

## Diagnostic Fault Codes

<b>Flashes</b>	<b>Fault Condition</b>
Slow Green	Normal operation
Slow Amber	Normal operation with call for heat
Steady On Red	Control failure
Rapid Red	Twinning error, incorrect 24V phasing
Rapid Amber	Low flame sense current
1 Red	Flame present with gas off
2 Red	Pressure switch stuck closed
3 Red	Pressure switch stuck open
4 Red	Limit switch open
5 Red	Rollout switch open
6 Red	Pressure switch cycle lockout
7 Red	Ignition lockout due to retries
8 Red	Ignition lockout due to recycles
9 Red	Grounding or line polarity fault
10 Red	Gas flow with no call for heat
11 Red	Limit switch open - blower failure
4 Amber	Y present with no G call

## Fault Code Retrieval

To retrieve fault codes, push and release the **LAST ERROR** button. The **LED** will flash up to five stored fault codes, beginning with the most recent. If there are no fault codes in memory, the **LED** will flash two green flashes.

To clear the fault code memory, push and hold the **LAST ERROR** button for at least five seconds. The **LED** will flash three green flashes when the memory has been cleared.

## Codes de diagnostic de troubles

<b>Clignotements</b>	<b>Condition de trouble</b>
Vert lent	Opération normale
Ambre lent	Opération normale avec demande de chauffage
Rouge constant	Trouble de contrôle
Rouge rapide	Erreur de jumelage, phase 24V incorrecte
Ambre rapide	Courant du capteur de flamme basse
1 Rouge	Flamme présente et gaz éteint
2 Rouge	Commutateur de pression gelé et fermé
3 Rouge	Commutateur de pression gelé et ouvert
4 Rouge	Commutateur de limite ouvert
5 Rouge	Commutateur de roulement
6 Rouge	Arrêt force du commutateur de pression
7 Rouge	Arrêt force de l'ignition dû aux démarrages répétitifs
8 Rouge	Arrêt force de l'ignition dû au recyclages
9 Rouge	Trouble de mise en terre ou le polarité de ligne
10 Rouge	Débit de gaz sans demande en chauffage
11 Rouge	Commutateur de limite ouvert - Panne de la soufflerie
4 Ambre	Y présent sans demande à G

## Repérer les Codes de Troubles

Pour repérer les codes de troubles, enfoncez et relâchez le bouton **LAST ERROR**. L'**ECL** clignotera jusqu'à 5 codes de troubles mémorisés, à partir du plus récent. S'il n'y a pas de codes en mémoire, l'**ECL** clignotera vert deux fois.

Pour vider la mémoire des codes de troubles, enfoncez et relâchez le bouton **LAST ERROR** durant au moins 5 secondes. L'**ECL** clignotera vert trois fois lorsque la mémoire sera vide.

# ACCESSORY KIT INSTALLATION INSTRUCTIONS

IGNITION CONTROL P/N S1-33101972200, S1-37326083000, S1-43101972100

FOR USE WITH THE FOLLOWING FURNACE MODELS:

GY9, GF9, GM9, P1UK, PAKU, P2MP, P2MPV, P9MP, P2UR, PBLU, P2LN, P2DP, P3UR, PCLU, P1CX, PACR, XED; P(1,2)CD, P(A,B)ND, XND, DGD, GDD; P3HU, P3GEB, GUD, DGU, PCUH, P1DU, FL8; P3UR, G9T; FG9, P3DN, P3DH; PCDF, P2DR, PBLD, PBKM, PBKD, P1CK, PACE

## GENERAL

Ignition control P/N 031-01973-000 is a direct replacement for part numbers 031-01933-000, 031-01267-000, 031-01267-001, 031-00662-000 (50A50-209), 031-01250-000 (50A50-230), 031-01266-000 (50A50-241), and 031-01284-000 (50A55-241). Figure 1 shows the basic board layout with general component and safety circuit connections (Refer to the electrical wire diagram for the furnace being serviced for circuit connections specific to that model.)

## SEQUENCE OF OPERATION

The following describes the sequence of operation of the furnace. Refer to Figure 1 for component location.

### CONTINUOUS BLOWER

Cooling/heating thermostats have a fan switch that has an ON and AUTO position. In the ON position the thermostat circuit is completed between terminals R and G. The motor will operate on the speed tap wire that is connected to the cooling terminal on the control board.

### INTERMITTENT BLOWER - COOLING

Cooling/heating thermostats have a fan switch that has an ON and AUTO position. In the AUTO position the thermostat circuit is completed between terminals R and G when there is a call for cooling. The motor will operate on the speed tap wire that is connected to the cooling terminal on the control board. The fan off setting is fixed at 60 seconds for SEER enhancement.

