

INSTALLATION MANUAL

Digi-Brake DC INJECTION BRAKE DB1

Warning:

Equipment is at line voltage when AC power is connected. Pressing STOP push-button does not remove AC mains potential. All phases must be disconnected before it is safe to touch motor terminals or control equipment.

SOFTAC[®]

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Revision 4.1

GENERAL

Digi-Brake DC Injection Brakes are used on three-phase squirrel cage and wound rotor induction motors.

The basic Digi-Brake contains four (4) SCRs, connected in a full wave bridge configuration. The design of this power circuit reduces the high peak current spikes seen with a two (2) SCR, one (1) flyback SCR design.

SOFTAC's Digi-Brakes 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 basic Digi-Brake contains four (4) 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-Brakes are rated to operate at a maximum DC current of 300% of the motor FLA for 3 minutes (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. Derating of one and one-half percent per degree Celsius above 40°C and one percent for every 325 feet (100 meters) above 5,000 feet, must be considered when applying the Digi-Brake.

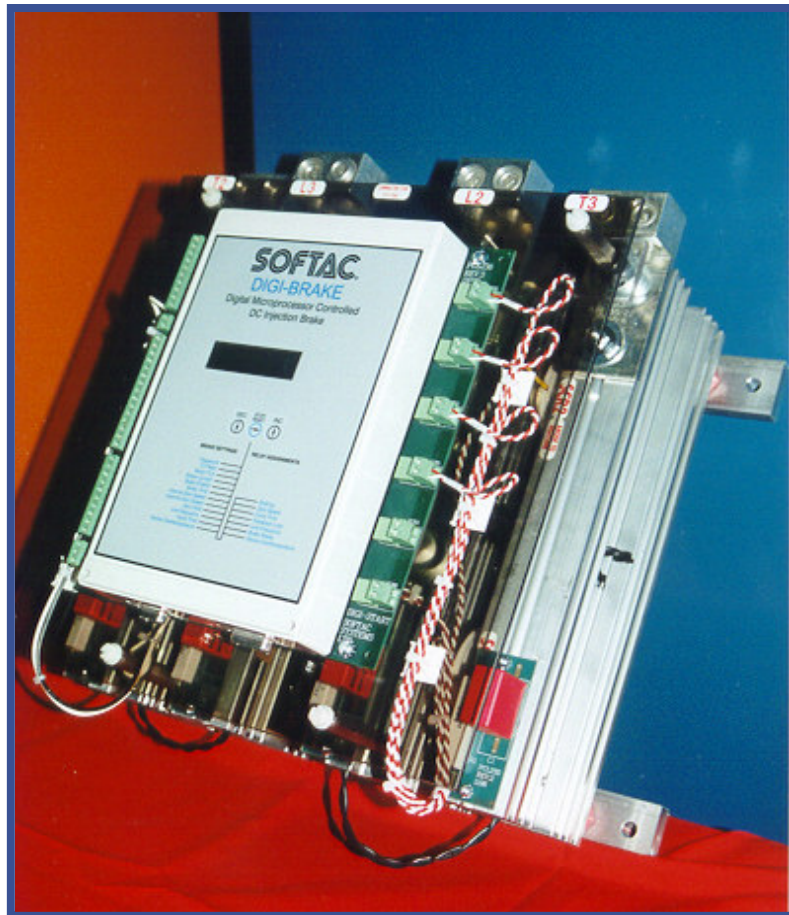


Figure 1

DB1 DIGI-BRAKE INSTALLATION PROCEDURE

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

Connect motor leads to output terminals T2 and T3.

a. TWO WIRE LOW VOLTAGE CONTROL

Two wire controls are used for automatic control.

Brake goes to "Brake Armed" mode when Maux closes. Brake comes on when Maux opens. If Maux is closed when the brake microcontroller comes out of reset, the brake will not go to the "Brake Armed".

