BRAKE MONITOR

OPERATION & MAINTENANCE MANUAL

MODEL DM3000

Engineering Corp.
Gordon
www.gordoneng.com

67 Del Mar Drive
Brookfield, CT 06804

toll free 1.800.315.9233
fax 1.203.775.1162

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WARRANTY

Seller warrants equipment manufactured by it against defects in material and workmanship for a period of five years from date of sale. Seller's sole responsibility under this warranty is limited to the repair or replacement without charge of any part of the Seller's equipment which is proven to have failed when used in strict accordance with the Seller's installation and operating instructions. Such repair or replacement is Purchaser's exclusive rememdy and Purchaser, at Purchaser's expense, must return all such parts to Seller's plant, unless such parts are destroyed or not within Purchaser's control. Repaired parts or replacements will be shipped to Purchaser F.O.B. Seller's plant. Modifications, incorrect installations or improper operation of equipment by purchaser voids this warranty. This warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability and fitness for a particular purpose, and Seller shall have no responsibility for consequential losses or damages resulting from defects in such equipment.

FAIL-SAFE OPERATION

IMPORTANT: NOTE THE FOLLOWING.

1. This equipment is designed to meet the OSHA requirements for being fail-safe, which are stated in Section 1910.217(b)(8)(vi) as follows:

   "Electrical clutch/brake control circuits shall incorporate features to minimize the possibility of unintended stroke in the event of the failure of a control component to function properly, including relays, limits switches, and static output circuits."

   The Model DM3000 BRAKE MONITOR design includes a self-checking circuit, which operates continuously and independently of machine cycle, and detects certain functional failures. **Any failure detected by the self-check will cause the control relay to de-energize and the SELF CHECK light to go on.** The cause of the malfunction must be determined before operation can continue.
2. Before installing the **BRAKE MONITOR** system, **READ THE MANUAL.**
   Particularly note: Chapter 2 system information.
   Chapter 3 for installation.
   Chapter 4 for operation.
   The system should be checked daily, in accordance with the operational test in Chapter 4, or after any changes involving dies, personnel, or environment.

3. If constant readjustment is required, without changing conditions, **something is wrong** with the system, environment, or installation, and **must be corrected**.

4. Obviously, fail-safe design is a matter of degree, i.e., reducing the probability of unsafe failure to minimum practical level. The foregoing instructions are directed at further reducing this probability level. The user must pay strict attention to all factors regarding safety on a hazardous machine. This includes operator methods and attitudes, use of complementary guarding, use of reliable fail-safe type controls, and attention to situations peculiar to his particular operation.

5. A chain break detection circuit is provided to the monitor the output of a cam chain driven Motion Detector. If, for any reason, (broken chain, etc.) the motion signal is not present at the Brake Monitor after initiation of a stroke, the STOP ALARM relay contact will open and prevent further cycling of the machine.

6. Additional assurance of safe operation may be realized by a periodic inspection of the **BRAKE MONITOR** to see that stopping times are being indicated on the display in a normal manner. Set the stop time below the normal stopping time of the press and see that it prevents a subsequent cycle before resetting.

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Chapter 1
General Description

The DM3000 BRAKE MONITOR is composed of a control unit, a motion detector, and a 10' interconnecting cable. The control unit houses the 3 digit LED display (which indicates press stopping time), warning LEDS, and a keypad (which allows setting of alarm levels). The control unit has electrical connections for the machine's brake solenoid line (input), the warning and stop alarm relays, and the motion detector. The motion detector is mechanically connected to a rotating part (usually the cam box shaft drive chain) of the press. It supplies an electrical signal to the DM3000 corresponding to press ram motion. (See Figure 1).

Figure 1

Over a period of time, the clutch or brake of any press will start to wear. As this happens, the stopping time of a press will become increasingly greater. Thus the press could continue to operate when it is supposed to stop, and possibly cause injury to the operator.

The DM3000 BRAKE MONITOR is a microprocessor based safety device designed to monitor the stopping time of any press having a brake/clutch system. On every stop of the press, the DM3000 measures the stopping time and compares it to a previously set level. If the stop time nears the pre-set warning alarm time, the press is allowed to continue operating, but a warning alarm occurs, indicating the brake should be serviced before it reaches a dangerous level. If the stop time exceeds a higher pre-set stop alarm time, a stop alarm occurs and the press is stopped, with further operation possible only after resetting by authorized personnel.

1.2
DM3000 Enhanced Features

In comparison to earlier models, the DM3000 BRAKE MONITOR has the following features:

Microprocessor based electronics for better reliability and improved noise immunity.

The 3 digit LED display, visible from the front panel, displays either stopping time or reserve time (time left before an alarm) on each press stop.

An additional self-contained safety relay has relay contacts which are connected in series with the control relay contacts. These relays are designed for safety applications and use a unique relay armature configuration that allows detection of a welded control contact. If a welded contact is detected, the redundant safety relay is opened to interrupt machine operation. If a fault is detected by the self check circuit, both control and safety relays will automatically de-energize.

Measured stopping range is now from 10 millisecs. to 9.99 seconds.

The Chain Break Delay Time can be set from 100 millisecs. to 9.99 secs.

An auto-learn mode automatically adjusts settings for a particular press.

Self checking is continuous, independent of press cycle.

A keypad allows entering and changing of stop alarm, warning alarm, and chain break delay times. (An access code allows only an authorized user to change settings.) In the advent of an alarm, reset of the DM3000 is also via an access code entered by the keypad.

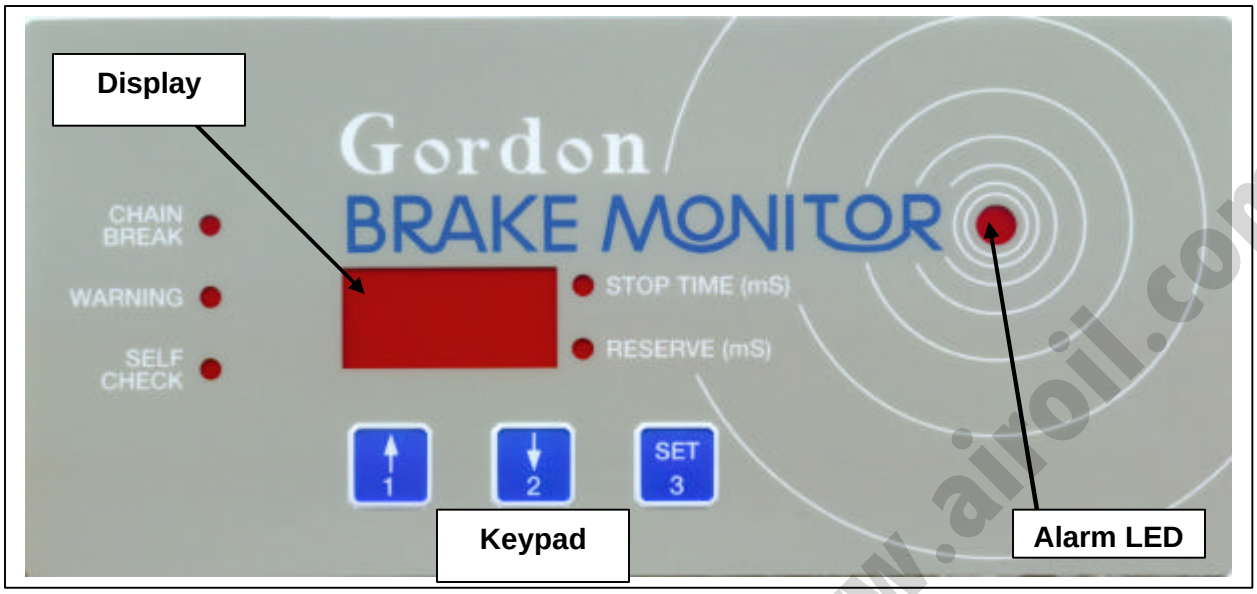
Improved filtering on the brake solenoid and motion input lines ensures better noise immunity and less likelihood of false alarms.

When a new die is being set up and a machine is run in motor-off inch or bar mode, the DM3000 can be put into motor-off inch mode, so that during the setup period, loss of motion will not cause an alarm.

Unit displays failure codes on display for easier troubleshooting.

1.3
DM3000 Specifications

Voltage Input:	115 VAC, 50/60 hertz, +/- 15%, single phase
Current Input:	50 mA. (AC - RMS)
Power Consumption:	6 VA
Control Relay Load Rating:	115 VAC: 2.5 A, (resistive), .25 A, (inductive)
Warning Relay Load Rating:	115/230 VAC: 8 A
Relay Contact Arrangement:	Normally closed contact
System Reaction Time:	Normal alarm: 12 mSECs, max. Safety alarm - additional 17 mSECs, max.
Self Checking:	Continuous, every 5 mSECs, independent of press cycle
Enclosure:	NEMA 12 (Industrial Plastic box) (see Fig. 3) w/ mounting flange, 10.2" L x 6.1" W x 4.0" D (259mm L x 154mm W x 102 mm D)
Mounting:	To any bulkhead, chassis, or control panel - vertical or horizontal. (see Fig. 4)
Environment:	Unaffected by normally encountered conditions (i.e., dirt, grease, humidity, vibration, etc.).
Weight:	4 lbs. (1.8 kg)



Indicators and Controls:

Alarm LED - Indicates an alarm condition. Stop relay is opened (de-energized). DM3000 must be reset.