### HEATING CYCLE

When the thermostat switch is set on HEAT and the fan is set on AUTO, and there is a call for heat, a circuit is completed between terminals R and W of the thermostat. When the proper amount of combustion air is being provided, the pressure switch will close, the ignition control provides a 17-second warm-up period, the gas valve then opens, the gas starts to flow, ignition occurs and the flame sensor begins its sensing function. The blower motor will energize 30 seconds after the gas valve opens, if a flame is detected. Normal furnace operation will continue until the thermostat circuit between R and W is opened, which causes the ignition system and gas valve to de-energize and the burner flames to be extinguished. The vent motor will operate for an additional 15 seconds and the blower motor will operate for the amount of time set by the fan-off delay jumper located on the control board. See Figure 6. The heating cycle is complete, and ready for the start of the next heating cycle.

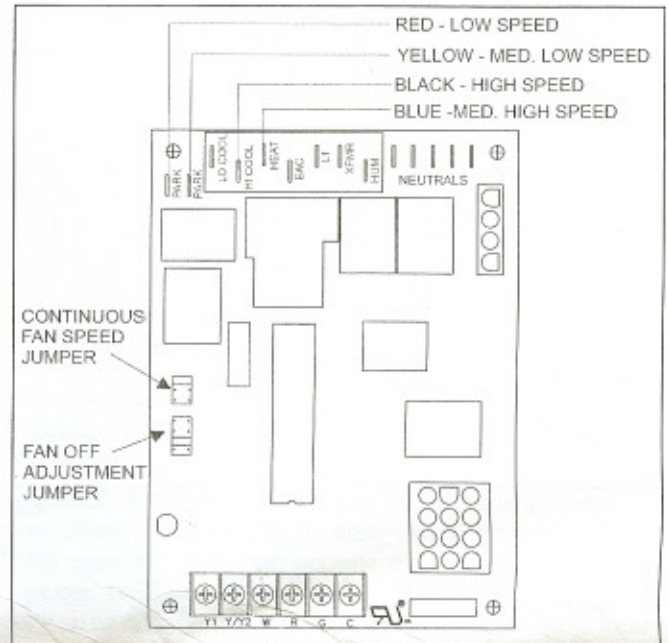


FIGURE 1: Typical Heat/Cool Speed Tap Connections

If the flame is not detected within 2 seconds of the gas valve opening, the gas valve is shut off and a retry operation begins. If the flame is lost for 2 seconds during the 10-second stabilization period, the gas valve is shut off and a retry operation begins. During a retry operation, the vent motor starts a 15 second inter-purge and the ignitor warm-up time is extended to 27 seconds. If the flame is established for more than 10 seconds after ignition during a retry, the control will clear the ignition attempt (retry) counter. If three retries occur during a call for heat, the furnace will shut down for one hour. If at the end of the one hour shut down there is a call for heat, the furnace will initiate a normal start cycle. If the problem has not been corrected the furnace will again lockout after three retries.

A momentary loss of gas supply, flame blowout, or a faulty flame probe circuit will result in a disruption in the flame and be sensed within 1.0 seconds. The gas valve will de-energize and the control will begin a recycle operation. A normal ignition sequence will begin after a 15 second inter-purge. If during the five recycles the gas supply does not return, or the fault condition is not corrected the ignition control will lockout for 60 minutes.

During burner operation, a momentary loss of power for 50 milliseconds or longer will de-energize the gas valve. When the power is restored, the gas valve will remain de-energized and the ignition sequence will immediately restart.

**HOT SURFACE IGNITION SYSTEM**

**▲WARNING**

**HOT SURFACE IGNITION SYSTEM**

Do not attempt to light this furnace by hand (with a match or any other means). There may be a potential shock hazard from the components of the hot surface ignition system. The furnace can only be lit automatically by its hot surface ignition system.

**ADJUSTMENT OF FAN CONTROL SETTINGS**

This furnace is equipped with a time-on/time-off heating fan control. The fan on delay is fixed at 30 seconds. The fan off delay has 4 settings (60, 90, 120 and 180 seconds). The fan off delay is factory set to 120 seconds. The fan-off setting must be long enough to adequately cool the furnace, but not so long that cold air is blown into the heated space. The fan-off timing may be adjusted by positioning the jumper on two of the four pins as shown in Figure 2.

**INSTALLATION**

The required number of steps to remove the failed ignition control and install the new ignition control will vary depending on the furnace model. However the method of mounting and the wire connections will remain the same.

