



MOTORTRONICS™

Solid State AC Motor Control

ABC

Series

10 to 1000 Amp Models

Electronic Motor Brake

INSTALLATION & OPERATION MANUAL



Table of contents

1	Introduction.....	2
1.1	General	3
1.2	Theory of Operation.....	3
1.3	Braking Sizing and Selection.....	3
1.4	Applications	5
1.5	Where Mechanical Brakes Should be Used.....	5
1.6	ABC Model Numbers, Ratings and Dimensions.....	6
2	Operation.....	13
2.1	Sequence of Operation.....	13
2.2	Fault Conditions.....	15
2.3	Mechanical Brake Control	16
3	Installation.....	17
3.1	Receiving and Unpacking.....	17
3.2	Initial Unit Inspection	17
3.3	Location	17
3.4	Mouting and Cleaning.....	17
4	Wiring.....	18
4.1	Introduction	18
4.2	Line and Load Connections.....	18
4.3	Control Connections	21
5	Adjustements.....	26
5.1	Time Adjustment Procedures	26
5.2	Jog Time Adjustment.....	26
5.3	Brake Time Adjustment	27
5.4	Brake Current Adjustment	27
5.5	50 Hz Operatiion.....	28
6	Start-Up.....	29
6.1	Start-up Check List	29
6.2	Equipment.....	29
6.3	Check Normal Sequence of Operation.....	29
7	Application Specific Settings.....	30
7.1	CPU Dip Swiath Settings.....	30
	APPENDIX A: TECHNICAL SPECIFICATIONS	32
	WARRANTY INFORMATION	33

1 Introduction

Your Role in Product Safety

This equipment is designed and manufactured to the highest standards to provide safe and reliable operation for its intended use. Only qualified personnel should install, maintain, and service this equipment, and only after reading and fully understanding all of the information in this manual. All instructions should be strictly followed. All Warnings, Cautions, and Notes must be taken into account for your particular installation. Users should consult Motortronics or a Motortronics distributor/service center if there are any questions.

All installation instructions may be superseded by applicable local, regional, or national electrical codes. Drawings, application information, and technical representations included in this manual are for typical installations, and should not in any way be considered specific to your application or conditions. Consult Motortronics for supplemental information if necessary.

Contents of this manual are believed to be correct at the time of printing. In following with our on-going commitment to meeting customer needs and developing our products to suit them, Motortronics reserves the right to change specifications of this product and/or the contents of this manual without notice. As a result, supplemental data sheets and/or drawings may be associated with this equipment. Please contact Motortronics and have the unit serial number available if you notice conflicts with what is depicted in the manual and what is installed in the field.

Phasetronics (dba Motortronics) accepts no liability for any consequences resulting from inappropriate, negligent, or incorrect installation, application, adjustment, or maintenance of this equipment.

Notice Label Explanation:



WARNING!

Warning labels such as this denotes specific concerns for life/safety/damage issues associated with this area of the manual. These statements are intended to be followed without exception.



CAUTION!

Caution labels are intended to alert the user to specific issues that MAY cause damage or personnel risks under circumstances as described. These items are critical in some installations but not all. The user is responsible for identifying the applicable installation issues.

NOTE: Notice labels are intended to alert the user to issues that require particular attention with regard to the proper use and long term reliability of the equipment.

1.1 General

The ABC Series is a solid state DC injection brake for stopping three phase AC induction motors. This full-wave DC brake design offers smooth, low peak level braking for quiet, steady operation and optimal performance. Designed to handle even high inertia loads, the ABC Series eliminates costly and potentially dangerous coast to stop times. A built-in microprocessor provides system supervision that includes digital timing control for jogging and braking.

The integral Operator Interface Module provides LED indication of the unit's operating status and easy adjustments for quick setup. Standard features include interlocks, mechanical brake release relays, a brake disable input and zero speed sensing with override.

1.2 Theory of Operation

Incoming AC power is fed to terminals L1 and L2 directly from the line side of the motor starter and is converted to DC within the ABC Series. Once the motor starter has been turned off (opened) and the residual energy in the motor has dissipated, the DC current from the ABC Series is applied (injected) to the starter terminals T1 and T2 respectively. This creates a stationary magnetic field in the AC motor stator windings.

The braking torque will increase in proportion to the amount of current allowed to flow. The DC injection level can be adjusted using the Brake Current Potentiometer on the operator interface module. This modulates the applied current based upon an "RMS" closed loop current feedback signal from the integral sensors. The rotor then pulls into alignment with this stationary field and brings the load to a stop faster than if it coasted to a stop.

1.3 Brake Sizing and Selection

ABC Series brakes are suitable for use in most AC motor applications where coast-to-stop times are undesirable or unacceptable. The ABC Series is a current controlling brake, so various sizes of brake units can be applied to various motor sizes. Because DC injection means applying power to the AC motor after turning it "Off", motor heating (although minimal) will continue during the braking cycle and should be considered when selecting the motor. AC motor manufacturers recommend that each braking cycle over 100% FLA be considered as an additional starting cycle when calculating the starts per hour ratings for the selected motor.

If the selected ABC Series is sized to deliver 200% of motor rated current, consider each brake cycle to be 2 start cycles for these calculations (and 300% FLA = 3 "starts" per brake). Never size any DC injection brake to exceed 400% of the motor nameplate FLA without first consulting the motor manufacturer. Additional guidelines for applying ABC Series brakes follow:

1.3.1 Standard Duty Sizing

Applying an ABC Series brake that is rated for $\leq 115\%$ of the FLA (Full Load Amp) rating of the motor allows maximum length of braking time without exceeding the thermal capacity of the stator windings. Since current is controlled by the ABC Series throughout the braking cycle, braking torque will vary as the motor circuit impedance decreases with speed. Braking torque will be highest at the beginning of the cycle, and can be as much as 100% of the FLT (Full Load Torque) when set to motor FLA.

As the motor slows, the braking torque slowly decreases, reducing the mechanical stresses as much as possible. Sizing a brake in this manner is typically good for machine tools, saws, conveyors, lumber machinery, and most chippers. Stop times vary greatly with load and friction, but can be expected to be 1/2 of the coast-to-stop time or less. Keep in mind that the maximum brake time setting is 127 seconds. In heavily loaded, high inertia machines and long coast-to-stop times, the Standard Duty model may not stop the load. Consider using the Extra Duty rating instead.

1.3.2 Extra Duty Sizing

For heavier machine loads such as large chippers, punch presses and other flywheel based machines, selecting an ABC Series brake based on 200-250% of the motor nameplate FLA allows faster braking. The maximum developed braking torque can be as much as 200% of the motor rated Full Load Torque. In this case, the load can typically stop in twice the across the line starting time. Duty cycling of the motor is a much more important consideration in these applications since additional thermal stresses due to higher current levels are applied to the motor.

1.3.3 Custom Sizing

Extreme loads (such as overhauling conveyors or large centrifuges), or short stop times (approaching the across-the-line starting time of the motor) may require sizing the ABC Series for 300% of the motor FLA or greater, and should be done with careful consideration of motor heating, duty cycle, and limitations of mechanical stress on the drive train components.

1.3.4 Emergency Stopping

If Emergency Stopping is required where the stopping time must be shorter than the across the line start time, a mechanical brake must be used in conjunction with the ABC.

1.4 Applications

The ABC Series electronic brake is ideal for machine and process equipment control applications. Among the benefits is improved efficiency, increased safety, and reduced equipment maintenance costs.

Efficiency is improved because you no longer have to wait through long coast-to-stop times for blade changes, batch loading, or maintenance shutdowns. Productive time increases as overall operating costs decrease because the load stops quicker. The ABC Series eliminates the common practice of jamming the load to a stop which seriously reduces the life and effectiveness of saw blades, molding heads, and knives.

Increase safety by eliminating the need to "jam-stop" equipment. This will prevent any personnel injuries caused by kickbacks and broken blades. Use the ABC Series in conjunction with safety inter-locked devices to stop the motor as quickly as possible, reducing the risk of contact with dangerous rotating elements of machinery. Prevent premature wear or component failure and eliminate the need for hasty repairs that can put maintenance personnel in potentially dangerous situations. ABC Series brakes can be used as part of a system to facilitate OSHA General Industry Standards (29 CFR1910 Subpart O) requiring that workers not be exposed to hazardous moving parts. They can also be utilized to satisfy braking requirements of the British Columbia Workers Compensation Amendment Act (Book 3 Part 27.42) for rotating knife machinery such as planers, chippers, and hogs.

Reduce maintenance costs by using the ABC Series. Eliminate the need to plug-reverse a load and reduce the associated damage to gear boxes and other power train components. The ABC Series can be used to stop or slow down the load in one direction before reversing to the other. On machines where mechanical brakes are used to stop or hold a load, use the ABC Series to stop it first, then set the mechanical brake as a "parking brake". This eliminates the normal wear and tear to the brake pads or shoes. On loads such as vibrating feeders, screens, or separators, damage from mechanical resonance that occurs during coast-down can be eliminated by using an ABC Series. It allows the motor/load to quickly pass through any dangerous speeds and come to a stop.

1.5 Where Mechanical Brakes should be used

The ABC Series, like all DC injection brakes, requires power to be applied during the braking cycle. If the incoming line power is lost, an upstream circuit protective device trips, or an emergency shutdown routine is initiated, no braking will take place. If braking is still necessary for safety reasons (even in the event of a power failure), consider using mechanical brakes as a backup device. Under normal operation conditions, the ABC Series stops the load and the mechanical brake holds it.

Holding the load after it comes to a stop - All DC injection brakes inherently lose braking torque when the motor comes to a complete stop and therefore **CANNOT BE USED AS HOLDING BRAKE**. If braking must be applied continuously while the load is at rest, mechanical "Parking Brakes" are required. The ABC Series includes a Mechanical Brake Release Relay to facilitate proper coordination of the mechanical brake in these applications.

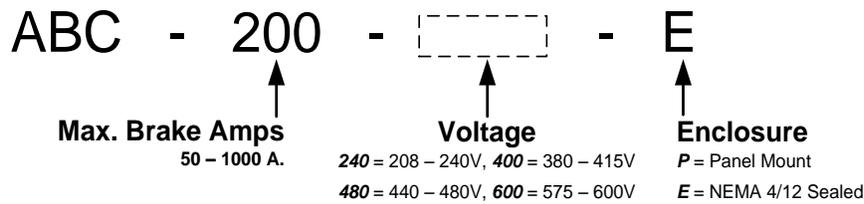
Like all DC injection brakes, the ABC Series waits for the residual motor energy to dissipate from the windings before DC current is applied (otherwise damage to the brake or circuit devices may occur). The length of this "wait state" depends on the motor's residual magnetism and the motor frame size. This, combined with the limits on braking torque, makes DC injection braking ineffective if braking time must be shorter than the starting time (Across-the-Line).



WARNING!

DC Injection brakes cannot be used for holding a load after it comes to a stop. The ABC Series includes a Mechanical Brake Release Relay that can be used to coordinate the operation of a mechanical brake for use in these applications.