Chain Break LED - Indicates broken chain or other motion failure.

Warning LED - Indicates that stopping time has exceeded the pre-set warning level.

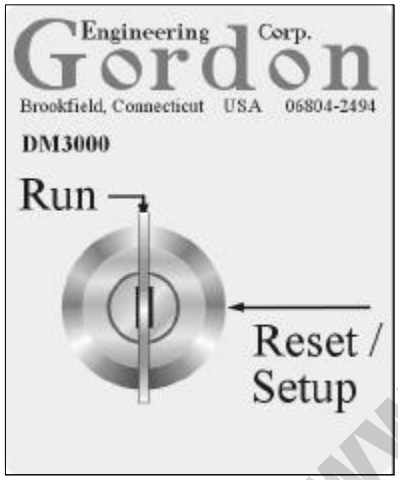
Self Check LED - When on continuously, indicates an internal failure within the DM3000 has occurred. Normally the LED will blink on briefly during each press cycle to indicate the beginning of stop time measurement.

Stop Time LED - Indicates that the stopping time is being shown on the display.

Reserve LED - Indicates that the reserve time (time remaining before a stop alarm will occur) is being shown on the 3 digit LED display.

3 digit LED display - Shows either the stopping time or reserve time.

Keypad - Three keys: KEY 1 (increment), KEY 2 (decrement), key 3 (set). During normal operation, pressing key 1 will display stop time and pressing key 2 will display reserve time. The keys are also used for entering the chain break delay, stop, and warning alarm times. Settings can only be changed by authorized personnel.



Keylock — On units equipped with a Keylock, a key is used to reset the unit from an alarm condition, or to put the unit into setup mode. The Keylock is located on the right side of the unit. Only authorized personnel should be in possesion of the key. Once the unit is reset or taken out of setup, and put back into Run mode, the key should be removed from the lock and held by authorized personnel.

Reset: Keylock — To reset a Keylock unit, insert the key, and turn the key to the Reset/Setup position. Note that the Stop Time and Reserve LEDs are alternately blinking. Turn the key back to the Run position. The unit will now reset and be able to run normally. Remove the key from the lock. ***Note: only authorized personnel should perform this operation***.

Setup: Keylock — To put the unit into setup, follow the instructions on page 19 for Autolearn Setup, page 20 for Manual Setup, or page 23 for Motor Off Inch Mode/Troubleshoot Mode.

Reset: No Keylock — If unit is not equipped with a Keylock, reset the unit by entering the following key sequence: 3 - 1 - 3 - 2 - 2.

Setup: No Keylock — To put the unit into setup, follow the instructions on page 19 for Autolearn Setup, page 20 for Manual Setup, or page 23 for Motor Off Inch Mode/Troubleshoot Mode.

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Chapter 2
Theory of Operation

A press's brake solenoid is a voltage activated switch that controls the brake/clutch system. When voltage is removed from the brake solenoid, the clutch is released, the brake applied, and the press begins slowing to a stop. At that instant, the DM3000 starts counting stopping time.

The motion detector, which is mechanically connected to a rotating part (usually the cam box shaft drive chain) of the press, supplies a voltage to the DM3000 for as long as the ram is in motion. When the ram stops, this voltage goes to zero and the DM3000 counter stops. The measured stop time is then displayed on the DM3000 3 digit LED display.

WARNING ALARM

If the stopping time of the press is greater than the pre-set warning alarm setting, the press is allowed to continue running, but a warning alarm is issued. The warning LED lights, and the warning relay is closed (energized). The warning relay can be made to activate a light, alarm, or other function. This indicates that the brake on the machine is starting to wear and that maintenance should be scheduled. At the start of the next press cycle, the warning alarm resets automatically.

STOP ALARM

If the stopping time of the press is greater than the pre-set stop alarm setting, the alarm LED lights and the stop alarm relay is opened (de-energized), stopping the press. This indicates that the brake has worn past a safe level, and that maintenance must be performed immediately. The DM3000 stop alarm relay remains open, preventing the press from operating further, and can only be reset by a setup person with the DM3000 access code.

CHAIN BREAK

In addition to measuring stopping time, the DM3000 monitors for a broken chain condition. The motion detector is mechanically connected to some rotating part on the press (usually connected to the cam box shaft), via a chain or belt. If this chain were to break, an unsafe condition would exist in that the DM3000 would never see a motion signal, and thus never count stopping time. If the press brake is released, and no motion occurs, the DM3000 issues a chain break alarm. The chain break LED lights, the alarm LED lights, and the stop relay is opened, causing the press to stop. The chain must be checked and repaired before resuming press operation (see Troubleshooting, Chapter 6).

CHAIN BREAK DELAY TIME

After the brake is released on a press, there will be a certain amount of delay before motion starts, due to clutch slippage. To allow for this (and so that a premature chain break alarm does not occur), the DM3000 has a selectable chain break delay time feature.

When the brake is released (voltage applied to brake solenoid), the DM3000 starts counting chain break delay time. The occurrence of motion ends the chain break counting period. If motion does not start before the end of the chain break delay time, the DM3000 issues a chain break alarm, lighting the chain break and alarm LEDS, and opening the stop relay. Note that a chain break alarm can be caused by either a broken chain or a clutch that has worn excessively.

The chain break delay time is adjusted by the user. See Chapter 4, Operating Instructions, for further details on adjustment.

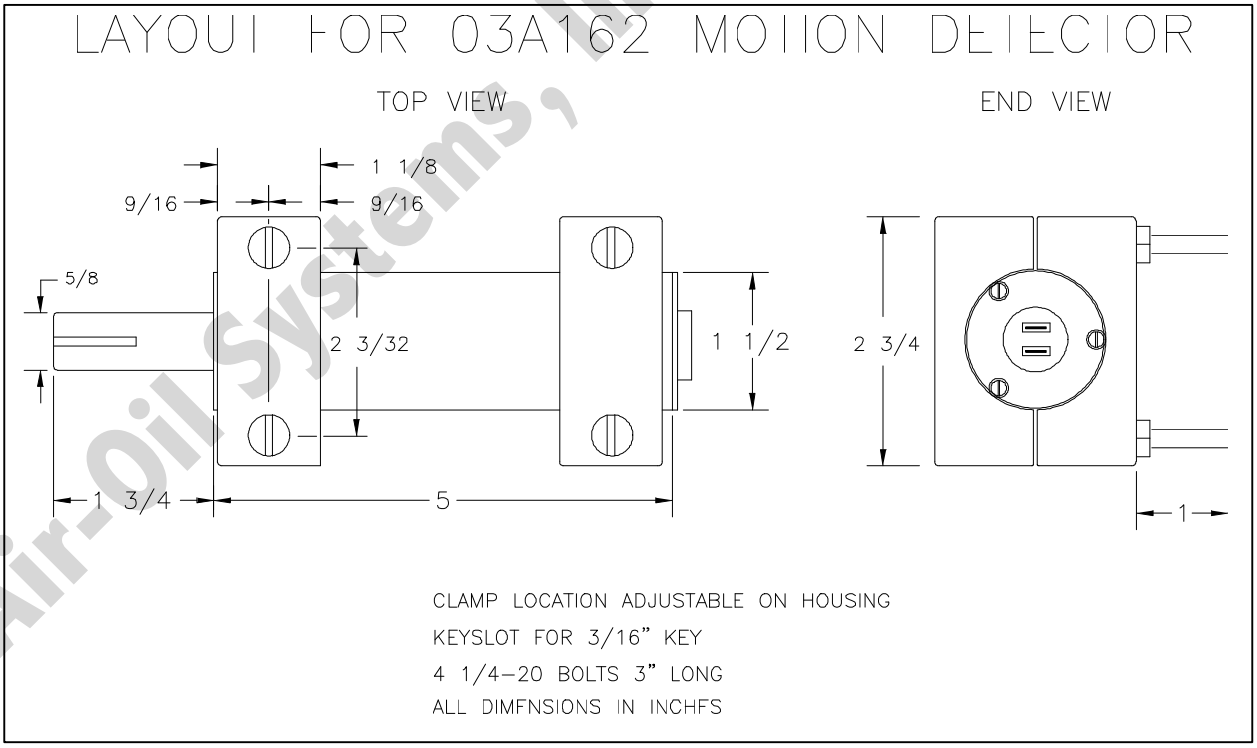
Chapter 3
Installation

NOTE: READ AND UNDERSTAND WARRANTY AND FAIL-SAFE OPERATION.

