Installation, Operation and Maintenance Manual

Adjustable Frequency Drive

1703 Series 7.5 through 100 Amp

9/00 Revision A

23-6088-00

⚠ 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.

Federal Communications Commission
Radio Frequency Interference Statement

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. The user is cautioned that any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the 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 Service Department.

Table of Contents

List of Illustrations

GENERAL

This operation and maintenance manual provides the necessary installation, adjustment and maintenance procedures for the 7.5 through 100 amp Graham Series 1703 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 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 -40°F (-40°C) and 185°F (+85°C). The relative humidity should not exceed 95%. 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 should be lifted using hooks or clevis pins through the lifting holes in the mounting rails.

⚠WARNING

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

SECTION 1. INSTALLATION

1.1 MOUNTING

The 1703 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 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 until it is time to wire the drive.

The following minimum clearances are recommended:

	Thru 21 amp	28 thru 77 amp	100 amp
To bottom of enclosure	6"	6"	6"
To right side of enclosure	6"	10"	15"
To left side of enclosure	6"	10"	15"
To top of enclosure	3"	3"	3"
To front of enclosure	19"	19"	19"
To back of enclosure	Mounting rails supply necessary clearance		

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 -20°C to 40°C (-4°F to 104°F). The drive should not be operated outside these extremes.

1. If the ambient will be below -20°C, Graham should be notified so a space heater can 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.

1703 Series drives are cooled by fan(s) drawing air through slots in the standard enclosure and across the heatsink. The slots must never be restricted in any way. The slots were covered for shipping. The covering material must be removed before operating the drive.

⚠DANGER

FLAMMABLE MATERIALS MUST BE KEPT AWAY FROM THE ENCLOSURE.

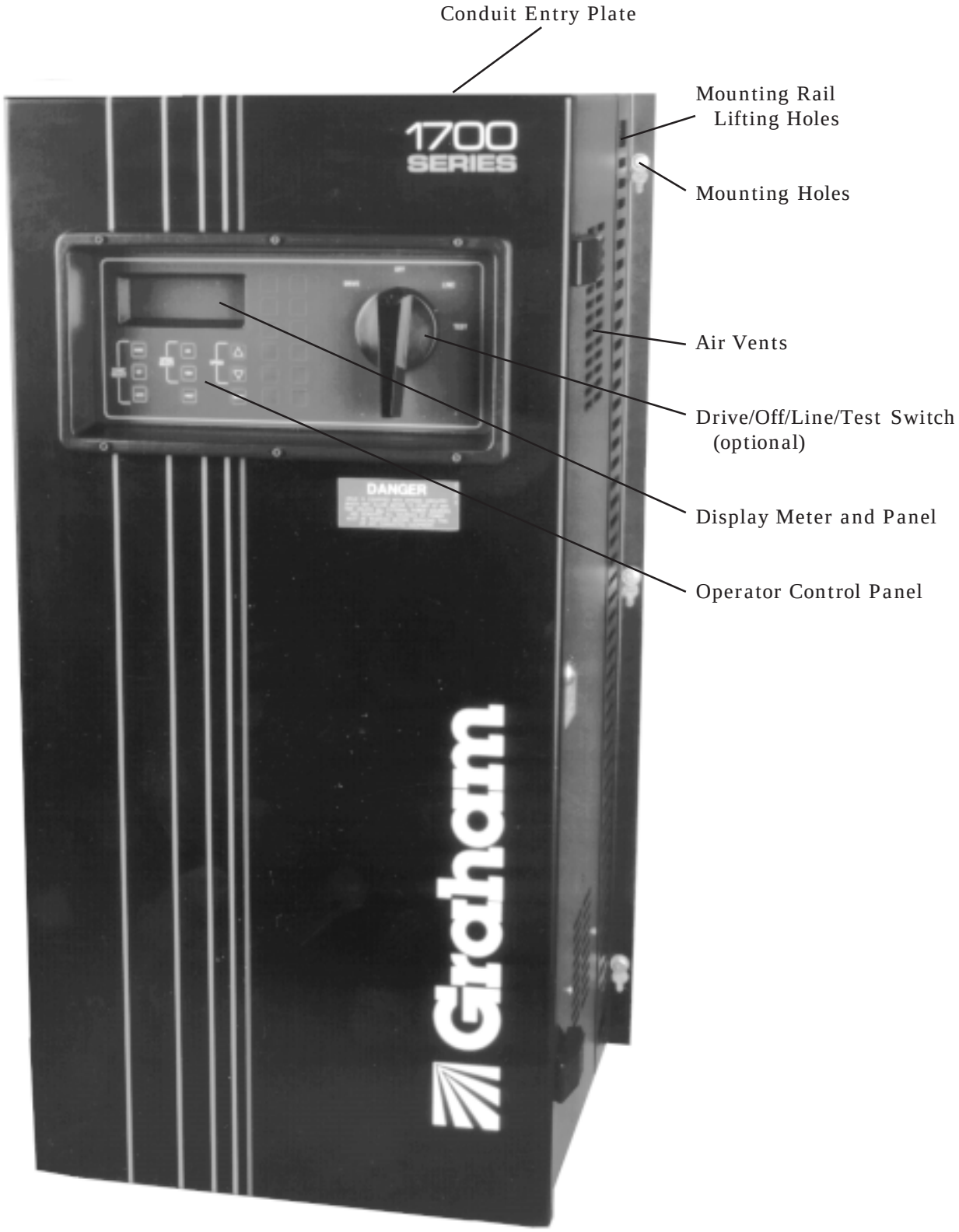
The drive must be installed in a clean, dry environment unless special enclosure provisions are provided. Periodically, the drive should be cleaned using a vacuum cleaner and a soft, long-bristled brush. Lightly brush the dust from the drive components with the brush and use the vacuum cleaner to remove 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.

⚠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 "BUS POWER" LED EXTINGUISHES BEFORE TOUCHING ANY INTERNAL COMPONENTS. THEN, USING A VOLTMETER ON THE 100 VOLT DC SCALE, MEASURE THE VOLTAGE FROM JACK J2 TERMINAL 9 (+) TO JACK J1 TERMINAL 6 (-) ON THE CONTROL BOARD TO VERIFY THAT ALL VOLTAGES HAVE DISSIPATED BEFORE SERVICING THE DRIVE.



TYPICAL 1703 SERIES

SECTION 2. WIRING

2.1 INPUT VOLTAGE

The drive can be setup to operate on a broad range of voltages. It was factory set to operate on the voltage shown on the nameplate. Check the drive nameplate for the proper input and output voltages before wiring the drive. If the input voltage shown on the nameplate is different than the voltage available, the drive may be changed by reconnecting the leads from the control transformer as shown below.

⚠CAUTION

CONTACT GRAHAM BEFORE CHANGING THE INPUT VOLTAGE CONNECTION.

On drives rated 21 amps or less, the P, S, and N connection taps are located either on the power board or on the snubber board. On all drives above 21 amps, the connection taps are on the snubber board.

H1 through H8 are the transformer taps. They are color coded as shown below.

Line Voltage	Transformer Wire H1 White	H2 Red	H3 Orange	H4 Yellow	H5 Green	H6 Blue	H7 Purple	H8 Grey
200/208	P3	P1	N1	P4	P2	N2	N3	N4
230	P3	N1	P1	P4	N2	P2	N3	N4
380	P3	N1	S1	S2	N2	N3	N4	P1
415	P3	S2	N1	S1	P1	N2	N3	N4
460	P3	N1	S1	S2	N2	P1	N3	N4
575*	P3	N1	S1	S2	N2	N3	P1	N4

*See warning below

⚠WARNING

A DRIVE NAMEPLATED FOR 460VAC OR LESS MUST NOT BE RECONNECTED FOR 575VAC INPUT VOLTAGE. DAMAGE TO THE DRIVE POWER COMPONENTS CAN RESULT FROM IMPROPER VOLTAGE CONNECTIONS.

A drive nameplated for 575 V AC may be reconnected for any of the lower voltages. Some 575 V AC drives rated 21 amps or less will have only the H1, H3, H4 and H7 connections. Connect these as shown in the table above.

⚠CAUTION

REDUCING THE INPUT VOLTAGE WILL REDUCE THE HORSEPOWER CAPABILITY OF THE DRIVE.

Selecting different input and output voltages may damage the drive or motor or both and will result in improper operation of the system.

2.2 GROUND CONNECTIONS

A yellow and green grounding terminal (4TB1) is provided 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

The drive may be supplied with or without an input disconnect and input fuses. Size the input disconnect and fuses to handle the Drive Input Current rating shown in the table on page 9. Input fuses are not required to protect the drive. Special fast acting fuses should not be used.

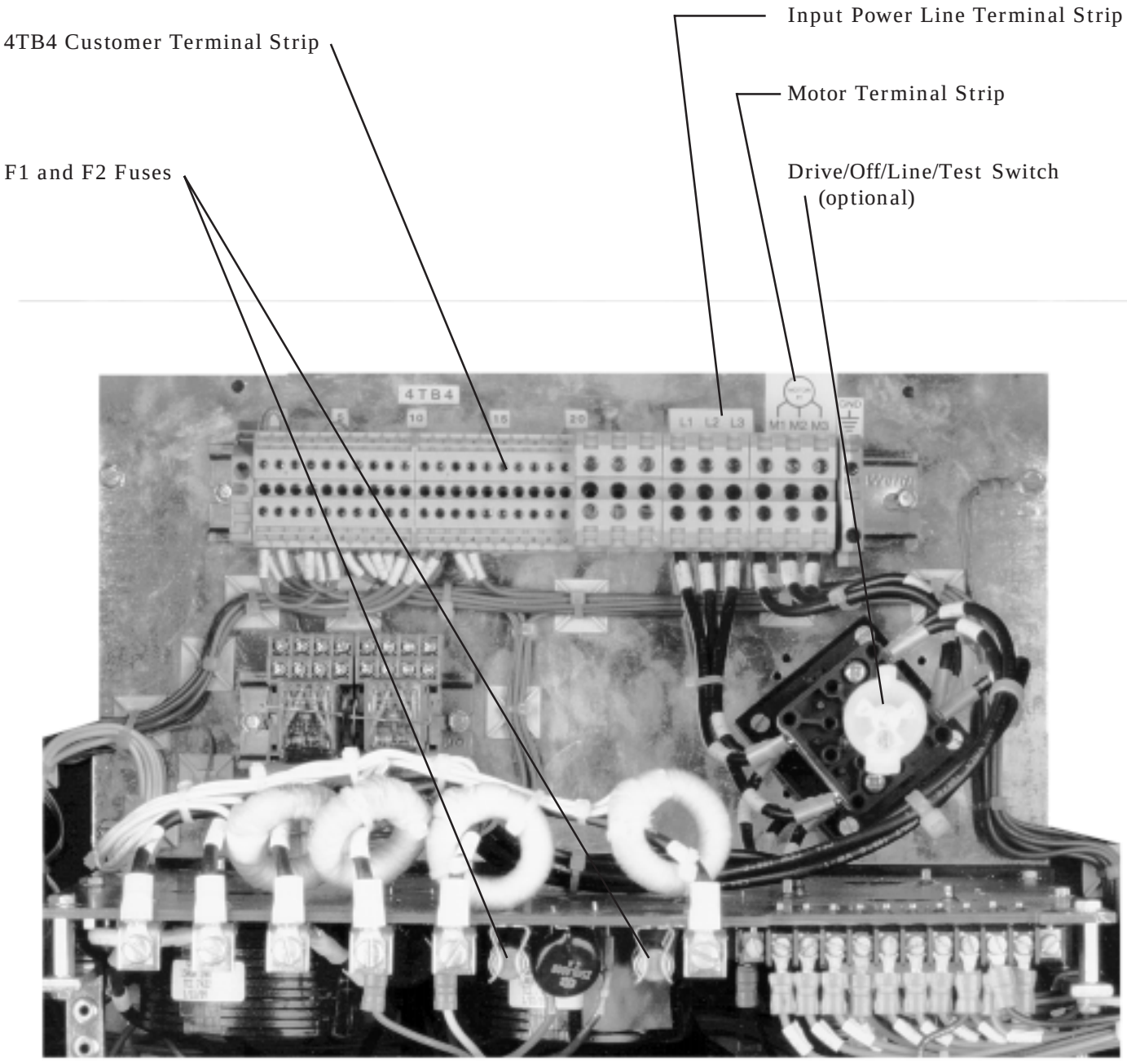
2.4 ISOLATION TRANSFORMER

If an isolation transformer is used, size it from the table on page 9.

