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# INSTALLATION INSTRUCTIONS

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## TEC40 ELECTRONIC CONTROLLER



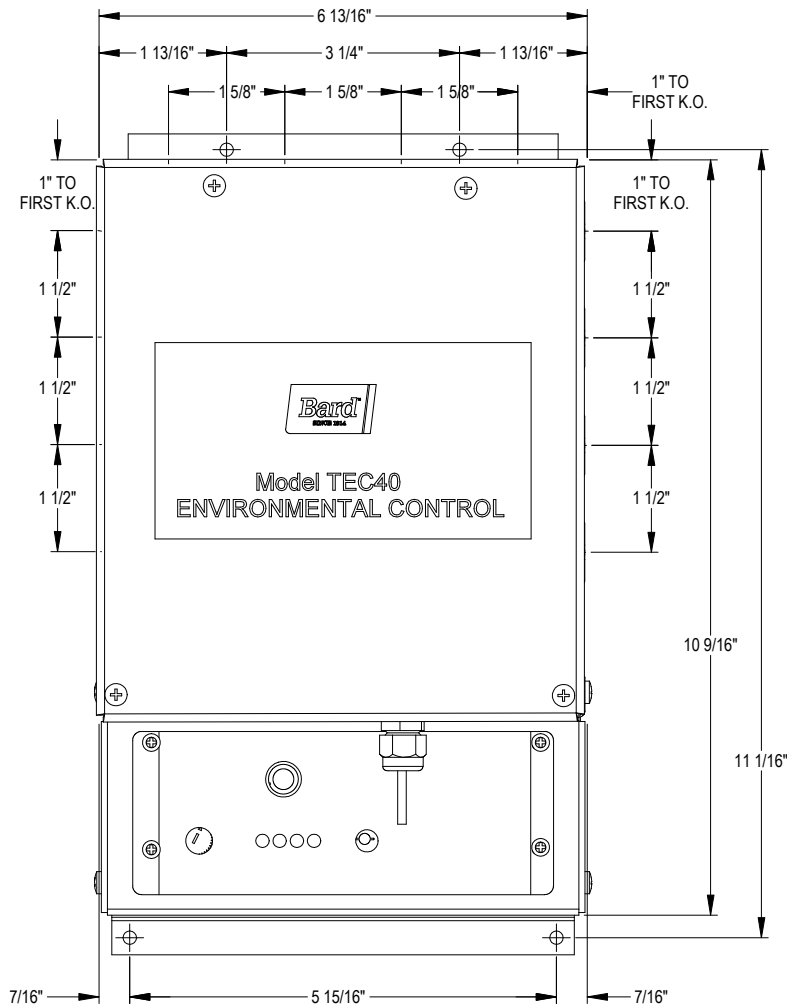
*Climate Control Solutions*

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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 Bard air conditioning wall-mount units. The TEC40 is for use with units with or without economizers.

It is recommended that a 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 on page 7 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, press and hold the change lead unit pushbutton for one second. Timer speed up is supplied for ease of troubleshooting.

Lead unit cycles between all four 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. Press

the pushbutton 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 (page 8), Figure 5 (page 11) or Figure 8 (page 14).

### Sequence of Operation – Cooling

First stage cooling setpoint is determined by the position of the cooling setpoint 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 an economizer, the compressor will energize. First stage cooling LED will light.

Second stage cooling setpoint is 2° warmer than first stage cooling setpoint. 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 an economizer, the compressor will energize. Second stage cooling LED will light.

Third stage cooling setpoint is 2° warmer than second stage cooling setpoint. 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 an economizer, the compressor will energize. Third stage cooling LED will light.

Fourth stage cooling setpoint is 2° warmer than third stage cooling setpoint. On a call for fourth stage cooling, the blower and either economizer or compressor of the next unit are energized. The enthalpy control on the economizer will make the

decision as to which is energized. If not equipped with an economizer, the compressor will energize. Fourth stage cooling LED will light.

### **Sequence of Operation – Heating**

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

Second stage heating setpoint is 2° colder than first stage heating setpoint. On a call for second stage heating, the blower and electric heat of the next unit are energized. Second stage heating LED will light.

Third stage heating setpoint is 2° colder than second stage heating setpoint. On a call for third stage heating, the blower and electric heat of the next unit are energized. Third stage heating LED will light.

Fourth stage heating setpoint is 2° colder than third stage heating setpoint. On a call for fourth stage heating, the blower and electric heat of the next unit are 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 (page 9), Figure 6 (page 12) or Figure 9 (page 15).

### **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 11 on page 17.

**NOTE:** *The configuration in Figure 11 is for two (2) HVAC units with two (2) compressors only (should not be used for units with two 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 setpoint is determined by the position of the cooling setpoint potentiometer. On

a call for first stage cooling, the blower and first compressor of the lead unit are energized. First stage cooling LED will light.

Second stage cooling setpoint is 2° warmer than first stage cooling setpoint. On a call for second stage cooling, the second compressor of the lead unit are energized. Second stage cooling LED will light.

Third stage cooling setpoint is 2° warmer than second stage cooling setpoint. On a call for third stage cooling, the blower and first compressor of the lag unit are energized. Third stage cooling LED will light.

Fourth stage cooling setpoint is 2° warmer than third stage cooling setpoint. On a call for fourth stage cooling, the second compressor of the lag unit is energized. Fourth stage cooling LED will light.

### **Sequence of Operation – Heating**

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

Second stage heating setpoint is 2° colder than first stage heating setpoint. 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 setpoint is 2° colder than second stage heating setpoint. 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 setpoint is 2° colder than third stage heating setpoint. 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 stage compressors or two air conditioners with dual compressors. For two air conditioners with two stage or dual compressors, make connections per Figure 12 on page 18.
- Two air conditioners with economizers with full redundancy. For two air conditioners with economizers, make connections per Figure 4 (page 10), Figure 7 (page 13) or Figure 10 (page 16).

**NOTE:** *The configuration in Figure 12 is for two (2) HVAC units each with two (2) compressors or two units with two 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 two stage compressor) in each unit does not change when the HVAC #1 and #2 units are reversed.*

### **Sequence of Operation – Cooling with Economizers**

First stage cooling setpoint is determined by the position of the cooling setpoint potentiometer. On a call for first stage cooling, the blower and either economizer or compressor of the lead unit are 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 setpoint is 2° warmer than first stage cooling setpoint. On a call for second stage cooling, the blower and either economizer or compressor of the lag unit are 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 setpoint is 2° warmer than second stage cooling setpoint. On a call for third stage cooling, the compressor of the lead unit is energized and the economizer returns to minimum position if open. Third stage cooling LED will light.