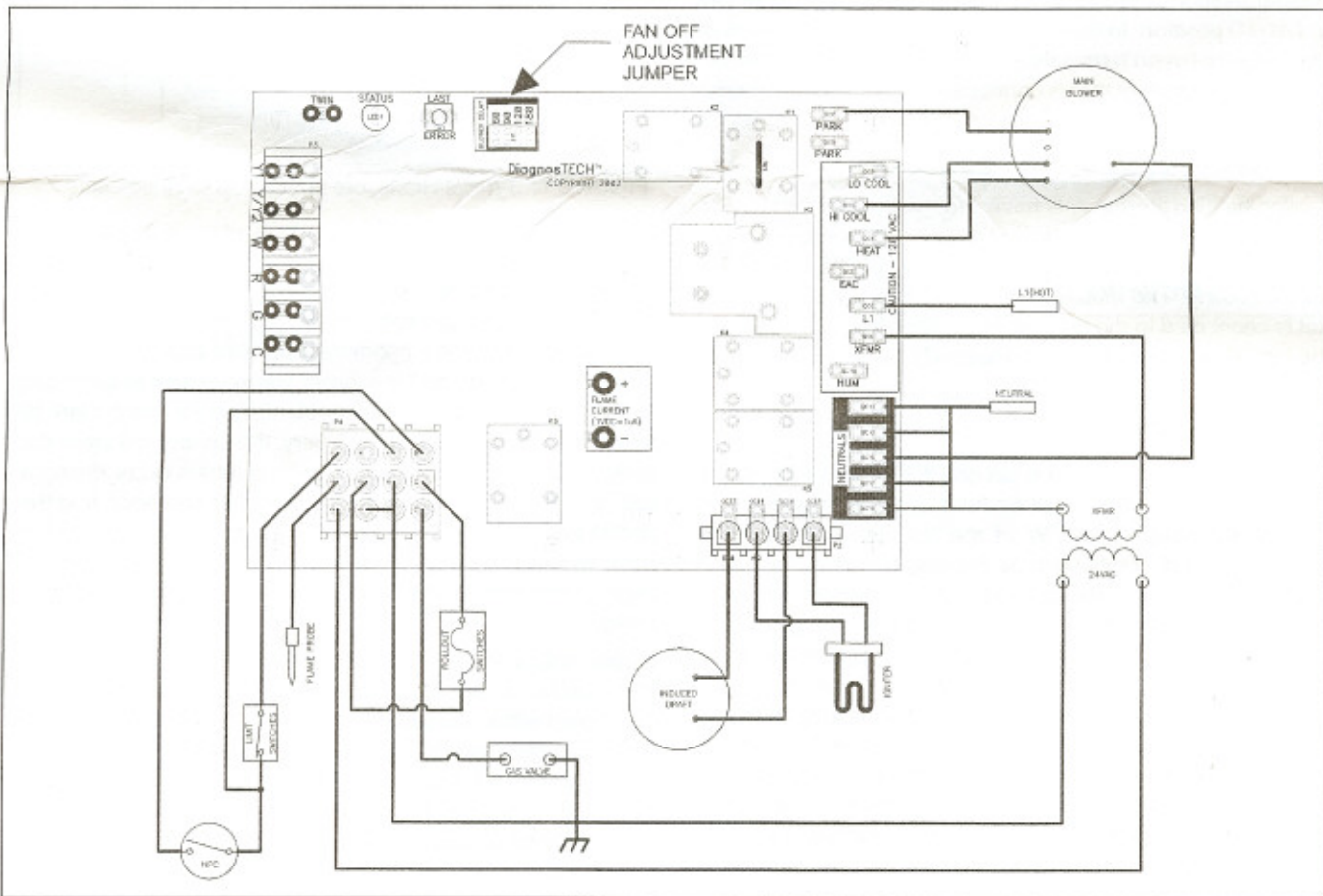
**▲WARNING**

Disconnect electrical power to the furnace before installing this control. Failure to cut power could result in an electrical shock or equipment damage.

**▲CAUTION**

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous furnace operation. Verify proper operation after servicing.

**NOTE:** All wiring must be in accordance with both the National Electric Code, latest edition, and all local electrical codes.



**FIGURE 2:** Board Layout

## REMOVAL OF FAILED IGNITION CONTROL

1. Turn off electrical power.
2. Remove furnace vent and blower access panels.
3. Remove electrical box cover, if required.
4. Label all wires prior to disconnection.
5. Disconnect all wires to failed ignition control.
6. Remove screws fastening ignition control to electrical panel.
7. Fasten hole template, included with this installation instruction, to electrical panel and drill new mounting holes. (If required)

## INSTALLATION OF IGNITION CONTROL

1. Orient the control as close as possible to the orientation of the board being replaced.
2. Align the plastic mounting feet with the mounting holes in the electric panel and press on each corner of the control board to seat the mounting feet.

### CAUTION

*Apply only enough pressure to seat the mounting foot or the ignition control may be damaged.*

1. Connect all wires according to the electrical wire diagram. Refer to Figure 2 for the locations of the terminals to be connected.
2. Check to see that all wire connections were made properly before applying power.
3. Affix DIAGNOSTIC FLASH CODE label to blower housing, electrical box or cover, or the front blower deck.
4. Apply power and test furnace operation.

## PARTS LIST

1. Ignition control P/N 031-01973-000
2. Hole template
3. Installation Instruction P/N 035-19631-001
4. Label/Diagnostic Flash Code

## DIAGNOSTICS

The control has built-in, self-diagnostic capability. If a system problem occurs, a blinking LED shows a fault code. The LED can flash red, green or amber to indicate various conditions.

The control continuously monitors its own operation and the operation of the system. If a failure occurs, the LED will indicate the failure code. If the failure is internal to the control, the light will stay on continuously. In this case, the entire control should be replaced, as the control is not field repairable.

Flash sequence codes 1 through 11 are as follows: LED will turn "on" for 1/4 second and "off" for 1/4 second. This pattern will be repeated the number of times equal to the code. For example, six "on" flashes equals a number 6 fault code. All flash code sequences are broken by a 2 second "off" period.