MOTION DETECTOR

The Motion Detector is a rotary device which provides an output as long as its shaft is rotating. It is usually mechanically coupled to the cam box shaft drive chain of the press, although it may be connected to any part that rotates while the ram is in motion, and stops when the ram stops.

NOTE: IF THE PRESS HAS A CAM BOX OR ROTARY LIMIT SWITCH, IT IS IMPERATIVE THAT THE MOTION DETECTOR BE INSTALLED SO THAT IT CAN MONITOR THE CAM DRIVE. CAM OR LIMIT SWITCH DRIVE FAILURE CAN RESULT IN THE ELECTRICAL PRESS CONTROL NOT BEING AWARE OF WHAT THE MECHANICAL PORTION OF THE PRESS IS DOING. THIS CAN RESULT IN SERIOUS INJURY TO THE OPERATOR.



1. Shaft size: The motion detector shaft is 5/8" diameter (15.88mm) with a 3/16" (4.76mm) keyway.

2. Speed Requirements: The motion detector will operate at any rotary speed of 6 RPM (1 revolution in 10 seconds) or higher. For lower speeds, it is necessary to translate the press speed to 6 RPM or more, by means of a gear box or proper sprocket or sheave ratios.

3. Chain Drives: If the press has a chain driven cam box, the motion detector should be connected to this linkage. Attach a sprocket with the same or fewer number of teeth as the driving sprocket (assuming 6 RPM or higher) to the motion detector. The motion detector can then be used as an idler to control chain tension. If mounting is convenient, it is sometimes possible to lengthen the drive chain and include the motion detector within the full loop.

4. Belt Drive: Belt drive is acceptable, provided there is not excessive slippage. It is not necessary to have accurate 1-to-1 coupling. It is merely necessary to provide reliable rotation in excess of 6 RPM as long as the press is in motion.

NOTE: When a belt or chain drive is used, the mounting bracket holding the motion detector MUST be tight and rigid. Vibration (from stopping of the press or from die contacts) must not cause the bracket to flex. The sprocket or pulley on the motion detector shaft, and the belt or chain all must be tight. A system installed with a loose motion drive arrangement will result in erratic motion signals arriving at the Brake Monitor and will cause timing errors.

5. Direct Drive: If the main shaft or cam box shaft is accessible, it may be possible to couple the motion detector directly to it by direct shaft, flexible coupling, gears or any other suitable means.

6. Back Gears: Connection to back gears is acceptable, provided rotation exceeds 6 RPM.

7. Electrical Connection: Electrical Connection is made to the terminals on the end of the motion detector with the cable supplied. Connection can be either way, and rotation can be in either direction. The other end of the motion detector cable is connected to the two terminals each marked "MD" (terminals 13 & 14) inside the control unit. If a longer cable is required, any two-conductor cable may be used. Voltage and current on this cable are less than .1 volts and 1 milliamp respectively (twisted pair or shielded cable is preferred). The cable is connected by the factory through the hole on the right of the control.

IMPORTANT: When routing the motion detector cable from the control to the press, mount the cable away from the other wires connected to the DM3000 control, and away from any other wires. This will minimize any electrical noise problems.

CONTROL UNIT

The control unit is housed in a 10x6x4 NEMA 12 Polymeric box. It may be mounted at any convenient location, preferably where the lights can be viewed by the operator.

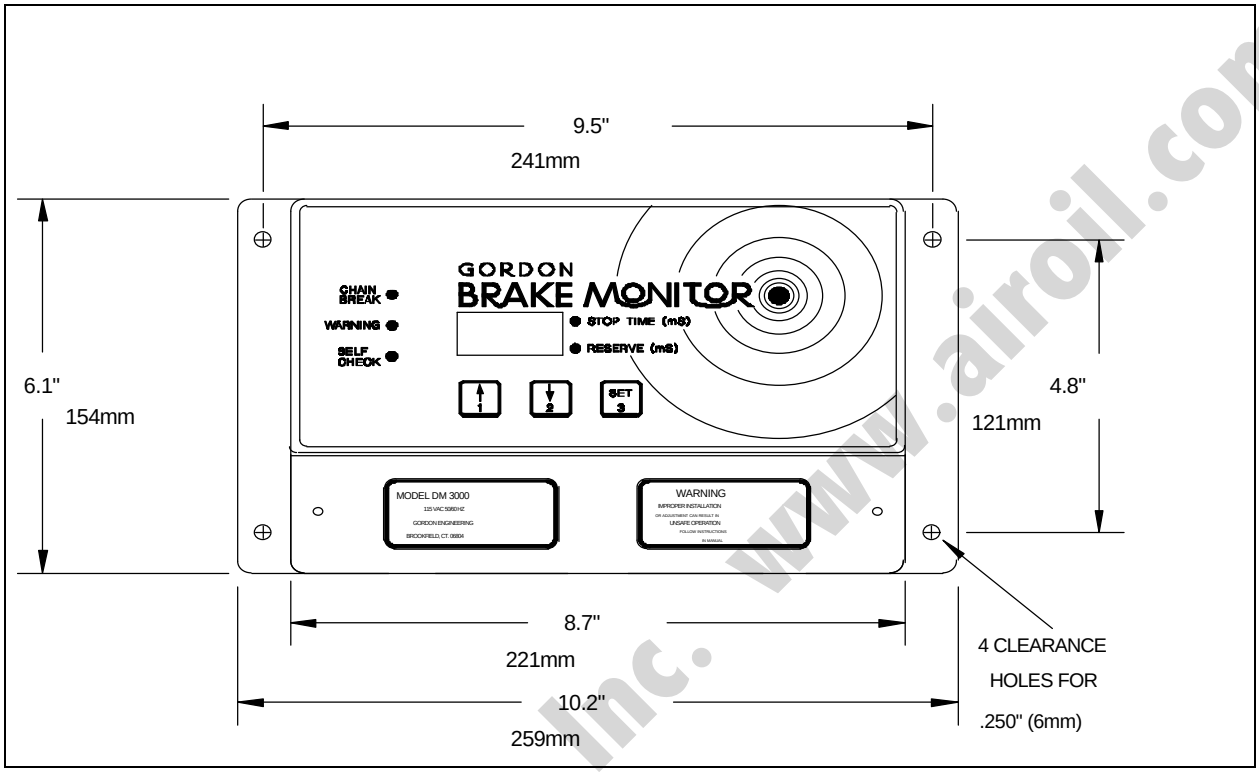
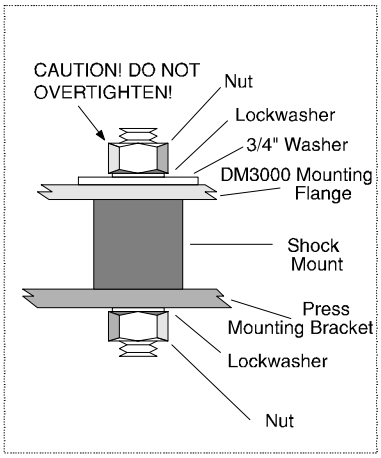
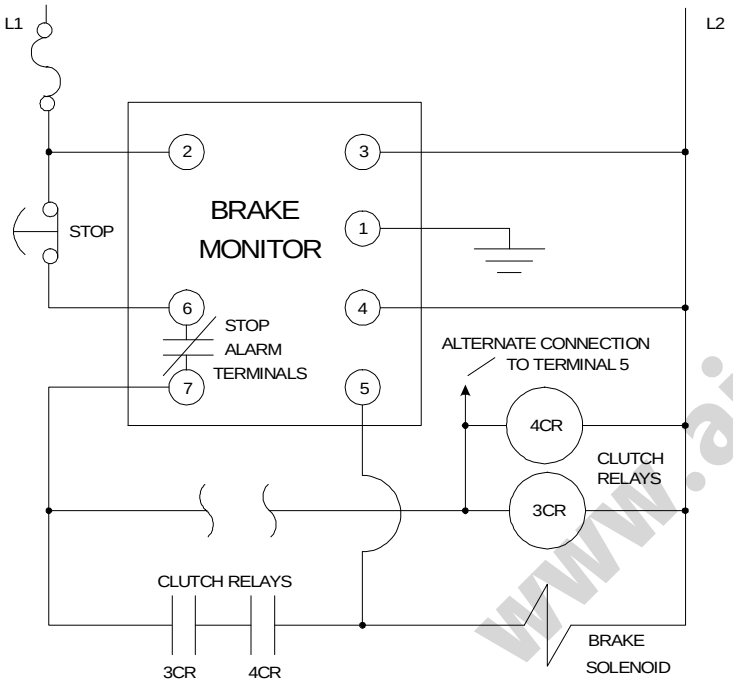