Fourth stage cooling setpoint is 2° warmer than third stage cooling setpoint. On a call for fourth stage cooling, the compressor of the lag unit is energized and the economizer returns to minimum position if open. Fourth stage cooling LED will light.

### **Sequence of Operation – Heating**

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

Second stage heating setpoint is 2° colder than first stage heating setpoint. 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 setpoint is 2° colder than second stage heating setpoint. 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 setpoint is 2° colder than third stage heating setpoint. 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**

### **Mounting**

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

The controller should be installed on a vertical wall approximately 4' 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" 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 isolates 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 Figures 2 – 12 depending on the mode of operation desired. Figures 2, 3 and 4 are for EIFM economizers; Figures 5, 6 and 7 are for W\*\*A2 models with ECONWM economizers; 8, 9 and 10 are for W\*\*AA models with WECOP economizers and Figures 11 and 12 are for controlling two unit dual compressor (or two stage compressor in Figure 12) air conditioners manufactured by other suppliers.

## **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 conditioners 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 of 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 Setpoint

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

### Dead Band

The dead band is the span between heating setpoint and cooling setpoint where no heating or cooling takes place. The cooling setpoint minus the dead band equals the heating setpoint. 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 Pushbutton

Pushing the lead change pushbutton 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 four (4) red LEDs 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 to OFF. Change jumpers as necessary and turn switch to

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 pushbutton 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 to ON.
6. After the four (4) red LEDs 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.

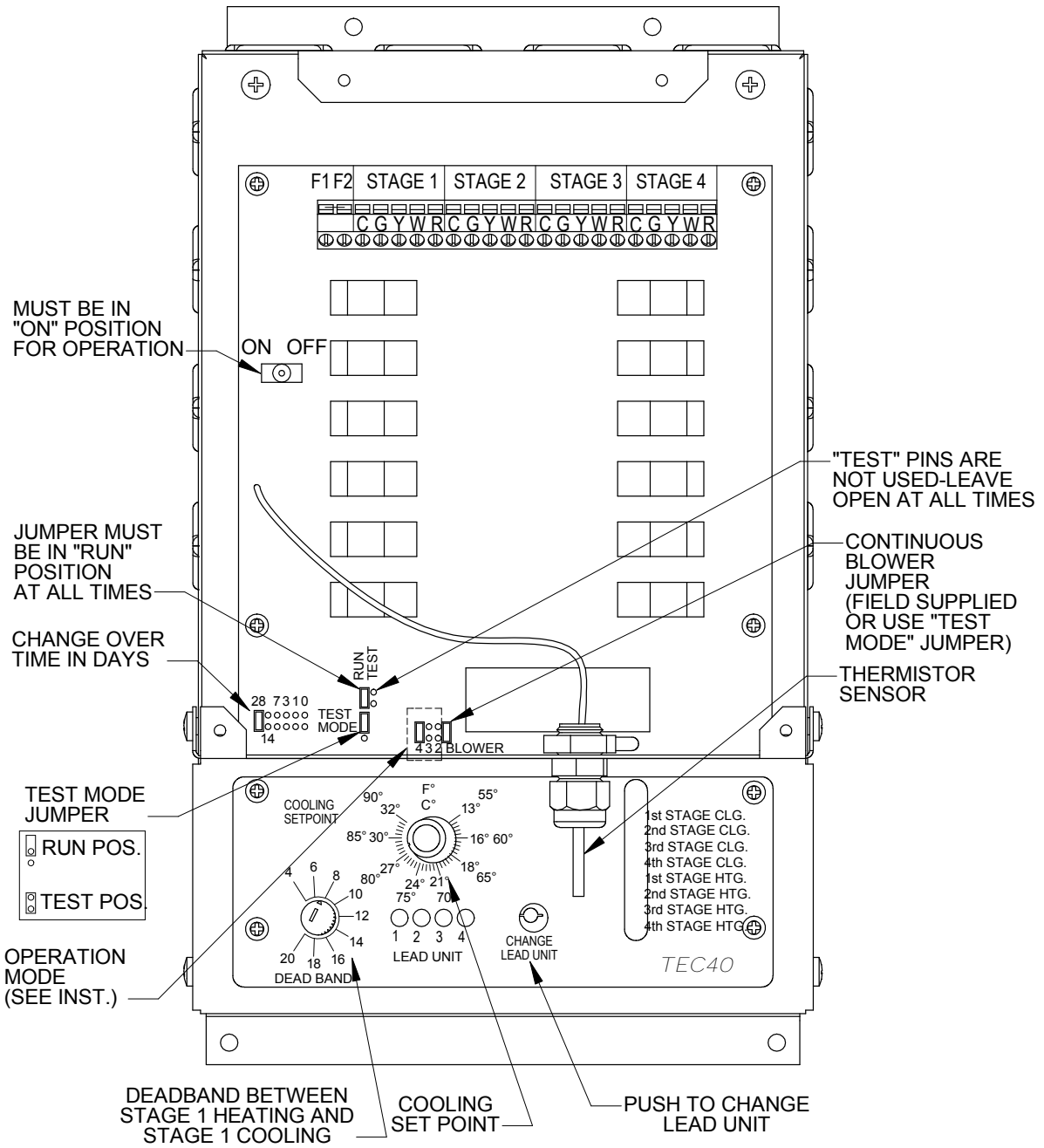
### Operation Mode Jumper (Under Cover)

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)