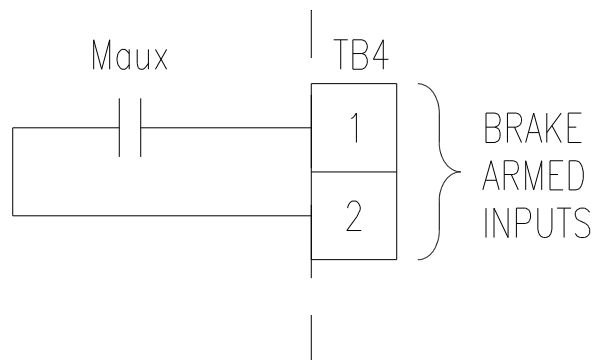


Figure 2

b. TWO WIRE 120 VAC CONTROL

Dry contact closure control requiring an external 120V supply.

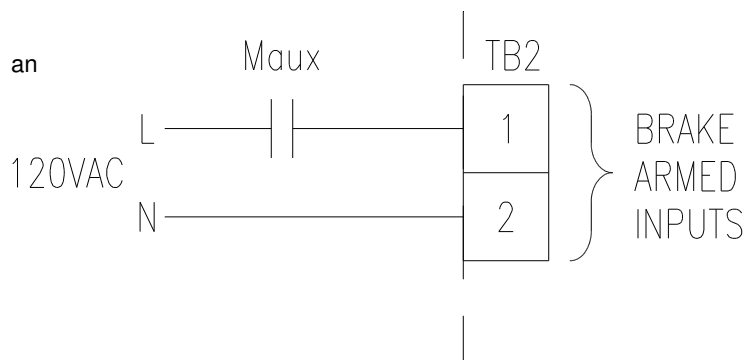


Figure 3

* Note: If using PLC output card, place 10W 2500Ω resistor across TB2/1-2.

Ensure that all trip functions are in series with the electro-mechanical starter or contactor stop pushbutton circuitry. There is a 200ms delay from the time "brake on" goes high (*Maux opens*) to the time the SCRs fire.

The motor starter must be interlocked with the brake to ensure the motor cannot be started while the brake is operating (see figure 5.)

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

REMOVE AC POWER

DB1 DIGI-BRAKE INSTALLATION PROCEDURE – continued

USER INPUTS

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

External pulses must have sinking output capable of sinking 5 mA. 24VDC is provided to power the device.