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

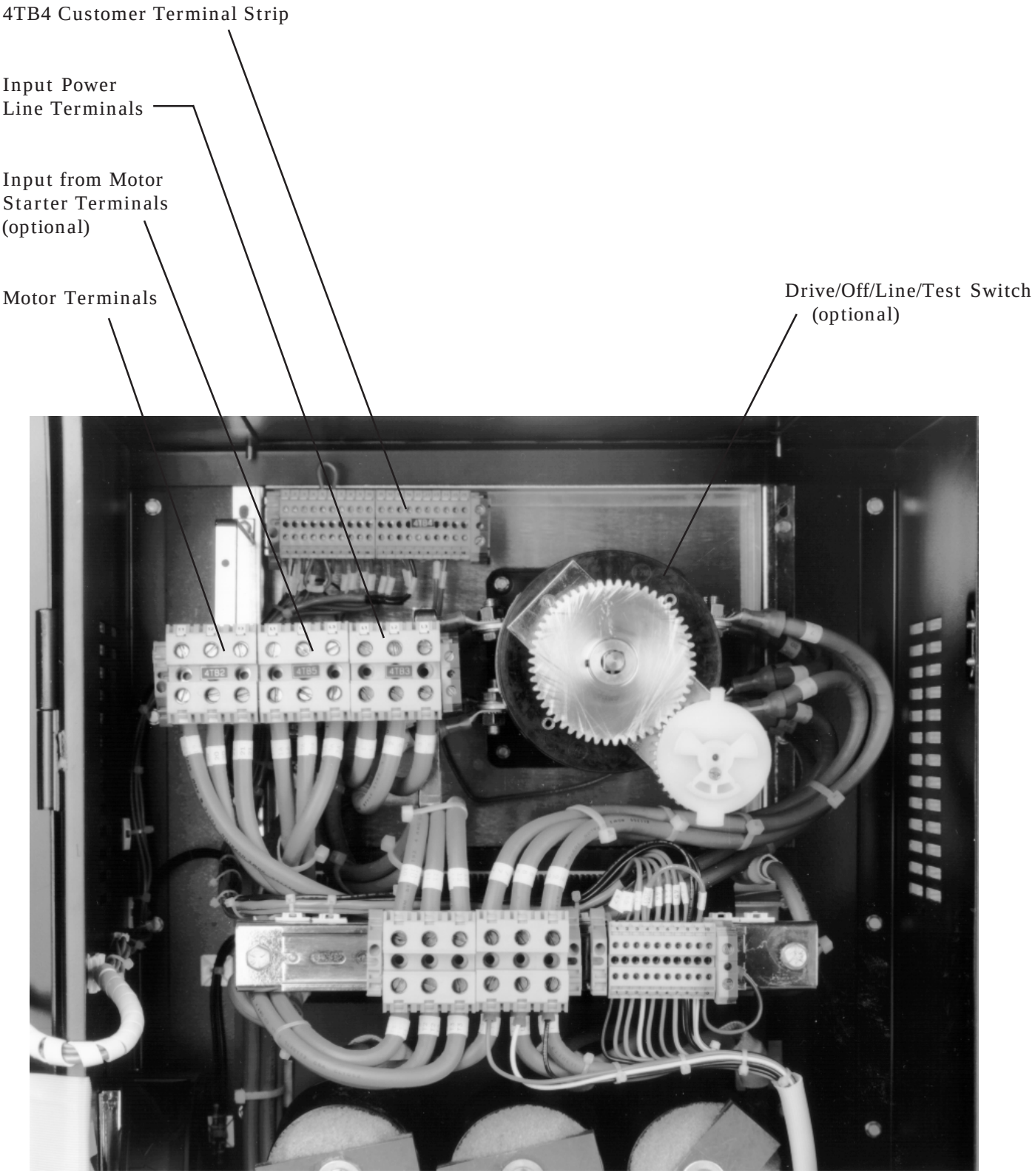
TO AVOID DAMAGE TO THE DRIVE, DO NOT OPEN OR CLOSE ANY DISCONNECT ON THE PRIMARY SIDE OF THE TRANSFORMER UNTIL AFTER THE DISCONNECT ON THE SECONDARY SIDE IS OPENED.



Older drives were built as shown here. Newer drives of 21 amps or below do not have a separate power board. The customer connections for these drives and all drives larger than 21 amps are shown on page 6.

TYPICAL OLDER 1703 SERIES, MODELS 21 AMPS AND BELOW
Customer Connections

See page 5 for older drives of 21 amps or less.



TYPICAL 1703 SERIES
Customer Connections

2.5 INPUT WIRING

Input wire types and sizes must be selected based upon conformance with the National Electrical Code and all local codes and restrictions. See table on page 9 for power wiring and ground wiring sizes.

2.6 OUTPUT WIRING

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 9 for power wiring and ground wiring sizes.

⚠CAUTION

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. Interlock contacts should be installed in series with terminals 5 and 6 of terminal strip 4TB4.

⚠WARNING

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

2.8 CONDUIT ENTRY

All 1703 model drives are designed for conduit entry at the top of the enclosure. A removable conduit entry plate is provided for ease of installation.

1. Mark the location of the conduit entries for input power, motor wiring and control wiring on the conduit entry plate.
2. Remove the conduit entry plate.
3. Drill the conduit entry holes in the plate.
4. Reinstall the plate on the drive and connect the conduit to the plate.

⚠WARNING

DO NOT DRILL, SAW, FILE OR PERFORM ANY OPERATION ON THE DRIVE ENCLOSURE OR CONDUIT ENTRY PLATE 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 120 volt AC) are terminated on terminal strip 4TB4. Shielded cable should be installed for all low voltage DC control signal wiring. The shield of the cable must be connected to the negative terminal for the control signal. Do not connect the shield at the other end of the cable. Insulate the shield so that no electrical connection is made at the other end of the cable.

⚠WARNING

NEVER CONNECT THE SHIELD TO EARTH GROUND.

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

2.10 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 13(+) and 14(-) of terminal strip 4TB4. These connections are used for both DC voltage and current input signals. Selection of the type of follower to be used is made by the position of the SW2 switch labeled 4-20mA as shown below.

Signal	Range	SW2 (4-20mA)
Current Input	0 to +40mA	On
Voltage Input	0 to +40VDC	Off

The voltage and current input circuits are electrically isolated from chassis ground by 1,000 ohms.

⚠WARNING

APPLICATIONS REQUIRING MORE THAN 24 V DC ISOLATION FROM EARTH GROUND OR A HIGH INPUT IMPEDANCE SHOULD SPECIFY A GRAHAM REFERENCE SIGNAL ISOLATOR.

The input impedance of the current follower circuit when connected across terminals 13 and 14 of 4TB4 and switch SW2 is in the 4 to 20mA position is 220 ohms. When SW2 is OFF, the input impedance is greater than 10 k ohms.

If a current transducer is supplied utilizing a traditional control with power supply (four wire system), the input signal is terminated as instructed above.

If a potentiometer, such as a 135 ohm potentiometer, was specified for use with the drive when it was ordered, refer to the customer connection diagram. If the drive is to be field modified to use a potentiometer, follow the table below.

Potentiometer Connection	Connection
+ 24 V DC	Control board jack J7 Pin 15
Wiper	4TB4 terminal 13
Negative	4TB4 terminal 14
Shield	4TB4 terminal 14

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

NOTE: CONNECTION OF POTENTIOMETERS RANGING IN VALUE FROM 135 TO 5,000 OHMS CAN BE ACCOMMODATED BY THE INSTALLATION OF A RESISTOR IN SERIES BETWEEN J7 PIN 15 AND THE POSITIVE SIDE OF THE POT. THIS SHOULD BE SIZED TO LIMIT THE POTENTIOMETER CURRENT TO LESS THAN ITS RATED VALUE. IN NO CASE SHOULD THE POTENTIOMETER CURRENT BE MORE THAN 25 mA.

All signals are direct acting only. This means that the minimum reference signal corresponds to minimum drive speed and the maximum reference signal corresponds to maximum speed. The minimum and maximum speeds corresponding to the input reference signal are adjustable by adjusting the MIN SPEED and MAX SPEED potentiometers. See Section 6.

2.11 RUN AND FAULT CONTACTS

Two Form C contacts (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 4TB4 as shown.

Relay	Contacts	4TB4 Pin #
RUN	N.O.	10 & 11
RUN	N.C.	11 & 12
FAULT	N.O.	8 & 9
FAULT	N.C.	7 & 8

The contacts are rated 120 V AC, 2 amps.

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

The FAULT relay drops out in the event of a fault condition.

2.12 REMOTE RUN/STOP

A customer supplied normally open remote switch may be wired to 4TB4 terminals 3 and 4 to start and stop the drive from a remote point when the drive is in the "Auto" mode.

2.13 REMOTE SAFETY INTERLOCK

A customer supplied normally closed safety interlock contact may be wired to 4TB4 terminals 5 and 6 to automatically stop the drive when the drive is either in the "Hand" or "Auto" mode in case of an emergency. The drive will restart when the safety interlock resets.

2.14 SPEED SIGNAL OUTPUT

A 0 to 10 V DC speed signal output is available on 4TB4 terminals 1 and 2. Use this to show a remote speed indication. Use shielded wire and connect the shield to 4TB4 terminal 2.

⚠WARNING

THIS SIGNAL IS NOT AVAILABLE ON ALL DRIVES. ON SOME DRIVES, TERMINALS 1 AND 2 HAVE A CONSTANT 115 V AC. CHECK THE WIRING NUMBERS TO BE SURE WHICH YOU HAVE. IF THE WIRE NUMBERS ARE 42 AND 30 TO TERMINALS 1 AND 2, THIS IS A 115 V AC CIRCUIT. IF THE WIRE NUMBERS ARE 66 AND 67, IT IS A 0

TO 10 V DC SPEED SIGNAL OUTPUT. FAILURE TO CONFIRM WHICH OUTPUT YOU HAVE COULD CAUSE AN ELECTRICAL SHOCK HAZARD, DAMAGE THE CONNECTED EQUIPMENT OR BOTH.

2.15 TORQUE SPECIFICATIONS

All of the screws on the field terminal connections must be torqued according to the tables to the right. Two different types of terminal blocks may be used. If the terminal blocks are beige colored, they are manufactured by Siemens and must be tightened per the first table. If the blocks are gray colored, they are manufactured by Entrelec or Woertz and must be tightened per the second table.

Siemens	Torque (lb-in)		
Drive Output Amp Rating	4TB1	4TB2 4TB3, 4TB5, 4TB6 & 4TB7	4TB4
34 A or less	7	10.6	4.4
Above 34 A	7	26.5	4.4

Woertz/Entrelec	Torque (lb-in)		
Drive Output Amp Rating	4TB1	4TB2 4TB3, 4TB5, 4TB6 & 4TB7	4TB4
34 A or less	31.5 to 35.0	31.5 to 35.0	7.2 to 8.0
Above 34 A	31.5 to 35.0	45.0 to 50.0	7.2 to 8.0

Drive Currents, and Isolation Transformer Sizing Table

Nominal 460 V AC Motor HP	Drive [1] Input Current (amperes)	Drive [2] Output Current (amperes)	Minimum Power and Ground Wiring Size (AWG)	Minimum Isolation [3] Transformer Size (kVA) Drive	Drive w/bypass
5	12	7.6	14	11	11
7½	15	11	12	14	15
10	19	15	10	20	20
15	26	21	8	27	34
20	34	28	8	34	34
25	40	34	8	40	51
30	42	40	6	40	63
40	57	53	4	51	63
50	73	65	3	75	93
60	79	77	3	75	93
75	100	100	1	93	145

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 40,000 RMS symmetrical amperes, 575 V AC maximum.

1 Input current measured using a 460 V AC , 2500 kVA, 7% impedence transformer. Actual input current will vary with transformer size.

2 Refer to “Output Drive Current” rating on the plastic cover over the control board for this value. Values are based on true RMS amps.

3 Isolation transformer sizing is based on 460 V AC input for drives without bypass. Consult Graham for other input voltages. isolation transformaers must be designed for use with adjustable frequency drives.

SECTION 3.

OPERATOR CONTROLS

The following controls, displays and indicators are located on the operator control panel on the door of the 1703 Series drives. This panel consists of soft touch membrane switches, a 3½ digit backlit LCD display and status indicating LCDs. On newer displays, the back light will automatically turn itself off after a few minutes of inactivity. To turn on the back light, press any of the membrane switches.