1.6 ABC Series Model Number, Rating and Dimensions

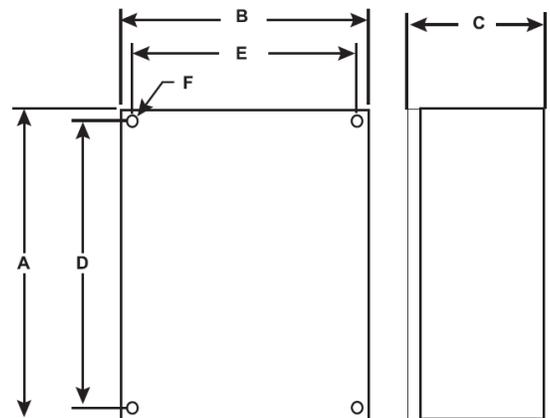


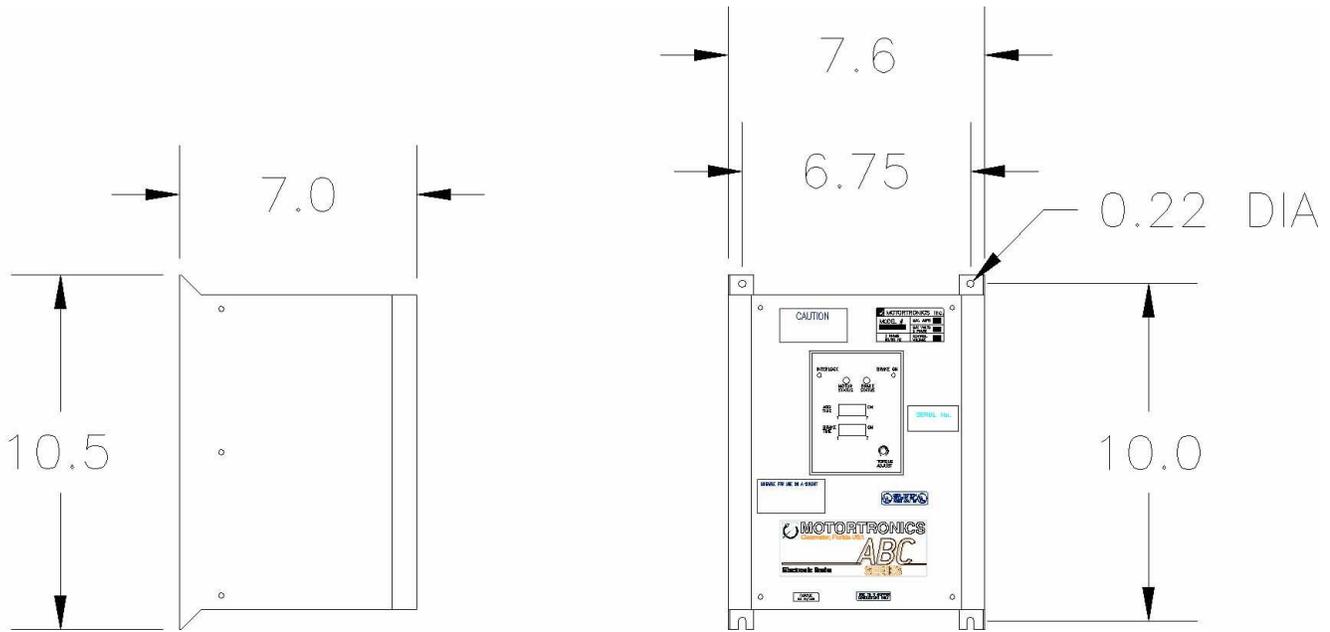
ABC SERIES											
Model Number*	Max Amps	Typical Horsepower Usage								Dimensions	
		208 V		240V		480V		600V		Panel Dim Ref.#	NEMA 4/12 Dim Ref. #
		Std. Duty	Extra Duty	Std. Duty	Extra Duty	Std. Duty	Extra Duty	Std. Duty	Extra Duty		
ABC-10	10	5	5	10	5	15	10	25	10	1	6
ABC-24	24	10	5	15	7.5	20	15	30	20	1	6
ABC-50	50	15	7.5	20	10	40	25	50	30	1	6
ABC-100	100	30	20	40	25	75	50	100	60	1	6
ABC-200	200	75	40	75	50	150	100	200	125	2	7
ABC-300	300	100	60	125	75	250	150	300	200	3	8
ABC-400	400	150	75	150	100	350	200	400	250	3	8
ABC-550	550	250	125	200	150	500	300	600	350	4	9
ABC-800	800	350	200	350	200	700	450	900	500	4	9
ABC-1000	1000	400	250	400	300	900	500	1000	600	5	10

NOTES:

- Never exceed the Full Load Amp rating of the motor without checking the motor manufacturer's data with regards to appropriateness of the application and duty cycle.
- If duty cycle is not known, Motortronics recommends using the Extra Duty Brake since braking current can be adjusted down to meet the actual load requirements.

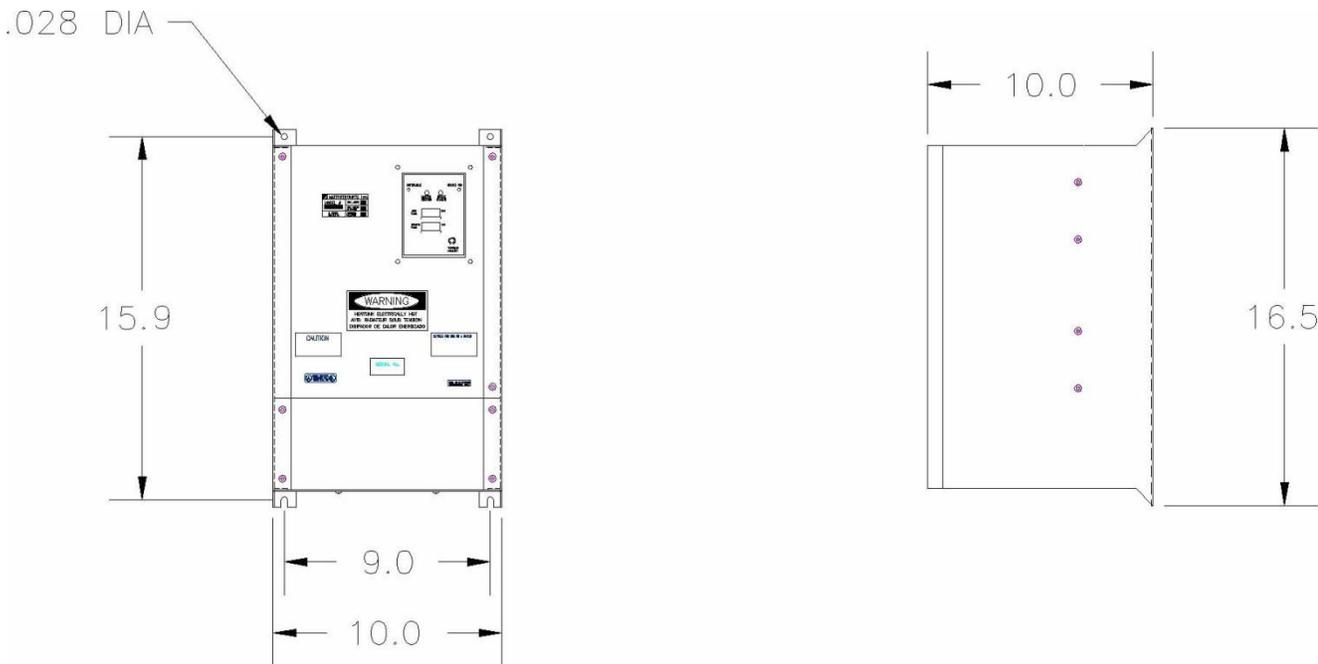
Dim Ref. #	Dimensions (Inches)					
	A	B	C	D	E	F
1	10.5	7.6	7.0	10.0	6.75	0.22
2	16.5	10.0	10.0	15.9	9.0	0.28
3	16.0	16.0	10.0	15.0	15.0	0.50
4	21.0	26.0	10.5	20.0	25.0	0.50
5	36.0	24.0	10.0	34.5	22.5	0.40
6	20.0	16.0	9.0	18.5	14.5	0.44
7	24.0	20.0	13.0	22.5	18.5	0.50
8	36.0	24.0	13.0	34.5	22.5	0.44
9	36.0	30.0	13.0	34.3	28.5	0.44
10	42.0	30.0	16.0	40.5	28.5	0.44





