TRANE™

VARIABLE SPEED II

Pub. No. 22-8058-2

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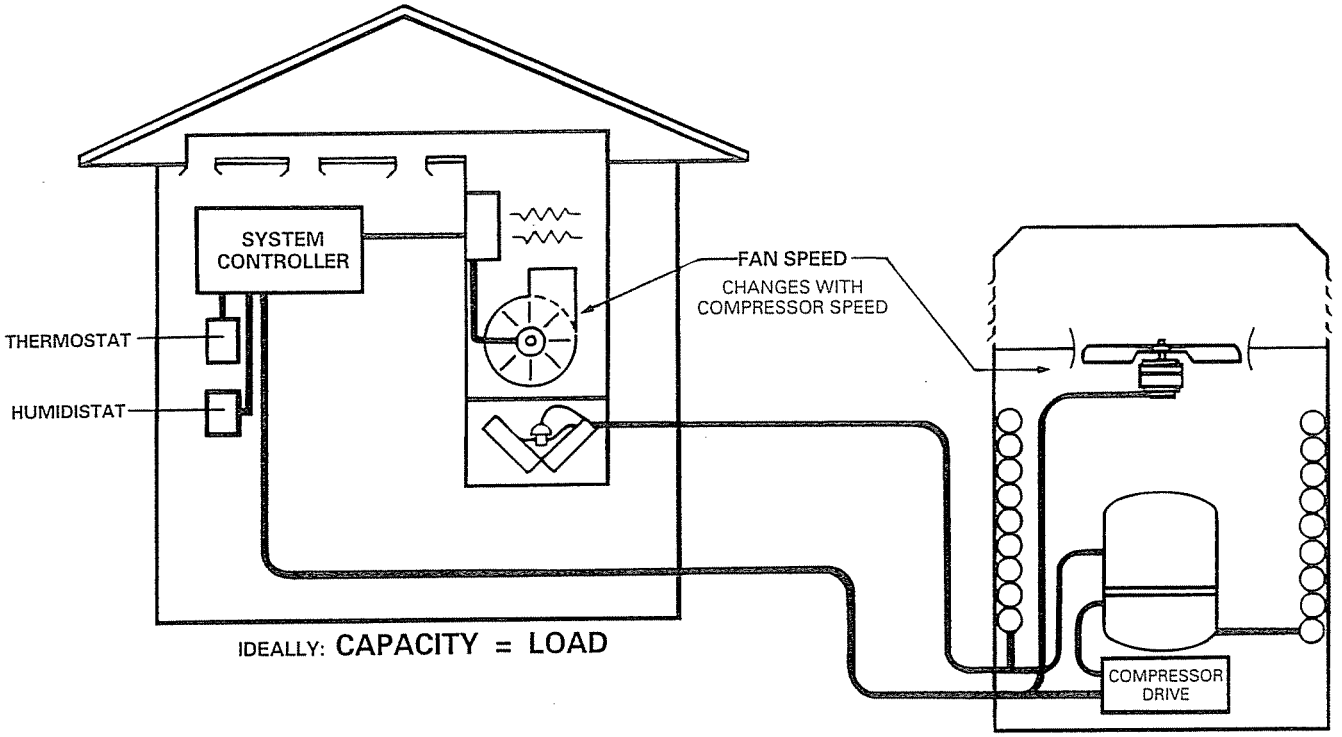
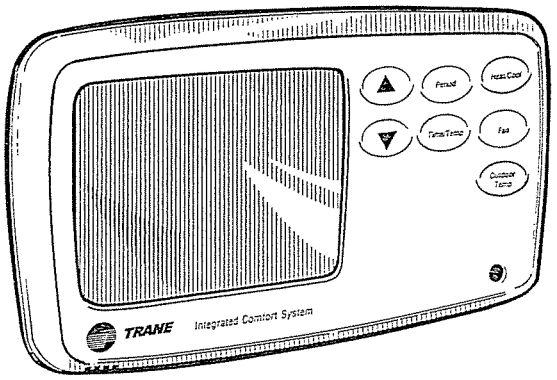
VARIABLE SPEED SYSTEM
CONVENTIONAL IN SERVICE AND INSTALLATION

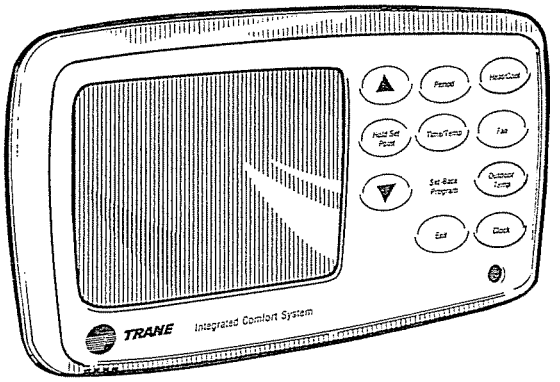


VARIABLE SPEED SYSTEM
OPERATING CHARACTERISTICS

- Soft Start
- Compressor Speed Ranges From 1950 RPM to 6950 RPM
- Controlled Speed Change (RAMP)
- Operates At Maximum Efficiency
- Fans Change Speed With Compressor
- Maintains Latent Control Regardless Of Capacity
- Completely Variable Selections Of I.D. Airflow
- Insensitive To Line Voltage Changes
- Speed Changes During Defrost Cycle



AYVSTAT100A



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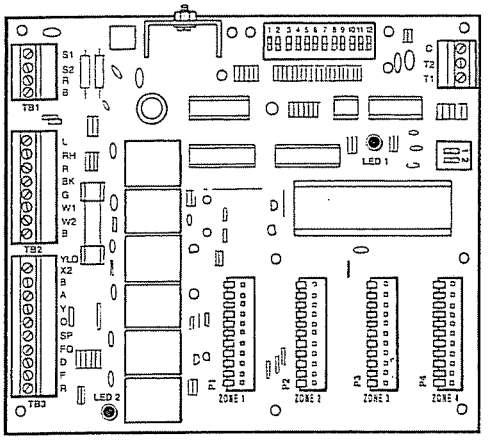


AYVCTLR100A

XV1800 THERMOSTAT

- Styled for Residential
- Sensor Only – "Dumb Stat"
- Remote Sensor
- Tactile/Audible Keyboard Feedback
- Non-Volatile Storage
- Programmable/Non-Programmable Versions
  - 5/2 Day with 2 Set Points/Day
- Battery Backup
- NEC 17201A mProcessor
- Simplified Thermostat Programming
- Improved Comfort Controls
- RS-485 Bi-Directional Communication
- Non-Dedicated Thermostat – "Dumb Stat"
  - All algorithms and control functions in system controller
- Zoning Capabilities
- XV1500 Compatible
- System Monitoring/Troubleshooting Capabilities
- Home Automation Interface

THERMOSTAT SET-UP MODE

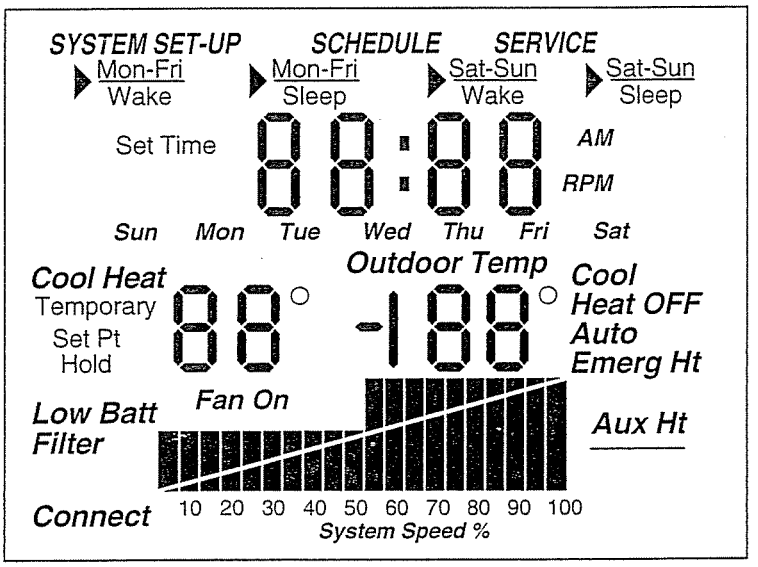
Two Key Pad Input (3 Seconds)

- Push and Hold Exit Pad
- Push Outdoor Temperature Pad
- Calibrate Indoor Temperature ▲ or ▼
- Push Heat/Cool Pad
- Set Time Format ▲ or ▼
  - Standard
  - Military
- Push Heat/Cool Pad
- Set Temperature Format ▲ or ▼
  - Fahrenheit
  - Celsius
- Push Heat/Cool Pad
- Set Zone Address ▲ or ▼
- Push Exit Pad

THERMOSTAT SERVICE MODE

Two Key Pad Input (3 Seconds)

- Push and Hold Exit Pad
- Push ▲ Up Arrow Pad
- View Message Buffer
- Push Heat/Cool Pad
- View Service Data
- Push Outdoor Temperature Pad
- Illuminate All LCD Segments



HOME AUTOMATION INTERFACE

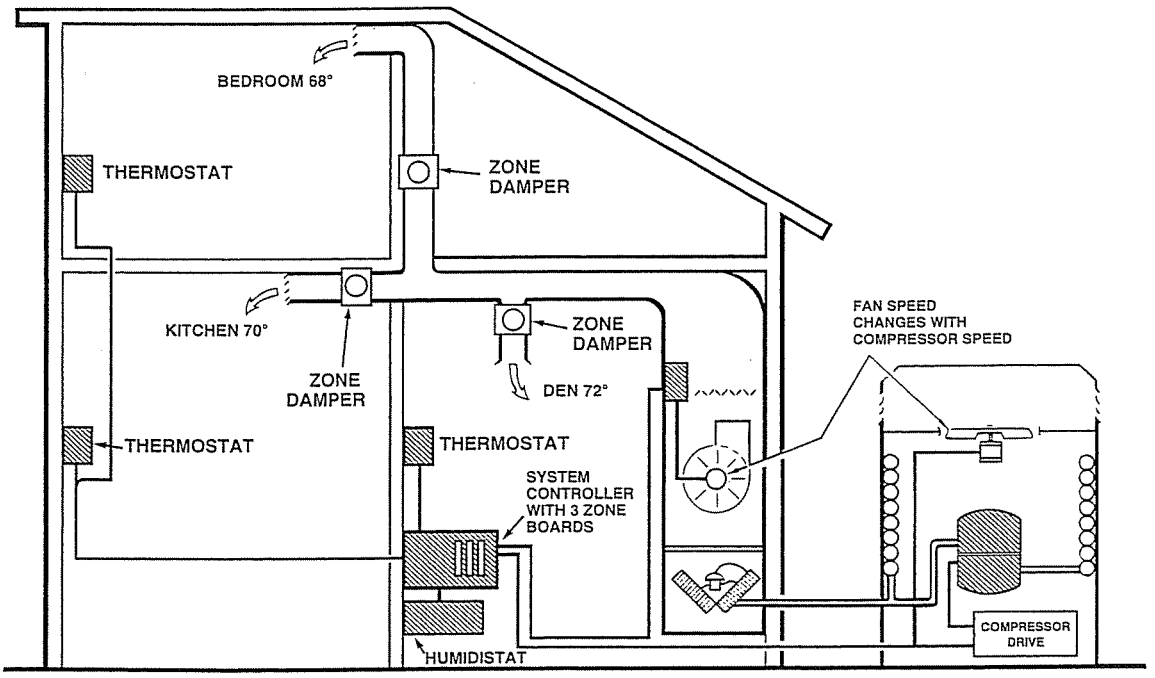
(Bridge)

Allows Home Automation Computer Control of Each Thermostat Zone

- Home Automation Access to RS-485 Bus
- Change Set Point (Heating/Cooling)
- Change Mode
- Change Fan Operation
- Lock Out Thermostat
- Allow Temporary Control By Thermostat
- Home Automation System Monitor Only
- "Open Architecture" – Access Home Automation Market
- Compatible With All Standards

VARIABLE SPEED SYSTEM

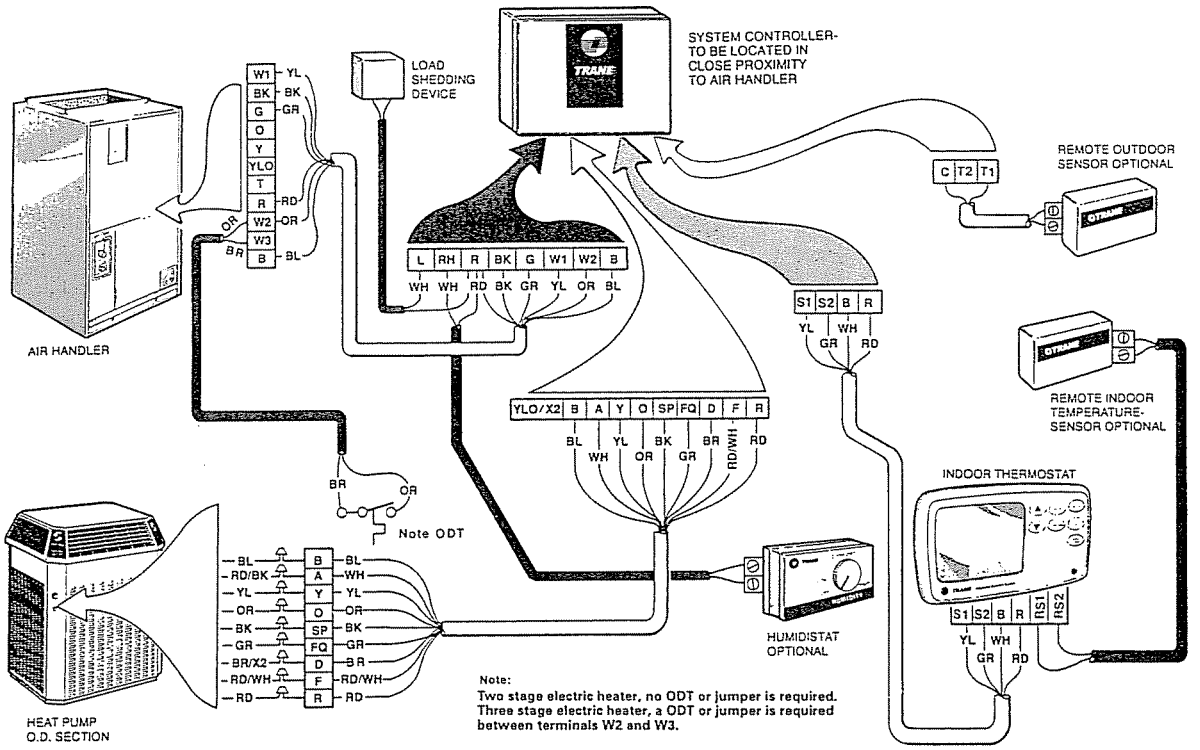
ZONED WITH ZONE DAMPERS



CONDITIONED AIR CAPACITY = ZONED LOADS

AYVSTAT100A/101A THERMOSTAT AND AYVCTLR100A CONTROLLER HEAT PUMP AND AIR HANDLER

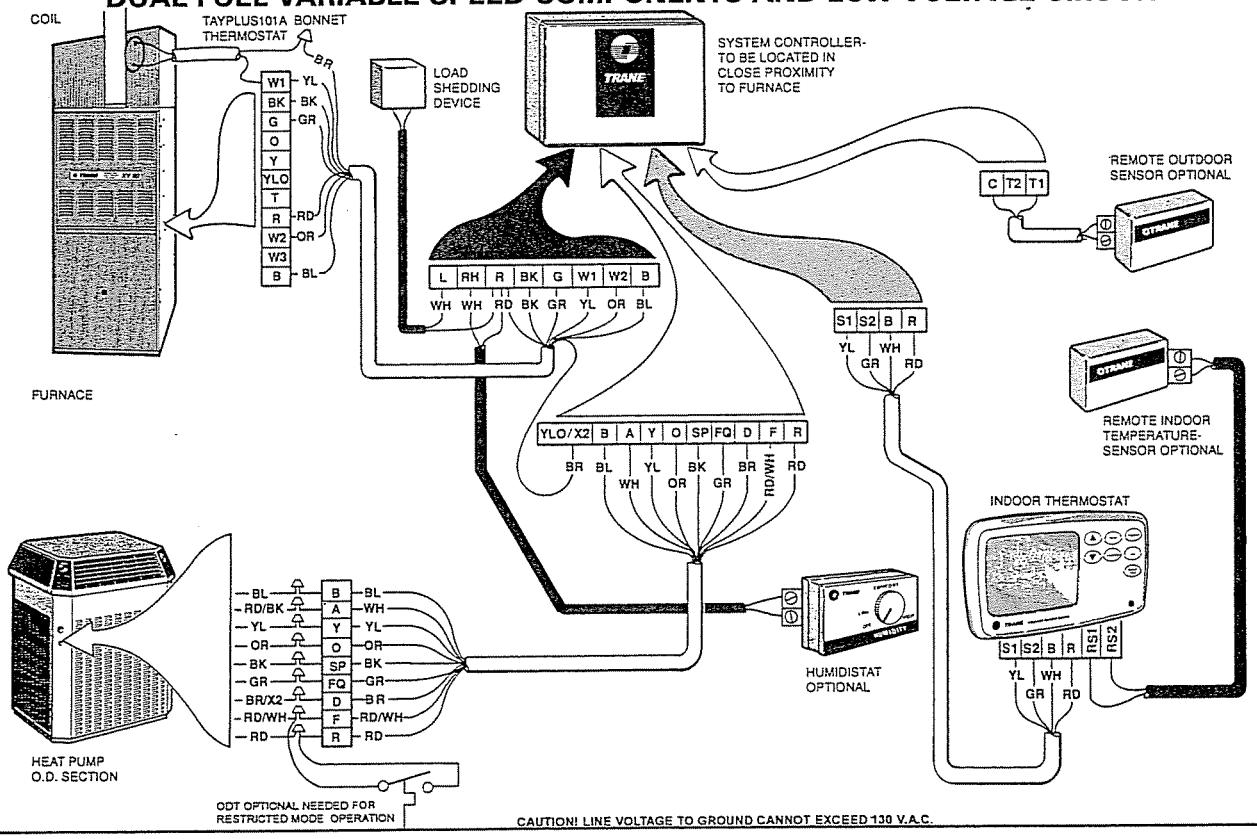
VARIABLE SPEED COMPONENTS AND LOW VOLTAGE CIRCUIT



CAUTION! LINE VOLTAGE TO GROUND CANNOT EXCEED 130 V.A.C.

AYVSTAT100A/101A THERMOSTAT AND AYVCTLR100A CONTROLLER HEAT PUMP AND GAS FURNACE

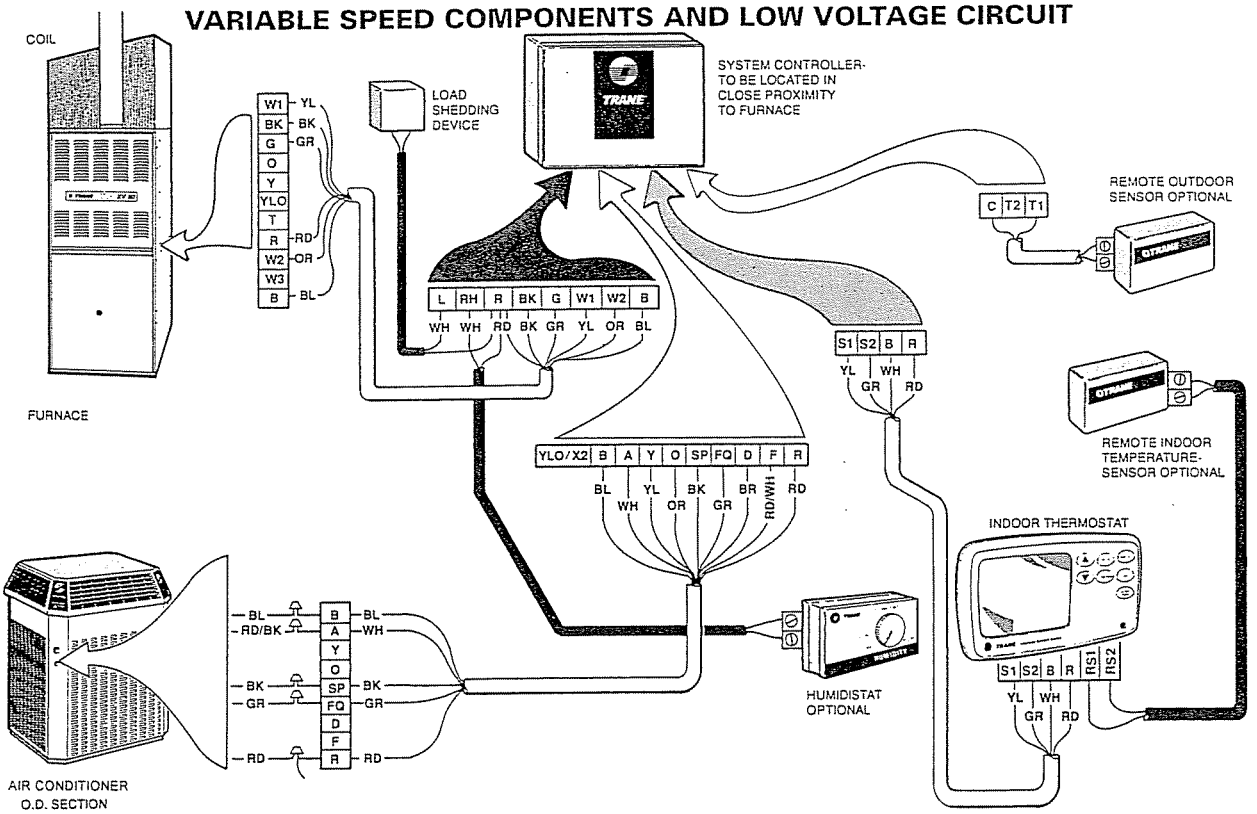
DUAL FUEL VARIABLE SPEED COMPONENTS AND LOW VOLTAGE CIRCUIT



CAUTION! LINE VOLTAGE TO GROUND CANNOT EXCEED 130 V.A.C.

AYVSTAT100A/101A THERMOSTAT AND AYVCTLR100A CONTROLLER COOLING AND GAS FURNACE

VARIABLE SPEED COMPONENTS AND LOW VOLTAGE CIRCUIT



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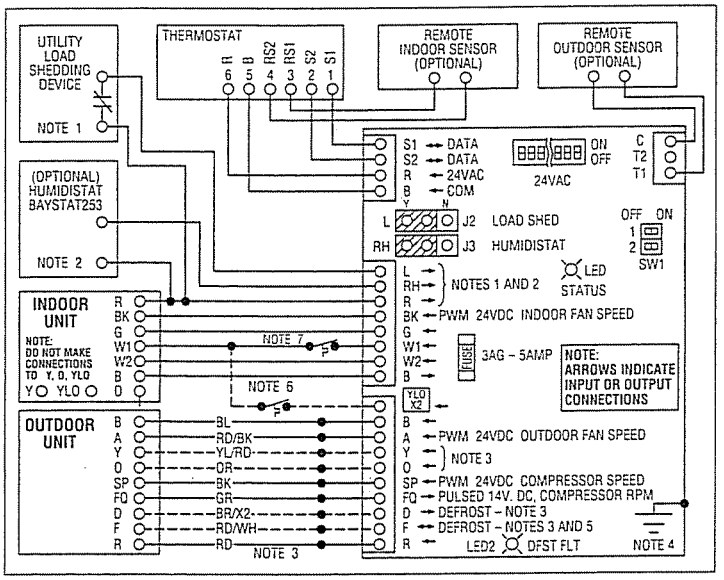
VARIABLE SPEED THERMOSTAT SYSTEM CONNECTION DIAGRAM AYSTAT100A AND AYSTAT101A



NOTES:

1. IF LOAD SHED SWITCH IS NOT USED, MOVE JUMPER J2 TO THE "NO" POSITION OR JUMPER R TO L.
2. IF HUMIDISTAT IS NOT USED, MOVE JUMPER J3 TO THE "NO" POSITION OR JUMPER R TO RH.
3. DASHED LINES ARE USED FOR HEAT PUMP CONNECTION BUT ARE NOT USED FOR HEAT/COOL SYSTEMS.
4. SYSTEM CONTROLLER CASE MUST BE GROUNDED TO THE INDOOR UNIT. ALL UNUSED THERMOSTAT WIRES MUST BE GROUNDED TO CONTROLLER.
5. FAULT WIRE MUST BE CONNECTED FOR USE WITH 4 AND 5 TON HEAT PUMPS. (OUTDOOR UNIT "F" WIRE).
6. TAYPLUS101A USED ON DUAL FUEL INSTALLATIONS ONLY.
7. BONNET THERMOSTAT PART NUMBER THT0732 REQUIRED ON GAS FURNACES WHEN SYSTEM IS ZONED. (SET THIS THERMOSTAT AT 120°F.)

NORMAL OPERATION

SWITCH		DESCRIPTION
DSW1	OFF	HEAT PUMP SYSTEM
	ON	HEAT-COOL SYSTEM
DSW2	OFF	GAS AUX. HEAT
	ON	ELECTRIC AUX. HEAT
DSW3	OFF	6 CYCLES/HOUR ON AUX. HEAT
	ON	3 CYCLES/HOUR ON AUX. HEAT
DSW4	OFF	SINGLE STAGE AUX.
	ON	TWO STAGE AUX.
DSW5	OFF	NORMAL OPERATION
	ON	TEST MODE
DSW6-OFF	DSW7-OFF	SPEED RANGE 1950 – 6950, XV 1500 - 2½, 3, 5 TON
DSW6-ON	DSW7-OFF	SPEED RANGE 1950 – 5250, XV 1500 - 4 TON
DSW6-OFF	DSW7-ON	SPEED RANGE 1700 – 6200, XV 1800A
DSW6-ON	DSW7-ON	SPEED RANGE 1700 – 6200, XV 1800B
DSW8	OFF	COOLING DROOP DISABLED
DSW8	ON	COOLING DROOP ENABLED
DSW9	OFF	COOLING DROOP – 1.0°F
DSW9	ON	COOLING DROOP – 2.0°F
DSW10-OFF	DSW11-OFF	LOAD SHED OFF
DSW10-ON	DSW11-OFF	LOAD SHED SPEED MIN.
DSW10-OFF	DSW11-ON	LOAD SHED SPEED 1/2
DSW10-ON	DSW11-ON	LOAD SHED SPEED 3/4
DSW12	OFF	STANDARD HEATING CFM
DSW12	ON	WARM DISH CFM

ZONING CONFIGURATION DIP-SWITCH

SWITCH		DESCRIPTION
SW1-1	OFF	NO BRIDGE
SW1-1	ON	BRIDGE
SW1-2	OFF	MULTIPLE VENT DAMPER
SW1-2	ON	MULTIPLE AIR HANDLER

TEST MODE OF OPERATION

SWITCH		DESCRIPTION
1	OFF	HEATING MODE
1	ON	COOLING MODE
2-OFF	3-OFF	MIN. SPEED
2-ON	3-OFF	INTER SPEED
2-OFF	3-ON	3/4 SPEED
2-ON	3-ON	MAX. SPEED
4	ON	TEST MODE
5	ON	TEST MODE
6-OFF	7-OFF	SPEED RANGE 1950 – 6950
6-ON	7-OFF	SPEED RANGE 1950 – 5250
6-OFF	7-ON	SPEED RANGE 1700 – 6200
6-ON	7-ON	SPEED RANGE 1700 – 6200
8,9,10,11,12-OFF	NOT USED	

SERVICE TEST MODE

The service test mode of operation is provided for field testing of the variable speed system. It allows operation of the variable speed system with or without the thermostat. During test operation the thermostat will not display compressor speed and it's green status LED will not be flashing. The test mode will operate a heat pump in either heating or cooling mode or a cooling only unit in the cooling mode. Four compressor operating speeds are provided: 1/4, 1/2, 3/4, and full speed. The indoor blower and outdoor fan motor speeds are properly scaled to match the speed of the compressor. The operation of the compressor is monitored (open loop, not controlled to Acturac RPM called for) in the test mode. If the compressor does not start and continue to run within 5 seconds, the system controller will turn off the call for compressor operation, the outdoor fan and indoor blower will continue to run if the system controller's microprocessor program is V2.06 or V3.0. The outdoor fan and indoor blower will come on and go off if the compressor does not start and continue to run if the system controller microprocessor program is a V3.1 or higher number. To get another compressor call remove power from system controller and repower system controller.

