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# INSTALLATION INSTRUCTIONS

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## TEC40 ELECTRONIC CONTROLLER



Bard Manufacturing Company, Inc.  
Bryan, Ohio 43506  
*Since 1914...Moving ahead, just as planned.*

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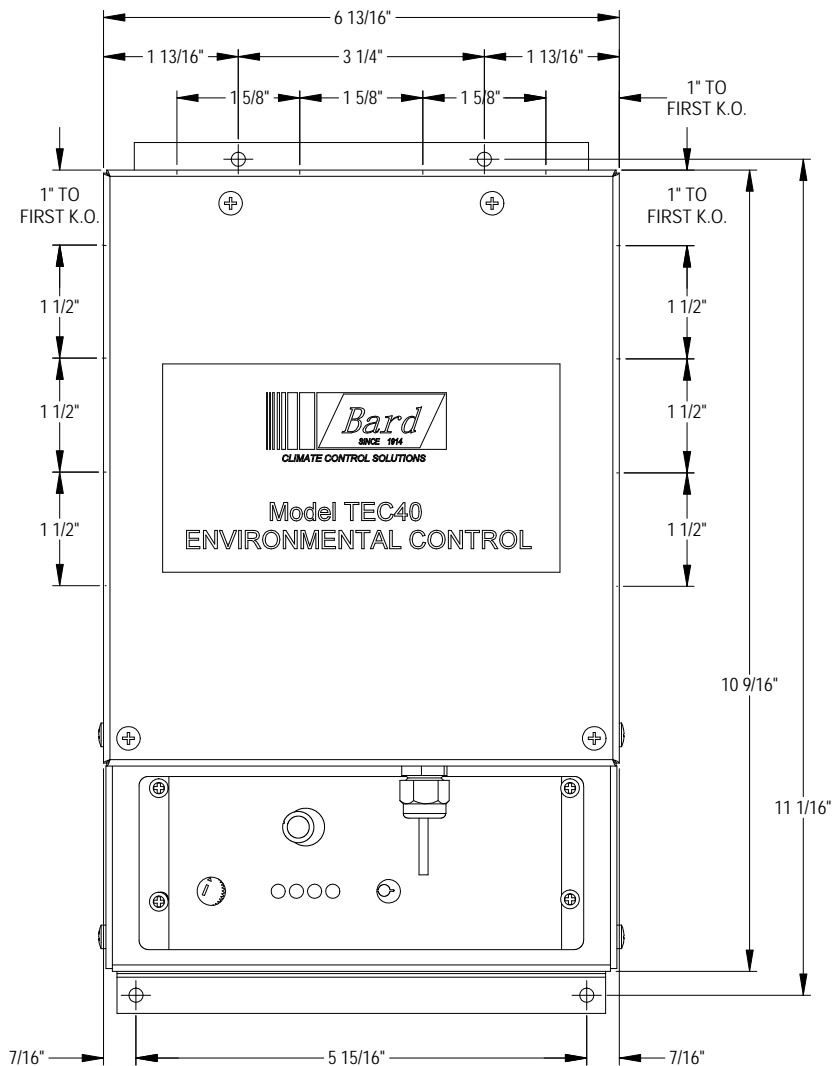
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## **\*\* IMPORTANT \*\***

The equipment covered in this manual is to be installed by trained, experienced service and installation technicians. Please read entire manual before proceeding.

### **SHIPPING DAMAGE**

Upon receipt of equipment, the carton should be checked for external signs of shipping damage. If damage is found, the receiving party must contact the last carrier immediately, preferably in writing, requesting inspection by the carrier's agent.

### **GENERAL**

These instructions explain the operation, installation and troubleshooting of the TEC40 controller.

All internal wiring is complete. Only attach low voltage field wiring to designated terminal strips.

The controller is for use with up to four (4) Bard air conditioning wall mount series units. The TEC40 is for use with units with or without economizers.

It is recommended that a five (5) minute compressor time delay relay be factory or field installed in each unit.

The TEC40 controller is suitable for both 50 and 60 HZ operation.

### **THEORY OF OPERATION**

The controller is used to control up to four wall mount air conditioners from one thermostat. It provides total redundancy for the structure and equal wear on all units. It can be used with units with economizers, but all units must be equipped alike. That is, all must have economizers or all must be without economizers. See Figure 1 for component locations.

### **LEAD-LAG CHANGEOVER TIME**

The lead-lag changeover time period is user selectable. Time periods available are 0, 1, 3, 7, 14 and 28 days. Once every time period the lead unit will be advanced to the next unit providing equal wear on the units. For timer speed up, push and hold the change lead unit push-button for one second. Timer speed up is supplied for ease of troubleshooting.

Lead unit cycles between all 4 units in four unit mode; between 1, 2 and 3 in three unit mode; and between units 1 and 2 in both two unit modes.

In the event of a unit(s) failure, the changeover time jumper may be set to 0 days. This will prevent the TEC40 from switching lead unit to the next unit. Push the push-button to make a functional unit the lead unit if necessary. If power is lost the controller will remember which unit was the lead unit when power is reapplied.

### **MODES OF OPERATION**

The TEC40 has four modes of operation.

1. Four Unit Mode
2. Three Unit Mode
3. Two Unit Alternating Mode
4. Two Unit Non-Alternating Mode.

### **STAGING DELAY PERIODS**

The following delays are built in for both cooling and heating: stage 1 – 0 seconds; stage 2 – 10 seconds; stage 3 – 15 seconds; and stage 4 – 20 seconds. The delays are active anytime there is a power interruption or the controller ON-OFF switch is exercised.