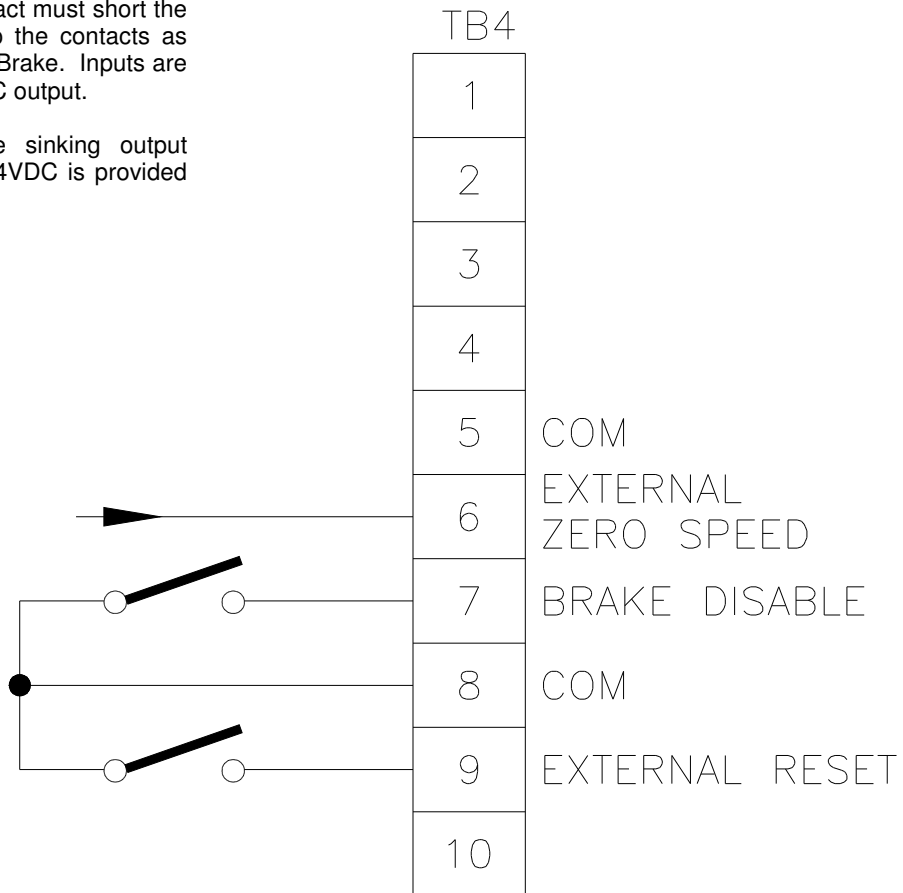


Figure 4

USER OUTPUTS

The Digi-Brake has 5 Form-C relay outputs, rated for 1 Amp @ 60 VDC or 120 VAC. Two of the Form-C contacts are dedicated to "Brake On" outputs (*TB3 1, 2, & 3 and TB3 13, 14, & 15*). Three (3) relays, user O/P 1, user O/P 2, and user O/P 3 are available for the following programmable output functions:

- | | |
|--|---|
| <ul style="list-style-type: none"> • Zero Speed • Cycle Time • Ext F/B Loss • Line Frequency | <ul style="list-style-type: none"> • Brake Armed • Device Overtemperature • Phase Loss |
|--|---|

The brake on relay is not programmable and must be used to interlock the brake with the motor starter.

THE MOTOR STARTER MUST NOT BE ABLE TO START THE MOTOR WHEN THE BRAKE IS ON.

