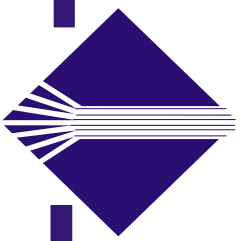
# DCB3 SERIES INSTRUCTION MANUAL

for

SOLID STATE
DC INJECTION BRAKING
STANDARD and HEAVY DUTY



**BENSHAW Inc**

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## PRE-START-UP INSPECTION

1. Clean out all metallic particles and 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. Repeat for L 2. Check all terminals to ground. All readings should be several megohms or more.

## GENERAL

Benshaw DCB3 DC Injection Brakes are used to provide DC braking current for induction type AC motors while operating in conjunction with an external motor starter that has its own start/stop control. When the external motor starter removes power from the motor, the loss of AC voltage at the motor leads triggers the D.C. brake.

When activated, the brake provides an adjustable DC current to two leads of the motor (0-300% full load amperes (FLA) STD Duty, 0-500% heavy duty) which develops braking torque. This current is applied for a time period adjustable from one and one-half to thirty seconds. A normally closed brake aux contact is provided to prevent restarting of the motor while brake current is applied. The voltage on the third lead of the motor is sensed to detect when the motor reaches zero speed, turning off the D.C. brake and allowing the motor to be restarted. A "Time" adjustment limits the maximum time that the D.C. brake can be on. The stopping brake torque adjustment enables smooth motor deceleration to zero speed providing controlled stopping times. This adjustment procedure reduces hazards associated with coasting machinery, overhauling loads, etc.

Three sets of Form C contacts are provided for external use, one set signals operation of the brake, and the other two can indicate when the motor reaches zero speed. Optional features include an input for zero-speed sensing by a proximity switch, and two dry contact inputs; one for independent brake operation (useful for "anti-windmilling" on large fans, for example) and another to inhibit D.C. brake operation when desired. The PC board can also be modified to extend the max. brake time from 30 sec. to one minute.

## POWER ASSEMBLY TECHNICAL DATA

Each DCB3 Brake contains 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 continuous current to the motor.

DCB3 Brakes are rated to operate at the maximum DC current 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 C above 40° C and one percent for every 330 feet (100 meters) above 3,300 feet, must be considered when applying DCB3 Brakes.

## OPTIONS

The P.C. board for the DCB3 can be modified to add the following options:

1. Extended brake Time – The standard range for adjusting the max. brake time is from 1.5 to 30 seconds. If desired, this range can be doubled to go from 3 seconds to one minute. Doing so, however, could damage the motor if high levels of brake current are applied for extended periods.

2. Prox switch sensing of motor speed – Normally the DCB3 senses when the motor comes to stop by monitoring the voltage present at the motor leads. When the motor stops, the DCB3 stops applying brake current to the motor and then allows it to be restarted. If it is desired to conclude braking when the motor slows to a desired speed instead, the card can be modified to sense "Zero Speed" by monitoring a prox switch that is placed to sense motor rotation. The card is modified by cutting the P.C. trace under Link 1 and installing Link 2. When the frequency at the switch input drops below a set level, the DCB3 stops applying brake current to the motor and allows it to restart. The "PROX SW" pot on the card sets this level from 0.8 Hz. (suitable for a switch sensing one pulse per revolution), to 40 Hz. (suitable for a switch sensing gear teeth).

   A DC type of prox switch is needed – Approximately 30 volts DC is available for powering the switch at TB1-6 ("+") and TB1-13("-"). The switch output (connected to TB1-12) can be an open collector type with either NPN or PNP polarity, or it can have a bipolar output. The output signal should be a square wave or pulse train at least 8 volts p-p.

## ZERO SPEED RELAY CONTACTS

The PC board is supplied with a six-position terminal block connected to a relay that is energized whenever the "ZERO SPEED" LED is lit. The contacts are two sets of "Form C" contacts. The first set has its normally open contact connected to TB5-1, its common contact to TB5-2, and its normally closed contact to TB5-3. Similarly, the second set is connected with its normally open contact at TB5-4, its common contact at TB5-5, and its normally closed contact at TB5-6. This relay energizes when power is first applied. It drops out when the motor is started, it stays out when the motor power is removed and during braking, and it energizes when the motor stops or the brake time is over. Since the zero speed sensing circuit needs voltage at the motor to detect rotation, the motor may still be turning when the relay is energized if the brake current stops while the motor is still turning. Because the prox switch option makes the "Zero Speed" LED pulse with each switch transition as the motor comes to a stop, the contacts will chatter. Therfore, these two features should not be used together.

## CONNECTION PROCEDURES FOR DC INJECTION BRAKING

### 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 parts.

**REMOVE AC POWER**

1. Connect two phases of the power input from the motor starter to terminals L1 and L2. Wire should be sized according to the motor current. Wire sizing may be determined by consulting local and/or NEC recommendations.

2. Connect three phases of the starter output to the motor to terminals T1, T2 and T3. Be sure they are connected between the motor overload and the motor. T1 should be on the same phase as L1, and T2 should be on the same phase as L2.