**SLOW GREEN FLASH:** Normal operation.

**SLOW AMBER FLASH:** Normal operation with call for heat.

**RAPID RED FLASH:** Twinning error, incorrect 24V phasing. Check twinning wiring.

**RAPID AMBER FLASH:** Flame sense current is below 1.5 microamps. Check and clean flame sensor. Check for proper gas flow.

**1 RED FLASH:** This indicates that flame was sensed when there was not a call for heat. With this fault code the control will turn on both the inducer motor and supply air blower. A gas valve that leaks through or is slow closing would typically cause this fault.

**2 RED FLASHES:** This indicates that the normally open pressure switch contacts are stuck in the closed position. The control confirms these contacts are open at the beginning of each heat cycle. This would indicate a faulty pressure switch or miswiring.

**3 RED FLASHES:** This indicates the normally open pressure switch contact did not close at the beginning of the heat cycle. This could be caused by a number of problems: faulty inducer, blocked vent pipe, broken pressure switch hose or faulty pressure switch.

**4 RED FLASHES:** This indicates that a primary or auxiliary limit switch has opened its normally closed contacts. With this fault code the control will operate the supply air blower and inducer. This condition may be caused by: dirty filter, improperly sized duct system, incorrect blower speed setting, incorrect firing rate or faulty blower motor.

**5 RED FLASHES:** This fault is indicated if the normally closed contacts in the rollout switch opens. The rollout control is manually reset. If it has opened, check for proper combustion air, proper inducer operation, and primary heat exchanger failure or burner problem. Be sure to reset the switch after correcting the failure condition.

**6 RED FLASHES:** This indicates that after the unit was operating, the pressure switch opened 4 times during the call for heat. If the main blower is in a "Delay on" mode it will complete it, and any subsequent delay off period. The vent motor continues to operate until the pressure switch re-closes or a call for heat is removed.

**7 RED FLASHES:** This fault code indicates that the flame could not be established. This no-light condition occurred 3 times (2 retries) during the call for heat before locking out. Low gas pressure, faulty gas valve, faulty hot surface ignitor or burner problem may cause this.

**8 RED FLASHES:** This fault is indicated if the flame is lost 5 times (4 recycles) during the heating cycle. This could be caused by low gas pressure or faulty gas valve.

**9 RED FLASHES:** Indicates reversed line voltage polarity. Both heating and cooling operations will be affected. Check polarity at furnace and branch. Check furnace grounding.

**10 RED FLASHES:** Gas flow with no call for heat. Check gas valve and gas valve wiring.

**11 RED FLASHES:** This indicates that a primary or auxiliary limit switch has opened its normally-closed contacts and has remained open for more than five minutes. This condition is usually caused by a failed blower motor or blower wheel.

**STEADY ON RED:** Control failure. Replace control board.

**60-MINUTE AUTOMATIC RESET FROM LOCKOUT:** This control includes a "watchdog" type circuit that will reset from a lockout condition after 60 minutes. Operational faults 1,6,7,8 will be reset. This provides protection to an unoccupied structure if a temporary condition exists causing a furnace malfunction. An example would be a low incoming gas supply pressure preventing unit operation. When the gas pressure is restored, at some point the "watchdog" would restart the unit and provide heat for the house.

If a flame is detected, the control flashes the LED for 1/8 of a second and then enters a flame stabilization period.

**IGNITION CONTROL (P/N 031-01973-000)**

Normal flame sense current is approximately  
3.7 microamps DC ( $\mu\text{a}$ )

Low flame signal warning starts at 1.5 microamps.

Low flame signal control lockout point is

0.9 microamps DC ( $\mu\text{a}$ )

