notice. Any drawings are for reference only, unless certified. For additional information contact Graham Company Service Department.

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GENERAL

This operation and maintenance manual provides the necessary installation, adjustment and maintenance procedures for the Graham 2001 Series adjustable frequency drives. Since these instructions are general, problems may occur which are beyond the scope of the manual. If further information is desired, please contact Graham Company for assistance. NOTE: As-built schematics and made to order equipment operation supersede the instructions in this manual.

Although every precaution has been taken in the design of the drive to ensure reliability under extreme operating conditions, it is possible to damage the equipment through misuse or misapplication. Therefore, this instruction manual should be carefully reviewed before installing and operating the equipment.

RECEIPT OF SHIPMENT

When the drive is received, it should be compared with the packing slip to be sure that everything is received. Any damages or shortages should be reported immediately to the carrier who transported the drive. If necessary, contact Graham for assistance, referring to the order number, equipment description and serial number.

STORAGE

For long periods of storage, the drive must be covered to prevent corrosion and contamination. It must be stored in a clean, dry location between -4°F (-20°C) and 140°F (+60°C). The relative humidity should not exceed 95%, non-condensing. The drive should be checked periodically to ensure that no condensation has formed. After storage, again check that it is dry before applying power.

Some of the electrolytic capacitors used in the drive are subject to the relaxation of an internal formed oxide film after long periods of storage and may require reforming prior to applying power. If the drive has been stored for over 18 months, Graham should be contacted for a determination as to whether a reforming procedure is necessary.

HANDLING

Care should be taken to prevent damage when moving the drive. The drive may be lifted by hand from the bottom and sides of the enclosure. If a hoist is to be used, secure a sling around the upper mounting

feet and lift carefully to ensure that the mounting feet, the enclosure and the rails that connect multiple enclosures (when used) do not bend.

⚠WARNING

DO NOT ATTEMPT TO LIFT OR SUPPORT THE DRIVE BY THE INTERNAL COMPONENTS.

SECTION 1. INSTALLATION

1.1 MOUNTING

The 2001 Series drives are all designed to be wall mounted. If they must be floor mounted, a floor stand can be supplied. Assemble the base struts of the floor stand to the vertical rectangular section struts using the support brackets supplied. The floor stand must be firmly anchored to the floor or wall for stability. Attach the drive to the vertical rectangular section struts using the spring loaded fasteners provided. Leave the enclosure closed and latched until it is time to wire the drive.

The following minimum clearances are recommended:

460 volt units	Amp Rating			
	thru 21	27 thru 52	65 thru 124	156 thru 180
230 volt units	thru 22	28 thru 42	54 thru 80	
208 volt units	thru 24.2	30.8 thru 46.2	59.4 thru 88	
To bottom of enclosure ¹	12"	12"	18"	18"
To right side of enclosure	6"	8"	10"	10"
To left side of enclosure	6"	8"	10"	10"
To top of enclosure	6"	6"	6"	6"
To front of enclosure	14"	19"	24"	37"
To back of enclosure	Mounting feet supply necessary clearance			

¹For ease of service and cleanliness, it is desirable to mount the drive at least 24" above the floor if space permits.

The current rating of the drive is shown on the name plate on the inside of the door.

These clearances are for access, air flow and conduit entry and must be maintained.

All conduit and wiring must enter through the top of the enclosure.

Do not remove the conduit entry plate during transportation or mounting. See Section 2 for details on wiring the drive.

1.2 TEMPERATURE AND VENTILATION

All electronic equipment is susceptible to failure if operated in ambient temperatures outside of its rating. The operating temperature range for this Graham drive is 0°C to 40°C (32°F to 104°F). The drive should not be operated outside these extremes.

1. If the ambient will be below 0°C, Graham should be notified so a space heater will be provided inside the enclosure.
2. If the ambient will exceed 40°C, a source of cooling will be required.
3. If the drive will be operated intermittently in cold and/or humid conditions, precautions must be taken to prevent condensation from forming when the drive is off. A thermostatically controlled temperature control should be installed to maintain acceptable temperature and moisture control. Consult Graham for further recommendations.
4. Do not mount in direct sunlight.

2001 Series drives are cooled by slots in the standard enclosure. The slots, including those on the back and or bottom of the unit, must never be restricted in any way. Many models also use fans to move air over the heatsink.

The slots in the standard enclosure were covered before shipping. Do not remove this material until the drives are installed and ready for start-up. If the drives must be started-up before all construction activity is complete, the drives must be protected from construction dust. All covering materials must be removed when operating the drive.

⚠ DANGER

FLAMMABLE MATERIALS MUST BE KEPT AWAY FROM THE ENCLOSURE.

Unless a special enclosure has been provided, these drives are to be used in a heated, indoor, controlled environment that is relatively free of moisture and conductive contaminants. The cooling air must be clean and free from corrosive materials. When necessary, the required cooling should be provided by using clean, dry air.

Periodically, the drive should be cleaned using a vacuum cleaner and a soft long bristled brush. Lightly brush the dust from the drive components with the brush and use the vacuum cleaner to remove the dust as it falls. If available, clean dry compressed air at a

maximum pressure of 50 psi (3.4 atmospheres) may be used to blow dust from the drive.

If the heatsink is not cleaned and it is not able to dissipate the heat, the heatsink temperature sensor will stop the drive with an over temperature fault.

⚠ WARNING

DO NOT USE A VACUUM CLEANER DIRECTLY ON THE ELECTRONIC COMPONENTS.

⚠ DANGER

ALWAYS REMOVE THE INCOMING POWER TO THE ENCLOSURE BEFORE OPENING THE DOOR. WAIT UNTIL THE "CHARGE ON BUS CAPS" LED ON THE POWER BOARD EXTINGUISHES BEFORE TOUCHING ANY INTERNAL COMPONENTS.

The "Charge on Bus Caps" LED is on the power board on the left side of the drive. It illuminates whenever there is a charge on the capacitors. The charge on the capacitors may be more than 600 V DC. When power is removed from the drive, the capacitors slowly discharge. When the LED is totally extinguished, the voltage has been reduced to a safe level.

⚠ DANGER

BEFORE TOUCHING ANY INTERNAL COMPONENTS, BE SURE THAT ALL POWER HAS BEEN REMOVED FROM THE DRIVE FOR AT LEAST TWO MINUTES AND THE CHARGE ON CAPS LED IS TOTALLY EXTINGUISHED.

SECTION 2 WIRING

2.1 INPUT VOLTAGE

The drive is designed for a specific input voltage. Check the drive nameplate for the proper input and output voltages before wiring the drive. The voltage tolerance is $\pm 10\%$ of the input voltage shown on the nameplate. Operation at any other voltage may damage the drive and will result in unsatisfactory operation.

2.2 GROUND CONNECTIONS

One of the ground terminals next to terminal strip TB10 or TB20 in the drive enclosure or 2TB10 or 2TB20 in the auxiliary enclosure must be used for a dedicated ground wire connection. All provisions of the National Electrical Code and local codes must be followed.

⚠WARNING

CONDUIT GROUND AND DAISY CHAIN GROUNDING ARE NOT ADEQUATE. COLD WATER PIPE CONNECTIONS ARE NOT ADEQUATE. A SEPARATE GROUNDING WIRE MUST BE RUN TO AVOID POSSIBLE ELECTRICAL NOISE PROBLEMS AND POTENTIAL SAFETY HAZARDS.

2.3 INPUT DISCONNECT AND INPUT FUSES

All drives except the IPM2001 models are normally supplied with semiconductor rated input fuses. The drive may be supplied with or without an input disconnect. Size fuses and input disconnects to handle the Drive Input Current rating shown on the nameplate or from the table on page 7. To protect the drive, fuses must be semiconductor rated.

2.4 ISOLATION TRANSFORMER

If an isolation transformer is used, size it from the table on page 7.

If an isolation transformer is used, the National Electrical Code requires that an input disconnect must be placed between the transformer secondary and the drive input.

⚠WARNING

DO NOT OPEN OR CLOSE ANY DISCONNECT ON THE PRIMARY SIDE OF THE TRANSFORMER UNTIL AFTER THE DISCONNECT ON THE SECONDARY SIDE IS OPENED. DOING THIS MAY DAMAGE THE DRIVE.

2.5 INPUT POWER WIRING

On drives without a second enclosure, input power wiring is always to terminal blocks TB10 through TB19, terminals L1, L2 and L3. On drives with one input, the terminal block will be TB10. On drives with multiple inputs, the terminal blocks will be TB10, TB11, etc.

On drives with two or more enclosures, the input power wiring is always to terminal blocks 2TB10 through 2TB19, terminals L1, L2 and L3 in the top enclosure. On drives with one input, the terminal block will be 2TB10. On drives with multiple inputs, the terminal blocks will be 2TB10, 2TB11, etc.

Input wire types and sizes must be selected based upon conformance with the National Electrical Code and all local codes and restrictions. See the table on page 7 for information for wire sizing.

2.6 OUTPUT POWER WIRING

Motor wiring is always to terminal blocks TB20 through TB29, terminals T1, T2 and T3 on drives without a second enclosure. On drives with one output, the terminal block will be TB20. On drives with multiple outputs, the terminal blocks will be TB20, TB21, etc.

On drives with two or more enclosures, the motor wiring is always to terminal block 2TB20 to 2TB29, terminals T1, T2 and T3 in the top enclosure. On drives with multiple outputs, the terminal blocks will be 2TB20, 2TB21, etc.

Motor wiring types and sizes must be selected based upon conformance with the National Electrical Code and all local codes and restrictions. See table on page 7 for information for wire sizing.

⚠WARNING

DO NOT CONNECT INPUT POWER TO THE MOTOR TERMINAL CONNECTIONS. SEVERE DAMAGE TO THE DRIVE WILL RESULT.

⚠ WARNING

DO NOT INSTALL MOTOR WIRING IN THE SAME CONDUIT OR RACEWAY WITH OTHER WIRING. IMPROPER INSTALLATION OF THE MOTOR WIRING CAN CAUSE ELECTRICAL NOISE IN THE POWER DISTRIBUTION WIRING.

2.7 OUTPUT/MOTOR DISCONNECT

It is recommended that any device which can disconnect the motor from the output of the drive be interlocked to the emergency shutdown circuits of the drive. This will provide an orderly shutdown if the disconnecting device is opened while the drive is in operation. A normally open contact from the disconnecting device should be wired as follows:

Drives with no line bypass circuit are wired to terminals 28 and 30 of TB1. Drives with a line bypass circuit are wired to terminals 1 and 2 of 2TB1.

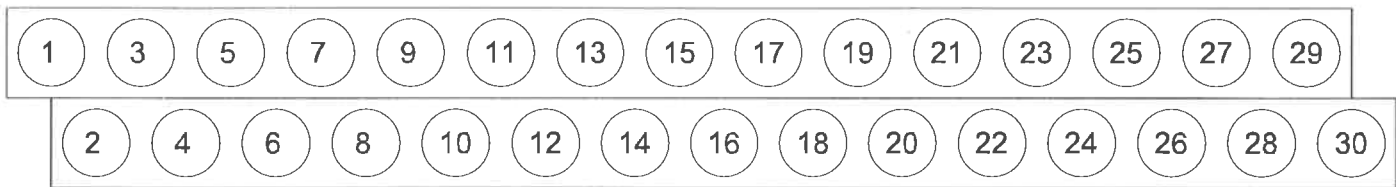
⚠ WARNING

CLOSING A MOTOR DISCONNECT SWITCH WHILE THE DRIVE IS RUNNING CAN CAUSE NUISANCE FAULT TRIPS.

