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## GENERAL

Digi-Start Solid State Reduced Voltage Starters are used on three-phase squirrel cage, wound rotor, and synchronous induction motors. The Digi-Start has an adjustable starting torque followed by either an adjustable voltage ramp or current limit start. These adjustments enable smooth motor acceleration to full speed, providing a soft start, and allowing for full starting torque, if and when required.

In cases where load and motor conditions cause instability near the end of the acceleration ramp, a selectable "accel kick" function provides a quick step-up to full motor voltage.

The Standard Digi-Start contains six SCRs, two connected back-to-back per phase. The design of this power circuit eliminates the additional heat producing harmonics which are a direct result of the non-symmetrical wave forms produced by a three SCR/three diode type starter.

SOFTAC's Digi-Start Starters are constructed to permit rapid repair and replacement if required; ensuring minimum downtime in the unlikely event a failure should occur.

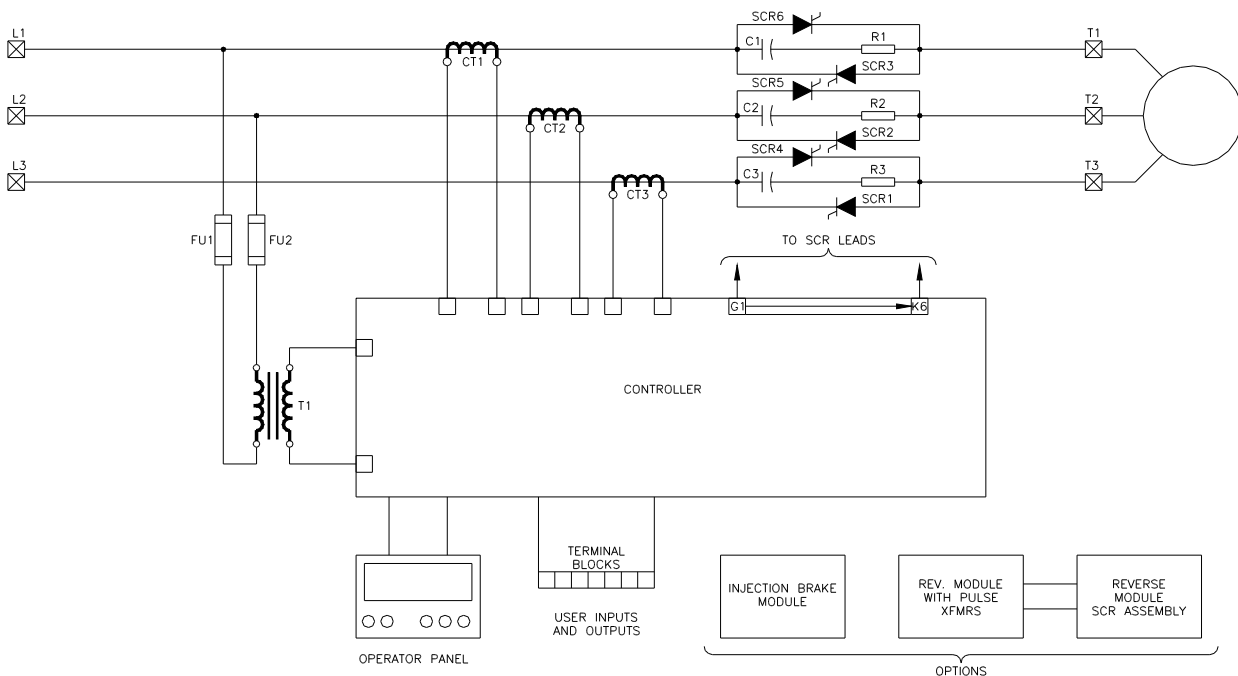
## POWER ASSEMBLY TECHNICAL DATA

The Standard Digi-Start contains six SCRs which have a minimum peak inverse voltage (PIV) rating of two and one-half times the line-to-line AC voltage and a root mean square (RMS) current rating normally selected to be three times the full load current of the motor.

Digi-Starters are rated to operate at a maximum continuous line current (based on HP and voltage) with a maximum ambient temperature of 40°C at an altitude of 6,500 feet (2,000 meters) above sea level. De-rating of one and one-half percent per degree C above 40°C and one percent for every 325 feet (100 meters) above 5,000 feet, must be considered when applying Digi-Start.

## USING POWER FACTOR CAPACITORS

Power factor correction capacitors can be used in conjunction with the Digi-Start Starter, however, the capacitors must be added ahead of the starter and never between the starter and motor. If the capacitors are installed between the motor and the starter, serious damage to the starter and/or the motor may result.



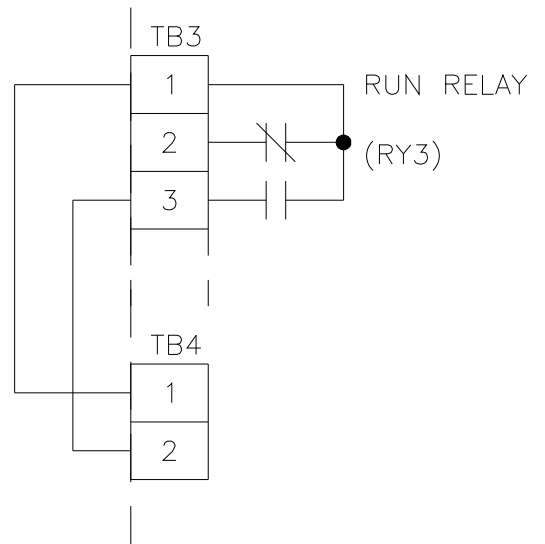
# INSTALLATION PROCEDURE

Connect the three-phase AC supply of the correct voltage and frequency to the input terminals L1, L2, and L3. Wire should be sized according to the motor current. Wire sizing may be determined by consulting CE Code / NEC and local regulations.

Connect motor leads to output terminals T1, T2, and T3.

## a. NO EXTERNAL CONTROL

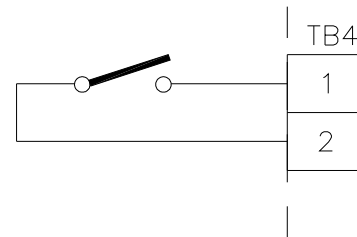
If your application does not require an external stop/start connect TB3-1 to TB4-1 and TB3-3 to TB4-2. This will seal in the run command from the keypad.



## b. TWO WIRE LOW VOLTAGE CONTROL

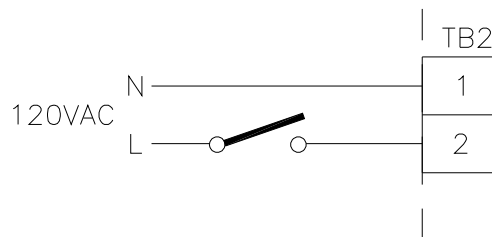
**TB4** Two wire controls are used for automatic control.

Dry contact closure control requiring no external voltage source. **The starter will start if parameter 07 is set to 1 and an overload condition clears.**



## c. TWO WIRE 120 VAC CONTROL

**TB2** Dry contract closure control requiring an external 120V supply, same caution as b.

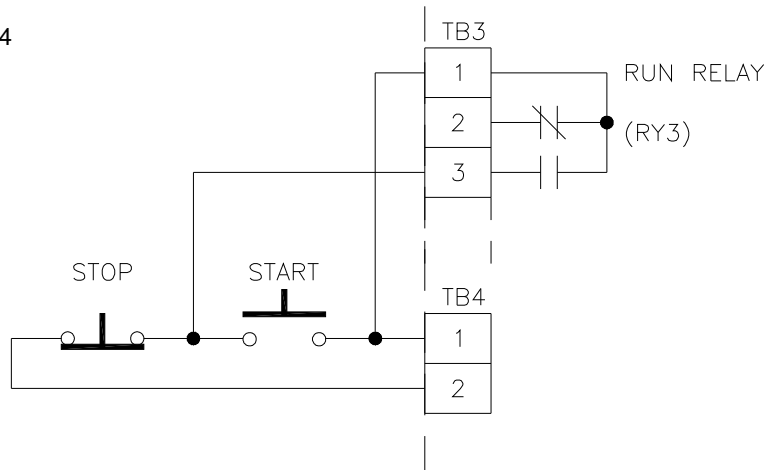


\* Note: If using PLC output card, place 10W 2K5 resistor across TB2/1-2.