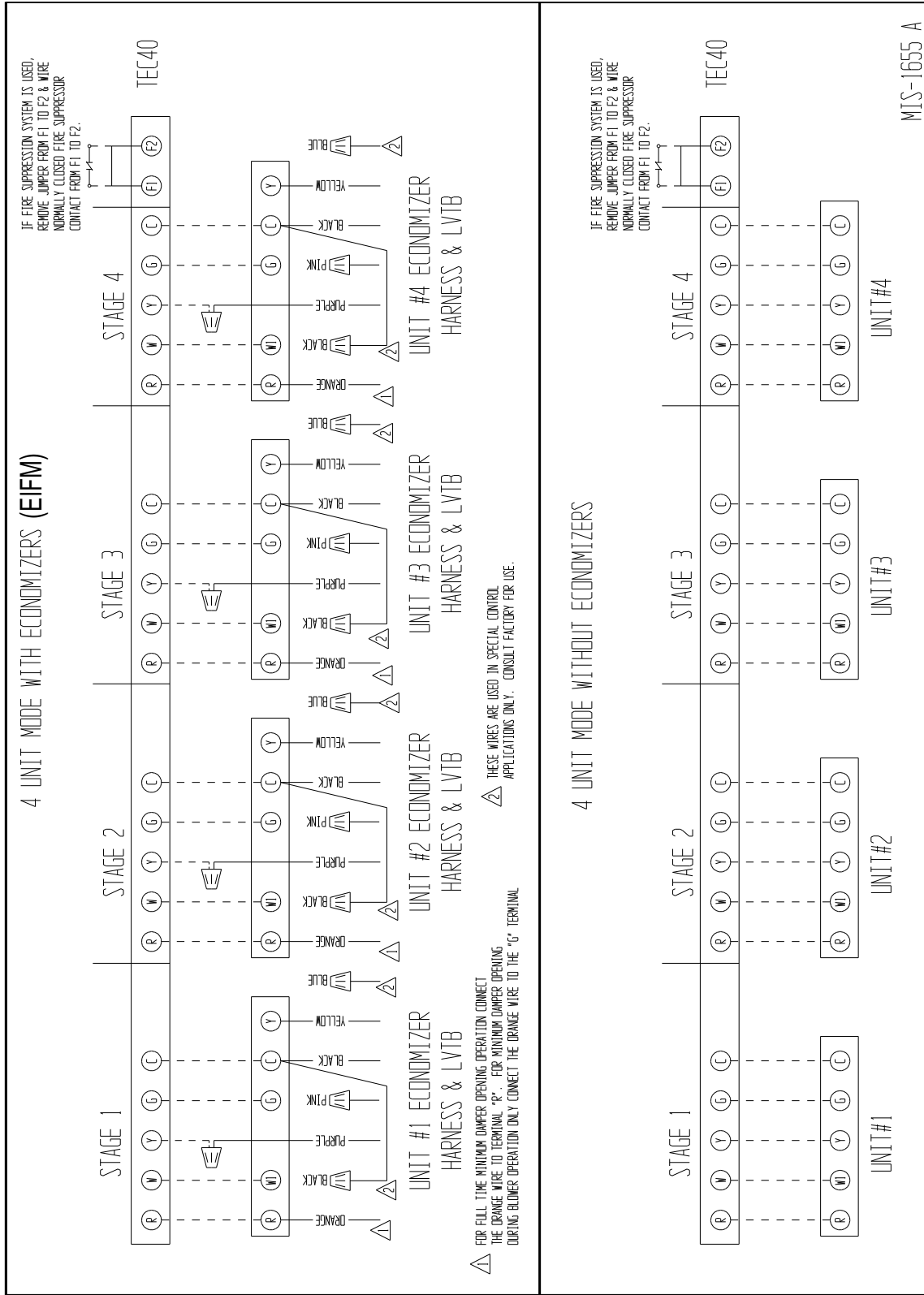
Position jumper across pins for continuous blower on the lead unit. Remove jumper to have the lead unit blower cycle with the compressor.

**FIGURE 1**  
**Control Locations**



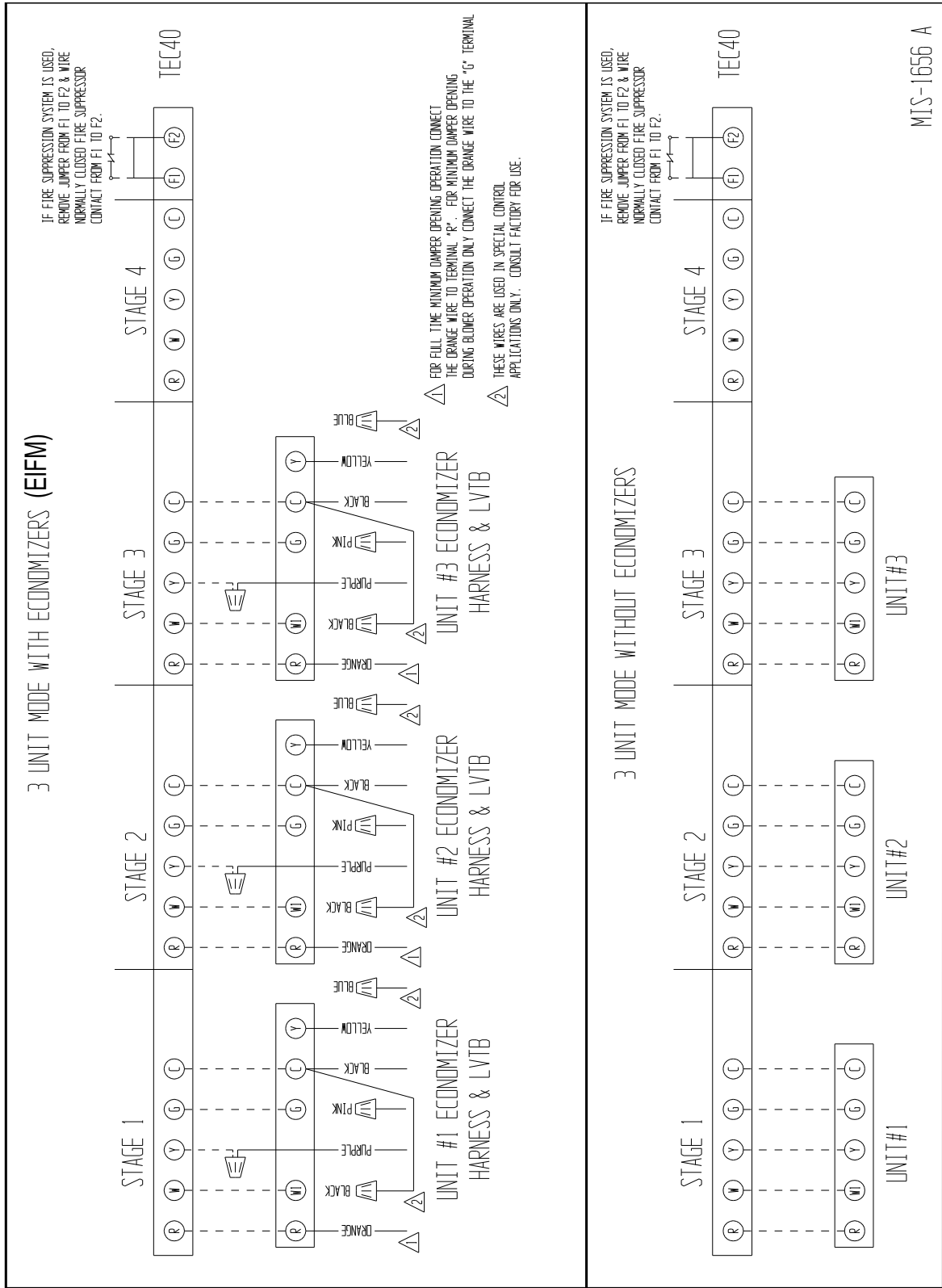
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**FIGURE 2**