3. Open the control connection to the coil of the motor starter and connect DC brake terminals 20 and 21 in series with the coil of the motor starter.

4. It may be desired for motor protection, that the starter overload, if tripped, should inhibit the DC brake. To do this, a set of N/O overload contacts should be connected to terminals 16 and 17 on the DC brake PC board. If the overload does not have a set of N/O contacts available, use a pilot relay circuit.

5. If desired, the optional dry contact inputs for independent brake and/or brake inhibit 5 can be connected. Connecting a normally-open contact to terminals 14 and 15 will allow independent D.C. brake operation whenever the motor isn't running and the contact is closed. Connecting a normally-open dry contact to terminals 16 and 17 will allow braking to be inhibited whenever the contact is closed. NOTE these inputs are for dry contact connection only. Do not connect any control voltages, either AC or DC, to these inputs or erratic operation and equipment damage could result.

6. The DC current through the motor must be measured to properly adjust its level. Temporarily install a DC ammeter in series with the brakes T1 lead with the "+" side away from the DCB3 Brake. The DC ammeter must be capable of reading at least 300% (500% Heavy Duty) of the motors full load ampere (FLA) rating.

7. On the DCB3 card in the DC brake, turn potentiometers "TORQUE" and "TIME" fully counterclockwise (CCW). Turn the "ZERO SPEED SENS" potentiometer fully clockwise (CW).

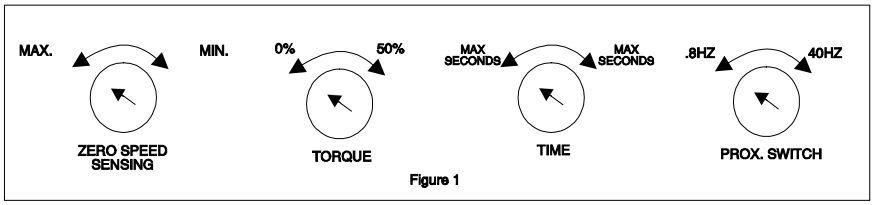

Figure 1

*Adjustments: Zero Speed Sensing: max to min.
Torque: 0% to 50% rated motor torque (0% to 300% FLA DC current)
0 to 130% rated motor torque (0-500% FLA DC Current Heavy Duty)
Time: 2 seconds to 30 seconds
Aux Switch: 0.8HZ to 40HZ

8. Apply AC power to the combination of the motor starter and the DC Brake.

9. Energize the motor starter. The "RUNNING" LED on the DCB3 card should be lit. Verify that the motor comes up-to-speed.

10. De-energize the motor starter. On the DCB3 card, the "Running" LED should turn off and the "Brake" LED should come on. The "Brake" LED should go out approximately 1.5 seconds after it comes on.

11. Calculate the maximum recommended braking current by the following formula.
***Maximum Braking Current (DC) = 3 x Motor FLA (AC)***
***5 x Motor FLA (AC) Heavy Duty***

12. On the DCB3 card, turn the "TIME" potentiometer fully clockwise (CW). Start the motor and allow it to come up-to-speed. Stop the motor. The "BRK ON" LED should turn on. Gradually turn the "BRK TORQUE" potentiometer, CW, until the DC ammeter indicates the desired - maximum - recommended braking current.

13. Check the time required for the motor to stop. If the motor stops too quickly, the "TORQUE" potentiometer can be turned CCW for the desired stopping time (this will vary for each application and will have to be adjusted accordingly). DO NOT, in any case, exceed the maximum recommended braking current. (Reference No. 11., above).

14. The "TIME" potentiometer should be adjusted so that the "Brake" LED goes out a few seconds after the motor stops. Turning the pot CCW reduces the time. Allow sufficient time for motor cooling between successive stops.

15. Once the "TORQUE" pot has been adjusted, the "ZERO SPEED SENS" pot can be adjusted. With the motor stopped, temporarily jumper terminals 14 and 15. The "BRAKE" LED should come on, and the DC ammeter should register brake current. Gradually turn the "ZERO SPEED SENS" pot CCW until the "ZERO SPEED" LED comes on. Turn the "ZERO SPEED SENS" pot slightly further CCW and remove the connection.

16. Disconnect power. Remove the DC ammeter and reconnect the wiring. The unit is now ready for use.

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**REMOVE AC POWER**

## USING POWER FACTOR CAPACITORS

Power factor correction capacitors can be used in conjunction with the DCB3 Brake; however, the capacitors must be added ahead of the brake and never between the brake and the motor. If the capacitors are installed between the brake and the motor, serious damage to the brake and/or the motor may result.