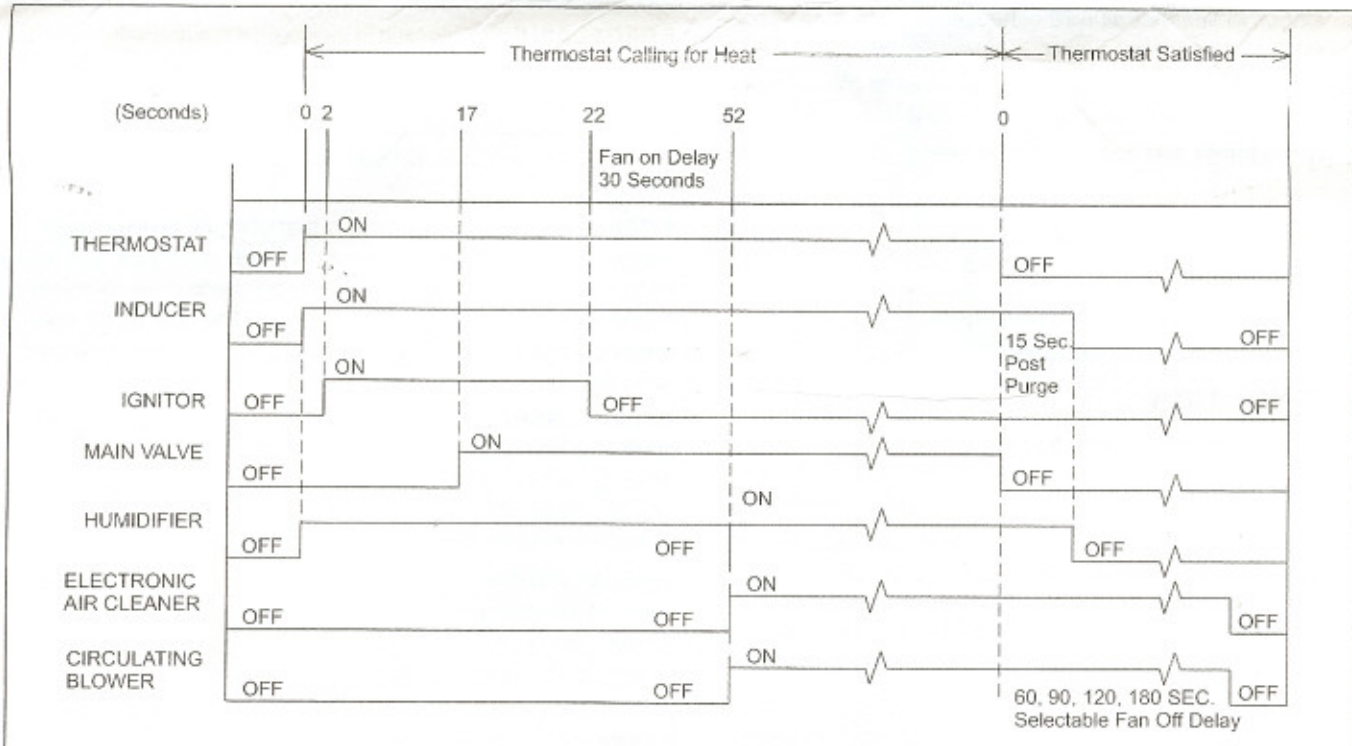
## DIAGNOSTIC FAULT CODE STORAGE AND RETRIEVAL

The control in this furnace is equipped with memory that will store up to five error codes to allow a service technician to diagnose problems more easily. This memory will be retained even if power to the furnace is lost. **This feature should only be used by a qualified service technician.**

The control stores up to five separate error codes. If more than five error codes have occurred since the last reset, only the five most recent will be retained. The furnace control board has a button, labeled "LAST ERROR" that is used to retrieve error codes. This function will only work if there are no active thermostat signals. So any call for heating, cooling or continuous fan must be terminated before attempting to retrieve error codes.

To retrieve the error codes, push the LAST ERROR button. The LED on the control will then flash the error codes that are in memory, starting with the most recent. There will be a two-second pause between each flash code. After the error codes have all been displayed, the LED will resume the normal slow green flash after a five second pause. To repeat the series of error codes, push the button again.

If there are no error codes in memory, the LED will flash two green flashes. To clear the memory, push the LAST ERROR button and hold it for more than five seconds. The LED will flash three green flashes when the memory has been cleared, then will resume the normal slow green flash after a five-second pause.



**FIGURE 3:** Furnace Control Event Schedule

## TWINNING

### GENERAL

In applications where more heating capacity or more airflow capacity is needed than what one furnace can deliver, twinning can be used to make two furnaces operate in tandem, using one duct system and one room thermostat. When one duct system is used for two furnaces, it is necessary that the two blowers operate in unison. The twinning function of this board ensures that both blowers turn on and off simultaneously, and operate on the same blower speed.

### SINGLE-WIRE TWINNING

This control has the single-wire twinning feature. With this feature, a single wire is connected between the TWIN terminal on one furnace board to the TWIN terminal on the second furnace board. The board then communicates the blower status from one furnace to the other along this wire. This communication makes the second furnace blower come on at the same time, and on the same speed, as the first furnace blower.

### 2TC03700124 TWINNING CONTROL

Older furnace control boards were not equipped with the single-wire twinning feature, so when twinning was necessary, use of a separate twinning kit was required. This twinning kit, P/N 2TC03700124, used current-sensing relays to detect blower operation in one furnace and then turn on the blower in the second furnace.

This control board (031-01973-000) is compatible with the 2TC03700124 twinning kit and may be used as a replacement control for applications using the twinning kit. Alternately, both controls can be replaced and the single-wire feature can be used. Instructions for using the single-wire twinning feature are shown below.

### REPLACEMENT OF THE CONTROL BOARD IN A SINGLE-WIRE TWINNED FURNACE

The communications wire between the two furnaces that is used for single-wire twinning is common to each control board manufacturer. So if this replacement control board is being used to replace a board in a twinning application using single-wire twinning, it will be necessary to make sure that both control boards are compatible.

This control board (031-01973-000) is compatible for twinning with 031-01972-000, 031-01973-000 and 031-01267-001 controls only.

Control board (031-01933-000) is only compatible for twinning with other 031-01933-000 controls.

### SINGLE-WIRE TWINNING INSTRUCTIONS

Connect the control wiring as shown in Figure 4.