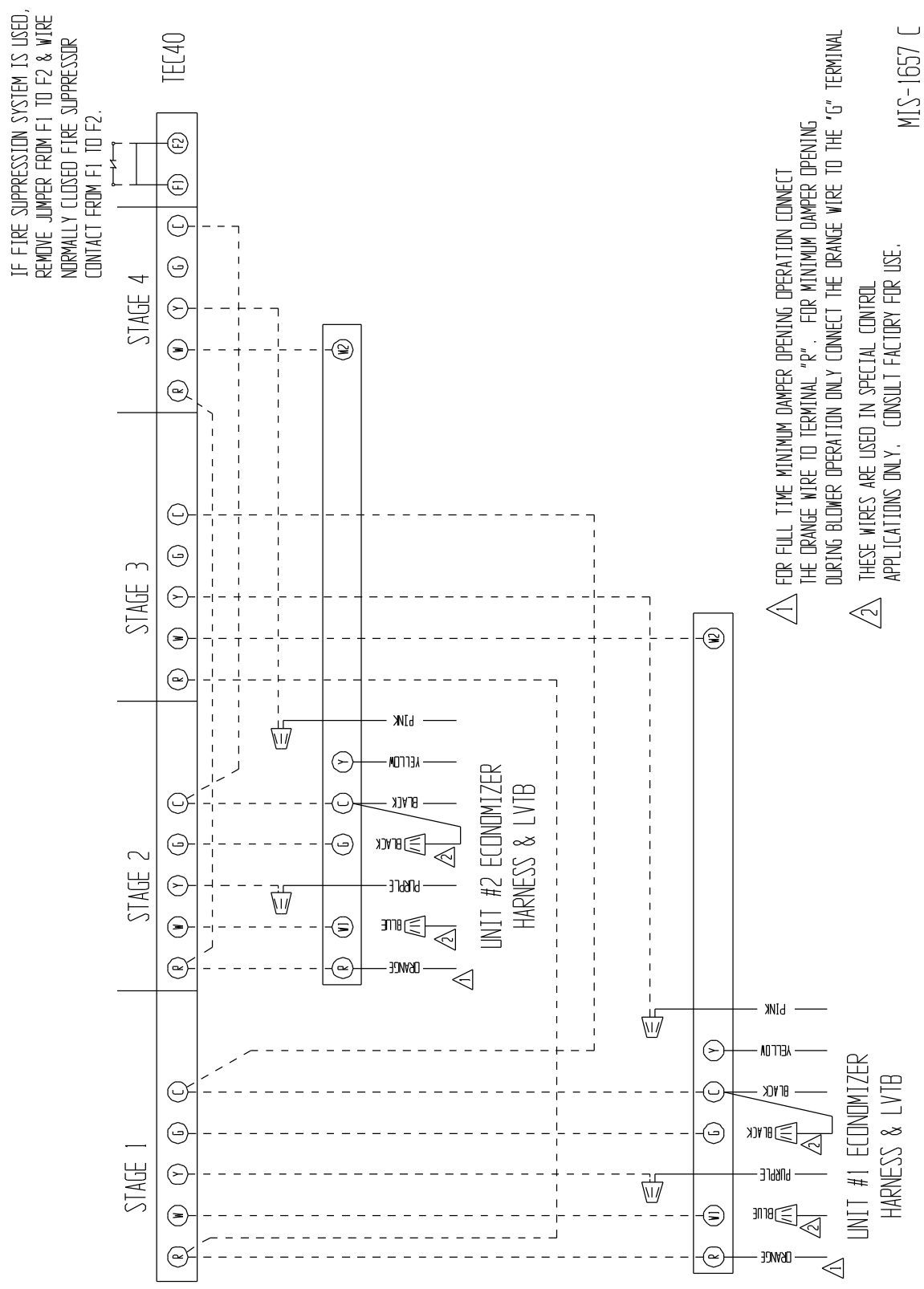




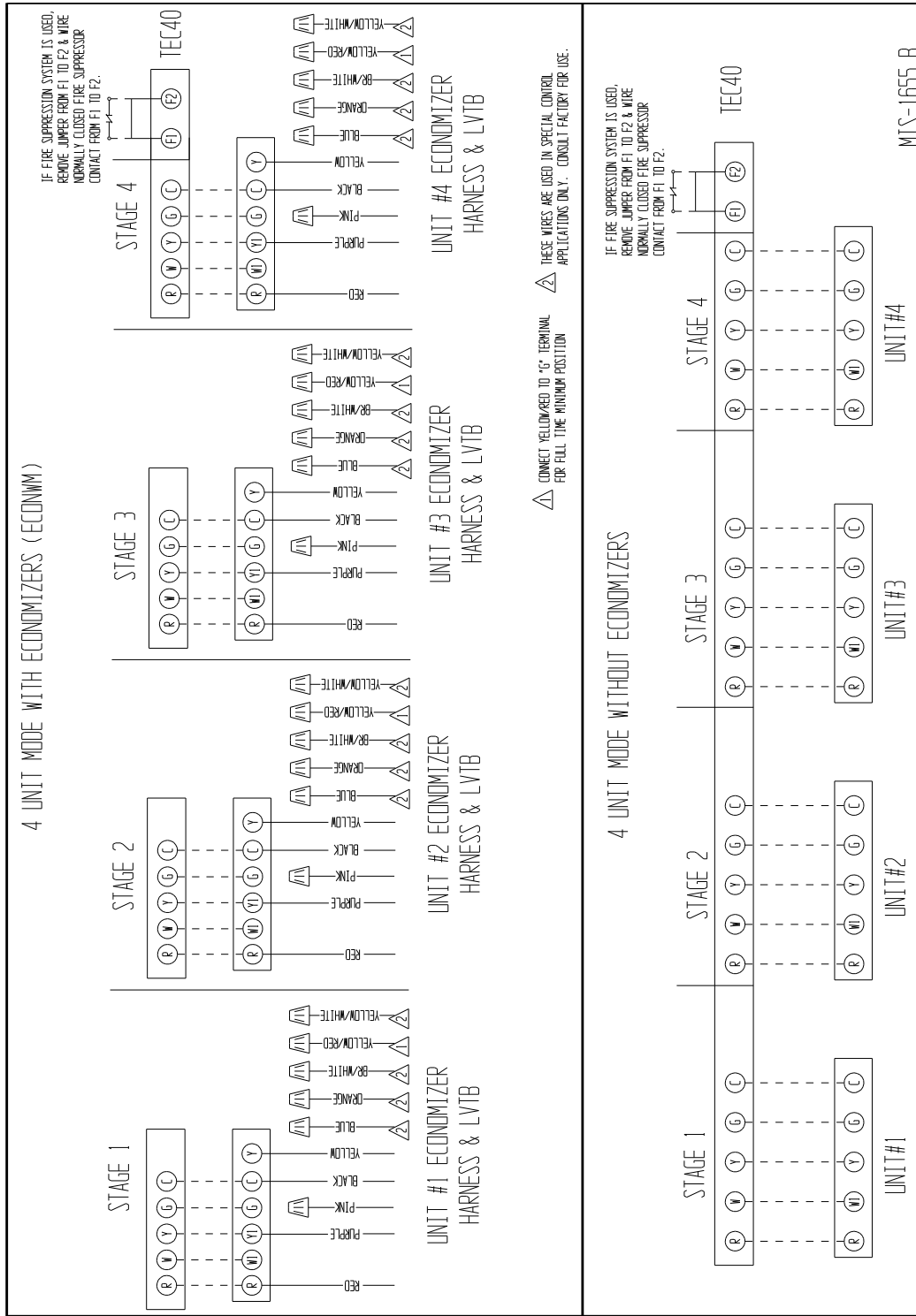
**FIGURE 3**



**FIGURE 4**  
TWO UNIT ALTERNATING MODE WITH ECONOMIZERS (EIFM)

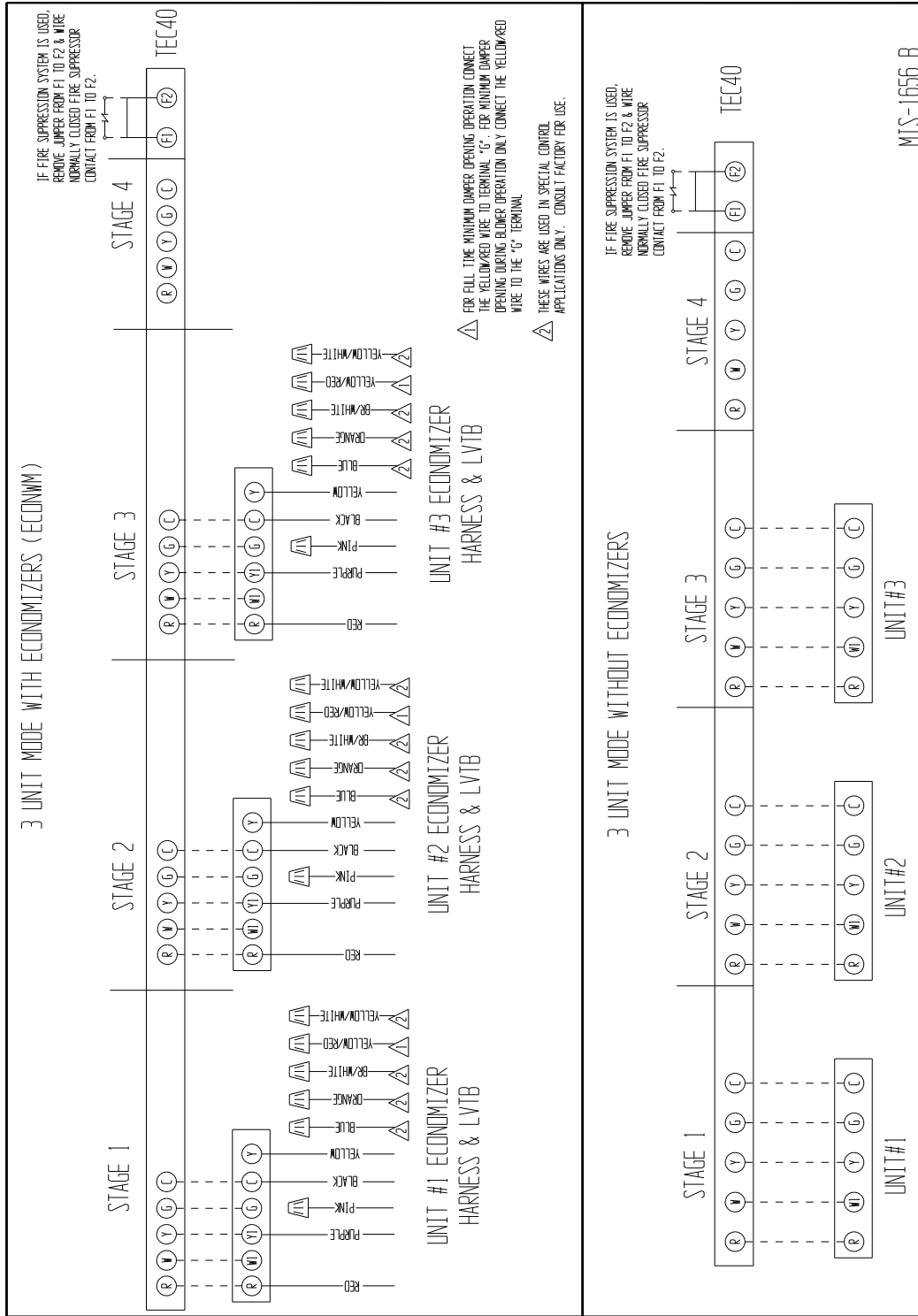


**FIGURE 5**  
**W\*\*A2 Models with ECONWM Economizers**



NOTE: TEC40 controller system has only 1-stage of cooling output available per unit when used in 3- or 4-unit configuration. ECONWM economizers have factory default outdoor decision setpoints that are 70°F DB for the temperature only versions and ES3 enthalpy versions that will result in DB changeover in 60-70°F range depending upon humidity. When these systems are used with the TEC40, it may require changing the DB setpoint to 55°F or the enthalpy setpoint to EX5 in order to limit economizer operation to an acceptable range. In these wiring applications, Y2 cooling call is not available. Compressor cooling call is handled by the outdoor economizer temperature or temperature/enthalpy sensor decision as noted above.