2.8 CONDUIT ENTRY

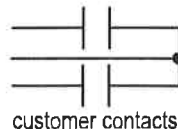
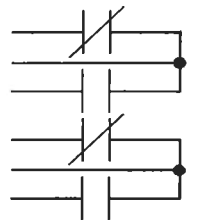
All 2001 Series drives are designed for conduit entry at the top of the enclosure. The 2001 Series drives have three removable conduit entry plates. They should be utilized as follows:

1. Mark the location of the conduit entries for input power and motor wiring on one conduit entry plate.
2. Mark the location of the wiring for the input signal on another conduit entry plate.
3. Mark the location of the wiring for the control system on the third conduit entry plate.
4. Remove the conduit entry plates.
5. Drill the conduit entry holes in the plates.
6. Reinstall the plates on the drive and make the connections to the plates.

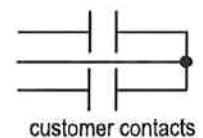


TB1 -- Located on top right of logic board

- 1 Fault N. C.
- 2 Fault Common
- 3 Fault N. O.
- 4 Run N. C.
- 5 Run Common
- 6 Run N. O.
- 7 4 to 20mA Speed Output
- 8 4 to 20mA Speed Common
- 9 4 to 20mA Speed & Load Shield
- 10 4 to 20mA Load Common
- 11 4 to 20mA Load Output
- 12 Run Input
- 13 Run/External Fault Return
- 14 External Fault Input



- 15 Preset Speed Input
- 16 Preset Speed/Reverse Return
- 17 Reverse Input
- 18 135 ohm Pot Source
- 19 4 to 20mA Signal Input
- 20 0 to 10V dc Signal Input
- 21 0 to 24V dc Signal Input
- 22 Signal Input Common
- 23 Signal Input Shield
- 24 Hand
- 25 Auto
- 26 Local
- 27 +24V, (MTO)
- 28 Interlock (MTO)
- 29 +24V, (MTO)
- 30 MTO Common



Not for customer use

Connections shown are for basic drive.

For drive with bypass, see the specific customer connection diagram that accompanies this manual.

Figure 1. Customer Connection Diagram, TB1

The IPM2001 models have a removable conduit plate with knockouts to accommodate 3/4" conduit fittings. The conduit plate can be removed from the drive by sliding it forward after removing the enclosure cover. Do not run power input and drive output wires in the same conduit.

⚠WARNING

DO NOT DRILL, SAW, FILE OR PERFORM ANY OPERATION ON THE DRIVE ENCLOSURE OR CONDUIT ENTRY PLATES WHILE THEY ARE ON THE DRIVE. METAL FILINGS AND OTHER FOREIGN MATERIALS WHICH CONTAMINATE THE DRIVE CAN CAUSE DAMAGE AND MAY VOID WARRANTY COVERAGES.

2.9 CONTROL CIRCUIT WIRING

Control circuit wiring connections (low voltage DC and 115 volt AC) are terminated on terminal strip TB1. See Figure 1. Shielded cable should be installed for all low voltage DC control signal wiring.

2.9.1 OUTPUT SIGNALS

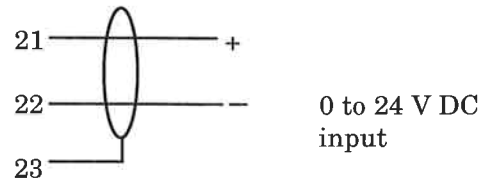
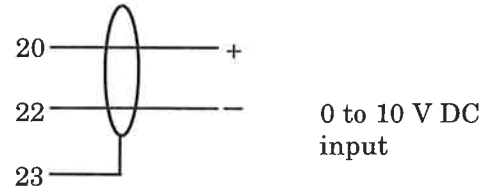
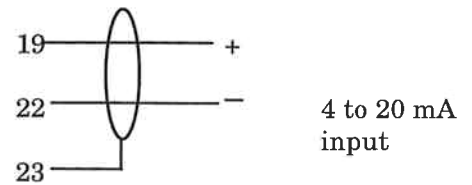
The drive can supply both a 4 to 20 mA speed output signal and a 4 to 20 mA load output signal from terminals 7 and 8, and 10 and 11 respectively on TB1. Normally the shield of the cable is terminated at the source of the signal. Terminal 9 of TB1 is provided for this purpose. Insulate the shield so that no electrical connection is made at the other end of the cable. See Note below Section 2.14.

⚠CAUTION

NEVER CONNECT THE SHIELDING WIRE OF A SHIELDED CABLE AT BOTH ENDS.

2.9.2 REMOTE FOLLOWER CONNECTIONS

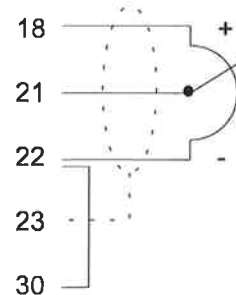
For automatic speed tracking, the drive is supplied with an interface circuit for inputs from a system control panel. The input signal wiring is terminated to terminals 18 through 22 as shown below.



The voltage and current input circuits are electrically isolated from chassis ground and all other connections.

The input impedance of the current follower circuit when connected across terminals 19 and 22 of TB1 is 180 ohms.

If a potentiometer, such as a 135 ohm potentiometer, is used, it should be connected as shown below.



The maximum recommended wire length for a potentiometer input is 50 feet.

NOTE: A 135 OHM POTENTIOMETER WILL GIVE GREATEST LINEARITY. HIGHER RESISTANCE POTENTIOMETERS MAY BE USED, BUT THE USABLE RANGE OF THE POT AND THE LINEARITY WILL BE REDUCED.

With a 135 ohm pot, there will be approximately 4 watts at the pot. If this wattage is too high, resistance can be added in series with the pot. Both direct acting and reverse acting signals are

wired as shown. Reverse acting signals are accommodated in the setup of the drive through the control module. See Section 6.

2.10 RUN AND FAULT CONTACTS

One Form C fault contact (one normally open and one normally closed contact) and one Form C run contact (one normally open and one normally closed contact) are provided for customer use from the drive's run and fault relays.

The relay connections are provided on terminal strip TB1 as shown.

Relay	Contacts	TB1 Pin #
FAULT	N.C.	1 & 2
FAULT	N.O.	2 & 3
RUN	N.C.	4 & 5
RUN	N.O.	5 & 6

The contacts are rated 115 V AC, 5 amps resistive.

The RUN relay picks up when the drive is running and drops out in a stop or fault condition.

The FAULT relay is normally energized and it drops out in the event of a fault condition.

In the event that the drive senses undervoltage, phase loss or a power loss, the drive first attempts to ride through the problem. These relays do not change state if the condition is corrected before the two second ride through time expires. During ride through, the motor is de-energized, but all control and logic circuits remain energized by utilizing capacitor bank energy. If the power problem is corrected before two seconds, the drive is able to restart immediately. If the problem is not corrected within two seconds, the drive shuts down and drops out the relays.

2.11 REMOTE RUN/STOP

A customer-supplied remote run/stop contact may be wired to the drive. On drives with no bypass or with Drive/Off/Line/Test switch (type B) bypass, this is wired to TB1 terminals 12 and 13. When in the Auto mode, this contact will start the drive when closed and stop the drive when opened. Hand mode will override an open contact.

If there is a bypass circuit, see the customer connection diagram that accompanies this manual.

2.12 REMOTE SAFETY INTERLOCK

⚠ CAUTION

THE REMOTE RUN/STOP CONTACT SHOULD ONLY BE USED FOR NON-SAFETY CONTACTS SUCH AS CLOCKS. IF THE SAFETY CONTACTS AND NON-SAFETY CONTACTS ARE WIRED IN SERIES, THE REMOTE SAFETY INTERLOCK SHOULD BE USED TO MEET CODE SPECIFICATIONS FOR SAFETY SHUTDOWNS.

If there is no line bypass circuit, wire the customer's safety interlock contact to TB1 terminals 13 and 14 in place of the jumper wire. If there is a bypass circuit, see the customer connection diagram that accompanies this manual. See Note below Section 2.14.

A customer-supplied normally closed safety interlock contact may be used to automatically stop the drive in case of an abnormal condition such as a fire alarm or freeze stat signal. When the safety interlock re-closes, the drive may restart. Restart may be manual, or automatic with time delay, or automatic with no time delay. This is selected through the control module.

2.13 PRESET SPEED INPUT

A customer-supplied normally open contact connected to terminals 15 & 16 of TB1 gives the ability to run the drive at a preset speed when the contact is closed. The preset speed capability is useful for night setback or other situations where the normal speed input signal is to be ignored. Enabling or disabling preset speed and the preset speed setting are set through the control module.

Closing the preset speed contact will affect the drive as follows:

If preset speed is disabled through the control module, the drive will change to the preset speed if it is already running. If not running, closing the preset speed contact will not start the drive.

If preset speed is enabled, closing the preset speed contact will cause a running drive to change to the preset speed. It will also start a stopped drive, overriding the Hand/Off/Auto commands and run it at the preset speed setting. Opening the contact will return the drive to its previous status. All speed changes will be at the selected accel/decel rates. See Note below Section 2.14.

2.14 REVERSE INPUT

A customer-supplied normally open contact connected to terminals 16 & 17 of TB1 will run the motor in the reverse direction when closed if the REVERSE function is enabled through the control module. If reverse is enabled, and the contact is closed while the drive is running, the drive will decelerate to zero speed and then accelerate to set speed in the reverse direction. The accel and decel rates will be those programmed on the control module. See Note below.

NOTE: THE CUSTOMER TERMINALS 8, 10, 13, 16 AND 30 OF TB1 ARE COMMON TO EACH OTHER, BUT ISOLATED FROM GROUND. GROUNDING ANY ONE INPUT WILL GROUND ALL OF THEM.

2.15 FIELD TERMINAL CONNECTIONS

All of the bolts on the field terminal connections must be torqued according to the table below.

Drive Output Amp Rating	Torque (lb-in)		
	TB10*, TB20*	2TB10*, 2TB20*	2TB1
to 14 A	15	15	15
21 to 34 A	31-35	31-35	15
40 to 52 A	31-35	31-35	15
65 to 180 A	45-50	45-50	15

*Drives with multiple inputs and/or multiple outputs will have terminal blocks TB10 and TB11; 2TB10 and 2TB11; TB20 and TB21; and 2TB20 and 2TB21, etc.

For drives rated 14 A or less, the input power (TB10 or 2TB10), and the motor output terminations (TB20 or 2TB20) must all be made with ring lugs or spade lugs. The lugs should be for a #8 screw.