1. Connect the low voltage wiring from the wall thermostat to the terminal strip on the control board of Furnace #1.
2. Connect a wire from the TWIN terminal of Furnace #1 to the TWIN terminal of Furnace #2.
3. Install a separate 24V relay as shown in Figure 4. Use of this relay is required, as it ensures that the transformers of the two furnaces are isolated, thus preventing the possibility of any safety devices being bypassed.

### SINGLE-WIRE TWINNING OPERATION

**Heating** - On a call for heat (W signal) from the wall thermostat, both furnaces will start the ignition sequence and the burners on both furnaces will light. About thirty seconds after the burners light, the blowers on both furnaces will come on in heating speed. When the thermostat is satisfied, the burners will all shut off and, after the selected blower off delay time, both blowers will shut off at the same time. The twinning control ensures that both blowers come on and shut off at the same time.

**Cooling** - On a call for cooling (Y signal) from the wall thermostat, both furnace blowers will come on at the same time in cooling speed. When the thermostat is satisfied, both blowers will stay on for 60 seconds, then will shut off at the same time.

**Continuous Fan** - On a thermostat call for continuous fan (G signal), both furnace blowers will come on at the same time in cooling speed and will stay on until the G signal is removed.

If there is a call for heat during the continuous fan operation, the blowers will immediately switch to heating speed and will stay there until the call for heat has been satisfied.

When the call for heat is satisfied, the blowers will switch back to cooling speed.

## TWINNING WIRING DIAGRAM

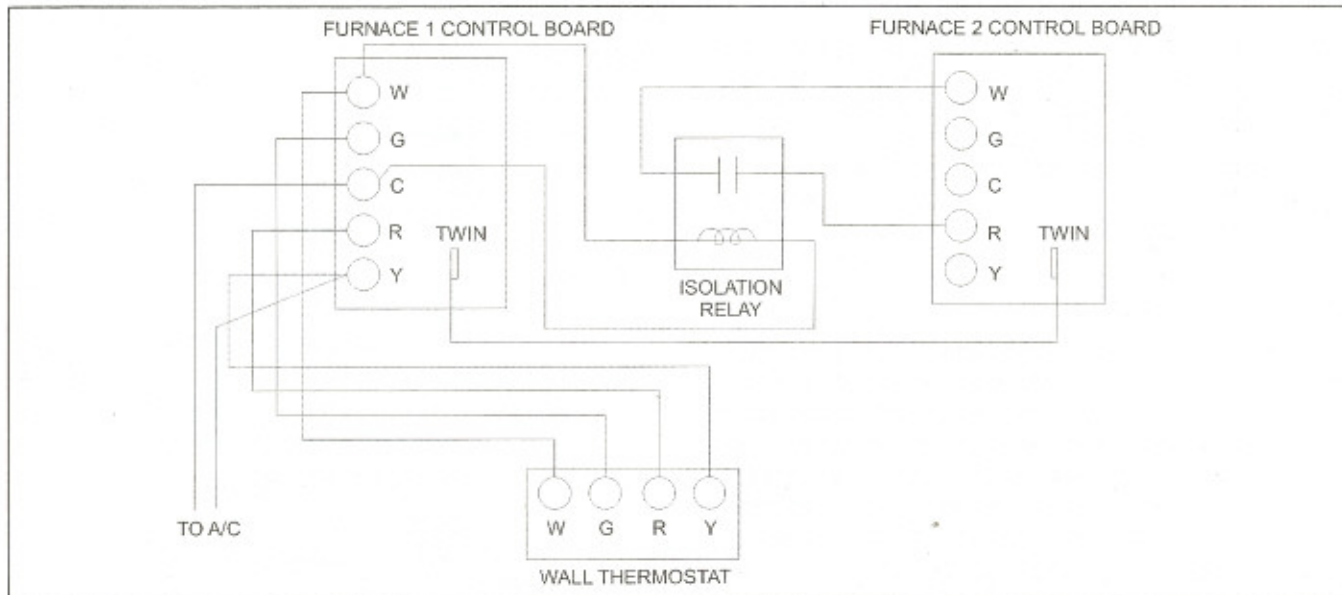


FIGURE 4: Twin Connection Diagram

## STAGING

### GENERAL

In applications where more heating capacity or more airflow capacity is needed than what one furnace can deliver, twinning can be used to make two furnaces operate in tandem, using one duct system and one room thermostat. This control can also be used along with a two-stage wall thermostat to stage two twinned furnaces, making them operate like a single two-stage furnace. This allows only one furnace to supply heat during times when the heat output from one furnace is sufficient to satisfy the demand. When one duct system is used for two furnaces, it is necessary that the two blowers operate in unison. The twinning function of this board ensures that both blowers turn on and off simultaneously, and operate on the same blower speed. Even when only one furnace is supplying heat, both furnace blowers must run.

### SINGLE-WIRE STAGING

The single-wire twinning feature of this board can also be used for staging of two furnaces. With this feature, a single wire is connected between the TWIN terminal on one furnace board to the TWIN terminal on the second furnace board. The board then communicates the blower status from one furnace to the other along this wire. This communication makes the second furnace blower come on at the same time, and on the same speed, as the first furnace blower.