## INDUCTION MOTOR TEMPERATURE MEASUREMENT

The motor's stator winding temperature rise can be determined by recording the winding resistance at room temperature before operation and after the motor has reached running temperature at full load. Using a digital ohmmeter capable of reading milliohms, calculate the stator winding temperature rise by using the following formula:

***Temperature Rise: T= (RF/R)-1) (234.5 + t) (Degrees C)***
***RF = Resistance in ohms of final temperature measurement***
***R = Resistance at beginning of test***
***t = Room temperature at beginning of test***

## PREVENTATIVE MAINTENANCE

The components of the DCB3 Brake will not deteriorate with use; however, some routine inspection and maintenance is suggested. Periodically disconnect brake input power and vacuum or blow off accumulated debris on the internal parts with a high-velocity, low pressure blower.

Power connections on newly installed brakes may relax and loosen after two or three weeks of operation. Turn power off and retighten. Check annually thereafter; more often if vibration is present. Loose power connections can cause voltage spikes, overheating, malfunctioning, or failure.

## SPARE PARTS

| HP @ 480V | DESCRIPTION | PART NUMBER STANDARD DUTY | PART NUMBER HEAVY DUTY | QUANTITY |
|---|---|---|---|---|
| | PC CARD | BIPC-300020-XX | BIPC-300020-XX | 1 |
| 5-15 | SCR | BISCR5012X | BISCR5012X | 3 |
| 20 | SCR | BISCR5012X | BISCR5012X | 3 |
| 30 | SCR | BISCR5012X | BISCR10012X | 3 |
| 40 | SCR | BISCR10012X | BISCR13212X | 3 |
| 50 | SCR | BISCR10012X | BISCR13212X | 3 |
| 60 | SCR | BISCR13212X | BISCR16212X | 3 |
| 75 | SCR | BISCR16112X | BISCR21012X | 3 |
| 100 | SCR | BISCR21012X | BISCR66012X | 3 |
| 125 | SCR | BISCR25012X | BISCR6601218 | 3 |
| 150 | SCR | BISCR6601218 | BISCR6601218 | 3 |
| 200 | SCR | BISCR6601218 | BISCR15001850 | 3 |
| 250 | SCR | BISCR6601218 | BISCR15001850 | 3 |
| 300 | SCR | BISCR8801830 | BISCR15001850 | 3 |
| 400 | SCR | BISCR15001850 | | 3 |
| 500 | SCR | BISCR15001850 | | 3 |
| 600 | SCR | BISCR15001850 | | 3 |
| 700 | SCR | | | |

Based on HP @ 480V
**4 = 480V

For other voltages, calculate as follows $\frac{480}{\text{Operating Voltage}} \times \text{Motor HP} = \text{Brake size (rated at 480V)}$

or

HP @ 230V, take HP x 2.4 = FLA FLA divided by 1.2 = HP @ 480V
HP @ 208V, take HP x 2.7 = FLA FLA divided by 1.2 = HP @ 480V
HP @ 380V, take HP x 1.52 = FLA FLA divided by 1.2 = HP @ 480V
HP @ 575V, take HP x .96 = FLA FLA divided by 1.2 = HP @ 480V

## TROUBLE SHOOTING

| PROBLEM | POSSIBLE CAUSE | AREA OF CORRECTION |
|---|---|---|
| Motor continues to coast even though "BRAKE" LED is on and TORQUE" pot is turned up. | 1. Blown fuse(s).<br><br>2. Gate connections open on SCR's. | 1. Replace fuse (always check SCRs for shorts after changing fuse)<br><br>2. Check for 8-200 ohms from G to K terminals on PC board. If bad, check wiring to SCR's |
| LED's don't light up and unit won't work. | 1. Motor operating voltage not present on Terminals 1 and 2 on P.C. board.<br><br>2. Defective P.C. board.<br><br>3. Blown fuse on card. | 1. Check voltage at P.C. board Terminals 1 & 2.<br><br>2. Replace P.C. board.<br><br>3. Replace fuse. |

Revision History

| Revision | Date | ECO# |
|---|---|---|
| 03 | 8/24/01 | 118 |
| 04 | 10/10/01 | 201 |
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# BENSHAW PRODUCTS

## Low Voltage Solid State Reduced Voltage Starters

- RSD/RSM6 - SSRV Non or Separate Bypass
- RDB/RMB6 - SSRV Integral Bypass
- RSM7 - SSRV + DC Injection Braking
- RSM10 - SSRV + Reversing
- RSM11 - SSRV + DC Injection Braking + Reversing
- RSM10/12TS - SSRV Two Speed
- WRSM6 - SSRV Wound Rotor
- SMRSM6 - SSRV Synchronous
- DCB3 - Solid State DC Injection Braking

## Medium Voltage Solid State Reduced Voltage Starters

- 5kV - Induction or Synchronous to 10,000HP
- 7.2kV - Induction or Synchronous to 10,000HP
- 15kV - Induction or Synchronous to 60,000HP

## Low Voltage - AC Drives

- Standard Drives to 1000HP
- Custon Industrial Packaged Drives
- HVAC Packaged Drives
- 18 Pulse/IEEE 519 Compliant Drives

## RSC Series Contactors

- SPO/SPE/SPD Motor Protection Relays
- Enclosed Full Voltage, Wye Delta, Two Speed Part Winding and Reversing Starters

## Custom OEM Controls

## Sales and Service

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