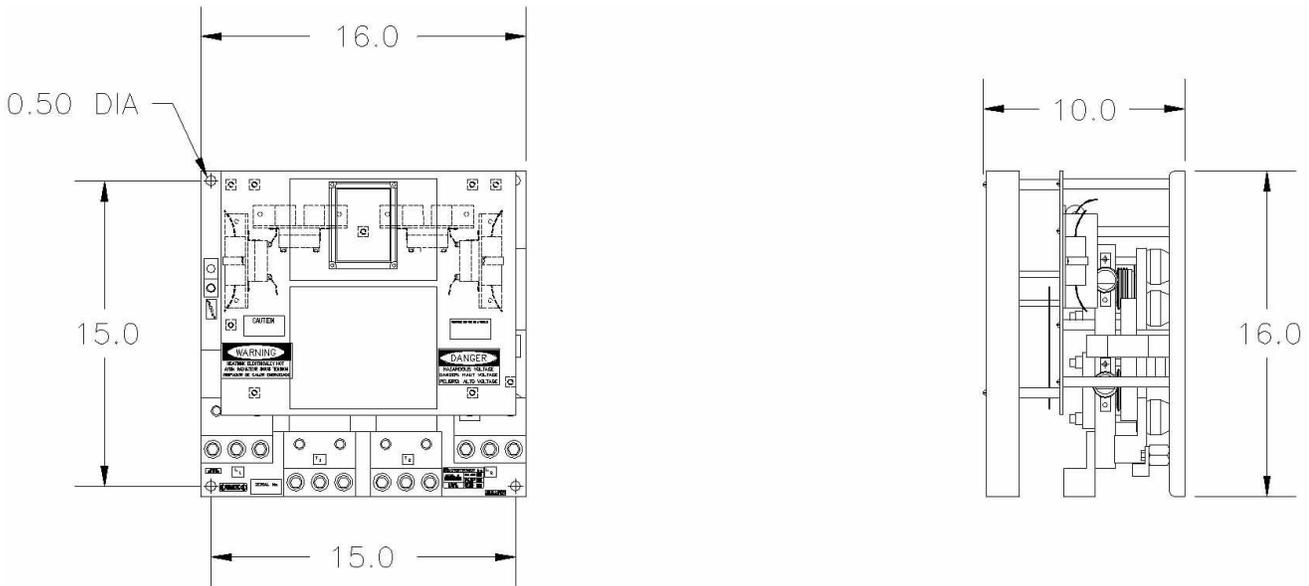
Dimension 1

Panels Outline: ABC-10/24/50/100



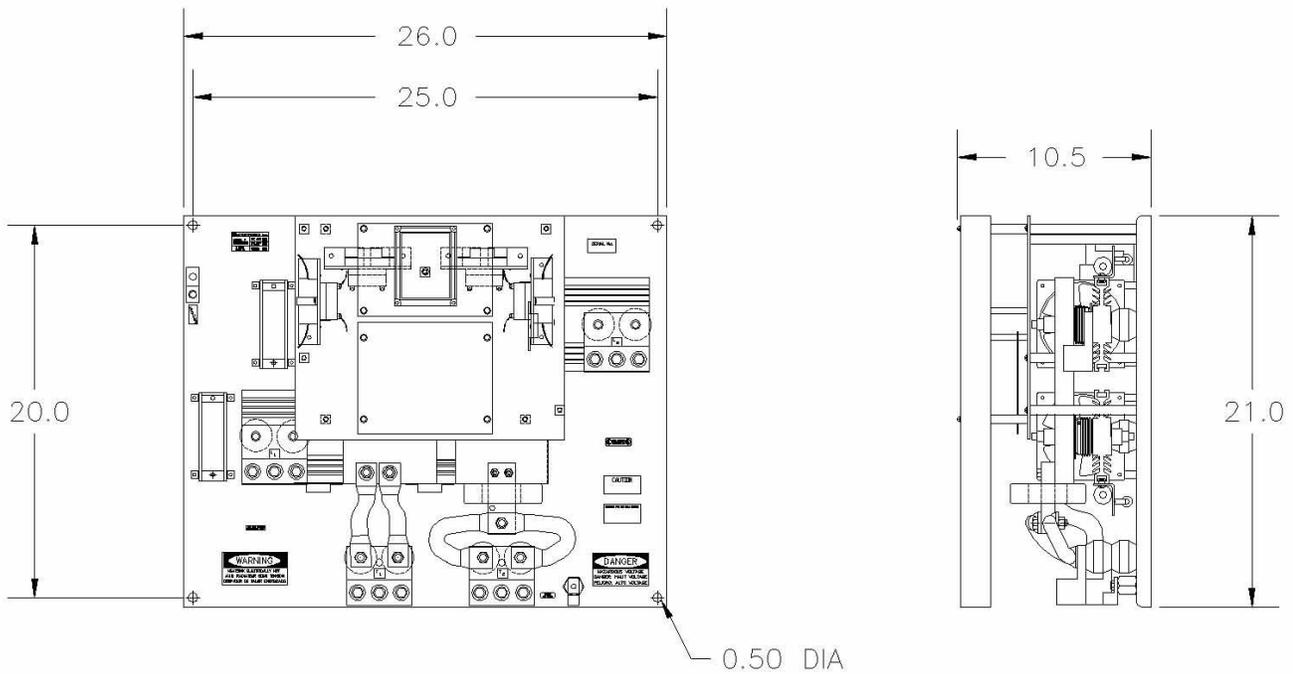
Dimension 2

Panels Outline: ABC-200



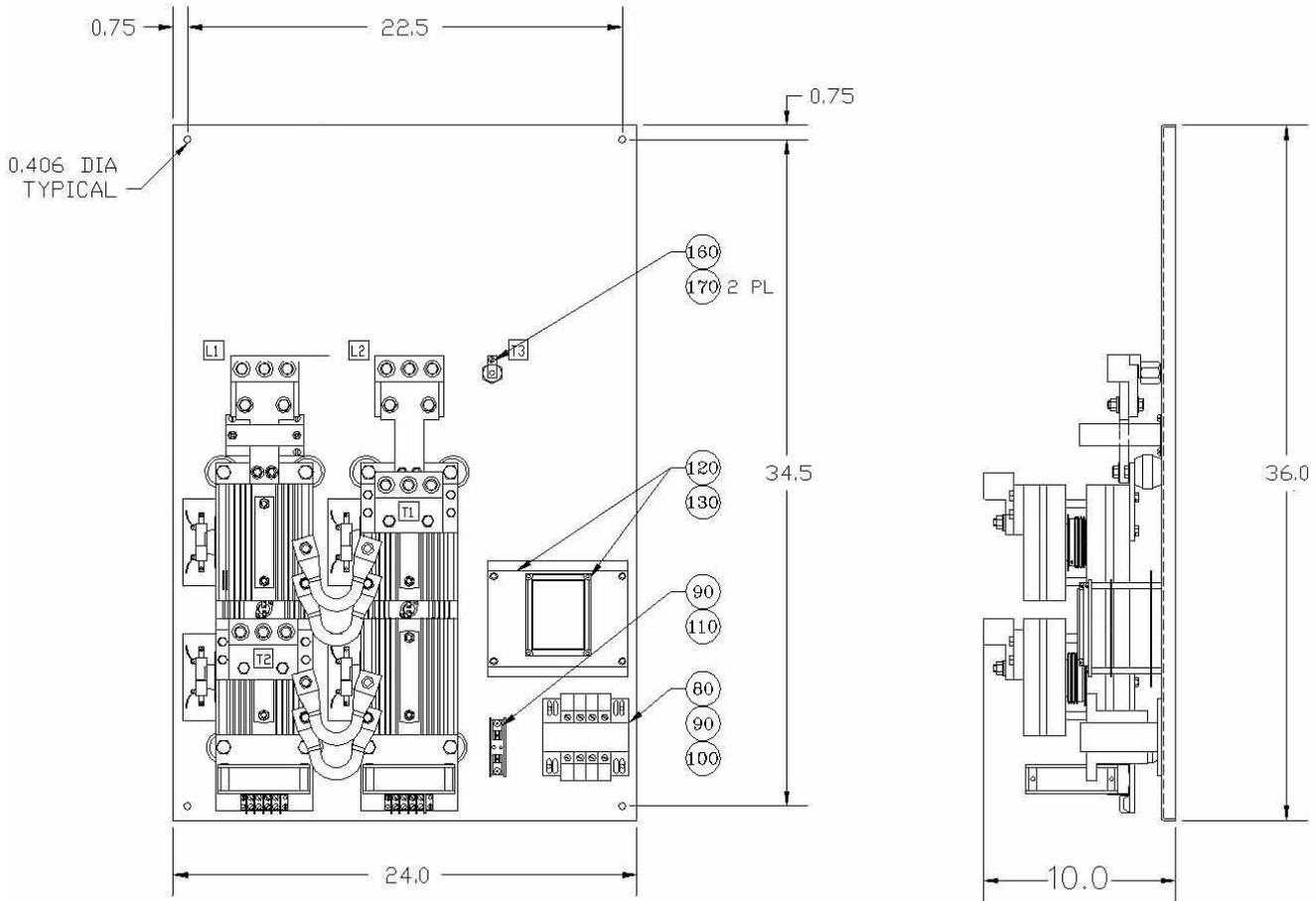
Dimension 3

Panels Outline: ABC-300/400



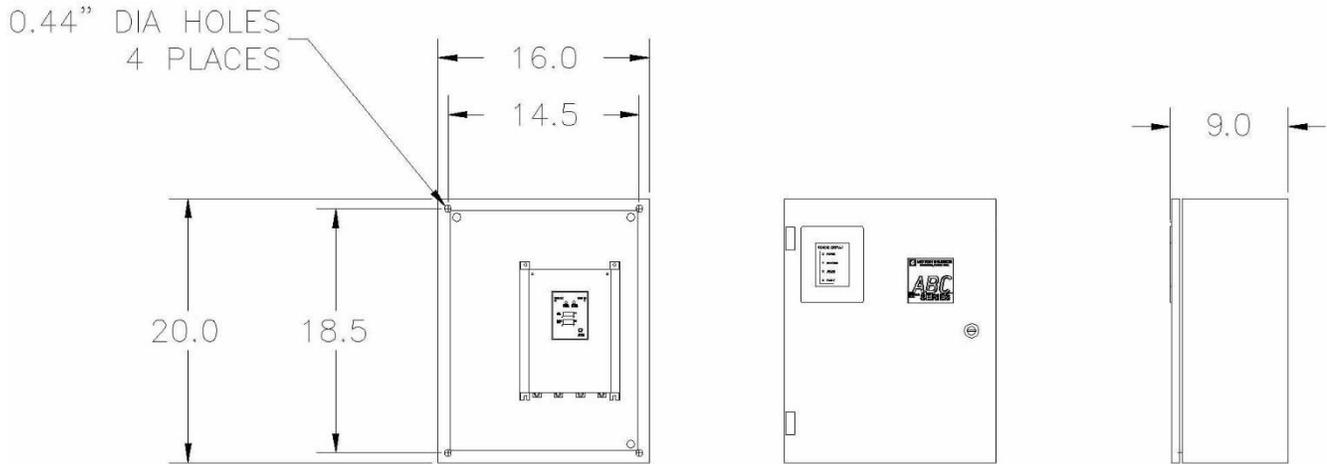
Dimension 4

Panels Outline: ABC-550/800



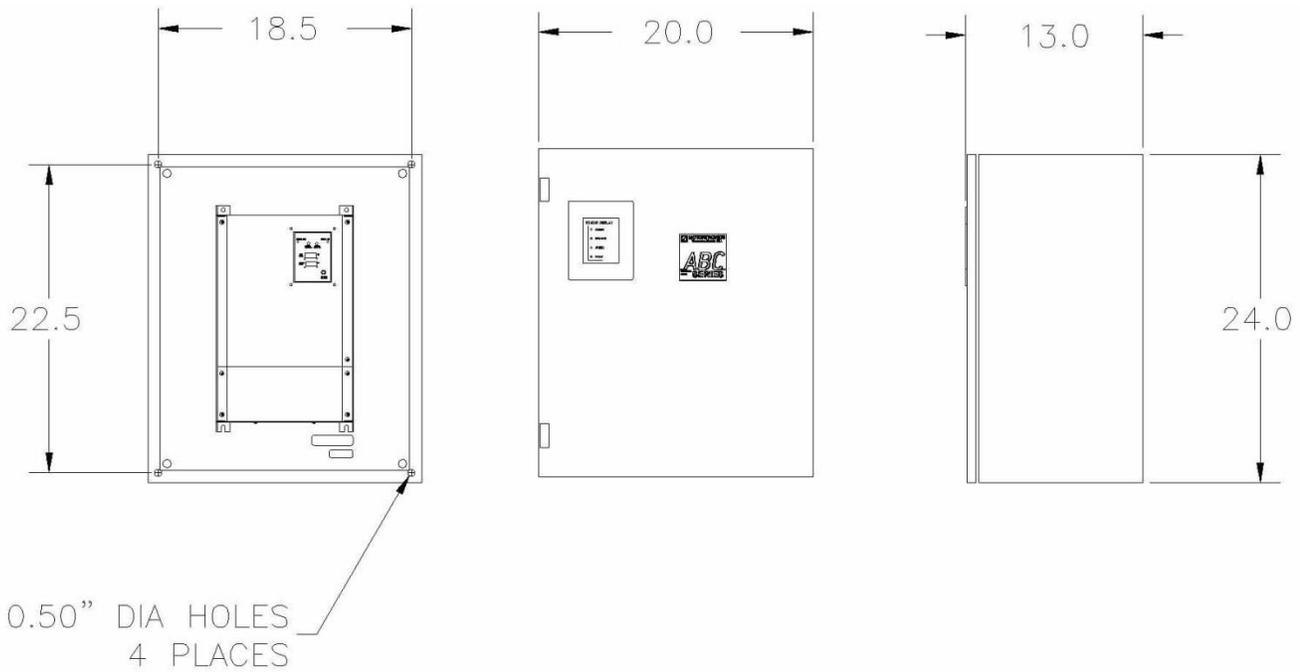
Dimension 5

Panels Outline: ABC-1000



Dimension 6

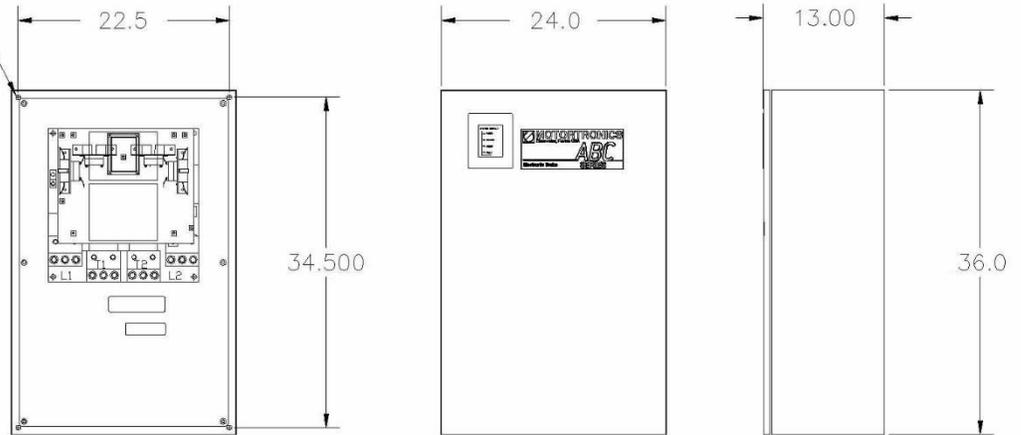
N4/12 Outline: ABC-10/24/50/100-E



Dimension 7

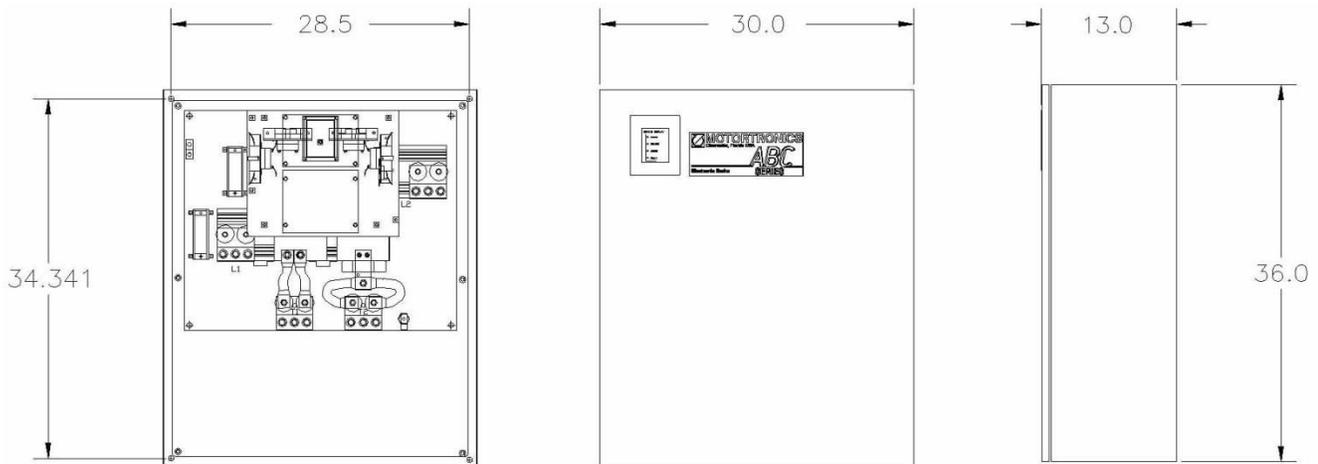
N4/12 Outline: ABC-200-E

0.44" DIA HOLES
4 PLACES



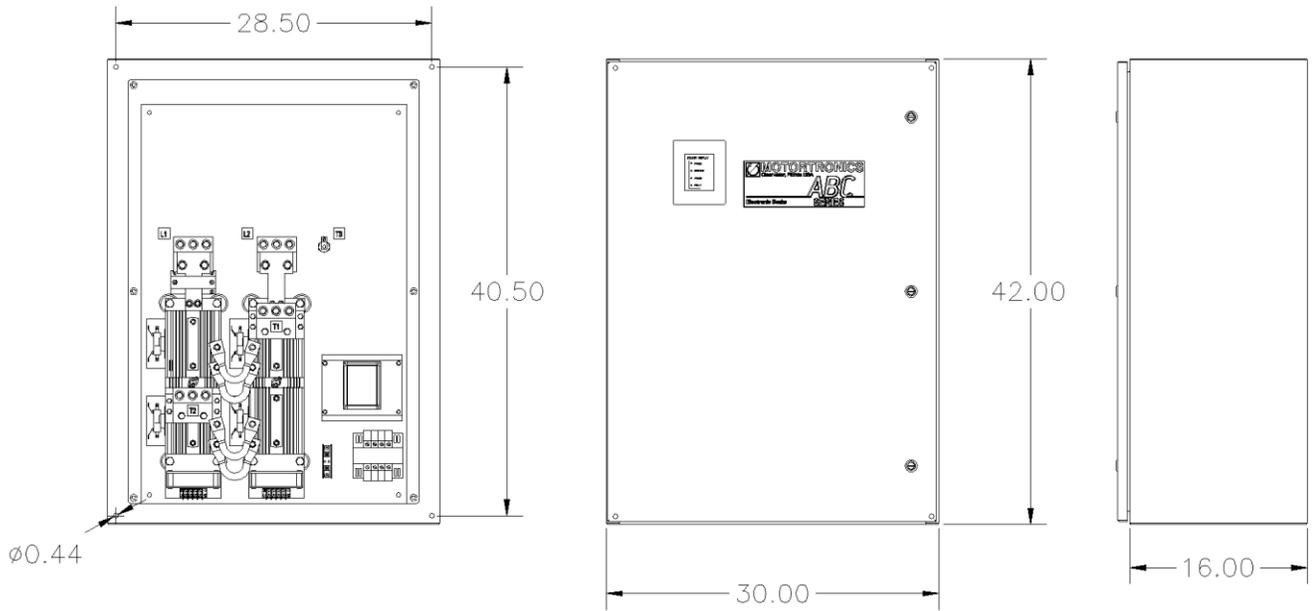
Dimension 8

N4/12 Outline: ABC-300/400-E



Dimension 9

N4/12 Outline: ABC-550/800-E



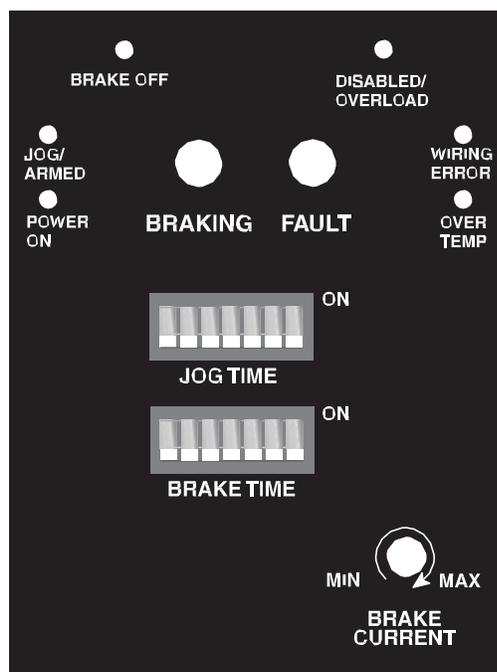
Dimension 10

N4/12 Outline: ABC-1000-E

2 Operation

2.1 Sequence of Operation

The ABC series brake has four typical states of operation during a normal cycle. They are BRAKE OFF, JOG TIME, ARMED and BRAKE ON. There is also one inhibit condition, DISABLED/OVERLOAD and four fault conditions, WIRING ERROR, OVER TEMP, OVER CURRENT and SHORTED SCR. All of which are indicated by the integral display. The display includes eight LEDs to indicate the various modes of operation, two seven position dip switches for setting the JOG and BRAKE TIME and one potentiometer for adjusting the Brake Current.



2.1.1 “Power On”

The ABC Series brake is self-powered from the available motor branch circuit and derived from Terminals L1 and L2. If fuses are used, this LED will indicate a blown fuse condition in either of these circuits by being off when power is applied to the starter. This LED does **NOT** indicate motor starter or ABC Series brake unit operational status.

2.1.2 Jog / Armed

The ABC series monitors the motor starter's condition by way of an auxiliary dry contact connected to the starter monitor input at TB1 pins 1 & 2 on the logic board. When this contact changes state the ABC begins the jog Time period. This is an adjustable time that is set by the jog Time dip switch which delays the arming of the brake to allow jogging of the motor for set up purposes and the load to come up to full speed before a braking cycle can be made. During the jog time the jog/Armed LED will flash at one second increments. At the end of the jog Time the LED will be on solid indicating the brake has entered the Armed mode and is ready for a brake on cycle. The Armed Mode has no time limit and will be maintained for the duration of the motor run time.

2.1.3 “Braking”

The ABC Series will enter the braking mode when the ABC is armed and the motor is given a stop command (see section 2.1.2). To prevent damaging current spikes, a factory programmed delay allows the existing magnetic field in the motor to decay before DC is applied. During the "BRAKING" mode, a set of N.C. interlock contacts change state and disable the motor starter control circuit during the braking cycle (see section 4.2.2).

The ABC Series begins injecting a regulated DC braking current, digitally times, controls the Interlock Relay and monitors the Zero Speed Sense Circuit simultaneously. Braking will continue until the first one of three events occurs: 1) the Zero Speed Sense circuit determines the motor has stopped, 2) the "Brake Time" expires, or 3) the unit receives a "Brake Disable" signal. When braking is complete, the ABC Series releases the Interlock Relay and is ready for another cycle.

2.1.4 Brake OFF