### **FOUR UNIT MODE**

In four unit mode the TEC40 will control four air conditioners with or without economizers. Make connections per Figure 2.

### **Sequence of Operation – Cooling**

First stage cooling set point is determined by the position of the cooling set point potentiometer. On a call for first stage cooling, the blower and either economizer or compressor of the lead unit is energized. The enthalpy control on the economizer will make the decision as to which is energized. If not equipped with economizers the compressor will energize. First stage cooling LED will light.

Second stage cooling set point is 2.0 degrees warmer than first stage cooling set point. On a call for second stage cooling, the blower and either economizer or compressor of the next unit is energized. The enthalpy control on the economizer will make the decision as to which is energized. If not equipped with economizer the compressor will energize. Second stage cooling LED will light.

Third stage cooling set point is 2.0 degrees warmer than second stage cooling set point. On a call for third stage cooling, the blower and either economizer is energized. The enthalpy control on the economizer will make the decision as to which is energized. If not equipped with economizer the compressor will energize. Third stage cooling LED will light.

Fourth stage cooling set point is 2.0 degrees warmer than third stage cooling set point. On a call for fourth stage cooling, the blower and either economizer or compressor of the next unit is energized. The enthalpy control on the economizer will make the decision as to which is energized. If not equipped with economizer the compressor will energize. Fourth stage cooling LED will light.

### Sequence of Operation – Heating

First stage heating set point is determined by subtracting the dead band setting from cooling set point setting. For example, if the cooling set point is 74 degrees and the dead band adjustment is set at 4 degrees the heating set point is 70 degrees. On a call for first stage heating, the blower and electric heat of the lead unit is energized. First stage heating LED will light.

Second stage heating set point is 2.0 degrees colder than first stage heating set point. On a call for second stage heating, the blower and electric heat of the next unit is energized. Second stage heating LED will light.

Third stage heating set point is 2.0 degrees colder than second stage heating set point. On a call for third stage heating, the blower and electric heat of the next unit is energized. Third stage heating LED will light.

Fourth stage heating set point is 2.0 degrees colder than third stage heating set point. On a call for fourth stage heating, the blower and electric heat of the next unit is energized. Fourth stage heating LED will light.

### THREE UNIT MODE

In three unit mode the TEC40 will control three air conditioners with or without economizers. Make connections per Figure 3.

#### Sequence of Operation

The cooling and heating sequence of operation are the same as four unit mode except that the fourth stage heating or cooling is not available.

### TWO UNIT NON-ALTERNATING MODE

In two unit non-alternating mode the TEC40 will control two air conditioners with dual compressors. Make connections per Figure 5.

**NOTE:** *This configuration (Fig. 5) is for two (2) HVAC units with two (2) compressors only (should not be used for units with 2-stage compressors) and is designed to reverse operating position of the two compressors within each HVAC unit at the selected Lead/Lag changeover interval, or when using Manual “Change Lead Unit” button. The operating position of HVAC Unit #1 and #2 does not change and Unit #1 is always the lead unit and the #2 the lag unit.*

#### Sequence of Operation – Cooling

First stage cooling set point is determined by the position of the cooling set point potentiometer. On a call for first

stage cooling, the blower and first compressor of the lead unit is energized. First stage cooling LED will light.

Second stage cooling set point is 2.0 degrees warmer than first stage cooling set point. On a call for second stage cooling, the second compressor of the lead unit will energize. Second stage cooling LED will light.

Third stage cooling set point is 2.0 degrees warmer than second stage cooling set point. On a call for third stage cooling the blower and first compressor of the lag unit will energize. Third stage cooling LED will light.

Fourth stage cooling set point is 2.0 degrees warmer than third stage cooling set point. On a call for fourth stage cooling, the second compressor of the lag unit will energize. Fourth stage cooling LED will light.

### Sequence of Operation – Heating

First stage heating set point is determined by subtracting the dead bank setting from cooling set point setting. For example, if the cooling set point is 74 degrees and the dead band adjustment is set at 4 degrees the heating set point is 70 degrees. On a call for first stage heating, the blower and electric heat of the lead unit is energized. First stage heating LED will light.

Second stage heating set point is 2.0 degrees colder than first stage heating set point. On a call for second stage heating, the second electric heat (if equipped) of the lead unit is energized. Second stage heating LED will light.

Third stage heating set point is 2.0 degrees colder than second stage heating set point. On a call for third stage heating, the blower and electric heat of the lag unit is energized. Third stage heating LED will light.

Fourth stage heating set point is 2.0 degrees colder than third stage heating set point. On a call for fourth stage heating, the second electric heat (if equipped) of the lag unit is energized. Fourth stage heating LED will light

### TWO UNIT ALTERNATING MODE

In two unit alternating mode the TEC40 will control two air conditioners with two speed or dual compressor or two air conditioners with economizers with full redundancy. For two air conditioners with economizers, make connections per Figure 4. For two air conditioners with two-speed or dual compressors, make connections per Figure 6.

**NOTE:** *This configuration (Fig. 6) is for two (2) HVAC units each with two (2) compressors (or 2 units with 2-stage compressors) and is designed to reverse operating position of the two machines at the selected Lead/Lag changeover interval, or when using Manual “Change Lead Unit” button. The operating sequence of the two compressors (or the 2-stage compressor) in each unit does not change when the HVAC #1 & #2 units are reversed.*

## Sequence of Operation – Cooling with Economizers

First stage cooling set point is determined by the position of the cooling set point potentiometer. On a call for first stage cooling, the blower and either economizer or compressor of the lead unit is energized. The enthalpy control on the economizer will make the decision as to which is energized. First stage cooling LED will light.