DB1 DIGI-BRAKE INSTALLATION PROCEDURE – continued

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

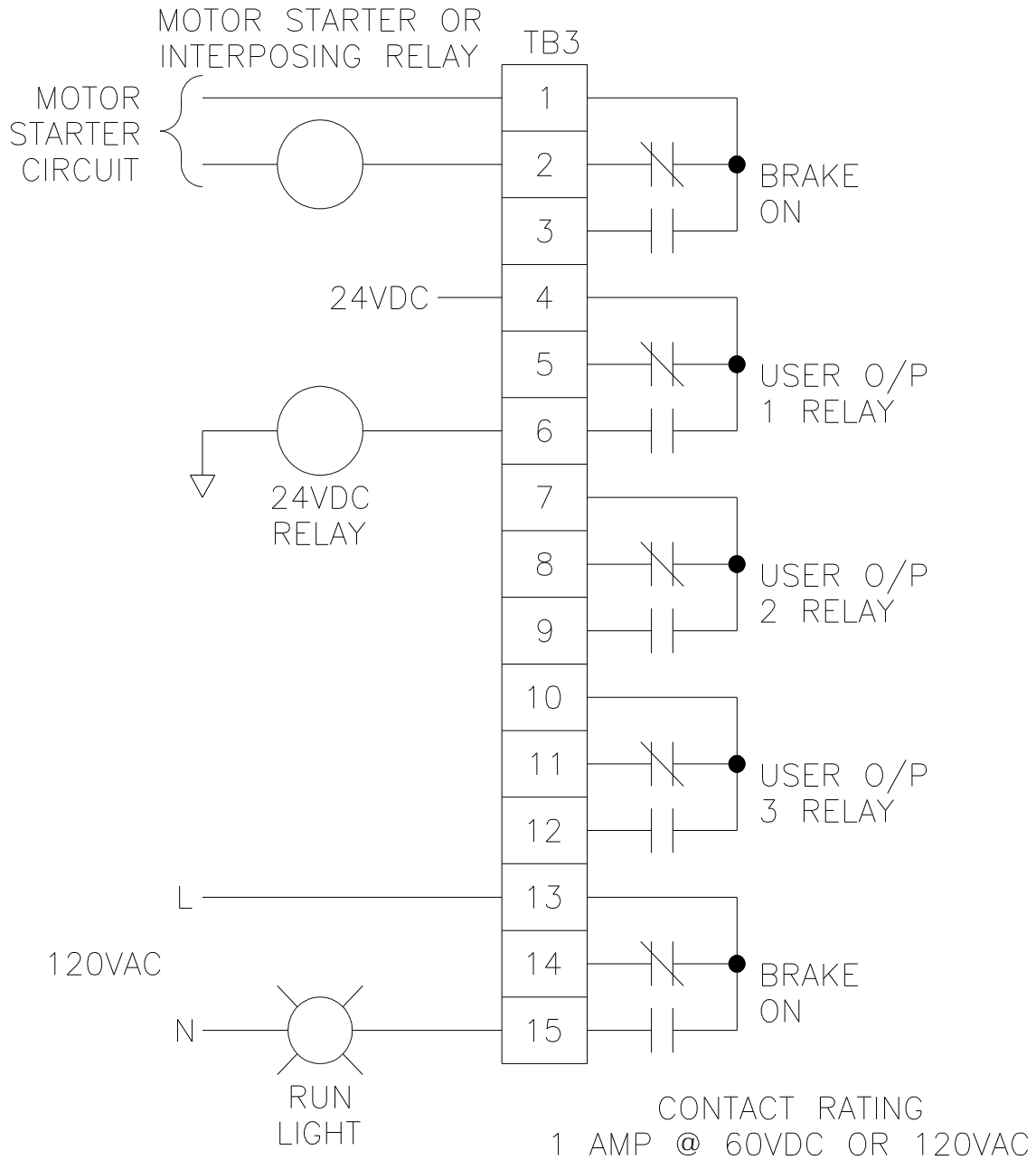


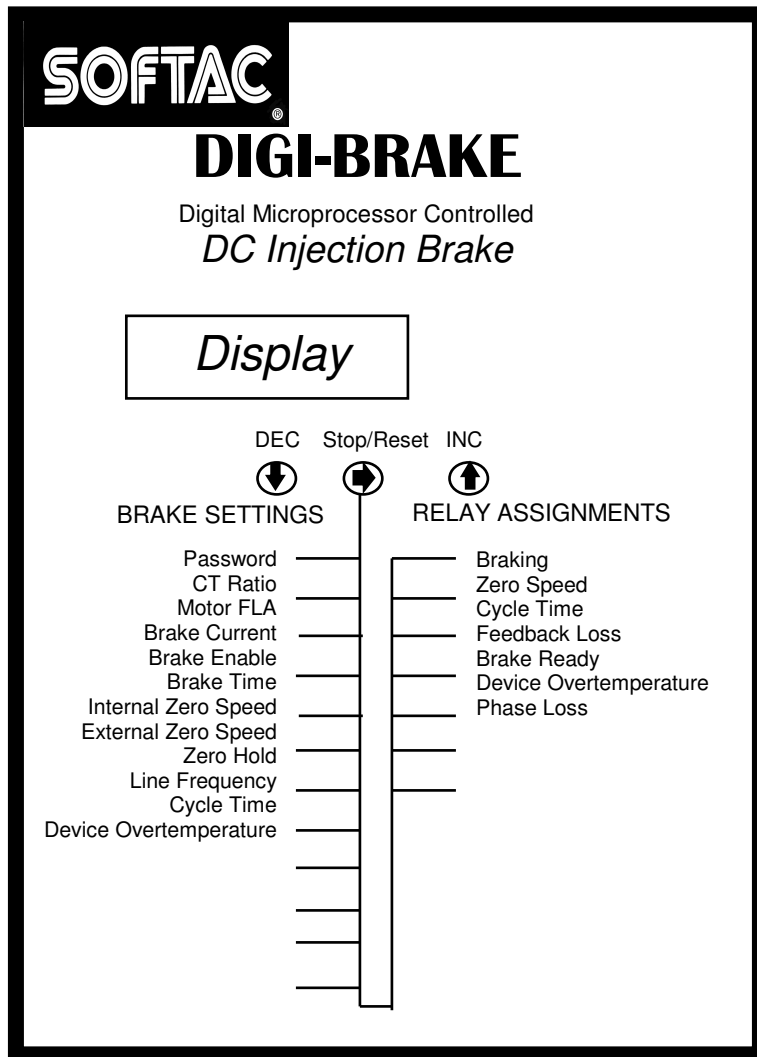
Figure 5

KEYPAD

To view messages and to change Menu parameters on the Digi-Brake, a keypad is provided as standard equipment. The Brake must be in the **BRAKE OFF** mode to view or change parameters. To enter the Menu Mode, press the **DEC** and **INC** keys together.

DEC – Used to decrement values when programming. When pressed once with the **INC** key the menu will scroll in the opposite direction. When pressed twice simultaneously 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 down faster. If this key and the **STOP/RESET** key is held down, the numbers will decrement by tens and then by hundreds.

INC – Used to increment values when programming. When pressed once with the **DEC** key the menu will scroll in the opposite direction. When pressed twice simultaneously with the **DEC** 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 **STOP/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. It is also used to acknowledge and reset alarm conditions.



Key Pad as detailed on basic Digi-Brake

* The Brake settings and relay assignments shown here are for the DB1 Brake model.

Figure 6

DB1 DIGI-BRAKE **SET UP PROCEDURE**

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

The parameters are grouped in three (3) different categories for ease of operation.

00 series are General Parameters

20 series are Monitor Parameters

50 series are Relay Output Assignments

The following eight (8) parameters **must** be set before braking. The rest are optional and selectable as required.

- 01 – Password (*Default set at 0001*)
- 02 – CT Ratio (*Factory set*) ***CAUTION:** *Consult Factory if this needs to be changed*
- 03 – Motor FLA (*Set to nameplate Amps*)
- 04 – Brake Current (*% FLA*)
- 06 – Brake (*set to internal or external zero detect*)