This LED illuminates whenever the ABC Series is not actively braking (either because the motor is on or the previous braking cycle has been completed). The ABC Series provides a built-in, closed-loop sensing circuit that accurately determines when the motor has stopped based on the subtle signals received from the unused motor winding. If the Zero Speed Sensing circuit determines that the motor has come to a stop before the Brake Time has expired, it will override the brake time setting and shut the ABC off. The "BRAKE OFF" LED will then illuminate.

NOTE: Since the Brake Time may expire prior to the Zero Speed override coming into play, this circuit should not be used as a true Zero Speed indicator.



WARNING!

The ABC Series DC Injection Brake requires AC power for braking. Power loss before or during braking will result in the loss of braking ability, which can be hazardous to personnel and/or equipment. If braking to a stop is critical regardless of the availability of electrical power, mechanical braking should be provided as a backup system. The ABC Series brake offers a Mechanical Brake Release Relay specifically for this purpose.

2.2 Fault Conditions

The "FAULT" LED will illuminate when any of the following conditions occur:

2.2.1 "Disabled"

The "DISABLED" mode is activated when the ABC Series receives a command on the Brake Disable input (a N.O. dry contact at TB1) (see section 4.3.2). This mode can be used to effectively remove the electronic brake from the system, and is useful in applications that only require braking at certain times during the process or during system setup.

Note: The ABC Series is a "smart brake" and will sense a running motor and automatically arm itself if released from the "DISABLED" mode. Under these circumstances, the ABC Series will go through the "JOG" and "ARMED" sequence again. If the unit has determined the motor is stopped, the brake will return to the normal ready state.

NOTE: The ABC Series Mechanical Brake Release Relay will set the mechanical brake if the ABC Series brake unit is disabled during the braking mode.

2.2.2 "Wiring Error"

The ABC Series unit will recognize when the interface connections or monitored signals are not correct with respect to the proper operation sequence. If the brake detects a miswire or an improper sequence of events, it will "self-disable" to prevent any conflicts with the existing systems and indicate "WIRING ERROR". If this occurs, the "Fault" LED and "Wiring Error" LEDs will illuminate. Once the miswire or wrong sequence is corrected, the brake will automatically enable itself and resume normal operation.

2.2.3 "Over Temp"

The ABC Series has thermal sensors built into the heat sink assembly. If the heat sink approaches temperatures too high for the SCRs, the sensors will cause a Fault to block the ABC from braking and illuminate the "Fault" and "Over Temp" LEDs.

2.2.4 "Over Current"

The braking current is regulated by an RMS value control loop that also monitors the level for any over current conditions. If an over current condition is detected, the braking cycle is immediately halted and the fault LED lit. The Fault LED will be blinking 10 times per second to indicate the over current condition. A thorough verification of the ABC load circuit and connections should be conducted before issuing a reset command to clear the fault condition.

2.2.5 "Shorted SCR Detection"

The ABC unit monitors the condition of all its SCRs on a real time basis. If for some unlikely reason one of the units SCRs were too short, the ABC will issue a fault and block the operation of the brake to prevent any abnormal operation conditions. The fault LED will be flashing at a 1 second rate if this condition is detected. This fault cannot be reset as the unit will require repair if the condition exists.