Second stage cooling set point is 2.0 degrees warmer than first stage cooling set point. On a call for second stage cooling, the blower and either economizer or compressor of the lag unit is energized. The enthalpy control on the economizer will make the decision as to which is energized. Second stage cooling LED will light.

Third stage cooling set point is 2.0 degrees warmer than second stage cooling set point. On a call for third stage cooling, the compressor of the lead unit will energize and the economizer will return to minimum position if open. Third stage cooling LED will light.

Fourth stage cooling set point is 2.0 degrees warmer than third stage cooling set point. On a call for fourth stage cooling, the compressor of the lag unit will energized and the economizer will return to minimum position if open. Fourth stage cooling LED will light.

## Sequence of Operation – Heating

First stage heating set point is determined by subtracting the dead and setting from cooling set point setting. For example, if the cooling set point is 74 degrees and the dead band adjustment is set at 4 degrees the heating set point is 70 degrees. On a call for first stage heating, the blower and electric heat of the lead unit is energized. First stage heating LED will light.

Second stage heating set point is 2.0 degrees colder than first stage heating set point. On a call for second stage heating, the electric heat of the lag unit is energized. Second stage heating LED will light.

Third stage heating set point is 2.0 degrees colder than second stage heating set point. On a call for third stage heating, the second electric heat (if equipped) of the lead unit is energized. Third stage heating LED will light.

Fourth stage heating set point is 2.0 degrees colder than third stage heating set point. On a call for fourth stage heating, the second electric heat (if equipped) of the lag unit is energized. Fourth stage heating LED will light.

## INSTALLATION INSTRUCTIONS

### MOUNTING

Included in the controller carton is the controller and installation instructions.

The controller should be installed on a vertical wall approximately four (4) feet above the floor away from drafts and outside doors or windows. Four (4) mounting holes are provided for mounting to the wall and holes for conduit connections are provided in both the base, side and top of the controller. The controller should not be mounted directly to a block wall; space away from wall with insulation or plywood.

Once mounted, slide the thermistor sensor down into the fitting on the bottom of the TEC40. Position the sensor so that 15/16 inch is protruding from the bottom of the fitting. Tighten the fitting to hold the sensor in position.

### LOW VOLTAGE FIELD WIRING

The TEC40 is powered from the air conditioners that it is controlling, 24 VAC, 50/60 HZ, low voltage only.

Circuitry in the TEC40 isolate the power supplies of all connected air conditioners so that no back feeds or phasing problems can occur. Additionally if one or more air conditioners lose power the TEC40 and the other air conditioners are unaffected and will continue to operate normally.

Connect the low voltage field wiring from each unit per the low voltage field wiring diagrams in Figure 2, 3, 4 or 5 depending on the mode of operation desired.

### FIRE SUPPRESSION CIRCUIT

To disable the TEC40 and shut down all air conditioners, terminal F1 and F2 may be used. The F1 and F2 terminals must be jumpered together for normal operation. A normally closed set of contacts may be connected across the terminals and the factory jumper removed for use with a field installed fire suppression system. The contacts must open if a fire is detected. Contacts should be rated for pilot duty operation at 2 amp 24 VAC minimum.

*IMPORTANT NOTE: Bard models employ an electronic blower control that has a 60-second blower off-delay. In order to have immediate shutdown of the blower motor in addition to disabling the run function of the air conditions will require a simple wiring modification at the blower control located in the electrical control panel of the air conditioners being controlled by the lead/lag controller. To eliminate the 60- second blower off-delay disconnect and isolate the wire that is factory connected to the "R" terminal to the electronic blower control, and then connect a jumper from the "G" terminal on the blower control to the "R" terminal on the blower control. The electronic blower control will now function as an on-off relay with no off-delay, and the blower motor will stop running immediately when the F1-F2 fire suppression circuit is activated (opened).*

## ADJUSTMENTS

See Figure 1.

### COOLING SET POINT

Set the cooling set point in degrees C° or F° as indicated on the front of the TEC40.

### DEAD BAND

The dead band is the span between heating set point and cooling set point where no heating or cooling takes place. The cooling set point minus the dead band equals the heating set point. Adjustable from 4° to 20° F.

Turn the potentiometer fully counter clockwise for 4° dead band. Turn fully clockwise for 20° dead band. The arrow on top of the potentiometer does not indicate dead band setting.

### LEAD CHANGE PUSH-BUTTON

Pushing the lead change push-button will immediately change the lead unit to the lag unit. It also resets the lead/lag changeover timer to zero and restarts the selected timing period.

### ON/OFF SWITCH – UNDER COVER

This disables the TEC40. This switch must be ON for any heating or cooling to operate.

*NOTE: Whenever the on/off switch is first turned ON, all 4 red LED's for lead unit indication will flash 4 or 5 times as the controller sequences itself, and then will revert to whichever unit was lead when on/off switch was turned OFF.*

### CHANGING SELECTABLE FEATURES

To change any selectable feature turn on/off switch OFF. Change jumpers as necessary and turn switch ON. Jumper changes do not take effect unless on/off switch is turned OFF, jumper plug moved, and on/off switch turned back ON.

### CHANGE OVER TIME JUMPER – UNDER COVER

The changeover period for the sequence can be adjusted to 0, 1, 3, 7, 14 or 28 days.