## INSTALLATION PROCEDURE Cont...

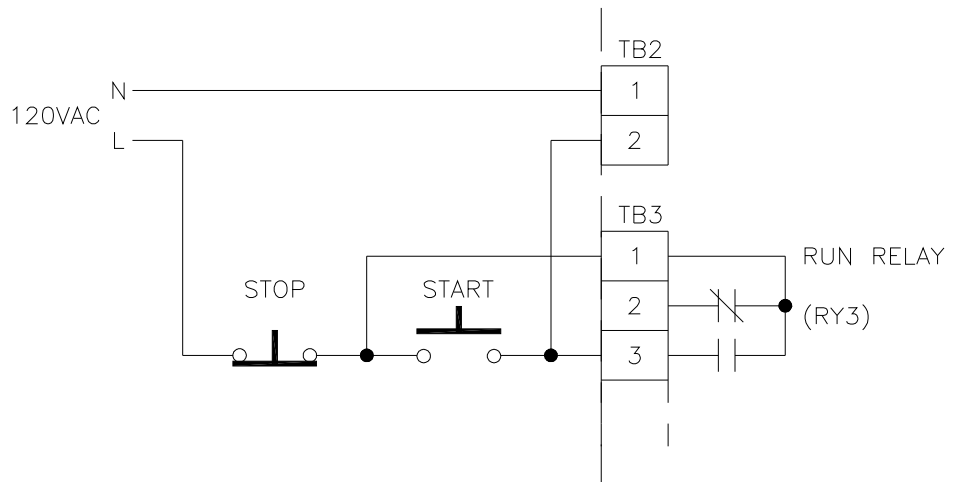
### d. **THREE WIRE STOP/START LOW VOLTAGE**

**TB3** Used for manual starting and stopping. +24 VDC is supplied by the starter.



### e. **THREE WIRE STOP/START 120 VAC**

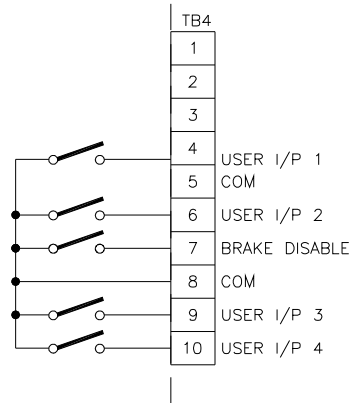
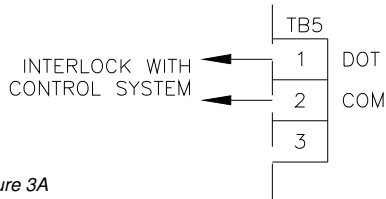
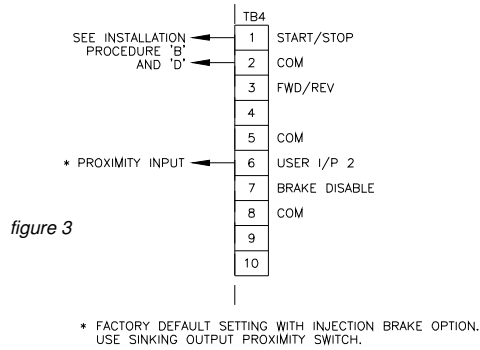
**TB2** Used for manual stopping and starting, requires external 120 volts.



## INSTALLATION PROCEDURE Cont...

### USER INPUTS (1, 2, 3, & 4)

Some features of the Digi-Start require additional inputs. A dry contact must short the input pin to common. Keep the contacts as close as possible to the Digi-Start. Inputs are compatible with a sinking PLC output.



### USER OUTPUTS

The Digi-Start has 4 Form-C relay outputs, rated for .5 Amps @ 120VAC and 1 Amp @ 24 VDC. The Run Relay has contacts rated for 5 Amps @ 120Vac and 24Vdc and has 2 form-C outputs (TB3 1, 2, & 3 and TB3 13, 14, & 15). Three relays, user O/P 1, user O/P 2 and user O/P 3 are available for the following programmable output functions:

Active  
Ramp Complete  
Brake On  
Reverse **User O/P 3 Only**  
Jog  
Low Voltage  
Phase Loss

Shorted SCR  
Current Imbal.  
Overload  
Stop Cur.  
Low Run Cur.  
High Run Cur.  
Drive O/T

Motor O/T  
Start Cycle Time  
Line Frequency  
Wrong Rotation  
No Rotation

## INSTALLATION PROCEDURE Cont...

These outputs are typically used as inputs to a PLC, to an indicator light, or as a seal in contact for safety circuits.

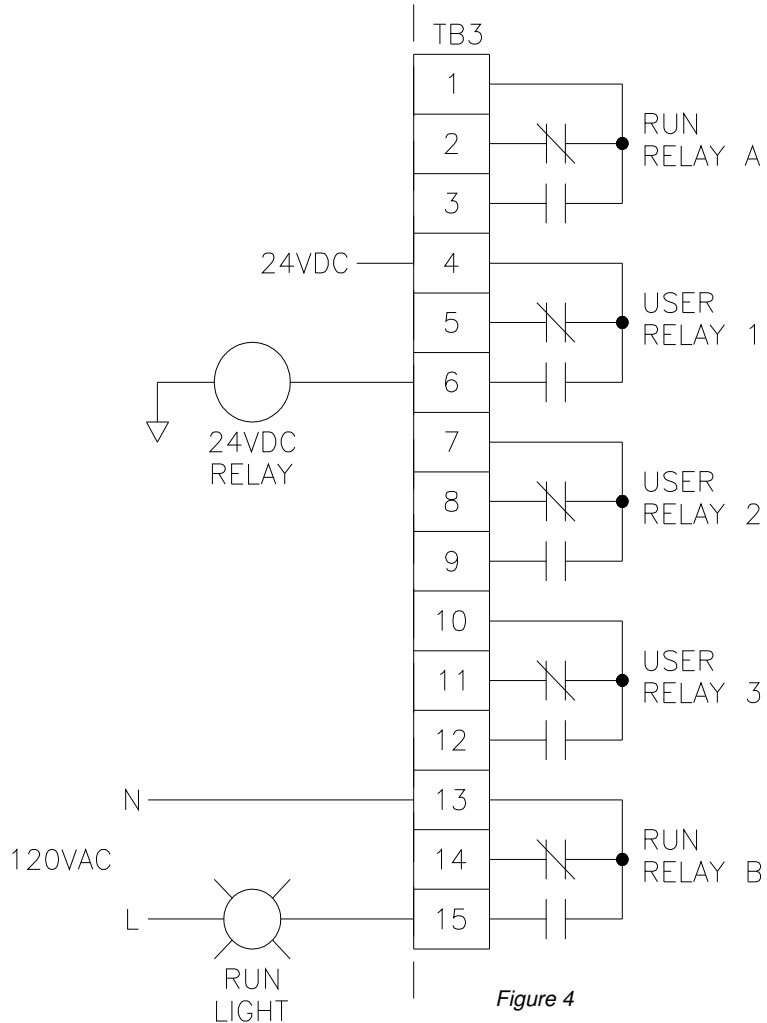


Figure 4

\*If an in-line electro-mechanical starter or contactor is being used, it must be installed between the Digi-Start and the motor. An auxiliary N/O contact should be connected to terminals TB2, 1-2 or TB4, 1-2 in place of the Start/Stop pushbuttons and trip functions (see figure 2, b & c). Ensure that all trip functions are in series with the electro-mechanical starter or contactor stop pushbutton circuitry.

All Digi-Start Starters are supplied with electronic motor overload protection. Check motor nameplate full load amperes (FLA) and verify that the overload is properly programmed.

**WARNING!** Equipment is at line voltage when AC power is connected. Pressing "STOP" pushbutton does not remove AC mains potential. All phases must be disconnected before it is safe to touch motor terminals or control equipment parts.

**REMOVE AC POWER**

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## SET UP PROCEDURE

The 'Digi-Start' line of products offer a wide range of user friendly selectable parameters. The digital keypad display allows easy entry of motor characteristics for precise motor control.

The parameters are grouped in ten (10) different categories for ease of operation:

- 00 series are General Motor Parameters
- 10 series are Current Setting Parameters
- 20 series are Kick Start Features
- 30 series are Ramp Time Settings
- 40 series are D.C. Injection Brake Settings (*optional*)
- 50 series are the Energy Saver Selector
- 60 series are the Jog Enable Features
- 80 series are Future User Inputs
- 90 / 100 series cover all of the Relay Output Functions

The following ten (10) parameters must be set before starting the motor, the rest are optional and selectable as required:

- 01 – Password: (*Default set at 0001*)
- 02 – Full Load Amps: (*Use motor FLA nameplate rating*)
- 03 – CT Ratings: (*Factory set, but can be selected*)
- 04 – Overload Class 10, 20, 30: (*Default class 10*)
- 05 – O/L Bypass (*default time 1 sec.*)
- 07 – Auto/Man/ O/L (*default 000, manual*)
- 11 – Current Limit: (*Generally set to 200% - 350% FLA*)
- 13 – Starting Torque (*Adjust so that the motor starts turning immediately – generally 25 – 100% FLA*)
- 31 – Ramp Up Time (*Time from start to full speed. A value of less than 5 sec. gives you a current limit start*)
- 36 – Ramp Mode (default 0)

The settings are stored for each parameter when select/reset is pressed. The starter can be engaged after all above parameters are set. **Caution Note:** In some cases, if the current limit is set too low, the motor may not start. This can potentially cause thermal damage to the motor. The starter has built in electronic overload protection and will not allow a start for 20 minutes after an O/L trip. After some electronic trips, power may have to be cycled to reset the starter once the trip condition has been corrected.

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## SET UP PROCEDURE Cont...

### PRE-START-UP INSPECTION

1. Check for and clean out any metallic particles or foreign matter.
2. Check all connections for tightness. Use recommended procedure for aluminum conductors.
3. On high resistance ohmmeter scale, check L1 to T1, T2, T3. Repeat for L2, L3. Check all terminals to ground. All readings should be several megohms or more.

Apply the three-phase AC power feeding the Digi-Start Starter.

Check incoming power to the starter. The line voltage should be within 10% of the starter nameplate data (*i.e.* A 480 VAC starter should have a line voltage not less than 430 VAC and not more than 510 VAC.)