2.3 Mechanical Brake Control

The ABC Series includes a Mechanical Brake Release Relay that can be utilized to control an electro-mechanical brake coil. This relay has a Form "A" contact (1 N.O.) that changes state as follows (see section 4.3.5):

OPERATION	RELAY STATUS
Power On	No change (Remains Open)
Jog / Armed	Closes when motor starter is closed
Brake On	Remains Closed
Brake Time Completed Zero Speed Detected	Opens when braking is done
Disabled during Jog / Armed	Remains Closed
Disabled during Braking	Opens upon receiving Disable command
Fault	Opens upon a fault being issued

3 Installation

3.1 Receiving and Unpacking

Upon receipt of the product you should immediately do the following:

- Carefully unpack the unit from the shipping carton and inspect it for shipping damage.
- Verify that the model number on the unit matches your purchase order.
- Check all electrical terminals to be sure screws are tight.

3.2 Initial Unit Inspection

Complete a visual check of the unit for damage which may have occurred during shipping and handling. Report any damage immediately and file a claim with the freight carrier within 15 days of receipt. Do not attempt to continue installation if the unit is damaged.

CAUTION!

Do not operate or install the ABC Series Brake if it appears to be damaged or visually defective. Doing so may result in personnel injury or equipment damage.



3.3 Location

Proper location of the ABC Series is necessary to achieve specified performance and normal operation lifetime. The unit should always be installed in an area where the following conditions exist:

- Ambient operating temperature: 0 to 40°C (32 to 122°F)
- Humidity: 5 to 95% non-condensing
- Free from metallic particles, conductive dust and corrosive gas
- Free from excessive vibration (below 0.5G)
- Open panel units must be mounted in the appropriate type of enclosure. Enclosure size and type must be suitable to dissipate heat generated by the unit. Contact factory for details.

3.4 Mounting and Cleaning

The unit is air cooled and must be properly mounted to allow for unrestricted airflow across the heat sink. The unit should be mounted with the heat sink fins in a vertical plane, with a minimum of five (5) inches (127mm) of free space around the unit for adequate ventilation. The ambient air should be free of any contaminants which can clog louvers or coat the unit. As with all electrical equipment, the unit must be protected from water and condensing humidity to prevent damage to the unit. In damp or cold environments, space heaters may be required.

WARNING!

Remove ALL source of power before cleaning the unit. In dirty or contaminated atmospheres the unit should be cleaned on a regular basis to ensure proper cooling. Do not use any chemicals to clean the unit. To remove surface dust, use 80 to 100 PSI clean, dry compressed air only. A three inch, high quality, dry paint brush is helpful to loosen up the dust prior to using compressed air on the unit.



4 Wiring

4.1 Introduction

- Installation of the brake unit should be done by properly qualified personnel.
- Check local and other applicable codes to ensure that all installation requirements are met prior to operation.
- Prior to beginning the installation, verify that the motor and brake unit have the same voltage ratings.
- Check the unit to verify that it is rated for the appropriate current (approximately equal to the motor FLA if sized for Standard Duty - see section 1.3).

**WARNING!**

Do not service equipment with voltage applied! Unit can be source of fatal electrical shocks! To avoid shock hazard, disconnect main power before working on the unit. Warning labels must be attached to terminals, enclosure and control panel to meet local codes.

4.2 Line and Load Connections

Power conductors for the Line and Load connections should be, at a minimum, sized for 125% of the current rating. Brake sizing and duty cycling should be considered when determining if conductors should be oversized for your application. For example, high torque, fast stop applications with maximum duty cycle may require conductors sized for the maximum output capability of the ABC Series, and motor lead wires should match.

4.2.1 Line Power Connections

Connect the line leads to the input terminals L1 and L2 provided on the unit. The line power must be supplied from a source with suitable Short Circuit Protective Devices (SCPD) conforming to local and national electric codes. Additional fusing is necessary only when the motor circuit is fused at a level too high to protect the ABC Series per code. Recommendations for commonly available SCPDs are as follows:

UNIT RATING (AMPS)	SCPD	Size
10 - 24	Fuse	50A Max
50 - 100	Fuse	225A Max
200	Fuse	300A Max
300 - 400	Fuse or Circuit Breaker	500A Max
550 - 800	Fuse or Circuit Breaker	1000A Max
1000	Fuse or Circuit Breaker	1200A Max



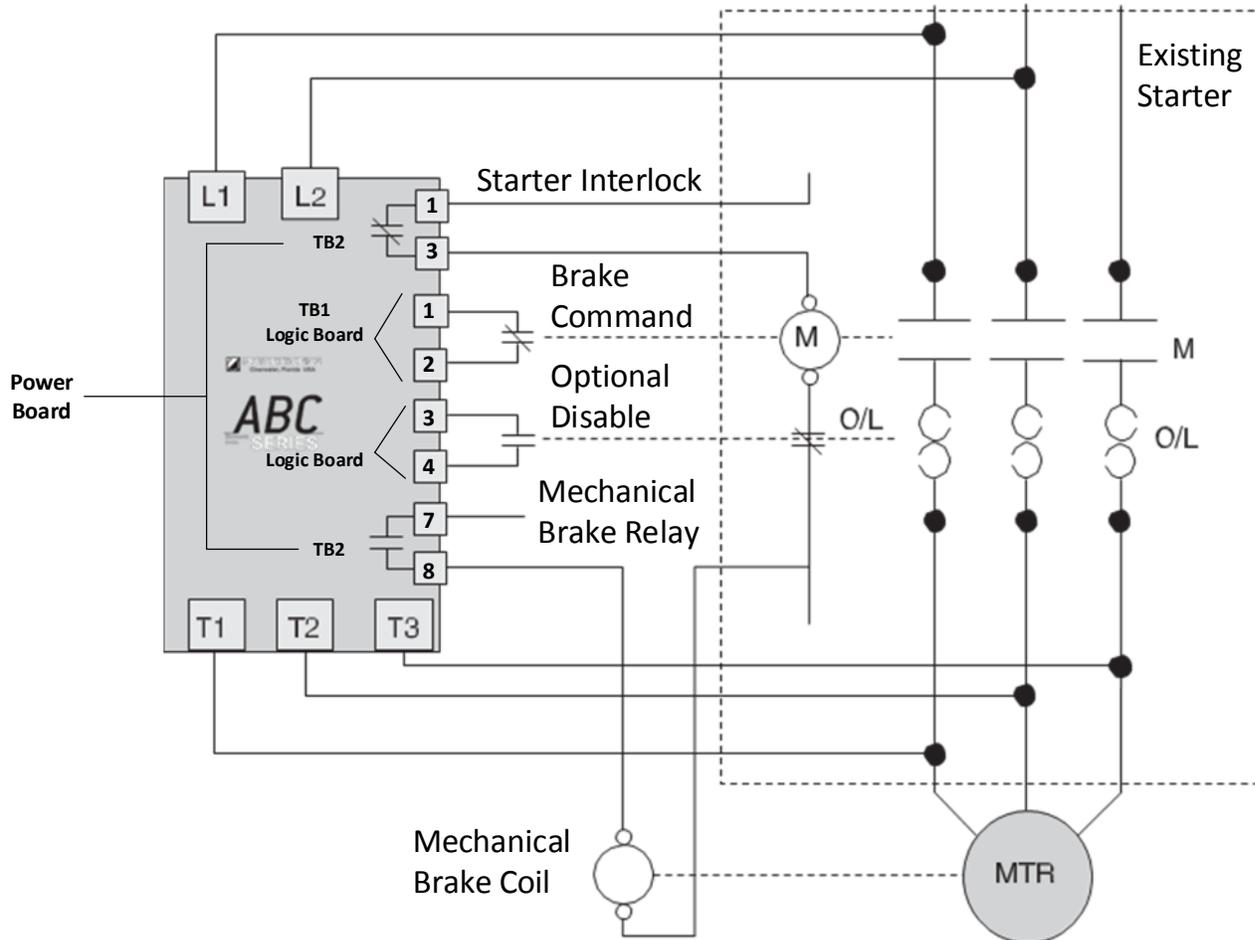
WARNING!

Many motor safety disconnect switches are not rated to interrupt DC current. Replace any load side safety disconnect switch with one that is rated for DC voltage at the motor line voltage rating or greater. As an alternative, disconnect incoming line power before opening any load side disconnect switches in the motor circuit during braking, and post warning labels at all affected devices. Failure to observe this precaution may result in damage to the disconnect and/or bodily injury

4.2.2 Load Power Connections

Connect the motor to the output terminals T1 and T2 provided on the unit. The unit will operate on either a Wye or a Delta connected motor. An additional sensing wire must be run from motor lead T3 of the starter to the voltage sensing circuit of the ABC Series. The terminal for this is marked "T3". This terminal carries very little current so #14 AWG wire (or higher) can be used. Fuse protection adequate for the field wiring used must be provided per code.

NOTE: If the ABC Series brake is being used with 2-speed, Wye-Delta or Reduced Voltage starter, consult factory for additional load connection information



CAUTION!

Power Factor Correction Capacitors should NOT be connected to the load side of the motor starter when used with an ABC Series brake. PFC Capacitors should only be connected to the line side and must include a separate isolation contactor.

4.3 Control Connections

Control wire should be run in a separate conduit from power lines (twisted, shielded cable should be adequate). Whenever possible, conduits containing control and power conductors should cross at right angles to each other. Control connections are made to terminal blocks mounted on the printed circuit boards inside the unit. TB1 is on the Logic Board (upper board) with the terminals for the Starter Monitor, Brake Disable and external Reset Input. TB2 is located on the Power Board (lower board), and contains terminals for the Interlock Contacts, Mechanical Brake Relay and Fault contacts.

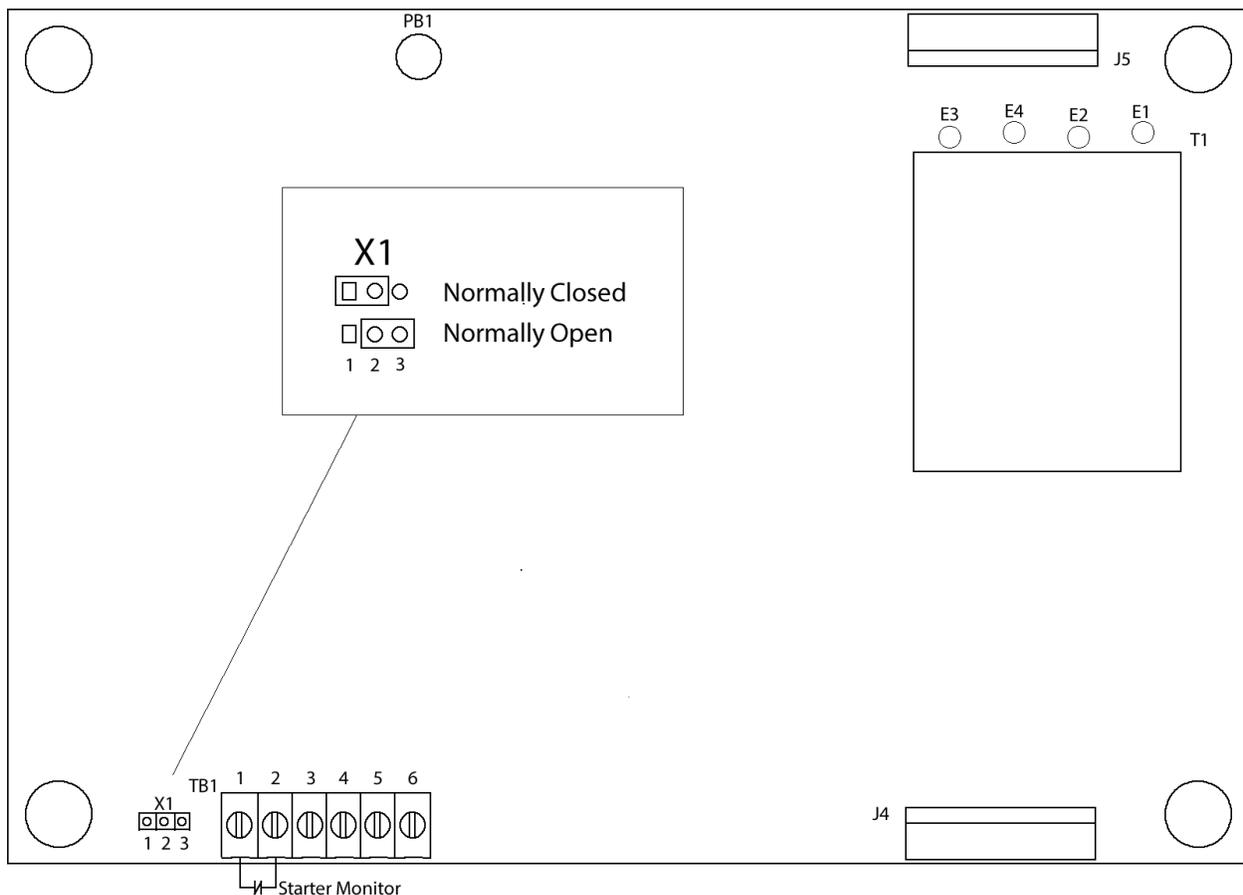


WARNING!