If the jumper is set to 7 days (or other selected choice), units will rotate upwards: first to second, second to third, third to fourth, and fourth to first place. If connected for three units then three will go to first, and fourth position is ignored.

The 0 day position is supplied in the event of a unit failure or if only one air conditioner is used with the TEC40. If the unit needs to run for a time and not switch to the lag unit, set the jumper to “0” and push the lead change push-button to make the functional or single unit the lead unit. When the jumper is in the 0 position the lead unit will never switch.

### TEST MODE JUMPER – UNDER COVER

There is a test mode to accelerate the timing circuit from days to seconds. For example, if the timing selection jumper plug were set to the 7 day position, then utilizing the test mode feature the lead unit would advance in 7 seconds.

To use the test feature take the following steps:

1. Turn the on/off switch to OFF.
2. Place the jumper across the test mode pins.
3. Turn the on/off switch to ON.
4. The lead unit will now advance in upward sequence through the enabled unit positions.
5. To stop the accelerated sequence turn the on/off switch to OFF, remove the jumper, and then turn the on/off switch back ON.
6. After the 4 red LED's stop flashing the lead unit may be the one indicated at the time the on/off switch was turned OFF or it may be the next one up, depending on where the timer was in the accelerated sequence when switch was turned OFF.

### OPERATION MODE JUMPER – UNDER COVER

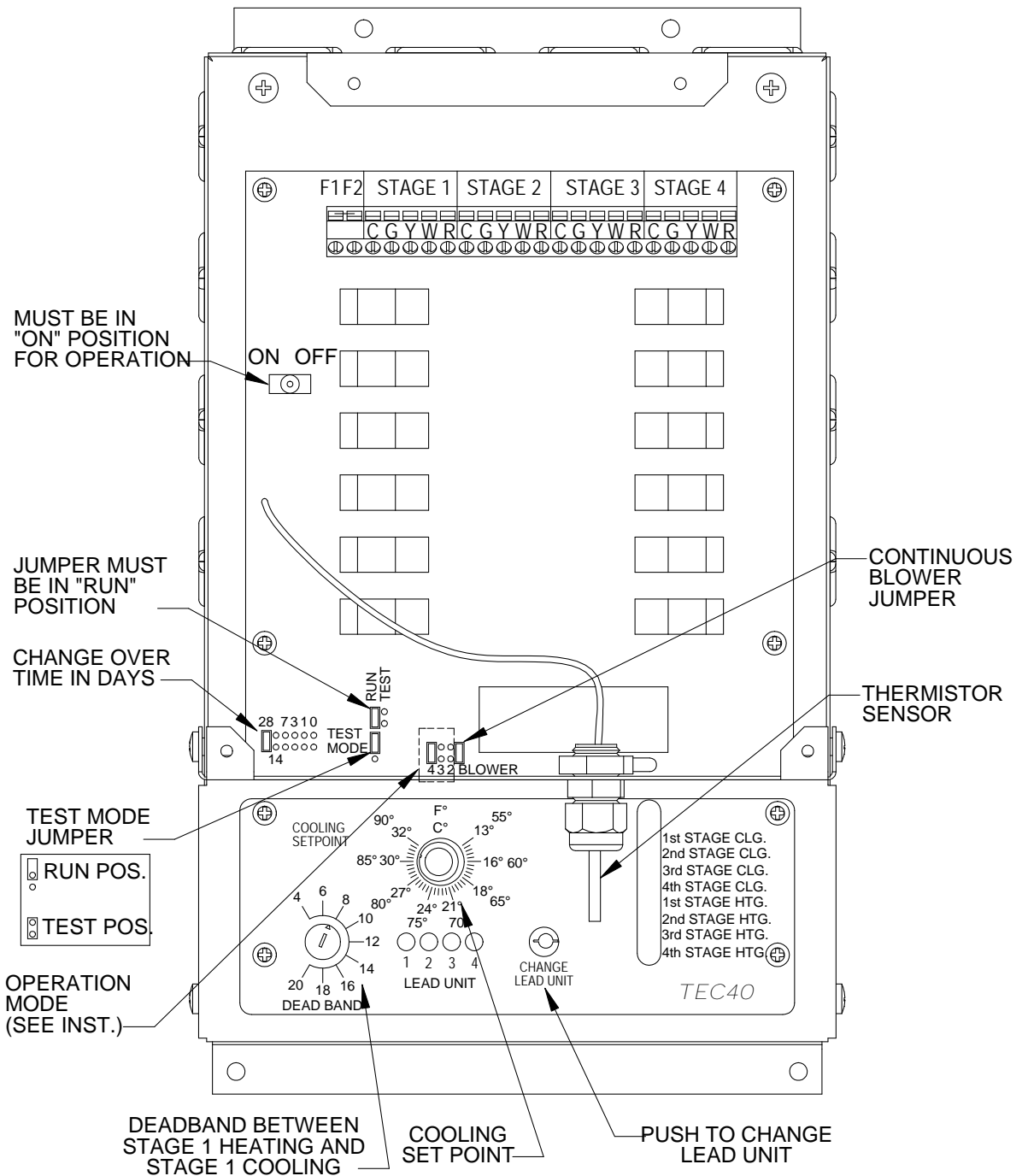
Position jumper across pins 4 for four unit mode.  
Position jumper across pins 3 for three unit mode.  
Position jumper across pins 2 for two unit alternating mode. Remove jumper for two unit non-alternating mode.