Dive Currents, and Isolation Transformer Sizing Table

Nominal 460 V AC Motor HP	Drive ¹ Input Current (amperes)	Drive ² Output Current (amperes)	Minimum Isolation ³ Transformer Size (kVA)	
			Drive	Drive w/bypass
5	9.8	7.6	11	11
7.5	17.6	11	15	15
10	20	14	20	20
15	30	21	27	34
20	37	27	34	34
25	45	34	40	51
30	54	40	51	63
40	67	52	63	63
50	81	65	75	93
60	90	77	93	93
75	105	96	93	145
100	124	124	118	175
125	144	156	145	175
150	159	180	145	275

Copper conductors are required. Power wiring must be 75°C rated. If higher temperature rated wiring is used, it must be sized based on 75°C wire ampacities.

Drive has been tested by UL and is suitable for use on a circuit capable of delivering not more than 200,000 RMS symmetrical amperes, 575 V AC maximum.

- ¹ Input current measured using a 460 V AC, 2500 kVA, 7% impedance transformer. Actual input current will vary with transformer size.
- ² Refer to "Output Drive Current" rating on nameplate for this value. Values are based on true RMS amps.
- ³ Isolation transformer sizing based on 460 V AC input. Consult Graham for other input voltages. Isolation transformers must be designed for use with adjustable frequency drives.

Operator's Control Module

SCROLL UP AND SCROLL DOWN

These keypad switches are always available to the operator. Press Scroll Down (Up) to scroll down (up) through the METERS and through the SETTINGS if the lockout is off. Press Scroll Down (Up) to scroll through the hidden settings when in that mode. Press either scroll switch to accept a new value for either a Setting or a hidden code.

SET UP AND SET DOWN

These keypad switches are always available to the operator when the Lockout is off. Press Set Down (Up) to change a Setting or view a value of a code and then change its value.

METERS

The six meter readings are always available to the user. They display on the seven segment LED panel to the right. Press either of the SCROLL switches to change which meter is displayed.

SETTINGS

The eight settings are available to the user if the control panel lockout is off. With access to the settings, the user can view the present setting by scrolling to it and viewing the set value in the seven segment LED panel. To change a setting, after scrolling to it, press one of the SET switches until the desired value is shown. To accept the new setting, press one of the SCROLL switches.

STATUS

The ten status LEDs show the selections made through the Hand/Off/Auto and Local/Remote Switches, and give a positive indication of power, ready, and running. They also show if remote run is selected or if the ability to accept a reverse command is enabled, and the status of the keypad lockout.

HAND/OFF/ AUTO, LOCAL/REMOTE SWITCHES

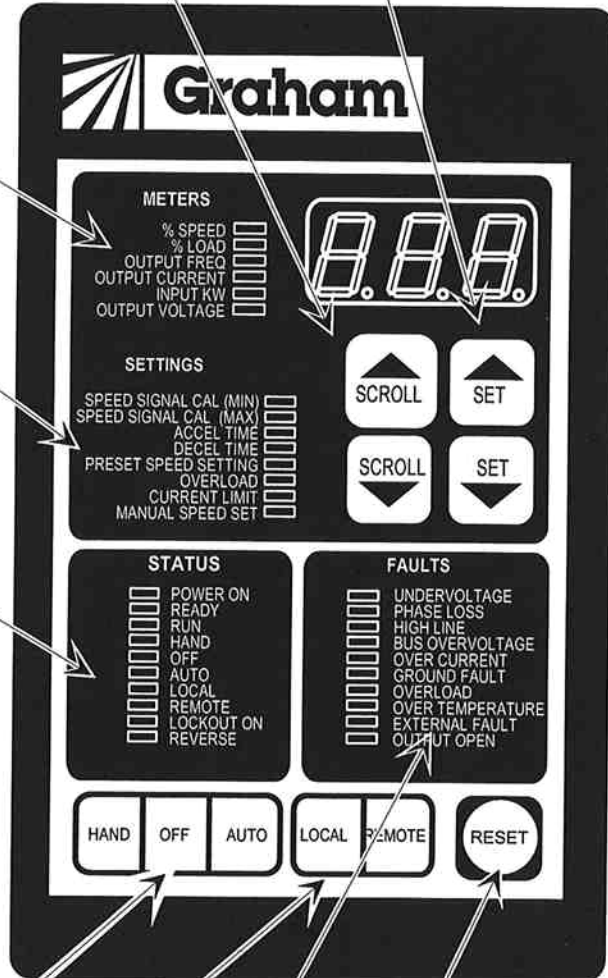
When the keypad lockout is off, the operator can run the drive using these switches.
HAND -- Press to start the drive
OFF -- Press to stop the drive
AUTO -- Press to start the drive through a remote start contact wired to the drive
LOCAL -- Press to control drive speed from Manual Speed Set
REMOTE -- Press to have drive speed respond to external control system

FAULTS

All operational problems that can cause the drive to stop are shown. The cause of the problem should always be found before the drive is reset.

RESET SWITCH

This keypad switch is always available to the operator. It will reset all resettable faults and allow exiting the Settings mode without changing the setting.



SECTION 3

OPERATOR CONTROLS

The following controls, displays and indicators are located on the operator control module on the door of the 2001 Series drives. This panel consists of soft touch membrane keypad switches, a large three digit LED display and four sets of status indicating LEDs. Access to the functions can be controlled.

3.1 KEYPAD SWITCHES

3.1.1 START SELECT KEYPAD SWITCHES

The start select keypad switches consist of three membrane switches labelled HAND, OFF and AUTO. They are located at the lower left of the control module. The start/stop functions of the drive are controlled using these keypad switches and the customer's remote start/stop contacts connected to the customer terminal strip.

HAND - The drive is commanded to energize the run relay and start. In the HAND position, any customer remote start/stop contacts will be overridden. The HAND LED on the Status panel will illuminate when HAND is pressed.

OFF - The drive is commanded to drop out the run relay and stop. In the OFF position, the customer's contacts will be overridden. The OFF LED on the Status panel will illuminate when OFF is pressed.

AUTO - The drive is commanded to pick up the run relay and start only if the customer remote start contact connected to TB1 terminals 12 and 13 is closed. The AUTO LED in the Status panel will illuminate when AUTO is pressed.

3.1.2 SPEED SELECT KEYPAD SWITCHES

The speed select keypad switches consist of two membrane switches, labelled LOCAL and REMOTE. They are located at the lower right of the control module. These switches select the speed reference input to be tracked.

LOCAL - In the LOCAL position, drive speed is controlled from the control module. In the LOCAL mode, the LOCAL LED in the Status

panel will illuminate when LOCAL is pressed.

REMOTE - The REMOTE selection commands the drive to track the speed command being provided from the customer's control system to two terminals on TB1. This input can be a voltage or current signal. See Section 2.9.2. In the REMOTE mode, the REMOTE LED in the Status panel will illuminate indicating REMOTE was pressed.

3.1.3 RESET KEYPAD SWITCH

The RESET keypad switch, located at the far lower right of the control module, will reset all faults that are not automatically reset. It is also used to leave the settings mode without changing the setting.

3.2 INDICATORS

The indicators are grouped into four sections, METERS, SETTINGS, STATUS, and FAULTS.

3.2.1 METERS

Normally one of the six METERS LEDs will be illuminated. The value indicated by the three LED digits in the upper right of the control module will correspond to the illuminated METERS LED. The six METERS displays are % speed, % load, output frequency, output current, input kW, and output voltage.

To change the display from one of the meters to another, press either the Scroll ▲ or the Scroll ▼ keypad switch. When first powered up, the display defaults to displaying % speed.

3.2.2 SETTINGS

Some of the more commonly adjusted drive parameters are available through the SETTINGS section of the control module. If the keypad lockout is off, continued pressing of the Scroll ▲ or the Scroll ▼ keypad switches will allow the user to scroll into the SETTINGS section.

In this section, the value indicated by the three LED digits in the upper right of the control module will correspond to the illuminated SETTINGS LED. The eight SETTINGS accessible here are Speed Signal Calibration (minimum), Speed Signal Calibration (maximum), Acceleration Time, Deceleration Time, Preset Speed

Setting, Overload, Current Limit, and Manual Speed Set. When selected, the present value of each of these settings is shown by the three digit LED display.

If the keypad lockout is on, access to some or all of the SETTINGS is denied. The Scroll ▲ or the Scroll ▼ keypad switches will skip over some or all portions of the SETTINGS section.

3.2.3 FAULTS SECTION

The FAULTS section of the control module shows any faults that have caused the drive to stop. The faults that are indicated are undervoltage, phase loss, high line, bus overvoltage, overcurrent, ground fault, overload, overtemperature, external fault, and output open.

3.3 STANDARD OPTION SWITCHES

The standard option switches are used when optional features such as the bypass or drive input disconnect switch options are supplied.

⚠WARNING

DO NOT OPERATE ANY DISCONNECT SWITCH WHILE THE MOTOR IS RUNNING, OR WHILE THE CUSTOMER'S MOTOR STARTER IS ENERGIZED. ALWAYS STOP THE DRIVE OR MOTOR STARTER OPERATION BEFORE OPERATING AN INPUT DISCONNECT, MOTOR DISCONNECT, MOTOR TRANSFER SWITCH OR DRIVE/OFF/LINE/TEST SWITCH.

3.3.1 DRIVE INPUT DISCONNECT SWITCH

This rotary switch is used to disconnect incoming utility power to the drive.

⚠DANGER

THE DRIVE DISCONNECT SWITCH DOES NOT DISABLE POWER TO THE BYPASS CIRCUITRY INSTALLED INSIDE THE DRIVE WHEN IT IS IN THE OFF POSITION.

3.3.2 BYPASS DISCONNECT SWITCH

This rotary switch is used to disconnect input power from the bypass motor starter.

⚠DANGER

THE BYPASS DISCONNECT SWITCH DOES NOT DISCONNECT POWER FROM THE MOTOR OR THE DRIVE CIRCUITS. DO NOT SERVICE THE DRIVE UNLESS POWER IS DISCONNECTED FROM THE DRIVE BY MEANS OF THE DRIVE INPUT DISCONNECT SWITCH, THE INPUT POWER DISCONNECT SWITCH, OR THE CUSTOMER-SUPPLIED BREAKER FEEDING THE DRIVE ENCLOSURE.

3.3.3 MAIN DISCONNECT SWITCH

This rotary switch is used to disconnect input power from both the drive and the bypass circuits. It may be supplied with or without fusing. If supplied with fusing, this FUSED MAIN DISCONNECT SWITCH provides motor fusing when the motor is run in bypass.

3.3.4 DRIVE/OFF/LINE TRANSFER SWITCH

The DRIVE/OFF/LINE switch is a rotary switch used as a motor transfer switch and a motor disconnect switch. The motor is transferred between the output of the drive (normal operation) and the output of a customer-supplied motor starter (bypass mode) using this switch. If the switch is in the OFF or LINE position, the drive will not run. For dual motor applications, two DRIVE/OFF/LINE switches are used.

DRIVE - The motor is connected to the output of the drive and isolated from the customer's motor starter. Motor operation is controlled by the variable voltage and frequency of the drive when it is commanded to run.