### STARTING AC MOTORS

When starting an AC motor, the idea is to get the motor up to full speed as quickly as possible without damaging the equipment and without drawing excessive currents. If you set the ramp up time to less than 5 sec., the Digi-Start will act like an across the line starter except that the current will be limited to the value set in the current limit (*parameter 11*). You also want to adjust the starting torque (*parameter 13*) so that the motor starts to spin as soon as the start button is pressed. If the amount of starting torque is not enough to start the motor right away then you will be needlessly heating the motor windings. At the same time, the starting torque should not be so high that damage will be done to the motor and/or load. The starting torque should generally be set between 25 – 100% FLA, although a high inertia load (*i.e.* chippers) will require higher settings. See section 20 (*kick start parameters*) for very high friction load starting. Once the starting torque is set up, adjust the ramp up time as required. In most applications, the motor should be able to get to full speed in under 1 minute. This set up procedure requires multiple stops and starts to the starter. Check your motor data for the recommended number of starts per hour (*larger motors generally limit the number of starts to 3/hour, smaller motors are generally more*). Do not exceed the recommended number of starts per hour or you could permanently damage your motor. Before you start the motor, make sure that you have entered the motor FLA (*parameter 02*) and the current limit (*parameter 11*). The motor FLA should match the motor nameplate and the current limit should not exceed 500% of the motor FLA.

When a motor gets close to being at full speed, the current will drop off and the Digi-Start will quickly ramp to full voltage. This prevents damage to the motor and load. Starters without this feature will wallow or hunt at the top end of the voltage curve, but the Digi-Start ensures a good start every time.

Before you start the Digi-Start, it is important to understand what you want it to do. Different applications require different starting techniques. For example, an application where the load does not change much while starting should generally be started with a current limit start, *i.e.*, chipper. Applications where the loads increase with the speed of the motor should be started with voltage ramp start, *i.e.*, fan.



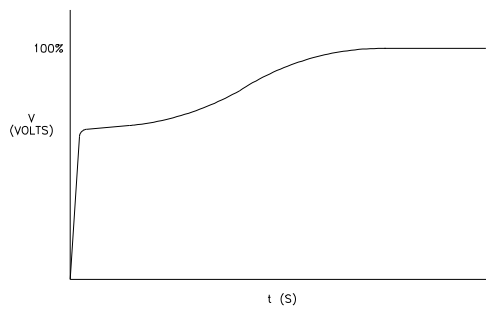
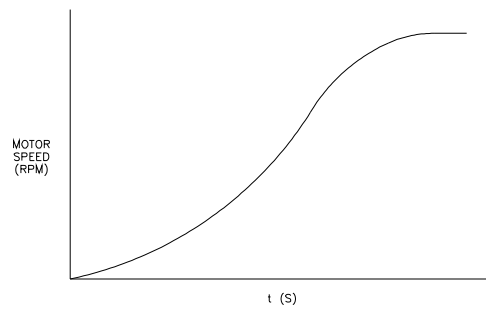
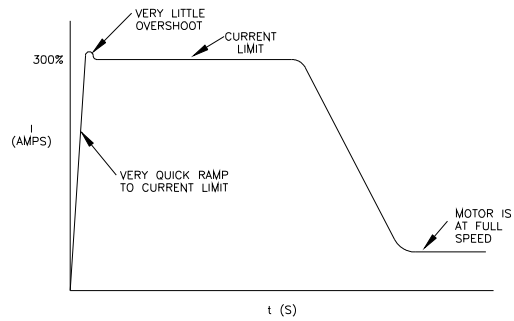
## SET UP PROCEDURE Cont...

### **CURRENT LIMIT START**

**(with Parameter 36 set to Voltage Ramp Mode and Parameter 31 set to less than 5 seconds)**

Current vs. Time, Speed vs. Time, and Voltage vs. Time.

Graphs for a simple current limit start. The current limit (*parameter 11*) is set to 300% FLA, starting torque = 0 Amps, and ramp up time to 1 sec.

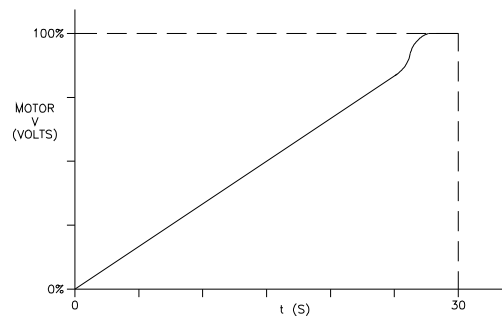
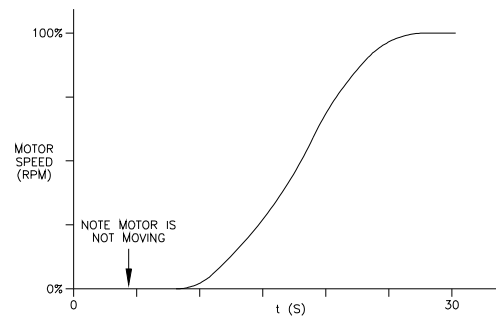
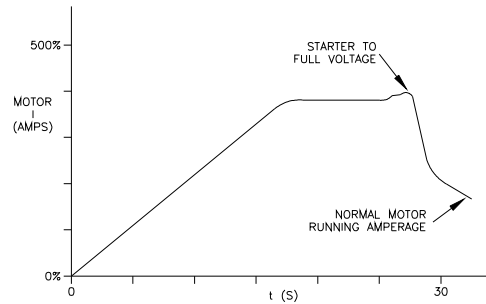


## SET UP PROCEDURE Cont...

### **VOLTAGE RAMP START** **– NO CURRENT LIMIT or STARTING TORQUE**

Current vs. Time, Speed vs. Time, and Voltage vs. Time.

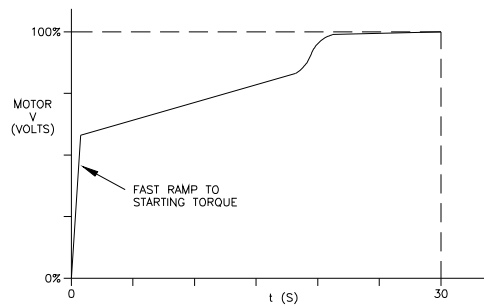
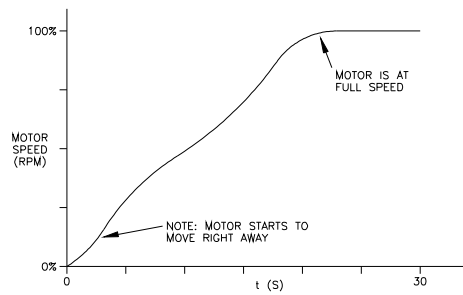
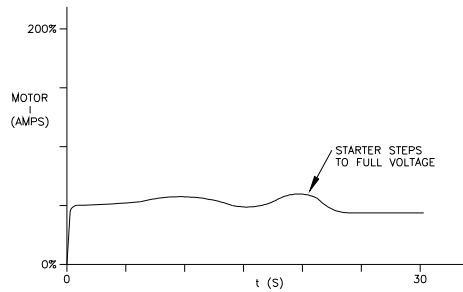
Graphs for a simple voltage ramp start. Current Limit is set to 500% FLA, starting torque is set to 0 Amps, and ramp up time to 30 seconds.



## SET UP PROCEDURE Cont...

### VOLTAGE RAMP START – CURRENT LIMIT OVERRIDE - WITH STARTING TORQUE OF 60%

Current, speed, and voltage graphs for a simple voltage ramp with a starting torque of 50% FLA.



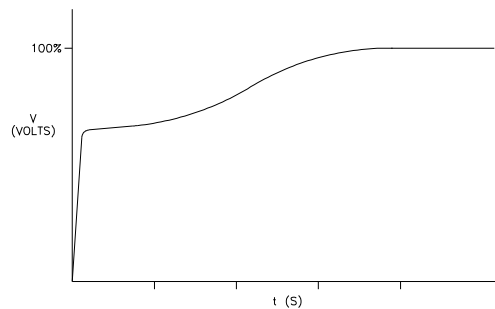
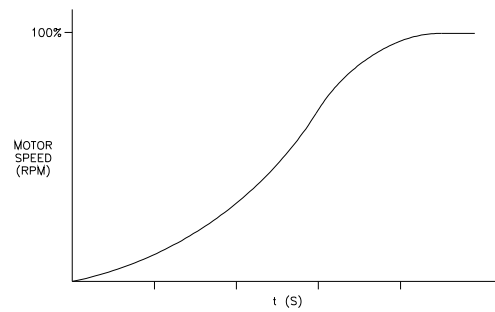
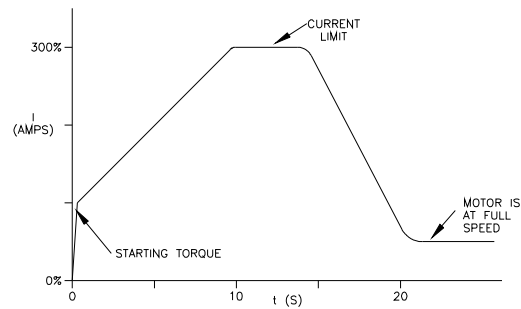
## SET UP PROCEDURE Cont...

### **CURRENT LIMIT START**

**(with Parameter 36 set to Current Ramp Mode and Parameter 31 set to 10)**

Current vs. Time, Speed vs. Time, and Voltage vs. Time.