### CONTINUOUS BLOWER JUMPER – UNDER COVER

Position jumper across pins for continuous blower on the lead unit. Remove jumper to have the lead unit blower cycle with the compressor.

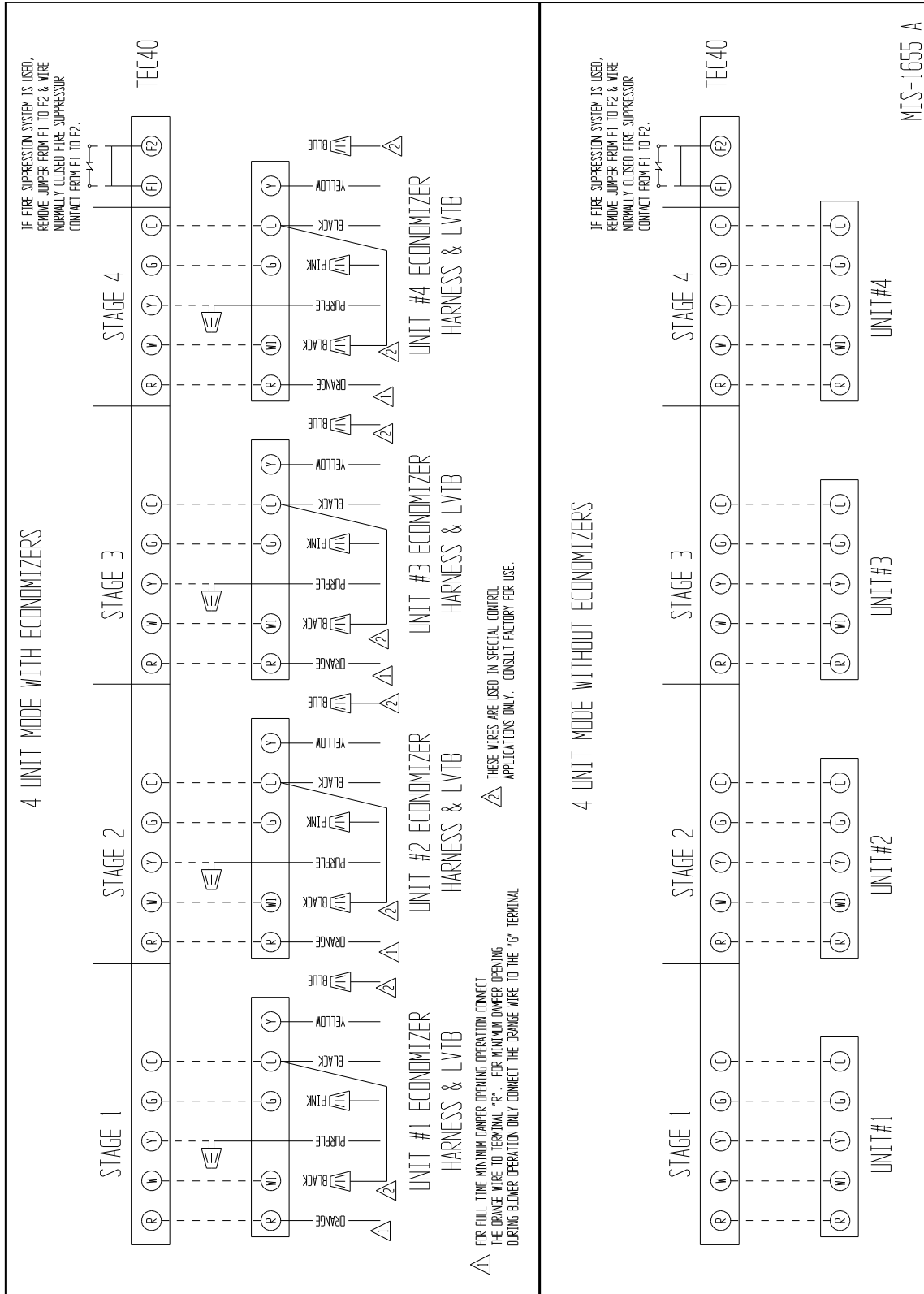


**FIGURE 1  
CONTROL LOCATIONS**



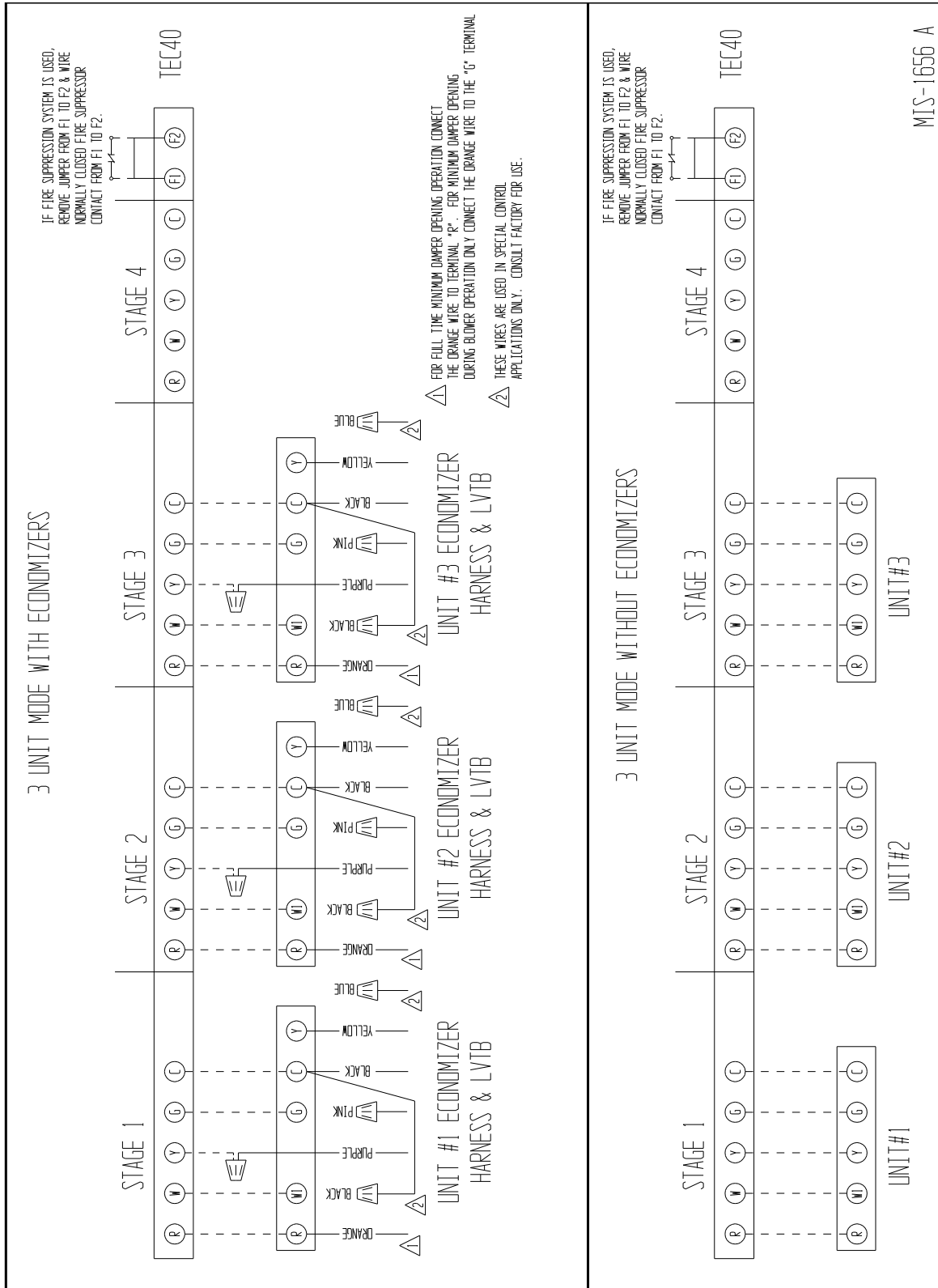
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FIGURE 2