DIP switch 1 selects heating mode (OFF), heat pump only or cooling mode (ON). Switching from heating to cooling modes, heat pump only, is allowed while the compressor is running. Switch numbers 2 and 3 select the desired operation speed of the system, see the Thermostat System Connection Diagram for proper settings.

Switches 4 and 5 must both be on for the test mode of operation. Switches 6 and 7 select the desired speed ramp for the indoor blower, see the Thermostat System Connection Diagram for proper settings.

The status LED will be on in the test mode. If the compressor fails to start or continue to run, the status LED will go to a fast flash pattern, if controller's microprocessor programs is V2.6, V3.0 or V3.1.

If controller's microprocessor program is V3.2 or higher, the LED pattern will be a long on and then a fast flash pattern if the compressor does not start in the test mode. Look at paper label on microprocessor chip for program number. Power to the system controller must be recycled to get another call for the compressor.

If the system is a zoned system, all individual zone dampers will be opened to allow test operation of the system. Multiple air handlers or furnaces (MAH) zoning, the blowers and refrigerant valves will be energized in all zones.

The test mode of operation can be exited by depowering the system controller and reconfiguring the DIP switches to their normal operation position, then repower.

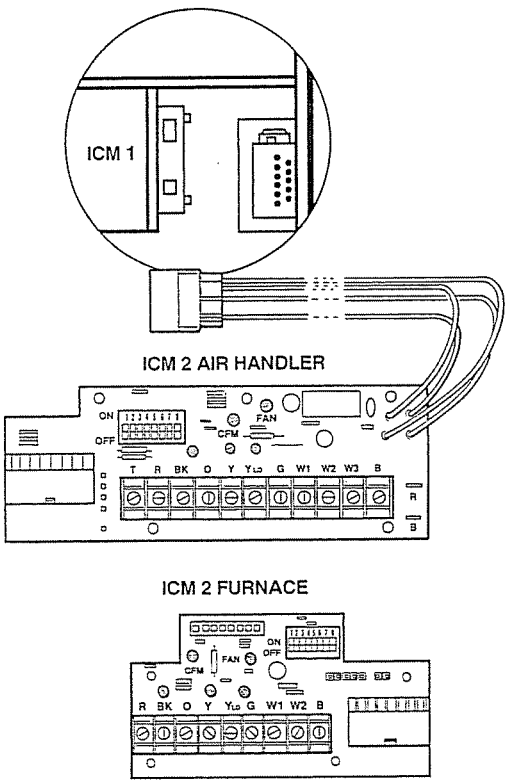
SET UP THE SYSTEM AIRFLOW, CFM, AT THE AIR HANDLER OR FURNACE

ICM-1 Motor use the Red, Black and White jumper wires inside the motor to set the cooling and heating CFM.

White jumper	=	minimum CFM cooling
Black jumper	=	maximum CFM cooling
Red jumper	=	Gas furnace heat CFM Air handler auxiliary heat CFM

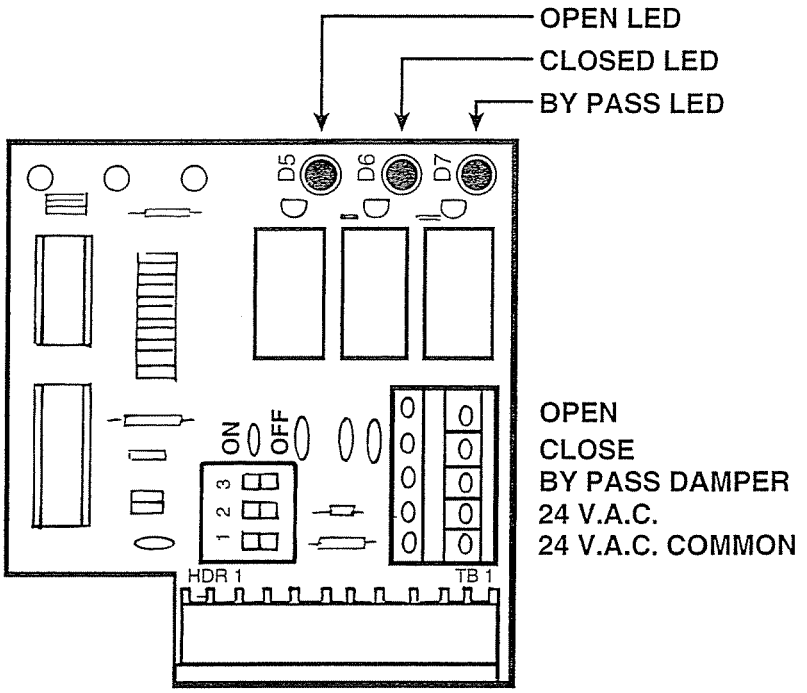
ICM-2 Motor use the DIP switches on the motor control board to set up the cooling and heating CFM.

Note: See installer guide for jumper or DIP switch settings.



ZONE BOARD – AYZNCRD100A

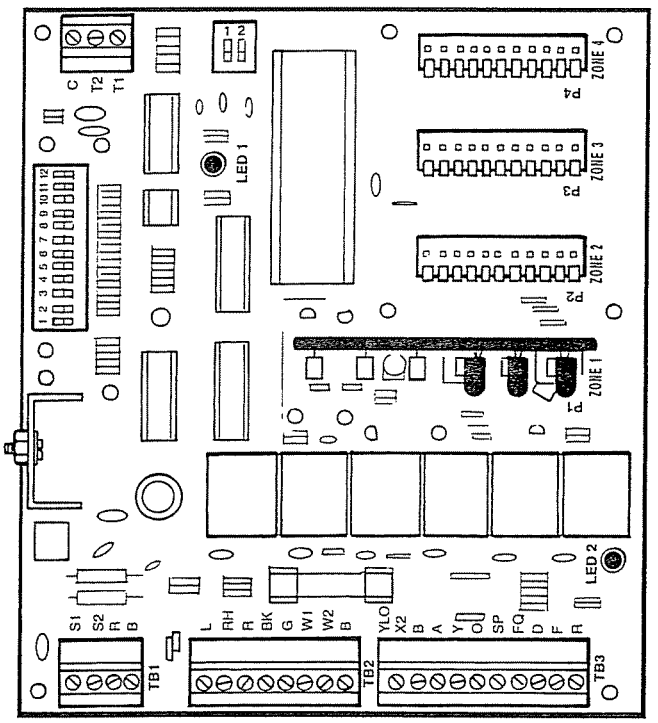
Use To Control VAV Damper or By Pass Damper



Each zone must have a zone board and a thermostat. The thermostat address must be set to the zone board number it is working with. Two zone minimum, four zone maximum.

SYSTEM CONTROLLER #AYVCTLR100A

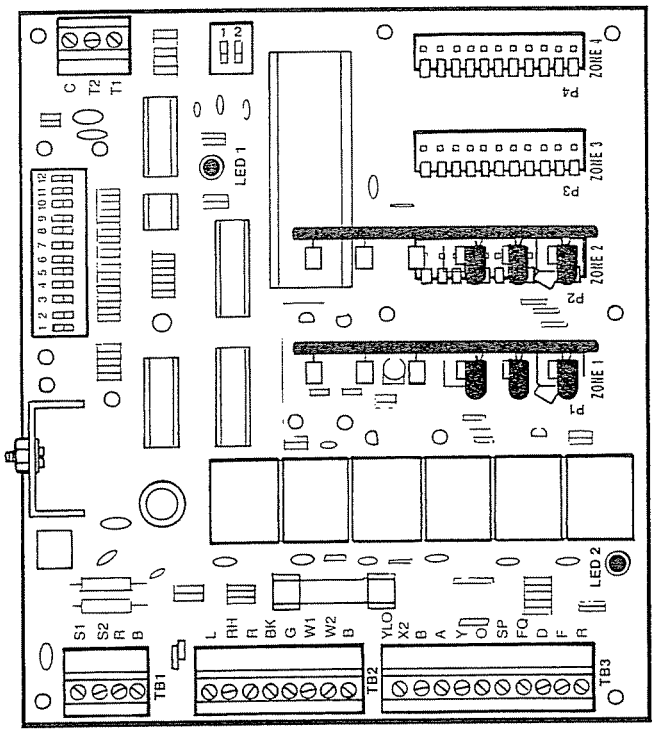
One Zone Board Installed



Two zone boards minimum for a zoned system, four zones maximum

SYSTEM CONTROLLER #AYVCTLR100A

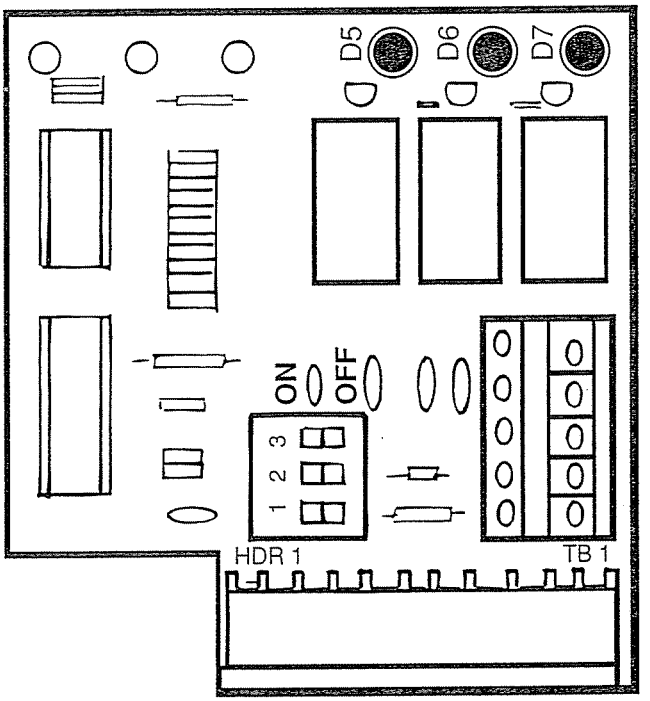
Two Zone Boards Installed – Two Thermostats Required



One thermostat address will be set to 01, the other thermostat address will be set to 02.

ZONE BOARD

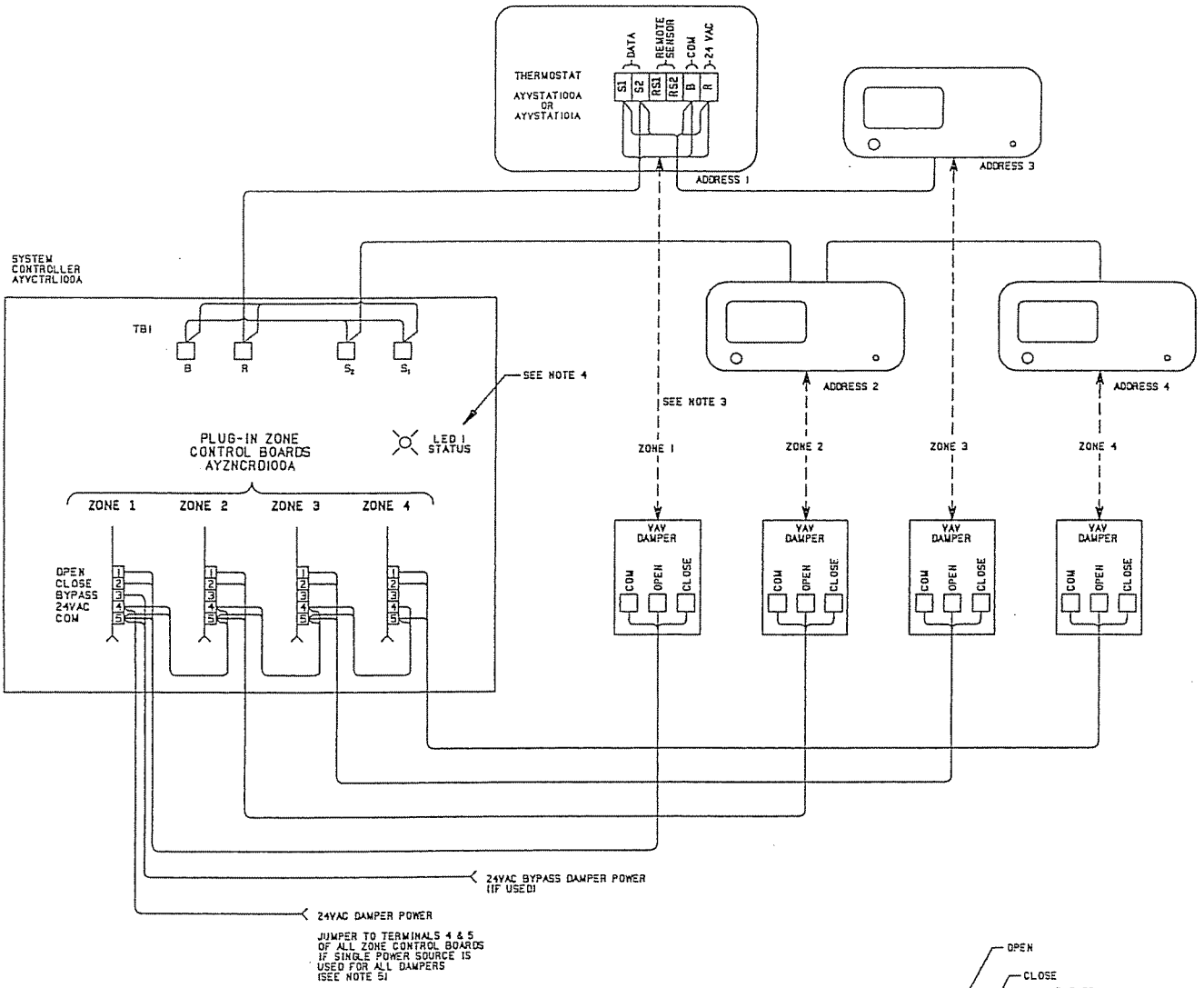
The zone board DIP switches must be set for the zone's highest CFM requirement, for the heating or cooling cycle. This switch setting also limits the system speed to this zone capacity if it is the only zone calling. If zone's capacity is less than the system's lowest capacity then the controller will open other zone dampers or on gas furnaces installation in the heating cycle the bypass damper will be opened. Two stage furnace: when the sum of the calling zone's CFM equals 73%, the bypass damper will close. These furnaces will not go to second stage heat until the sum of the calling zone's CFM equals 100%. Single stage furnace: when the sum of the calling zone's CFM equals 82%, the bypass damper will close.

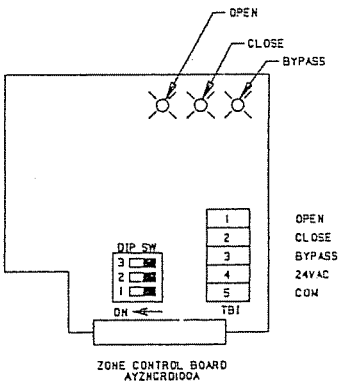


Zone Board Dip Switch Setting

Zone Wgt.	% of Total CFM	ZONE BOARD DIP SWITCH Sw1	Sw2	Sw3	
7	100%	ON	ON	ON	
6	75%	OFF	ON	ON	
5	50%	ON	OFF	ON	
4	40%	OFF	OFF	ON	
3	35%	ON	ON	OFF	
2	25%	OFF	ON	OFF	
1	17%	ON	OFF	OFF	
0	0%	OFF	OFF	OFF	= Zone Off

CONNECTION DIAGRAM





NOTES:

1. THERMOSTATS MAY BE "HOME RUNNED" TO SYSTEM CONTROLLER OR DAISY CHAINED AS SHOWN.
2. ALL WIRING TO BE A MINIMUM 18 GAGE THERMOSTAT WIRE.
3. THERMOSTATS ADDRESS MUST CORRESPOND TO PLUG-IN CONTROL BOARD POSITION. TO SET THERMOSTAT ADDRESS SEE THERMOSTAT HOME OWNERS MANUAL.
4. LED 1 "STATUS" ON SYSTEM CONTROLLER WILL FLASH ON A ONE SECOND INTERVAL WHEN ALL THERMOSTATS ARE INTERCONNECTED AND ADDRESSED PROPERLY. RAPID FLASHING INDICATES THE SYSTEM CONTROLLER HAS NOT COMMUNICATED TO A THERMOSTAT CORRESPONDING TO EACH PLUG-IN CONTROL BOARD.
5. THE 24 VAC DAMPER POWER SOURCE MUST BE ADEQUATELY SIZED TO HANDLE ALL ZONE DAMPERS.
6. RELAY CONTACTS ON ZONE CONTROL CARDS ARE RATED AT 1.25 AMP CONTINUOUS.

USE DIP SW TO SET THE MAXIMUM PERCENTAGE OF EQUIPMENT CFM TO BE SUPPLIED TO EACH INDIVIDUAL ZONE.

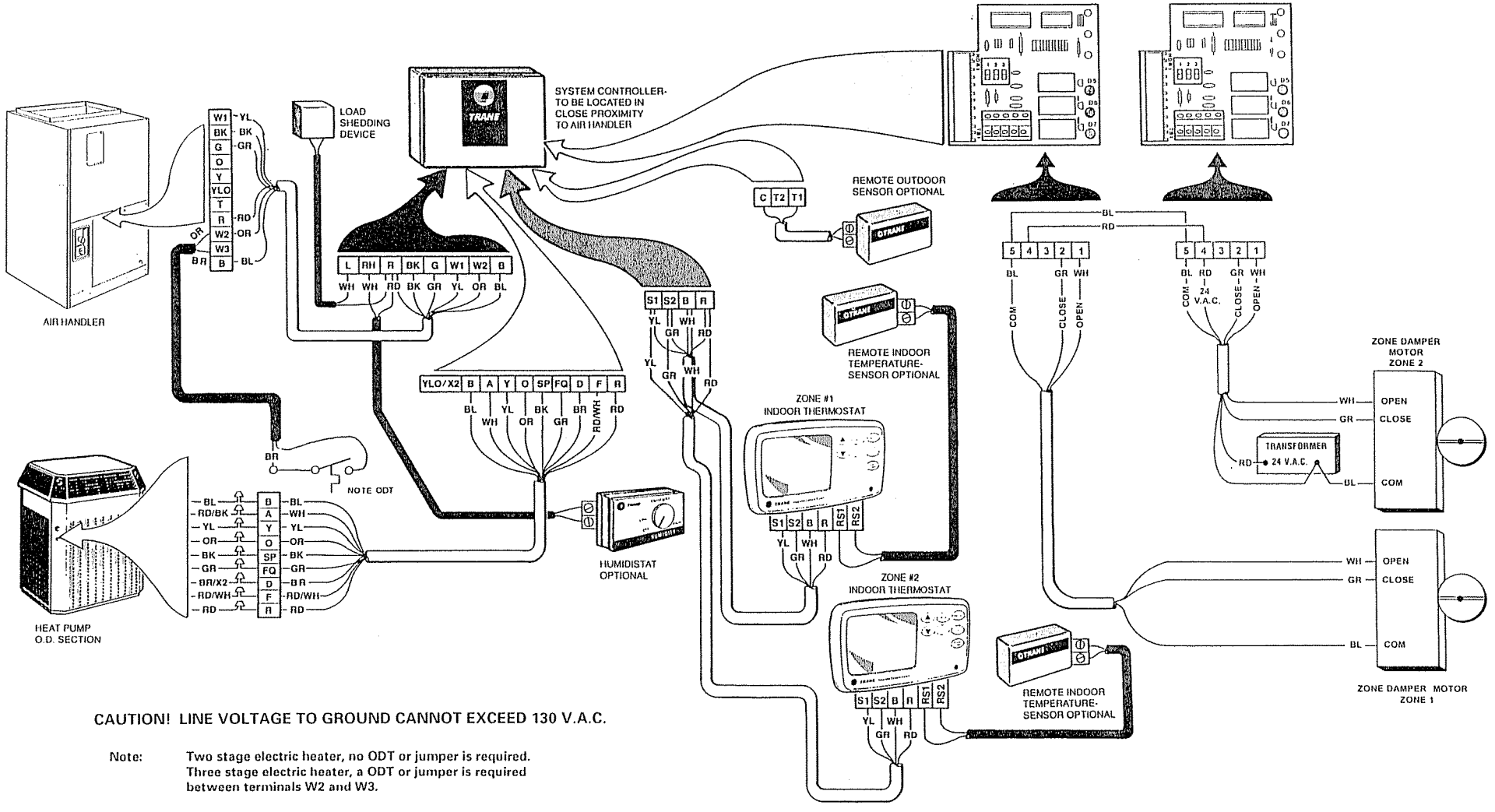
SWITCH	3	2	1
HIGHEST 100%	ON	ON	ON
75%	ON	ON	OFF
50%	ON	OFF	ON
40%	ON	OFF	OFF
35%	OFF	ON	ON
25%	OFF	ON	OFF
LOWEST 17%	OFF	OFF	ON
ZONE NOT USED	OFF	OFF	OFF

From Dwg. 21B149144

VARIABLE SPEED COMPONENTS AND LOW VOLTAGE CIRCUIT HEAT PUMP AND AIR HANDLER

AYVSTAT100A/101A THERMOSTAT & AYVCTLR100A CONTROLLER

ZONE BOARDS AYZNCRD100A



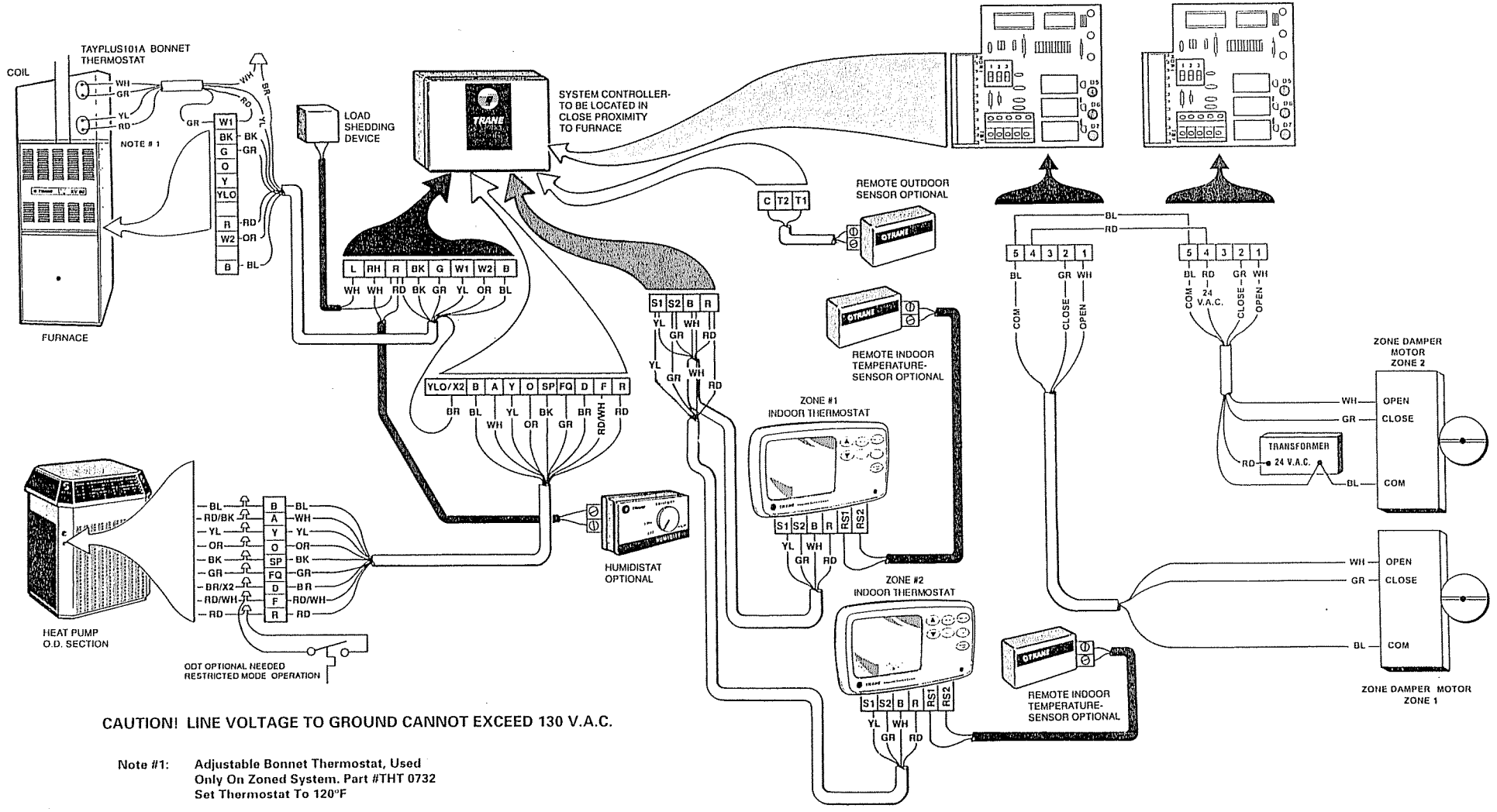
CAUTION! LINE VOLTAGE TO GROUND CANNOT EXCEED 130 V.A.C.

Note: Two stage electric heater, no ODT or jumper is required. Three stage electric heater, a ODT or jumper is required between terminals W2 and W3.