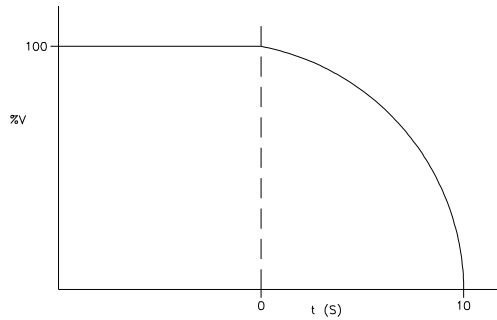
Graphs for a simple current limit start. The current limit (*parameter 11*) is set to 300% FLA, starting torque = 100% and ramp up time to 10 sec.



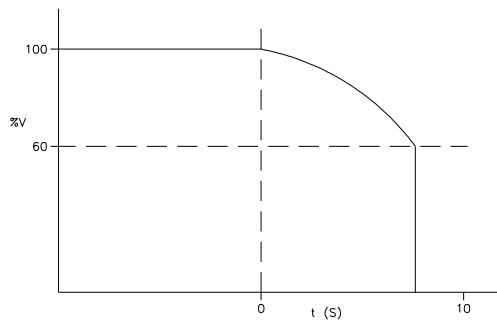
## SET UP PROCEDURE Cont...

### STOPPING AC MOTORS

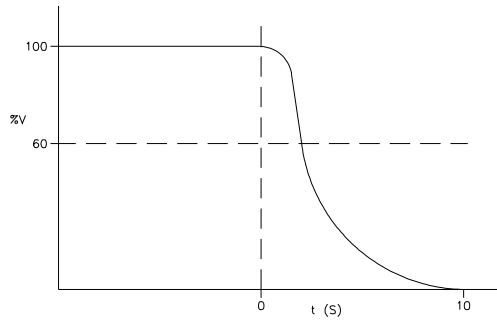
The standard Digi-Start has two methods of stopping the motor. The first is to simply shut off and let the motor coast to a stop. This is done by setting the ramp down time to one (*parameter 32*). The second method slowly ramps down the motor, gradually reducing the Digi-Start output to zero. The length of this ramp is set in the ramp down time 1 (*parameter 32*), Ramp Down Knee (*parameter 33*) and ramp down time 2 (*parameter 34*). *If the DC Injection Brake option was purchased, the Digi-Start will inject DC into the motor windings to stop the motor quickly. See section 40 for more information on DC Injection Braking.*



Parameter 32: 10 Seconds  
Parameter 33: 1%  
Parameter 34: 1 Second



Parameter 32: 10 Seconds  
Parameter 33: 60%  
Parameter 34: 1 Second



Parameter 32: 2 Seconds  
Parameter 33: 60%  
Parameter 34: 10 Second

## KEYPAD

To START and STOP the Digi-Start, and to view or change parameters, a keypad is provided as standard equipment. The starter must be in the STOP mode to view or change parameters.

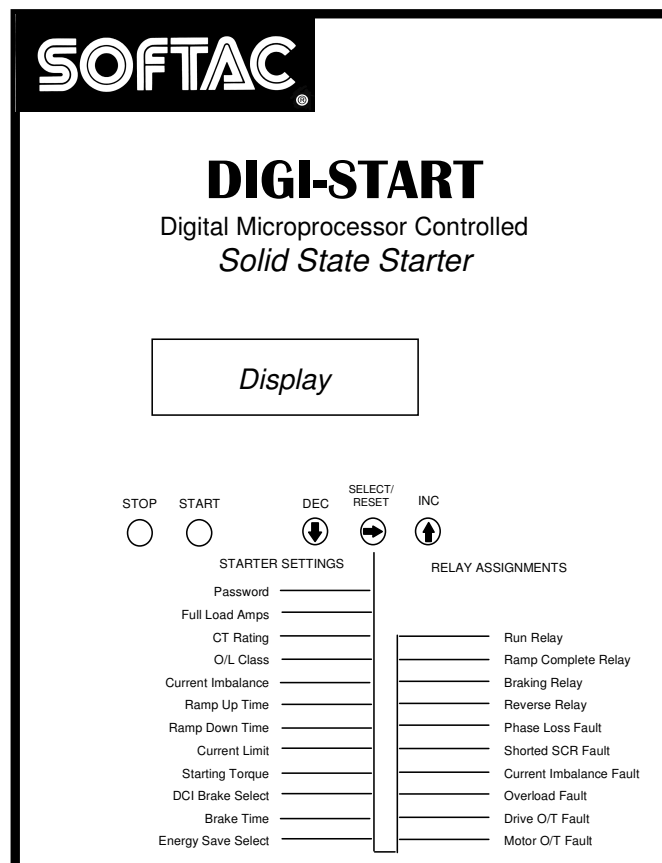
**STOP** - Pressing the STOP key when in RUNNING mode will cause the starter to stop. If the brake option is installed and enabled, the brake will come on automatically. The brake will remain on until ZERO SPD DET, if that option is selected, or until the preset BRAKE TIME expires. The BRAKE TIME setting always takes precedence over the ZERO SPD DET function. Pressing SELECT/RESET while braking will cause the brake cycle to terminate. Pressing STOP when in STOP mode has no effect. (See installation procedure figure 'a' for required wiring.)

**START** - Pressing this key when in STOP mode initiates the "no external control" starting cycle. During the start cycle the Digi-Start will display "RAMP UP" and the real time Amperes. Once the output is at full voltage the starter will be in RUNNING mode and the display will show "RUN FWD" and the real time Amperes. (See installation procedure figure 'a' for required wiring.)

**DEC** - Used to decrement values when programming. When pressed once simultaneously with the INC key, the menu will toggle to reverse scrolling mode. When toggled twice with the INC key, menu will go to the PASSWORD parameter from any other parameter location. If the key is held down the numbers in the units place will count down faster. If this key and the SELECT/RESET key is held down the numbers will decrement by tens and then by hundreds.

**INC** - Used to increment values when programming. When pressed simultaneously with the DEC key, the menu will toggle to reverse scrolling mode. When toggled twice with the INC key, the menu will go to the PASSWORD parameter from any other parameter location. If the key is held down the numbers in the units place will count up faster. If this key and the SELECT/RESET key is held down the numbers will increment by tens and then by hundreds.

**SELECT/RESET** - This key is used to move from parameter to parameter when in the menu mode. It is also used as an "enter" key to accept changes made to parameters. If the SELECT/RESET key is held down with either the INC or DEC key the numbers will scroll faster. This key can also be used to turn off the brake before zero is detected and/or it times out. If a fault is detected by the starter logic, the reset key is used to manually reset the alarm.



Key Pad as detailed on Digi-Start

\*The Starter and Relay Assignments shown here do not include the full range of parameters available. For complete listing of functions see parameter list on page 26.

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## DISPLAY MESSAGES

The following list shows all of the non-programmable messages that will be displayed on the LCD display during normal operation.

*SOFTAC *SYSTEMS*! SVx.x , HVx.x	This message is displayed on power up or if the MCU is reset. It shows the manufacturer's name, SOFTAC SYSTEMS LTD., and the software and hardware versions used.
*NO ROTATION*	Starter failed to detect phase rotation on power up. Probably due to a lost phase.
*COMPUTER FAILED*!	This message is displayed if the Microcontroller Unit fails. Contact SOFTAC for repair/replacement.
RUN FAULT	This message is displayed if a run command is detected when the micro controller comes out of reset (power on).
*RAMP UP* Amps!	This message is displayed during a start until the starter is up to full voltage. The Amps shows the actual current.
*RAMP DOWN*!	This message is displayed during a stop until the starter is fully off.
*RUN FWD* Amps!	This message is displayed after the starter is up to full voltage. The Amps shows the actual running current.
*LOW VOLTAGE*!	This message is displayed if the line voltage drops to approximately 75% of nominal. A low voltage alarm will cause the starter to stop. This function is first implemented on HV5.0 control boards.
*INSTANT O/L*!	The starter will stop immediately if a current of 800% or more of FLA is detected. Also can be displayed if the motor FLA ( <i>parameter 02</i> ) is set to zero.
*BRAKING*!	This message is displayed while the brake is energized.
*JOGGING*!	This message is displayed when jogging.
*CYCLE TIME*	This message is displayed if a second start is attempted before the time in parameter 08 has expired.

## FAULT MESSAGES

101	Low Voltage	Displayed when the line voltage to the starter drops below 75% of the nominal value. Check the line voltage. Press Select/Reset to clear the fault.
102	Phase Loss	Displayed when the Digi-Start detects a phase loss. Check the line voltage to make sure all three phases are present. Press Select/Reset to clear the fault message once phase is connected.
103	Shorted SCR LX	Displayed when the Digi-Start detects a shorted SCR. Before each start, the Digi-Start fires each SCR, one at a time and looks for any current. If there is a shorted SCR a current bump will be seen and this fault will occur. Replace the defective SCR (s) and restart the Digi-Start, or set SCRCHK bypass to 1 to allow one start.
104	Current Imbal	Displayed when the line current varies phase to phase. The allowable variance is set in parameter 09. Press Select/Reset to clear this fault.
105	Overload	This message is displayed when the drive has detected a motor overload trip. The Starter will not allow another start for 20 minutes giving the motor time to cool down. The amount of overloading is controlled by the overload class ( <i>Parameter 05</i> ). Removing power from the starter will clear this fault.
106	Stop Cur.	Current detected by starter while in stop mode. This would only occur if an SCR is shorted.
107	Low Run Cur.	This message will be displayed when the current drawn by the motor drops below the value set in parameter 16 while the motor is running. Press Select/Reset to reset the fault.
108	High Run Cur.	This message will be displayed when the current drawn by the motor exceeds the value set in parameter 14 while the motor is running. This fault can only occur when the Digi-Start is at full voltage. Press Select/Reset to reset the fault.
109	Drive O/T	The message will be displayed when the thermal-switches mounted on the power electronics opens. These switches open at 100°C. After the power electronics have cooled off and the thermal switches have closed, this fault can be reset with the Select/Reset button.
110	Motor O/T	This message is displayed if user I/P 1, 2, 3, or 4 is programmed as MOT and motor over heating is detected.
111	Start Cycle	This function energizes the selected USER RELAY if the start interval timer has not timed out before a second start is initiated.
112	Line Frequency	A line frequency error occurs if the line frequency falls below 45 Hz or above 65 Hz.
113	Ph. Reversal	When the Phase Rotation lock flag is set (parm 65) and line rotation reversal is detected the starter will display this message and not allow a start. If the new rotation is the one required, clear parameter 65 and cycle power to reset. Be sure to set parameter 65 before the next start to lock in the new rotation.
114	No Rotation	Starter software cannot determine the phase rotation. This condition would be accompanied by a phase loss fault. If phases are okay, then unit has an internal hardware problem.