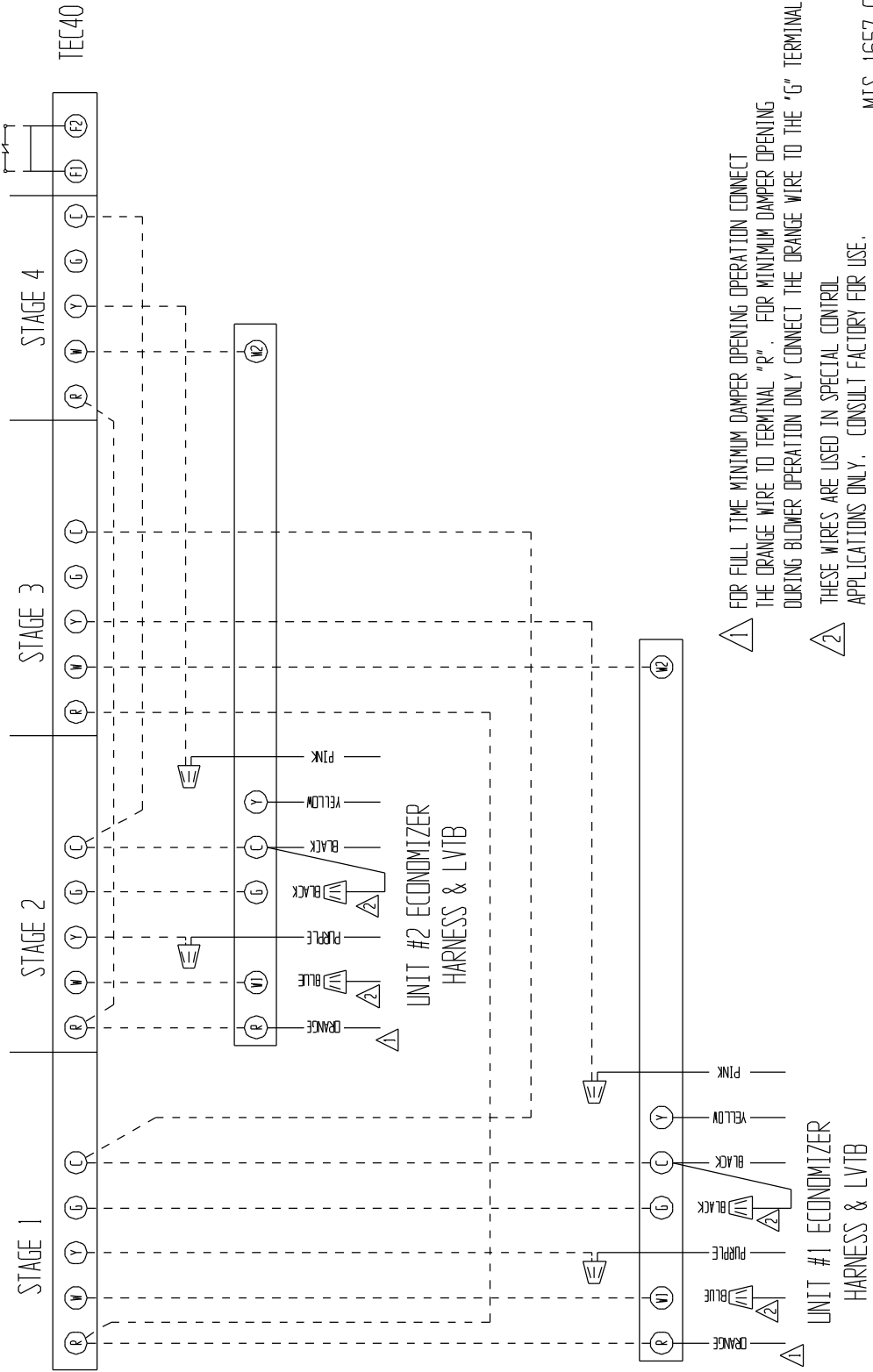
**FIGURE 3**



**FIGURE 4**

TWO UNIT ALTERNATING MODE WITH ECONOMIZERS

IF FIRE SUPPRESSION SYSTEM IS USED,  
REMOVE JUMPER FROM F1 TO F2 & WIRE  
NORMALLY CLOSED FIRE SUPPRESSOR  
CONTACT FROM F1 TO F2.

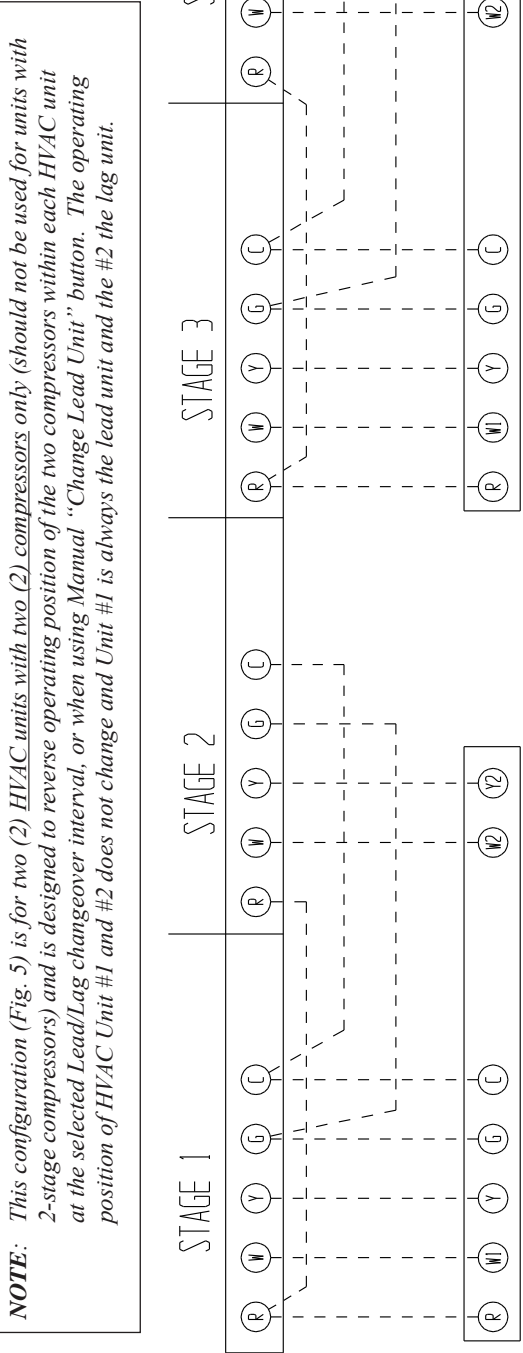


- ① FOR FULL TIME MINIMUM DAMPER OPENING OPERATION CONNECT THE ORANGE WIRE TO TERMINAL "R". FOR MINIMUM DAMPER OPENING DURING BLOWER OPERATION ONLY CONNECT THE ORANGE WIRE TO THE "G" TERMINAL
- ② THESE WIRES ARE USED IN SPECIAL CONTROL APPLICATIONS ONLY. CONSULT FACTORY FOR USE.

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**FIGURE 5**  
**TWO UNIT NON-ALTERNATING MODE WITH DUAL COMPRESSORS**  
**NO JUMPER ACROSS "2" PINS**

**NOTE:** This configuration (Fig. 5) is for two (2) HVAC units with two (2) compressors only (should not be used for units with 2-stage compressors) and is designed to reverse operating position of the two compressors within each HVAC unit at the selected Lead/Lag changeover interval, or when using Manual "Change Lead Unit" button. The operating position of HVAC Unit #1 and #2 does not change and Unit #1 is always the lead unit and the #2 the lag unit.