**FIGURE 6**  
**W\*\*A2 Models with ECONWM Economizers**



NOTE: TEC40 controller system has only 1-stage of cooling output available per unit when used in 3- or 4-unit configuration. ECONWM economizers have factory default outdoor decision setpoints that are 70°F DB for the temperature only versions and ES3 enthalpy versions that will result in DB changeover in 60-70°F range depending upon humidity. When these systems are used with the TEC40, it may require changing the DB setpoint to 55°F or the enthalpy setpoint to ES5 in order to limit economizer operation to an acceptable range. In these wiring applications, Y2 cooling call is not available. Compressor cooling call is handled by the outdoor economizer temperature or temperature/enthalpy sensor decision as noted above.

FIGURE 7

W\*\*A2 Models with ECONWM Economizers

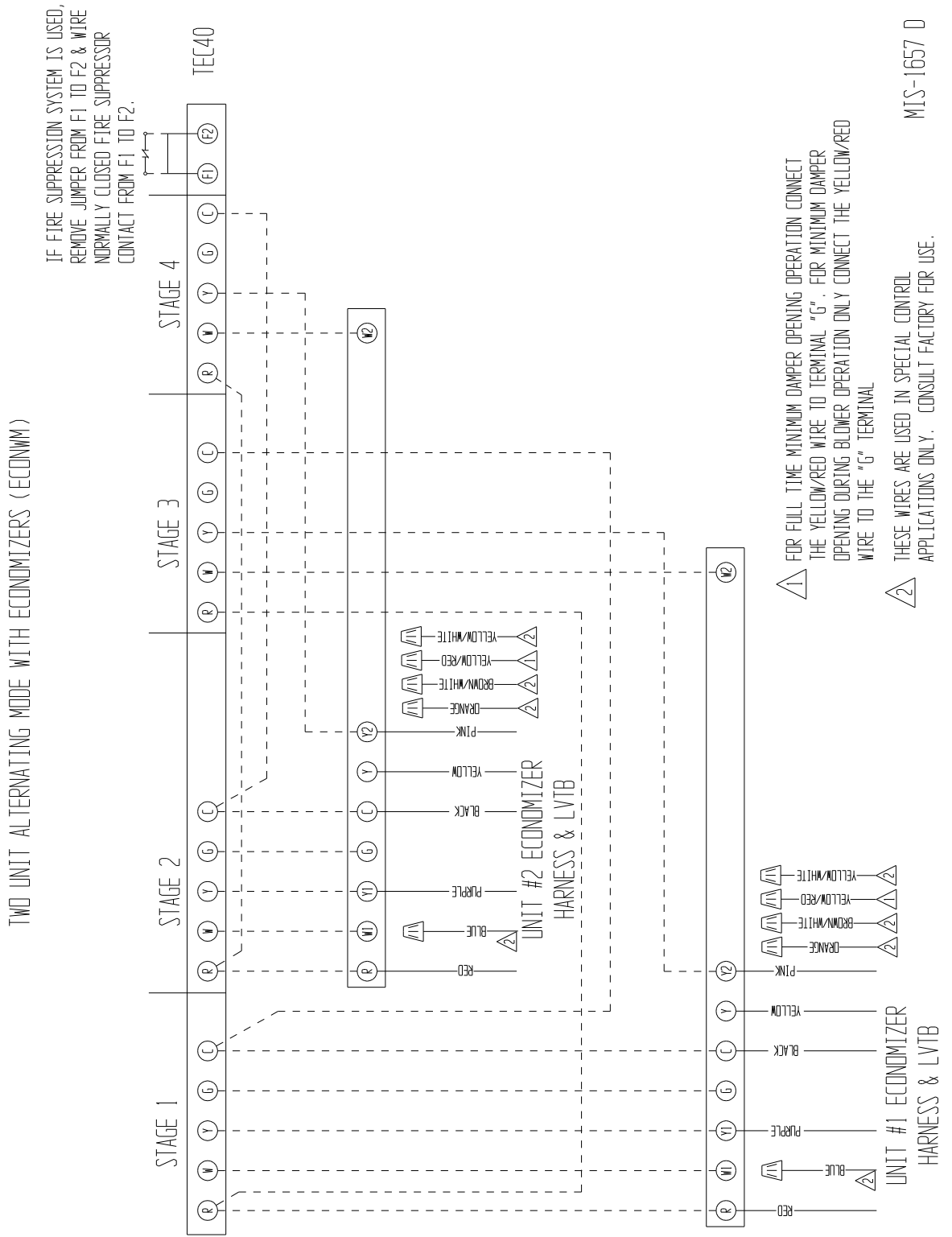
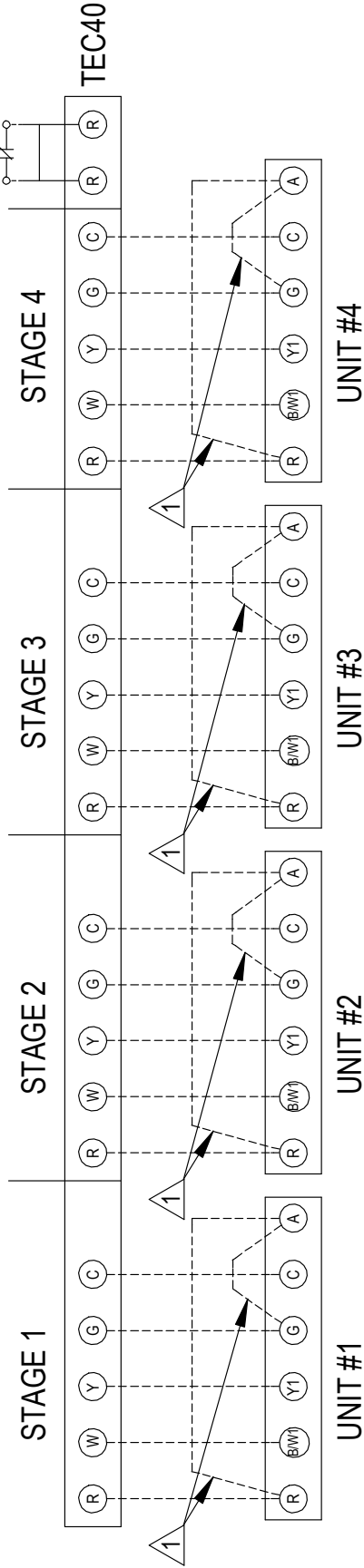


FIGURE 8

W\*\*AA Models with WECOP Economizers

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

### 4 UNIT MODE WITH OR WITHOUT ECONOMIZERS



IF EQUIPPED WITH ECONOMIZER, FOR FULL TIME MIN. DAMPER OPENING OPERATION, ADD JUMPER FROM "R" TO "A" OR FOR MIN. DAMPER OPENING DURING BLOWER OPERATION ONLY, ADD JUMPER FROM "G" TO "A".