OFF - The motor is isolated from both power sources (drive and customer motor starter). The switch is being used as a motor disconnect switch.

LINE - The motor is connected to the output of the customer-provided motor starter and isolated from the output of the drive. Motor operation is now full speed (no variable speed control) when the customer's motor starter is energized.

3.3.5 DRIVE/OFF/LINE/TEST TRANSFER SWITCH

This option combines four functions. It acts as a motor transfer switch, motor disconnect switch, drive input disconnect switch, and drive test mode for service and maintenance while system operation is maintained in bypass. This option may be supplied either with or without a motor starter. A motor starter, supplied by either Graham or the customer is required for LINE operation.

DRIVE - The motor is connected to the output of the drive and power is connected to the input of the drive. Motor speed is controlled by the drive.

OFF - The motor and the drive are disconnected from the power source. The switch acts as a drive input disconnect switch and a bypass input disconnect switch to isolate the drive and motor from power sources during service and maintenance functions.

LINE - The motor is connected to the bypass motor starter for full speed operation. Power is disconnected from the drive input and the motor is isolated from the drive output for service functions on the drive without interruption of customer operation. If the motor starter is supplied by Graham, the LINE ON/OFF switch energizes the starter.

TEST - The motor is connected to the bypass motor starter for continued operation of the customer's application at full speed while testing the drive under power. The test mode disconnects the motor from the output of the drive and connects power to the input of the drive for operational testing without the motor.

⚠WARNING

THE DRIVE/OFF/LINE/TEST SWITCH SHOULD NOT BE MOVED IN EITHER DIRECTION BETWEEN THE OFF AND LINE POSITIONS WITH THE MOTOR STARTER ENERGIZED.

3.3.6 INTERLOCKED CONTACTOR BYPASS

Interlocked contactor bypass is the use of two interlocked conventional motor starter contactors to provide the customer with the ability to transfer the motor to full speed operation in the event of a drive fault. This circuitry can be operated manually or automatically. When the drive is equipped with this option, the front panel has one additional switch and two additional panel indicator lamps labeled MOTOR ON DRIVE and MOTOR ON BYPASS. The DRIVE/OFF/BYPASS selector switch allows the user to select:

1. Variable speed from the drive (DRIVE)
2. Disconnection of the motor from the drive and the motor starter (OFF)
3. Constant full speed operation from a conventional motor starter (BYPASS)

DRIVE - The motor operates with variable speed operation from the drive. The MOTOR ON DRIVE lamp on the front panel is illuminated. Interlocks from the energized DRIVE contactor lock the bypass motor starter out of operation.

OFF - The motor is disconnected from both the drive and the bypass power sources. The drive contactor and the line contactor are disabled.

BYPASS - The motor operates at a constant speed from the motor starter connected to the utility power line. The BYPASS lamp on the front panel is illuminated. Interlocks from the energized LINE contactor lock the drive in the stop mode and the drive contactor in the de-energized mode to prevent back-feeding of utility power to the drive.

⚠DANGER

UNLESS A DRIVE DISCONNECT SWITCH OR CONTACTOR IS SUPPLIED, POWER IS ALWAYS CONNECTED TO THE DRIVE. IN THIS CASE, POWER MUST BE DISCONNECTED FROM THE ENTIRE DRIVE AND BYPASS BEFORE THE DRIVE CAN BE SERVICED.

AUTO TRANSFER (If provided) Automatic transfer to the bypass mode (BYPASS) is accomplished by recognition of a fault condition in the drive circuitry which does not reset and restart the drive in a designated amount of

time. If the fault condition resets within the time delay, the LINE transfer system is not activated. If the fault condition does not reset within the allotted time delay period, the BY-PASS contactor is energized. At the time the BYPASS contactor is activated:

1. The DRIVE contactor is de-energized to isolate the motor and utility power from the output of the drive to prevent back-feeding.
2. The drive's emergency shutdown circuitry is activated.

The required time delay before automatic transfer is determined by the application and the amount of inertia in each individual system. Delay time selection is determined by 2TMR1 in the bypass circuitry.

3.3.7 TRANSFER SWITCH MOTOR SELECTION

This three position manual switch will connect the output of the drive to either motor #1 or motor #2. In the middle "OFF" position, neither motor is connected to the drive.

This switch is interlocked with the drive to shutdown the drive if the switch is turned while the drive is running. If the transfer is completed within two seconds, the drive will start the connected motor and accelerate it in the correct direction to the correct speed.

The drive may be transferred to a motor that is already spinning in the correct direction up to 100% speed in the forward direction or up to 30% speed in the reverse direction if the catch a rotating motor feature is enabled. If this feature is enabled, the drive will automatically find the speed of this motor and synchronize with it. The drive will slow the motor to zero speed and reverse it if necessary. As shipped from the factory, this feature is normally enabled. See Section 6 to enable this feature if necessary.

▲ CAUTION

THE MOTOR SHOULD NOT BE SPINNING AT MORE THAN 30% SPEED IN THE REVERSE DIRECTION WHEN THE TRANSFER IS MADE.

If the transfer is not completed within two seconds and no motor is connected to the output of the drive, the drive will trip on a MOTOR OPEN fault. To restart it, the transfer must be completed and the drive restarted either manually or automatically.

3.3.8 CONTACTOR MOTOR SELECTION

When motor alternation is required for an application which has a backup or redundant system, such as a lead/lag pumping system, CONTACTOR MOTOR SELECTION is typically provided.

In this system only one motor may be operated at any time. Motor operation is determined via a three position door mounted selector switch. MOTOR #1 position connects that motor to the drive through a contactor. MOTOR # 2 position connects that motor through a second contactor. With the switch in the AUTO position, motor selection is determined via customer contact closure.

This switch is interlocked with the drive to shutdown the drive if the switch is turned while the drive is running. If the transfer is completed within two seconds, the drive will start the connected motor and accelerate it. At the time the transfer is made, this motor may be spinning in the correct direction up to 100% speed or in the reverse direction up to 30% speed. The drive will automatically find the speed of this motor and synchronize with it. It will slow it to zero speed and reverse it if necessary.

If the transfer is not completed within two seconds and no motor is connected to the output of the drive, the drive will trip on a OUTPUT OPEN fault. To restart it, the transfer must be completed and the drive restarted either manually or automatically.

3.4 MOTOR ROTATION

Always be sure the motor rotates in the proper direction before bringing the motor up to speed. On a drive with bypass, check and correct motor rotation as follows:

1. If the motor rotates in the wrong direction when driven by the drive, before changing the motor wiring to correct the rotation,

you should check motor rotation in the bypass mode.

2. If both rotations; drive and bypass, are wrong, exchange the wiring on any two motor phases.
3. If the rotation is incorrect in the bypass mode but it is correct in the drive mode, exchange the wiring on any two of the input power wire phases.
4. If the rotation is correct in the bypass mode, but incorrect in the drive mode, exchange the wiring on any two motor phases and the wiring on any two of the input power wire phases.

SECTION 4.

DRIVE STATUS INDICATORS

4.1 STATUS INDICATORS

The STATUS indicators on the control module on the enclosure door function as described below.

4.1.1 POWER ON indicates the drive power supplies are energized.

4.1.2 READY indicates that there are no drive faults and the drive output is not energized. This indicator will go out when the output is energized or a fault exists.

4.1.3 RUN indicates that the drive output is energized and there are no drive faults.

4.1.4 HAND, OFF, AUTO, LOCAL and REMOTE indicators are described in Sections 3.1.1 and 3.1.2.

4.1.5 LOCKOUT ON indicates that the keypad is locked out. When Lockout On is illuminated, the Reset and the Scroll keypad switches are functional. Other switches may be locked out. See Section 6.6.

4.1.6 REVERSE indicates that a contact closure has been made to the reverse input terminals 16 and 17 on TB1 when it is illuminated. If REVERSE has been disabled through the control module, no change will occur. If REVERSE is enabled, the drive will run the motor in the opposite direction. If the drive is running when the contact closure is made, the drive will decelerate the motor to zero speed, and accelerate it to the commanded speed in the reverse direction.

▲DANGER

FOR ONE DIRECTIONAL APPLICATIONS, CUSTOMER WIRING SHOULD BE CORRECTED AT START-UP IF ROTATION IS INCORRECT. USING THE REVERSE SWITCH COULD CAUSE OPERATOR CONFUSION AND/OR EQUIPMENT DAMAGE IF IMPROPERLY USED. SEE SECTION 3.4.

4.2 FAULTS

The FAULT indicators illuminate to indicate that a fault condition exists.

4.2.1 UNDERVOLTAGE illuminates when the undervoltage circuit is activated due to a loss of power (blackout), or low voltage (brown-out). In the event of a loss of power, the UNDERVOLTAGE LED will illuminate for about two seconds while the drive is waiting for power restoration to "ride through" the blackout.

If the UNDERVOLTAGE circuit activates, check:

1. The incoming power for voltage more than 10% below nominal.
2. Interruptions or severe drops in power line voltage due to the operation of other equipment, overloading the transformer on the incoming power to the drive, or utility company power drops.

4.2.2 PHASE LOSS illuminates if any one of the three input phases is missing or low. If two phases are missing or low, the drive will fault on UNDERVOLTAGE instead.

Potential causes of this fault trip are:

1. Voltage dip.
1. Blown drive input fuse.
2. Unequal voltage of the three input lines. They should be balanced and none more than 10% below rated drive input voltage.

4.2.3 HIGH LINE illuminates when the line voltage is more than 10% above rated drive input voltage.

Potential causes of this fault trip are:

1. Voltage spike or surge.
2. Defective transformer.
3. Drive wired to incorrect input voltage.

4.2.4 BUS OVERVOLTAGE illuminates when the inverter output circuit voltage exceeds normal limits due to a regenerating motor or an excessively high input line voltage. The rotation of a motor in excess of the drive's commanded speed causes the motor to act as a generating power source. This regeneration of power causes the BUS OVERVOLTAGE fault circuit to trip if the drive output voltage level becomes excessive.

Starting a stopped drive into a rotating motor would ordinarily also cause a bus overvoltage fault. If the Catch a Rotating Motor feature has been enabled, the drive will automatically syn-

chronize with the motor and avoid a bus overvoltage fault. This feature will work for any motor rotation speed in the forward direction, and up to 30% in the reverse direction. Optional dynamic braking is required for starting into a motor rotating at more than 30% speed in reverse.

BUS OVERVOLTAGE trips are typically caused by the application. The system either causes the motor to rotate without the drive as the prime mover, or rotate faster than the prime mover is commanding it to operate (overhauling). Examples of typical application related problems are:

1. Lack of, or defective operation of, a check valve in a pumping system.
2. Lack of, or defective operation of, a back draft damper on a fan system.
3. Defective damper control in a variable air volume (VAV) system.
4. Drive deceleration rate set too fast for the inertia of the system.
5. If the overvoltage trip occurs upon starting into a rotating motor, be sure catch a rotating motor is enabled.

4.2.5 OVERCURRENT

illuminates if the OVERCURRENT circuit has activated. An OVERCURRENT trip indicates a short circuit in the inverter section of the drive or in the motor wiring, or the output of the drive was subjected to a severe surge of current.