The motor starter must never be operated manually when the brake unit is connected. Blown fuses and/or damage to the unit may occur.

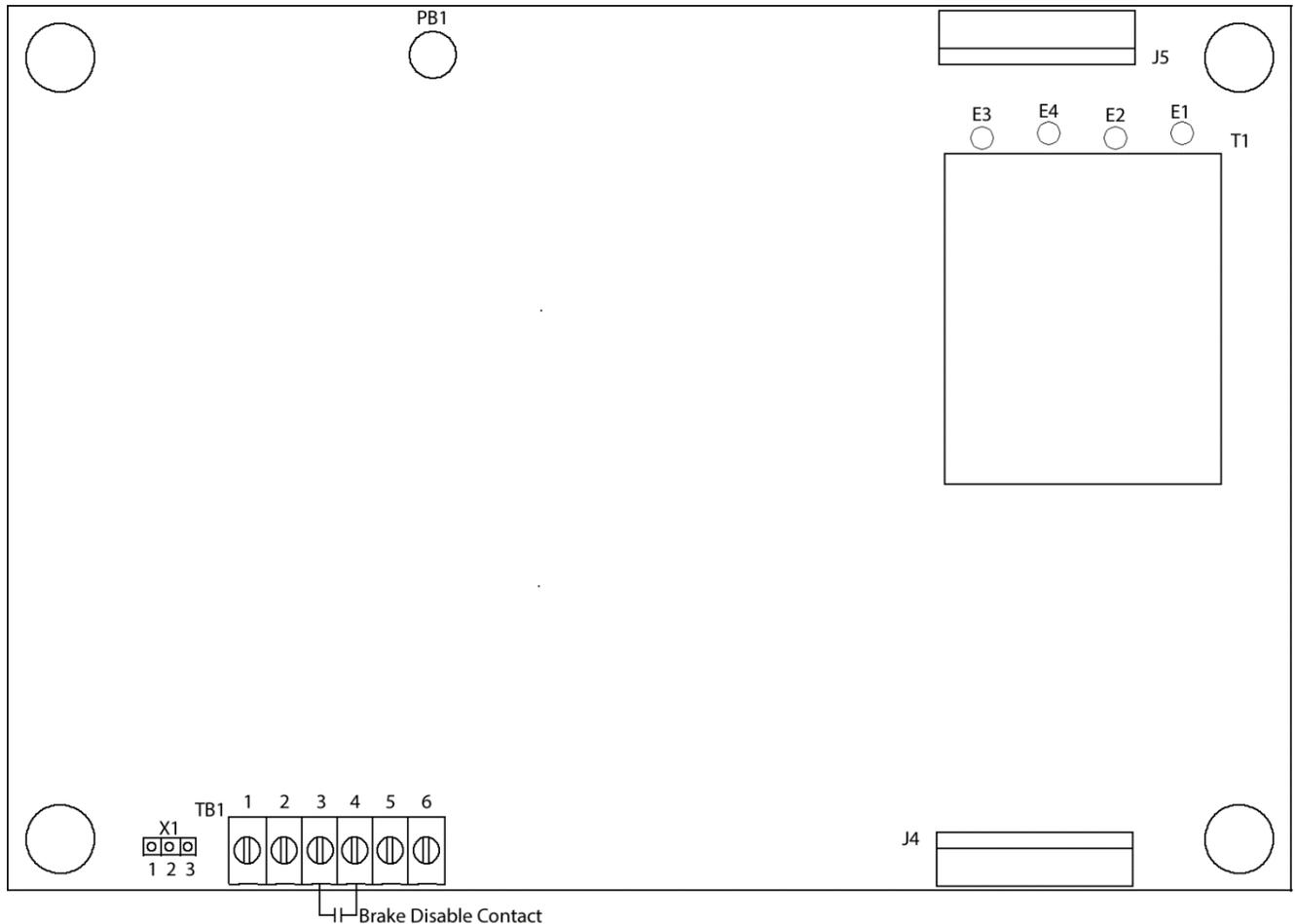
4.3.1 Starter Monitor Input

Provides a brake command signal from the motor starter (see section 2.1.3). Connect either the normally open, or normally closed (normally closed recommended) dry auxiliary contact on the motor starter to TB1, terminals 1 and 2 on the logic board. When the X1 jumper is in positions 1 & 2, the starter monitor input is configured for a N.C. (Normally Closed) input contact. When the X1 jumper is set to positions 2 & 3 the starter monitor input is configured for a N.O. (Normally Open) input contact.



4.3.2 Brake Disable Input

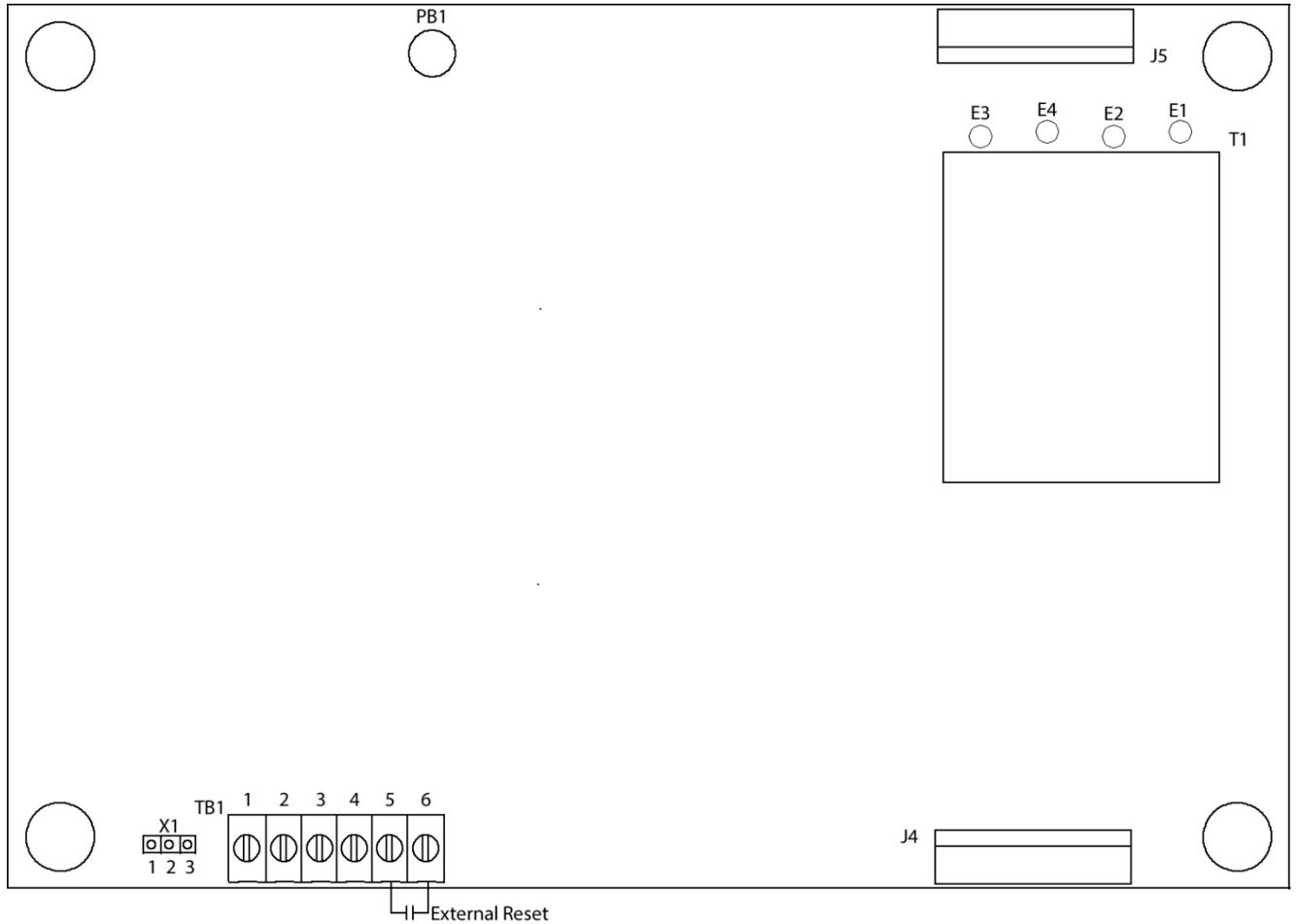
This input disables the electronic braking functions before, during, or after operation (see section 2.2.1). To utilize this feature, wire a N.O. dry contact to TB1 terminals 3 and 4 on the logic board. The disable feature will be active as long as the contact is closed, and will resume operation sequence only when the disable command is released (i.e. the contact is opened). Once the ABC Series has resumed operation, it will evaluate the status of the motor and re-enter the "JOG" mode if conditions are correct. Circuit voltage potential: 15VDC maximum.



NOTE: The Brake Disable can and should be used to disable the ABC Series brake in the event of a motor thermal overload by wiring a normally open contact from the overload relay to these terminals. This will prevent the brake from operating if a motor overload trip condition occurs.