## PARAMETER TABLES

### 00 GENERAL MOTOR PARAMETERS

Par #	Parameter	Default	Description
01	PASSWORD	0001	A password number from 0000 to 9999 is required to change parameters. The factory default is 0001.
02	FULL LOAD [Amps]	0000	User enters the motor nameplate Full Load Amps (FLA).
03	CT. RATING [Ratio]	nnnn	This is factory set but can be changed. The range is from 500:1 to 10000:1 in steps of 500 for starter sizes greater than 15 HP and 333:1 for sizes 5, 7.5 and 10 HP.
04	CAL. FACTOR [Ratio]	nnnn	This factor is used to scale the calculated current to compensate for component tolerances in the current feedback path. Use the up down arrows to increase or decrease the factor. The default is the CT ratio entered into parameter 03.
05	O/L CLASS [10, 20, 30]	0010	This sets the class of electronic overload protection. Class 10 protection should be used for easy starting loads such as pumps. Class 20 protection should be used for normal starting loads such as conveyors. Class 30 protection should be used for hard starting loads such as chippers.
06	O/L BYPASS [Seconds] ( 1 – 240 )	0001	Allows user to delay start of O/L integration during a start. This feature is provided for instances of a C/L start and a low line voltage resulting in a longer than normal start. The maximum delay is 240 seconds.
07	AU/MAN OL RST [0, 1] 1 = AUTO	0000	This parameter allows the user to choose manual or auto overload reset. If set to manual, the starter must be reset with the reset button or an external reset input after the 20 minute overload time has expired. If set to auto, the starter resets automatically after the overload time has expired.
08	START CYCLE [minutes] ( 0 – 60 )	0000	This parameter sets a time interval between successive starts. It is adjustable from 0 to 60 minutes. The timer can be reset by cycling power.
09	CURRENT IMBAL [%] ( OFF, 50, 25, 12, 6 )	OFF %	This sets the current imbalance threshold, phase to phase, which results in the starter shutting down. The display will show "CURRENT IMBAL". The user can assign this fault to the user 1,2 or 3 relay outputs.

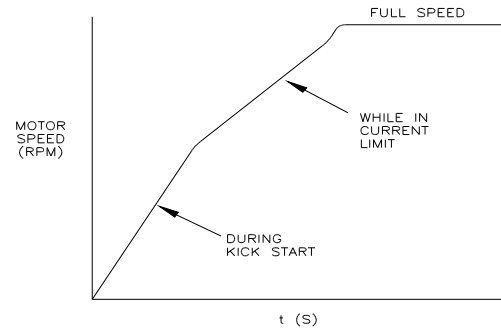
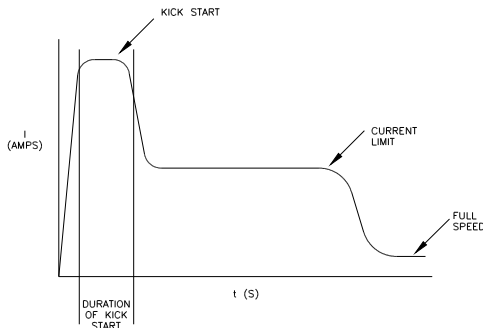
## 10 CURRENT SETTING PARAMETERS

Par #	Parameter		Default	Description
11	CURRENT LIMIT ( 0 to 6 * FLA )	[Amps]	0000	This sets the current level during the start mode. The range of values accepted is from 0 to 6 times FLA. For a straight voltage ramp start a setting of 5 times FLA should be sufficient.
12	STOP CUR. (0-150)	[Amps]	0000	The starter can monitor the CTs for current when in the stop mode. 0000 disables the function. Range is 1 to 150 amps. Recommended value to use is 50% of FLA for FLA < 300 A and 150 for FLA > 300 A.
13	STARTING TORQ ( 0 to 4 * FLA )	[Amps]	0000	This sets the initial motor current when a start is initiated. The Digi-Start will fast ramp to this level. The starting torque should be set just high enough to start the motor rotating. The range of input values is 0000 Amps to 4 times FLA. A typical value is motor FLA. Setting this parameter to 0000 Amps disables the function.
14	HIGH RUN CUR ( 0 to 5 * FLA )	[Amps]	0000	Any non-zero number sets the maximum current trip level, in Run FWD/REV mode. The range of values is 0000 Amps to 5 times FLA. A 0000 Amps setting disables the function. When the average current exceeds the high run current level, the starter will count down MX RC BYPASS time. If the average current is still above the high run level after MX RC BYPASS has reached zero, the starter will energize any required relays and either shut down or keep running as chosen by MAX RUN MODE parameter [68].
15	MX RC BYPASS (1-20)	[Seconds]	0001	This is a down counter that counts down whenever the starter is in Run FWD/REV mode and the average current is greater than the high run current set in parameter [14]. This parameter lets the user delay any action due to a high run current condition.
16	LOW RUN CUR ( 0 to 1 * FLA )	[Amps]	0000	This sets the minimum current trip level in RUNNING mode. If the motor current goes below this level, the starter will immediately trip. It is meant to function as load loss detection for a cavitating pump or broken belt. The range of values are 0000 Amps to FLA. A 0000 Amps setting disables the function.

## 20 KICK START PARAMETERS

The KICK START function is provided for situations where a high friction load requires additional torque to start the load moving. It is designed to supply a “breakaway torque” after which the starter will resume ramping from the STARTING TORQ current setting. This function should be used with caution. Mechanical damage can result from improper use.

Par #	Parameter	Default	Description
21	KICK START [Amps]	0000	The range of values is 0000 Amps to 6 times FLA. A 0000 Amps setting disables the function.
22	KICK START TM [nnnn * 16 milliseconds]	0000	The range of values is 0000 to 0250. This number is multiplied by 16 ms to get the duration time of the “kick”. A typical value would be between 20 and 40.



## 30 RAMP TIME PARAMETERS

Par #	Parameter	Default	Description
31	RAMP UP TIME [Seconds] (1 to 240)	0001	The range for this function is 001 to 0240 seconds. This sets the slope of the voltage ramp, provided the current limit value set in Parameter 11 is not reached. STARTING TORQ sets an initial voltage but does not change the slope. Therefore, the greater the STARTING TORQ, the shorter the time to full voltage for a given slope.
32	RAMP DN TIME 1 [seconds] (1 – 240)	0001	The range for this function is 001 to 0240 seconds. This sets the time it takes for the starter to go from full voltage to zero voltage.
33	RAMP DN KNEE [% Full Phase] (1 – 100)	0001 %	This function provides a settable breakpoint between the RAMP DN TIME 1 and RAMP DN TIME 2 slopes. The default setting gives RAMP DN TIME 2 no effect and in effect provides a single slope determined by the RAMP DN TIME 1 setting (parameter 32).
34	RAMP DN TIME 2 [Seconds] (1 – 240)	0001	Maximum of 240 seconds.
35	ACCEL KICK [0, 1]	0001	When set to 0, this function disables the Accel Kick function
36	RAMP MODE [0, 1]	0000	0 for voltage ramp. When in voltage ramp, use par #31 as time to integrate up to full voltage with current limit override. 1 for current ramp. When in current ramp, use par #31 as time to integrate up to current limit.
37	SCRCHK BYPASS [0, 1]	0000	When a shorted SCR is detected, the user can set this flag to 1 to allow 1 start. The flag will always reset to 0 after a start or on power up.

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## 40 DC INJECTION BRAKE PARAMETERS (Optional Brake Card is Required)

This factory installed option is available for single direction starters only and requires the addition of an extra SCR and a brake firing / zero speed detect card (PCL243). The starter automatically detects the presence of the brake firing card and **will not permit braking if the card is absent**. Parameter 41 should be set to zero if a brake is not installed.