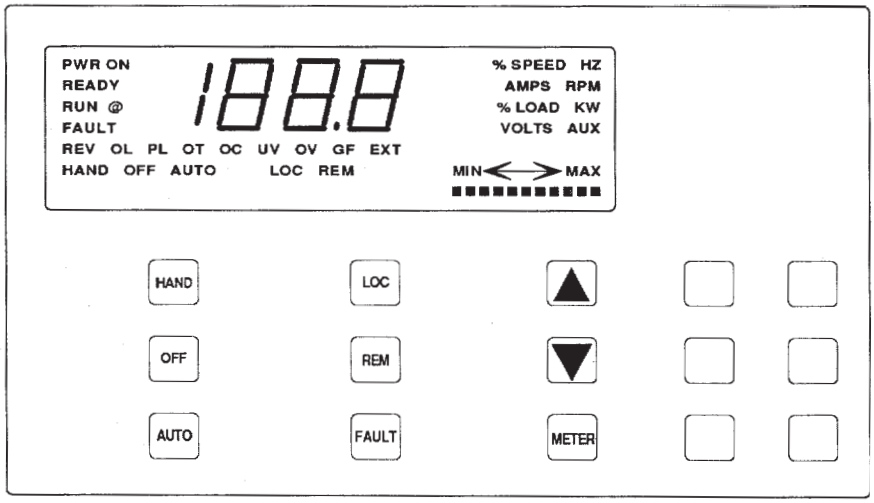
3.1 SWITCHES

3.1.1 START SELECT SWITCHES

The start select switches consist of three membrane switches (HAND, OFF, AUTO). The start/stop functions of the drive are controlled using these switches and the customer's remote start/stop contacts connected in series with terminals 3 and 4 of terminal strip 4TB4.

HAND - The drive is commanded to energize the run relay and start. In the HAND position any customer interconnect contacts connected to 4TB4 terminals 3 and 4 will be overridden. The HAND LCD on the display panel will be visible.

OFF - The drive is commanded to stop. In the OFF position any customer interconnect contacts connected to 4TB4 terminals 3 and 4 will be overridden. The OFF LCD on the display panel will be visible.



Operator Control Panel and Readouts

AUTO - The drive is commanded to start only if the customer interlock contacts connected to 4TB4 terminals 3 and 4 are closed. The AUTO LCD on the display panel will be displayed.

3.1.2 SPEED SELECT SWITCHES

The speed select switches consist of two membrane switches (LOC, REM). These switches select the speed reference input to be tracked.

LOC - In the LOCAL position, drive speed is controlled with the SPEED switches (▲, ▼) on the operator panel. The LOC LCD on the display panel will be visible.

REM - The REMOTE selection commands the drive to track the speed commands being provided from the customer's control system on 4TB4 terminals 13 and 14. This input can be a voltage or current signal. In the REMOTE mode, the REM LCD on the display panel will be visible.

3.1.3 SPEED SWITCHES

The speed switches consist of two membrane switches (▲,▼) which are used to increase and decrease the drive speed command when the LOCAL mode is selected. The LOC LCD must be displayed for the switches to control drive speed. As the speed command is changed using the up or down buttons, the "MIN <—> MAX" display will light more or fewer LCD segments.

▲ - Increase speed command in LOCAL mode

▼ - Decrease speed command in LOCAL mode

3.1.4 METER SELECT SWITCH

The meter select membrane switch is used to step through the LCD display meter functions. As the different meter functions are selected, their signals will be displayed on the 3½ digit LCD display and the meter function selected will display that specific LCD section. The meter function LCDs will only remain displayed if that meter function has been installed. The meter display sequence is:

% SPEED
% LOAD

VOLTS
AMPS
Hz
RPM
KW
AUX

If the optional displays are not installed, the meter sequence will pause at that display momentarily and then cycle to the next display. Standard meter functions displayed are % SPEED, % LOAD and VOLTS (output voltage).

3.2 OPTION SWITCHES

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

3.2.1 DRIVE INPUT DISCONNECT SWITCH (optional)

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.

⚠DANGER

THE DRIVE DISCONNECT SWITCH DOES NOT REMOVE POWER TO THE MOTOR OR THE BYPASS CIRCUITS IF THE BYPASS PROVIDED IS A DRIVE/OFF/LINE TRANSFER SWITCH USING A CUSTOMER PROVIDED MOTOR STARTER.

3.2.2 BYPASS DISCONNECT SWITCH (optional)

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 DISCONNECT SWITCH FEEDING THE DRIVE ENCLOSURE.

3.2.3 MAIN DISCONNECT SWITCH (optional)

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.

3.2.4 DRIVE/OFF/LINE TRANSFER SWITCH (optional)

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. For dual motor applications, two DRIVE/OFF/LINE switches are used. If either switch is in the OFF position, the drive will not run.

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 from the drive.

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 opera-

tion is now full speed (no variable speed control) when the customer's motor starter is energized.

3.2.5 DRIVE/OFF/LINE/TEST TRANSFER SWITCH (optional)

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 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 controls 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.

⚠DANGER

DO NOT OPERATE ANY OF THE STANDARD OPTION SWITCHES 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.

3.2.6 INTERLOCKED CONTACTOR BYPASS (optional)

Interlocked contactor bypass is the use of two interlocked conventional motor starter contactors to provide the ability to transfer the motor to full speed operation in the event of a drive fault or during maintenance. This circuitry can be operated manually or automatically. When the drive is equipped with this option, the front panel has three additional switches and three additional panel indicator lamps labeled DRIVE, OFF and LINE.

The DRIVE/OFF/LINE selector switches allow 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. (LINE)

DRIVE - The motor operates with variable speed operation from the drive. The 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 OFF lamp on the front panel is illuminated. The drive contactor and the line contactor are disabled.

LINE - The motor operates at a constant speed from the motor starter connected to the utility power line. The LINE 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 backfeeding of utility power to the drive.

AUTO TRANSFER (If provided) Automatic transfer to the bypass mode (LINE) 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 LINE contactor is en-

ergized. At the time the LINE 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 backfeeding.
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 4TMR3 in the bypass circuitry.

3.2.7 TRANSFER SWITCH MOTOR SELECTION (optional)

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.

⚠WARNING

DO NOT TURN THIS SWITCH UNLESS THE DRIVE AND BOTH MOTORS ARE STOPPED

This switch is interlocked with the drive to shutdown the drive if the switch is turned while the drive is running.

3.2.8 CONTACTOR MOTOR SELECTION (optional)

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 a customer contact closure.

SECTION 4.

EXTERNAL DRIVE STATUS INDICATORS

The external drive status LCD indicators appear on the door mounted panel display to the left and below the 3½ digit LCD display.

4.1 POWER ON indicates the 120 V AC control power of the drive is energized.

4.2 READY indicates that the drive power-up sequence has been successfully completed. There are no drive faults. This indicator will go out when the drive is in the run mode.

4.3 RUN indicates that the drive is in the run mode and there are no drive faults.

4.4 @ indicates that the drive circuits have reached and synchronized with the commanded speed reference signal. The AT SPEED indicator displays only when speed synchronization is maintained.

NOTE: IF THE SPEED CONTROL SIGNAL IS UNSTABLE, SPEED OSCILLATIONS (HUNTING) WILL CAUSE THIS LCD TO FLASH ON AND OFF.

4.5 REV indicates the internal drive switch which determines motor rotation direction has been activated to REVERSE the direction of the motor's rotation. This indicator should not be displayed for single direction applications.

⚠CAUTION

FOR SINGLE DIRECTION 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.

4.6 FAULT displays to indicate that a fault condition exists from the OL, PL, OC, UV, OV, GF or EXT fault circuits.

4.7 OL displays when the OVERLOAD circuit is activated due to excessive current being drawn by the motor.

Potential causes of this fault trip 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.

After eliminating the cause, reset an overload fault by switching the drive to stop mode and then restarting. An overload fault cannot be reset automatically or by the optional fault switch.

4.8 PL flashes on and off if the L1 input line phase is low or missing. The PHASE LOSS LED should not be visible if the voltage on L1 phase is within tolerance.

NOTE: IF PHASE L2 OR L3 IS LOW IN VOLTAGE OR MISSING, THE 120 VAC CIRCUITS OF THE DRIVE ARE DE-ENERGIZED AND THE DRIVE WILL SHUT DOWN. THE PL LED DOES NOT DISPLAY FOR THESE CONDITIONS.

See Section 7.2.5 for information on resetting this fault.

4.9 OT displays if the internal thermostats of the drive see an OVER TEMPERATURE. There are two thermostat circuits.

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

If this fault circuit activates, check to ensure:

1. All drive fans are functioning properly.
2. The air flow paths 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.
6. The filters, if supplied, are clean and clear.

This fault automatically resets when the drive cools down.

4.10 OC displays if the OVERCURRENT circuit is activated. An OVERCURRENT trip indicates a short circuit in the inverter section of the drive or in the motor wiring, or the drive was subjected to a severe surge of input or output current.

If this circuit trips check:

1. The motor and motor wiring for a short from phase to phase or phase to ground.
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 SCRs SCR1, SCR2, SCR3, SCR4, SCR5 and SCR6 for a short or open circuit or bad gate sections.
7. Check the conduction or commutation transistors in the Q1/Q2 module for a short or open circuit.
8. Check the commutation power supply fuse F3 on the snubber board.

See section 7.2.4 for information on resetting this fault.

4.11 UV displays when the UNDERVOLTAGE circuit is activated due to a loss of power (blackout), low voltage (brownout) or loss of phase L2 or L3 power. The LCD will display when power is restored.

If the UNDERVOLTAGE circuit activates check:

1. The incoming line voltage is less than 90% of nominal.
2. Momentary 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.

See Section 7.2.3 for information on resetting this fault.

4.12 OV is displayed when the inverter output OVERVOLTAGE circuit is activated by a regenerating motor. The rotation of a motor in excess of the drive's commanded speed, or in the reverse direction of the drive's commanded rotation causes the motor to act as a generating power source. This "backfeeding" of power causes the OVERVOLTAGE fault circuit to trip if the drive output voltage levels become excessive.

NOTE: THIS OV CIRCUIT DOES NOT MONITOR OR PROTECT AGAINST HIGH POWER LINE VOLTAGES.

OV 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.

See Section 7.2.2 for information on resetting this fault.

4.13 GF displays if the motor or its wiring GROUND FAULTS by short circuiting or arcing to ground. See Section 7.2.1 for information on resetting this fault.

4.14 EXT displays if the motor overload is tripped or if drive sees an open circuit in the EXTERNAL fault circuitry supplied by the customer wiring terminated on 4TB4 terminals 5 and 6. This circuitry includes the customer's emergency shutdown interlocks such as the fire alarm contact, freeze stats, high pressure cutout contacts, etc.

⚠DANGER

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

4.15 LAMP TEST/HIGH VOLTAGE

Immediately upon applying power, all fault indicators and the READY, RUN, TEMP and @ LCDs will display briefly as a lamp test.

If the input line voltage from the utility is excessively high, the individual fault, READY, RUN, TEMP and @ LCDs will display and remain on.

4.16 METER DISPLAY INDICATORS

When the meter select switch is pressed and released, it will step to the next meter display. The appropriate meter display indicator will display to indicate which function is currently shown on the LCD display. The meter function indicators are: % SPEED, AMPS, % LOAD, VOLTS, Hz, RPM, kW and AUX. If the meter function is not installed, that function will display briefly and then cycle to the display.

4.17 MIN <—> MAX

The MIN <—> MAX speed indicator is a bar scale that displays additional LCD segments as the local speed command to the drive is increased and extinguishes segments as the speed command is decreased.

NOTE: THE DRIVE SPEED IS SHOWN ON THE LCD DISPLAY AS % SPEED.

SECTION 5.
INTERNAL DRIVE STATUS INDICATORS

Many of the drive status indicators are displayed both internally and externally. The following circuits are displayed in this dual indicator form.

Circuit	Internal LED	Normal Status of Internal LED
READY	YELLOW	On in READY mode - see 4.2
AT SPEED	YELLOW	On when AT SPEED - see 4.4
RUN	GREEN	On in RUN - see 4.3
TEMP	GREEN	On normally - see 4.9
FAULT	RED	On in FAULT - see 4.6
OLI	RED	On in OVERLOAD - see 4.7
OCI	RED	On in OVERCURRENT - see 4.10
OVI	RED	On in OVERVOLTAGE - see 4.12
UVI	RED	On in UNDERVOLTAGE see 4.11
PLI	RED	On in PHASE LOSS - see 4.8
GFI	RED	On in GROUND FAULT see 4.13

Additional status indicators are provided internally only to indicate BUS PWR, COMM P.S., COMM DRIVE, COND DRIVE and RUN CMD.

5.1 BUS PWR 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

5.2 COMM P.S. is a green LED that is illuminated when the COMMUTATION POWER SUPPLY is energized. This LED should be on any time that input power is supplied to the drive.

⚠DANGER

DO NOT ATTEMPT TO START THE DRIVE IF THE COMM P.S. LED IS NOT ILLUMINATED. DRIVE DAMAGE CAN OCCUR IF ATTEMPTS ARE MADE TO OPERATE THE DRIVE WITHOUT A COMMUTATION POWER SUPPLY.