VARIABLE SPEED COMPONENTS AND LOW VOLTAGE CIRCUIT HEAT PUMP AND GAS FURNACE

AYVSTAT100A/101A THERMOSTAT & AYVCTLR100A CONTROLLER

ZONE BOARDS AYZNCRD100A



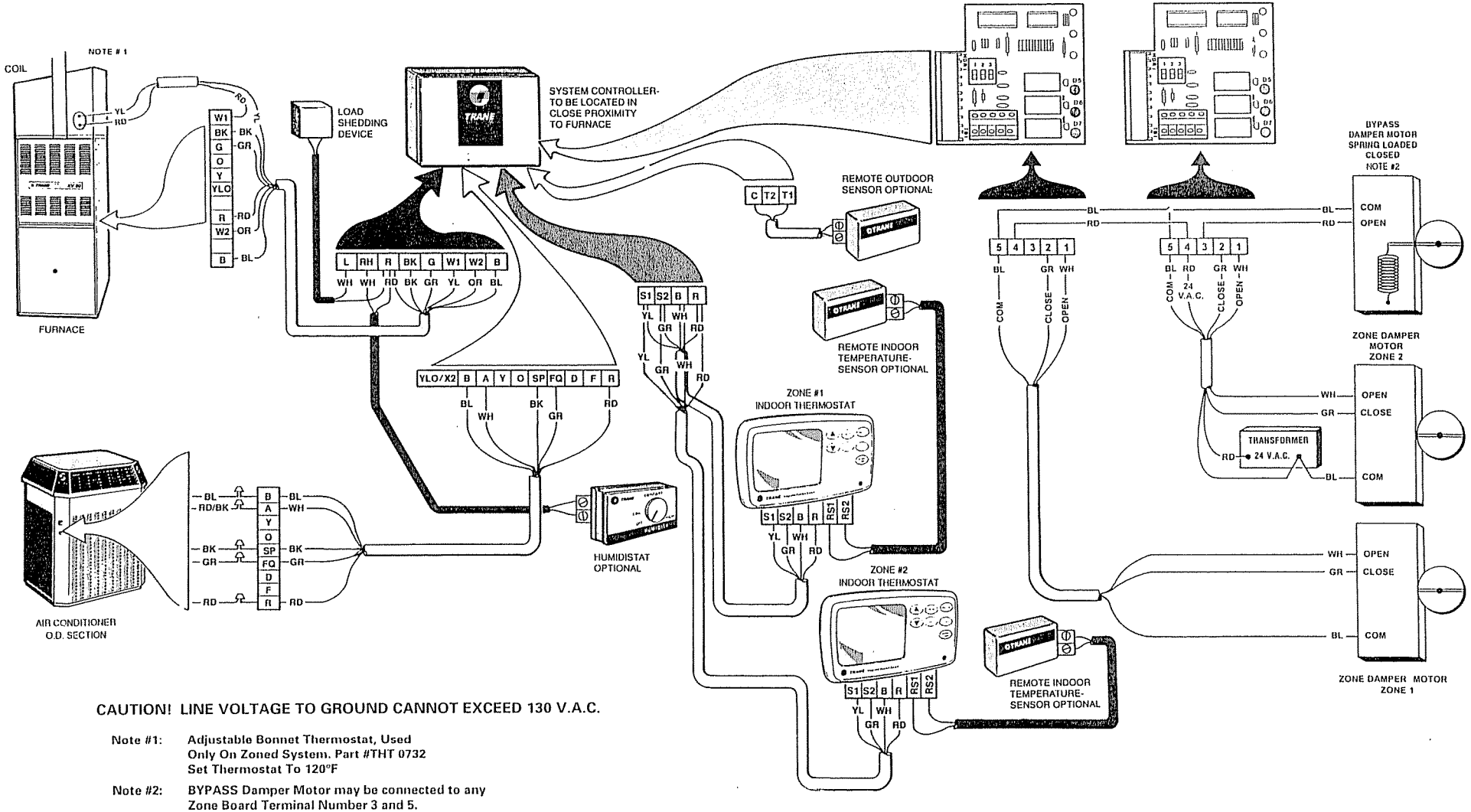
CAUTION! LINE VOLTAGE TO GROUND CANNOT EXCEED 130 V.A.C.

Note #1: Adjustable Bonnet Thermostat, Used Only On Zoned System. Part #THT 0732 Set Thermostat To 120°F

VARIABLE SPEED COMPONENTS AND LOW VOLTAGE CIRCUIT COOLING ONLY AND GAS FURNACE

AYVSTAT100A/101A THERMOSTAT & AYVCTLR100A CONTROLLER

ZONE BOARDS AYZNCRD100A



CAUTION! LINE VOLTAGE TO GROUND CANNOT EXCEED 130 V.A.C.

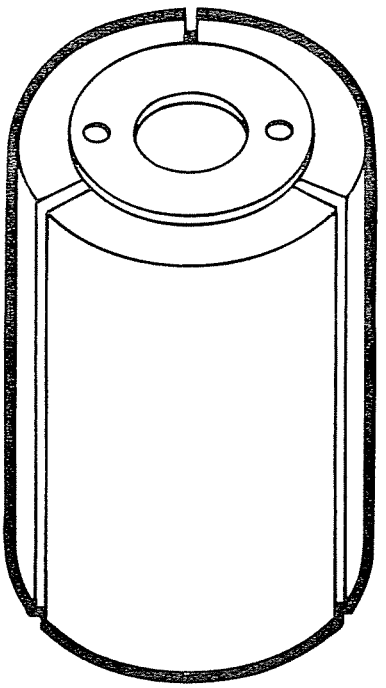
Note #1: Adjustable Bonnet Thermostat, Used Only On Zoned System. Part #THT 0732 Set Thermostat To 120°F

Note #2: BYPASS Damper Motor may be connected to any Zone Board Terminal Number 3 and 5.

WHAT IS ECM?

Motor

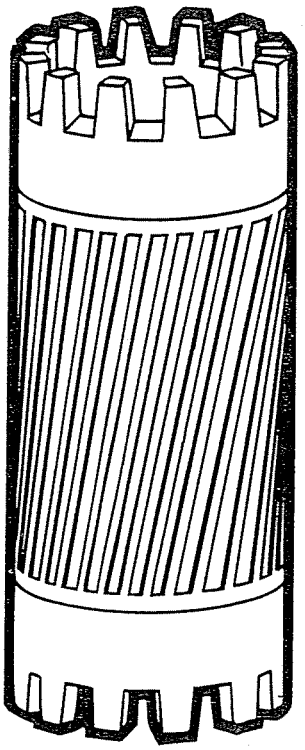
- An Electronically Commutated Motor
- Three Phase Wound Stator
- Permanent Magnet Rotor



PERMANENT MAGNET

AC MOTOR THEORY

- Rotating Magnetic Fields
- Squirrel Cage Rotor
- Efficiency

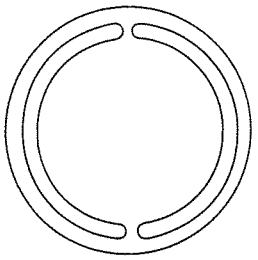


SQUIRREL CAGE

MOTOR SPEED

- 2 Pole Motor

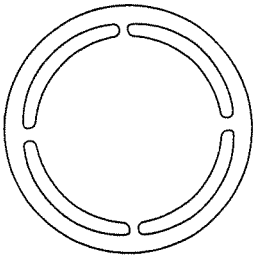
POLE DISTANCE = 180



1 CYCLE = 360° DISTANCE

- 4 Pole Motor

POLE DISTANCE = 90°

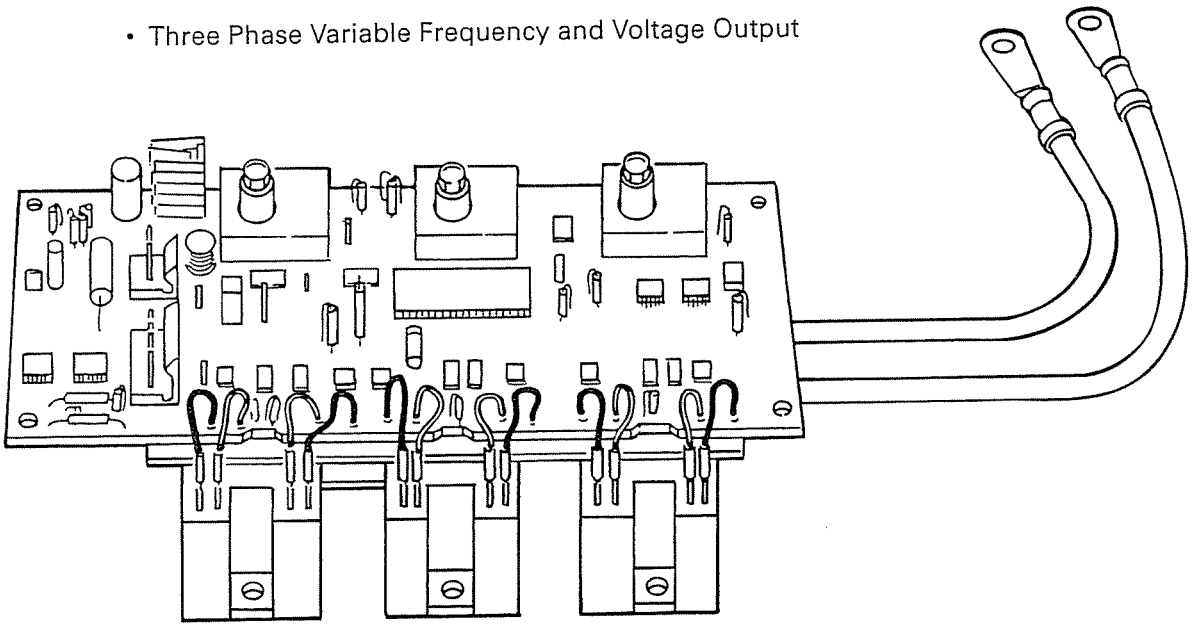


1 CYCLE = 180° DISTANCE

- Frequency is measured in cycles per second
- R.P.M. is measured in revolutions per minute
- **Synchronous Motor R.P.M. =** $\dfrac{\textbf{AC Frequency in Hertz x 120}}{\textbf{Number of Poles in Motor}}$
- Motor Impedance
- Synchronous Torque
- Slip
- Maximum Current
- Motor Speed Varied by Changing Power and Frequency

COMPRESSOR DRIVE

- Inverter
- Three Phase Variable Frequency and Voltage Output



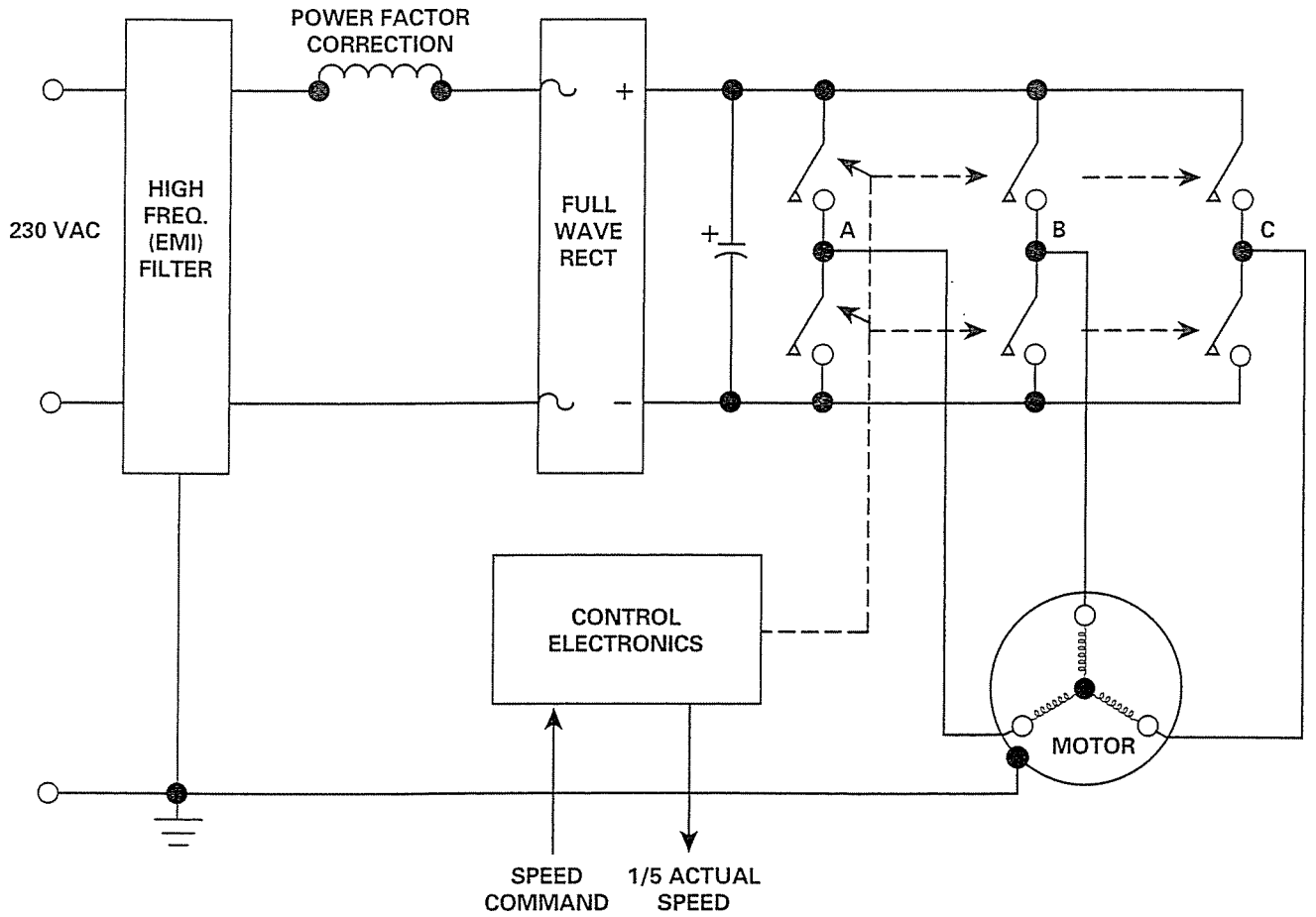
VARIABLE SPEED ELECTRICAL SYSTEM BLOCK DIAGRAM

The compressor drive uses the latest technology in high current high voltage power switching electronics. The block diagrams show the power factor correction control board, boost inductor, high frequency E.M.I. filter, full wave bridge rectifier, D.C. capacitor, microprocessor control circuit and the solid state power switches for phases A, B and C.

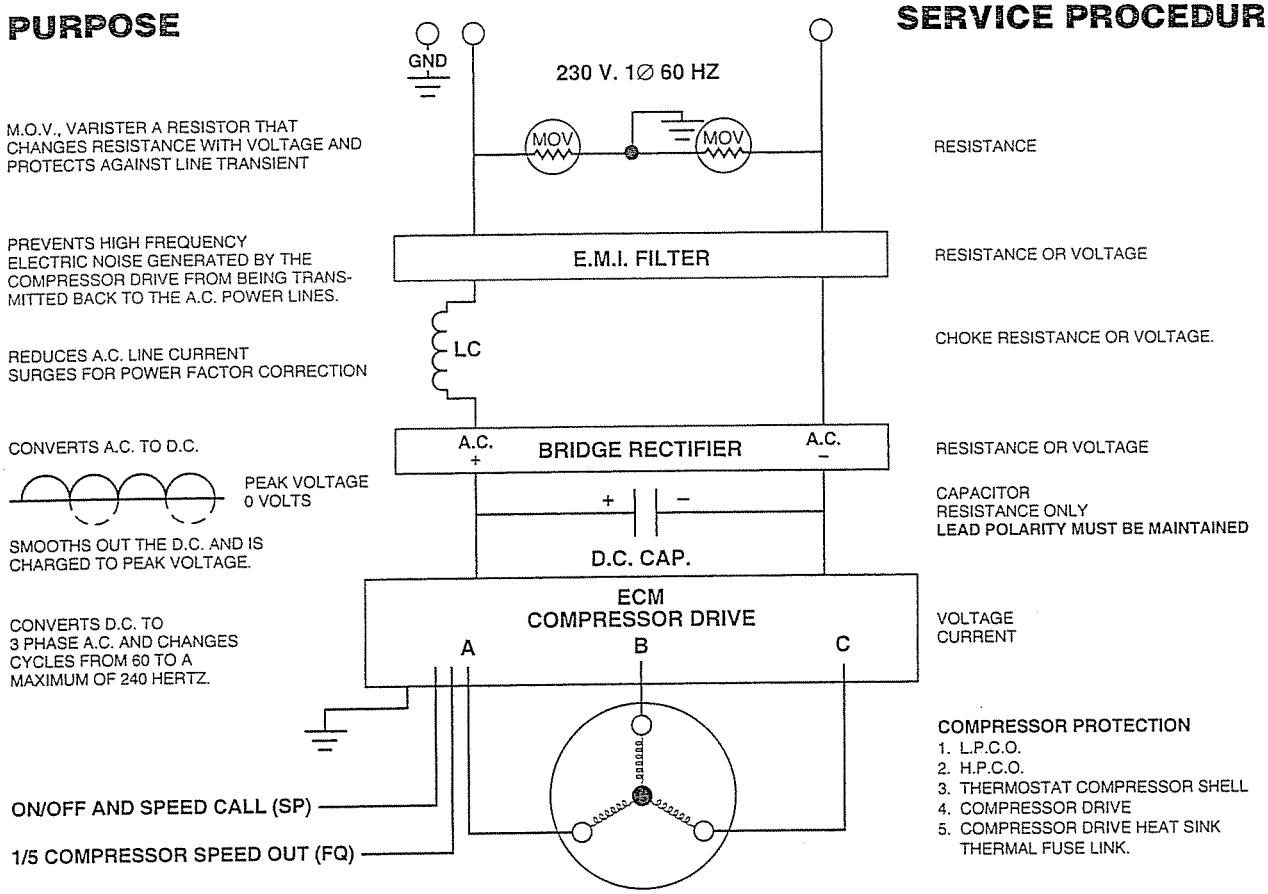
The power switches are drawn as contractor switches for ease of explanation only. To show current flow through the compressor motor, start at power switch A and close its switch to the negative terminal and close power switch B to the positive terminal and current can flow through two legs of the compressor motor windings. Continue to open and close power switches between their positive and negative terminals to show how the motor stator is electrically commutated.

In actuality, there are periods of time in a three-phase cycle that the current will also be entering two legs at the same time and leave through the third leg. The time at which the switches are closed and opened to each entering leg is not the same. Remember, that current flows from negative to positive and current cannot flow in both directions through any leg of the motor winding at the same time. Three-phase current flow through the motor can be simply explained this way. When in operation, the power electronic switches will be operated at different speeds to generate the frequency (in Hertz) to cause the compressor motor to run at different speeds.

VARIABLE SPEED ELECTRICAL SYSTEM BLOCK DIAGRAM



PURPOSE



DEFINITIONS AND COMPONENT FUNCTIONS

CAPACITOR is constructed of two conducting surfaces separated by an insulator. A capacitor stores electrical energy, blocks the flow of direct current and permits the flow of alternating current to a degree dependent upon the capacitance and the frequency applied. In a capacitance circuit current will lead voltage by 90°.

INDUCTOR is that element of an electrical circuit which opposes any sudden increase or decrease of the current flowing in the circuit. It is generally a coil of wire wound on an iron core. An inductor is used to impede the flow of pulsating direct current or alternating current by means of storing energy in the magnetic field created by the current flow through it. When the current flow through an inductor starts to rise or drop, the magnetic field cuts its own windings, inducing current flow into the circuit. In an inductive circuit, voltage will lead current by 90°.

POWER FACTOR is a ratio of the actual power used by an alternating current device measured by a wattmeter compared to the apparent power measured by an ammeter and volt meter.

RESONANCE circuit is one that the inductive reactance and capacitive reactance, or impedence, components of a circuit are balanced at a narrow frequency range.

REACTANCE is opposition to the flow of alternating current. Capacitive reactance Xc is the opposition offered by a capacitor. Inductive reactance XL is the opposition offered by a coil. Both reactances are measured in ohms. The formulas are as follows:

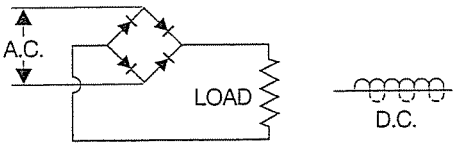
$$X_C = \frac{1}{2\,\pi\,fc} \qquad X_L = 2\,\pi\,FH$$

f – in Hertz c – in Farads H – in Henrys π = 3.1415

MOV is the abbreviation for Metal Oxide Varistor, MOV's have a rated break down voltage and rated energy handling capability. Their resistance will be infinite until their break down voltage is reached and then their resistance goes down to near 0 ohms. They are used to protect equipment against line transients.

E.M.I. is the abbreviation for Electro Magnetic Interference. The E.M.I. filter will prevent electronic noise generated by the compressor drive and PFC Control from being conducted back into the power lines. The EMI filter is composed of coils and capacitors forming a low pass filter. It is called low pass because it will pass low frequencies like 60 cycle A.C. and block high frequencies. The electronic noise generated by the drive is at a much higher frequency and the E.M.I filter is designed to reduce or attenuate these high frequencies.

BRIDGE RECTIFIER is a full wave rectifier with four rectifiers connected in the form of an electrical bridge circuit. When alternating voltage is applied across the bridge, a pulsating D.C. voltage and current is allowed to flow through the load. Rectifiers are rated in their current capacity and peak inverse voltage P.I.V. that can be applied across them.



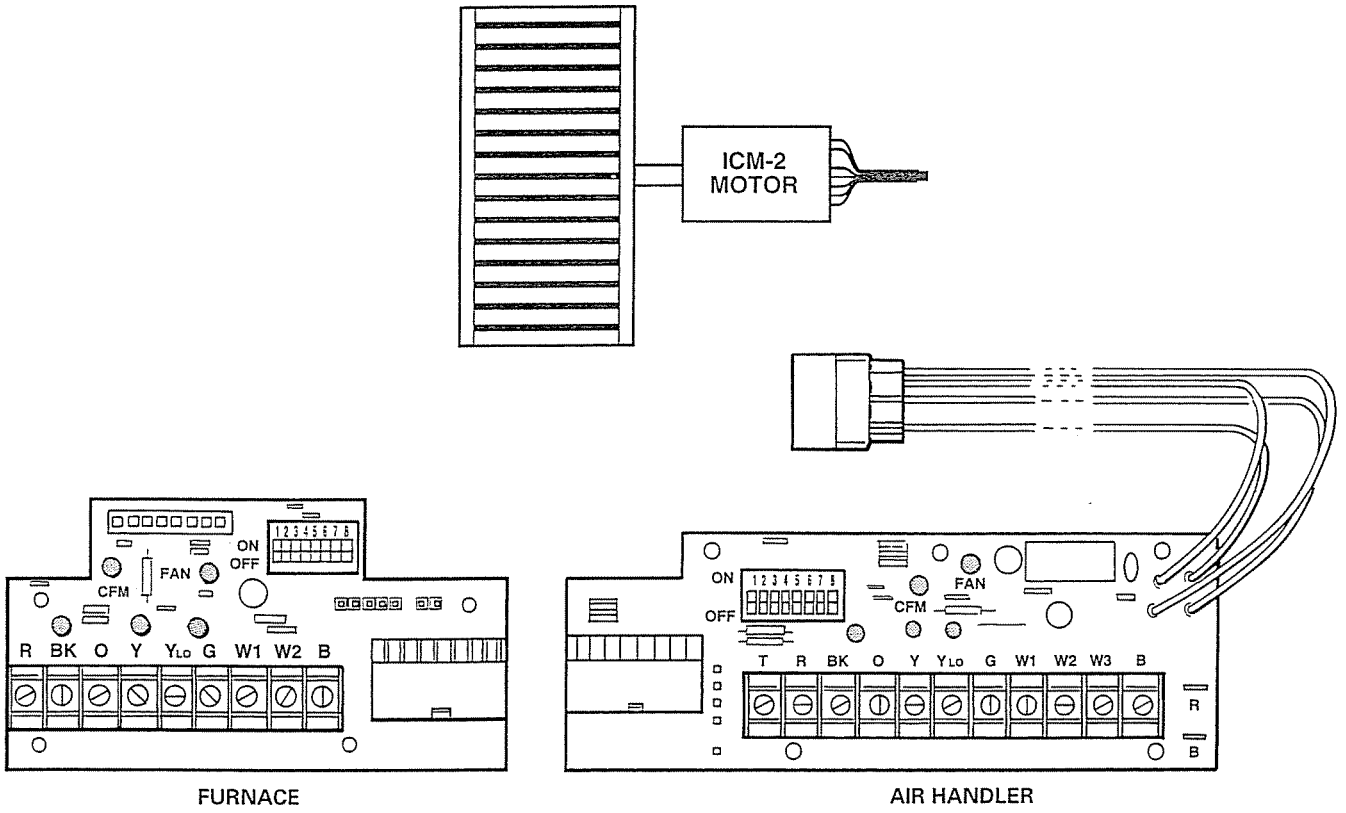
D.C. CAPACITOR is of the electrolytic type. The insulating material used between the two conductive plates is voltage polarity sensitive. This type capacitor can only be used in a D.C. circuit. If the capacitor terminal polarity is reversed, the insulating material will break down and the capacitors may rupture. The D.C. capacitor is used to smooth out the pulsing D.C. voltage coming out of the bridge rectifier. The capacitor will be charged to the peak voltage coming out of the bridge rectifier. To find peak-to-peak voltage of the alternating voltage, use the formula below:

A. C. Volts RMS X 1.414 = peak voltage

or

240 VAC RMS X 1.414 = 339.4 VAC peak voltage

ICM-2 MOTOR CONTROL BOARD



MOTOR CONTROL

- Motor Speed Is Controlled By The Drive Output Frequency
- Motor Torque Is Controlled For Specific Requirement By Varying Output Current
- Rotor Position and RPM Sensed By Motor Back EMF
- Performance and Efficiency Are Optimitized By Motor Drive
- Motor Is Protected Uunder Abnormal Load Conditions

HIGHER EFFICIENCY

- Speed Varied To Match Load
- Systems Always Operated At Minimum Speed Possible
- ECM™ 3Ø Motors
- Permanent Magnet Rotors (No Power Required To Magnetize Rotor)
- Negligible Eddy-Current Loss In Rotor
- Negligible Hysteresis Loss In Rotor
- Each ECM™ Motor Controlled By It's Own Micropressor
- No Motor Slip

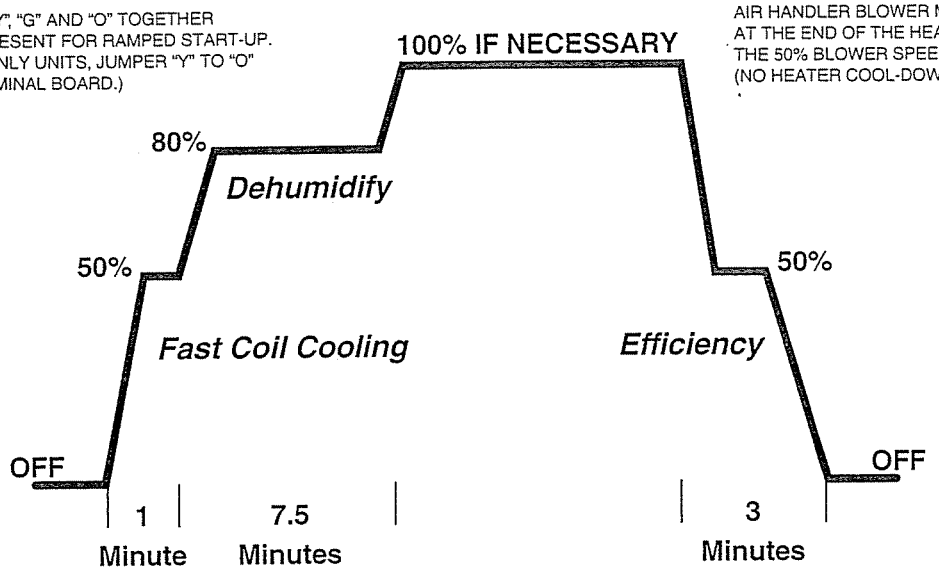
RAMPED ON OPERATION

DIP SWITCHES No. 5 AND No.6 ON

A CALL ON "Y" AND "G" TOGETHER
THE INDOOR BLOWER WILL RUN AT 100%
AFTER THE 1 MINUTE STARTING SEQUENCE.