Figure 1. Control Mounting Dimensions



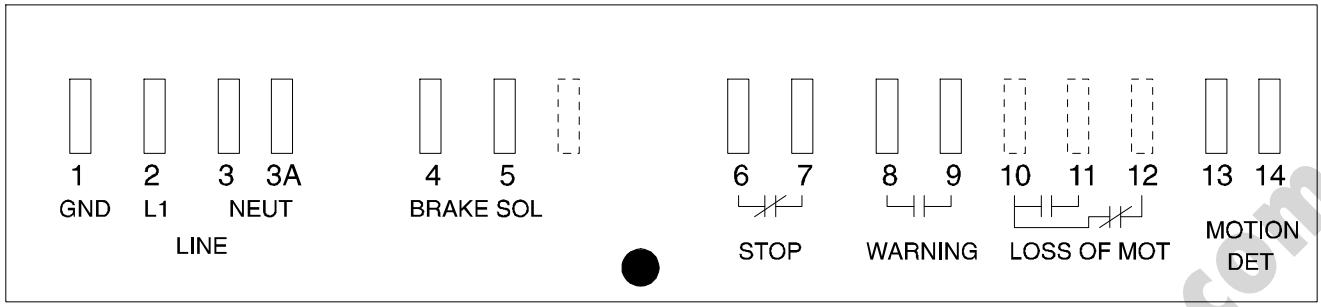
1. Mechanical Mounting: Use the shock mount kit that is included with each DM3000 unit (see Figure 4A). This kit contains a wide fender washer that will prevent the plastic flange on the DM3000 unit enclosure from cracking. Do not overtighten the hardware on the flange side , this may cause the flange to crack.

2. Electrical Wiring: Power and control wires are connected through the two 7/8" (22.2mm) holes provided. Remove the plastic hole plug and fasten an electrical connector suitable for the type of wiring to be used. The hole is for 1/2" (12.7mm) electrical fittings. To maintain Type 12 integrity, use a UL approved Type 12, 12K, 13 or equivalent fitting. Due to electrical noise considerations, it is important that the power and brake solenoid wires enter the DM3000 through the hole on the left side. The stop relay, warning relay and Loss of Motion (if used) wires should enter through the center hole. The Motion Detector is pre-wired through the right side hole. When these wires are routed away from the DM3000 control, they should not be bundled together. The Motion Detector should be physically routed away from all other wires.



All wiring to the DM3000 (except the low voltage Motion Detector wires) must be 14 AWG stranded with insulation conforming to local electrical codes. Female disconnects crimped on the wires must be a UL approved .250" x .032" insulated or fully insulated type with an insulation gripping sleeve (ferrule). To achieve a proper crimp, the tool and the tool nest (die) used must be of a type specified by the disconnect manufacturer. Use of an improper disconnect or tool may result in a crimp failure, creating a safety or fire hazard. The disconnects supplied with the DM3000 are Hollingsworth #XS09723SN. The proper tool is Hollingsworth #H43. Thomas & Betts has alternates in the 250 series. Part #RB14-250F, 14RB-250F or 14RB-2577. The same tools can be used for all three (#WT145C or ERG2001).

Installation: Wiring & Terminals:
1) Strip the insulation carefully to avoid nicking or cutting the strands. With the proper strip length, the conductor should be fully inserted into the connector barrel with the conductor end visible in the inspection hole.
2) Train the wires to eliminate fanning of strands.
3) Insert disconnect in proper die nest and position it properly (in accordance with the tool instructions).
4) Crimp slightly to hold the disconnect, but do not deform it.
5) Insert wire and crimp.
6) If in doubt of crimp quality, try to pull the disconnect off the wire. ***A good crimp will not fail.***



3. Power: 115 volts AC, 50/60 Hz. Since only 6 VA is consumed, wire size may be whatever minimum is permitted by local codes. Normally #14 AWG will meet all known requirements, provided it is supplied from a 15 amp fuse or breaker.

(a) Connect power to terminals 2 (L1) and 3 (L2) marked "LINE" inside box.

(b) Connect a ground wire from terminal 1, marked "GND" to the press control common ground.

The Brake Monitor may be left on continuously, or turned on only during hours of use. No warm-up is required. Life or reliability will not be affected by continuous running. Connection for power may be made at any point inside the main disconnect for the machine.

4. Brake Solenoid: Terminals 4 and 5 are input terminals, sensing the presence or absence of voltage across the press brake solenoid. These terminals must be wired in parallel with the brake solenoid or a "run relay " coil. Route wires with the power wires through the left hole of the control. See note on routing on page 14.

Note: If one side of the brake solenoid is already directly connected to L2, (see Fig. 5) a jumper can be connected to terminals 3A and 4. With the jumper connected, a separate wire does not have to be run to terminal 4; simply connect other side of brake solenoid to terminal 5.

5. Stop Alarm: Terminals 6 & 7 are the normally closed set of contacts of the stop relay. These terminals must be wired in series with the emergency stop switch. Route wires through the center hole of the control. See note on routing on page 14.

CAUTION: BE SURE CONNECTIONS ARE CORRECT BEFORE APPLYING POWER, OR DAMAGE TO STOP RELAY CAN OCCUR.

CAUTION: THE RELAY CONTACTS HAVE A 2.5 AMP MAXIMUM RATING WHICH MUST NOT BE EXCEEDED.

6. Warning Alarm: For special applications, the warning relay contacts, normally open, are brought out to terminals 8 & 9. These may be used to turn on external lamps or audible alarms to alert the operator of the degradation of the clutch/brake system. Route wires through the center hole of the control. See note on routing on page 14. Warning contacts are rated at 8A for 115/230 VAC.

7. Loss of Motion: Loss of Motion does not need to be connected in the vast majority of cases, only on press controls that require it, such as older Allen Bradley press controls. See page 34 for connection details.

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Chapter 4
Operating Instructions

ALARM TIME LEVEL SETTINGS:

In order to select the stop alarm time, warning alarm time, and chain break delay times, the user must enter the time settings via the DM3000 keypad. The user has two choices for time selection: manual entry or auto learn. In manual entry, the user already has a good idea of the proper times to select, and simply enters these into the keypad. In auto learn mode, the press is cycled 10 times, after which the DM3000 automatically calculates the proper time settings. These times can later be adjusted by the user, if need be.

NOTE: BEFORE CHANGING ANY SETTINGS ON THE DM3000 MAKE SURE THAT THE BRAKE AND CLUTCH ON THE PRESS ARE IN GOOD CONDITION AND ARE OPERATING PROPERLY.

PRESS SETUP:

Before selecting the time settings in the DM3000:

1. Place the heaviest die on the press.

2. On variable speed presses, select the fastest speed.

3. Check the press counterbalance to make sure that the stopping time on the upstroke is the same as on the downstroke.

NORMAL POWER-UP SEQUENCE FOR THE DM3000

1. Power is applied.
2. The alarm and safety relays are open (de-energized).
3. The Alarm LED is lit.
4. The Self Check LED is lit.
5. After a few seconds, the Self Check LED will go out, followed by the Alarm LED.
6. The Stop Time LED comes on.
7. The stop and safety relays will both close (energize), allowing the press to operate.

(NOTE: If the DM3000 does not power-up according to the above sequence, see Trouble Shooting section.)

Note: Before entering settings into the DM3000, an easy way to check for proper installation is described on page 23, Motor Off Inch Mode. In this mode the brake monitor will not alarm and will indicate, using the LEDs, brake and motion operation.

CHAIN BREAK DELAY TIME

The DM3000 monitors clutch performance. At the start of a machine cycle, voltage is applied to the brake solenoid. This engages the clutch and releases the brake, allowing the press to operate. All clutches exhibit a certain amount of slippage. As a clutch wears, there will be a longer delay from when the clutch is released to when ram motion starts.

When voltage is first applied to the brake solenoid the DM3000 starts counting chain break delay time. The start of motion ends the chain break counting period. If the press takes longer to begin motion than the preset chain break delay time, the chain break LED will light and the stop alarm relay will be de-energized, preventing further operation of the press.

A selectable time delay is provided to cover most press speeds. The proper delay setting must be selected for each press, so the chain break detector will not react to normal press start time delays caused by clutch slippage.

The delay time should be set for approximately 1/2 of the time per stroke.

Here are some suggested delay times:

Strokes per minute	Time per stroke	Chain break delay
200	0.3 sec	0.15 sec
100	0.6 sec	0.3 sec
25	2.5 sec	1.25 sec

STOP ALARM TIME

The stop alarm time should be set 30% higher than the maximum stopping time of the press.Example: The maximum stopping time is .200 secs. Set the stop alarm for .260 secs. (.200 secs. + 30%).

WARNING ALARM TIME

The warning alarm time should be set 15% higher than the maximum stopping time of the press. Example: The maximum stopping time is .200 secs. Set the warning alarm for .230 secs. (.200 secs. + 15%).

AUTO LEARN OPERATION

In auto-learn mode, the DM3000 allows the press to run for 10 cycles and then automatically calculates the proper chain break delay time, stop time, and warning time. Once these times are calculated, the user can accept them or change them manually.