If this circuit trips check:

1. The motor and motor wiring for a short circuit.
2. The motor wiring for an intermittent/ loose connection.
3. The motor wiring for proper voltage connection.
4. That there are no power factor correction capacitors installed between the drive output and the motor.
5. That the motor disconnect, motor starter or contactor, or other devices which can open and close connections between the output of the drive and motor are not being operated while the drive is running.
6. Check drive with motor disconnected for proper operation.
7. If all of the above check out, one or more of the drive's inverter circuit IGBTs may be short circuited.

⚠WARNING

THE CAUSE OF THE OVERCURRENT CONDITION SHOULD BE IDENTIFIED AND CORRECTED BEFORE RESETTING THE DRIVE.

4.2.6 GROUND FAULT

Illuminates if the motor or its wiring ground faults by shorting or arcing to ground. If this circuit trips, check the motor and motor wiring for a short from phase to phase or phase to ground.

⚠WARNING

THE CAUSE OF THE GROUND FAULT SHOULD BE IDENTIFIED AND CORRECTED BEFORE RESETTING THE DRIVE.

The ground fault LED will not illuminate on IPM 2001 drives. This is because the signal from the intelligent power module for ground fault is the same as the signal for overcurrent. The IPM2001 is fully protected from ground faults, but a ground fault condition will be indicated by the overcurrent LED.

4.2.7 OVERLOAD

Flashes on and off if the load reflected to the drive through the motor is greater than the setting of the overload circuit. The drive will continue to run in overload for one minute. If the load is reduced during that time, the LED will stop flashing. If the overload condition continues for a minute, the OVERLOAD LED will light continuously and the drive will decelerate to a stop.

Potential causes of this fault are:

1. Motor bound or not free to rotate.
Example: Brake on, bearing problems, etc.
2. Belts improperly tensioned or aligned.
3. Sheaves and/or shaft couplings improperly aligned.
4. Maximum speed of the drive set too high.
5. Misapplication or undersized drive

⚠WARNING

THE CAUSE OF THE OVERLOAD SHOULD BE IDENTIFIED AND CORRECTED BEFORE RESETTING THE DRIVE.

4.2.8 OVERTEMPERATURE

Illuminates if the internal thermostat(s) of the drive experience too high a temperature. The trip points are approximately as shown:

Internal ambient	160°F (70°C)
Heatsink	195°F (90°C)

If this fault circuit activates, check to ensure:

1. All drive fans are functioning properly.
2. The air flow slots are not clogged or restricted.
3. The ambient temperature outside of the enclosure is not in excess of 104°F (40°C).
4. The clearances required in Section 1.1 of this manual are as specified.
5. The drive is mounted vertically.

4.2.9 EXTERNAL FAULT

Illuminates to indicate that something external to the drive commanded the drive to shut down. This is a normally closed circuit that opens to shutdown the drive and indicate the fault. Typically the fire alarms, freeze stats, high pressure cutout contacts, etc. are wired to these terminals. The drive cannot be restarted until the external fault is cleared.

⚠ DANGER

THE DRIVE MAY RESTART AUTOMATICALLY WHEN AN EXTERNAL FAULT IS CLEARED UNLESS A STOP COMMAND IS GIVEN PRIOR TO RESETTING THE FAULT.

4.2.10 OUTPUT OPEN

Illuminates to indicate that a motor transfer was not successfully completed.

When the interlock contact, terminals 28 and 30 of TB1, are open for more than 3 seconds, the run relay and the fault relay drop out and latch the fault. The drive will fault and illuminate the OUTPUT OPEN LED. This contact is present when interlocked contactor bypass, transfer switch motor selection, or contactor motor selection is supplied. (See Sections 3.2.6, 3.2.7 and 3.2.8.)

Drive logic problems may also illuminate the OUTPUT OPEN LED. If the microprocessor in the drive cannot find the motor during its Catch a Running Motor search, this LED will illumi-

nate. This fault will be identified within one minute of attempting to start the drive.

The drive will automatically restart on a contact closure if it has been programmed for auto reset for this fault condition. If it is programmed for manual reset, after the contact closure has been made, press the Reset keypad switch.

4.3 INTERNAL INDICATORS

The drive is designed so that all setup and operational adjustments are made through the keypad switches on the control module. In normal operation there is no need to open the enclosure door or remove the enclosure cover.

If the enclosure is to be opened for any reason, be sure to check the Charge on Bus Caps LED. It is located on the power board on the left side of the drive. Charge on Bus Caps is a red LED that is illuminated when BUS POWER is available on the DC bus. After power is removed from the drive input, this LED will remain lit and dim slowly as the bus capacitors discharge.

⚠ DANGER

DO NOT ATTEMPT TO SERVICE THE DRIVE WHEN THE BUS POWER LED IS ILLUMINATED.

After the input disconnect switch has been turned to the OFF position to remove the input power to the drive, the capacitor bank on the drive will still be fully charged. This can be over 600 V DC and is extremely dangerous. This voltage will slowly decrease, and as it decreases, the LED will dim and finally extinguish.

⚠ DANGER

WAIT UNTIL THE CHARGE ON CAPS LED NO LONGER GLOWS BEFORE CONTACTING ANYTHING INSIDE THE DRIVE. THIS WILL BE APPROXIMATELY 2 MINUTES AFTER INPUT POWER HAS BEEN REMOVED.

SECTION 5

SETTING UP THE DRIVE

Product changes have resulted in variations in how settings are made to the drive, the number of hidden codes, and the numbering of the hidden codes. Before making any settings, you need to determine the revision level of the logic board in the drive.

Open the drive door or remove the IPM drive cover. The part number and the revision level of the logic board are printed on the paper label on the upper left side of the logic board. For purposes of this manual, there are three variations of drives as shown below.

Logic Board Number	Type
02-8462-00	Type 1
02-8539-00, -01, -02	Type 1
02-8699-00 through Rev G	Type 1
02-8677-00 through Rev G	Type 1
02-8699-00 Rev H through Rev M	Type 2
02-8677-00 Rev H through Rev M	Type 2
02-8699-03 all revisions	Type 2
02-8677-05 all revisions	Type 2
02-8699-00 Rev N and beyond	Type 3
02-8677-00 Rev N and beyond	Type 3

The manual will refer to the drive by the type of logic board.

THE "SETTINGS" SECTION

Before making any changes to any of the settings, it is recommended that the present value of all the settings be entered on the 2001 Settings Worksheet on page 26 of this manual. This will allow returning to the original values if desired.

▲ CAUTION

ENTERING INAPPROPRIATE VALUES AS SETTINGS MAY PRODUCE UNEXPECTED RESULTS. RECORD ALL SETTINGS BEFORE MAKING ANY CHANGES.

The adjustments in the SETTINGS section of the control module are accessible if the Keypad Lockout is disabled. If the Lockout On LED is lit, the lockout is enabled, and the Scroll keypad switches may not access all of the settings. See Keypad Lockout below and Section 6.6. In normal operation, it may be desirable to have the keypad lockout enabled to prevent unauthorized individuals from starting, stopping or changing speed of the drive or changing the Settings.

If that is the case, the description of the access to the keypad lockout described below must be safeguarded.

If a setting routine is begun but not completed, after five minutes, the new setting will be written to memory and used until changed again. After five minutes, the display will automatically leave the settings and display % Speed.

For Type 1 and Type 2 drives, some of the settings are "active settings". They require that the drive be running in order to make a change in the setting. The Manual Speed setting, the Preset Speed setting, the Speed Signal Cal (min), and Speed Signal Cal (max) settings all require that the drive be running and the minimum or maximum input follower signal be sent to the drive. The rest of the adjustments in the SETTINGS section of the control module can be made with the motor stopped. All of these settings may be made with the motor running or stopped on Type 3 drives.

When changing an "active setting", first be sure that you can operate the drive at the desired level. Attempting to change an "active setting" without running the drive at the desired speed or load will result in the loss of the factory setting and the inability to make a correct new setting.

5.1 KEYPAD LOCKOUT

When the Keypad Lockout is on, the operator can scroll through the Meters section to view the meter readings and press the Reset button to reset faults. Depending on the type and setup of the drive, it may not be possible to change other drive settings. See Section 6.6.

To change the keypad lockout status, access to the hidden codes must be obtained. The hidden codes are identified by numbers. Hidden codes for Type 1 drives are numbered sequentially from 1 to 31. For Type 2 drives, the hidden codes are the same as Type 1 through code 31, but codes 32 through 39 have been added. For Type 3 drives, the hidden codes are numbered from 41 through 59, and from 67 through 89. Additional capability beyond Type 2 drives has been added through codes 57, 58 and 59. For a complete listing of the hidden codes, see pages 24 and 25.

1. To access the hidden codes, simultaneously press and hold the Scroll ▲, Set ▲ and Auto keypad switches for four seconds. When the display shows 1 or 41, access has been obtained, and hidden code #1 or 41 can be set. This is described in detail in Section 6.
2. To access the keypad lockout, press and hold Scroll ▲. The display will initially advance slowly and then more rapidly. Release when 28 for Type 1 and 2 drives appears, and when 78

appears for Type 3 drives.

3. To access the setting of the keypad lockout, press and release Set ▲ or Set ▼. This will show the present setting. The display will show either 0 or 1. 0 is enable, meaning that the operator has access. 1 is disable, meaning the operator has no access.
4. To allow access, 0 must be displayed. If 0 is not displayed, press and release Set ▼. The LED display should now show 0.
5. To save this 0 setting, which allows access to Settings, momentarily press and release Scroll ▲ or Scroll ▼. This saves the new setting, and advances to the next hidden code. To exit the hidden codes, press Reset.
6. The Lockout On LED should now be off, and pressing either Scroll keypad switch should allow access into the Settings.

Type 2 and Type 3 drives allow individual keypad functions to be selectively unlocked while keypad lockout is on. See Section 6.6.

5.2 SPEED SIGNAL CAL (MIN) SETTING

When the Speed Signal Cal (Min) LED is illuminated, you have access to change the minimum follower input level and speed for remote operation and speed for local operation on Type 1 and Type 2 drives. On Type 3 drives, local minimum speed is set through a hidden code. Setting the local minimum speed on Type 3 drives is through the hidden codes as described in Section 6.

The procedure directly below will set both the local and remote minimum speeds on Type 1 and Type 2 drives, and the remote minimum speed on Type 3 drives.

Pressing the Set ▲ or the Set ▼ keypad switches will allow you to increase or decrease the minimum speed setpoint and set the minimum running speed for the local and remote modes regardless of the type of input signal connected. The minimum speed setpoint for local and remote operation is always the same speed setpoint and is not independently settable for Type 1 and Type 2 drives.

To set a minimum drive speed to correspond with an input signal, proceed as below.

1. Send the minimum speed remote speed signal to the drive.
2. Start the drive and run in local or remote mode by pressing the Local or Remote keypad switch. If the system cannot be run, the drive output may be disconnected from the motor and the drive run into an open circuit.