- 07 – Brake Time (*Set to time required to stop*)
- 10 – External Sample (*Set to sample time if external zero is selected in parameter. Default 30*)
- 23 – Max Phase (*Maximum value is typically 2500, the actual value varies from motor to motor*)

The settings are stored for each parameter when Stop/Reset is pressed. The Brake can be engaged after all above parameters are set.

PRE-START-UP INSPECTION

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

Apply the AC power feeding the Digi-Brake brake.

Check incoming power to the Brake. The line voltage should be within 10% of the brake nameplate data (*i.e. A 480 VAC line should not be less than 432 VAC and not more than 528 VAC.*)

TYPE 1 DIGI-BRAKE

DISPLAY MESSAGES

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

DIGI-BRAKE SVx.x, Hvx.x Rx	This message is displayed on power up or if the MCU is reset. It shows the Model name, Digi-Brake, and the software and hardware versions used.
COMPUTER FAILED	This message is displayed if the Microcontroller Unit fails. Contact SOFTAC for repair/replacement.
BRAKE OFF	This message is displayed after all the initialization tests pass and the unit is waiting for a command. At this point, it is possible to examine or change the Digi-Brake Parameters.
BRAKE INHIBIT	This message is displayed if a Brake On request is detected but the brake is inhibited either internally via the keypad or by the external Brake Disable.
BRAKE ARMED	This message is displayed when a Brake Armed input is detected.
BRAKE ON	This message is displayed while the Brake is energized. The DC Brake current is displayed.
CYCLE TIME	This message is displayed if a second braking cycle is attempted before the time in parameter [21] has expired.
VOLTAGE PRESENT	This message is displayed if a command to brake is received and the Digi-Brake senses motor voltage is still present. The brake will NOT come on until it is re-armed and a new brake command is detected