1. Power up the DM3000 unit.

2. On Keylock units, insert key into lock and turn key to Reset/Setup position. (On units without Keylock, enter the sequence: 3 - 2 - 1 - 2 - 3 on the keypad.)

3. The STOP TIME and the RESERVE TIME LEDs will alternately blink if the unit has been successfully put into Setup. The alarm LED will light, and the stop alarm relay will de-energize (open), stopping the press. (On non-Keylock units, if the LEDs do not blink, the password entry was incorrect. Wait 10 seconds, then try entering passcode again: (3-2-1-2-3).

4. Press KEY 1 (this selects the auto-learn mode).

5. The DM3000 will now energize (close) the stop alarm relay, allowing the press to operate.

6. After the press operates for 10 cycles, the DM3000 will de-energize (open) the stop alarm relay, stopping the press. The DM3000 will calculate the chain break delay time, stop alarm time, and warning alarm time.

7. The calculated chain break delay time will appear on the display. It will be blinking, indicating that this was an auto-learned time. The chain break LED will also blink.

8. If you want to change this setting, press either the increment (KEY 1) or decrement (KEY 2) keys. (Holding the keys down for more than a second speeds up the displayed count.)

9. If this time is acceptable, press the SET key (KEY 3). (Remember that it is easy to change ANY of the settings at any time, so don't worry if you are not sure that this is the best setting.)

10. Now that you have selected a chain break delay time, the DM3000 displays the auto-learned stop alarm time. The display is blinking with the auto-learned stop alarm time, and the stop time LED is blinking.

11. As above, if you want to change the stop alarm time, press either the increment or decrement keys.

12. To accept the stop alarm time setting, press the SET key (KEY 3).

13. Now that the stop alarm time has been accepted, the DM3000 displays the auto-learned warning alarm time. Again, the display is blinking with the auto-learned warning time, and now the warning LED is blinking.

14. As above, if you want to change the warning alarm time, press either the increment or decrement keys. (Note that you cannot make the warning alarm time greater than the stop alarm time.)

15. To accept the warning alarm setting, press the SET key (KEY 3).

16. Once the warning alarm time has been accepted, the Stop Time and Reserve LEDs will alternately blink. Turn the key back to the Run position. The new chain break delay, stop alarm, and warning alarm times will now take effect. (On non-Keylock units, the unit will automatically reset after hitting the SET key in step 15.)

MANUAL SETUP

In manual setup, the chain break delay time, stop alarm time, and warning alarm time are all manually set by the user.

1. If you are not sure of what the settings should be: run the press at least 10 times (10 cycles), stopping the ram at 908 . Observe the DM3000 display for these 10 cycles. On a piece of scratch paper record the longest stopping time. This is the maximum stopping time. Also note (by observance) the approximate time per stroke of the press, and jot this down.

2. To enter setup, insert the key into the Keylock and turn to the Reset/Setup position (on non-Keylock units, enter: 3 - 2 - 1 - 2 - 3 on the keypad).

3. The STOP TIME and the RESERVE LEDs will blink alternately, indicating that the DM3000 is in setup mode. (On non-Keylock units, if the LEDs are not blinking, the passcode was entered incorrectly. Wait 10 seconds and try again.) The DM3000 de-energizes (opens) the stop relay, stopping the press.

4. Press the decrement key (KEY 2) to enter manual setup.

5. The chain break LED will blink and the display will show the previous chain break delay time. The chain break delay time should be set to approximately 1/2 of the time per stroke. See page 18 for detailed description of delay time selection.

6. If you want to change the chain break delay time, press either the increment (KEY 1) or decrement (KEY 2) key. (Holding down the keys for more than 1 second causes the displayed number to change rapidly.)

7. When you are satisfied with the setting, press the SET key (KEY 3) to accept it.

8. Once the chain break delay time has been accepted, the stop time LED will blink, and the display will show the previous stop alarm time setting.

9. If you want to change the stop alarm time, press the increment or decrement keys. The stop alarm time should be set at approximately 30% higher than the longest stopping time.

10. When you are satisfied with the stop alarm time, press the SET key (KEY 3) to accept it.

11. Once the stop alarm time has been accepted, the warning LED will start blinking and the display will show the previous warning alarm time.

12. If you want to change the warning alarm time, press either the increment or decrement keys. The warning alarm time should be set at approximately 15% higher than the longest stopping time. Note that the warning alarm time cannot be made greater than the stop alarm time.

13. When you are satisfied with the warning alarm time, press the SET key (key 3) to accept it.

14. The Stop Time and Reserve LEDs will now blink alternately. Turn the key in the Keylock to the Run position. (Note: On non-Keylock units, the unit will automatically reset after hitting the SET key in step 13.)

EXAMPLE: The press operates at 50 strokes per minute, or 1.2 secs per stroke. The longest stopping time is .200 seconds. Set the chain break delay time at 1/2 the time per stroke, or 600 millisecs (1.2 x .5). Set the stop alarm time at .260 (.200 + 30%). Set the warning time at .230 (.200 + 15%).

In operation, assuming the settings are as in the example above, if .230 is exceeded, the warning LED will light. The press will still operate, and the warning alarm will automatically reset each time the press is cycled. Maintenance should be scheduled as soon as the warning LED starts to indicate, to prevent further deterioration of a dangerous condition.

If .260 is exceeded, the alarm LED will light, the stop relay will de-energize, and the press cannot be recycled until the access code is entered by an authorized user. Cycle the press again to confirm stopping time. Do not continue to operate the press if actual stopping time exceeds safe stopping time previously determined.

POINT OF OPERATION GUARDS & TWO HAND TRIP CONTROLS

SYSTEM REACTION TIMES:

All point of operation guards take time to react to an intrusion and open the emergency stop circuits. The Brake Monitor receives its stop command (start counting) signal from removal of voltage from the press brake solenoid, which occurs when the emergency stop circuit (of the press) is opened.

When using the Brake Monitor to establish safety distances for point of operation guards or two-hand trip controls, it becomes important to determine these reaction times and add them to the observed Brake Monitor stop time. Typical reaction times are:

A. Gordon Proxagard PC1000: 15 mSECs (.015 seconds)
B. Light Curtain: 20 to 40 mSECs (.020 to .040 secs) depending on manufacturer.
C. Other Point of Operation Guards: Consult Manufacturer.

SAFETY DISTANCE FORMULA:

The safety distance is the minimum distance for locating two hand trip controls or presence sensing devices from the nearest pinch point.

OSHA has set forth a formula for determining the safety distance for any machine using either two hand trip controls or presence sensing devices.

OSHA has determined that the maximum speed that a person can move his hand into the point of operation of a machine is 63" (1600 mm) per second. This results in the formula below:
(Use this formula or refer to the Safety Distance Table in Appendix C.)

D" = 63T or (Dmm = 1600T)
Where: D = distance in inches or millimeters between the nearest pinch point and either two hand trip controls or presence sensing device.
T = time in seconds of DM3000 stop alarm setting (maximum press stop time + 30 %) + system reaction time.

Example: If press maximum stop time is .184 secs, DM3000 stop alarm time = .239 secs (.184 + 30% = .239). If the presence sensing device is a Gordon PC1000, add 15 mSecs reaction time: 239 + .015 = .254 secs. Using the above formula (or consulting the chart in Appendix C): 63 x .254 = 16" . Thus the presence sensor must be at least 16" from the nearest pinch point.

Conversely, if the two hand trip or presence sensor is 18" (457 mm) from the nearest pinch point, the maximum safe stopping time (plus system reaction time) is .286 seconds. See chart, Appendix C, page 35, for convenient determination of safe stopping time, or distance.

If presence sensor or trip control is already installed, measure the distance from the nearest

pinch point (with the largest die) to the two hand trip control or presence sensing device on the machine in question. Determine the maximum safe stopping time from the chart in Appendix C or from the above formula. The Stop Alarm setting on the Brake Monitor (plus system reaction time) must not be set higher than this time.

STOPPING TIME TOO LONG

The following steps should be taken if the stop alarm setting exceeds the maximum safe stopping time:

1. Be sure the brake and clutch are in good condition and properly adjusted so that the press is stopping as fast as its normal capability would allow.

2. If the DM3000 stop alarm setting is only a small amount higher than allowed its setting can be arbitrarily reduced. Too much reduction, however, could result in frequent alarms and create a nuisance.

3. Move the two hand trip controls or presence sensing device further away from the point of operation until the corresponding safe stopping time equals or exceeds the stop alarm setting.

VARIABLE SPEED MACHINES

A variable speed press should be set up at the maximum speed used since this will provide the maximum stopping time. As long as the stop alarm setting is less than the maximum safe stopping time, the press can be operated safely at any speed. If the stopping time is too long, refer to previous paragraph.