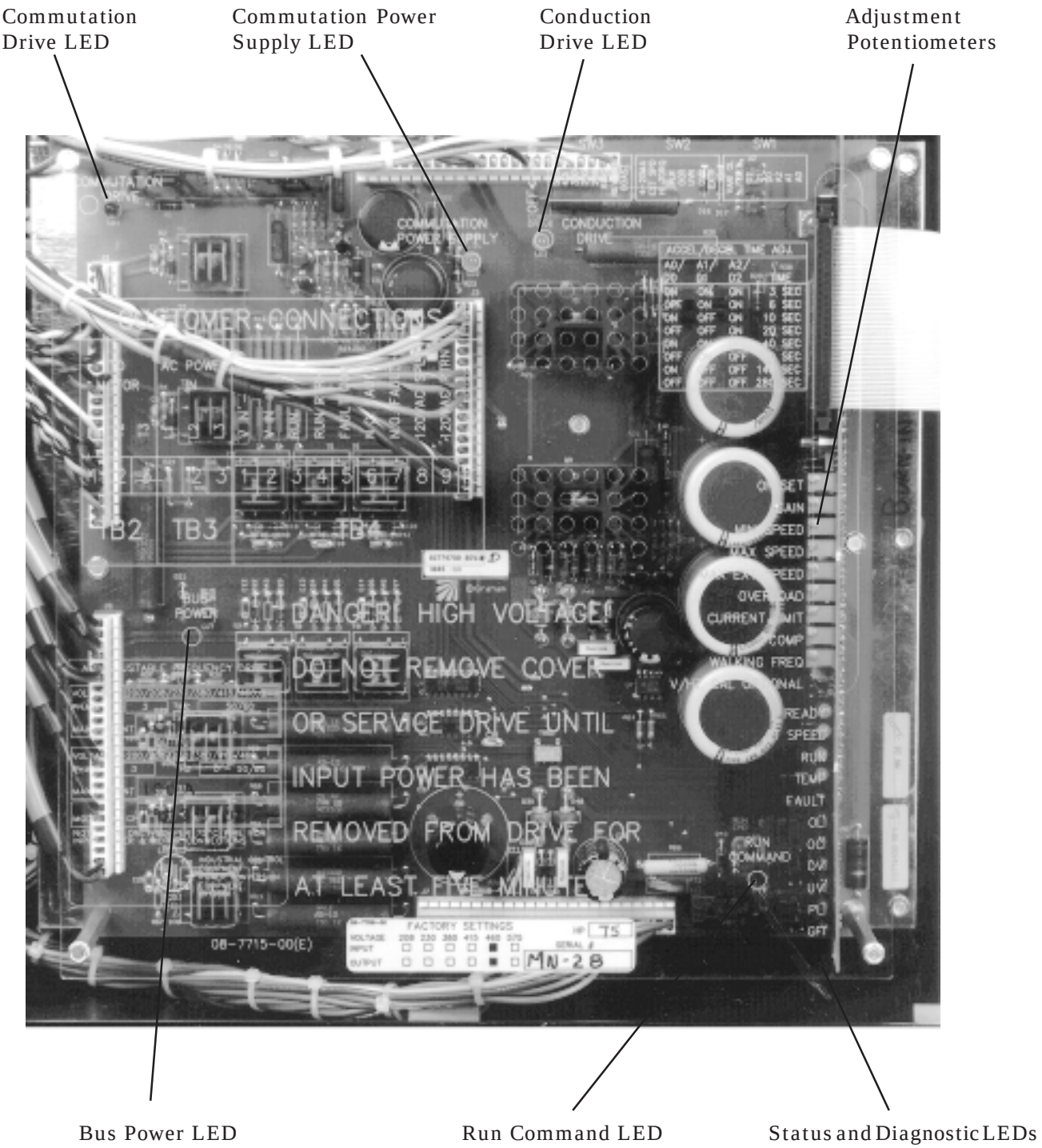
5.3 COMM DRIVE is a red LED that pulses on and off slowly at slow speeds. It pulses faster and appears brighter as the drive speed is increased. The COMMUTATION DRIVE LED indicates the frequency at which the Q2 commutation transistor is pulsed to facilitate the inverter SCR commutation (turn off).

⚠WARNING

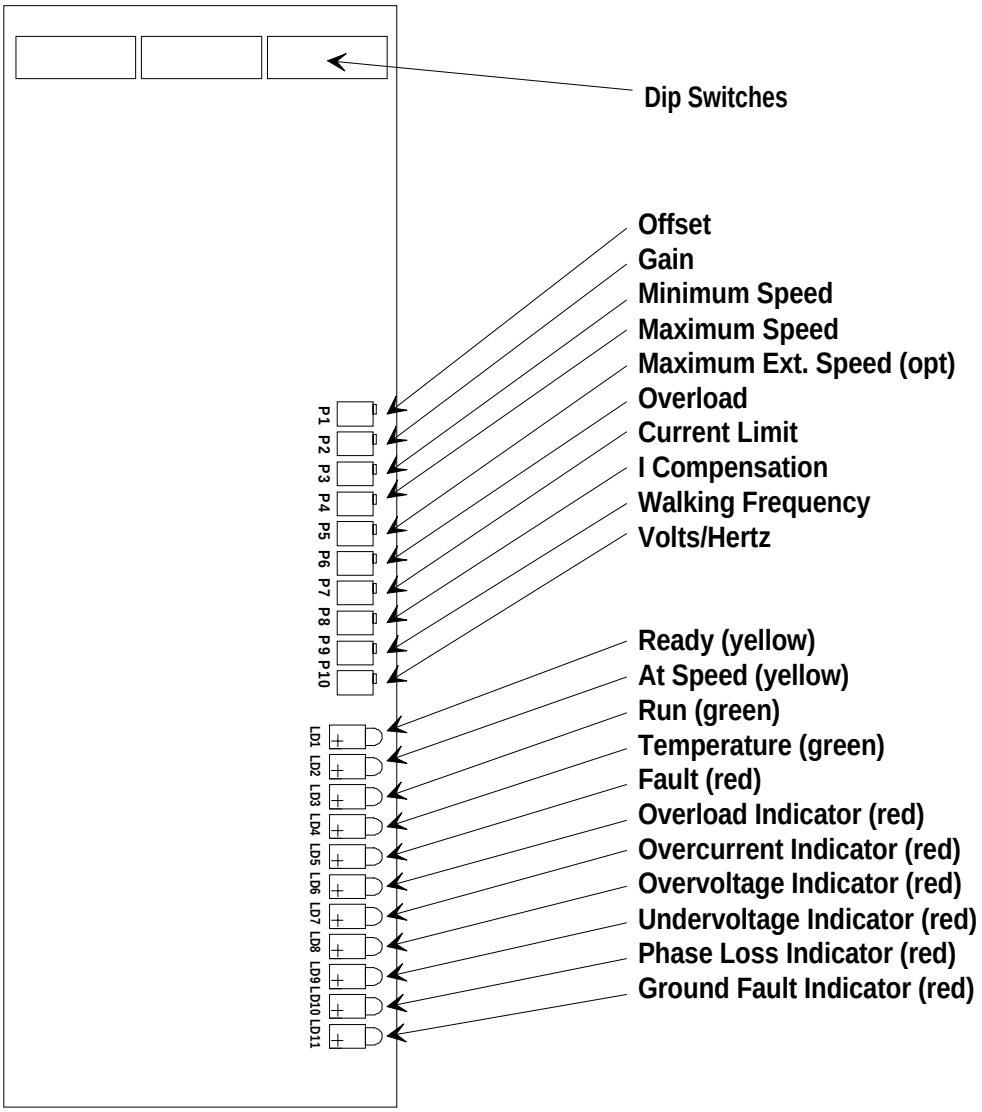
IF THE COMM DRIVE LED IS BRIGHTLY ILLUMINATED WHEN NO RUN COMMAND IS PRESENT, THE CIRCUIT IS NOT FUNCTIONING PROPERLY AND NO ATTEMPT SHOULD BE MADE TO RUN THE DRIVE.

5.4 COND DRIVE is a green LED which is normally on. The LED is extinguished in the event of a fault condition. The drive will not operate if the COND DRIVE LED is not illuminated.

5.5 RUN CMD is a green LED that illuminates when a RUN COMMAND is given to the drive from 4TB4 terminals 3 and 4. It should be illuminated when the customer contacts 3 and 4 are closed and extinguished when they are open.



TYPICAL 1703 SERIES
Control Board



CONTROL CHIP BOARD
Showing Location of Dip Switches, Potentiometers and LEDs

SECTION 6.

INTERNAL ADJUSTMENTS

These calibration potentiometers are located on the control chip board.

6.1 OFFSET AND GAIN

Customer Calibration

The OFFSET and GAIN potentiometers are used to fine tune the customer's automatic control speed reference input with the drive when the REMOTE mode is selected. These adjustment potentiometers do not function in the LOCAL mode. See Section 8 for proper start-up and calibration procedures.

6.2 MINIMUM AND MAXIMUM SPEED

Customer Calibration

The MIN SPEED and MAX SPEED calibration potentiometers are used to set the operating speed range in the LOCAL and the REMOTE speed control modes. See Section 8 for proper start-up and calibration procedures.

6.3 MAXIMUM EXTENDED SPEED

Customer Calibration--Optional Feature

The MAX EXT SPEED potentiometer is used to calibrate the maximum speed above 100% which you wish to operate at. This circuit is not functional unless the EXT SPD switch on switch SW2 is in the on position and the drive is in the REMOTE mode. The extended frequency range is up to 120 Hz.

⚠DANGER

OPERATING THE MOTOR AND ITS DRIVEN EQUIPMENT AT SPEEDS ABOVE THE MOTOR NAMEPLATE RPM CAN CAUSE DAMAGE TO THE DRIVEN EQUIPMENT OR THE APPLICATION RELATED COMPONENTS. DO NOT OPERATE IN THE EXTENDED SPEED MODE WITHOUT PRIOR VERIFICATION THAT YOUR SYSTEM AND EQUIPMENT CAN WITHSTAND THE ADDED CAPACITY CAUSED BY INCREASING THE MOTOR RPM ABOVE BASE SPEED.

6.4 OVERLOAD

Factory Calibration

The 1703 Series is designed to provide motor overload protection. The overload is factory set for 105% of drive's rated output. This setting should not be changed without factory authorization.

6.5 CURRENT LIMIT

Factory Calibration

Full CW rotation of this potentiometer calibrates the drive for a maximum output current capacity of 110% of the drive's nameplated output current. This adjustment can be utilized to calibrate the maximum drive output current clamp threshold to a lower setpoint level. This setting should not be changed without factory authorization.

⚠WARNING

IF THE CURRENT LIMIT POTENTIOMETER IS TO BE ADJUSTED TO A LOWER SETPOINT, THE OVERLOAD POTENTIOMETER MUST FIRST BE ADJUSTED TO A LOWER SETPOINT. FAILURE TO ADJUST THE OVERLOAD POTENTIOMETER FIRST CAN DEFEAT THE OVERLOAD PROTECTION CIRCUIT OF THE DRIVE.

6.6 I COMP

Factory Calibration

The I COMP potentiometer is used to provide increased starting torque to initiate motor rotation on a start command. This circuit is not functional unless the HI-TORQUE switch on switch SW2 is in the ON position. When this potentiometer is fully CW the drive will deliver up to 125% motor torque for starting the motor. This setting should not be changed without factory authorization.

NOTE: THE HI-TORQUE SWITCH SHOULD BE IN THE OFF POSITION UNLESS THE MOTOR REQUIRES ADDITIONAL TORQUE FOR STARTING.

NOTE: IF THE HI-TORQUE CIRCUIT IS REQUIRED, START YOUR CALIBRATIONS WITH THE I COMP POTENTIOMETER IN THE FULLY CCW POSITION AND ADJUST IT CW ONLY TO THE POINT WHEN THE MOTOR WILL START.

⚠CAUTION

USE OF THE HI-TORQUE CIRCUIT WHEN IT IS NOT REQUIRED OR EXCESSIVE STARTING TORQUE CAN CAUSE THE MOTOR TO RUN WARM, BE NOISY IN OPERATION, AND OPERATE AT REDUCED EFFICIENCY.

⚠CAUTION

THE I COMP AND WALKING FREQUENCY CIRCUITS ARE INTERACTIVE AND THEY FUNCTION AS OPPOSING CONTROLS.

Before the I Comp potentiometer is adjusted, the WALKING FREQUENCY potentiometer should be turned fully counter clockwise.

6.7 WALKING FREQUENCY

Factory Calibration

Most centrifugal applications do not require high torque for starting the motor. The WALKING FREQUENCY potentiometer is used to calibrate the drive's starting frequency and voltage.

⚠CAUTION

EXCESSIVE CW ADJUSTMENT OF THIS POTENTIOMETER CAN CAUSE THE DRIVE TO NOT START WITH A START COMMAND, OR NOT TO REVERSE IF THE REVERSING CIRCUITS ARE ACTIVATED.

6.8 V/HZ CAL

Factory Calibration

The VOLTS PER HERTZ CALIBRATION potentiometer, when installed, is used to provide precise calibration of the drive's output V/Hz ratio.