4.3.3 External Reset Pins

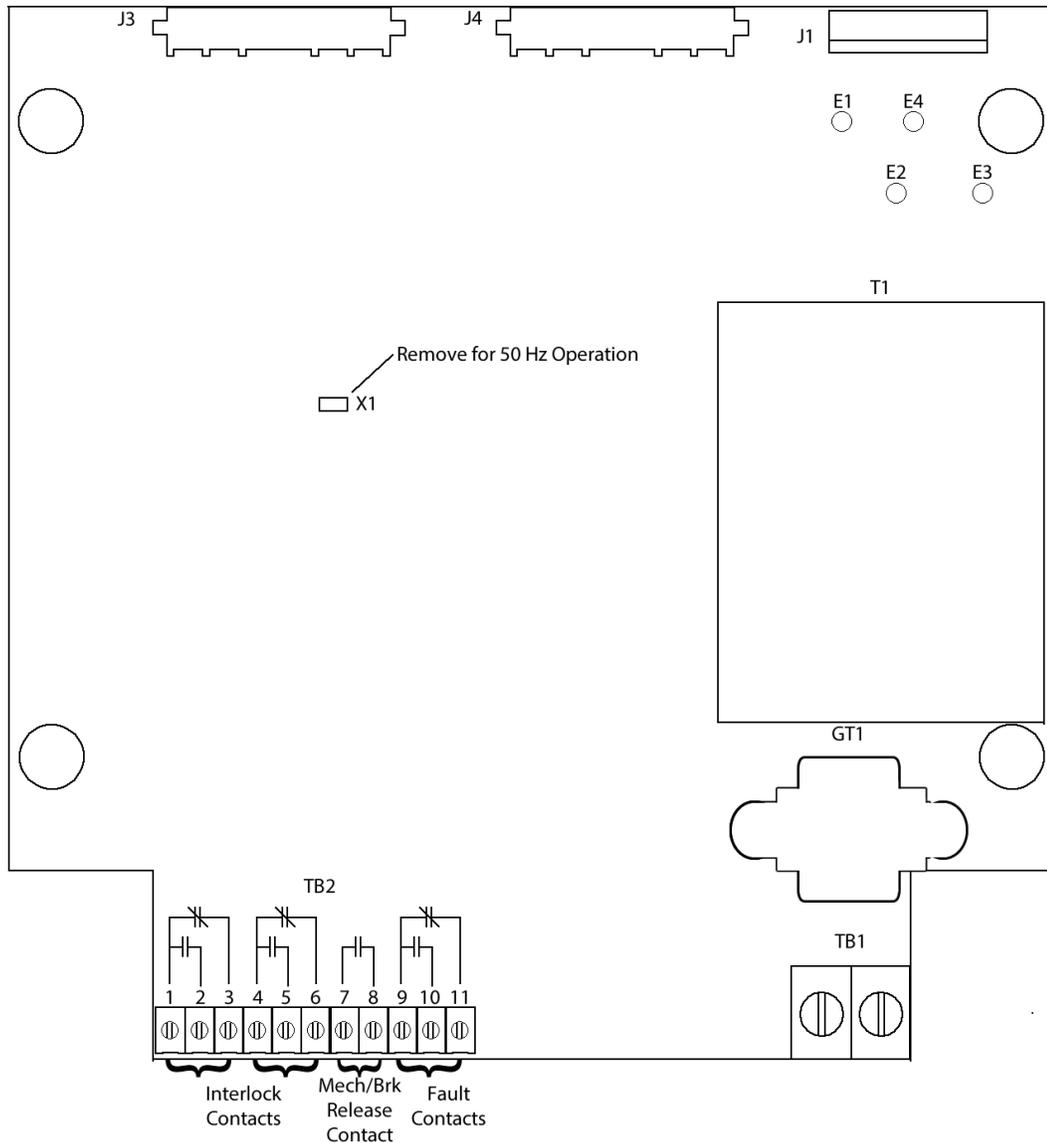
Positions 5 & 6 are the External Reset Input terminals. This input requires a normally open dry contact that when closed will issue a reset command to reset a Shorted SCR, Over Current or Over Temperature Trip.



4.3.4 Interlock Contacts

The ABC Series unit must be interlocked with the motor starter coil circuit to disable the motor starter during the braking cycle for proper operation (see section 2.1.3). Two sets of "FORM C" contacts are provided on TB2 on the power board to interlock the motor starter with the brake. Terminals 1, 2, and 3 are the first set and terminals 4, 5, and 6 are the second. Use both sets for reversing starters, each in one of the contactor coil circuits. The second set may be used as a status indicator in non-reversing starter applications.

NOTE: Never connect the interlock contacts parallel to the contactor coil or across the power line. Circuit voltage potential: same as starter control circuit, 250VAC maximum.



WARNING!

If this wiring is done incorrectly or not at all, severe damage to the unit may occur and the warranty on the unit may be voided.

4.3.5 Mechanical Brake Release Relay

The ABC Series brake unit can work in conjunction with a mechanical brake by interfacing with the motor and allowing for mechanical brake control. The ABC Series brake can be used for stopping, and the mechanical brake for holding. The Mechanical Brake Release contacts are N.O. relay contacts rated for 5A, 250VAC and are located at terminals 7 and 8 of TB2 on the Power Board (see section 2.3 for additional operating details).

The unit will detect the motor start command and release the mechanical brake. When the stop command is given, the ABC Series brake unit will continue to keep the mechanical brake released, proceed with the DC injection braking sequence, then engage the mechanical brake at the end of the braking cycle. If the disable feature is engaged while in "BRAKING" mode, the ABC Series will automatically set the mechanical brake.

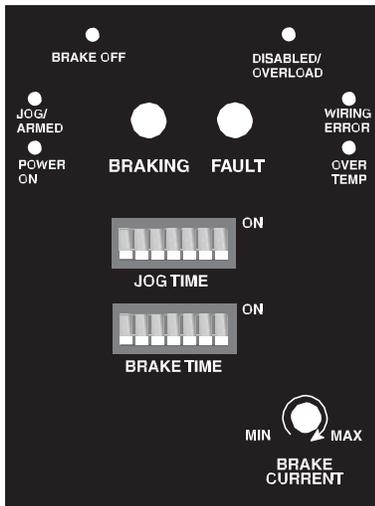
4.3.6 Fault Relay Contact

Fault relay contacts are available at position 9, 10, & 11 on TB2 and are rated for 5A, 250VAC. The fault contacts change state on Brake Disabled Shorted SCR, Over Current, or Over Temperature trip.

5 Adjustments

5.1 Time Adjustment Procedures

Time settings for "Jog Time" and "Brake Time" are adjusted by use of dip switches on the front mounted Operator Interface Module. Time settings are in seconds (set in binary code). Each switch denotes a binary digit, totalling 127 seconds maximum when all are switched to the "On" position.



Operator Interface Module

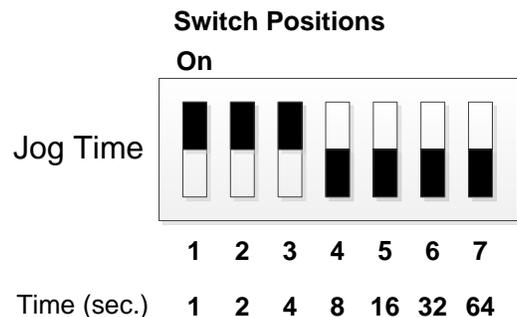
5.2 Jog Time Adjustment

Factory Setting: 7 seconds

The Jog time is adjustable from 0-127 seconds and is made using the 7 position dip switch, labeled "Jog Time". Set the switches according to the Jog Time required. Setting all the switches to the "Off" position (Jog Time = 0) will disable this function.

Example:

Setting dip switch positions 1, 2, and 3 to "ON" = $1+2+4$
 = 7 seconds total jog time.



CAUTION!

Damage to the motor, equipment, brake and/or electrical circuit may occur if this adjustment is not correct. Setting this switch to less than the factory setting may involve risk to the equipment and affect normal operations. Setting the jog time too long may result in equipment operating without the benefit of the DC injection brake. The Jog Time should typically be set equal to the time it takes the motor to accelerate the load to full speed plus approximately 2 seconds.

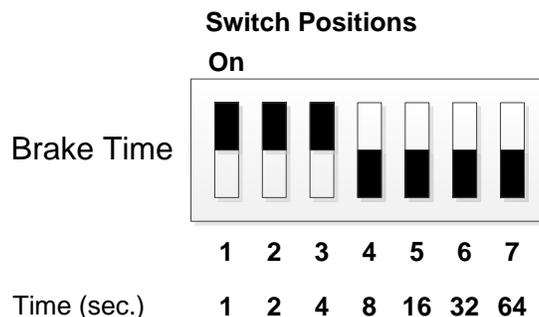
5.3 Brake Time Adjustment

Factory Setting: 7 seconds

The brake time is programmable from 1 to 127 seconds. Set the switches marked "Brake Time" to the brake time required. Typical brake time settings should be 1/2 of the load's coast-to-stop time or less, as necessary. Each dip switch represents a binary time value. Add the times together for the final brake time setting

Example:

Setting dip switch positions 1, 2, and 3 to "ON" = $1+2+4$
 = 7 seconds total brake time.



NOTE: Stop times shorter than 4 seconds will not allow enough time for the Zero Speed Sensing circuit to accurately sense that the motor has stopped. The Brake Time settings must be used in applications that require brake times less than 4 seconds.

5.4 Brake Current Adjustment

Factory Setting: 50% of Unit Rating

It is strongly recommended that you try the factory settings first before making and adjustments. If adjustments are necessary a "true" RMS AC current clamp on meter should be used to monitor the current supplied to the motor during braking. To adjust the brake current turn the adjustment potentiometer located on the display clockwise to increase or counter clockwise to decrease the current. Always adjust the brake current while the brake is in the brake on mode. The braking current should be set such that the motor stops at the same time the brake time expires. Start and brake the motor several times to ensure your settings are correct.

See section 6.3 for a step by step procedure.



WARNING!

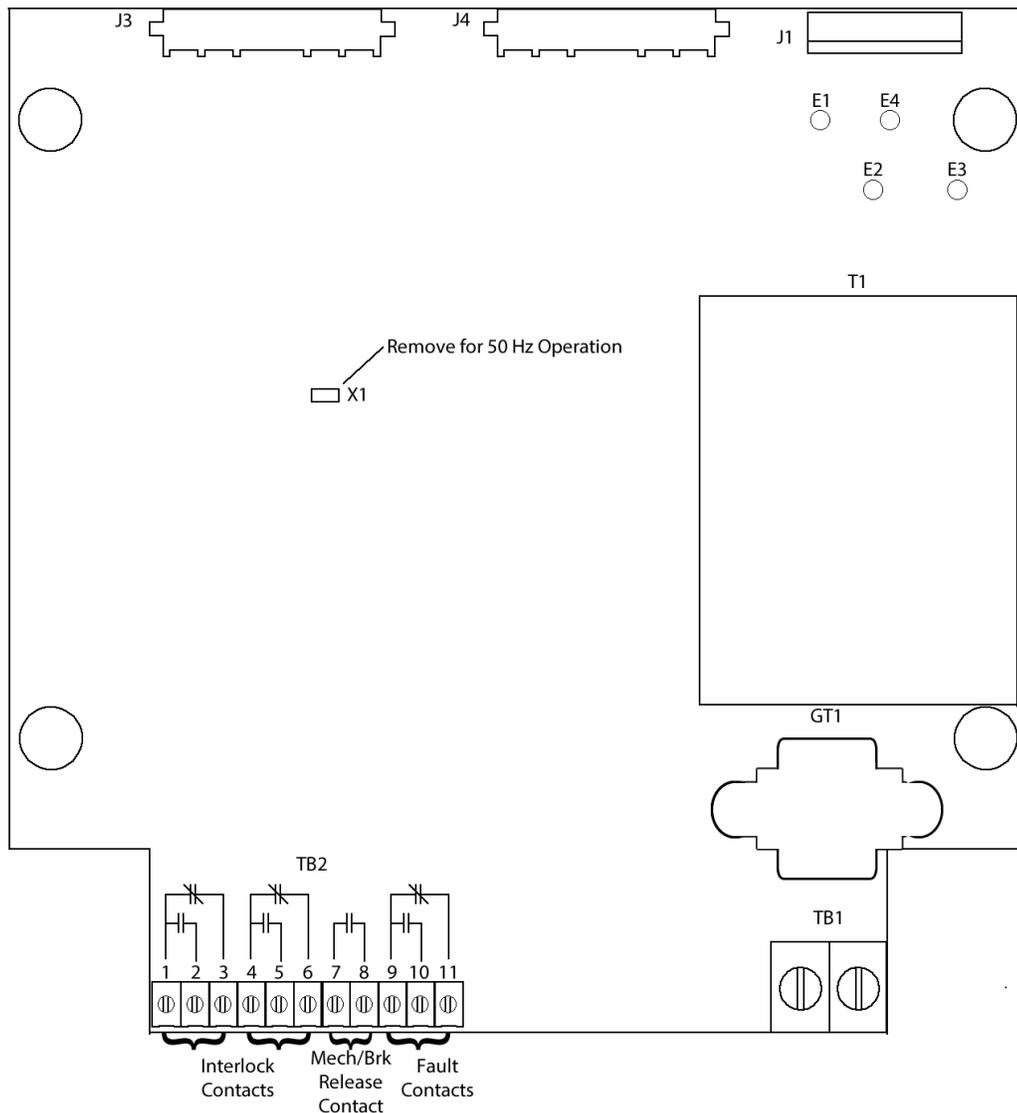
Never exceed the RMS full load current rating of the motor without first checking with the motor manufacturer for the maximum allowable amount of DC current that can be supplied to the motor during braking application.