MOTOR OFF INCH MODE / TROUBLESHOOT MODE

When a new die is being set up on a press, the setup person will usually put the press into "motor off inch", "coasting inch", or "bar" mode. In order to check for proper mating, the setup person will "inch" the ram down to the die, by pressing and releasing the palm button. As the ram travels towards the die, the press flywheel will continue to run out of inertia. The palm button will have to be held down longer to get the ram to move, and the ram will move more slowly. At some point, the palm button will have to be held down for longer than the chain break delay time, and a chain break alarm will occur. (Or, motion will occur within the chain break delay time, but the ram will be moving so slowly that the DM3000 will not respond to the motion - the motion detector must revolve at greater than 6 RPM to respond to motion.)

To compensate for this "motor off inch" setup situation, the DM3000 can be put into motor off inch mode. In this mode, the DM3000 will not alarm when the chain break delay time is exceeded without motion occurring. Thus, the ram can be inched down to the die without a false "nuisance" alarm occurring. Once the DM3000 is placed into motor off inch mode, the DM3000 stays in this mode for 5 minutes. After 5 minutes the unit resets back to normal operation. (The unit can also be taken out of inch mode by simply pressing the SET key.)

Note that during inch mode operation the DM3000 display will be blank.

To place the DM3000 into motor off inch mode:

1. Insert the key into the Keylock and turn it to the Reset/Setup position. (On non-Keylock units, enter the passcode on the keypad: 3 - 2 - 1 - 2 - 3.

2. If the unit is in Setup Mode, the Stop Time and Reserve LEDs will alternately blink. The alarm LED will light, and the stop alarm relay will de-energize (open), stopping the press. (On non-Keylock units, if the LEDs do not blink, the password entry was incorrect. Wait 10 seconds, then try entering the passcode again: 3 - 2 - 1 - 2 - 3.)

3. Press KEY 3 (this selects motor off inch mode).

4. The Stop Time and Reserve LEDs will blink at the same time, indicating that the DM3000 is in motor off inch mode. The stop alarm relay will energize (close), allowing the press to operate. The DM3000 will stay in inch mode for 5 minutes and then go back to basic Setup Mode - turn the key back to the Run position to run the press. (On non-Keylock units, the unit will simply return to normal run mode automatically after 5 minutes. To manually return to normal run mode at any time, simply press Key 3 on the keypad.)

5. As an aid to troubleshooting a DM3000 installation, while in setup the Chain Break and Warning LEDs have different functions. The Chain Break LED indicates press brake operation. When the brake is on, the Chain LED will be lit. The Warning LED will indicate motion, being lit whenever motion occurs.

OPERATIONAL TEST

After installation and set-up of the Brake Monitor, a quick operational test should be performed as follows:

1. Set proper warning, stop, and chain break delay times (by setting manually or using auto learn - see Chap. 4)

2. Temporarily reduce warning setting below actual press stopping time and then cycle press. The warning light on the panel should light as the press stops. It should reset automatically at the start of the next cycle.

3. Temporarily reduce stop setting below actual press stopping time and cycle press. The alarm light must come on as the press stops. Make sure that the press cannot be restarted until Reset by an authorized user. Reset by inserting the key into the Keylock - turn to the Reset/Setup position, then back to the Run position. (On non-Keylock units enter the reset code on the keypad: 3 - 1 - 3 - 2 - 2.

4. Temporarily remove a motion detector wire from terminal 13 or 14 (simulating a cut motion detector wire) The display will blink with failcode 4. The chain break, self check, and alarm LEDs will light. Observe that the press cannot be restarted. Reset the DM3000 - insert key into Keylock and turn to Reset/Setup position, then turn back to Run position (on non-Keylock units, enter the reset code: 3 - 1 - 3 - 2 - 2.) The LEDs should all go out, the stop relay will close, and the press is allowed to be restarted.

5. Temporarily short together (NOT TO GROUND) terminals 13 and 14 (motion input) and then cycle the press. The display will blink with failcode 3. The chain break LED will light, and the press must shut off before one stoke is completed. If not, recheck the setting. Observe that the press cannot be restarted until the unit is reset - insert key into Keylock and turn to Reset/Setup position, then turn back to Run position (on non-Keylock units, enter the reset code: 3 - 1 - 3 - 2 - 2.)

6. Cycle the press. After the chain break delay period, short terminals 13 & 14 together. During the stroke, the press must immediately stop. The DM3000 display will blink with failcode 5. Remove the short from terminals 13 & 14 and reset the DM3000 - insert key into Keylock and turn to Reset/Setup position, then turn back to Run position (on non-Keylock units, enter the reset code: 3 - 1 - 3 - 2 - 2.)

7. Operate the press in "inch" mode, stopping the ram in both the down and up stroke. Make sure that the stopping times are consistent, and that no false alarms occur. Note that as the inch button is pushed again, before the ram has completely stopped, the display will halt with an apparently low stopping time. This is a normal occurrence. For accurate stop time measurements, always allow the ram to come to a complete stop before reactivating.

9. Operate the press in "continuous" mode (if the press has one). Observe that the Brake Monitor operates only when the press "Stop" button is pushed.

10. Operate the press in any other set-up mode that is used ("Bar", "Motor Off", "Coasting Inch", etc.). In these modes, the press motor is turned off, but momentum is still left in the flywheel for some amount of time. Note that at some point, as the flywheel slows, the ram will move so slowly that the motion detector will spin below the 6 rpm threshold. At this point, the unit may alarm (probably with a failcode 3). To avoid having the unit alarm, place the unit into Motor Off Inch Mode (see page 23) while in these type of set-up modes.

11. If the Brake Monitor does not operate as indicated above, DO NOT PLACE IT IN OPERATION. Re-check the installation, wiring and set-up. If no fault is found, call the factory immediately.

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Chapter 5
Troubleshooting

1. Be sure that the voltage applied to the LINE terminals L1 & L2 is always between 100 and 130 volts during press operation. Make sure that terminal 1 (GND) is connected to a solid electrical ground.

2. See that between 100 and 130 volts AC appears across the BRAKE SOL (brake solenoid) terminals when press is running and that this voltage goes to zero when the press is stopped.

3. Check to see that both ends of the motion detector cable are properly attached and that neither cable conductor is open.

4. Check to see that both ends of the brake solenoid cable are properly attached and that neither cable conductor is open.

5. If the Self Check LED is on, reset the Brake Monitor by turning power off then on again. If the Self Check LED comes on a second time, the Brake Monitor has failed its own internal test and should be returned to the factory for service (please call factory first).

6. If the Self Check LED occasionally comes on at the beginning of the stroke but no count results on the display, electrical noise may be present at the brake solenoid terminals. Electrical noise is random voltage pulses or bursts varying in length depending on the cause. See ELECTRICAL NOISE section on page 28.

7. If the DM3000 display is displaying a number and blinking, see Failcode section on page 28.

8. An excellent diagnostic aid is available by putting the DM3000 into Troubleshoot Mode. Read: “Motor Off Inch Mode / Troubleshoot Mode.” on page 23. In Troubleshoot Mode, the DM3000 Chain Break LED displays press brake signals (LED on when brake is on) and the Warning LED displays press motion signals (LED on when motion detector is turning). After putting the DM3000 into Troubleshoot mode, cycle the press while watching the LEDs. This may help pinpoint the cause of a problem.

   NOTE: After checking out system, the DM3000 may need to be reset: insert key into Keylock and turn to Reset/Setup position, then turn back to Run position (on non-Keylock units, enter the reset code: 3 - 1 - 3 - 2 - 2.)

FAILCODES

A single blinking digit on the DM3000 display indicates that a failure has occurred. Look up the blinking digit (failcode) in the list below and follow the corresponding instructions. After following instructions under a failcode, the DM3000 may be reset by: insert key into Keylock and turn to Reset/Setup position, then turn back to Run position (on non-Keylock units, enter the reset code: 3 - 1 - 3 - 2 - 2.) Failcodes can only be cleared by reseting unit.

FAILCODE #

(1) The stop relay in the DM3000 control has failed, and the DM3000's safety relay had to take over. Reset the unit (see section on resetting) and operate as before. If the stop relay fails again, the unit must be sent back to the factory for repair.

(2) The DM3000 self check monitor has found a fault with the DM3000 internal circuitry. Reset the unit. If self check failure occurs again, the unit must be sent back to the factory for repair.

(3) Chain break delay failure. The brake was released, and no motion occurred within the chain break delay period. Check the following:

(a) Check out clutch operation on press - clutch may be worn, or oil soaked, causing excessive slippage.
(b) Broken cam drive chain.
(c) Chain has jumped a sprocket.
(d) Make sure that chain connecting press to motion detector is not broken.
(e) Make sure that motion detector is in working order.
(f) If all above steps check out, chain break delay time may need to be adjusted. See MANUAL SETUP on page 20.

(4) While brake was on, motion signal occurred.
(a) Motion detector cable open. Check all connections.
(b) If motion detector connected to drive chain, make sure chain is tight and that there is no play or sloppiness when motion starts and stops.
(c) This symptom could possibly be caused by electrical noise. See section on electrical noise pertaining to motion detector.