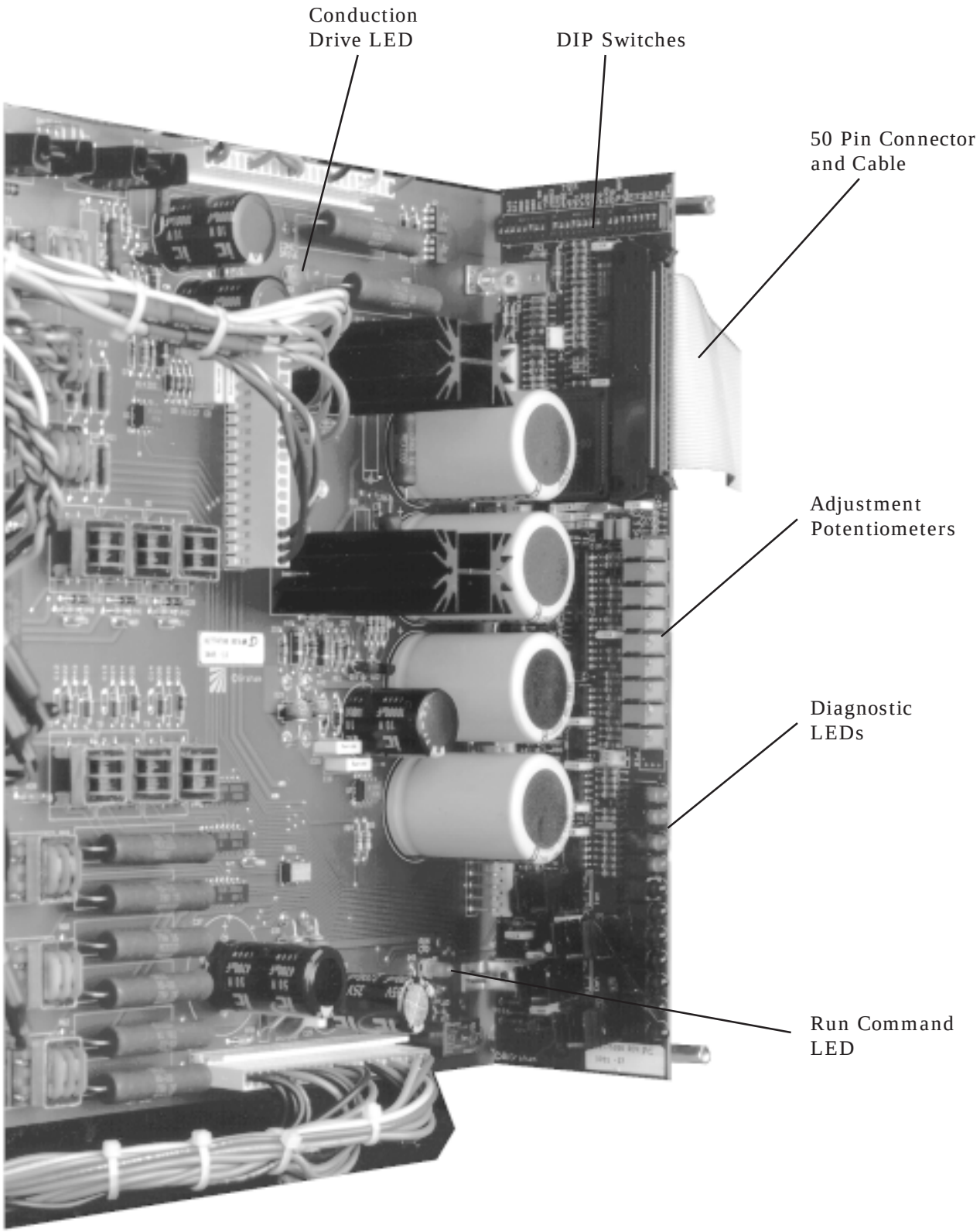
⚠CAUTION

IF THE V/HZ CAL POTENTIOMETER IS INSTALLED, DO NOT ADJUST IT. THIS IS A FACTORY CALIBRATION. IMPROPER CALIBRATION OF THIS ADJUSTMENT CAN CAUSE IMPROPER DRIVE OPERATION AND/OR MOTOR DAMAGE.

6.9 STANDARD CALIBRATION SETTINGS

Unless designated otherwise, the following calibration setpoints are typical for these applications.

Potentiometer	Centrifugal Fan	Centrifugal Pump
OFFSET	minimum speed (as set by minimum speed pot)	
GAIN	100% with maximum remote signal	
MIN SPEED	10% (Fully CCW) if controlled by EMS circuit min 30% if drive sets min setpoint	35% if drive sets min setpoint
MAX SPEED	100%	
MAX EXT SPEED	0% (Fully CCW)	
OVERLOAD	105% of output rating	
CURRENT LIMIT	110% of output rating	
I COMP	0% (Fully CCW)	
WALKING FREQ	Factory set	
V/HZ CAL	Factory set	



TYPICAL 1703 SERIES
Control Chip Board

The following calibration potentiometers are located on the display board. The display board is mounted on the inside of the door, directly behind the operator's control panel. These multi-turn potentiometers are on the side of the display board closest to the door, but they can be accessed from the bottom of the display board.

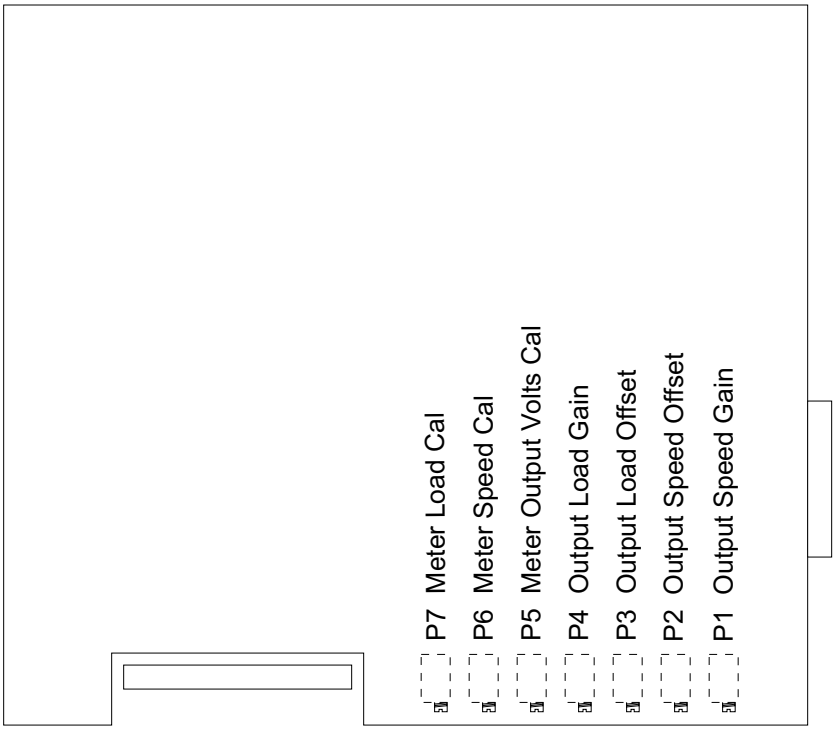
6.10 P1, P2, P3 and P4

These potentiometers are for adjusting the output speed and load signals. The 0 to 10 V DC speed signal is available at terminal 4TB4-1 and 4TB4-2 of most drives (see Section 2.14). The load signal is not standard, and only provided when ordered. Refer to the specific customer connection diagram if this output signal was ordered. P1 will set the speed signal gain (value at maximum speed); P2 the speed signal offset (value at minimum speed); P3 the output load offset (value at minimum load); and P4 the output load gain (value at maximum load

.

6.11 P5, P6 and P7

These potentiometers are for calibrating the digital meter in the operator's control panel. They are factory set and should need no further adjustment. P5 will set the maximum reading for output volts; P6 will set the maximum reading for % speed; and P7 will set the maximum reading for % load.



The Display Board mounts to inside of door behind display. The potentiometers are mounted towards the door, but can be accessed from the bottom of the board.

SECTION 7.

INTERNAL SWITCHES

There are three sets of DIP switches, each consisting of eight individual switches, located on the control chip board. They are used to set the operational characteristics of the drive for your specific application and should not require resetting unless the application or system requirements change. The switches have two positions:

ON - toward the outside edge (top) of the circuit board

OFF - toward the center of the circuit board

NOTE: A drive may have either rocker switches or slide switches. For drives with slide switches, slide the raised portion of the switch in the desired direction. For drives with rocker switches, press in on the rocker switch at the desired side.

⚠CAUTION

DO NOT ALTER ANY SWITCH SETTINGS WITHOUT A CLEAR UNDERSTANDING OF THE SWITCH'S FUNCTION AND A REQUIREMENT IN YOUR APPLICATION FOR THAT FUNCTION. IMPROPER SWITCH SETTINGS CAN CAUSE IMPROPER OPERATION AND CAN DAMAGE EQUIPMENT. DO NOT OPERATE THE DIP SWITCHES WHILE THE DRIVE IS RUNNING.

7.1 SWITCH SW1

7.1.1. **A0, A1,** and **A2** are used to set the acceleration time of the drive. Set the switch positions as shown to select the acceleration time most suitable for your system and application.

A0	A1	A2	FULL RANGE ACCEL TIME
ON	ON	ON	3 sec
OFF	ON	ON	6 sec
ON	OFF	ON	10 sec
OFF	OFF	ON	20 sec
ON	ON	OFF	40 sec
OFF	ON	OFF	70 sec
ON	OFF	OFF	140 sec
OFF	OFF	OFF	280 sec

7.1.2 D0, D1, and **D2** are used to set the deceleration time of the drive:

D0	D1	D2	FULL RANGE DECEL TIME
ON	ON	ON	3 sec
OFF	ON	ON	6 sec
ON	OFF	ON	10 sec
OFF	OFF	ON	20 sec
ON	ON	OFF	40 sec
OFF	ON	OFF	70 sec
ON	OFF	OFF	140 sec
OFF	OFF	OFF	280 sec

7.1.3 FCR - The **FAULT COUNTER RESET** switch is used to select unlimited automatic fault resets in the on position. In the off position, the drive will attempt seven automatic resets and will lock and hold the fault on the eighth trip until it is manually cleared.

NOTE: THE EIGHT FAULT TRIPS COUNTED IN THE LIMITED AUTOMATIC FAULT RESET MODE CAN BE FOR DIFFERENT FAULTS.

NOTE: THE SWITCHES OF SW2 CAN BE SET TO LOCK OUT ANY OF THE INDIVIDUAL FAULT CIRCUIT RESETS. IF NONE OF THE FAULT RESET SWITCHES OF SW2 ARE ON, THE AUTOMATIC FAULT RESET FEATURE OF THE DRIVE IS DEFEATED.

7.1.4 OL - The **VARIABLE OVERLOAD** switch allows the overload trip curve to be tailored to the application.

ON - Variable overload curve for centrifugal and lightly loaded applications. The OL trip curve is 100% current at full speed and approximately 60% current at zero speed.

OFF - Constant torque loads may require more current, so the OL trip in this mode is 100% current at all speeds.

7.2 SWITCH SW2

7.2.1 EXTR - The **EXTERNAL FAULT RESET** is associated with the GROUND FAULT

protection circuits. In the on position, ground fault trips will be automatically reset. This function is for use by factory personnel utilizing special testing procedures. This switch must be off! In this position, power to the drive must be cycled to reset the fault.

DO NOT SELECT THE ON POSITION OF THE EXTR SWITCH. DAMAGE CAN OCCUR TO THE DRIVE AND/OR THE MOTOR IF A GROUND FAULT PROBLEM EXISTS AND THE CIRCUIT IS AUTOMATICALLY RESETTING AND RESTARTING WITH THIS CONDITION.

7.2.2 OVR - The **OVERVOLTAGE RESET** switch selects whether the OV fault trip is automatically reset (on position) or manually reset (off position) by cycling power or by using the optional front panel FAULT reset switch. To prevent nuisance fault trips, this switch should always be on, allowing automatic reset. See Section 4.12.

7.2.3 UVR - The **UNDERVOLTAGE RESET** switch selects whether the UV fault trip is automatically reset (on position) or manually reset (off position) by cycling power or by using the front panel FAULT reset switch. See Section 4.11.

7.2.4 OCR - The **OVERCURRENT RESET** switch selects whether the OC fault trip is automatically reset (on position) or manually reset (off position) using the optional front panel FAULT reset switch. See Section 4.10.

7.2.5 PLR - The **PHASE LOSS RESET** switch selects whether the PL fault trip is automatically reset (on position) or manually reset (off position) by cycling power or by using the optional front panel FAULT reset switch. See Section 4.8.

7.2.6 HI-TORQUE - The amount of motor starting torque available from the drive is selectable using this switch.

ON - Maximum torque is available for starting the motor.

OFF - Up to 80% of the drive's rated torque is available for starting the motor.

NOTE: THIS SWITCH SHOULD BE IN THE OFF POSITION UNLESS YOUR APPLICATION REQUIRES ADDITIONAL STARTING TORQUE. SEE SECTION 6.6 FOR CALIBRATION.