A CALL ON "Y", "G" AND "O" TOGETHER
MUST BE PRESENT FOR RAMPED START-UP.
(COOLING ONLY UNITS, JUMPER "Y" TO "O"
AT THE TERMINAL BOARD.)

AIR HANDLER BLOWER MOTORS GO OFF
AT THE END OF THE HEAT CYCLE WITHOUT
THE 50% BLOWER SPEED REDUCTION.
(NO HEATER COOL-DOWN IS NEEDED.)



HEAT PUMP UNITS CALL FOR "O" IN THE COOLING
CYCLE TO TURN ON THE S.O.V.

GAS FURNACE COOL-DOWN CYCLES
AIR FLOW WILL GO TO 50% OF COOLING AIR FLOW.
COOL-DOWN TIME IS CONTROLLED BY THE
WHITE-RODGERS INTEGRATED IGNITION CONTROL
(DIP SWITCHES No. 2 AND No. 3.)

OPERATIONAL COMMANDS

For The ICM-2 Motor

BLOWER ON = 24 V.A.C. Call on G terminal. Air flow will be one half of the high speed cooling air flow.

LOW SPEED COOLING Air Flow = 24 V.A.C. Call on G and YLO terminals. Two speed systems, or two compressor systems only.

HIGH SPEED COOLING Air Flow = 24 V.A.C. Call on G and Y terminals.

LOW HEAT Air Flow = 24 V.A.C. Call on G and W1 terminals.

HIGH HEAT Air Flow = 24 V.A.C. Call on G, W and W2 for furnaces, air handlers = W3.

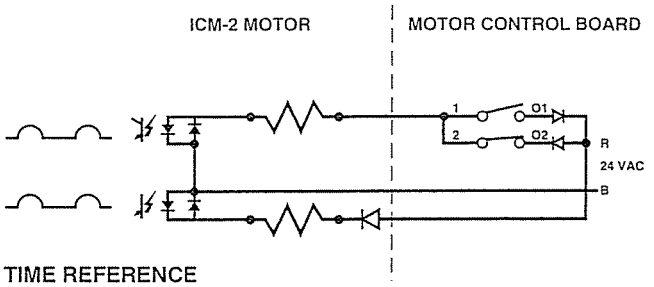
HUMIDISTAT Operation = 24 V.A.C. Call on 0, G, Y and BK will give high cooling air flow. 24 V.A.C. Call on 0, G and Y will give lower cooling air flow. Approximately 80 CFM per ton lower than the high cooling air flow. If a Humidistat is not installed on a heat pump installation, BK terminal must be jumpered to R terminal.

WARNING!

IF POWER IS INTERRUPTED AND RESTORED, AND THE BIMETAL THERMOSTAT IS CALLING FOR W1 AND W3, THE INDOOR BLOWER WILL GO TO ITS MAXIMUM AIR FLOW SETTING.

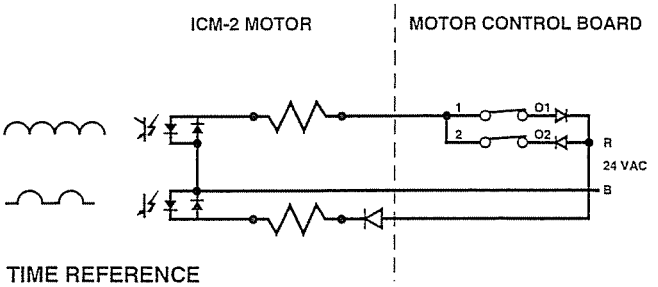
For 24 V.A.C.

1. IN TIME COMMAND



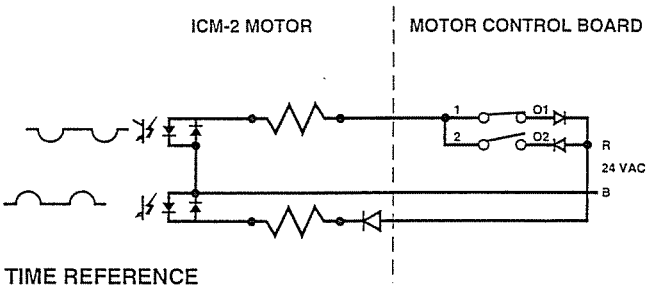
TIME REFERENCE

2. DOUBLE COMMAND



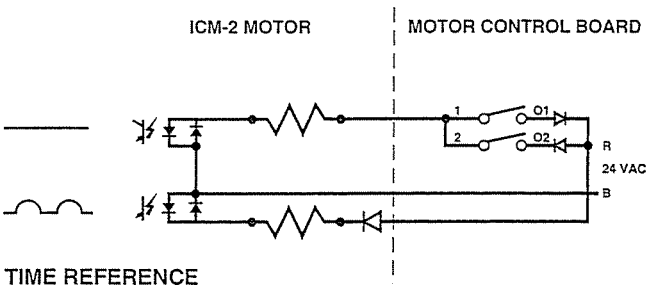
TIME REFERENCE

3. OUT OF TIME COMMAND



TIME REFERENCE

4. NO COMMAND



TIME REFERENCE

LED'S AND THEIR USE

Single and Two Speed Units

RED YLO LED will be on when a call for LOW SPEED cooling is received and the ICM-2 Motor Control circuit is receiving it. (Used on two speed units only.)

RED Y LED will be on when a call for (High Speed Two Speed units only) or cooling single speed is received and the ICM-2 Motor Control circuit is receiving it.

RED BK LED will be on when a Humidistat is installed and it's switch is closed. When it is on, it means high cooling (CFM) is being requested and the ICM-2 Motor Control circuit is receiving it. When it is out, it means the Humidistat's switch is open, high humidity, and the ICM-2 Motor will now reduce the cooling CFM. Cooling Only units must have Y terminal jumpered to O terminal to obtain High/Low cooling air flow with the Humidistat. The O terminal will be energized only in the Cooling Cycle, therefore heating air flow will not be affected by the Humidistat opening or closing.

RED FAN LED will be on when the indoor blower is called for in the heating or cooling cycle, by the G circuit. When on, it means the fan is being called for and the ICM-2 Motor Control circuit is receiving it.

GREEN CFM LED will flash the number of times requested by the Dip Switches and the thermostat in the heating or cooling cycle. Then the LED goes on dim and during this time the motor RPM information is being sent. By using a frequency counter connected between terminals TP1 and TP5 on the motor control board, the motor RPM can be determined. The frequency read on the meter must be multiplied by 1.67 which then equals actual motor RPM. Green CFM LED (cycles) Hertz times 1.67 = Actual Motor RPM. When the blower is not being called for on the G circuit, the Green CFM LED will be flashing dimly.

GREEN CFM LED will FLASH on and off. A long "on time" equals 100 CFM, and the last "on time" (if it is a short "on time") means 50 CFM. By counting the number of flashes in the heating or cooling cycle, the air flow in CFM requested can be verified. The air flow is adjustable by using the Dip Switches. Numbers 1 – 4 for the Cooling Cycle and Switches Numbers 7 – 8 for the Heating Cycle. Power must be turned off before changing these switches.

Dip switches Numbers 5 and 6 are used to select blower start up ramp time and delay time at the end of a cooling cycle in a gas furnace CFM will be reduced to 50% of cooling air flow for the heat exchanger cool down cycle. The White Rodgers module will control the cool down time. If continuous fan operation is being requested, the blower will go to the low heat CFM. When heating is called for, there is no 45 second time delay after burner comes on.

GREEN CFM LED COOLING FLASH RATE = Switches #1 and #2, tonnage. Time Switches #3 and #4 CFM per ton in the Cooling Cycle with no Humidistat installed. If a Humidistat is installed and BK LED is out, high humidity, the flash rate will go down about 80 CFM per ton.

GREEN CFM LED HEATING FLASH RATE = Switches #7 and #8. First stage Heating = G & W1 calling at the ICM-2 motor. Furnaces Second stage Heating = G, W1 & W2 calling at the ICM-2 motor. Air Handler Second stage Heating = G, W1 & W3 calling at the ICM-2 motor.

Heat pump installation only the Green CFM LED Heating Flash Rate will be the highest air flow called for. Example: G and Y calling equals 1200 CFM requested, auxiliary heat also being called for on G & W1 = 800 CFM requested. The ICM-2 Motor Control will stay at 1200 CFM and the Green CFM LED will flash 12 times.

Variable Speed

RED FAN LED will be on when the indoor blower is called for in the heating or cooling cycle, by the G circuit. When on, it means the fan is being called for and the ICM-2 Motor Control circuit is receiving it.

RED BK LED will be on when the control system is connected and powered up. At low speed commands, it will be dimly lit and as the speed command goes up, the BK LED will get brighter. When the thermostat is satisfied, turned off or fan only, the BK LED will be on. When on, it means a speed command is being sent and the ICM-2 motor control circuit is receiving it.

GREEN CFM LED will flash the number of times requested by the Dip Switches and the speed command received on BK in the heating or cooling cycle.

Cooling air flow will be set up using switches #1 and #2 for the tonnage of the unit installed. Switches #3 and #4 will be set at the 350 CFM per ton position. Switches #5 and #6 turned off. Ramping on and time delay to off are done by the variable speed controller.

RED YLO LED AND RED Y LED are not used and will be off.

ICM-2 CONTROL INPUT

Air Flow Priority

The ICM-2 motor will run at the called CFM. If two or more calls are being received at the same time, G, Y and W1, for example the ICM-2 motor will run at the highest speed call it is receiving, Y or W1.

BK ——— Humidistat input for single, or two speed systems. Two speed system may be a two speed compressor or a two compressor system. If system is a heat pump installation and a humidistat is not installed, a jumper must be installed between "R" and "BK." A variable speed system BK is the input for the PWM blower speed command.

W1 ——— CFM, blower speed, for low heat.

W2 ——— CFM, blower speed, for high heat. W2 on gas furnaces or W3 on air handlers.

G ——— On or off command for the motor.

YLO ——— CFM, blower speed, for low speed cooling on a two speed system.

Y ——— CFM, blower speed, for high speed cooling on a two speed system, or cooling CFM for a single speed system.

CFM ——— LED, Will flash the number of times programmed by the Dip switches in the cooling or heating cycle. Cooling CFM is programmed by Dip switches #1 and #2 tonnage times dip switch #3 and #4 CFM per ton. Heating CFM is programmed by Dip switches #7 and #8.

B ——— Common 24 VAC.

O ——— Cooling Cycle humidistat enable. Single or 2 speed system only. On a cooling only system, "Y" must be jumpered to "O" for humidistat operation.

R ——— Timing reference for the ICM-2 motor computer, and power to the Dip switches.

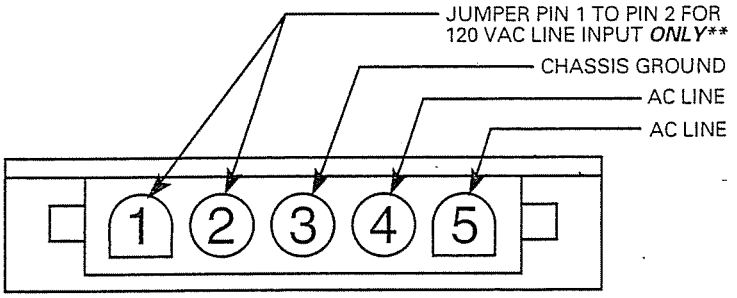
#1 and #2 — Tonnage of outdoor unit.

#3 and #4 — CFM per ton. 350 - 400 or 450 CFM.

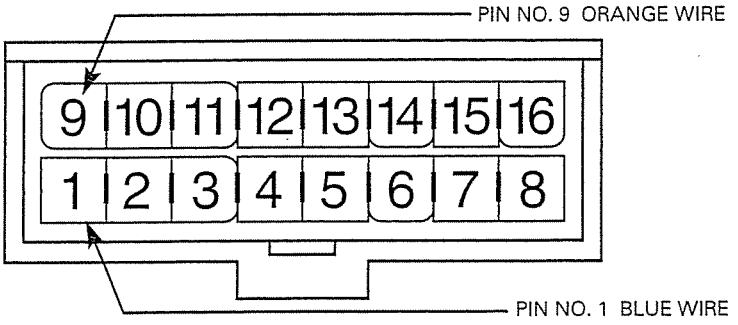
#5 and #6 — Are used to set up indoor blower time delay at the end of a cooling cycle and the amount of air flow, CFM. See chart. If a 3 minute delay or ramped on cycle is programmed, the heating cycle blower off cycle will also be affected. The air flow, CFM, will be reduced by 50%. A gas furnace installation, the furnace integrated control, White-Rodgers 50A51-505, will control the amount of time the blower is on at the end of the heating cycle. On a variable speed system #5 and #6 must be in their off position.

#7 and #8 — CFM for low heat and high heat, 2 stage gas furnace or three stage electric heat.

PLUGS

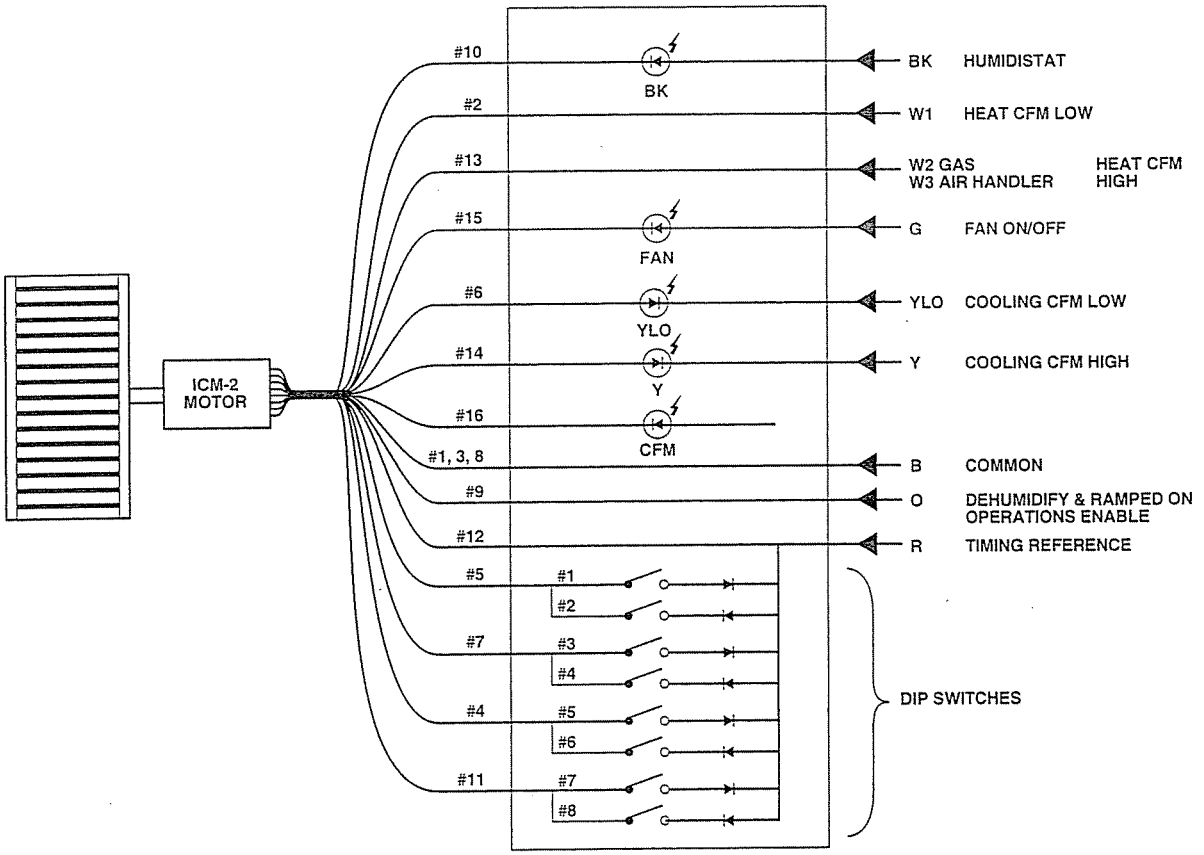


Motor Power

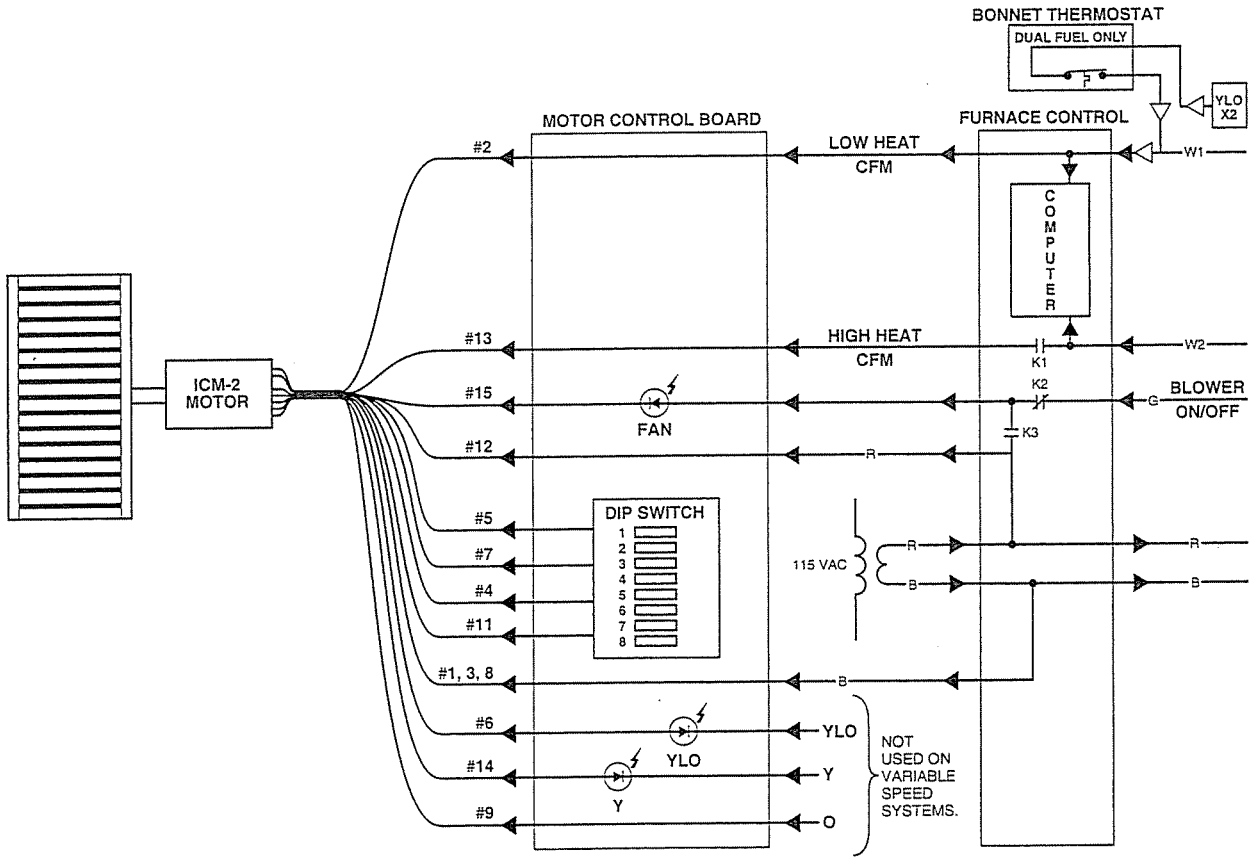


Low Voltage No. P1

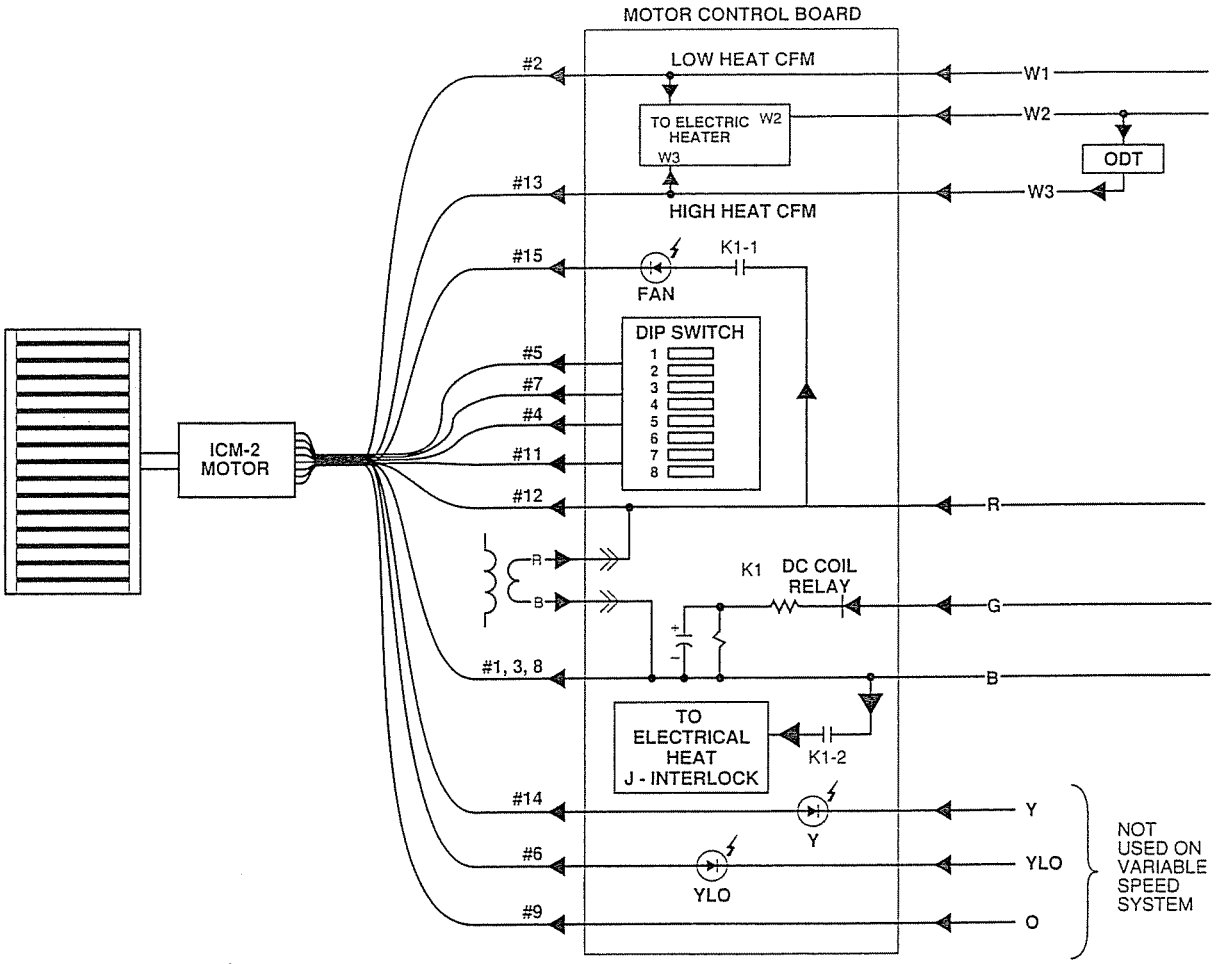
ICM-2 MOTOR CONTROL BOARD



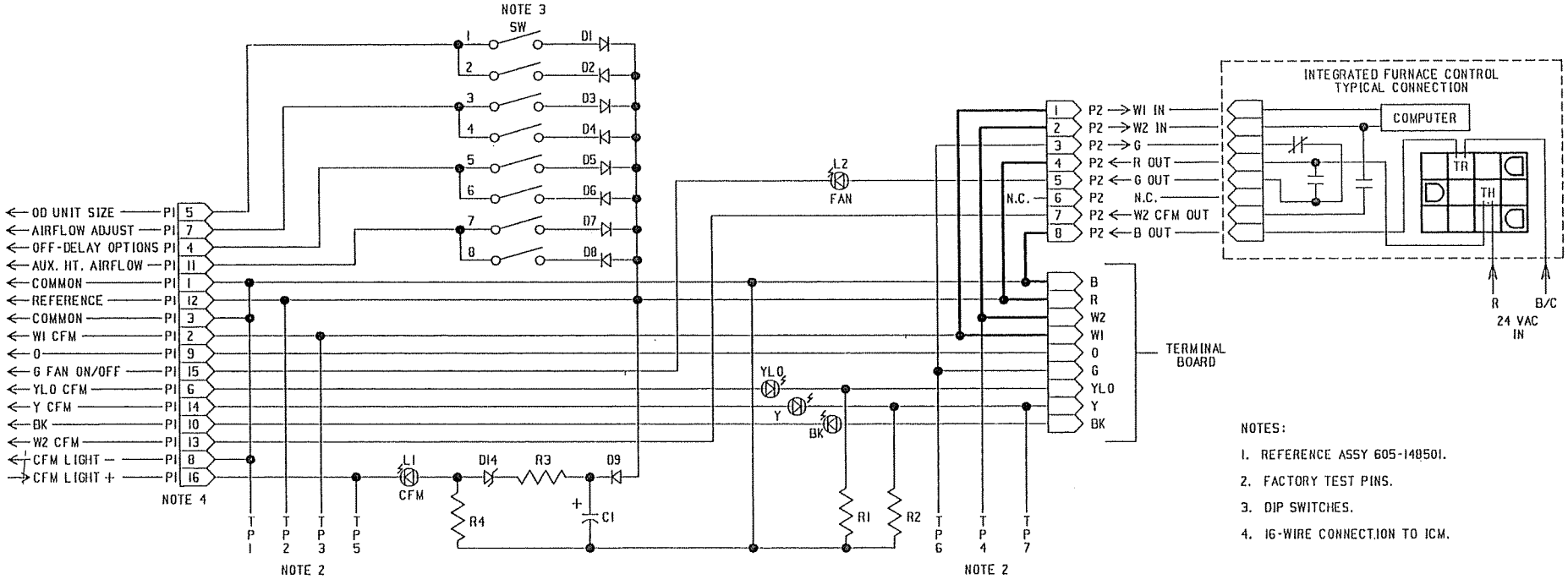
20 AND 24 VOLT AC FURNACE



20 AND 24 VOLT A/C AIR HANDLER CONTROL



INTERFACE SCHEMATIC – FURNACE

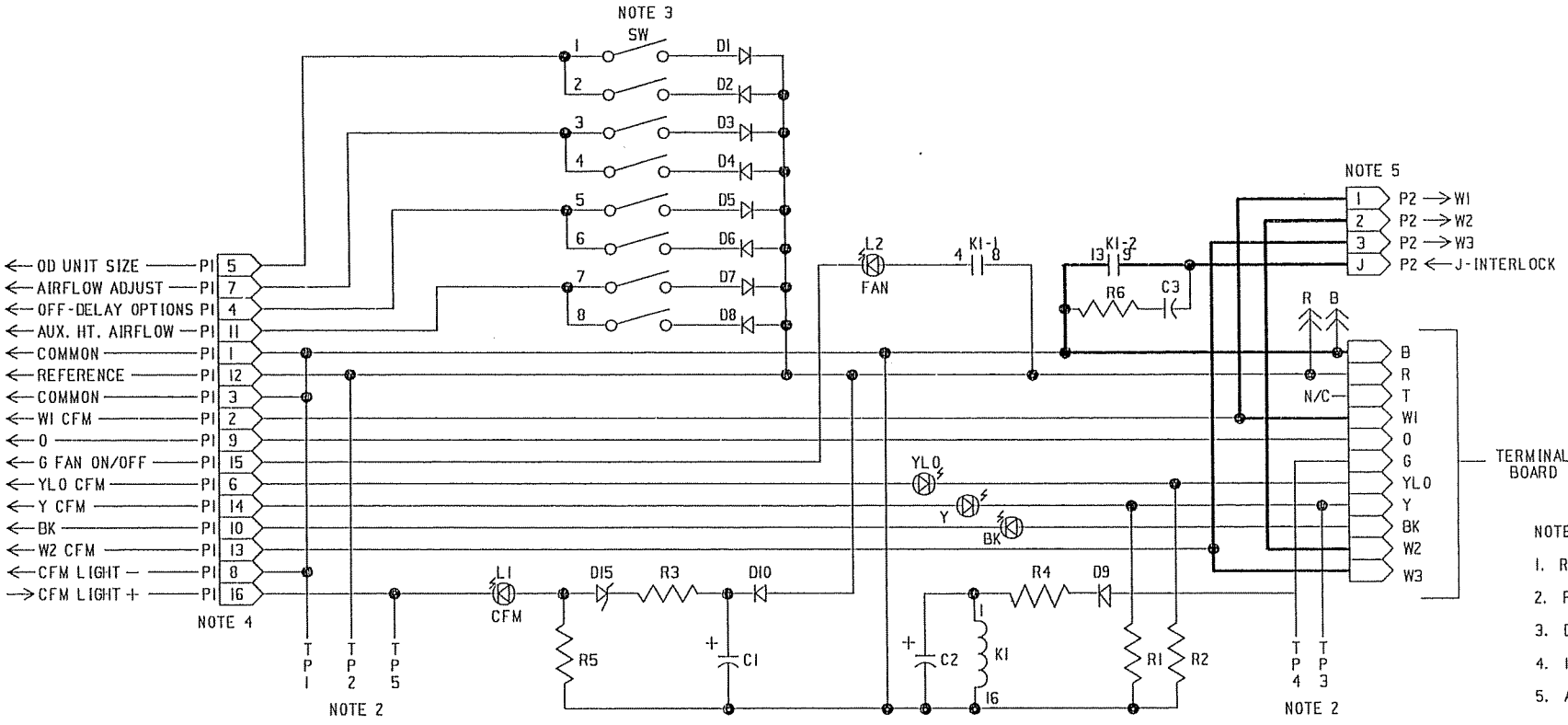


NOTES:

1. REFERENCE ASSY 605-148501.
2. FACTORY TEST PINS.
3. DIP SWITCHES.
4. 16-WIRE CONNECTION TO ICM.

From Dwg. 21C148846 Rev. 1

INTERFACE SCHEMATIC – AIR HANDLER

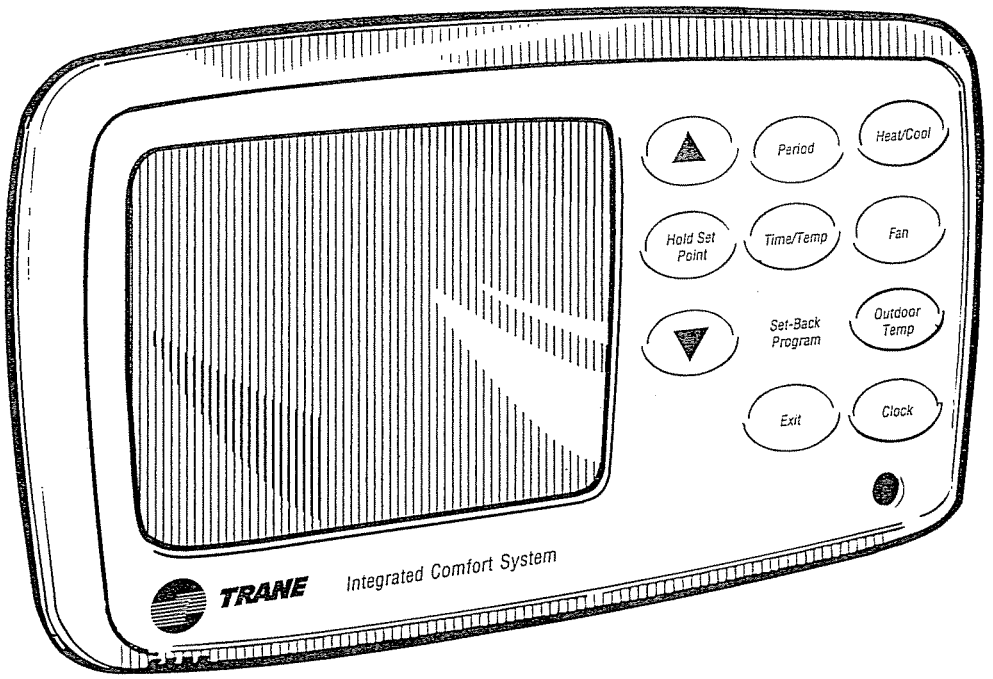


From Dwg. 21C148847 Rev. 1

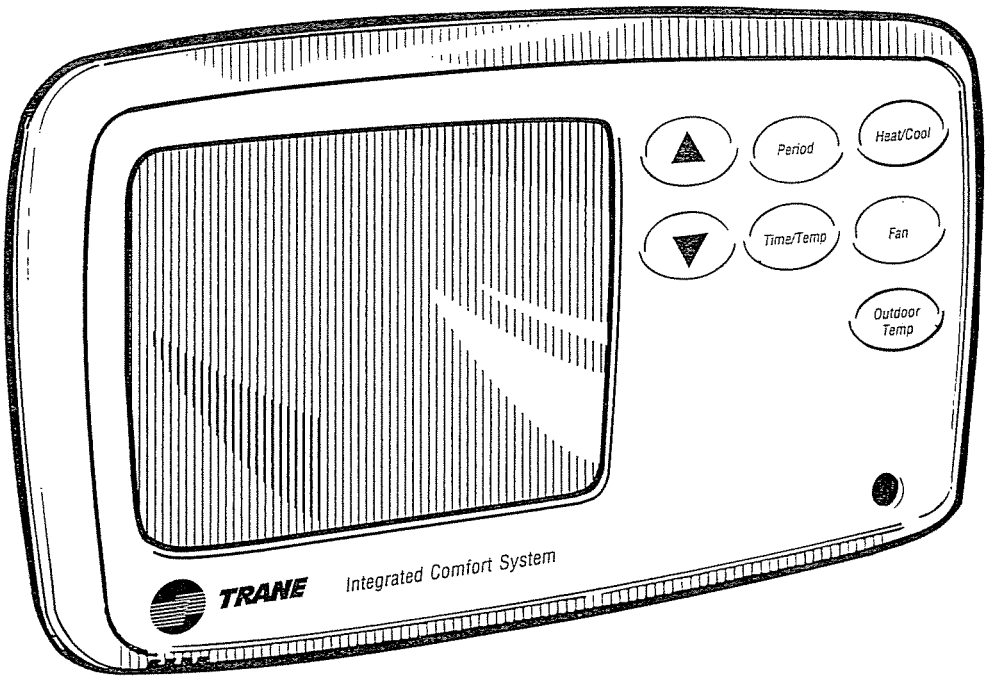
NOTES:

1. REFERENCE ASSY 605-14850I.
2. FACTORY TEST PINS.
3. DIP SWITCHES.
4. 16-WIRE CONNECTION TO ICM.
5. AUX. HEAT CONNECTOR.

AYVSTAT101A



AYVSTAT100A



VARIABLE SPEED THERMOSTAT AND CONTROLLER

The variable speed thermostat and controller are designed to be used with a variable speed cooling unit and a gas furnace or a variable speed heat pump system.

The variable speed thermostat can be set-up to heat or cool only or operate in the heat/cool automatic mode, with continuous fan or automatic fan operation. The L.C.D. displays the indoor temperature and an optional outdoor temperature sensor can be connected to the system controller so the customer can check to see what the outdoor temperature is. A twenty section bargraph is used on the L.C.D. display to indicate the actual speed. The display will display a "service" symbol to alert the customer of a fault if there is a compressor or defrost problem.

The thermostat can be put into an emergency heat mode for heat pump installation. When in the emergency heating mode, the emergency heating symbol will be on and the compressor will be locked out. The thermostat has a memory that stores the mode of operation and setpoints whenever power is interrupted. Back-up battery power is provided by three 1.5 V. batteries.

The control system has an adjustable droop humidity control cycle which can be set at 1°F, 2°F or off. The humidity control cycle is a computer program within the controller. This cycle will occur when the indoor temperature is at its setpoint or up to 1°F or 2°F below the setpoint temperature. The controller will call for a dehumidification cycle at low speed when the minimum compressor off time of 7 minutes is met. The off time gets longer when the indoor temperature goes further below the thermostat set point. The dehumidification cycle will vary in length depending on the difference of the indoor temperature and the thermostat's set point. The greater the difference the shorter the run time will be.

There is a five minute minimum run time when droop humidity control is active. This operation is similar to a cooling anticipator operation in an electromechanical thermostat. For a zoned system this cycle is disabled.

Additional latent capacity can be obtained in the cooling or droop humidity control cycle by connecting an optional humidistat to the control system. The optional humidistat can not cause the system to run. When installed and the indoor humidity is higher than the setpoint of the humidistat, the controller causes the compressor speed to be increased, if it is not at full speed. When the compressor is already operating at full speed, the indoor fan will be slowed down to obtain the additional latent capacity needed for humidity control.

The system controller is used as the central field wiring point. It has four plug-in connectors for ease of field wiring. Each terminal is labelled with corresponding letters or numbers to match the thermostat, air handler or gas furnace and the outdoor unit.

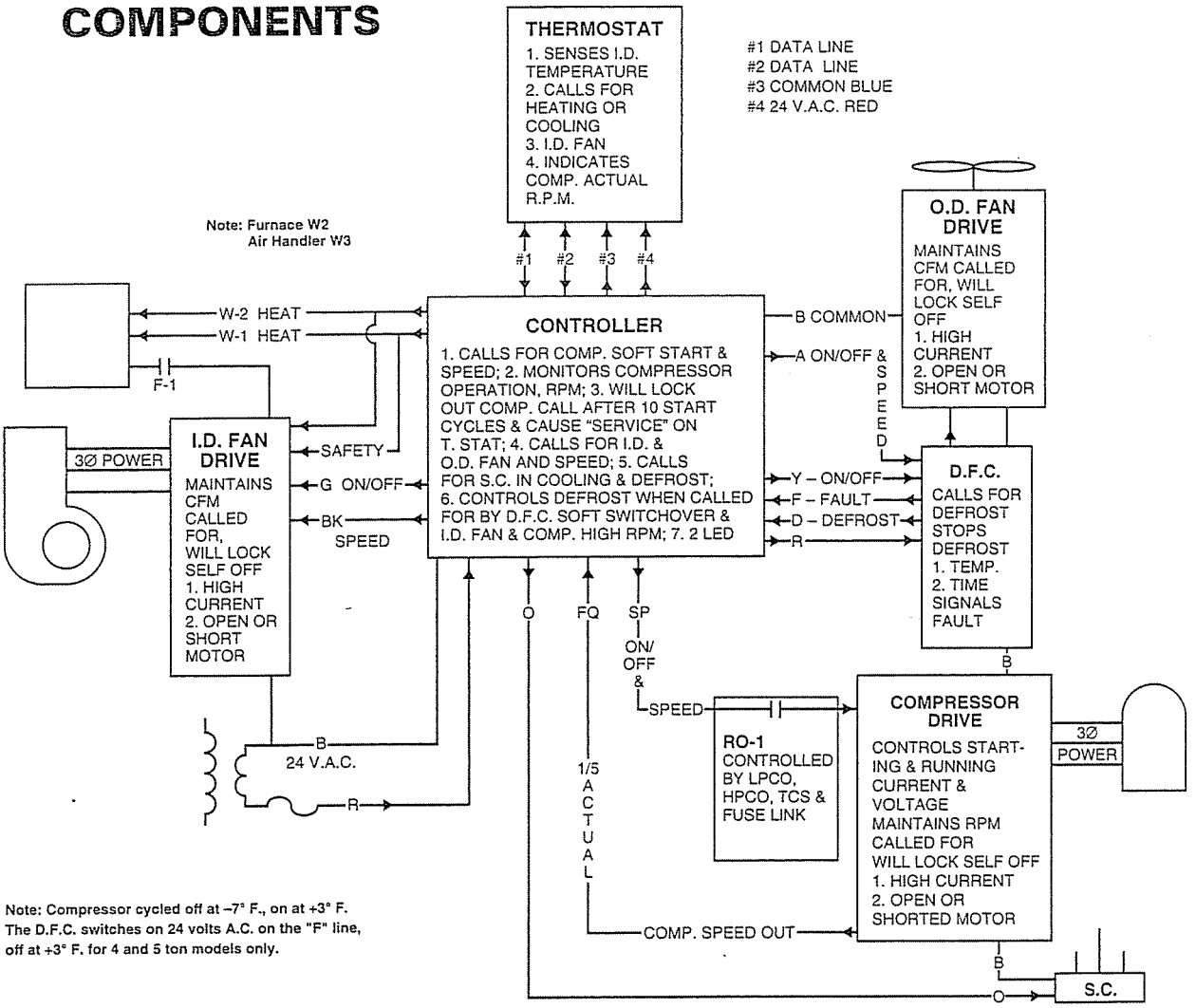
The controller contains fourteen DIP-switches which are used to program the controller for installation of a variable speed cooling unit or heat pump installation. The DIP-switches also are used by the servicer to place the system in a cooling or heating service cycle at one half or full speed, and bypass the seven minute anti-short cycle protection portion of the controller.

The controller has two L.E.D.'s which are used by service personnel. The status L.E.D. performs three different service functions. When the control system is programmed for normal operation it can perform two of these functions, one is to prove the thermostat and controller are communicating by flashing once per second, or not communicating by flashing fast. The second function the status L.E.D. performs is a com-pressor under speed indication. The status L.E.D. will be continuously lit if the compressor is running 15% slower than full speed when full speed is being called for. The status L.E.D. will go out automatically when the compressor speed is back to within 10% of full speed. The compressor drive will reduce the compressor speed if the compressor starts to draw high current which could be caused by low voltage, outdoor temperature above 115°F, low indoor or outdoor fan speeds, etc.

The third function is when the control system is placed in the service mode of operation. The status L.E.D. will be continuously lit if the compressor starts and continues to run; if the compressor fails to start, the status L.E.D. will now have a long on time and then flash fast pattern. The other L.E.D. is the fault light which will flash off and on if the defrost control detects a fault with the heat pump or continuously lit if the heat pump is locked out by the outdoors temperature. The controller will start the outdoor fan and the compressor at one half speed and compressor operation must be sensed at the controller. The compressor will be operated at one half speed for one minute and then ramped down or up depending on the speed the thermostat is calling for. When the controller senses compressor operation, it then calls for the indoor fan operation. If compressor operation is not sensed by the controller, the controller will not call for indoor fan operation. The controller will call for compressor operation for several starting cycles before it locks out a compressor call and causes the "service" symbol on the thermostat to display. (See Service Section for a complete write-up of controller operating sequences).

On a heat pump installation, the defrost control calls for a defrost cycle to the controller. The controller brings the compressor to about one half speed and energizes the switchover valve, calls for the supplemental heaters and ramps the compressor to high speed. The defrost control stops its call for a defrost cycle by temperature or time and the controller ramps the compressor back to about one half speed and then de-energizes the switchover valve and turns off the supplemental heat. The defrost control turns the outdoor fan back on. The controller then ramps the compressor and fan back to the speed being called for by the thermostat. A forced defrost cycle can not be obtained when the system is being operated in the service mode by the controller DIP-switch. The O.D. fan will go off only in the service mode. On 4 and 5 ton heat pumps only the defrost control monitors the outdoor temperature. When the outdoor temperature goes to –7°F the defrost control informs the controller. The controller will then cycle off the compressor. When the outdoor temperature rises to +3°F the defrost control informs the controller that compressor operation is now permitted and the controller will then call for compressor operation.

COMPONENTS



20 AND 24 V.A.C. CONTROL CIRCUITS

1. The thermostat calls the controller for heating or cooling and indoor fan operation. The controller performs on/off functions to the indoor fan drives, supplemental heaters and the defrost control by switching on or off 24 V.A.C. to these devices. The speed information to the fans and compressor drives are a D.C. pulse width signal.

2. The indoor fan drive will be turned on when 24 V.A.C. is switched on to the "G" line.

3. The supplemental heaters are turned on when 24 V.A.C. is switched on the "W-1" and "W-2" lines. When 24 V.A.C. is applied to "W-1" line, this voltage is also applied to the indoor blower drive. The ICM-1 blower will go to the red heating speed. The red speed wire on heat pumps must be set at a higher speed tap than the black speed wire. The ICM-2 blower will go to the airflow setup by Dip switches numbers 7 and 8 on the motor control board.

4. The defrost control will be turned on when 24 V.A.C. is switched onto
the "Y" line. The outdoor fan drive can also be turned on or off by the defrost control relay K-2; this is done during a defrost cycle.

5. The switchover valve coil will be energized when 24 V.A.C. is switched onto the "O" line for cooling or defrost, by the controller.

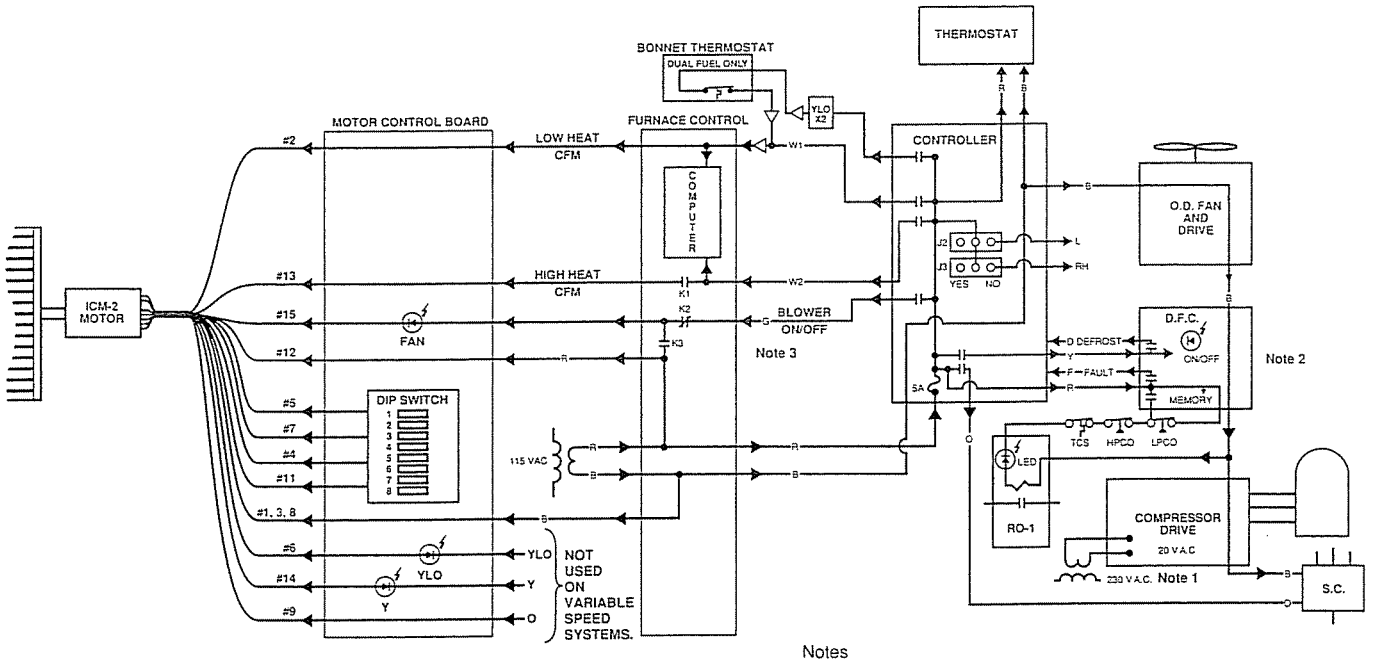
6. A defrost cycle will start when the defrost control switches on 24 V.A.C. onto the "D" line to inform the controller that a defrost is needed and turns off the 24 V.A.C. when the defrost is complete.

7. If defrost fault is detected by the defrost control, the defrost control will then start switching on and off 24 V.A.C. onto the "F" line. The controller will cause "service" to display on the thermostat.

8. The transformer in the outdoor unit provides 20 V.A.C. power for the compressor drive electronics. CAUTION: High voltage present at this plug to case ground.

9. Defrost control on the 4 and 5 ton heat pumps switches 24 V.A.C. on "F" line when the outdoor temperature goes to -7°F. The controller then cycles off the compressor and outdoor fan. When the outdoor temperature rises to +3°F, the defrost control switches off the 24 V.A.C. on "F" line and the controller will cycle the compressor and outdoor fan back on.

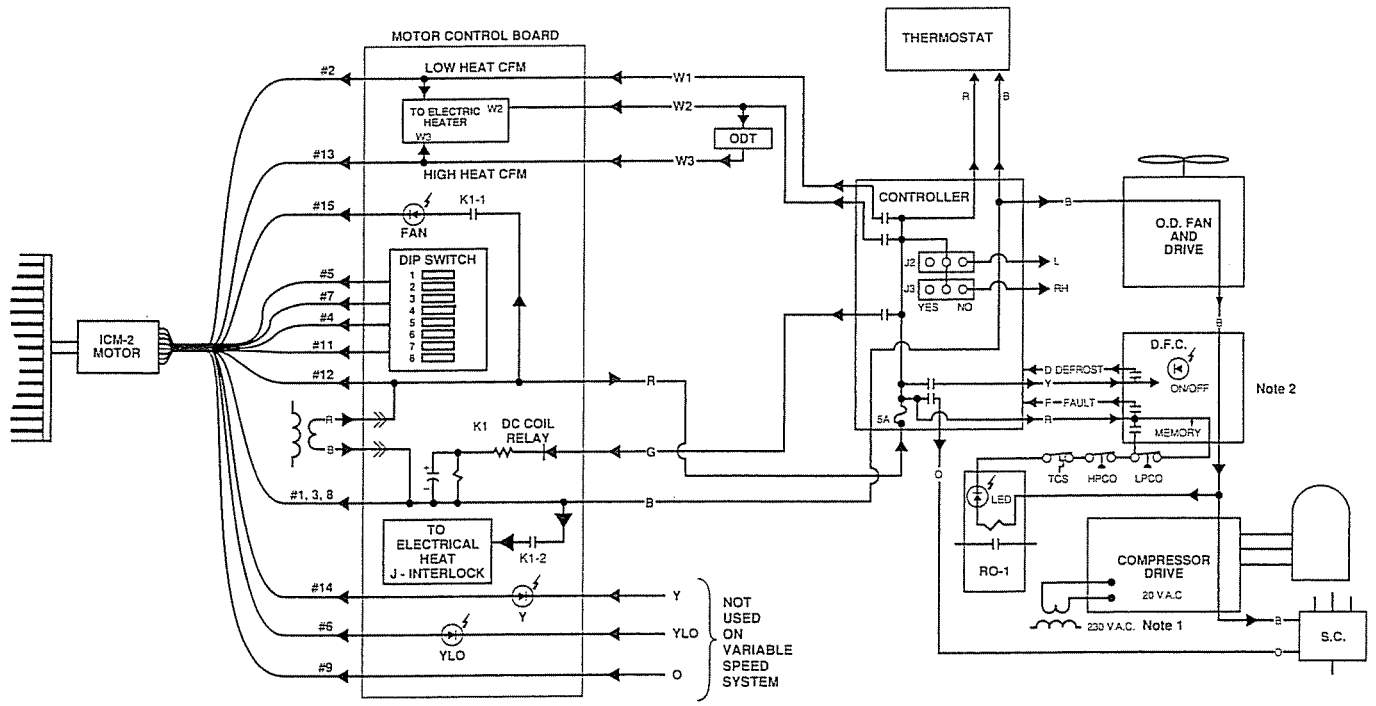
20 AND 24 VOLT AC FURNACE CONTROL CIRCUITS



Notes

1. **CAUTION: High voltage present at 20 V.A.C. Drive pins to ground.**
2. 4 and 5 ton models at -7°F D.F.C. switched on 24 V.A.C. on "F", controller turns off outdoor unit. At +3°F, 24 V.A.C. is turned off and outdoor unit comes back on.
3. System Controller does not turn on blower in the gas heating cycle. The furnace control will turn on blower 45 seconds after flame is established.

20 AND 24 VOLT AIR HANDLER CONTROL CIRCUITS



Notes

1. **CAUTION: High voltage present at 20 V.A.C. Drive pins to ground.**
2. 4 and 5 ton models at -7°F D.F.C. switched on 24 V.A.C. on "F", controller turns off outdoor unit. At +3°F, 24 V.A.C. is turned off and outdoor unit comes back on.

D.C. CONTROL CIRCUIT
FUNCTION OF ELECTRONIC COMPONENTS

FOR COMPRESSOR OPERATION

1. Call for compressor on "SP" wire 4 – 7 V.D.C. from controller, to compressor drive terminal board BK/RD wire, 7 V.D.C. maximum speed.
2. RPM of compressor out on "FQ" wire 1/2 speed 11.5 V.D.C. high speed 7 V.D.C.