(5) The brake was released and motion started within the chain break delay period. Some time after this, the motion signal was lost. Check the following:

(a) - Broken cam drive chain
(b) - Chain has jumped a sprocket
(c) - Shorted motion detector cable
(d) - Defective motion detector
(e) - Electrical noise may cause this symptom. See page 29.

(7) Stop Time Alarm Setting Exceeded. The press ran past the DM3000 Stop Time Alarm setting, and continued to free run. Before counting stopped, power was removed from the DM3000. Resetting the unit will clear this fault.

(8) EEPROM failure. Note the serial number of the unit and call the factory.

(11) EEPROM failure. Note the serial number of the unit and call the factory.

(12) EEPROM failure. Note the serial number of the unit and call the factory.

(13, 14, 15) Self check failure, usually due to electrical noise. Unit can be reset by turning power off, then back on. If symptom persists, note serial number of unit and call the factory.

(17) Self Check failure. Note the serial number of the unit and call the factory.

(Numbers greater than 19): Stop Time Alarm Setting Exceeded. The stopping time of the press exceeded the Stop Time Alarm setting, causing the unit to alarm. If the DM3000 was turned off without being reset, the display will blink with the previous stop time upon power-up. Resetting the unit will clear this fault. Read "Stopping Time Too Long" on page 23 and either adjust the press brake & clutch, or increase Stop Time Alarm setting (see "Manual Setup" – page 20).

ELECTRICAL NOISE

Noise bursts are created by relay contacts that do not make or break cleanly. All relay contacts take some amount of time to settle down (stop bouncing). For example, a new Allen Bradley contactor takes about 7 mSECs (.007 seconds) to settle. An old contactor with worn, dirty contacts could take 15 mSECs (.015 seconds) . The DM3000 has 15 mSECs (.015 seconds) delay built into the timing start input. If the run relay contacts are taking longer than 15 mSECs to settle, electrical noise may be generated. False chain break alarms, or short "doubled" counts on a single stroke may result.

CORRECTIVE ACTION:

1. Verify that the press control circuit voltage is above 100 volts. Low voltage will cause sluggish contactor operation.
2. Check the condition of the run relay contacts. Replace contacts or contactor as necessary.
3. Routing of the wires connected to the DM3000 control unit is very important to minimize electrical noise interference. In particular, the brake solenoid wires and the motion detector cable must be physically separated from each other. See page 15 for electrical wiring and routing instructions.
4. Connect the DM3000 terminal 5 to the alternate location shown in Figure 5.: This places the timing start input in a different circuit that may be "cleaner".

CAUTION: SOME PRESSES DO NOT USE THE RUN RELAYS IN "INCH" MODE. IF YOURS DOES NOT, DO NOT WIRE TERMINAL 5 TO THE RUN RELAY COIL.

4. If step 4 above does not correct the problem, or if the press does not use run relays in inch mode, a slave relay must be installed in the press control in accordance with Figure 7 below.

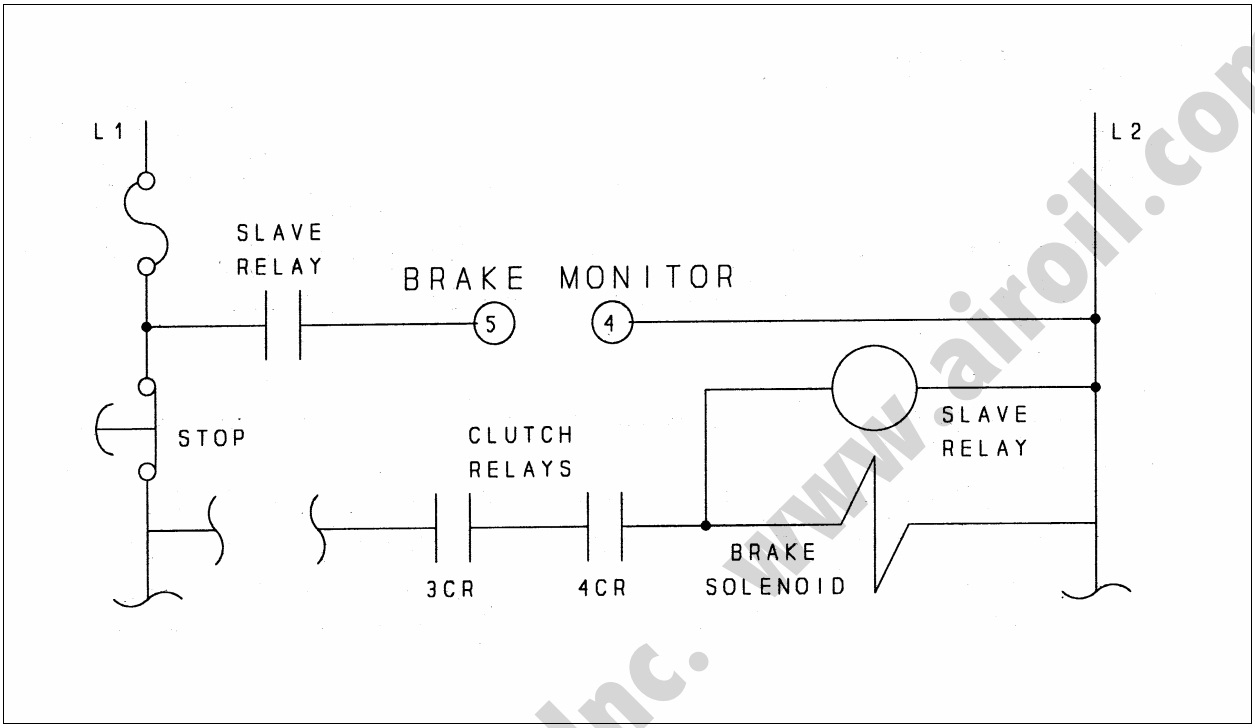


Figure 7. Slave Relay Wiring

6. Noise pulses can be caused by intermittent wire connections (including crimped terminals) in the press control or Brake Monitor. They are usually vibration-sensitive and can cause a variety of symptoms. Check all wire connections.

7. Voltage Transients or Surges

   The DM3000 Brake Monitor has suppression and protection circuits built in. However, occasionally an inductive spike may be present that exceeds this built in suppression and affects operation. The typical symptom would be an occasional stop time reading (at top stop) of .001 to .005 seconds.

a. Inductive (Back EMF) Spike: The spike can be as high as 2000 volts peak to peak and is caused by quickly breaking the voltage to a relay coil or solenoid with another relay contact. The amplitude of the spike will depend (among other things) on the timing between the opening relay contact and the 60 Hz. sine wave; i.e., if the sine wave is going through zero, no spike will be produced. If the sine wave is at either 908 or 2708 , a maximum amplitude spike will be produced. This spike can cause excessive arcing across relay contacts, can upset or destroy solid state electronic components and, in severe cases, can actually puncture wire insulation.

Corrective Action:

Place an arc suppression (snubber circuit) across the relay coil or solenoid that is causing the spike:

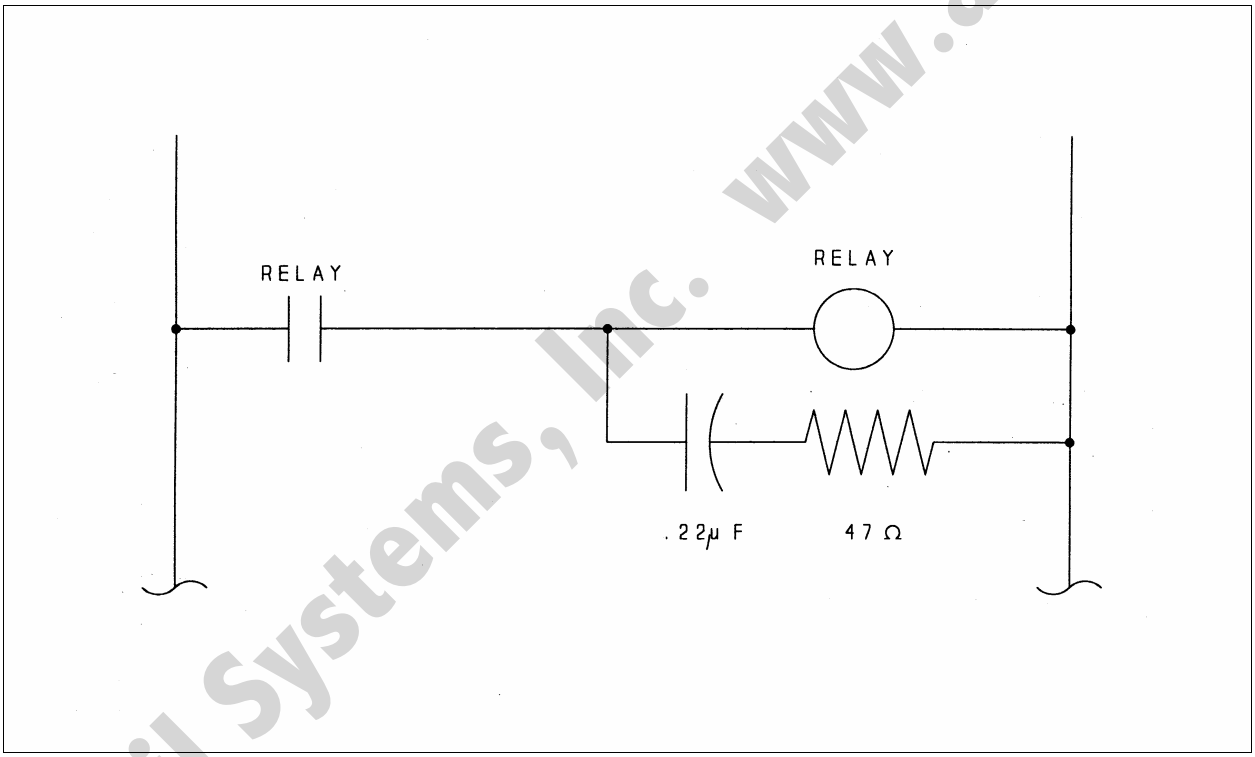
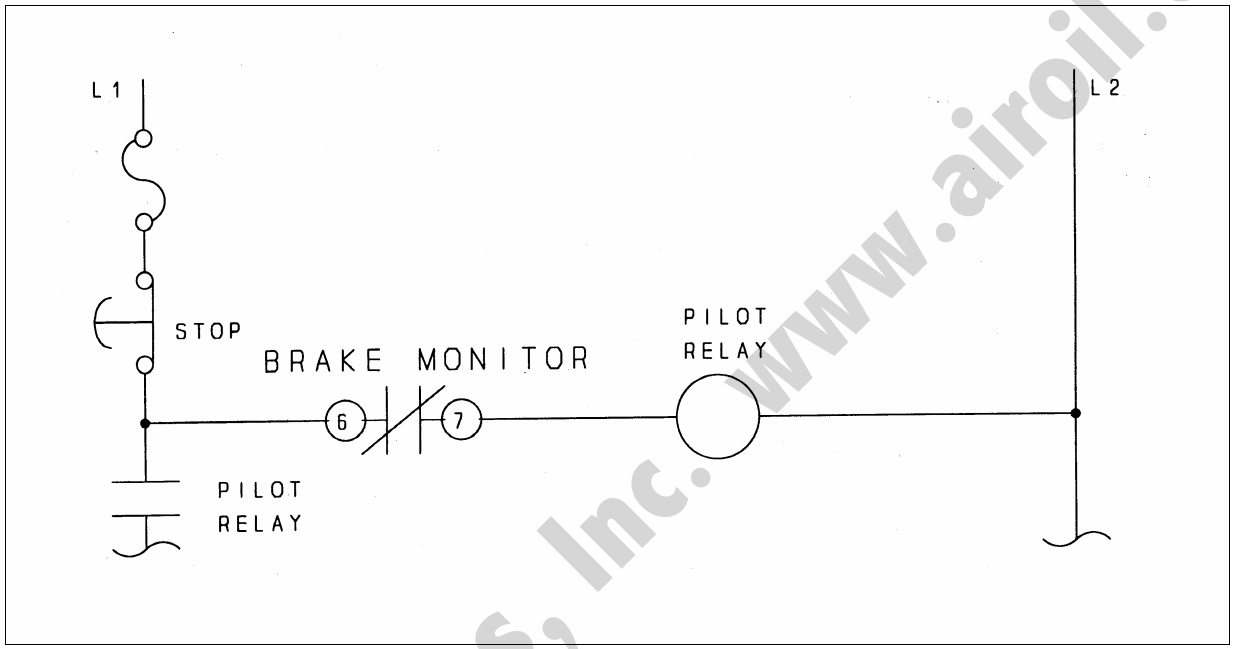


Figure 8. Snubber Circuit

A snubber circuit consists of a 47 ohm, 1 watt resistor in series with a .22 microfarad nopolarized capacitor. The capacitor voltage rating should be at least 200 volts .

Stop Circuit Terminals 6 & 7

Terminals 6 & 7 are normally wired in series with the emergency stop button. The DM3000 terminals 6 & 7 are connected to the relay socket by printed circuit track that is designed to blow open like a fuse in case of an overload. This protects the relay contact. Occasionally on some presses, a power surge can blow open the PC track. A repeated occurrence indicates a need for installation of a pilot relay with normally open contacts (5 amp min).



Appendix A
Simple Check Out Procedure

The Brake Monitor may be tested when disconnected from the machine by doing the following:

1. Connect line voltage to LINE terminals 2 & 3, electrical ground to terminal 1.
2. Connect one side of line to Brake Solenoid terminal 4 through one pole of a normally open push button switch.
3. Connect other side of line to Brake Solenoid terminal 5 through other pole of a normally open push button switch.
4. See that the cable is connected between motion detector and the motion detector terminals 13 and 14 on the DM3000.
5. Put DM3000 in Motor Off Inch Mode: insert key into Keylock, turn to Reset/Setup position, then press Key 3 on keypad (on non-Keylock units, enter the following sequence on the keypad: 3 - 2 - 1 - 2 - 3 - 3). Observe that TIME and RESERVE LEDs are blinking together. While in this mode, when the Chain Break LED is lit when the brake is on, and the Warning LED is lit when motion occurs. Press down on push button and observe that Chain LED goes out. Spin motion detector, and observe that Warning LED comes on. While in this mode, no alarms will occur. Turn the key in the keylock back to the Run position to exit this mode (on non-Keylock units, press SET key to exit this mode). Note that the DM3000 can be put into this mode after being installed on the press to check for proper wiring.
6. Spin the motion detector by hand. The unit should alarm and blink with fault code 4. This simulates motion occurring with the brake on, a fault condition. Reset the DM3000 - insert key into Keylock and turn to Reset/Setup position, then turn back to Run position (on non-Keylock units, enter the reset code: 3 - 1 - 3 - 2 - 2.)Reset by pressing SET key, then 1 - 3 - 2 - 2.
7. Hold down the push button for a few seconds. The unit should alarm with fault code "3". This simulates the brake being on and no motion occurring within the chain break delay period. Reset the unit.
8. Push switch down, and start rotating the motion detector by hand. Release switch, and stop rotating motion detector a short time later. When motion detector rotation stops, the DM3000 will indicate the stopping time. (Releasing the switch simulates application of the brake. Stopping rotation of the motion detector simulates the press stopping.) Note that an alarm will occur (alarm LED comes on) if the stopping time was longer than the stop alarm setting. Note that it is difficult to coordinate the push button and motion detector by hand in the proper sequence. If switch and motion detector are not operated in the proper sequence, the display may blink with a failcode. If unit alarms, simply reset and try again.
9. Short terminals 13 and 14 together; push and hold the push button switch. The chain break LED should light after the chain break delay time has been exceeded. This simulates a broken chain condition, where the press brake is released, but no motion signal is received.
10. Unplug the motion detector from terminals 13 and 14; The display on the DM3000 will blink failcode 4. The chain break, alarm, and self check LEDs will light. The stop relay will open (de-energize). Reset the unit.

Appendix B
Loss of Motion

NOTE: Loss of Motion is standard on all Keylock units and is an option on all non-Keylock units (listed as Loss of Motion Option #03A143). Loss of Motion is not needed on most press controls - only those that require it, such as older Allen Bradley press controls.

Loss of Motion provides a relay monitoring the motion input voltage to the circuit board. The relay energizes with machine motion and de-energizes when the machine stops. One set of relay contacts are connected to terminals 10 (common), 11 (normally open), and 12 (normally closed).

> NOTE: "Normal" for this relay means: power is applied to unit, no press motion is occurring (no voltage on terminals 13 & 14).

Typically, the relay contacts are wired into a compatible press control to perform two functions:

1. Stop the press during a stroke if the motion voltage is lost for any reason. The normally open terminal (11) is used.

2. Prevent initiation of the next stroke until all motion from the previous stroke has ceased. The normally closed terminal (12) is used. Terminal 10 is common for both contacts.

Appendix C
Safety Distance Table

DISTANCE		TIME	DISTANCE		TIME
in.	**mm**	**sec.**	**in.**	**mm**	**sec.**
2	50.8	.032	34	863.6	.540
4	101.6	.064	36	914.4	.571
6	152.4	.096	38	965.2	.603
8	203.2	.127	40	1016.0	.635
10	254.0	.159	42	1066.8	.667
12	304.8	.190	44	1117.6	.698
14	355.6	.222	46	1168.4	.730
16	406.4	.254	48	1219.2	.762
18	457.0	.286	50	1270.0	.794
20	508.0	.317	52	1230.8	.825
22	558.8	.349	54	1371.6	.857
24	609.6	.381	56	1422.4	.889
26	660.4	.413	58	1473.2	.921
28	711.2	.444	60	1524.0	.952
30	762.0	.476	62	1574.8	.984
32	812.8	.508			