7.2.7 EXT SPD - The EXTENDED SPEED switch, used with the optional extended speed potentiometer, determines the maximum output frequency the drive is capable of achieving.

ON - Frequency calibration up to 120 Hz (constant HP mode available above 60 Hz) in the REMOTE mode only. The extended speed circuit will not function in the LOCAL mode from the control panel.

OFF - Frequency calibration up to 60 Hz (normally calibrated for 60 Hz operation unless otherwise specified).

NOTE: THE MAX SPEED POTENTIOMETER (SECTION 6.1) SHOULD BE SET FOR 100% SPEED (60 HZ) WHEN A FULL SPEED COMMAND IS GIVEN BEFORE ACTIVATING THE EXT SPD SWITCH TO ACHIEVE SPEEDS HIGHER THAN 60 HZ. SEE SECTION 6.3.

OPERATING THE MOTOR AND ITS DRIVEN APPLICATION AT SPEEDS ABOVE THE MOTOR NAMEPLATE RPM CAN CAUSE DAMAGE TO THE DRIVEN EQUIPMENT OR THE APPLICATION RELATED COMPONENTS. DO NOT OPERATE IN THE EXT SPD MODE WITHOUT PRIOR VERIFICATION THAT YOUR SYSTEM AND EQUIPMENT CAN WITHSTAND THE ADDED CAPACITY CAUSED BY INCREASING THE MOTOR RPM ABOVE BASE SPEED.

7.2.8 4-20 mA - This switch selects the type of input speed reference signal to be followed (DC voltage or current). See Sections 3.1.2, 6.1, and 6.2.

ON - Current input signals between zero and 40 mA can be tracked (typically 4 to 20 mA).

OFF - Voltage input signals between zero and +40 V DC can be tracked (0 to +10 V DC is typically used).

7.3 SWITCH SW3

7.3.1 COAST - Selectable deceleration mode for stop commands.

ON - The power to the DC bus is removed immediately when a stop command is given. This causes the motor to decelerate rapidly at a rate controlled by the inertia of the load. Do not use this setting for normal operation.

OFF - The motor will be driven to a stop at the deceleration rate determined by SW1 switches D0, D1, and D2. See Section 7.1.2.

7.3.2 REVERSE - The direction of motor rotation is determined by the position of this switch. See Section 4.5.

ON - the REV LCD on the front panel is illuminated and the motor rotation is opposite of the normal directional rotation.

OFF - The motor rotation is as the wires are connected to the drive output (forward).

⚠WARNING

FOR ONE DIRECTION APPLICATIONS, CUSTOMER WIRING SHOULD BE CORRECTED AT START-UP IF THE ROTATION IS INCORRECT. USING THE REVERSE SWITCH CAUSES OPERATIONAL CONFUSION AND COULD DAMAGE DRIVEN EQUIPMENT IF IMPROPERLY USED.

7.3.3 60 HZ - The output frequency of the drive to be delivered to the motor at full speed is determined by the 60 HERTZ switch. The speed is calibrated by the MIN SPEED and MAX SPEED potentiometers (see Section 6.1), but the frequency (Hz) of the V/Hz ratio is set by this switch

ON - 60 Hertz
OFF - 50 Hertz

7.3.4 OUTPUT VOLTAGES - The switches on SW3 labeled 208, 230, 380, 415, and 575 are used to determine the maximum voltage to be delivered to the motor. Use of these switches and the 60 HZ switch determine the V/Hz ratio to be delivered to the motor. The voltage on the motor nameplate is used to determine this setting.

NOTE: THE UTILITY POWER VOLTAGE BEING SUPPLIED TO THE DRIVE DOES NOT DETERMINE THE SWITCH SETTINGS. (SEE SECTION 2.1).

Output Voltage Desired	Voltage Switches ON
200/208 V AC	208 only
230 V AC	230 only
380 V AC	380 only
415 V AC	415 only
460 V AC	None
575 V AC	575 only

NOTE: ONLY ONE VOLTAGE SWITCH SHOULD BE ON AT ANY TIME.

⚠WARNING

DO NOT SELECT AN OUTPUT VOLTAGE HIGHER THAN THE UTILITY POWER VOLTAGE. IF A BYPASS CIRCUIT IS SUPPLIED, THE DRIVE OUTPUT VOLTAGE AND THE UTILITY POWER VOLTAGE MUST BE THE SAME.

DO NOT SELECT A VOLTAGE SETTING DIFFERENT THAN THE MOTOR NAMEPLATE VOLTAGE.

DRIVES ORDERED FOR 460 V AC OPERATION OR LESS ARE NOT RATED FOR 575 V AC OPERATION. DO NOT SWITCH THE 575 SWITCH ON UNLESS THE DRIVE NAMEPLATE DESIGNATES THE DRIVE AS BEING DESIGNED FOR 575 V AC OPERATION. THE MODEL NUMBER SUFFIX OF 1703AFC DRIVES DESIGNED FOR 575 V AC IS "J".

SELECTION OF THE OUTPUT VOLTAGE USING THE VOLTAGE SWITCHES DOES NOT CHANGE THE INPUT VOLTAGE DESIGN OF THE DRIVE. SEE SECTION 2.1.

7.4 STANDARD SWITCH CONFIGURATION

Unless designated otherwise, the following switch settings are standard for typical application requests for 460 V AC operation using a 4 to 20 mA signal for remote speed tracking control.

NOTE: INDIVIDUAL APPLICATIONS, UTILITY VOLTAGES, MOTOR SELECTION, AND CONTROL SYSTEMS WILL CAUSE VARIATIONS IN THE REQUIRED SWITCH SETTINGS.

Switch	Centrifugal Fan	Centrifugal Pump	Constant Torque
SW1			
A0	OFF	ON	ON
A1	ON	ON	ON
A2	OFF	ON	ON
D0	OFF	ON	ON
D1	ON	ON	ON
D2	OFF	ON	ON
FCR	ON	ON	ON
VARI OL	OFF	OFF	OFF
SW2			
EXTR	OFF	OFF	OFF
OVR	ON	ON	ON
UVR	ON	ON	ON
OCR	OFF	OFF	OFF
PLR	ON	ON	ON
Hi-Torque	OFF	OFF	ON
EXT SPD	OFF	OFF	OFF
4-20 mA	ON	ON	ON
SW3			
COAST	OFF	OFF	OFF
REVERSE	OFF	OFF	OFF
60 HZ	ON	ON	ON
208	OFF	OFF	OFF
230	OFF	OFF	OFF
380	OFF	OFF	OFF
415	OFF	OFF	OFF
575	OFF	OFF	OFF

SECTION 8.

START-UP AND CALIBRATION PROCEDURES

⚠WARNING

NO CALIBRATION OR SWITCH POSITION CHANGES SHOULD BE MADE WITHOUT A CLEAR UNDERSTANDING OF THE PROCEDURE, EFFECT, AND RESULT OF THE CHANGES. REFER TO THE SECTION OF THIS MANUAL DESCRIBING THE FUNCTION OF EACH CONTROL DEVICE YOU DESIRE TO CHANGE FOR A DESCRIPTION OF THAT CIRCUIT'S FUNCTIONS AND LIMITATIONS.

HIGH VOLTAGE AC AND DC POWER IS PRESENT INSIDE THE DRIVE ENCLOSURE. THE VOLTAGES AND CURRENTS PRESENT ARE EXTREMELY DANGEROUS AND COULD BE FATAL IF CONTACTED BY AN INDIVIDUAL. THE UTMOST CAUTION MUST BE EXERCISED WHEN WORKING WITHIN THE DRIVE ENCLOSURE.

8.1 PRE-CHECK SEQUENCE

Upon applying power to the drive, the following sequence of events should occur.

1. All indicators on the door mounted operator's panel and on the control chip board should flash briefly as a lamp test and then extinguish.
2. The LCD display meter should begin to display.
3. The READY or RUN indicators on the front panel should become visible (dependent upon the status of HAND/OFF/AUTO switch position and the remote customer contact status for run commands.)
4. The TEMP and READY or RUN indicators on the control chip board should illuminate (dependent upon the status of HAND/OFF/AUTO switch position and remote customer contact status of run commands.)
5. The COMM DRIVE LED on the control board should pulse dimly in the stop mode.
6. The COMM P.S. LED on the control board should light.
7. The COND DRIVE LED on the control board should illuminate a second or two after power is applied.

⚠WARNING

IF ITEMS ONE THROUGH SEVEN DO NOT OCCUR, DO NOT PROCEED.

8.2 CALIBRATION PROCEDURE

1. Press the LOC and HAND push buttons on the front panel. The RUN indicator should display.

2. Press the ▲ or ▼ push buttons on the SPEED switch (see Section 3.1.3) until four of the MIN <—> MAX indicating LCDs are displayed. Check the motor for rotation and proper direction.
   A. If the motor does not rotate:
      1. Check to ensure the motor disconnect is closed.
      2. Check to ensure the motor shaft is free to rotate.
   B. If the motor rotates in the wrong direction and the drive has a bypass circuit, before changing the motor wiring to correct the rotation, you should check motor rotation in the bypass mode (see Section 3.2 a bypass is provided).
      1. If both rotations (drive and bypass) are wrong, exchange the wiring on any two motor phases.
      2. 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.
      3. If the rotation is correct in the bypass mode but it is 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.

NOTE: AC VARIABLE FREQUENCY DRIVES DEVELOP THEIR OWN PHASE ROTATION DIRECTIONS FOR THE OUTPUT TO THE MOTOR, SO MOTOR ROTATION CAN DIFFER WHEN WIRED TO AN AC DRIVE AS OPPOSED TO A CONVENTIONAL MOTOR STARTER.

NOTE: DO NOT CHANGE MOTOR ROTATION BY USING THE REV SWITCH ON THE CONTROL CHIP BOARD. SEE SECTION 7.3.2.

3. Connect the positive lead of a DC voltmeter at the top of R33 resistor and the negative voltmeter lead to the R37 lead closest to J5 terminal block on the control circuit board. See the drawing to the right for exact location.

THESE TEST POINTS MAY BE AT A DANGEROUSLY HIGH VOLTAGE WITH RESPECT TO EACH OTHER AND WITH RESPECT TO EARTH GROUND.

4. Press the REM push button of the SPEED SELECT switch. Command the automatic control system to transmit the minimum speed command signal (Example: 4 mA on a 4 to 20 mA control system) to terminals 13 and 14 of terminal strip 4TB4. Adjust the OFFSET potentiometer until the voltmeter begins to increase. Then slowly reverse the adjustment of the OFFSET potentiometer until the voltmeter just reaches its minimum value. This adjustment fine tunes the drive's remote circuitry to match the automatic control system.

5. Transmit the maximum speed command signal from the automatic control system (Example: 20 mA on a 4 to 20 mA control system) to terminals 13 and 14 of terminal strip 4TB4. Adjust the GAIN potentiometer CCW until the voltmeter begins to decrease in voltage. Then adjust until the voltage on the meter just reaches its maximum value.

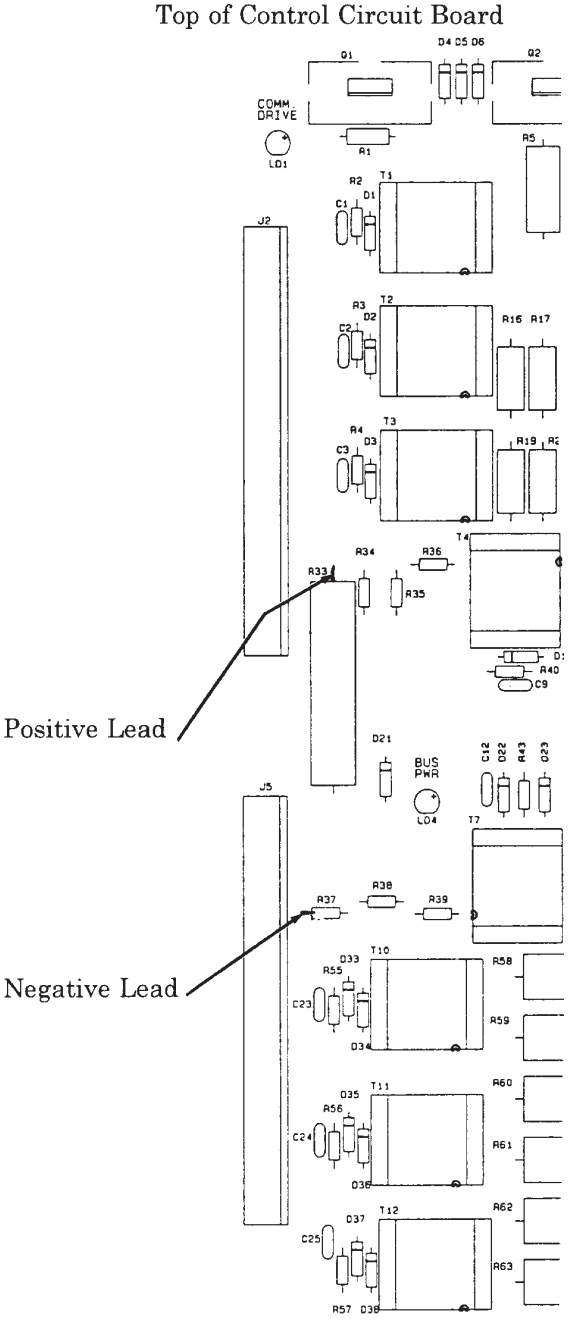
6. Repeat steps 3 and 4.