FOR OUTDOOR FAN OPERATION

1. Call on "A" wire to O.D. fan plug (yellow wire) 1/2 speed 7 V.D.C. high speed 12 V.D.C.

FOR I.D. FAN OPERATION

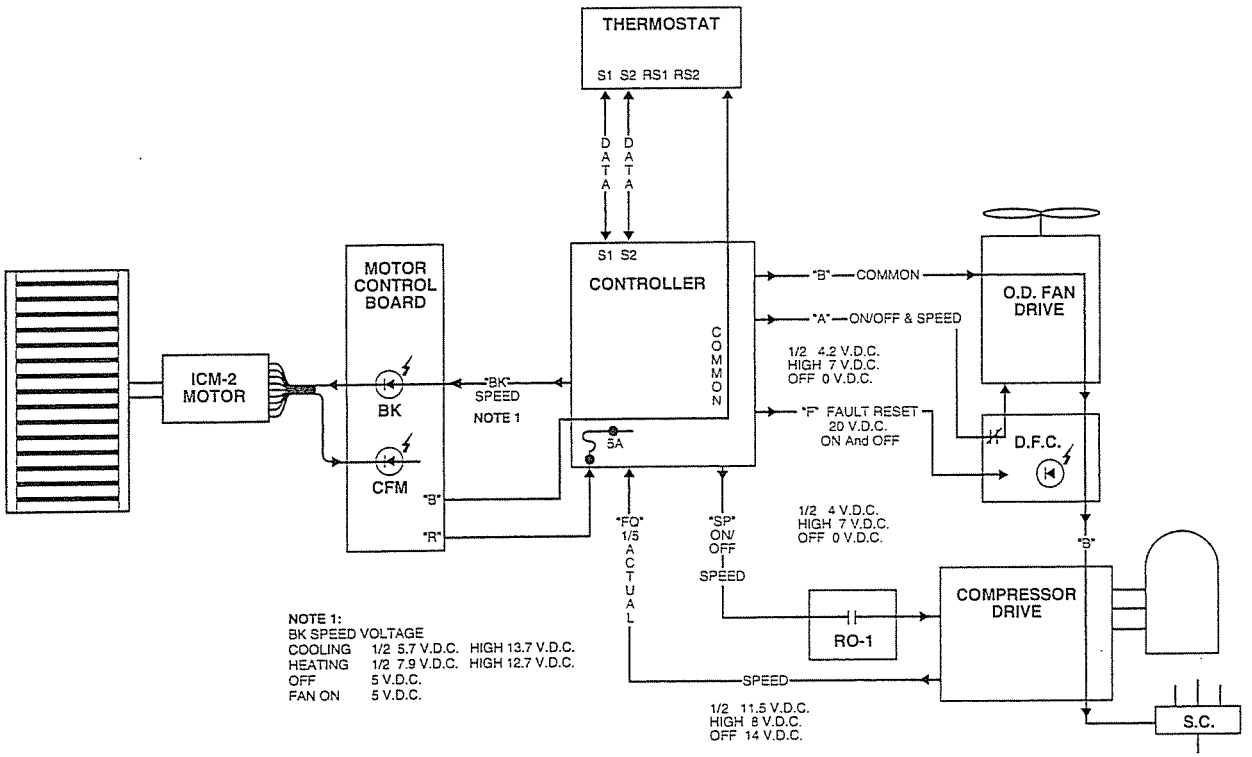
1. Call on "G" wire 24 V.A.C. to I.D. fan drive is the on/off command.
2. **Cooling** – Call on "BK" wire to I.D. fan drive
   1/2 speed = 5.7 V.D.C. high speed = 13.7 V.D.C.

   Heating – Call on "BK" wire to I.D. fan drive
   1/2 speed = 7.9 V.D.C. high speed = 12.7 V.D.C.
3. Call on "W-1" wire 24 V.A.C. to I.D. fan drive, may override command for speed on BK and air flow may go to the W1 speed setting on ICM-2 motor. Speed command on BK is reduced by 10% when control system calls for W1, Aux. Heat. ICM-2 motor will run at the highest speed it sees. On heat pump installations, the red wire on ICM-1 motor speed tap should always be set above the black wire speed tap.

FAULT RESET "F"

1. Fault reset is 20 V.D.C. This voltage will be present when the thermostat is set to Emergency Heat to clear a fault. Voltage is repeatedly turned on for 10 seconds and then off for 10 seconds. When Defrost Fault is cleared the controller will not turn on 20 V.D.C. again.

VOLTAGE CHART D.C. CONTROL CIRCUITS



THERMOSTAT

1. Senses the indoor temperature.
2. Communicates to the controller: Mode, setpoint and indoor temperature.
3. Indoor fan operation, automatic or continuous. When the thermostat is satisfied, the I.D. fan will run at half speed when in the continuous fan operation. Zone system all dampers will open when no zone is calling for heat or cooling.
4. Displays actual compressor speed.
5. Will display "service" if the defrost controls detects a fault or the compressor will not run after ten starting cycles.

CONTROLLER

1. Calls for a compressor soft start and sets compressor speed.
2. Monitors compressor operation, R.P.M.
3. If compressor does not start, the controller will call for the compressor six times, one starting cycle, and then locks out the calls for 7.5 minutes. The controller will call for compressor a total of 10 starting cycles and if there is no compressor operation, it will lock out the call and cause "service" to flash on thermostat. To reset the controller and regain control of the compressor, turn power off, then back on to controller or set thermostat mode to off or emergency heat then call for normal operation.
4. Calls for indoor and outdoor fan motor; soft starts and their required speeds.
5. Energizes switchover valve coil for cooling and defrost.
6. Controls defrost functions when a defrost is called for.
   A. Controls compressor speed and fan speeds for a soft switchover. Compressor and I.D. fan will then be ramped to high speed for defrost.
   B. Calls for auxiliary heat.
7. Has two L.E.D. lights used for troubleshooting.
   A. Signals communications from the thermostat to the controller.
   B. Signals a defrost fault or compressor not running at high speed when called for.

COMPRESSOR AND FAN DRIVES

1. The compressor drive has outboard D.C. power supply E.M.I. filter, a power correction choke and transient protection.
2. The fan drives have an on-board D.C. power supply. The indoor fan drive has on board E.M.I. filter, power correction components and transient protection. The outdoor fan drive uses the E.M.I. filter and transient protection MOV mounted on the relay filter board.
3. All drives perform these functions:
   A. Controls starting current and running current. Will lock self off if motor current goes above maximum.
   B. Can sense open or shorted motor windings and will lock self off.
   C. Ability to sense motor watts and R.P.M. and change the motor R.P.M. up or down to match the work called for.
   D. Ability to sense motor R.P.M. and position of motor rotor.
   E. Motor speed is controlled by invertor drive output voltage and frequency; three phase D.C. pulses.
   F. Motor torque is controlled for specific requirement by drive programs.

LOAD VALUE

System Load Value = ΔT + Time

The Controller uses this system load value to increase or decrease compressor, fan, and blower speed.

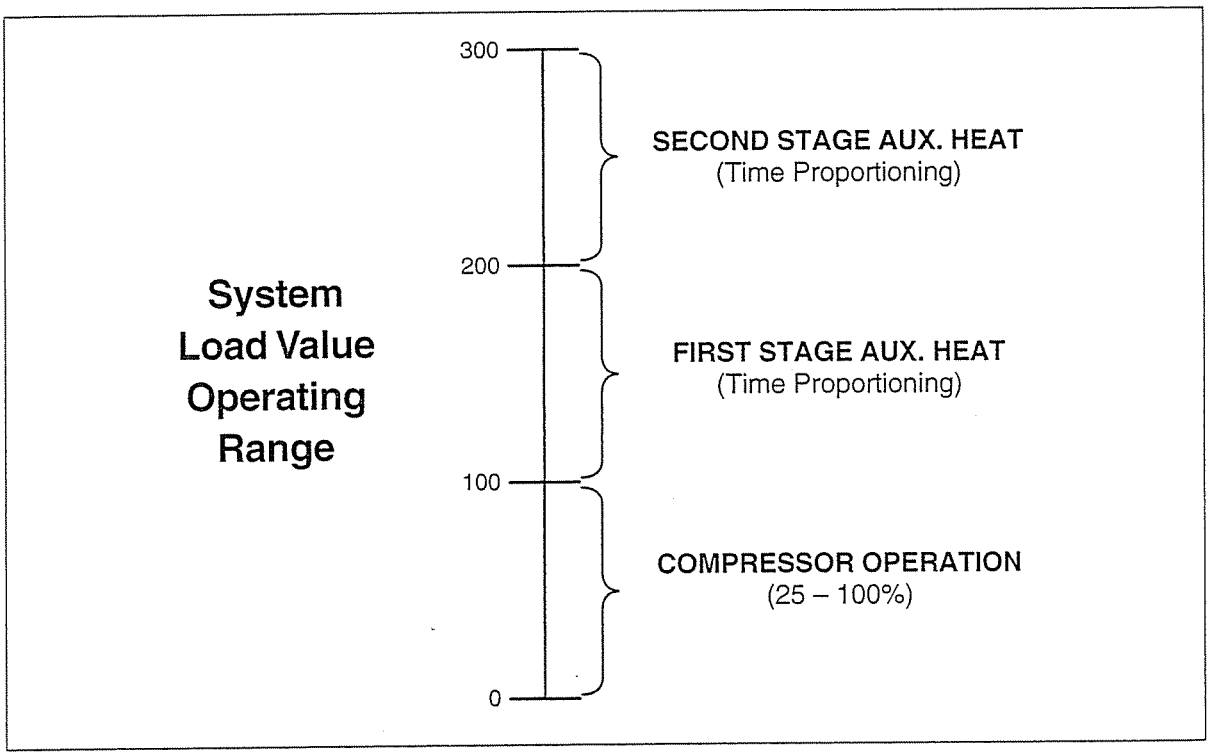
If ΔT does not change after time, the system load value will get larger and will continue to get larger if, ΔT does not change, or the system load value will wind up to a higher number.

If ΔT gets larger, the system load value will get larger, or wind up to a higher number.

When the ΔT gets smaller, the system load value will wind down. When system load value goes down, the system will slow down.

When ΔT gets to 0, the system may continue to run if the system load value time portion has not wound down to 0, or minimum run time requirement meet.

If system ΔT overshoots the set point, by 2°F, the system will shut off.



ZONED SYSTEM

Zone Load Value = Δ_T + Time x CFM%

The zone's CFM% is the DIP switch setting on it's zone board. This % is used to limit the zone's load value which limits the system load value to the maximum need of that zone.

Zoned System Load Value.

1. Add all zone load values.
2. The result is the system load value.

If only one zone is calling and its zone load value, capacity requirement, is less than the system minimum capacity, then the following will happen.

VAV LOW AIRFLOW ALGORITHMS

Heat Pump Compressor Operation

If one zone is calling AND that zone's CFM% is less than 35%, then ALL other zone dampers are cracked to provide leakage for the excess air. The dampers are activated for 15 seconds (1/4 of the travel time) to provide approximately 12 – 14 % leakage into all of the zones.

For a VAV Zone system ONLY, the minimum blower speed for normal heating operation is the same as the minimum speed for cooling operation.

Heat Pump Aux Heat Operation

No airflow restrictions are needed. It is assumed the compressor will already be at maximum speed (max. compressor CFM), therefore the system can handle the Aux heat blower speeds.

Heat Pump Emergency Heat Operation

All the dampers are opened and the primary zone is used to control the system. The primary zone is the lowest numbered zone. (NOTE: The primary zone is also used during defrost to determine how the Aux Heater(s) should be cycled On and Off.)

Heat /Cool System: Cooling Operation and Heating Operation with Wet Heat

Same as Heat Pump Compressor Operation

Heat/Cool System: Operation with a Gas Furnace

2 Stage Gas Furnace

First Stage: If the sum of the calling zone's CFM% is less than 72%, then the Bypass relay on the zone control boards is Enabled.

If the sum of the calling zone's CFM% is greater than or equal to 72%, then the Bypass relay on the zone control boards is Disabled.

Second Stage: The Bypass relay on the zone control boards is Disabled.

Note: The 2nd Stage CAN NOT come on till the sum of the calling zone's CFM% is equal to 100 or ALL zones are calling because of the clamping method on the system load value.

Single Stage Gas Furnace

If the sum of the calling zone's CFM% is less than 81%, then the Bypass relay on the zone control boards is Enabled.

If the sum of the calling zone's CFM% is greater than or equal to 81%, then the Bypass relay on the zone control boards is Disabled.

Heat/Cool System: Operation with Electric Heat

1 and 2 Stage Electric Heat

All the dampers are opened and the primary zone is used to control the system. The primary zone is the lowest numbered zone.

2 DEGREES OR MORE OF OVERSHOOT CLAMP

The system has a fixed maximum limit on the amount of overshoot allowed while the system IS "ON". ANY TIME (except droop or defrost) the system is ON and there is MORE THAN 2' degrees of overshoot the system will be shut off.

Load Value calculations proceed as normal, NO 'extra' steps are taken to modify the Load value calculations.

Once the Overshoot error is LESS THAN OR EQUAL to 3/4' degree and all applicable minimum off times have been met, the system will operate 'normally' (the system will turn back on if Load Value is still greater than the turn off threshold).

COMPRESSOR TIMING

Minimum RUN Time

Non Zoned System	Zoned System[1]	Droop Cycle
12 Min.	3 Min.	5 Min.

Minimum OFF Time

Non Zoned System	Zoned System[1]	Droop Cycle
7 Min.	7 Min.	7 Min.

1 Zoned System Droop Cycle is disabled.

DEFROST

The demand defrost board signals the system controller when a defrost cycle is needed.

To initiate a defrost cycle, the system controller ramps the compressor to half speed and then the SOV and the Auxiliary Heat① relays are energized. During defrost, the compressor is run at maximum speed, G is always on, and the Blower PWM output is 90%. To terminate a defrost cycle, the system controller ramps the compressor to half speed and then the SOV and Auxiliary Heat① relays are de-energized.

Load value calculations are 'suspended' during a Defrost Cycle.

① The Auxiliary Heat relays are cycled on/off based on temperature error.

Temperature Error (IDT - Setpoint)		
	Turn ON Threshold	Turn OFF Threshold
Stage 1 (W1)	error less than –1/2°	error more than 0°
Stage 2 (W2)	error less than –1°	error more than –1/2°

The maximum time for a defrost cycle allowed by the system controller is 18 minutes. If the system controller terminates a defrost on maximum time, the controller will not allow a new defrost cycle until the "D" terminal has been de-energized and then reenergized.

DEFROST FAULT

The demand defrost board will signal the system controller that a defrost fault has occurred.

The defrost fault LED on the system controller will flash to indicate a defrost fault. The thermostat will also light and flash the "SERVICE" icon.

To clear a defrost fault, the thermostat must be put into the EMERGENCY HEAT mode. The system controller will then attempt to reset the fault condition at the demand defrost board be sending a positive voltage out on the "F" terminal for 10 seconds. If after 10 seconds the demand defrost board still indicates a fault, the system controller will continue the 10 seconds positive voltage, wait 10 seconds cycle UNTIL the fault signal from the demand defrost board is no longer present.

Once the fault condition on the demand defrost board has been cleared, the "SERVICE" icon the thermostat will be cleared.

COMPRESSOR FAULT

When the system controller recognizes a compressor fault, compressor operation is stopped and the thermostat is signaled that a fault has occurred. The thermostat will light and flash the 'SERVICE' icon until the compressor fault has been cleared.

To clear a compressor fault, the thermostat must be put into the OFF or EMERGENCE HEAT mode. Once the system controller has cleared the fault, the 'SERVICE' icon will no longer be displayed.

When the system is in heating mode and a compressor fault occurs, the system controller will switch to Emergency Heat mode to satisfy the current load conditions.

A compressor fault occurs when any of the following four conditions are met.

1. Failed start sequence.
2. Compressor Stall and the compressor FAILED to restart.

   If the compressor stalls and then fails to re-start after the first 7 start attempts (fails the first "Small Cycle").
3. High Speed Fault.

   A High Speed Fault occurs when the compressor RPM exceeds the maximum RPM and the compressor PWM output is at minimum.
4. Under Speed Fault.

   A Under Speed Fault occurs after the compressor has been cycled on 10 consecutive times while an Under Speed Condition exists.

UNDER SPEED

An Under Speed condition is caused when the compressor PWM output is at maximum value and the compressor RPM is less than 85% of its maximum speed.

The Under Speed condition will clear itself once the actual RPM is greater than half speed and the compressor RPM is within 10% of the "Commanded Speed".

The Communications LED on the System Controller will be steady ON to indicate a Under Speed condition.

COMMUNICATIONS FAULT

A communication fault occurs when at LEAST 1 thermostat is not communicating. A thermostat is not communicating when the system controller has not received a valid reply from the thermostat in 20 consecutive tries.

A 'faulted' thermostat is consider 'communicating' again if the system controller receives 1 valid reply from the thermostat.

When a thermostat is 'not communicating'. the system controller forces the thermostat mode and fan operation to OFF and Fan Auto until the thermostat re-establishes communications with the system controller.

The system controller will **signal a communication fault by flashing the communication** LED 5 times a second (it is normally flashed 1/second).

VARIABLE SPEED SYSTEM CONTROLLER VOLTAGE

Controller Terminal and Function (W_1 and X_2 See Next Page)	Thermostat Off	Fan Continuous	Thermostat Satified	Cooling Call	Heating Call	Defrost Call	Emergency Heat	Notes
"BK" Blower Speed	5 V.D.C.	5 V.D.C. (1) - (2)	5 V.D.C. (1)	D.C. Voltage As Speed Call Goes Up D.C.V. Goes Up			9 V.D.C.	(1) BK D.C. voltage is at the low speed value when thermostat satifies and then goes to 5 Volts D.C.
"G" Blower On/Off (3)	0 V.A.C.	24 V.A.C.	0 V.A.C.	24 V.A.C.				(2) There is a time delay at the end of the heating cycle of 75 – 90 seconds.
Heat Pumps Only: "O" Switch Over Valve	0 V.A.C.	0 V.A.C.	(24 V.A.C.) Cooling (0 V.A.C.) Heating	24 V.A.C.	0 V.A.C.	24 V.A.C.	0 V.A.C.	(3) Blower Drive can lock itself off. To reset power must be removed from motor.
Heat Pumps Only: "Y" Signals to D.F.C. that Compressor is running	0 V.A.C.			24 V.A.C.		0 V.A.C.		(4) O.D. fan is turned off by D.F.C. during defrost cycle.
Heat Pumps Only: "D" Call from D.F.C. for a Defrost Cycle	0 V.A.C.				24 V.A.C.	0 V.A.C.		(5) 1/2 speed 4.7 V.D.C. High speed 9 V.D.C.
Heat Pumps Only: "D" Analog Voltmeter	0 V.A.C.				24 V.A.C.	0 V.A.C.		(6) No RPM 14 V.D.C. 1/2 speed 11.5 V.D.C. High speed 8 V.D.C.
Heat Pumps Only: "D" Digital Voltmeter	0 V.A.C.				24 V.A.C.	0 V.A.C.		(7) Fault LED in controller and Service in thermostat flashing.
"A" D.C. Speed call for O.D. Fan (4)	0 V.D.C.			D.C. Voltage As Speed Call Goes Up D.C.V. Goes Up			0 V.D.C.	(8) 4 & 5 ton H.P. model only. Fault LED in controller On.
"SP" D.C. Speed call for Compressor minimum on 12 minutes (5 and 10)	0 V.D.C.			D.C. Voltage As Speed Call Goes Up D.C.V. Goes Up			0 V.D.C.	(9) Fault LED in controller On.
"FQ" R.P.M. of Compressor (6)	14 V.D.C.			D.C. Voltage As Compressor Speed Goes Up Voltage Goes Down			14 V.D.C.	(10) Zone systems mimimum goes to 3 minutes.
"F" Fault or Compresasor Lockout – Heat Pump Only	0 V.A.C.	(7) Fault A or B Detected by D.F.C. 24 V.A.C. On & Off (8) O.D.T. – 7°F 24 V.A.C. On. Will Go Off At 3°F (9) H.P. & Gas Furnace Using O.D.T. H.P. Locked Out By O.D.T. 24 V.A.C. On					24 V.A.C.	

HEATING OPERATION REFERENCE MATRIX FOR VARIABLE SPEED

This matrix shows which terminals of the system controller that will be turned on or off during the following cycles:

CONTROL SYSTEM	SYSTEM DESCRIPTION	HEATING OPERATION		
		NORMAL	DEFROST	EMERGENCY
AYVCTLR100A	HEAT PUMP WITH ELECTRIC	W1 – ON (1) W2 – ON (1)	W1 – ON (1) W2 – ON (1)	W1 – ON (1) W2 – ON (1)
	HEAT PUMP WITH GAS	W1 – ON (1) W2 – ON (1)	X2 – ON (2) W2 – ON (1)	W1 – ON (1) W2 – ON (1)
	HEAT – COOL WITH ELECTRIC OR GAS	W1 – ON (1) W2 – ON (1)	W1 – N/A W2 – N/A	W1 – N/A W2 – N/A

Notes:

(1) System controller will cycle this terminal with demand. The demand for heat is determined by the thermostat and the controller. Dip switch #3 set for 3 or 6 cycles per hour.

(2) Bonnet thermostat #TAYPLUS101A will cycle the YLO/X2 call to the gas valve during defrost.

General

a. There is no "DEFROST" or "EMERGENCY" heat mode when using a heat-cool system.
b. Minimum compressor run time 12 minutes, all cycles except off zoned system, this minimum goes to 3 minutes.
c. Minimum compressor off time between cycles 7 minutes.
d. Minimum electric off time between cycles 3 minutes.
e. Heat pump operation minimum time to bring on electric heaters from a system power up is 10 minutes. Remember recovery ramp.

VARIABLE SPEED SYSTEM CONTROLLER VOLTAGE

Thermostat	H.P. Electric Aux. Heat: Cooling	Heating	Defrost	Emergency Heat	H.P. Gas Aux. Heat: Cooling	Heating	Defrost	Emergency Heat	Heating Below Balance Point	Cooling Gas or Electric Heat: Cooling	Heating	Defrost	Emergency Heat
Speed Bars – Note 1	YES	YES	YES	NO	YES	YES	YES	NO	YES	YES	NO	N/A	N/A
Possible Faults, Flashing Service													
No Compressor	YES	YES	YES	NO Note 2	YES	YES	YES	NO Note 2	YES	YES	N/A	N/A	N/A
Under Speed	YES	YES	YES	NO	YES	YES	YES	NO	NO	YES	N/A	N/A	N/A
Defrost Faults, A or B	N/A	YES	YES	NO Note 2	N/A	YES	YES	NO Note 2	YES Note 3	N/A	N/A	N/A	N/A
Controller, Fault L.E.D. Flashing													
No Compressor	OFF	OFF		OFF Note 2	OFF	OFF		OFF Note 2	Note 3	OFF	N/A	N/A	N/A
Defrost Faults A or B – Note 4	N/A	F	F	OFF Note 2	N/A	F	F	OFF Note 2	F Note 3	N/A	N/A	N/A	N/A
4 and 5 Ton Heat Pumps Only													
O.D. temperature –7°F or below will go out when O.D. temperature goes above +3°F	N/A	ON	N/A	ON	N/A	ON	N/A	ON	ON Note 3	N/A	N/A	N/A	N/A
Controller, Status L.E.D.													
Underspeed 15% Low	ON	ON	ON	ON	ON	ON	ON	ON	Note 3	ON	N/A	N/A	N/A

Notes

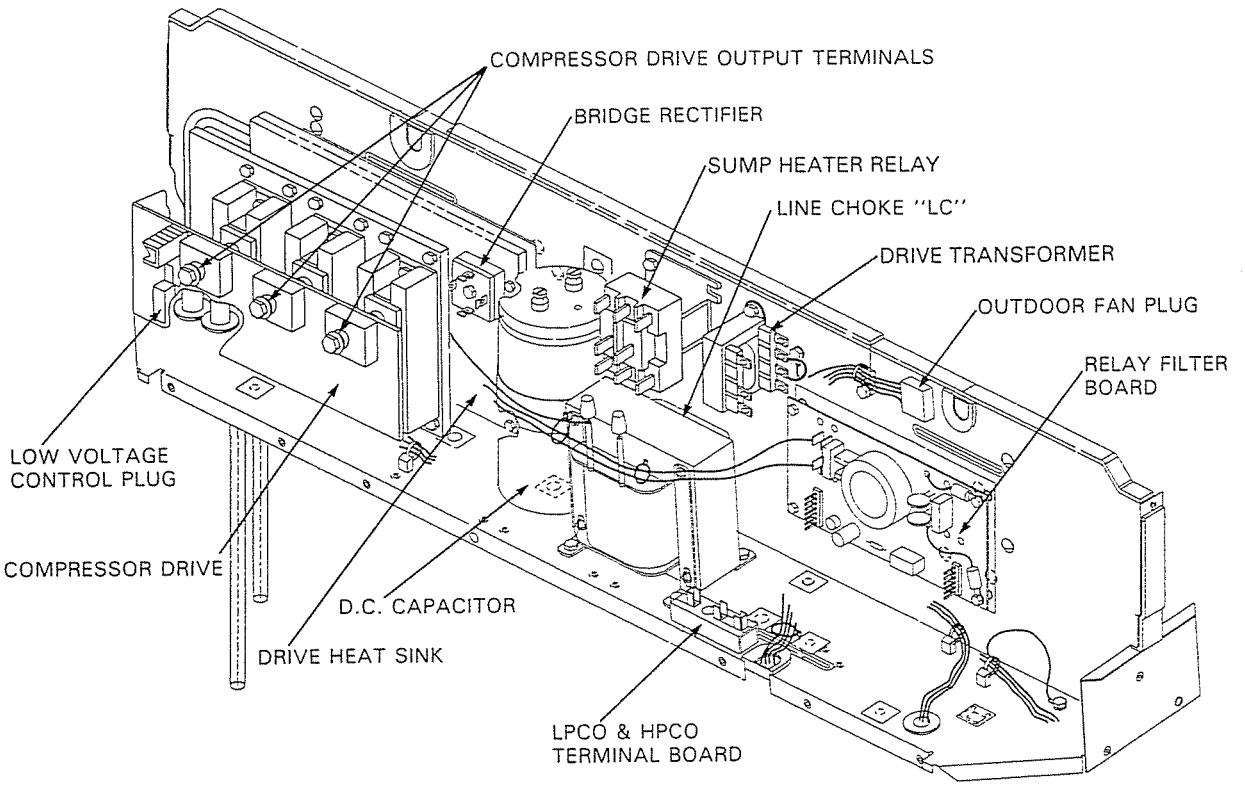
(1) If thermostat HP/HC switch in the H/C position No Speed Bars will be shown in the heating cycle. Their will also be no Emergency Heat Cycle.

(2) Emergency Heat or Off at thermostat will clear fault indicator.