3. Press Set ▲ or the Set ▼ until the Speed Signal Cal (min) LED is lit. Then press Set ▲ or the Set ▼ once. The LED display will now show % speed and Cal (min) speed. Press and hold Set ▲ or the Set ▼ until the desired speed for Cal (min) is shown. If the desired speed was initially shown, press Set ▲ or the Set ▼ to change the value and then return it to the desired value. This is necessary to establish the relationship between the external signal and the drive's speed. The minimum speed for the drive is approximately 5% (3 Hz).
4. Check to be sure the remote speed signal is transmitting the desired signal.
5. Press and release either Scroll ▲ or Scroll ▼. This permanently calibrates the drive to run at the set minimum speed when that value is received.
6. If at any time during the above procedure, you wish to abort and not change the previous setting, remove the input power to the drive for at least 10 seconds.

5.3 SPEED SIGNAL CAL (MAX) SETTING

When the Speed Signal Cal (Max) LED is illuminated, you have access to change the maximum speed setpoint for the local and the remote operation on Type 1 and Type 2 drives. On Type 3 drives, local maximum speed is set through a hidden code. Setting the local maximum speed on Type 3 drives is through the hidden codes as described in Section 6.

The procedure directly below will set both the local and remote maximum speeds on Type 1 and Type 2 drives, and the remote maximum speed on Type 3 drives.

Pressing the Set ▲ or the Set ▼ keypad switches will allow you to increase or decrease the maximum speed setpoint and set the maximum running speed for the local and remote modes regardless of the type of input signal connected. The maximum speed setpoint for local and remote operation is always the same speed setpoint and is not independently settable for Type 1 and Type 2 drives. To set a maximum drive speed to correspond with an input signal, proceed as below.

1. Send the maximum speed remote speed signal to the drive.
2. Start the drive and run in local or remote mode by pressing the Local or Remote keypad switch. If the system cannot be run, the drive output may be disconnected from the motor and the drive run into an open circuit.
3. Press Scroll ▲ or Scroll ▼ until the Speed Signal Cal (max) LED is lit. Then press Set ▲ or Set ▼ once. The LED display will now show

% speed and Cal (max) speed. Press and hold Set ▲ or Set ▼ until the desired speed for Cal (max) is shown. If the desired speed was initially shown, press Set ▲ or the Set ▼ to change the value and then return it to the desired value. This is necessary to establish the relationship between the external signal and the drive's speed. The maximum speed for the drive is approximately 105% (63 Hz).

4. Check to be sure the remote speed signal is transmitting the desired signal.
5. Press and release either Scroll ▲ or Scroll ▼. This permanently calibrates the drive to run at the set maximum speed when that value is received.
6. If at any time during the above procedure, you wish to abort and not change the previous setting, remove the input power to the drive for at least 10 seconds.

NOTE: THE MIN AND MAX SPEED SETTINGS DO NOT LIMIT THE RANGE OF THE PRESET SPEED SETTING. IF THE PRESET SPEED SETTING IS FOR A SPEED OUTSIDE THE MIN AND MAX RANGE, AND THE CONTACT IS CLOSED ACROSS TB1 TERMINALS 15 AND 16 ON THE MAIN CONTROL BOARD, THE DRIVE WILL OPERATE AT THE PRESET SPEED.

▲WARNING

TO SET OR RESET SPEED SIGNAL CAL (MIN) OR (MAX), THE OPERATOR NEEDS CONTROL OF THE VALUE OF THE INPUT SIGNAL. IF DURING THE COURSE OF NORMAL OPERATION, THE OPERATOR CHANGES EITHER OF THESE CALIBRATIONS, WHATEVER SIGNAL IS BEING SENT AT THAT TIME WILL BE THE NEW MIN OR MAX SIGNAL. THIS WILL LIKELY RESULT IN UNSATISFACTORY OPERATION.

FOR THIS REASON WE RECOMMEND THAT THE KEYPAD BE LOCKED WHENEVER POSSIBLE.

5.3.1 REVERSE ACTING FOLLOWER SIGNAL

If the follower signal is reverse acting (20 mA is

to correspond to minimum speed and 4 mA is to correspond to maximum speed, for example), the setup is exactly the same as above. When setting minimum speed send 20 mA, and when setting maximum speed send 4 mA.

▲CAUTION

DO NOT ATTEMPT TO SET THE MINIMUM SPEED HIGHER THAN THE MAXIMUM SPEED. THESE SETTINGS WILL NOT BE ACCEPTED.

5.3.2 DRIVE RESPONSE TO LOST FOLLOWER SIGNAL

If the drive is running in remote, following the signal, and the follower signal value drops to less than 4 mA or less than 0.5 V DC, the drive will respond as follows.

1. On Type 1 and Type 2 drives, the drive speed will go the speed set for the minimum value of the follower signal.
2. On Type 3 drives, the drive speed will go the speed set as minimum speed (Code 58).

5.4 ACCEL AND DECEL TIME

With the keypad lockout off, the Accel Time and Decel Time calibrations are accessed by pressing the Scroll keypad switches until the Accel Time or Decel Time LED is illuminated in the Settings section of the control module. The accel or decel ramp time can be set for any time between 3 and 300 seconds as described below.

1. Press Scroll ▲ or Scroll ▼ until the LED in the Settings section next to Accel Time (or Decel Time) is lit. The number displayed is the present setting in seconds to ramp from 3 to 60 Hz (or from 60 to 3 Hz).
2. To change the length of the ramp, press Set ▲ or Set ▼ until the desired value is shown.
3. To save this new value, press and release either Scroll ▲ or Scroll ▼. This writes this new ramp time to memory.
4. If at any time during the above procedure, you wish to abort and not change the previous setting, remove the input power to the drive for at least 10 seconds.

NOTE: A RAPID ACCEL RATE MAY CAUSE THE DRIVE OUTPUT CURRENT TO REACH THE CURRENT LIMITED LEVEL. IF IT DOES, THE ACCEL RATE WILL BE LENGTH-

ENED REGARDLESS OF THE SET-
POINT PROGRAMMED TO PRE-
VENT DRIVE DAMAGE.

⚠CAUTION

A RAPID DECEL RATE MAY CAUSE THE MOTOR TO REGENERATE EXCESSIVE POWER TO THE OUTPUT OF THE DRIVE. IF IT DOES, THE DRIVE MAY SHUT DOWN ON A BUS OVERVOLTAGE FAULT TRIP TO PREVENT DRIVE DAMAGE. IF NECESSARY, LENGTHEN THE DECEL TIME TO AVOID THIS FAULT TRIP.

5.5 PRESET SPEED SETTING

The Preset Speed Setting is a speed calibration used to calibrate a fixed speed setpoint that the drive will ramp to any time there is a contact closure across TB1 terminals 15 and 16 on the logic board. This speed is independent of the Minimum and Maximum Speed Signal Cal setpoints of all drive types, and the Minimum and Maximum Speed setpoints of Type 3 drives. The setpoint can be calibrated for any speed between 5 and 105%. This circuit can be used for night setback control, smoke purge systems and other similar applications. With the keypad lockout off, the Preset Speed Setting is accessed as shown below.

1. Press Scroll ▲ or Scroll ▼ until the LED in the Settings section next to Preset Speed Setting is lit. The number displayed is the present setting in percent speed.
2. For Type 1 and Type 2 drives, start the drive and run in local or remote mode by pressing the Local or Remote keypad switch. If the system cannot be run, the drive output may be disconnected from the motor and the drive run into an open circuit.
For Type 3 drives, the Preset Speed setting can be with or without the drive running.
3. To change the speed, press Set ▲ or Set ▼ until the desired speed is shown.
4. If at any time during the above procedure you wish to abort and not change the previous setting, remove the input power to the drive for at least 10 seconds.

If the drive is a Type 1 or Type 2, the following Warning must be observed.

⚠WARNING

IF THE DRIVE OUTPUT IS CON-

NECTED TO THE MOTOR WHILE THIS SETTING IS BEING MADE, THE DRIVE WILL CHANGE SPEED TO RUN AT THE PRESET SPEED DURING THE SETTING PROCEDURE. IF THAT SPEED IS FASTER THAN THE PRESENT SPEED COMMANDED BY THE SYSTEM, DAMAGE TO THE SYSTEM MAY RESULT. TO PREVENT DAMAGE, THE SETTING MAY BE MADE WITH THE DRIVE OUTPUT DISCONNECTED FROM THE MOTOR.

For all types of drives, the following Warnings must be observed.

⚠WARNING

THE PRESET SPEED SETTING DOES NOT MONITOR THE BUILDING AUTOMATION SYSTEM SPEED COMMANDS, SO CARE SHOULD BE TAKEN TO PROPERLY INTERFACE DAMPER AND VALVE CONTROLS WHEN THE SYSTEM CONTACT IS CLOSED FOR PRESET SPEED TO PREVENT OVERPRESSURING THE MECHANICAL SYSTEM COMPONENTS.

⚠WARNING

IF PRESET SPEED IS ENABLED AND THE CONTACT IS CLOSED ON TB1 TERMINALS 15 AND 16, THE DRIVE WILL GO TO THE PRESET SPEED SETTING EVEN IF THE HAND/OFF/AUTO SWITCH IS IN THE OFF POSITION.

5.6 OVERLOAD

The overload setting is the calibration of the trip setpoint of the drive for excessive current being drawn by the motor. The setpoint can be calibrated for any percentage of rated current up to 110%. If the current rating of the motor is lower than the drive output current rating, it may be desirable to reset the overload to a lower value. With the keypad lockout off, the Overload setting is accessed as shown below.

1. Press Scroll ▲ or Scroll ▼ until the LED in the Settings section next to Overload is lit. The number displayed is the present setting in percent of rated drive current.

2. To change the value, press Set ▲ or Set ▼ until the desired value is shown.
3. To permanently save this value, press and release either Scroll ▲ or Scroll ▼. This writes this new value to the memory.
4. If at any time during the above procedure you wish to abort and not change the previous setting, remove the input power to the drive for at least 10 seconds.

5.7 CURRENT LIMIT

The current limit setting is the setpoint for determining the maximum intermittent duty of the drive. The setpoint can be calibrated for any percentage of rated current up to 115%. With the keypad lockout off, the Current Limit setting is accessed as shown below.

1. Press Scroll ▲ or Scroll ▼ until the LED in the Settings section next to Current Limit is lit. The number displayed is the present setting in percent of rated drive current.
2. To change the value, press Set ▲ or Set ▼ until the desired value is shown.
3. To permanently save this value, press and release either Scroll ▲ or Scroll ▼. This writes this new value to memory.
4. If at any time during the above procedure, you wish to abort and not change the previous setting, remove the input power to the drive for at least 10 seconds.

▲WARNING

THE CURRENT LIMIT SETTING SHOULD ALWAYS BE HIGHER THAN THE OVERLOAD SETTING.

5.8 MANUAL SPEED SET

The Manual Speed Set works like a digital manual speed potentiometer. Using the Set ▲ or Set ▼ keypad switches will allow you to increase and decrease the local speed setpoint. This setpoint is overridden when the Remote keypad switch on the control module is pressed and during Preset Speed operation. With the keypad lockout off, changing the Manual Speed Set is done as shown below:

1. Press Scroll ▲ or Scroll ▼ until the LED in the Settings section next to Manual Speed Set is lit. The number displayed is the present setting in percent of maximum speed. For Types 1 and 2 drives, the drive must be running to change the Manual Speed Set. For Type 3 drives, the drive may be either running or not. If the drive is not running, setting a new Manual Speed Set determines the speed the

drive will run at when next run in Manual mode.