7. With the automatic control system still sending its maximum speed command signal, adjust the MAX SPEED potentiometer for the desired maximum speed by noting the voltage on the DC volt meter. The following table shows the voltage for a maximum speed for various drive voltages. If a reduced maximum speed is desired, the DC volt meter reading will be proportionally lower.

Drive Voltage	DC Voltage at Maximum Speed
575 V AC	750 V DC
460 V AC	600 V DC
230 V AC	300 V DC
208 V AC	270 V DC

NOTE: THE MAXIMUM SPEED POTENTIOMETER LIMITS THE DRIVE'S MAXIMUM SPEED FOR BOTH LOCAL AND REMOTE OPERATION.

7. Command the automatic control system to send its minimum speed command signal. Adjust the MIN SPEED potentiometer for a DC voltage which corresponds to the desired speed. For example, for a minimum speed of 30% on a 460 V AC drive, adjust this potentiometer for a reading of 180 V DC. (30% x 600 V DC)



Remote Speed Signal Calibration on Control Board

SECTION NINE — SERVICE INFORMATION

9.1 INTRODUCTION

This section of the manual is intended for those who wish to perform their own troubleshooting and repair. Persons attempting to perform the drive service described in this section should have a strong background in power electronics, experience in using test equipment, and a good understanding of analog and digital control circuitry. Graham Company offers service schools to show you how to troubleshoot and repair this drive. Contract the Graham Service Department for service assistance.

9.2 DESCRIPTION OF OPERATION

The drive consists of two main sections, the power section and the control section.

The first part of the power section is the input SCR bridge. It converts the incoming three phase AC to a regulated DC voltage.

The second part of the power section is the conduction/ commutation switching circuit. This circuit directs the regulated DC to the inverter.

The third part of the power section is the inverter. The inverter directs the regulated DC to the correct phases of the motor for the proper time period.

The control board contains the circuitry required to interface the power section with the low voltage control chip board. It also provides the interface between the customer inputs and the control chip board. The control board is the large square printed circuit board located under the clear plexiglass cover.

The control chip board contains the control logic circuitry, customer selection switches, customer and factory adjustment potentiometers and LED indicators.

9.3 TROUBLESHOOTING

The procedures outlined here are intended to assist in locating and correcting a problem in a standard drive. Power circuit measurements should only be made by qualified technicians.

⚠DANGER

EYE PROTECTION IS REQUIRED ANY TIME THAT THE ENCLOSURE IS OPEN.

⚠DANGER

EXTREME CAUTION MUST BE USED WHENEVER POWER IS APPLIED AND THE ENCLOSURE IS OPEN. ANYONE WORKING ON THE DRIVE WILL BE EXPOSED TO HIGH VOLTAGE. ALWAYS REMOVE POWER WHEN SERVICING THE COMPONENTS OF THE DRIVE. WAIT UNTIL THE "BUS POWER" AND "COMMUTATION POWER SUPPLY" LEDS HAVE EXTINGUISHED.

THEN MEASURE FOR VOLTAGE FROM J2-9 TO J5-20 ON THE CONTROL BOARD USING A VOLTMETER SET ON THE 100 V DC SCALE. ALLOW THIS VOLTAGE TO DROP TO ZERO BEFORE WORKING ON THE DRIVE.

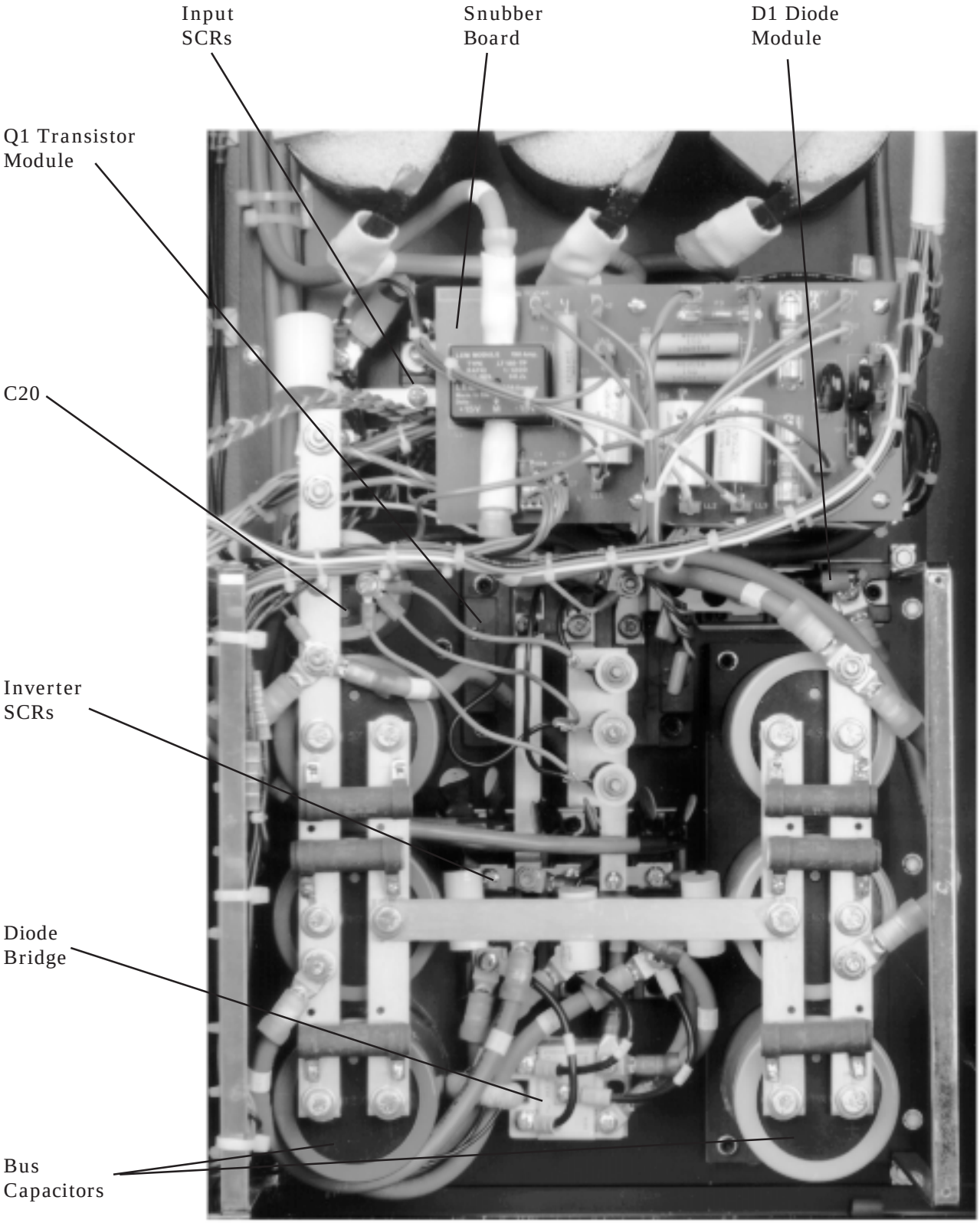
All power circuit voltages are floating at a very high potential with respect to ground and require isolated or floating test equipment. Control signal voltages are referenced to ground through a 1,000 ohm resistor.

If a problem is isolated to a calibration setting, refer to the internal adjustments section of this manual before attempting any changes.

Some steps in these instructions use conditions set up in previous steps. Therefore, any time power is interrupted or controls are changed, care must be taken to repeat the specified set-up.

It is recommended that a complete checkout of the Main Control Board be made or a known good Main Control Board be installed whenever problems recur or components continue to fail. A log of all service should be maintained. The following information should be included.

1. Date and time of failure
2. Description of symptoms
3. Operating conditions
4. What component failed
5. Other conditions occurring at the same time which may be related
6. Service performed
7. Who performed the service



TYPICAL 1703 SERIES
With Control Board Swung Open

9.4 MINIMUM RECOMMENDED TEST EQUIPMENT

VOLTOHM METER — Simpson #260, Fluke 73 or equal
AMMETER — Simpson #150 or equal
OSCILLOSCOPE — Tektronix #323 or equal
SCOPE PROBE — Tektronix #P600T or equal; set on X10 scale for use on circuit boards, X100 scale for power components.
TORQUE WRENCH — For power components, with hex key sockets
HAND TACHOMETER — For measuring motor speed

9.5 DIODE, TRANSISTOR AND SCR TEST PROCEDURE

Remove the input power and wait for the BUS PWR LED to extinguish. After checking to confirm that no voltage is present from J2-9 to J5-20 on the Control Board, visually inspect the drive for any physical evidence of a failure such as:

1. Leaking or distorted capacitors
2. Discolored component
3. Loose connections
4. Cracked or broken semiconductors

Check all power semiconductors and large capacitors for shorts. All fuses should be checked. For proper testing methods of diodes, transistors and SCRs see Section 9.5.1. These steps will generally locate most of the problems that may occur under normal operating conditions and should be performed first.

9.5.1 DIODE, TRANSISTOR AND SCR TESTING

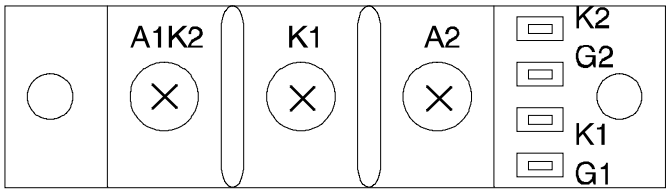
All leads, including the bus bars, must be disconnected from the device being tested. The resistance values shown are for good components. If a reading is in doubt, compare it to a known good component. Exact values cannot be given, as readings will vary with meter and scale used.

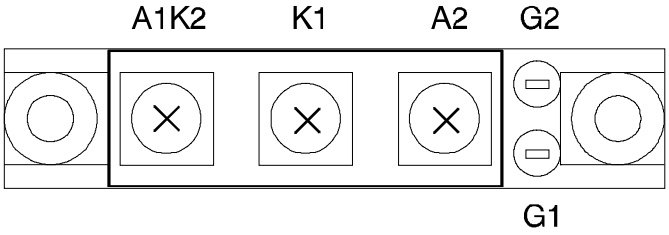
Diodes, transistors, and SCRs may be tested by using the procedure outlined in this section to check for short or open circuits. When readings fall into questionable or faulty areas, do not replace the device until a comparison test is made with a known good device. Recheck the components out of the circuit. Always use the same ohmmeter when performing comparison tests.

Failure of a power transistor or SCR indicates the need to completely check out the control board. This should be performed by a factory trained technician, or the control board should be replaced. Failure to check out or replace the board could cause repeated failure.

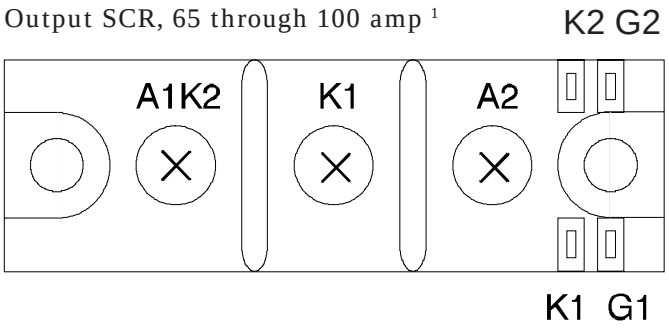
INPUT/OUTPUT SCR MODULES

Input SCR, all models, and
Output SCR 7.5 through 53 amp [1]
Either style may be used





Output SCR, 65 through 100 amp [1]

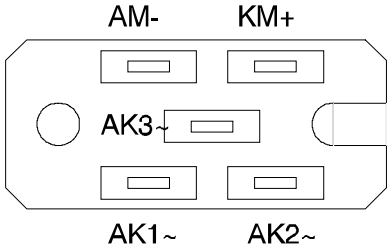


Meter Lead		Resistance Reading
Positive	Negative	(ohms)
A1K2	K1,A2	>10,000
K1, A2	A1K2	>10,000
A1K2	G2	<1,000
G2	A1K2	<1,000
K1	G1	<1,000
G1	K1	<1,000

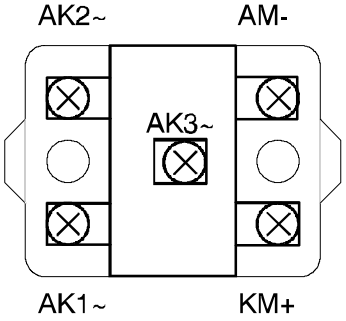
[1] Refer to the "Output Drive Current" rating on the plastic cover over control board for this value.