### 40 DC INJECTION BRAKE SETUP

1. SETTING BRAKE CURRENT:
  - a. Set the parameters as in 2 below except set Parameter [42] to 240 seconds.
  - b. Ensure it is safe to run the motor. Now press START on the Digi-Start keypad and as soon as the display goes out of the STOP mode press STOP. The display will now show "Braking". Press the "up arrow" key to increase braking current and the "down arrow" key to reduce braking current. A DC clamp-on meter should be on the T2 or T3 conductor to monitor current magnitude. A typical braking current will be between 100% and 300% of the FLA. **The MAXIMUM dc BRAKING CURRENT should not exceed 350% of FLA. A stop is considered the same as a start so it is necessary to limit the number of start / stop cycles to the equivalent number of starts only. A motor overtemperature detection device should be used.**
  - c. As soon as the clamp-on meter reading reaches the desired current level press the SELECT / RESET key to turn off the braking current. A good general braking current to start with is 150% of FLA.  
-Now start the motor and let it get up to full speed. Have a stopwatch ready and record the time interval from the moment that STOP is pressed to the moment the motor reaches zero RPM. If the brake time is satisfactory go to step two or three below, otherwise adjust the braking current up or down. **Do not overheat the motor.**
  - d. If for some reason the braking current gets too high you can use the SELECT / RESET key on the keypad or the External Brake Disable input on TB4/7 to turn it off at any time. Now if you want to RESET THE BRAKE CURRENT to ZERO and start over, set DCI Brake [41] to 0 and BRK Disable [64] to 0 and CYCLE CONTROL POWER. The braking current will also be reset to zero if a phase reversal is detected on power up.
  - e. Now go to step 2 or 3 below. **Set Brake Time [42] to be one or two seconds longer than it took the motor to stop.**
2. BRAKE TIME ONLY:
  - a. DC1 Brake [41] set to 1
  - b. Brake Time [42] set to the time it took the motor to stop plus one or two seconds. The brake current will always turn off once Brake Time [42] as timed out.
  - c. Zero Speed Detection [43] set to 0
  - d. BRK Disable [64] set to 1
  - e. Start the motor and run up to full speed. Stop the motor.
3. MISSING PULSE ZERO SPEED DETECTION:
  - a. DC1 Brake [41] set to 1
  - b. Brake Time [42] set to the time it for motor to stop plus one or two seconds. The brake current will always turn off once Brake Time [42] has timed out even if zero speed has not been reached.
  - c. Zero Speed Detection [43] is used as an internal timer to detect missing pulses. Initially set to 28.
  - d. BRK Disable [64] set to 3.

Par #	Parameters	Default	Description
41	DCI BRAKE [0, 1]	0000	This function is used to enable / disable the brake. Setting parameter 41 and parameter 64 to zero and then cycling the power will reset the braking current to zero. - 0 to Disable - 1 to enable
42	BRAKE TIME [seconds] ( 0-240 )	0000	This timer sets the braking duration in seconds. This function takes precedence over ZERO SPD DET [ 43 ] and turns off the braking current even if zero speed has not been detected.
43	ZERO SPD DET [0.1 seconds] ( 0 -100 )	0000	This parameter enables the Zero Speed Detect function if BRK DISABLE [64] is also set to 3. The time interval entered here is used to look for zero speed. If no feedback pulse is detected in this time interval it is assumed that the motor is at zero speed. - 0 to Disable - 1 or more to enable. A good initial value is 28 ( 2.8 seconds).
44	ZERO SPD HOLD [0.1 seconds] ( 0 – 50 )	0000	This parameter set to a non-zero value will keep the brake on after zero speed is detected.
45	FB RIPPLE [1 – 10]	0004	Not used.

## 50 ENERGY SAVER PARAMETERS

Par #	Parameter	Default	Description
51	ENERGY SAVE [0, 1]	0000	This function, when set to 1, enables the energy save feature. This feature is useful for motors under 25 HP that are lightly loaded or run unloaded for long periods of time. The DIGI-START phases back the motor voltage until it senses a small increase in motor current. It then slightly increases and maintains that motor voltage until there is an increase in motor current due to loading. When load current is sensed the DIGI-START goes to full voltage.

## 60 USER MISCELLANEOUS FUNCTIONS

The following functions are hard-wired.

- Forward/Reverse: Form `C` dry contact closure between TB4/3 and TB4/2 to go reverse. Only possible if option card and extra SCR's are installed.

- External Brake Disable: Form `C` dry contact closure between TB4/7 and TB4/8.

Par #	Parameter	Default	Description
61	BRK BYPASS DELAY [seconds] ( 0 – 30 )	0000	This Brake Bypass timer is a count down timer initialized on each start. If a STOP is received before the timer has counted down, the brake will not come on. This is useful for machine setup procedures requiring a 'bump and coast'.
62	JOG ENABLE [Amps] ( 0 – 2 * FLA )	0000	Any non-zero value will enable the jog feature. The range of values is 0000 Amps to 2 times FLA. A zero value disables the jog function. The starter ramps quickly to the current limit set here in approximately 2 seconds.
63	BRK AFTER JOG [0, 1]	0000	This function, when set to 0, will disable the brake after an external JOG command is removed. The starter will instead ramp down according to Parameter 32 ( RAMP DN TIME ).
64	BRK DISABLE [0, 1, 3]	0003	When set to 0, this function provides an unconditional disabling of the brake. The brake can also be disabled externally by pulling TB4/7 low. 0: Disabled 1: Brake time only 2: not used 3: Missing pulse zero speed detection
65	PH. ROT. LOCK [0, 1] 0 = Disable	0000	When set to 1, this parameter will save to memory the present phase rotation and prevent the motor from starting if a rotation reversal is detected. The brake current will also be set to zero if a rotation reversal is detected.
66	FREQ. CHECK [0, 1]	0001	This switch is used to disable the frequency check function. 1 = enabled.
67	CAL FACTOR EN [0, 1]	0000	This switch is used to let the user dynamically change the CAL FACTOR when in Run mode. Pressing the up / down keys increases or decreases the number respectively. The switch is always reset to zero when the starter goes into stop mode or comes out of the power on initialization routines. Remember the final factor number, stop the motor and enter the number into the CAL FACTOR parameter [04].
68	MAX RUN MODE [0, 1]	0000	This switch selects the starter's action when the Max Run Current conditions occur. 0 – Starter will stop and energize a selected output relay. 1 – Starter will keep running and energize a selected output relay. The relay will drop out once the motor reaches 95 % of its FLA.

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## 80 USER CONFIGURABLE INPUTS

There are four USER INPUTS standard with the DIGI-START. Each input accepts only one function assignment but the same function can be assigned to multiple inputs. The following functions are available: MOT – Motor over temperature; JOG – Motor jog requires parameter [62] to be set; RST – External fault reset /acknowledge; NONE – No function selected for the input

The ports are opto-isolated +24VDC sourcing inputs so they must be pulled to COM to be active.

Par #	Term	Parameter	Default	Description
81	TB4, 4	USER I/P 1	NONE	
82	TB4, 6	USER I/P 2	NONE	Factory configured for the PCL-243 or a +24Vdc sinking output proximity switch when the DC injection brake option is provided. Parameter [64] set to 3.
83	TB4, 9	USER I/P 3	NONE	
84	TB4, 10	USER I/P 4	NONE	

## 90 OUTPUT RELAYS

There are four relays standard to the DIGI-START. The Run Relay is rated for 5 Amps at 120 Vac or 24 Vdc. The other three relays are rated 120 Vac @ 0.5 Amp and 24 Vdc @ 1Amp. The RUN relay and REV relay are not programmable. The RUN relay is energized on a START command and dropped on a STOP command. The REV relay is only energized when a reversing starter is run in the reverse direction.

TB3 Term	Contact	Relay Name	Description
1	com	RUN RELAY A	This relay output is not user configurable. The coil is energized on START and de-energized on STOP. It is a double pole relay.
2	n.c.		
3	n.o.		
4	com	USER O/P 1 RELAY	This relay output is defined by Group 90 functions. More than one function can be assigned to the relay.
5	n.c.		
6	n.o.		
7	com	USER O/P 2 RELAY	This relay output is defined by Group 90 functions. More than one function can be assigned to the relay.
8	n.c.		
9	n.o.		
10	com	USER O/P 3 RELAY	This relay output is defined by Group 90 functions. More than one function can be assigned to the relay. If the starter has a reversing option this relay must be used assigned to [94] REVERSE only.
11	n.c.		
12	n.o.		
13	com	RUN RELAY B	The coil is energized on START and de-energized on STOP. The contacts are the second pole of the above RUN RELAY (term 1, 2, 3).
14	n.c.		
15	n.o.		

*See Diagrams at end of manual.*

These functions are used to define the USER RELAY outputs. A ZERO disables the function. A 1 selects USER RELAY 1, a 2 selects USER RELAY 2 and a 3 selects USER RELAY 3. A function may only be assigned to one USER RELAY but it is possible to assign more than one function to a single relay. If two functions are assigned to the same relay they are logically OR'd together.

Par #	Parameter	Default	Description
91	ACTIVE [ 0,1,2,3]	0000	This function energizes the selected USER RELAY any time the starter is NOT in stop mode or in a fault condition.
92	RAMP COMPLETE [ 0,1,2,3]	0000	This function energizes the selected USER RELAY when the starter reaches full voltage. It de-energizes on STOP.
93	BRAKE ON [ 0,1,2,3]	0000	This function energizes the selected USER RELAY when the DCI BRAKE is on.
94	REVERSE [ 0,1,2,3]	0000	This function energizes the selected USER RELAY when the reversing starter is in reverse mode.
95	JOG [ 0,1,2,3]	0000	This function energizes the selected USER RELAY when Parameter 62 (JOG ENABLE) is set to 1 and Parameter 81 (USER 1) input is true. The display shows JOGGING.
101	LOW VOLTAGE [ 0,1,2,3]	0000	This is a FAULT function. This function energizes the selected USER RELAY when the line voltage drops to approximately 75% of nominal, stops the starter and displays LOW VOLTAGE.
102	PHASE LOSS [ 0,1,2,3]	0000	This is a FAULT function. This function energizes the selected USER RELAY when the DIGI-START detects a phase loss, stops the starter and displays PHASE LOSS.
103	SCR SHORT [ 0,1,2,3]	0000	This is a FAULT function. This function energizes the selected USER RELAY when the DIGI-START detects a shorted SCR, stops the starter and displays SHORTED SCR.