FAULT MESSAGES

Phase Loss	Displayed when the Digi-Brake detects a phase loss. Check the line voltage to make sure phases are present. Press STOP/RESET or bring Ext Reset low to reset the fault once phases are restored.
Device Overtmp	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 STOP/RESET button.
Line Freq.	Displayed if line frequency falls outside a 45 Hz to 65 Hz window.
Ext F/B Loss	Displayed if external feedback loss is detected. Parameter [6] must be set to External Zero . Press STOP/RESET or bring Ext Reset low to reset the fault once feedback is restored.

PARAMETER TABLES

TYPE 1 DIGI-BRAKE PARAMETERS

Item	Range (Default)	Units	Comments
01 PASSWORD	0-9999 (1)	n/a	Password required to change configurable parameters.
02 CT RATIO	333:1–10000:1 (Factory Preset)	n/a	Factory pre-set CT ratio. If the control unit is a spare or moved to a different unit, consult the factory.
03 MOTOR FLA	0-max. for brake model (0) (Factory Preset)	Amps	Enter the motor Full Load RMS Current here. It is used to calculate the maximum braking current.
04 BRAKE CURRENT	0-300 (0)	FLA	RMS braking current in % of MOTOR FLA. Maximum is 300% unless limited by parameter [23].
05 MOTOR SCALE	100-250 (250)		Scales DC current F/B to compensate for inductance in motor.
06 BRAKE	Disabled, Timer only Zero SPD Detect (Disabled)	n/a	Unconditional disabling of the brake when set to Disabled and the display will show "BRAKE INHIBIT". Timer only selects constant Brake Time as set in Parameter [7]. Zero Speed selects pulsed external input for zero speed detection. Maximum input frequency is 120 Hz.
07 BRAKE TIME	0-180 (0)	Sec	This parameter sets the MAXIMUM braking duration. If zero speed detection is selected, and this timer times out before zero speed, the brake will shut off.
08 BRAKE DELAY	0-5 (0)	Sec	This parameter delays the onset of braking current once brake command is received
09 M VOLT DETECT	0-255 (100)	n/a	Zero to disable. This number sets the motor voltage detection threshold. If motor voltage feedback is greater than this number the brake will not come on.
10 ZERO SPD PERIOD	0, 1-100 <i>Typical Setting Is 30</i>	0.1 Sec	Zero to disable. This function monitors an external input pulse train to determine zero speed if parameter [06] is set to External Zero. The user selects an interval between pulses, from 0.1 to 10 seconds, to determine zero speed. If this feature is selected, and no pulse is detected within the selected time interval at the beginning of the braking cycle, the brake will turn off and a FEEDBACK LOSS message will be displayed.
11 ZERO HOLD	0, 0-50 (0)	0.1 sec	Zero to disable. The brake stays on from 0.1 to 5.0 seconds after zero speed is detected. The BRAKE TIME will override this.
12 JOG DELAY	0-30	Sec	A non-zero value initiates a timer when brake is armed. If brake command is received before timer has timed to zero, the brake will NOT come on
20 LINE FREQ CHK	Off, On (Off)		Alarms if line frequency falls outside of a 45 Hz to 65 Hz window and LINE FREQUENCY will be displayed.
21 CYCLE TIME	0-60 (0)	Min	Zero to disable. Sets a time interval, in minutes, between successive braking cycles. Brake will not come on if cycle timer is not zero and CYCLE TIME will be displayed
22 DEV OVERTMP	On, Off (Factory Set)	n/a	Off to disable. This function monitors the brake heat sink temperature. Brake will not come on if fault is detected. Factory set to off if overtemp detection not installed.
23 MAX PHASE	0-9999 (0)	n/a	This parameter is set up during commissioning of the Brake. The maximum phase angle is set so that the maximum current is just greater (i.e. 20%) than the current set in parameter [04].