5.5 50 Hz Operation

50 Hz Operation (Power Board Jumper X1)

This jumper is located on the Power (lower) board and is configured accordingly with respect to the unit voltage and frequency requirements. For example, 380 and 415 volt units would be factory configured for 50Hz operation in comparison to a 240 or 480v unit which would be factory configured for 60Hz operation. The unit can also be reconfigured in the field if needed.

The jumper is located on the power board. With the jumper installed the unit is configured for 60Hz operation. Remove the jumper for 50Hz operation.



CAUTION!

Some adjustments and devices visible on the ABC Series boards are preset at the factory and should NOT be field adjusted without specific instructions from factory authorized service personnel. These devices include: P1 and P2 potentiometers, and push button PB1. Tampering or altering these devices may void your warranty.

6 Start-up

6.1 Start-up Check List

- Verify the supply voltage matches the supply voltage of the ABC Series brake.
- Confirm the power lines are attached to the input terminals.
- Verify the output leads are connected to the output terminals.
- Complete the appropriate control and interlock connections.
- Clear the area of people and extra parts before start up.

NOTE: For 50 Hz operation, be sure that jumper X1 on the Power Board is removed.

6.2 Equipment

The following equipment will be needed for start-up:

- A "true" RMS AC clamp-on ammeter to check braking current.
- A small screw driver to adjust braking torque (if necessary).
- Stop watch or other means of measuring time.

6.3 Check Normal Sequence of Operation

- Apply power to the system.
- Both the "Power On" and the "Brake Off" LED should be illuminated.
- Start the motor by energizing the motor starter.
- Start the motor. The "Jog / Armed" LED should flash once per second to indicate programmed Jog Time.
- Allow the programmed jog time to expire (Factory set for 7 sec.) and the brake to arm.
- Monitor the input current to the ABC Series unit on any one of its input leads with the "true" RMS AC clamp-on ammeter.
- Initiate the motor stop command. The "Brake Off" LED should go out and the "Brake On" LED should illuminate. The unit should continue braking until the motor comes to a stop or the programmed brake time expires.
- Adjust the brake time if necessary.
- If the brake times out before the motor stops, increase the value of the brake time switch, or increase the brake current (**NOTE:** Never exceed the RMS rating of the motor without checking with the motor manufacturer).
- If the Zero Speed Sense option engages and turns off the brake before the programmed brake time expires, adjust the brake time dip switch for approximately two (2) seconds longer than the actual stop time.

7 Application Specific Settings

7.1 CPU Dip Switch Settings



WARNING!

The unit CPU dip switch is factory set for the majority of applications. DO NOT change any dip switch settings without consulting factory tech support. Failure to do so may damage the brake or cause it to not function correctly.

The function of each switch is described below.

Switch #	Function																																				
1	Sets Brake On Delay Time when Motor Voltage Sense Feature is Disabled. <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Switch 3</th> <th>Switch 2</th> <th>Switch 1</th> <th>Brake On Delay Time</th> </tr> </thead> <tr> <td>OFF</td> <td>OFF</td> <td>OFF</td> <td>0.125 sec</td> </tr> <tr> <td>OFF</td> <td>OFF</td> <td>ON</td> <td>0.25 sec</td> </tr> <tr> <td>OFF</td> <td>ON</td> <td>OFF</td> <td>0.5 sec</td> </tr> <tr> <td>OFF</td> <td>ON</td> <td>ON</td> <td>1 sec</td> </tr> <tr> <td>ON</td> <td>OFF</td> <td>OFF</td> <td>2 sec</td> </tr> <tr> <td>ON</td> <td>OFF</td> <td>ON</td> <td>3 sec</td> </tr> <tr> <td>ON</td> <td>ON</td> <td>OFF</td> <td>4 sec</td> </tr> <tr> <td>ON</td> <td>ON</td> <td>ON</td> <td>5 sec</td> </tr> </table>	Switch 3	Switch 2	Switch 1	Brake On Delay Time	OFF	OFF	OFF	0.125 sec	OFF	OFF	ON	0.25 sec	OFF	ON	OFF	0.5 sec	OFF	ON	ON	1 sec	ON	OFF	OFF	2 sec	ON	OFF	ON	3 sec	ON	ON	OFF	4 sec	ON	ON	ON	5 sec
Switch 3		Switch 2	Switch 1	Brake On Delay Time																																	
OFF		OFF	OFF	0.125 sec																																	
OFF		OFF	ON	0.25 sec																																	
OFF		ON	OFF	0.5 sec																																	
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ON		OFF	OFF	2 sec																																	
ON		OFF	ON	3 sec																																	
ON		ON	OFF	4 sec																																	
ON		ON	ON	5 sec																																	
2																																					
3																																					
4	Motor Voltage Sense Enable / Disable																																				
5	Unit Display Self Test																																				
6	Shorted SCR Detection																																				
7	Over Current Detection																																				
8	Zero Speed Sensing Enable / Disable4																																				

Switch 1, 2 and 3:

These switches set the Brake On Delay when the Motor Voltage Sense is disabled.

These switches are factory set according to unit rating and must not be changed without factory guidance as damage to the brake may occur.

Switch 4:

This switch Enables or Disables the Motor Voltage Sense feature. This feature monitors the decay of the stator voltage when a stop command is given and delays the application of the brake current until the stator voltage has dropped to a safe level. Depending on motor size and type, this decay may take 5-10 seconds. When the Motor Voltage Sense feature has determined the stator voltage is low enough to activate the brake, a normal braking cycle takes place. The unit is shipped with this feature ENABLED (switch 4 ON). To disable this feature and revert back to the fixed brake on delay times, set switch 4 to the OFF position.

Switch 5:

Switch 5 allows for a unit display self test function. To run a display self test, remove power from the unit, set dip switch 5 to the ON position and apply power to the unit. The self test will light each display indicator allowing the user to verify all are functional. When you have confirmed all display elements are functional, remove power from the unit and set switch 5 back to the OFF position. The unit is shipped from the factory with switch 5 in the OFF position.

Switch 6:

This switch Enables / Disables the Shorted SCR Detection feature and is shipped from the factory in the ON (ENABLED) position. This feature will detect if any one of the SCRs has shorted for any reason. If a failed SCR is detected the Fault Relay will be activated and the unit disabled from further braking cycles. To disable the Shorted SCR Detection set switch 6 to the OFF position.

Switch 7:

This switch ENABLES or DISABLES the Over Current Detection feature. While braking is active the brake current is regulated by the True RMS control loop. If for some reason the brake current were to exceed a set value the unit would immediately shut down, activate the Fault relay and remain disabled until it receives a RESET command or power was cycled. The unit is shipped from the factory with switch 7 in the ON position, enabling this feature. To disable this feature, set switch 7 to the OFF position.

Switch 8:

The Zero Speed Sense circuitry is ENABLED or DISABLED by this switch. It is factory set in the ON (Enabled) position. If however, the application requires stopping times less than four (4) seconds and/or rapid starting and stopping cycles are needed, it is recommended to disable the Zero Speed Sense feature and utilize the digital timing for optimal repeatability and precision.

APPENDIX A: Technical Specifications

Voltage Rating:	Models rated from 208 – 600 +/- 10%
Line Frequency:	Selectable for 50 / 60 Hz + 2Hz
Current Ratings:	10, 24, 50, 100, 200, 300, 400, 550, 800, 1000A
Output Capacity:	25% duty cycle at 100% unit rating
Power Circuit:	Full wave bridge, 4 SCRs, designed for use without isolation contactors.
Transient Protection:	RC snubber dv/dt circuit on each SCR device.
Fusing:	Approved for use with existing motor starter fusing when unit is sized for motor FLA. Consult NEC for any other fusing requirements.
Control Circuit:	Self-powered directly from line terminals. No separate control voltage required.
Control Method:	Microprocessor unit control sequencing, I/O monitoring and status annunciation. Braking current is adjustable via true RMS regulated control using phase angle firing of SCRs.
Operator Adjustments:	Brake Time and Jog Time = 7 position binary dip-switch. Brake Current = potentiometer
Adjustment Ranges:	Brake/Jog Time = 0 – 127 seconds in 1 sec. increments. Brake Current = Up to 100% of unit rating.
Inputs:	<p>Starter Monitor = Dry input for auxiliary contact from motor starter. Jumper selectable for N.O. or N.C. contact.</p> <p>Brake Disable = Dry input for N.O. contact to disable braking before or during operation. Can be wired to the starter thermal overload N.O. auxiliary contact to prevent braking of overloaded motor.</p> <p>Motor Power Sensor (T3) = Voltage input used for sensing motor power presence in sequencing / status circuit and for zero speed sensing during braking.</p>

Outputs:	<p>Starter Coil Interlock = Two sets of FORM "C" relay contacts for use in interlocking the starter coil and/or other devices to prevent energizing as the braking power is applied.</p> <p>Mechanical brake Release = N.O. relay contact for use in controlling electro-mechanical brake as a holding brake. When the ABC Series is "disabled", this circuit controls the mechanical brake normally as if it is the only brake in the system.</p>
Aux. Contact/ Fault Contact Ratings:	5 Amps, 250 VAC max.
LED Status Indicators:	Large LEDs: braking = green; Fault = Red Small LEDs: Power On, Jog/Armed, Brake Off, Disabled, Over Temp and Wiring Error.
Operating Design Temperature:	32°F – 122°F / 0°C to 50°C
Storage Temperature:	-4°F – 176°F / -20°C to 80°C
Ambient Conditions:	5% to 95% relative humidity 0 – 3300ft (1000m) elevation
Approval:	UL, cUL Listed

Warranty information

Motortronics warrants its products to be free from defects in material and/or workmanship for a period of one year from the date of installation, to a maximum of 18 months from the date of shipment as indicated by the unit's date code. The Company reserves the right to repair or replace any mal- functioning units under warranty at their option. All warranty repairs must be performed by the Company factory or on site by factory authorized service firms or personnel approved by the Company.

Solid state controls have different operating characteristics from those of electromechanical equipment. Because of these differences and the wide variety of applications for solid state controls, each application designer must verify that the solid state equipment is acceptable for his application. In no event will Motortronics be liable or responsible for indirect or consequential damages resulting from the use or application of this equipment. The diagrams and illustrations in this document are included solely for illustrative purposes. Because of the number of different applications, Motortronics cannot be responsible or liable for actual use based on the examples or diagrams.



MOTORTRONICS™

Solid State AC Motor Control

ABC *Series*

Electronic Motor Brake

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