90 OUTPUT RELAYS - *continued*

Par #	Parameter		Default	Description
104	CUR. IMBAL	[ 0,1,2,3]	0000	This is a FAULT function. This function energizes the selected USER RELAY when the DIGI-START detects a current imbalance greater than Parameter 09, stops the starter and displays CURRENT IMBAL.
105	OVERLOAD	[ 0,1,2,3]	0000	This is a FAULT function. This function energizes the selected USER RELAY when the DIGI-START detects an overload as per Parameter 05, stops the starter and displays OVERLOAD.
106	STOP CUR.	[ 0,1,2,3]	0000	This is a FAULT function. This relay is energized if current is detected when the starter is in stop mode.
107	LOW RUN CUR	[ 0,1,2,3]	0000	This is a FAULT function. This function energizes the selected USER RELAY when the DIGI-START detects a low running current as per Parameter 16, stops the starter and displays LOW RUN CUR.
108	HIGH RUN CUR	[ 0,1,2,3]	0000	This is a FAULT function. This function energizes the selected USER RELAY when the DIGI-START detects a high running current as per Parameter 14, stops the starter and displays HIGH RUN CUR.
109	DRIVE O/T	[ 0,1,2,3]	0000	This is a FAULT function. This function energizes the selected USER RELAY when the DIGI-START detects a drive overtemperature (loss of continuity between TB5/1 and TB5/2), stops the starter and displays DRIVE O/T.
110	MOTOR O/T	[ 0,1,2,3]	0000	This is a FAULT function. This function energizes the selected USER RELAY when the DIGI-START detects a motor overtemperature, stops the starter and displays MOTOR O/T.
111	START CYCLE	[ 0,1,2,3]	0000	This function energizes the selected USER RELAY if the start timer is not zero when the start is initiated.
112	LINE FREQ	[ 0,1,2,3]	0000	A line frequency error occurs if the line frequency falls below 45 Hz or above 65 Hz.
113	PH. REVERSAL	[ 0,1,2,3]	0000	This is a FAULT function. The relay is energized "if PH ROT LOCK " parameter 64 is set to 1 and a phase reversal is detected.
114	NO ROTATION	[ 0,1,2,3]	0000	This is a FAULT function. The relay is energized if the starter logic cannot determine phase rotation at power up.

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## PARAMETER LIST

Par. #	Parameter		Default	Custom Setting
01	PASSWORD		0001	_____
02	FULL LOAD	[Amps]	0000	_____
03	CT. RATING	[Ratio: Factory Set]	nnnn	_____
04	CAL. FACTOR	[ CT +/- 10%]	nnnn	_____
05	O/L CLASS	[10,20,30]	0010	_____
06	O/L BYPASS	[Seconds]	0001	_____
07	AU/MAN OL RST (1=Auto)	[0, 1]	0000	_____
08	START CYCLE	[minutes]	0000	_____
09	CURRENT IMBAL	[%]	OFF %	_____
11	CURRENT LIMIT	[Amps]	0000	_____
12	STOP CUR.	[Amps]	0000	_____
13	STARTING TORQ	[Amps]	0000	_____
14	HIGH RUN CUR	[Amps]	0000	_____
15	MXRC BYPASS	[Seconds]	0001	_____
16	LOW RUN CUR	[Amps]	0000	_____
21	KICK START	[Amps]	0000	_____
22	KICK START TM	[nnn * 16 milliseconds]	0000	_____
31	RAMP UP TIME	[Seconds]	0001	_____
32	RAMP DN TIME 1	[Seconds]	0001	_____
33	RAMP DN KNEE	[%]	0001	_____
34	RAMP DN TIME 2	[Seconds]	0001	_____
35	ACCEL KICK	[0, 1]	0001	_____
36	RAMP MODE	[0, 1]	0000	_____
37	SCRCHK BYPASS	[1 = enable]	0000	_____
41	DCI BRAKE	[0,1]	0000	_____
42	BRAKE TIME	[Seconds]	0000	_____
43	ZERO SPD DET	[0.1 Seconds]	0000	_____
44	ZERO SPD HOLD	[0.1 Seconds]	0000	_____
45	FB RIPPLE	[1 – 10]	0004	_____
51	ENERGY SAVE	[0, 1]	0000	_____
61	BRK BYPASS DELAY	[Seconds]	0000	_____
62	JOG ENABLE	[0 – 2 *FLA]	0000	_____
63	BRK AFTER JOG	[0, 1]	0000	_____
64	BRK DISABLE	[0, 1, 3]	0003	_____
65	PH ROT LOCK	[0, 1]	0000	_____
66	FREQ. CHECK	[0, 1]	0001	_____
67	CAL FACTOR EN	[0. 1]	0000	_____
68	MAX RUN MODE	[0, 1]	0000	_____

Automatically resets to disabled in STOP mode.

Par. #	Parameter		Default	Custom Setting
<b>USER INPUTS</b>				
81	TB4, 4	USER I/P 1	NONE	_____
82	TB4, 6	USER I/P 2	NONE	_____
83	TB4, 9	USER I/P 3	NONE	_____
84	TB4, 10	USER I/P 4	NONE	_____
<b>OUTPUT RELAYS</b>				
91	ACTIVE	[0,1,2,3]	0000	_____
92	RAMP COMPLETE	[0,1,2,3]	0000	_____
93	BRAKE ON	[0,1,2,3]	0000	_____
94	REVERSE	[0,1,2,3]	0000	_____
95	JOG	[0,1,2,3]	0000	_____
101	LOW VOLTAGE	[0,1,2,3]	0000	_____
102	PHASE LOSS	[0,1,2,3]	0000	_____
103	SHORTED SCR	[0,1,2,3]	0000	_____
104	CURRENT IMBAL	[0,1,2,3]	0000	_____
105	OVERLOAD	[0,1,2,3]	0000	_____
106	STOP CUR	[0,1,2,3]	0000	_____
107	LOW RUN CUR	[0,1,2,3]	0000	_____
108	HIGH RUN CUR	[0,1,2,3]	0000	_____
109	DRIVE O/T	[0,1,2,3]	0000	_____
110	MOTOR O/T	[0,1,2,3]	0000	_____
111	START CYCLE	[0,1,2,3]	0000	_____
112	LINE FREQUENCY	[0,1,2,3]	0000	_____
113	PH. REVERSAL	[0,1,2,3]	0000	_____
114	NO ROTATION	[0,1,2,3]	0000	_____

**NOTES:**

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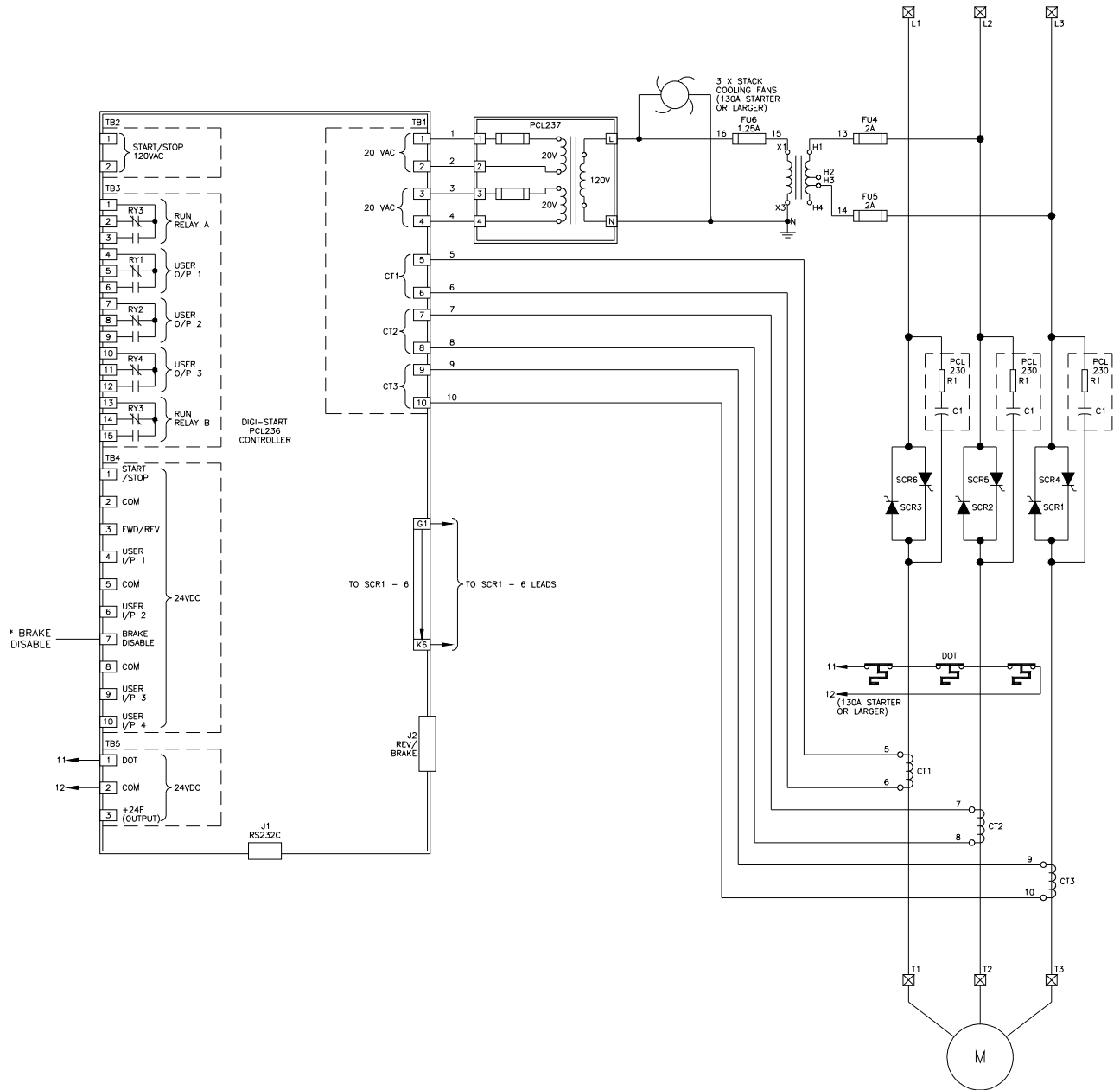