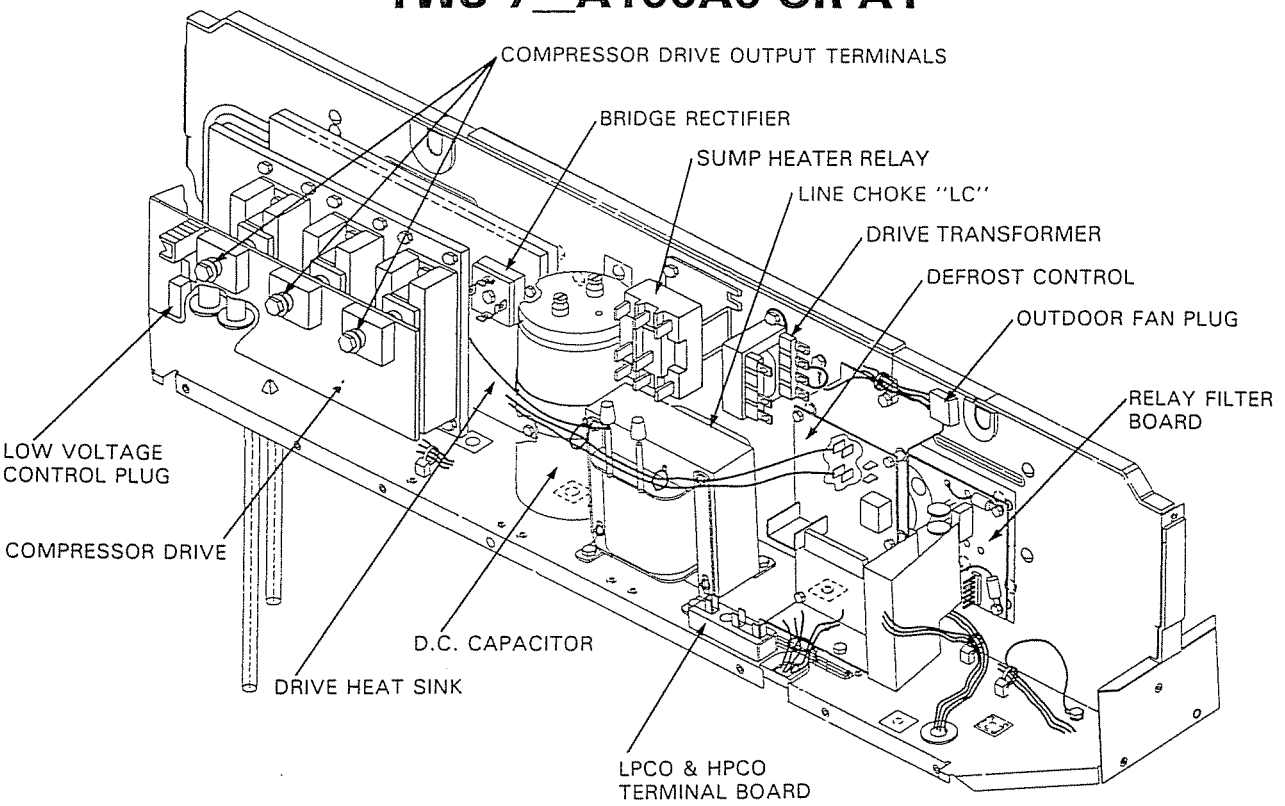
(3) If O.D.T. is used for restricted operation Fault L.E.D. will be on when O.D.T. locks out heat pump.

(4) F = Flashing possible fault, "Service" on stat.

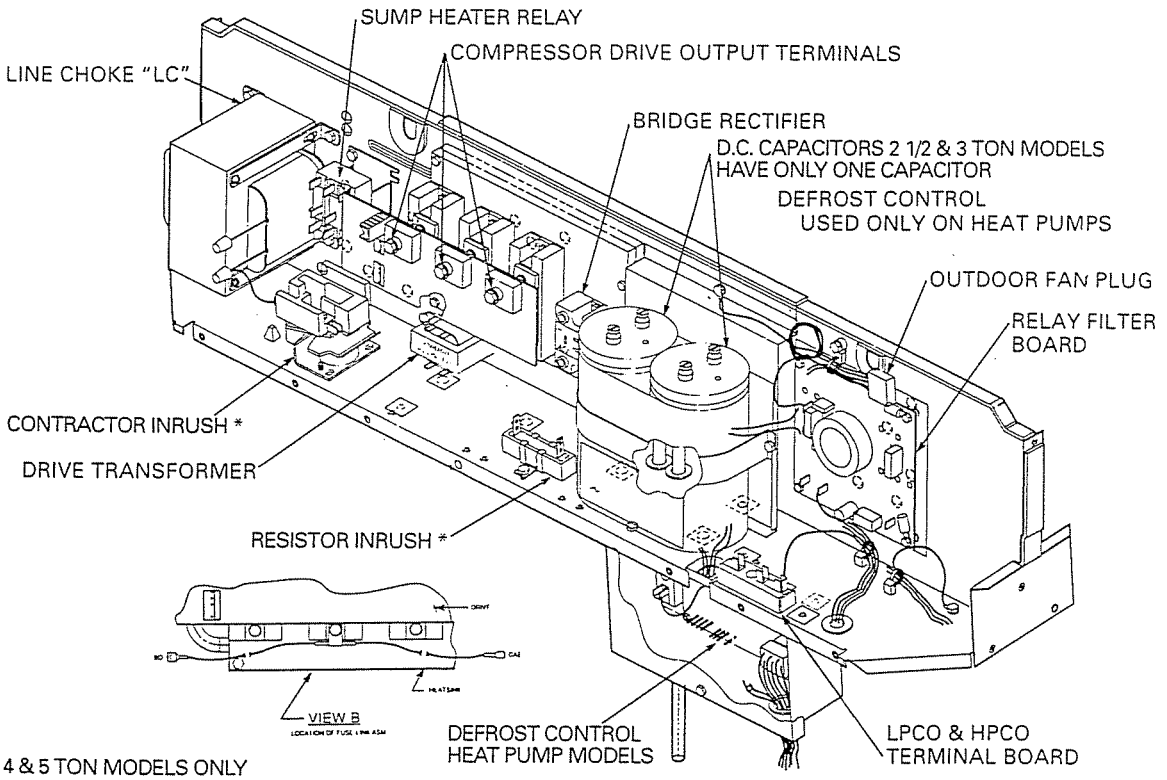
2-1/2 AND 3 TON COOLING CONTROL BOX TTS 7__A100A0 AND A1



2-1/2 AND 3 TON HEAT PUMP CONTROL BOX TWS 7__A100A0 OR A1



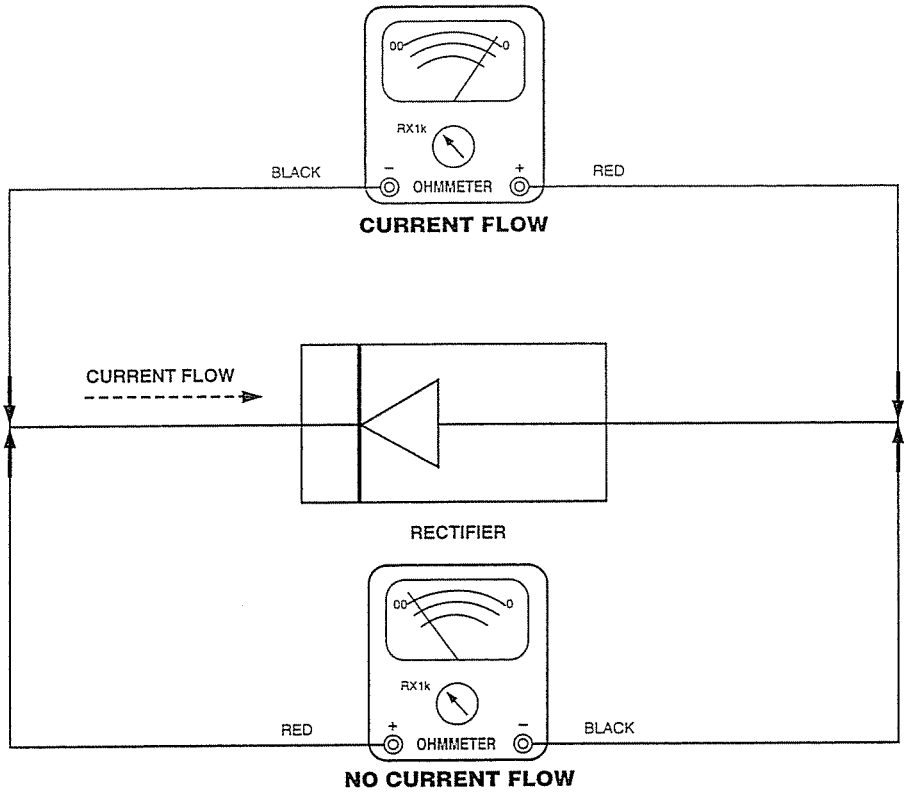
COOLING AND HEAT PUMP CONTROL BOX 2-1/2 AND 3 TON TTS AND TWS 7__A100A2 4 AND 5 TON ALL MODELS



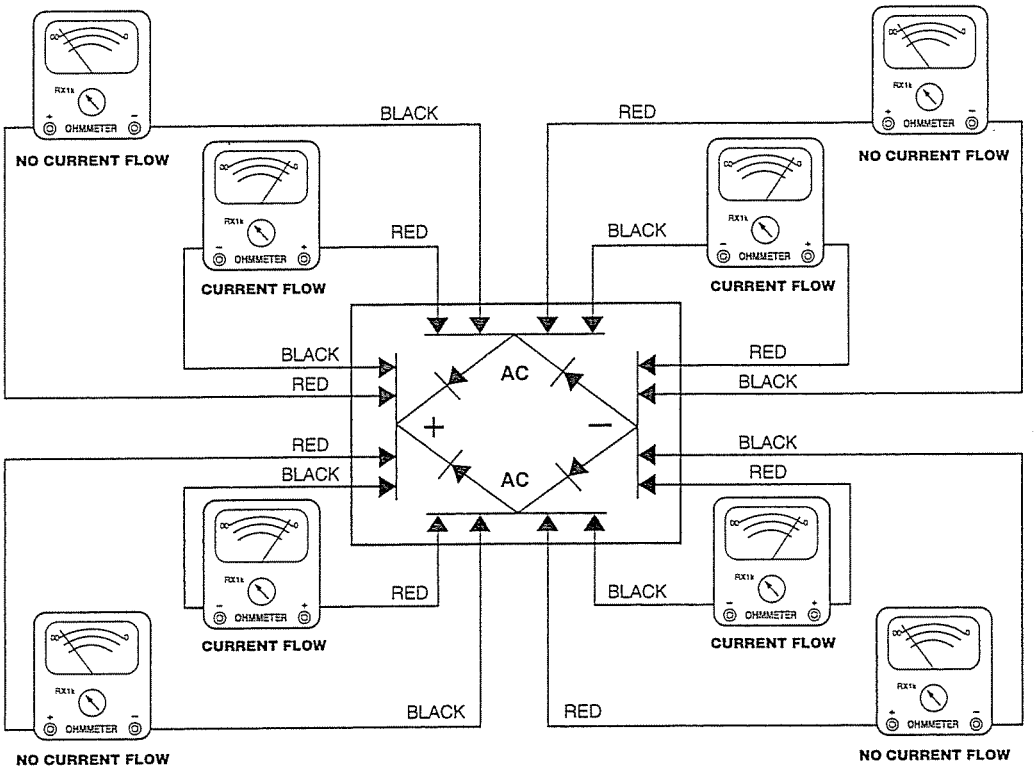
* 4 & 5 TON MODELS ONLY

RECTIFIER CHECKING

The Rectifier Is Good If It Has Current Flow, Low Resistance, In Only One Direction.

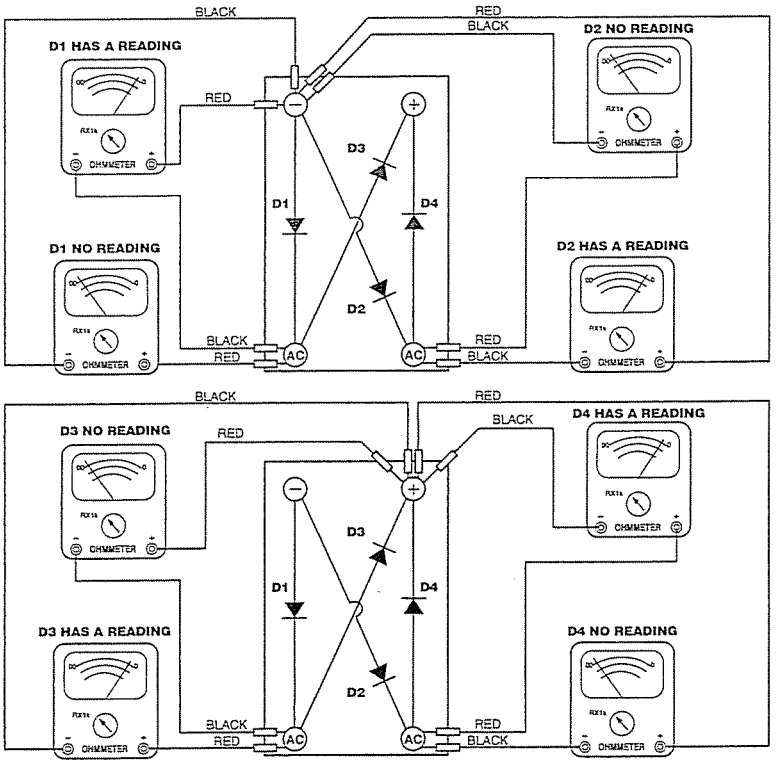


CHECKING A BRIDGE RECTIFIER WITH AN OHM METER 2 1/2 AND 3 TON MODELS ONLY



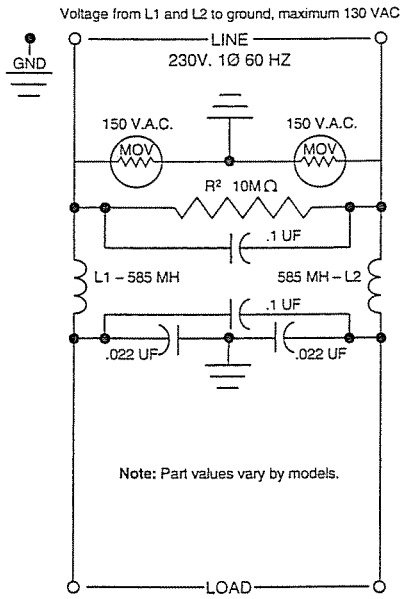
NOTE: Some OHM Meters The + Probe Has – Voltage On The + Probe In The OHM Positioning And All Readings Will Be Reversed.

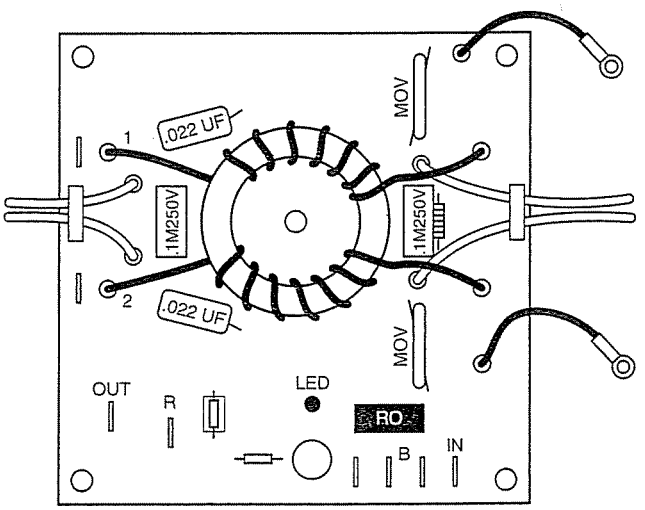
CHECKING A BRIDGE RECTIFIER WITH AN OHM METER
4 AND 5 TON MODELS ONLY

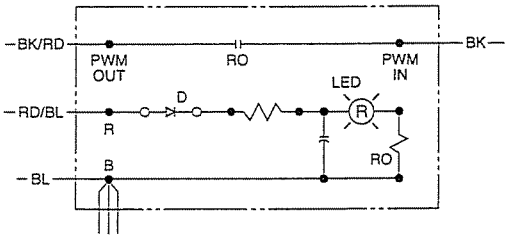


NOTE: Some OHM Meters The + Probe Has – Voltage On The + Probe In The OHM Positioning And All Readings Will Be Reversed.

RELAY/FILTER BOARD
TTS-TWS730, 736A2 AND ALL 4 AND 5 TON MODELS







REACTANCE IS MEASURED IN OHMS

$$X_C = \frac{1}{2\,FC} \qquad X_L = 2\,FH$$

Note: The 5 Mounting Screws Must Be In Place For EMI Filter To Work

QUICK CHECK
NO COMPRESSOR OPERATION

STEP A

Jumper the red 24 V.A.C. low voltage wire to the black compressor speed low voltage wire. Does the compressor run?

YES → Go to troubleshooting chart Step #4B.

NO

STEP B

Jumper the red 24 V.A.C. low voltage wire to the black/red compressor speed low voltage wire at the 4 pin compressor drive plus, does the compressor run? **CAUTION, HIGH VOLTAGE AREA.**

YES → Compressor locked out by RO relay. Go to troubleshooting chart Step #7.

NO

STEP C

Is there 230 V.A.C. to the bridge rectifier in the outdoor unit?

NO → Go to troubleshooting chart Step #8.

YES

STEP D

Is there 24 V.A.C. to the outdoor unit? Red to blue low voltage wire.

NO → Go to troubleshooting chart Step #3.

YES

STEP E

CAUTION HIGH VOLTAGE — CAUTION HIGH VOLTAGE

Is there 20 V.A.C. to the compressor drive? 20 V.A.C. is supplied by the outdoor transformer to the compressor drive at the 2 pin low voltage connector on the drive. **CAUTION, THERE IS 160 VOLTS FROM THESE PINS TO CASE GROUND.**

NO → Checkout 20 V.A.C. transformer in the outdoor unit.

YES

STEP F

Is there a minimum of 300 V.D.C. to the compressor drive?

NO → Go to troubleshooting chart Step #9.

YES

Go to troubleshooting Chart #11A.

continued

QUICK CHECK
NO OUTDOOR FAN OPERATION

STEP A

Jumper the red 24 V.A.C. low voltage wire to the outdoor fan speed red/black low voltage wire. Will fan run?

YES → Go to troubleshooting chart Step #18A.

NO

STEP B

HEAT PUMPS ONLY. Jumper the red 24 V.A.C. low voltage wire to the outdoor fan motor yellow low voltage lead connected to the defrost control terminal T2. Does the outdoor fan run?

YES → Defrost control relay K-2 defective. Replace control.

NO

STEP C

Is there 230 V.A.C. at the outdoor fan motor leads? No voltage, restore power to fan motor.

YES → Go to Quick Check D.

NO

STEP D

Is there 24 V.A.C. to the outdoor unit?

YES → Replace fan motor.

NO

Go to troubleshooting chart Step #3.

QUICK CHECK
NO INDOOR BLOWER OPERATION

STEP A

Jumper the R terminal to the G terminal at the air handler or furnace. Does the blower run? Blower should run at the low speed tap.

NO → Go to Quick Check Step C.

YES

STEP B

Jumper the R terminal to the G&W terminals of the air handler or furnace. Does the blower speed change from Step A?

YES → Go to troubleshooting chart Step #2C.

NO → ICM-2 Motor See Installer's Guide for DIP Switch Air Flow Settings

Check the speed tap jumpers: ICM-1
On 2 piece motors there are 2 speed taps.
On 1 piece motors there are 3 speed taps, the red speed wire is for heat.

VERTICAL

TONAGE	HUMID CLIMATES	DRY CLIMATES
2-1/2	6 & 1	8 & 1
3	8 & 1	10 & 1
4	7 & 2	8 & 2
5	8 & 2	10 & 2

HORIZONTAL

TONAGE	HUMID CLIMATES	DRY CLIMATES
2-1/2	4 & 1	6 & 1
3	6 & 1	8 & 1
4	6 & 2	7 & 2
5	7 & 2	10 & 2

If speed taps are correct and blower speed does not change, on the 2 piece motor system change the drive, and on the 1 piece motor system, change the motor.

STEP C

Is there 230 V.A.C. going to the blower motor drive, 115 V.A.C. required on gas furnaces? Is there 24 V.A.C. between terminals R & B at the A/H or furnace terminal board?

YES → If there is 24 V.A.C. at motor drive plug. Replace motor drive on a 2 piece system, on a 1 piece system change motor.

If there is no 24 V.A.C. at motor drive plug. Check fan relay and wiring going to motor plug from the A/H or furnace terminal board.

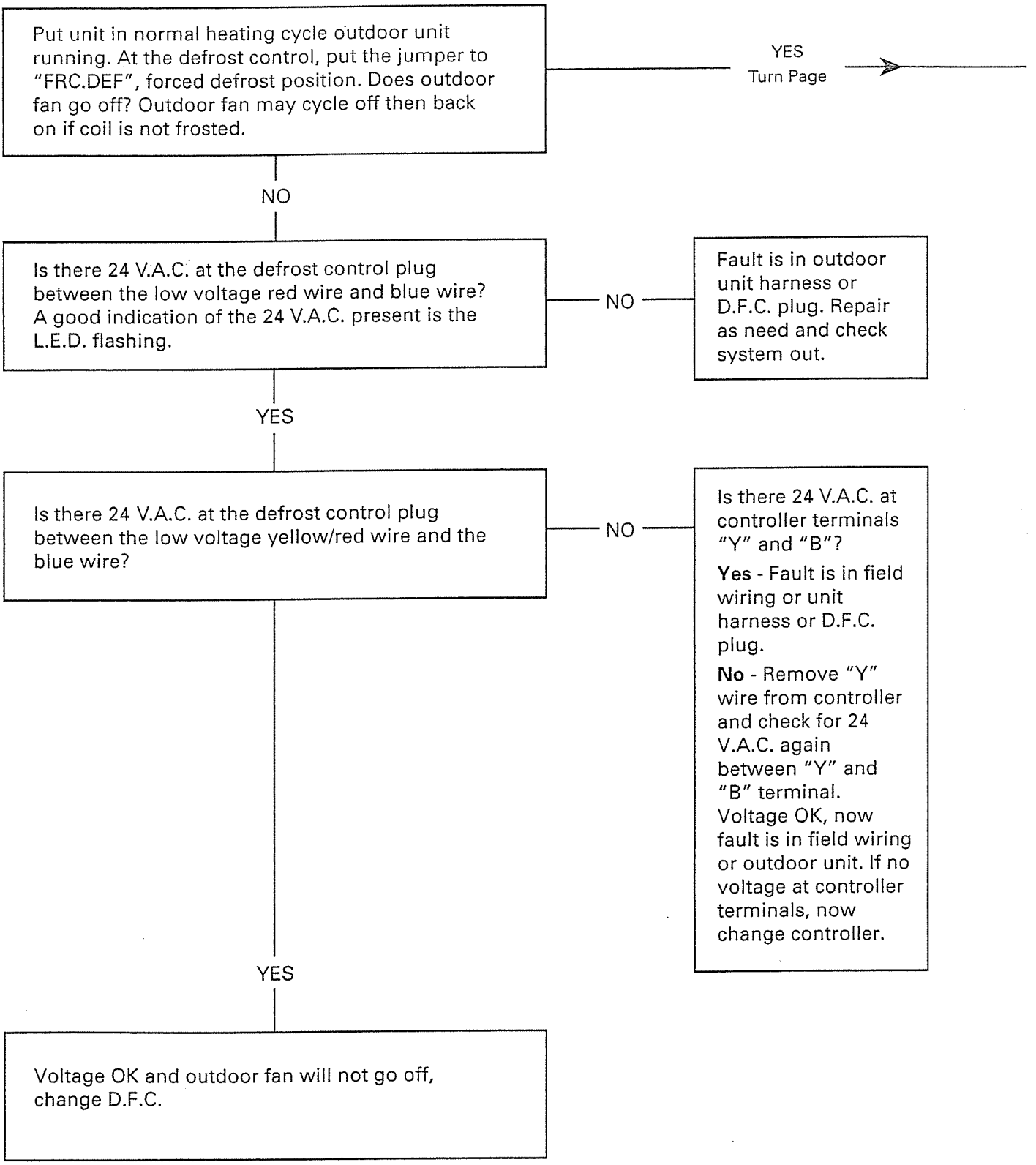
NO

Restore power to motor drive or 24 V.A.C.

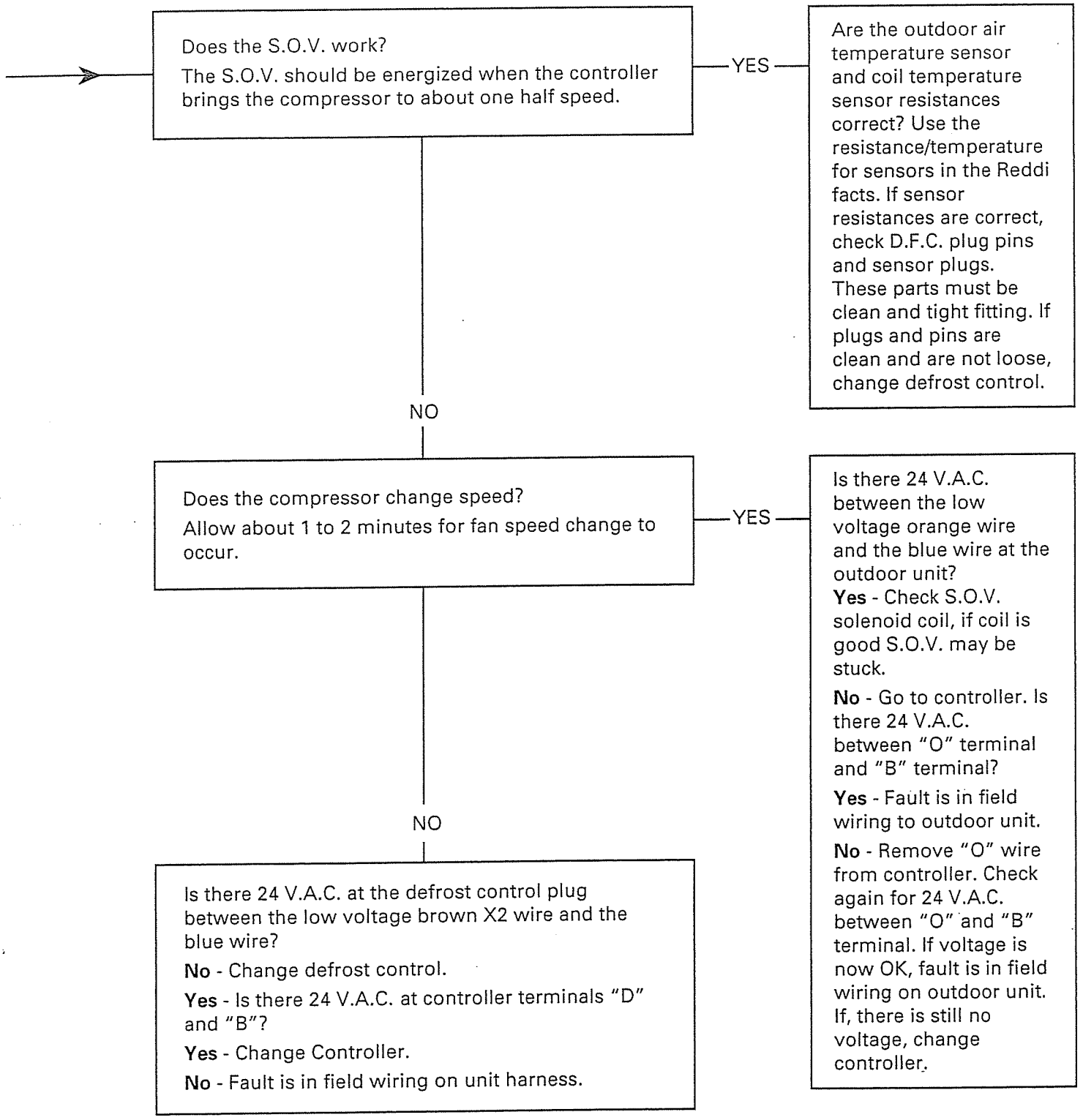
continued

QUICK CHECK
DEFROST PROBLEMS

Variable speed heat pumps cannot be put through a defrost cycle in the service mode.



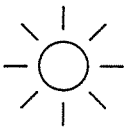
QUICK CHECK
DEFROST PROBLEMS



LED INDICATOR

LED ON LED OFF

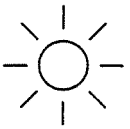
1. Thermostat Green Status L.E.D.