### 2TC03700124 TWINNING CONTROL

Older furnace control boards were not equipped with the single-wire twinning feature, so when staging was necessary, use of a separate kit was required. This twinning kit, P/N 2TC03700124, used current-sensing relays to detect blower operation in one furnace and then turn on the blower in the second furnace. This twinning control could also be used for staging two furnaces.

This control board (031-01973-000) is compatible with the 2TC03700124 twinning kit and may be used as a replacement control for applications using the twinning kit. Alternately, both controls can be replaced and the single-wire staging feature can be used. Instructions for using the single-wire staging feature are shown below.

### REPLACEMENT OF THE CONTROL BOARD IN A SINGLE-WIRE STAGED FURNACE

The communications link between the two furnaces that is used for single-wire twinning and staging is unique to each control board manufacturer. If this replacement control board is being used to replace a control board in a twinning or staging application using single-wire twinning, it will be necessary to make sure that both control boards are compatible.

This control board (031-01973-000) is compatible for staging with 031-01972-000, 031-01973-000 and 031-01267-001 controls only.

Control board (031-01933-000) is only compatible for staging with other 031-01933-000 controls.

### SINGLE-WIRE STAGING INSTRUCTIONS

Connect the control wiring as shown in Figure 5.

1. Connect the low voltage wiring from the wall thermostat to the terminal strip on the control board of Furnace #1. For staging applications, the wire from thermostat W1 is

connected to the W connection on the board on Furnace #1. The wire from thermostat W2 is connected to Furnace #2 through a separate relay, as shown in Figure 5.

2. Connect a wire from the TWIN terminal of Furnace #1 to the TWIN terminal of Furnace #2.
3. Install a separate 24V relay as shown in Figure 5. Use of this relay is required, as it ensures that the transformers of the two furnaces are isolated, thus preventing the possibility of any safety devices being bypassed.

### SINGLE-WIRE STAGING OPERATION

**Heating** - On a call for first-stage heat (W1 signal) from the wall thermostat, Furnace #1 will start the ignition sequence and the burners will light. About thirty seconds after the burners light, the blowers on both furnaces will come on in heating speed. When the thermostat is satisfied, the burners will shut off and, after the selected blower off delay time, both blowers

will shut off at the same time. On a call for second stage of heat, the burners of Furnace #2 will also light and both blowers will run. The twinning control ensures that both blowers come on and shut off at the same time.

**Cooling** - On a call for cooling (Y signal) from the wall thermostat, both furnace blowers will come on at the same time. When the thermostat is satisfied, both blowers will stay on for 60 seconds, then will shut off at the same time.

**Continuous Fan** - On a thermostat call for continuous fan (G signal), both furnace blowers will come on at the same time in cooling speed and will stay on until the G signal is removed.

If there is a call for heat during the continuous fan operation, the blowers will immediately switch to heating speed and will stay there until the call for heat has been satisfied.

When the call for heat is satisfied, the blowers will switch back to cooling speed.