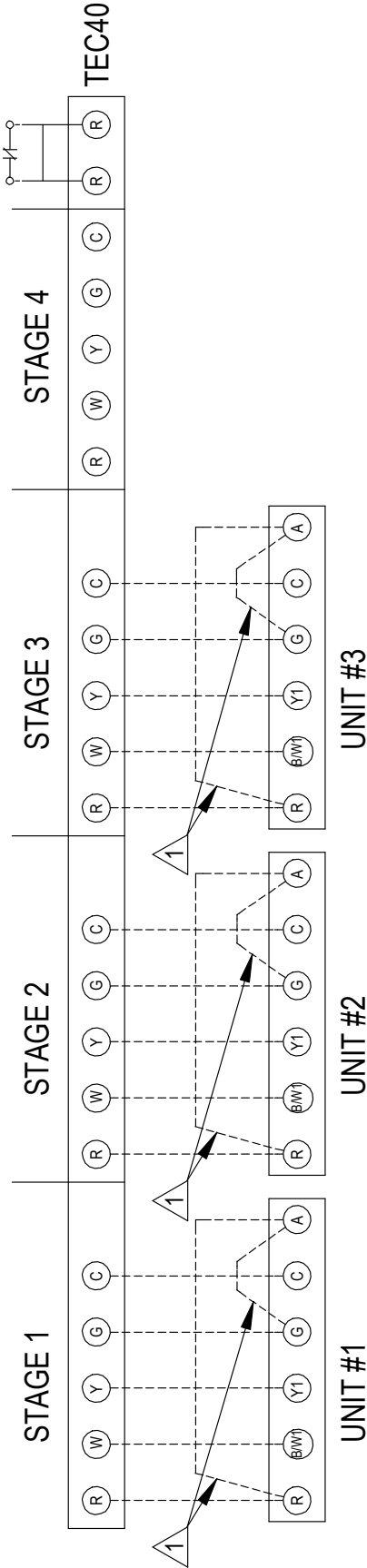
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FIGURE 9

W\*\* AA Models with WECOP Economizers

### 3 UNIT MODE WITH OR WITHOUT ECONOMIZERS

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



IF EQUIPPED WITH ECONOMIZER, FOR FULL TIME MIN. DAMPER OPENING OPERATION, ADD JUMPER FROM "R" TO "A" OR FOR MIN. DAMPER OPENING DURING BLOWER OPERATION ONLY, ADD JUMPER FROM "G" TO "A".

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**FIGURE 10**  
**W\*\*AA Models with WECOP Economizers**