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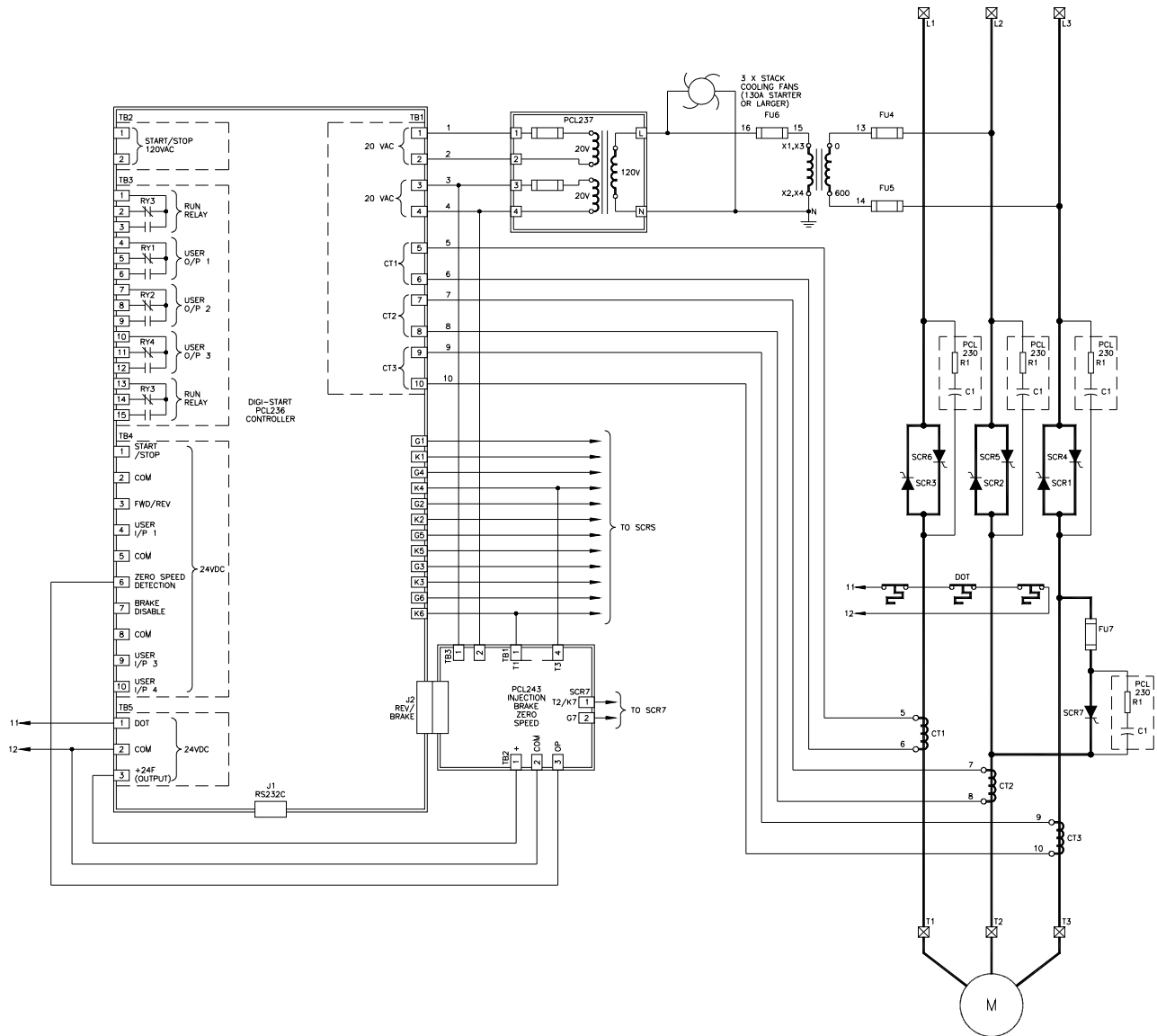
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# STANDARD DIGI-START CONNECTION DIAGRAM



\* Not User Configurable

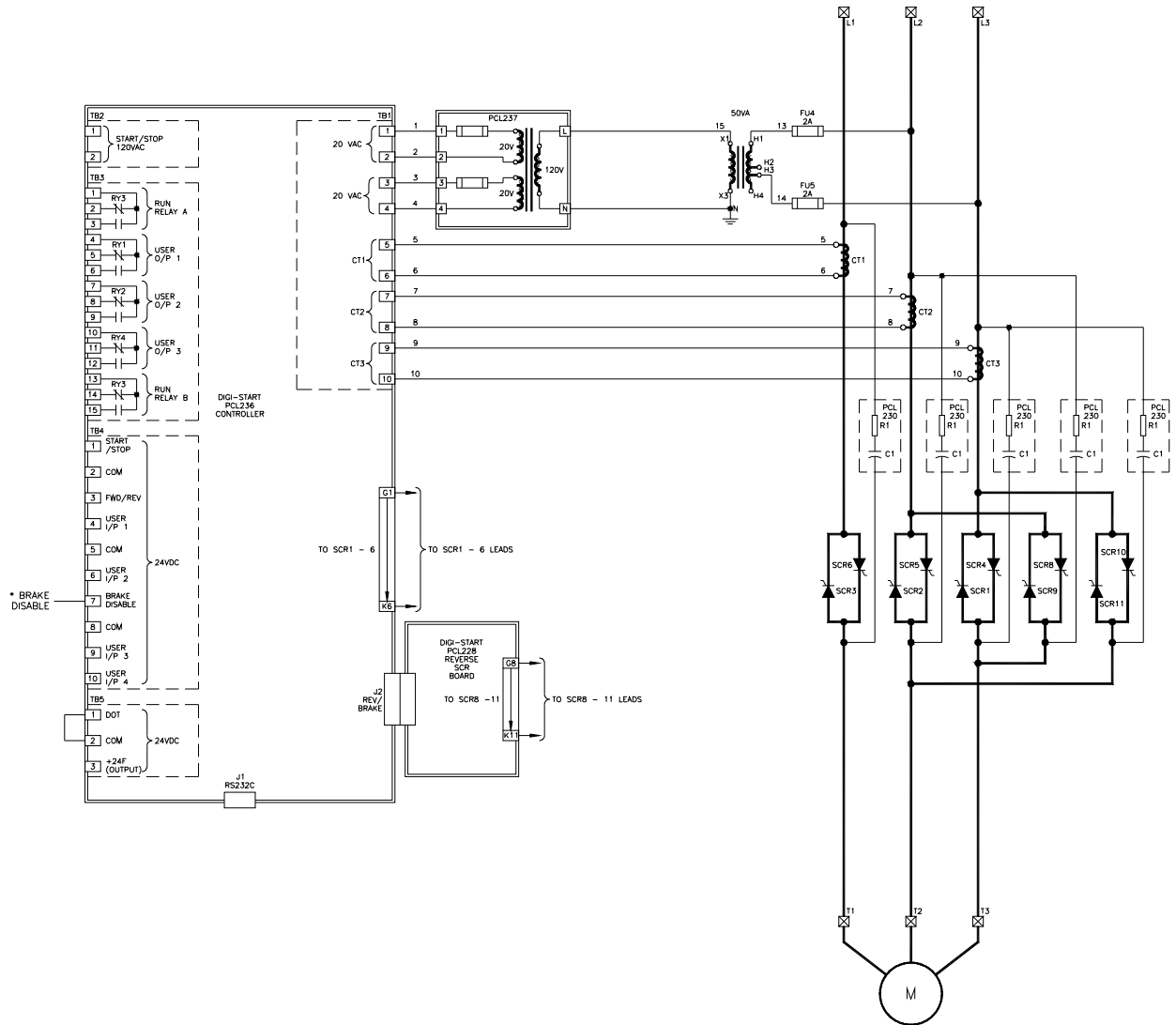
# OPTIONAL INJECTION BRAKE CONNECTION DIAGRAM



## MODIFICATION FOR CHANGING FROM PCL243 Rev.3 TO Rev.5

1. Make sure that FU 4 is wired to L2 and FU 5 is wired to L3.
2. Add wiring from PCL243 TB3 Pin 1 to PCL236 TB1 Pin 3 and from PCL243 TB3 Pin 2 to PCL236 TB1 Pin 4
3. Connect existing TB to appropriate connector.

# OPTIONAL REVERSING CONNECTION DIAGRAM



\* Not User Configurable