UNIT #1  
UNIT #2

**Sequence of Operation for 2 Units (No Jumper Across the "2" Pins)**  
**Controller Indicates Lead Unit is #1**

Cooling Call	Controller Stage	Operation
1	1	Unit #1 Compressor #1
2	2	Unit #1 Compressor #2
3	3	Unit #2 Compressor #1
4	4	Unit #2 Compressor #2

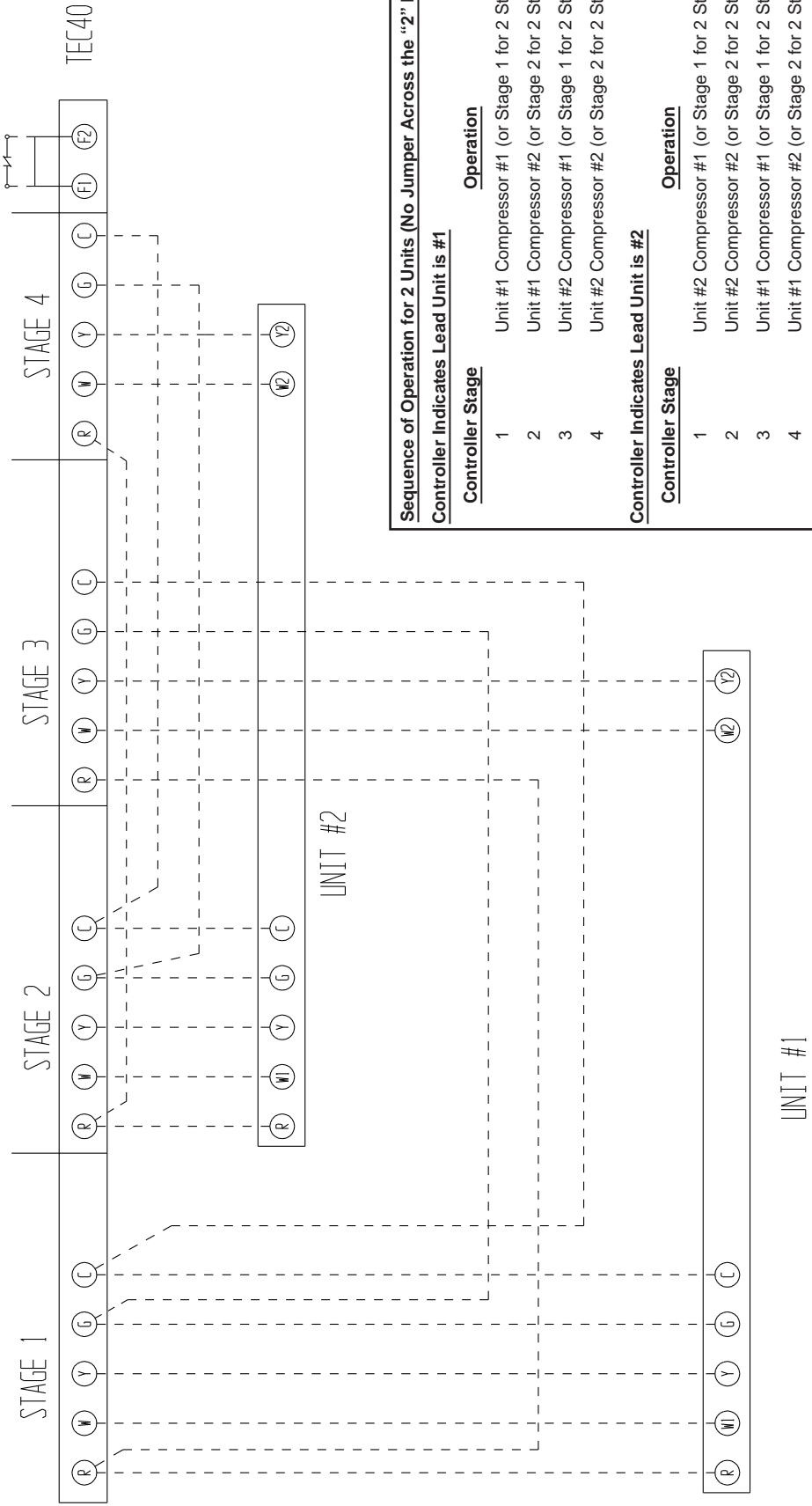
**Controller Indicates Lead Unit is #2**

Cooling Call	Controller Stage	Operation
1	1	Unit #1 Compressor #2
2	2	Unit #1 Compressor #1
3	3	Unit #2 Compressor #2
4	4	Unit #2 Compressor #1

**FIGURE 6**  
**TWO UNIT ALTERNATING MODE WITH 2-SPEED OR DUAL COMPRESSORS**  
**JUMPER REQUIRED ACROSS "2" PINS**

**NOTE:** This configuration (Fig. 6) is for two (2) HVAC units each with two (2) compressors (or 2 units with 2-stage compressors) and is designed to reverse operating position of the two machines at the selected Lead/Lag changeover interval, or when using Manual "Change Lead Unit" button. The operating sequence of the two compressors (or the 2-stage compressor) in each unit does not change when the HVAC #1 & #2 units are reversed.

IF FIRE SUPPRESSION SYSTEM IS USED, REMOVE JUMPER FROM F1 TO F2 & WIRE NORMALLY CLOSED FIRE SUPPRESSOR CONTACT FROM F1 TO F2.



Sequence of Operation for 2 Units (No Jumper Across the "2" Pins)	
Controller Indicates Lead Unit is #1	
Controller Stage	Operation
1	Unit #1 Compressor #1 (or Stage 1 for 2 Stage)
2	Unit #1 Compressor #2 (or Stage 2 for 2 Stage)
3	Unit #2 Compressor #1 (or Stage 1 for 2 Stage)
4	Unit #2 Compressor #2 (or Stage 2 for 2 Stage)
Controller Indicates Lead Unit is #2	
Controller Stage	Operation
1	Unit #2 Compressor #1 (or Stage 1 for 2 Stage)
2	Unit #2 Compressor #2 (or Stage 2 for 2 Stage)
3	Unit #1 Compressor #1 (or Stage 1 for 2 Stage)
4	Unit #1 Compressor #2 (or Stage 2 for 2 Stage)

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