OUTPUTS

These functions are used to define the USER RELAY outputs. A ZERO disables the function. 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.

Item	Relay Output	Units	Comments
51 ZERO SPEED	0, 1, 2, 3 (0)	n/a	Zero for no relay output. The selected relay will pick up when the motor is at zero speed. It is dropped after a brake cycle if: - the BRAKE ON input goes from high to low, - the EXT RESET input on TB4/9 goes low, or - the STOP/RESET key is pressed.
52 CYCLE TIME	0, 1, 2, 3 (0)	n/a	Zero for no relay output. The selected relay energizes if a second brake cycle is initiated before the CYCLE TIME timer has timed out. The relay drops after the timer goes out.
53 EXT F/B LOSS	0, 1, 2, 3 (0)	n/a	Zero for no relay output. If parameter [06] is set to External Zero and upon initiating the brake, no feedback pulse is detected within the time interval selected in parameter [10], the brake will shut off. FEEDBACK LOSS will be displayed and the selected relay will energize. The relay is dropped when the External Reset input or Stop/Reset key is asserted.
54 LINE FREQ.	0, 1, 2, 3 (0)	n/a	Zero for no relay output. If parameter [20] is set to ON, the selected relay will energize upon detection of a line frequency fault. The relay is dropped when the External Reset input or Stop/Rest key is asserted (provided the fault is cleared).
55 BRAKE ARMED	0, 1, 2, 3 (0)	n/a	Zero for no relay output. If BRAKE ON input has gone from high to low, the relay will activate. The relay drops once a braking cycle is initiated. The output coincides with the BRAKE ARMED display.
56 DEVICE OVERTMP	0, 1, 2, 3 (0)	n/a	Zero for no relay output. The relay drops after the brake stack cools and TB5/1 goes low.
57 PHASE LOSS	0, 1, 2, 3 (0)	n/a	Zero for no relay output. The selected relay will energize and the brake will not come on if: - L2 or L3 are lost prior to braking or - L2 or L3 are not detected after a control power reset (if control power comes from a source other than the line). The relay is dropped when the External Reset input or Stop/Reset key is asserted (provided the fault is cleared).

DC INJECTION BRAKE SETUP

1. WITHOUT ZERO SPEED DETECTION (TIME ONLY)
 - Parameter [06] set to Timer Only
 - Parameter [07] set to time in seconds for the motor to stop plus 3 seconds
 - Parameter [08] set to 0
 - Parameter [09] set to 0

2. WITH ZERO SPEED DETECTION
 - Parameter [06] set to Zero SPD Detect
 - Parameter [07] set to time in seconds for motor to stop plus 3 seconds
 - Parameter [08] set to 0
 - Parameter [10] set from 0.1 to 10 seconds. This will be the gated sample time used to detect a feedback pulse. If, upon starting to brake, a pulse is not detected within this time period, an EXT F/B LOSS message will be displayed and the brake will switch off. Initially set to 30

3. SETTING BRAKE CURRENT
Choose 1 or 2 above, Set Parameter [07] to twice the time estimated for a stop.

Depending on the application, start by putting 100% into Parameter [04]. Depending on the inductance of the motor, the DC current value will need to be scaled by adjusting Parameter [05] Motor Scale. This parameter must be set to 250, and the brake Current [04] limited to 100% before collecting data for the scale calculation.

Calculation: $(\text{DC Current measured from clamp} / \text{DC current displayed}) * 250$
This value can be entered in Parameter [5] Motor Scale
Maximum scaling value is 250.

To check the Motor Scale number, reinitiate a brake cycle. The DC brake current measured with the clamp should match the current on the display.

Now the brake current can be set to the desired % of FLA.