2. To change the speed, press Set ▲ or Set ▼ until the desired speed is shown.
3. To permanently save this value, press and release either Scroll ▲ or Scroll ▼. This writes this new value to the memory.
4. If at any time during the above procedure you wish to abort and not change the previous setting, remove the input power to the drive for at least 10 seconds.

The drive will remember the last saved manual speed setting even if it is turned off or power is removed. If this last manual speed setting is not saved, when the drive is restarted the manual speed will be whatever value was previously saved.

For Type 1 and 2 drives, the commanded speed will change at a 40 second accel/decel rate. If the drive is connected to a high inertia load, this rate may be too rapid. If the drive trips on a Bus Overvoltage fault while slowing, the operator will have to pause periodically while slowing the drive to allow the motor speed to catch up with the commanded speed. When changing to a higher speed, the Overload LED may light. This means that by attempting to accelerate the load at the 40 second accel rate, a temporary overload has been created. If the motor accelerates to the commanded speed in less than 60 seconds, the overload will clear and the drive will continue to run. If the motor does not reach the commanded speed in 60 seconds, the operator will have to pause periodically while accelerating the drive to avoid an Overload fault.

For Type 3 drives, speed change is controlled by the set accel/decel rates. If an Overload fault occurs, lengthen the accel time. If a Bus Overvoltage fault occurs, lengthen the decel time.

Section 5 continues on next page.

5.9 STANDARD CALIBRATION SETPOINTS

Unless specified otherwise, the following calibration setpoints are the factory settings. They are typical for these applications.

FUNCTION	CENTRIFUGAL FAN	CENTRIFUGAL PUMP
Speed Signal Cal (Min)	10%	30%
Speed Signal Cal (Max)	100%	100%
Minimum Speed (Type 3 only, hidden code)	10%	30%
Maximum Speed (Type 3 only, hidden code)	100%	100%
Accel Time	60 sec	10 sec
Decel Time	60 sec	10 sec
Preset Speed Setting	10%	30%
Overload	110% of output rating	110% of output rating
Current Limit	115% of output rating	115% of output rating
Manual Speed Set	10%	30%

SECTION 6

SETTING UP THE DRIVE -- THE HIDDEN CODES

Additional setup, if necessary, can be done through a menu of codes that are not visible in the normal operating mode. This array of codes is hidden because they will seldom be needed after the initial setup is performed. They may not need to be accessed at all as the factory values are suitable for many applications.

Some of the hidden codes are "active settings". They require that the drive be running at the set conditions in order to make a change in the value. The "active settings" in the hidden codes are codes 2/42, 3/43, 4/44, 5/45, 6/46, and 7/47 for all types of drives. These are the output current, input kW, and output voltage meter values. The motor must either be run or it must be disconnected from the drive and the drive run into the open circuit to set hidden codes 9 through 12 on Type 1 and 2 drives. The rest of the hidden codes can be set with the drive stopped.

When changing an "active setting", first be sure that you can operate the drive at the desired level. Attempting to change an "active setting" without running the drive at the desired speed or load will result in the loss of the factory calibration and the inability to make a correct new setting.

Before making any changes to any of the hidden codes, it is recommended that the present value of all the hidden codes be entered on the 2001 Settings Worksheet on page 26 of this manual. This will allow returning to the original values if desired.

▲ CAUTION

ENTERING INAPPROPRIATE VALUES AS HIDDEN CODES MAY PRODUCE UNEXPECTED RESULTS. RECORD ALL SETTINGS BEFORE MAKING ANY CHANGES.

▲ CAUTION

THE VALUES SHOWN FOR HIDDEN CODES 3/43, 5/45, AND 7/47 ARE FACTORY SET AND ARE CORRECT. DO NOT RESET THESE VALUES WITHOUT FIRST CONSULTING GRAHAM COMPANY SERVICE DEPARTMENT.

6.1 ACCESS TO THE HIDDEN CODES

To access the hidden codes:

1. Simultaneously press and hold the Scroll ▲, Set ▲ and Auto keypad switches for four seconds. When the display shows 1 for Type 1 and 2 drives, and 41 for Type 3 drives, access has been obtained, and hidden code # 1/41 can be set.
2. Refer to the Hidden Codes table at the end of this manual to find the code number of the function you wish to view or change.
3. Press Scroll ▲ to advance the code number from 1/41 to the number that represents the function you wish to change. At first the numbers will scroll slowly, and then more rapidly. Press Scroll ▼ to scroll to a smaller code number.
4. When the desired hidden code number is reached, press Set ▲ or ▼ once to view the present value of the hidden code. This will be a number which will range from 0.0 through 999 depending upon the code and its present value. See the Hidden Codes table for the range of the number and what the number represents.

6.2 CHANGING THE VALUE OF THE HIDDEN CODES

To change the value of the hidden codes:

1. Follow the procedure in Section 6.1 to display the present value of the hidden code.
2. Press Set ▲ or ▼ to begin changing the value. Pressing Set ▲ and holding it will index up to larger values, pressing Set ▼ and holding it will index down to smaller values. The new value will be used immediately in the operation of the drive. For "active settings", if the desired value is initially shown, you must press Set ▲ or the Set ▼ to change the value and then return it to the desired value. This is necessary to establish the relationship between the external signal and the drive's speed.

6.3 ACCEPTING THE NEW VALUE

To accept and use the new value, proceed as described below.

1. After selecting the new value for the hidden code being set, you may accept that value by pressing Scroll ▲ (or Scroll ▼) to move up (or down) to the next hidden code. This saves the new value to the EPROM, and moves to the next hidden code. Repeat the procedure in Sections 6.1 and 6.2 until all the hidden func-

tions are verified or set. If you wish to lock the keypad before exiting the hidden codes mode, after making all other changes, scroll to code 28/78 and press Set ▲ or Set ▼ twice to change the present value of the code from 0 (enabled) to 1 (disabled).

2. Then press Scroll ▲ (or Scroll ▼) to accept the change and Reset to exit the hidden mode. If you locked the Global Keypad enable, this action can be confirmed by looking at the Lockout On LED. If it is illuminated, the keypad is locked out.

6.4 IGNORING THE NEW VALUE

If a new value for a hidden code has been selected, but not written to memory by pressing the Scroll ▲ or Scroll ▼ keypad switches, it can be aborted by pressing the Reset keypad switch. The drive will now be using that new value, but if powered down and powered back up, the old value will again be used. The new value will be lost when power is removed, as it was not written to memory.

6.5 RECALLING THE LAST THREE FAULTS

For diagnostic purposes, the last three causes of a drive fault can be retrieved from memory. To display these proceed as follows:

1. Be sure that the drive has power, but is not running. (Press Off.) None of the fault indicators should be lit.
2. Press and hold the Scroll ▼, Set ▼, and Remote keypad switches simultaneously for four seconds. One or more of the fault indicators should light. They will remain lit for four seconds. This was the most recent fault. After the first fault indicates, the three switches may be released.
3. After four seconds, that fault indicator will go out. After one more second, one or more fault indicators will light. They will remain lit for four seconds. That is the second most recent fault.
4. After four seconds, that fault indicator will go out. After one more second, one or more fault indicators will light. They will remain lit for four seconds. That is the third most recent fault.

6.6 SELECTIVE LOCKOUT

Type 2 and Type 3 drives have additional hidden codes that selectively enable portions of the keypad when the Keypad Lockout is on (Global Keypad Enable is dis-

abled). These additional codes are 32 through 38 on Type 2 drives, and 82 through 88 on Type 3 drives. When the Keypad Lockout is on, these codes may be selectively enabled to allow the user access to portions of the keypad. When the Keypad Lockout is off, these codes have no effect.

SECTION 7 CONTROL OPTIONS

7.1 RS-485 COMMUNICATION

Type 3 drives can be equipped with an optional circuit board that mounts in front of the logic board that makes all of the functions of the operator's control module available to remote locations via RS-485 based network connections.

7.1.1 CABLING AND ELECTRICAL SETUP

The RS-485 standard allows the connection of up to 32 transmitters and 32 receivers on a single or double twisted pair cable of total length not to exceed 1,200 meters or about 4,000 feet. Each motor control constitutes one transmitter and one receiver, as does the master controller. Therefore, each network may contain up to 31 motor controls and one master control. For installations where more than 31 motor controls are required, some master controls may be configured to manage more than one network.

The master control and motor controls may be located anywhere along the cable length. It is recommended that the cable not be longer than is necessary. Branches from the main trunk are not a very good idea, but, if they are required, a maximum of 6 feet may be allowed at the current data transmission rate.

Any twisted pair cable may be used between receiver and transmitter. For noise immunity, we recommend a twisted pair shielded cable with number 22 or 24 AWG conductors and an inter-conductor capacitance of 22 pF per foot or less. All local codes and practices must be followed.

Each end of the trunk must be terminated by a 100 ohm, ¼ watt resistor. This resistor is customer terminal block jumper selectable on the RS-485 option board. It may be connected by jumpering terminals 8 and 9 on the option board terminal block. If a connection is removed from either end of a trunk cable, a terminating resistor MUST be connected to the cable to replace

the one lost by the removed equipment. The RS-485 system is polarity sensitive. To operate correctly, all of the connections to the motor controls must be connected the same way. We suggest that the white or red wire of the pair (depending on the cable) be connected to terminal 7 of the option board and that the black wire be connected to terminal 8. If an RS-232 to RS-485 adapter is being used to connect to the master control, some experimentation may be required to determine the correct connection polarity. All manufacturers do not follow the same conventions. Follow the instructions supplied with the adapter for single pair installations.

Additional notes:

1. A dedicated cable should be used for the RS-485 connections. Do not use a multiple-pair cable to carry other signals on adjacent wire pairs.
2. The cable shield must be continuous along the trunk. At each break in the cable for a motor control, the shields must be soldered together. The shield is to be connected to ground at only one connection, usually at the master controller.
3. The drivers utilized on each motor control are isolation rated at 1200 V from signal wires to ground. The actual signals on the cable are less than 5 volts peak to peak between the pair.

7.1.2 SOFTWARE SETUP

The "node address" of the control must be set. This is done by entering hidden code 57. The control will be shipped from the factory set to zero. For use with RS-485 communication, it must be set to any number from 1 to 31. The master control will be set to 0. Each controller on the network must have a different number. It is not necessary to begin at 1 when assigning numbers and the numbers need not be assigned in sequential order. The master controller will have to be programmed to recognize the relationship between each number and the motor control.

A separate manual will be provided with detailed instructions for RS-485 communication.

7.2 FLOATING POINT CONTROL

Floating point control is available through the optional floating point control circuit board which mounts in front of the logic board. A voltage input or a contact

closure may be used to cause the drive to accelerate (or decelerate) at the set acceleration (deceleration) rate until the signal is removed or the drive reaches maximum (minimum) speed. The voltage may be up to 120 V DC.