OUTPUT DIODE BRIDGE MODULE

Output Diode Bridge, 7.5 through 34 amp [1]



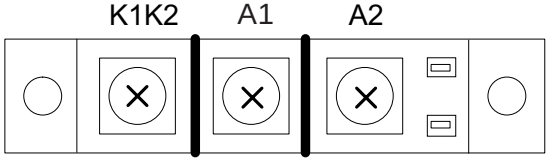
Output Diode Bridge, 40 through 100 amp [1]



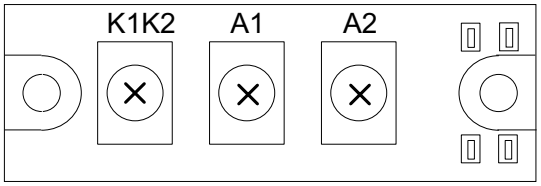
Meter Lead Positive	Meter Lead Negative	Resistance Reading (ohms)
AM-	AK1~, AK2~, AK3~	<1,000
KM+	AK1~, AK2~, AK3~	>10,000
AK1~, AK2~, AK3~	AM-	>10,000
AK1~, AK2~, AK3~	KM+	<1,000

FREE-WHEELING DIODE MODULE

Free-wheeling Diode, 7.5 through 53 amp [1]



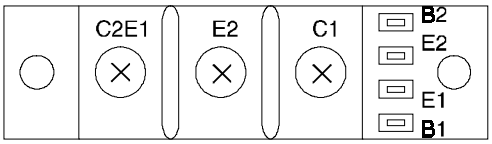
Free-wheeling Diode, 65 through 100 amp [1]



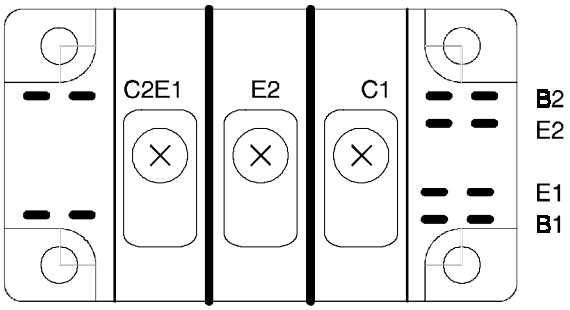
Meter Lead Positive	Meter Lead Negative	Resistance Reading (ohms)
A1	K1, K2	<1,000
K1,K2	A1	>10,000
K1	A2	>10,000
A2	A1,K2	<1,000

CONDUCTION/COMMUTATION TRANSISTOR MODULE

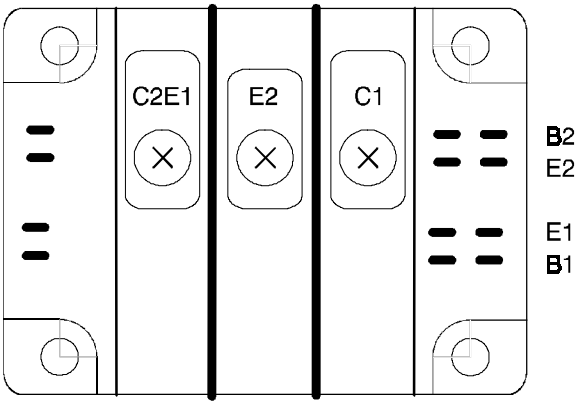
Conduction/Commutation Transistor Module, 7.5 through 28 amp [1]



Conduction/Commutation Transistor Module, 34 through 53 amp [1]



Conduction/Commutation Transistor Module, 65 through 100 amp [1]



Meter Leads Positive	Meter Leads Negative	Resistance Reading (ohms)
C1	C2,E1	>10,000
C2,E1	C1	<1,000
C2,E1	E2	>10,000
E2	C2,E1	<1,000
B2	E2	<1,000
E2	B2	<1,000
B1	E1	<1,000
E1	B1	<1,000
B1	C1	<1,000
C1	B1	>10,000
B2	C2,E1	<1,000
C2,E1	B2	>10,000

[1] Refer to the “Output Drive Current” rating on the plastic cover over control board for this value.

9.6 DIODE, TRANSISTOR AND SCR REPLACEMENT

9.6.1 INPUT SCR MODULES

SCRs designated SCR 7/10, SCR 8/11, SCR 9/12 are input SCR modules. When changing an input SCR module, use a new thermal pad or apply heatsink compound. Use Thermalcote®, manufactured by Thermalloy, Inc., or equivalent heatsink compound and apply a 1 mil thick layer. The heatsink must be thoroughly cleaned before reassembly. Retorque the mounting screws and wire screws to 35 inch pounds.

9.6.2 OUTPUT SCR MODULES

SCRs designated SCR 1/4, SCR 2/5, SCR 3/6 are output SCR modules. When changing an output SCR module, a new thermal pad, or heat sink compound, must be used. Use Thermalcote®, manufactured by Thermalloy, Inc. or equivalent for heatsink compound and apply a layer 1 mil thick. The heatsink must be thoroughly cleaned before reassembly. Retorque the mounting screws and wiring screws to 35 inch pounds on the 7.5 through 53 amp drives. Retorque the mounting screws and wiring screws to 55 inch pounds on the 65 through 100 amp drives. Refer to the "Output Drive Current" rating on the plastic cover over the control board for this value.

9.6.3 OUTPUT DIODE BRIDGE

The diode bridge designated D BRDG 1 is the output diode bridge module When changing a diode bridge module, a new thermal pad, or heatsink compound, must be used. Use Thermalcote®, manufactured by Thermalloy, Inc. or equivalent heatsink compound and apply a layer 1 mil thick. The heatsink must be thoroughly cleaned before reassembly. Retorque the mounting screws to 18 inch pounds on the 7.5 through 34 amp drives. Retorque the mounting screws and wiring screw to 44 inch pounds on the 40 through 100 amp drives. Refer to the "Output Drive Current" rating on the plastic cover over the control board for this value.

9.6.4. FREE-WHEELING DIODE

The diode module designated D1 is the free-wheeling diode module. When changing a diode module, a new thermal pad, or heatsink compound, must be used. Use Thermalcote®, manufactured by Thermalloy, Inc. or equivalent heatsink compound and apply a layer 1 mil thick. The heatsink must be thoroughly cleaned before reassembly. Retorque the mounting screws and wiring screws to 35 inch pounds on the 7.5 through 53 amp drives. Retorque the mounting screws and wiring screws to 53 inch pounds on the 65 through 100 amp drives. Refer to the "Output Drive Current" rating on the plastic cover over the control board for this value.

9.6.5 CONDUCTION/COMMUTATION TRANSISTOR MODULE

The dual transistor module designated Q1 is the conduction/commutation transistor module. When changing this module, a new thermal pad, or heatsink compound, must be used. Use Thermalcote®, manufactured by Thermalloy, Inc. or equivalent heatsink compound and apply a layer 1 mil thick. The heatsink must be thoroughly cleaned before reassembly. Retorque the mounting screws to 26 inch pounds and the wiring screws to 17 inch pounds on the 7.5 through 28 amp drives. Retorque the mounting screws and wiring screws to 26 inch pounds on the 34 through 100 amp drives. Refer to the "Output Drive Current" rating on the plastic cover over the control board for this value.

9.7 POWER UP SEQUENCE

⚠DANGER

HIGH VOLTAGE WILL BE PRESENT IN THE DRIVE WHEN PERFORMING OPERATIONAL TESTS WITH POWER APPLIED TO THE DRIVE.

Apply input power to the drive. All the LEDs on the control chip board should light for approximately one second. Then, if the drive is in the stop mode, all but the READY and TEMP LEDs should turn off.

On the control board, the COMM P.S. LED should light immediately after power is applied. After approximately one second, the COND. DRIVE LED should light, and the COMM. DRIVE LED should flash very dimly.

9.8 POWER SUPPLY ON THE CONTROL BOARD

Power supply common is connected to J6-19 on the control board which connects to J3-19 on the control chip board. Connection to common is also available from the top side of R67. R67 is a 2 watt resistor located on the extreme lower right hand corner of the Control Board. These circuit common points can be used for test equipment connection for the following steps.

Check the +24 V DC power supply on J6-17 on the Control Board for +20 to +30 V DC.

Check the -24 V DC power supply on J6-20 on the Control Board for -20 to -30 V DC.

Check the +15 V DC power supply on J6-15 on the Control Board for +14.4 to +15.6 V DC.

Check the -15 V DC power supply on J6-16 on the Control Board for -14.4 to -15.6 V DC.

Check the +5 V DC power supply on J4-19 on the Control Board for +4.8 to +5.2 V DC.

An oscilloscope should also be used in checking the above voltages to ensure that there is no excessive ripple voltage in these DC power supplies.

9.9 OUTPUT CHECKS

Start the drive and accelerate the motor to full speed. Measure the phase to phase voltage on the motor leads. These should be balanced within ±0.5 V AC. Any lack of balance indicates a problem with the motor windings, the wiring to the motor or the inverter circuits in the drive.

NOTE: BECAUSE THE OUTPUT OF THE DRIVE IS NOT A PURE SINE WAVE, THE METER MAY NOT READ THE RATED AC OUTPUT VOLTAGE. THIS IS NOT A CAUSE FOR CONCERN. THIS CHECK IS ONLY FOR VOLTAGE BALANCE BETWEEN THE OUTPUT PHASES AND NOT THE EXACT VOLTAGE READINGS.

⚠WARNING

HIGH VOLTAGE WILL BE PRESENT IN THE DRIVE WHEN PERFORMING THE OPERATIONAL TESTS WITH POWER APPLIED TO THE DRIVE. THE POWER CIRCUITS OF THE DRIVE NECESSARILY FLOAT AT A HIGH VOLTAGE ABOVE GROUND POTENTIAL. BOTH LEADS OF ANY TEST EQUIPMENT THAT IS CONNECTED TO THE DRIVE'S POWER CIRCUITS WILL ALSO BE AT A HIGH VOLTAGE WITH RESPECT TO GROUND. INSTRUMENTS CONNECTED TO THE POWER CIRCUITS MUST HAVE BOTH LEADS ISOLATED FROM EARTH GROUND. IF ONE TEST LEAD IS CONNECTED TO THE CASE OF THE TEST INSTRUMENTS, THE TEST INSTRUMENT'S CASE WILL ALSO BE AT A HIGH VOLTAGE WITH RESPECT TO EARTH GROUND.

Troubleshooting Flow Chart

Drive does not operate normally

Is input power applied to disconnect? ⇨NO → Apply power

YES ⇓

Are cooling fan(s) operating? ⇨NO → Check fan wires
Check for rated line voltage between terminals L1, L2 and L3 on terminal block TB3 on the drive
Check fuses F1 and F2 located on the Power Board or Snubber Board

YES ⇓

Is the COMM PS light on the Control Board illuminated? ⇨NO → Check fuse F3 located on the Power Board or Snubber Board

YES ⇓

Is OT (overtemperature) indicated on the enclosure door? ⇨YES → See Section 4.9 to help diagnose the problem

NO ⇓

Is FAULT indicated on the enclosure door? ⇨YES → See Section 4 to help diagnose the problem

NO ⇓

With the drive stopped, is the COND DRIVE light on the Control Board illuminated and the COMM DRIVE light dim but flickering? ⇨NO → Replace the control board

YES ⇓

Give the drive a run command. Is RUN indicated on the enclosure door? ⇨NO →
If using auto run input:
1. Press the AUTO button on the enclosure door
2. Check for 115VAC between terminals 3 and 4 on terminal block TB4

If using HAND/OFF run input:
1. Press the HAND button on the enclosure door
2. Check the 50 pin ribbon cable connections

YES ⇓

Is the motor rotating? ⇨NO → Is the motor disconnect switch closed? Has a speed reference command been given?

YES ⇓

Does the motor turn in the proper direction? ⇨NO → Reverse two of the power leads to the motor

Reverse two of the power leads to the motor ⇨ Does the drive have a constant speed bypass?

Does the drive have a constant speed bypass? ⇐NO YES ⇓

Does the motor turn in the proper direction during bypass? ⇐YES NO ⇓

Reverse two of the input power leads to the drive

YES ⇐ (from Does the motor turn in the proper direction?) ⇓

Does the motor accelerate to full speed under load? ⇨NO → For local operation, hold down the SPEED increase button on the enclosure door until all 9 squares of the bar graph are on. (Hold down for approximately 15 sec)

For remote operation:
1. Check that the external reference input applied to terminals 1 and 2 on TB4 is at maximum
2. Is the current limit potentiometer (P7) on the Control Chip Board fully clockwise?
3. Are the maximum speed, gain and offset potentiometers (P4, P2 and P1) on the Control Chip Board at their factory settings?

YES ⇓

END