- Start the motor and let it run up to full speed. Run the motor for a while to allow the windings some time to cool. Stop the motor, allowing the brake to initiate. Closely monitor the time it takes to stop.
- Depending on the Load to be stopped, the brake current can be increased or decreased to achieve the desired performance. Be cautious in adjusting brake current as increases in DC braking current increase the stopping torque. Also keep in mind that the stopping torque affects the time it takes to stop the load.
- Now run another start/stop cycle carefully timing the stop. **Set Parameter [07] to be two or three seconds longer than it took to stop.** Parameter [07], the brake timer, will always shut off the brake once it has timed out.

<p>Due to heating effect the MAXIMUM DC BRAKING CURRENT should not exceed 300% 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.</p>
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EQUIVALENT TORQUE

Torque is approximately equal to (.235 times DC/FLA) all squared.

DC / FLA	% RATED TORQUE
.5	1.3
.75	3.1
1.00	5.5
1.25	8.6
1.50	12.4
1.75	16.9
2.00	22.1
2.25	28.0
2.50	34.5
2.75	41.8
3.00	49.7

OPERATION

- | | | |
|--------------|------------|---|
| 1. BRAKE OFF | - no fault | - display BRK OFF after a braking cycle and before a high to low transition is detected on the BRAKE ON input. |
| | - fault | - display BRK ARMED after a high to low transition is detected on the BRAKE ON input.
- display BRK INHIBIT if parameter BRK ENABLE is set to zero or Brake Disable input is low.
- display fault and activate output relays as required. |
| 2. BRAKE ON | - no fault | - display DC braking current. At the end of the braking cycle display the motor volt detect number for 5 seconds |
| | - fault | - turn brake off and display fault. Activate output relays as required. |

OUTPUT RELAYS

There are four relays standard to the DIGI-BRAKE. The contacts are rated 1 Amp at 60 VDC or 120 VAC. The BRAKE ON relay is not programmable. The BRAKE ON relay stays energized while the brake is on.

TB3 Term	Contact	Relay Name	Description
1	com	BRAKE ON RELAY	This relay output is not user configurable. The coil is energized whenever the brake is on.
2	n.c.		
3	n.o.		
4	com	USER O/P 1 RELAY	This relay output is defined by Group 50 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 50 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 50 functions. More than one function can be assigned to the relay.
11	n.c.		
12	n.o.		
13	com	RUN RELAY B	The coil is energized whenever the Brake is On. The contacts are the second pole of the above BRAKE ON RELAY (term 1, 2, 3)
14	n.c.		
15	n.o.		

See Diagrams at end of manual.

PARAMETER LIST

Type 1 Brake Parameters

Par. #	Parameter		Default	Custom Setting
GENERAL PARAMETERS				
01	PASSWORD		0001	_____
02	CT RATIO	[Ratio]	Factory	_____
03	MOTOR FLA	[Amps]	0	_____
04	BRAKE CURRENT	FLA	0	_____
05	MOTOR SCALE	[100-250]	250	_____
06	BRAKE	[n/a]	Disabled	_____
07	BRAKE TIME	[sec]	0	_____
08	BRAKE DELAY	[sec]	0	_____
09	M VOLT DETECT	[n/a]	100	_____
10	ZERO SPD/ SAMPLE	[0.1 sec]	5	_____
11	ZERO HOLD	[0.1 sec]	0	_____
12	JOG DELAY	[sec]	0	_____
MONITOR PARAMETERS				
20	LINE FREQ CHK	[n/a]	Off	_____
21	CYCLE TIME	[min]	0	_____
22	DEV OVERTMP	[n/a]	Off	_____
23	MAX PHASE	[n/a]	0	_____
OUTPUTS				
51	ZERO SPEED		0	_____
52	CYCLE TIME		0	_____
53	EXT F/B LOSS		0	_____
54	LINE FREQ.		0	_____
55	BRAKE ARMED		0	_____
56	DEV OVERTMP		0	_____
57	PHASE LOSS		0	_____
	Measured DC Braking Current		n/a	_____
	Displayed Braking Phase Angle Number		n/a	_____

STANDARD DIGI-BRAKE CONNECTION DIAGRAM