### STAGING WIRING DIAGRAM

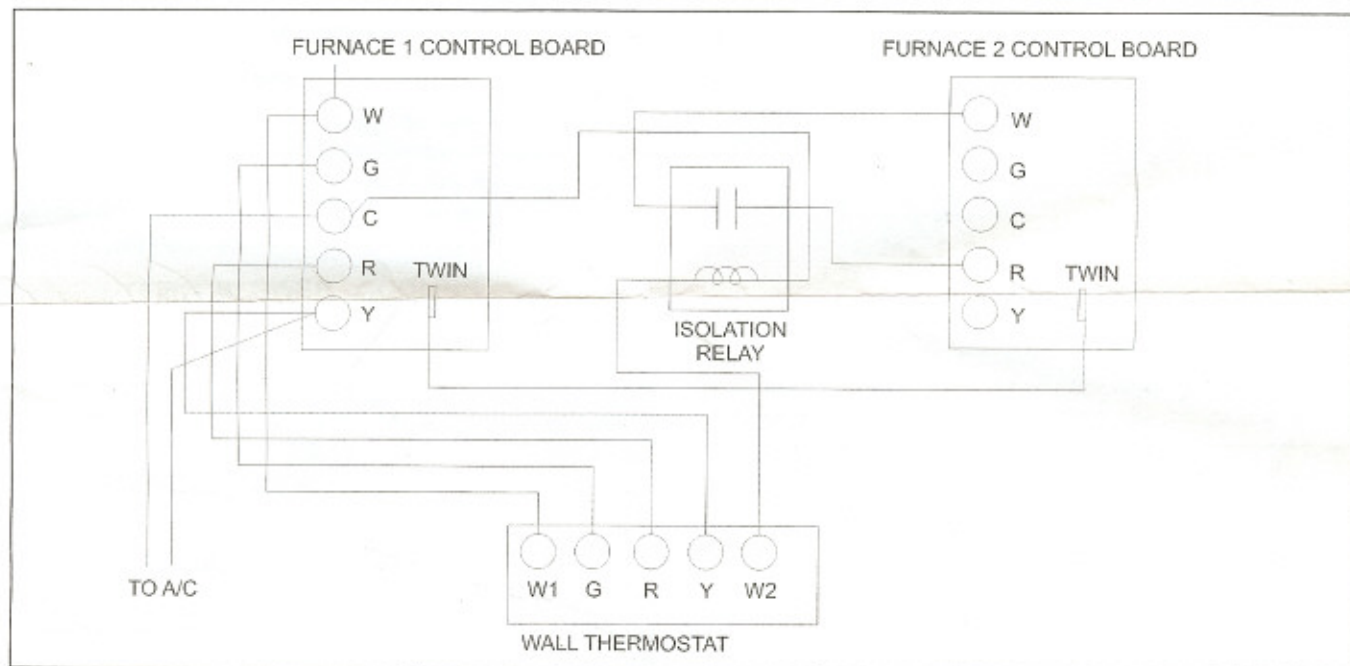
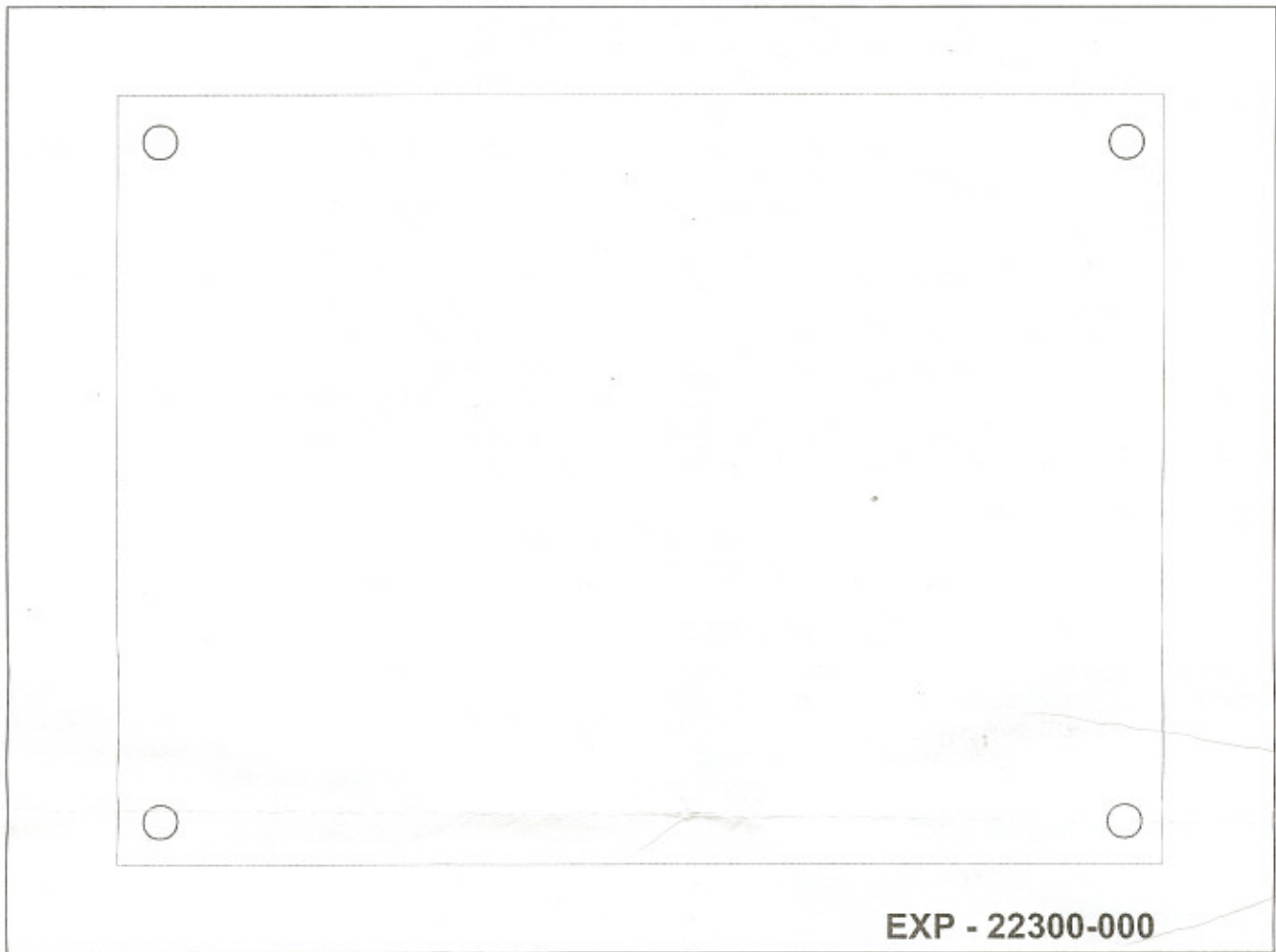


FIGURE 5: Staging Connection Diagram





**FIGURE 6:** Hole Template