To control drive speed, one set of input terminals is used to accelerate the drive, and a second set is used to decelerate the drive. The drive will run at a constant speed when there is no signal on either input.

Drive speed can be controlled either through a local speed command on the control module, a remote signal or the floating point control board. The LOCAL and REMOTE switches on the control module select between these speed commands. To control speed through the floating point control board, simultaneously press and hold the OFF, LOCAL and SCROLL ▼ switches for four seconds. After four seconds, the LED display will show either a "0" or a "1". Press either the Set ▲ or the Set ▼ switch to toggle from "0" to "1". When "0" is selected, the speed control for the drive is through the control module, when "1" is selected, the speed control is through the floating point control input. The factory setting is "0". Select the desired source of speed input signal, and press either RESET, or SCROLL ▲ or SCROLL ▼ to exit the selection mode.

To act upon the signals from the floating point control board, the control module must be set for RUN and REMOTE.

Refer to customer connection diagrams 19-7490-00 and 19-7490-11 for use with contact closure and voltage input respectively.

Don't change
set network

Drive Type ¹

Hidden Codes

1 & 2 3

Code	Code	Function	Purpose
1	41	Volts/Hz	Calibrate line voltage to line Hz.
2	42	Output Current Meter - Minimum Value	Calibrate to 0.0 at zero output
3	43	Output Current Meter - Maximum Value	Calibrate to drive nameplate
	2/42 & 3/43	also set limits of 4 to 20 mA output signal	and sets reference for codes 15/55 and 16/56 below
4	44	Input kW Meter - Minimum Value	Calibrate to 0.3 kW at zero output
5	45	Input kW Meter - Maximum Value	Calibrate to measured or calculated kW at maximum output
6	46	Output Voltage Meter - Minimum Value	Calibrate to 0 volts at zero output
7	47	Output Voltage Meter - Maximum Value	Calibrate to line voltage at 100% output
8	48	Reset Time (from fault occurrence)	Prevent too short a reset time for associated equipment (drive needs no delay)
9	49	Stepover Frequency #1 - Upper Limit	Set highest speed to be avoided
10	50	Stepover Frequency #1 - Lower Limit	Set lowest speed to be avoided
11	51	Stepover Frequency #2 - Upper Limit	Set highest speed to be avoided
12	52	Stepover Frequency #2 - Lower Limit	Set lowest speed to be avoided
13	53	% Speed Output Signal - Minimum	Calibrate to desired level at zero output speed
14	54	% Speed Output Signal - Maximum	Calibrate to desired level at maximum output speed
15	55	% Remote Load Output Signal - Minimum	Calibrate to desired level at zero output speed
16	56	% Remote Load Output Signal - Maximum	Calibrate to desired level at maximum output speed
	57	RS-485 Network node address	Set node address of each drive on RS-485 network
	58	Minimum Speed	Set minimum operating speed for both local and remote
	59	Maximum Speed	Set maximum operating speed for both local and remote
17	67	Auto/Manual Reset - Line Undervoltage	Select auto or manual fault reset
18	68	Auto/Manual Reset - Phase Loss	Select auto or manual fault reset
19	69	Auto/Manual Reset - Line Overvoltage	Select auto or manual fault reset
20	70	Auto/Manual Reset - Bus Overvoltage	Select auto or manual fault reset
21	71	Auto/Manual Reset - Overcurrent	Select auto or manual fault reset
22	72	Auto/Manual Reset - Ground Fault	Select auto or manual fault reset
23	73	Auto/Manual Reset - Overload	Select auto or manual fault reset
24	74	Auto/Manual Reset - Overtemperature	Select auto or manual fault reset
25	75	Auto/Manual Reset - External Fault	Select auto or manual fault reset
26	76	Auto/Manual Reset - Motor Open	Select auto or manual fault reset
27	77	Variable Overload Enable	To taper current trip point with reduced speed to protect motor
28	78	Global Keypad Enable	To enable all Settings (codes 32/82 - 38/88 will selectively enable settings when Global Keypad Enable is disabled)
29	79	Preset Speed Enable	To allow running at a preset speed
30	80	Reverse Enable	To allow running in reverse direction
31	81	Catch a Rotating Motor	To allow the drive to find and synchronize with a rotating motor
32 ²	82	Hand/Off/Auto Keypad Enable	To enable Hand/Off/Auto when globally disabled by Code 28/78
33 ²	83	Local/Remote Keypad Enable	To enable Local/Remote when globally disabled by Code 28/78
34 ²	84	Speed Calibration Min /Max Keypad Enable	To enable Speed Calibration Min/Max when globally disabled by Code 28/78
35 ²	85	Accel/Decel Time Keypad Enable	To enable Accel/Decel Time when globally disabled by Code 28/78
36 ²	86	Preset Speed Keypad Enable	To enable Preset Speed when globally disabled by Code 28/78
37 ²	87	Overload/Current Limit Keypad Enable	To enable Overload/Current Limit when globally disabled by Code 28/78
38 ²	88	Manual Speed Set Keypad Enable	To enable Manual Speed Set when globally disabled by Code 28/78
39 ²	89	Frequency Select	Sets drive output frequency at 100% speed

¹ See page 16 to determine drive type ² Not on Type 1 drives. See Section 6.6

Drive Type ¹

1 & 2 3

Hidden Codes

Code	Code	Range	Calibration/Units	Factory Setting
1	41	0 through 31	0 » 8% below line voltage 31 » 1% above line voltage	460 V at 60 Hz
2	42	0.0 through 999	Amps	0.0 at zero output
3	43	0.0 through 999	Amps	Drive current at 100%
4	44	0.0 through 999	Kilowatts	0.3 kW at zero output
5	45	0.0 through 999	Kilowatts	Maximum kW calculated
6	46	0.0 through 600	Volts	0.0 V at zero output
7	47	0.0 through 600	Volts	Output voltage at 100%
8	48	0 through 300	Seconds	60 seconds
9	49	0 through 100 ³	%	0 %
10	50	0 through 100 ³	%	0 %
11	51	0 through 100 ³	%	0 %
12	52	0 through 100 ³	%	0 %
13	53	0 through 255	0 = 0 mA; 255 = 25 mA	4 mA
14	54	0 through 255	0 = 0 mA; 255 = 25 mA	20 mA
15	56	1 through 255 ³	0 = 0 mA; 255 = 25 mA	4 mA
16	56	1 through 255 ³	0 = 0 mA; 255 = 25 mA	20 mA
	57	0 through 31	Node address	0
	58	5 through 115	% of base speed	10 for fans; 30 for pumps
	59	5 through 115	% of base speed	100
17	67	0 and 1	0 = Manual Reset; 1 = Auto Reset	Auto
18	68	0 and 1	0 = Manual Reset; 1 = Auto Reset	Auto
19	69	0 and 1	0 = Manual Reset; 1 = Auto Reset	Auto
20	70	0 and 1	0 = Manual Reset; 1 = Auto Reset	Auto
21	71	0 and 1	0 = Manual Reset; 1 = Auto Reset	Manual
22	72	0 and 1	0 = Manual Reset; 1 = Auto Reset	Manual
23	73	0 and 1	0 = Manual Reset; 1 = Auto Reset	Manual
24	74	0 and 1	0 = Manual Reset; 1 = Auto Reset	Manual
25	75	0 and 1	0 = Manual Reset; 1 = Auto Reset	Manual
26	76	0 and 1	0 = Manual Reset; 1 = Auto Reset	Auto
27	77	0 and 1	0 = Enables; 1 = Disables	Disable
28	78	0 and 1	0 = Enables; 1 = Disables	Disable
29	79	0 and 1	0 = Enables; 1 = Disables	Enable
30	80	0 and 1	0 = Enables; 1 = Disables	Disable
31	81	0 and 1	0 = Enables; 1 = Disables	Enable
32	82	0 and 1	0 = Enables; 1 = Disables	Enable
33	33	0 and 1	0 = Enables; 1 = Disables	Enable
34	84	0 and 1	0 = Enables; 1 = Disables	Disable
35	85	0 and 1	0 = Enables; 1 = Disables	Disable
36	86	0 and 1	0 = Enables; 1 = Disables	Disable
37	87	0 and 1	0 = Enables; 1 = Disables	Disable
38	88	0 and 1	0 = Enables; 1 = Disables	Enable
39	89	0 and 1	0 = 60 Hz input; 1 = 50 Hz input	60 Hz

³ Must be within limits of minimum and maximum speed settings. Set all to 0 or minimum speed to disable.

2001 Settings Worksheet

		Description	Initial Setting	Final Setting	Comments
		SPEED SIGNAL CAL (MIN)			
		SPEED SIGNAL CAL (MAX)			
		ACCEL TIME			
		DECEL TIME			
		PRESET SPEED SETTING			
		OVERLOAD			
		CURRENT LIMIT			
		MANUAL SPEED SET			
Type 1 and 2 Drive	Type 3 Drive	Hidden Settings Access Using SCROLL▲ SET▲ AUTO			
1	41	* V/HZ			
2	42	* OUT CURR METER MIN			
3	43	* OUT CURR METER MAX			
4	44	* INPUT KW METER MIN			
5	45	* INPUT KW METER MAX			
6	46	* OUT V METER MIN			
7	47	* OUT V METER MAX			
8	48	AUTO RESET TIME			
9	49	STEPOVER 1 UPER LIMIT			
10	50	STEPOVER 1 LOWER LIMIT			
11	51	STEPOVER 2 UPPER LIMIT			
12	52	STEPOVER 2 LOWER LIMIT			
13	53	% SPD OUT SIG MIN			
14	54	% SPD OUT SIG MAX			
15	55	% LOAD OUT SIG MIN			
16	56	% LOAD OUT SIG MAX			
	57	RS-485 ADDRESS			
	58	MINIMUM SPEED			
	59	MAXIMUM SPEED			
17	67	AUTO RESET - UC			
18	68	AUT RESET - PL			
19	69	AUTO RESET - LINE OV			
20	70	AUTO RESET - BUS OV			
21	71	AUTO RESET - OC			
22	72	AUTO RESET - GND FLT			
23	73	AUTO RESET - OL			
24	74	AUTO RESET - OT			
25	75	AUTO RESET - EXT FAULT			
26	76	AUTO RESET - OUT OPEN			
27	77	VARIABLE OL ENABLE			
28	78	KEYPAD ENABLE			
29	79	PRESET SPEED ENABLE			
30	80	REVERSE ENABLE			
31	81	CATCH ROTATING MTR EN.			
32	82	H/O/A KEYPAD ENABLE			
33	83	LOC/REM KEYPAD ENABLE			
34	84	SPEED CAL SET ENABLE			
35	85	ACCEL/DECEL SET ENABLE			
36	86	PRESET SPEED SET EN.			
37	87	OL/OC SET ENABLE			
38	88	MAN SPEED SET ENABLE			
39	89	50/60 HZ SELECT			

* These settings should not be changed during a normal start-up.



Graham Company

8800 West Bradley Road / P. O. Box 23880
Milwaukee, Wisconsin 53223-0880 U. S. A.
Phone: 414/355-8800 Fax: 414/355-6117