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

**TWO UNIT ALTERNATING MODE WITH CONOMIZERS (WECOP)**

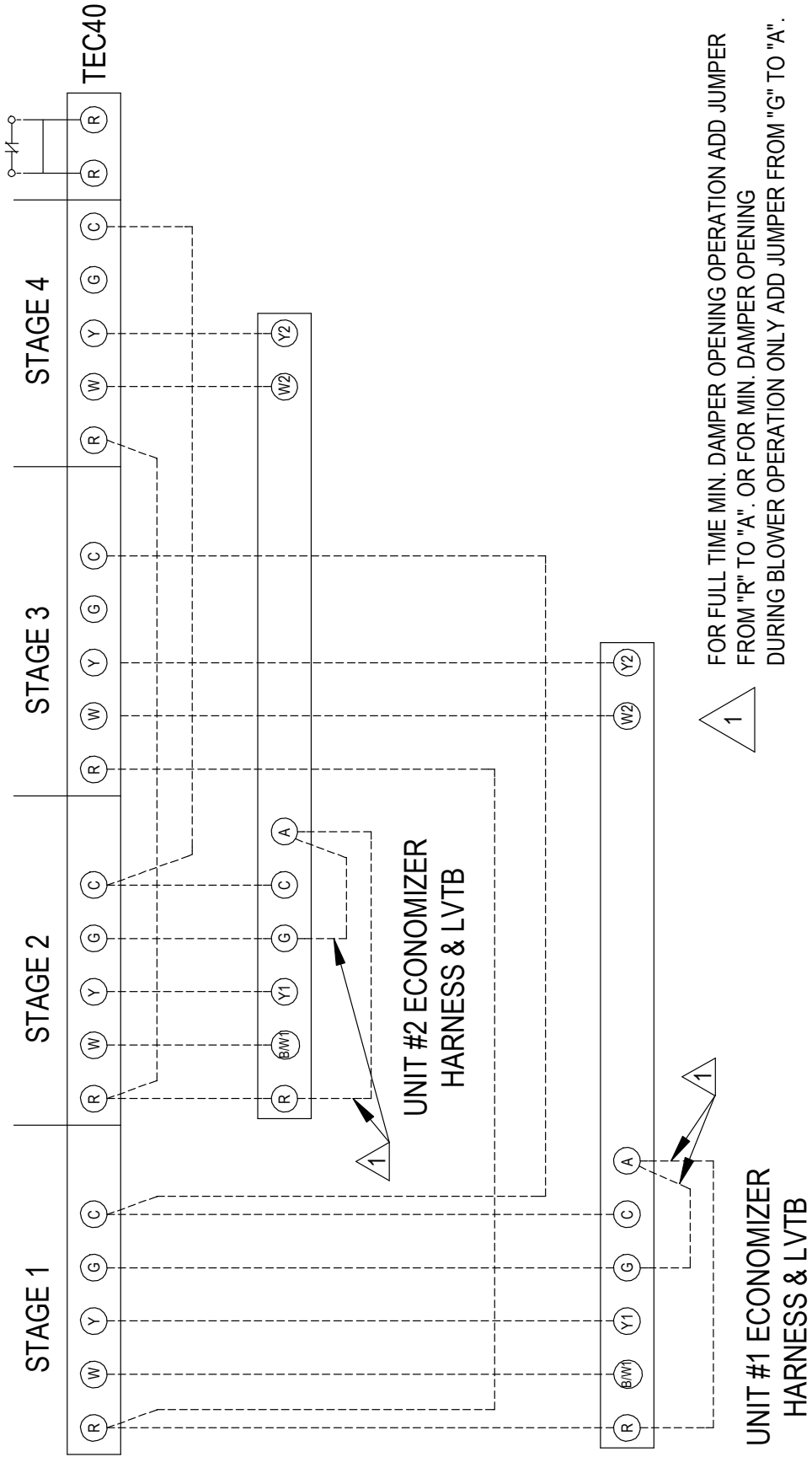


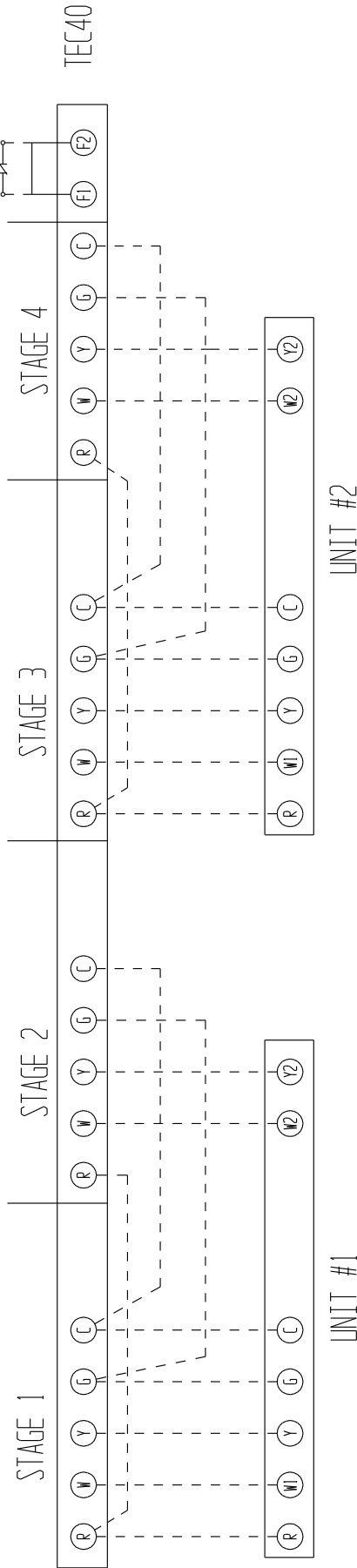


FIGURE 11

**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.

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**

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

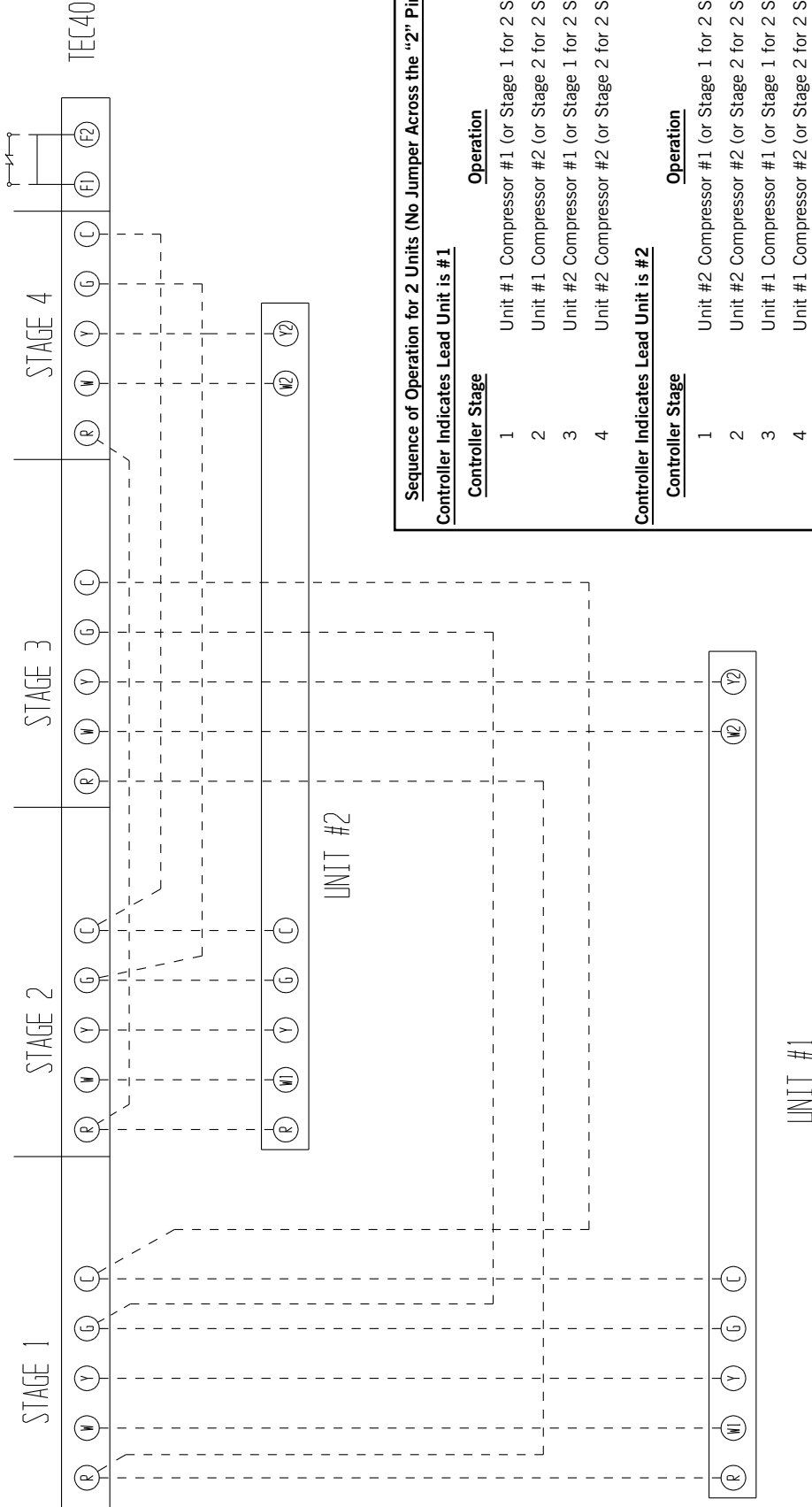
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FIGURE 12

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.



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