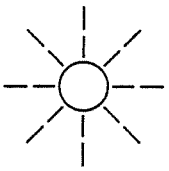
SLOW FLASH RATE: 1 flash per second, non-zoned system means thermostat has been queried, questioned, by the system controller and the thermostat is replying. Zoned system, the thermostat will not flash every second. The more zones installed and turned on, the slower the flash rate will be.

LED OFF: means the thermostat has not been queried by the controller or the thermostat has failed.

2. System Controller Status L.E.D.



SLOW FLASH RATE: 1 flash per second means the thermostat or all thermostats in the zoned system are communicating with the system controller.

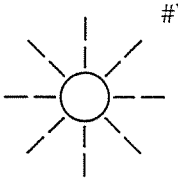


FAST FLASH RATE: 5 flashes per second means thermostat or one or more thermostats in a zoned system are not communicating with system controller, or bridge switch (#SW1-1) is turned on, or if a computer is connected to the controller it is not replying. (This fast flash rate will also be seen in the service mode of operation if the compressor did not start or continue to run. Controller computer program #V2.06 or 3.0 only.)

LED ON: May mean the controller's DIP switches are in their service position and the compressor is running or when the DIP switches are in the normal operating position this indication means the compressor is running slower than it is being called for.

and

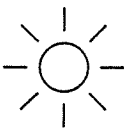
and



This combination pattern will only be seen when the controller's DIP switches are in their service position and the compressor did not start or continue to run. Controller's computer program #V3.4 or higher.

3. System Controller DFST FLT L.E.D.

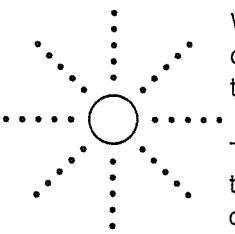
Normally out.



SLOW FLASH RATE: Means the defrost control has detected a failed fault with the heat pump only.

Thermostat is in the emergency heat mode of operation or the outdoor temperature has dropped below –7°F and is still below +3°F. 4 and 5 Ton heat pumps only.

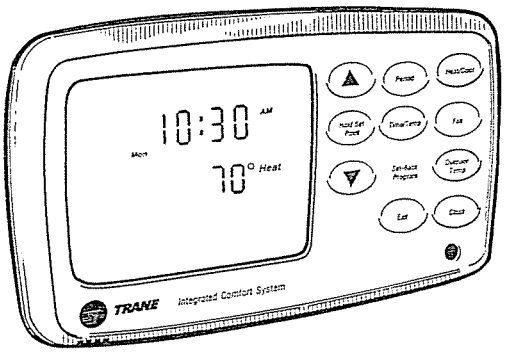
4. Logic Probe



WINKING: Flash rate can not be counted manually, but is not on all the time.

This indication will only be used in troubleshoot thermostat/controller circuits S1 and S2 using a field supplied logic probe.

What Does Thermostat Display and Green Status LED Show?

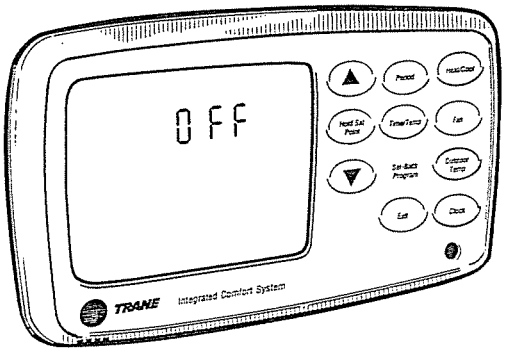


CHECK No. 1

(A)

No Green status LED or on a zoned system all thermostat green status LED are out.

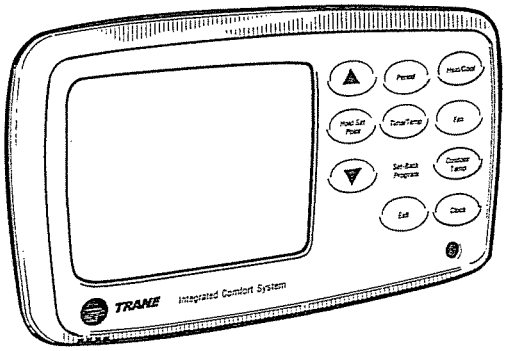
Perform check **No. 1A1**.



(B)

No Green status LED

Perform check **No. 1B1** for NON ZONED system or Zone system that all thermostats have OFF displayed. If one or more thermostats in a Zoned system display off, fault is in 24V.A.C. field wiring to thermostat.



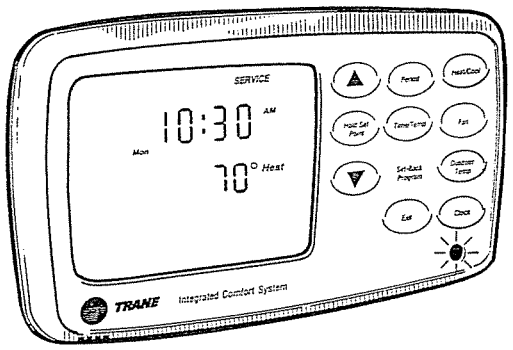
(C)

No Green Status LED

Perform check **No. 1B1** and check Battery pack inside thermostat, check **No. 1C1**.

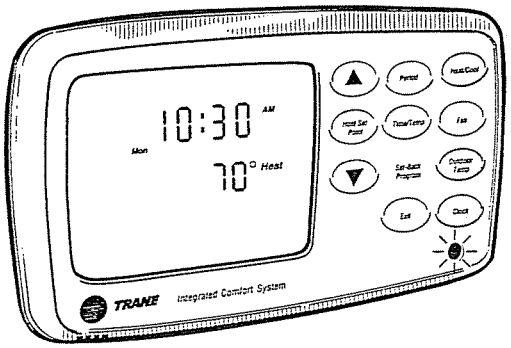
continued

What Does Thermostat Display and Green Status LED Show?



(D)

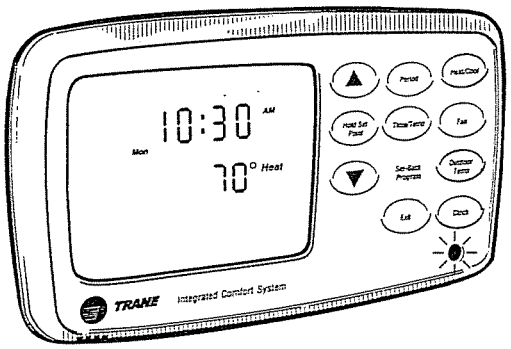
Perform check **No. 1D1**.

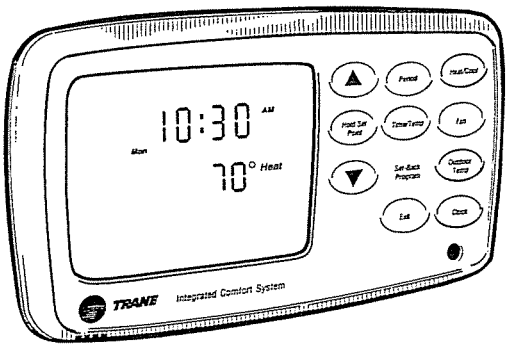


(E)

Green status LED flashing, non zoned system no system operation. Zoned system one or more zones will not operate system.

Perform check **No. 1E1**.





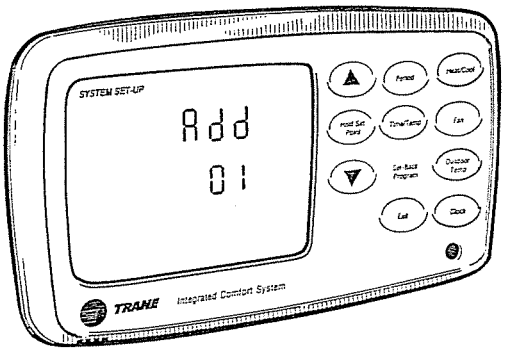
(F)

Zoned system only

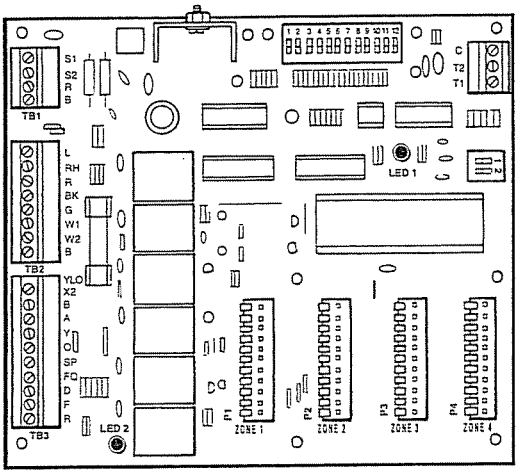
One or more zones Green status LED flashing. System operating in these zones. There is nothing wrong with these zones. If no system operation in these zones perform check No. 1E1.

One or more zones Green status LED NOT flashing. Perform check No. 1A1.

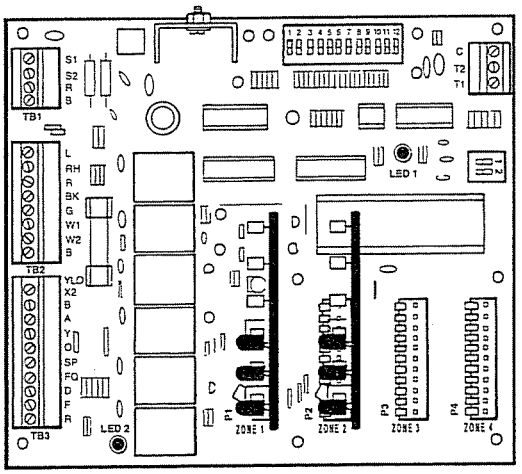
CHECK SYSTEM



NOT ZONED



ZONED



CHECK No. 1A1

CHECK ADDRESS ON THERMOSTAT.

To put thermostat in the system set up mode

1. Push Exit button and hold.
2. Also push Outdoor Temperature button and hold until system setup appears in the display.
3. Repeatedly push and release the Heat/Cool button until address number appears in display.
4. The address must be 01 for a non-zoned system. For a zoned system, with zone dampers, the thermostat address must agree with the zone board that it is working with. The address for the zone board is printed below the zone board in the system controller, 1 – 4.
5. Is the address correct?

YES: Perform check No. 1A4 for non-zoned system or a zoned system when all thermostat Green status LED's are out. Zoned system perform check No. 1A2 if any one of the zone thermostats is working.

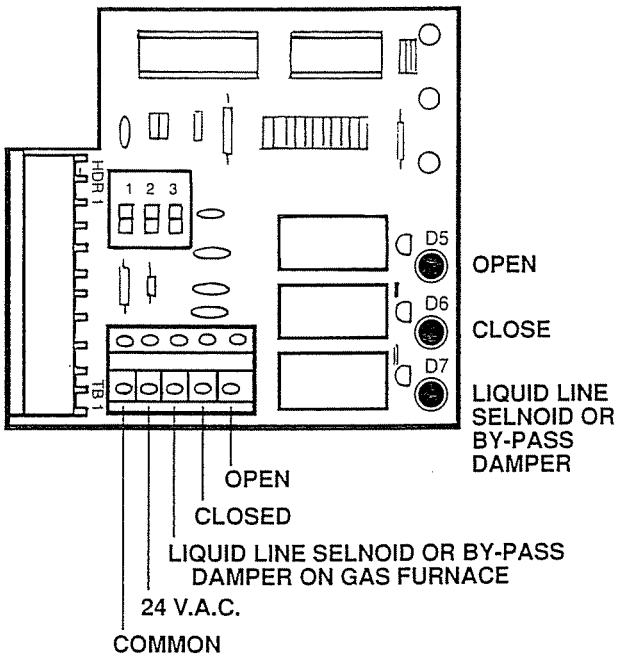
NO: Push the up button or down button until the correct zone address is set — 01, 02, 03, 04. Does the thermostat Green status LED now flash.

NO: If it is still out, go back to check No. 1A1 question No. 5 above.

YES: Check for system operation.

CHECK SYSTEM

ZONE BOARD



CHECK No. 1A2

Is the zone board turned on? The dip switch assembly must have one of its three switches turned on for the zone to operate. Off, off, and off means zone off.

YES: Perform check 1A3.

NO: Turn on zone board for the C.F.M. requirements of the zone. Use dip switches No. 1, 2, 3 to set the CFM for each zone. Check for system operation.

Zone Board Dip Switch Setting

Zone Wgt.	% of Total CFM	ZONE BOARD DIP SWITCH Sw1	Sw2	Sw3
7	100%	ON	ON	ON
6	75%	OFF	ON	ON
5	50%	ON	OFF	ON
4	40%	OFF	OFF	ON
3	35%	ON	ON	OFF
2	25%	OFF	ON	OFF
1	17%	ON	OFF	OFF

Zone CFM and Weight Settings

2 1/2 Ton System

Wgt.	CFM / TON 350	400	450
7	875	1000	1125
6	650	750	850
5	450	500	550
4	350	400	450
3	325	375	425
2	225	250	275
1	175	200	225

3 Ton System

Wgt.	CFM / TON 350	400	450
7	1050	1200	1350
6	800	900	1000
5	525	600	675
4	425	500	555
3	400	450	500
2	250	300	350
1	200	225	250

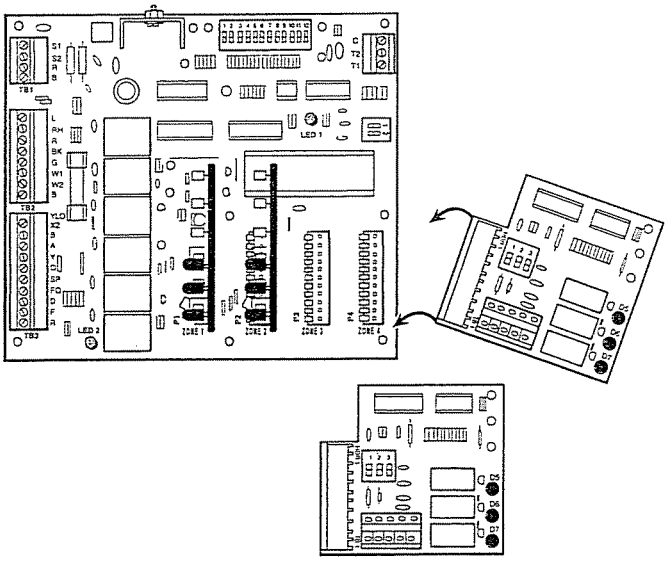
4 Ton System

Wgt.	CFM / TON 350	400	450
7	1400	1600	1800
6	1050	1200	1350
5	700	800	900
4	575	650	725
3	525	600	675
2	350	400	450
1	250	300	350

5 Ton System

Wgt.	CFM / TON 350	400	450
7	1750	2000	2200
6	1325	1500	1625
5	875	1000	1100
4	700	800	900
3	650	750	825
2	450	500	550
1	325	375	425

CHECK SYSTEM



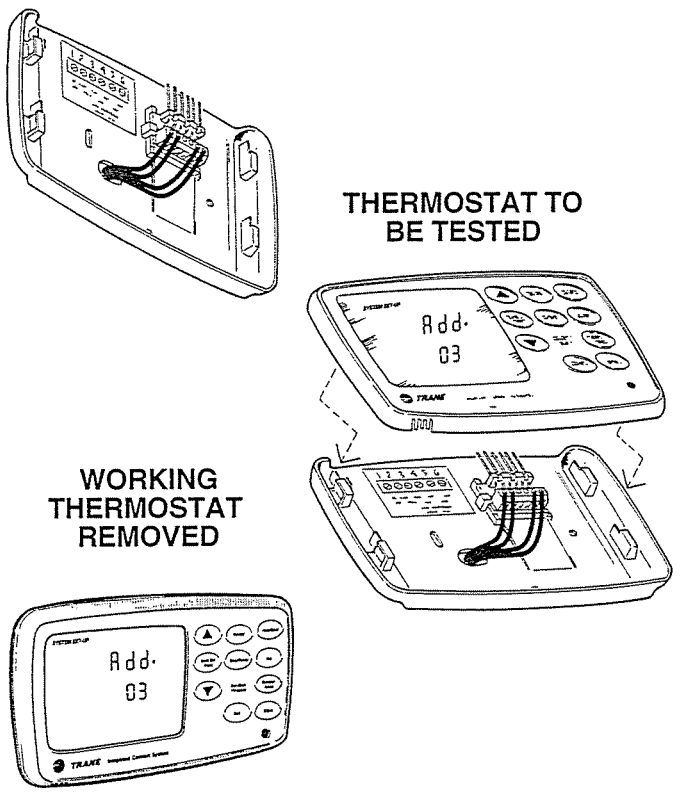
CHECK No. 1A3

Turn 24 V.A.C. off by pulling fuse out of the controller. Unplug the zone board, for the zone thermostat that is NOT working, then pull out another board from a zone that is working and put it into the zone board slot that was not working, swap them. Repower control system. Allow system to operate for at least one minute. Does the zone thermostat Green status LED flash at its normal rate now?

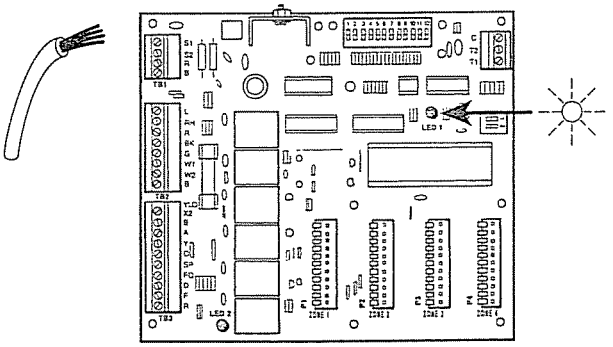
YES: Original zone board defective.

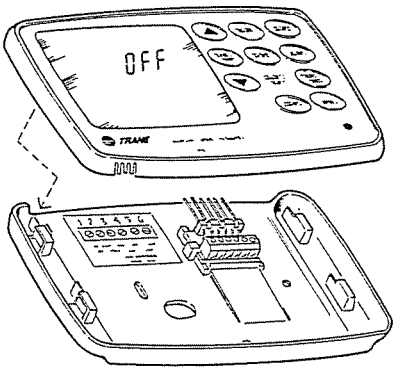
NO: Unplug inoperative thermostat and remove batteries, then install it in a sub base of a thermostat that is working and set address on inoperative thermostat to the same address as the working zone thermostat removed. If thermostat does not work at this location, replace thermostat. If thermostat works at this location, reinstall it in its original location. If thermostat works now at original location thermostat's flip-flop circuit was reversed. Replace thermostat batteries. If thermostat will not work at its original location, fault is in the thermostat field wiring, S1 or S2 wires.

(**Note:** An OHM meter continuity check of thermostat wire will not always detect the fault with field wiring S1 and S2.)



CHECK SYSTEM





CHECK No. 1A4

Controller red status LED No. 1 flashing fast five flashes per second means that controller is not receiving a reply from a thermostat.

If system is zoned and all thermostat green status LED's are out, this procedure will be used. If any one or more thermostat green status LED's are flashing and the indoor or outdoor equipment will run when called for by a zone thermostat, perform check No. 1A2.

There are three things that can cause this fault.

A. Thermostat

B. Controller

C. Thermostat field wiring S1 and S2.

STEP 1 – Remove controller fuse.

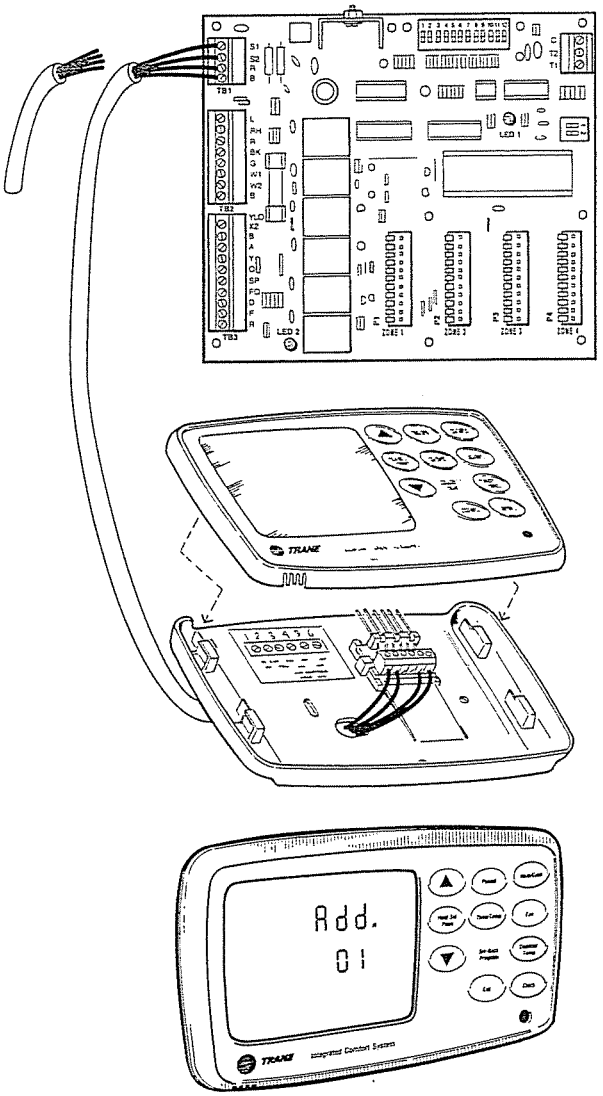
STEP 2 – Remove wires from thermostat terminal block terminals S1, S2, R, B in controller.

NOTE: Record color of wires removed from these terminals.

STEP 3 – Remove a thermostat and subbase from wall. Remove batteries from thermostat.

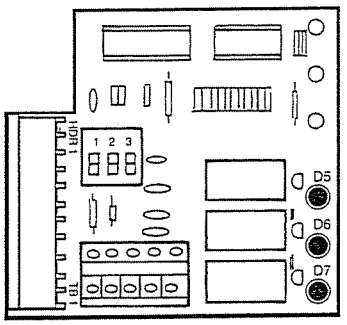
continued

CHECK SYSTEM



CHECK No. 1A4 continued

STEP 4 – Using a short piece of thermostat wire reconnect thermostat to controller and install thermostat into sub base. Thermostat address must be 01 for this test.



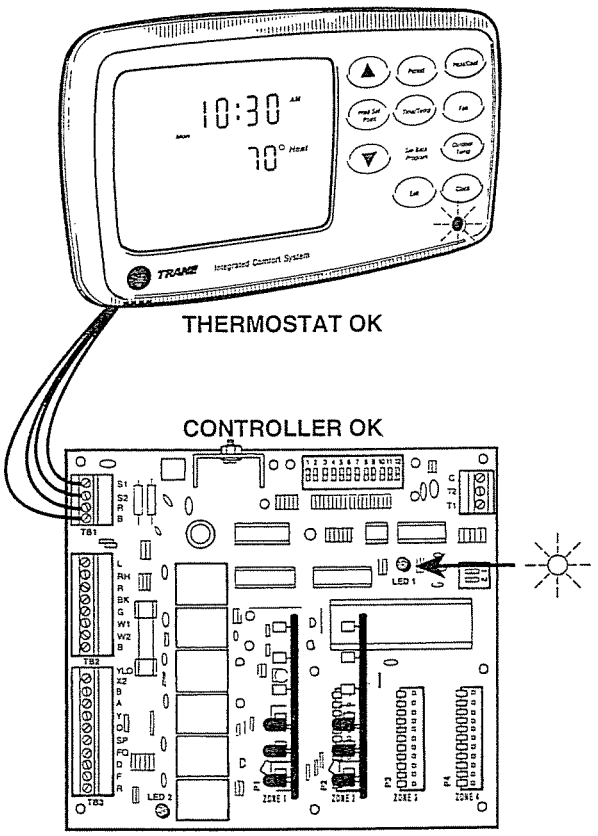
ALL ZONED BOARDS TURNED OFF

STEP 5 – Zone system all zone board DIP switches must be turned to their off position for this test.

STEP 6 – Replace fuse in controller removed in step 1.

continued

CHECK SYSTEM



CHECK No. 1A4 continued

STEP 7 – Check for thermostat green status LED's and controller status LED operation.

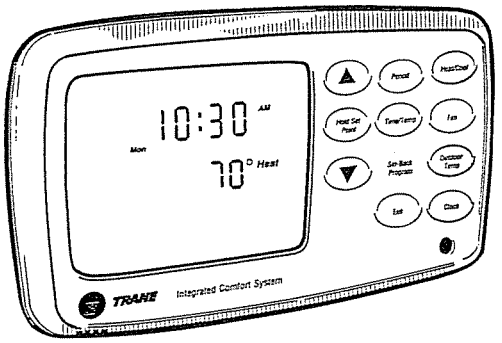
Are they flashing correctly?

YES: Check all zone thermostats one at a time. Remember to remove batteries. If all thermostats work fault may be in field wiring. Leave batteries out and reinstall thermostat in its original location. Reconnect field wiring to controller and check for operation. If it will not work fault is in wiring.

NOTE: An OHM meter continuity check of thermostat wire will not always detect the fault with field wiring S1 and S2.

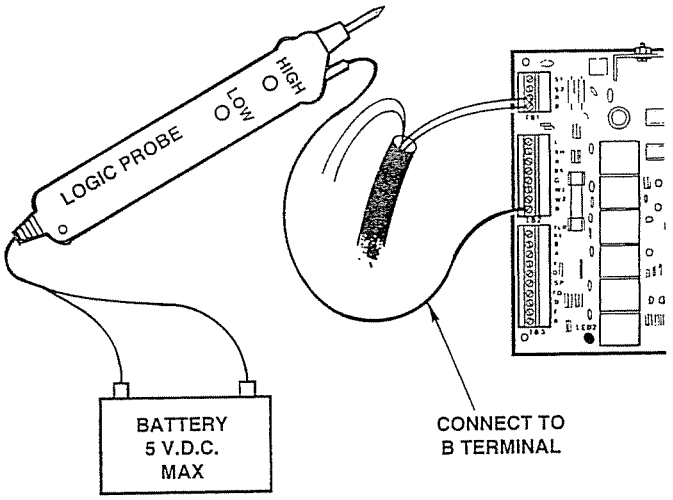
NO: Thermostat green status LED out. Perform check No. 1A5 controller output test. Zoned system if any thermostat works in this test, controller is OK.

Replace non-working thermostats.



continued

CHECK SYSTEM



CHECK No. 1A5

Controller output S1 and S2 test.

STEP 1 – Remove controller fuse

STEP 2 – Remove all wires from thermostat terminal block S1 and S2 in controller. Note color of wires and terminal I.D.

STEP 3 – Connect logic probe as pictured.

STEP 4 – Replace control fuse.

STEP 5 – Observe logic probe light patterns.

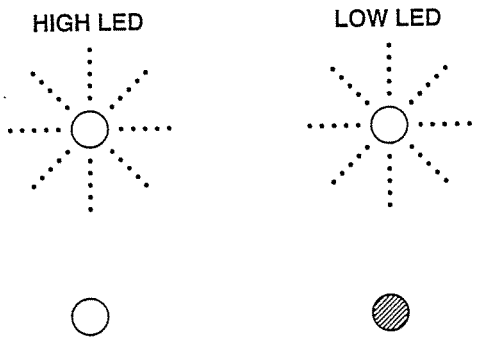
STEP 6 – Is light pattern observed correct for S1 and S2?

YES: Controller output appears to be OK. Replace thermostat.

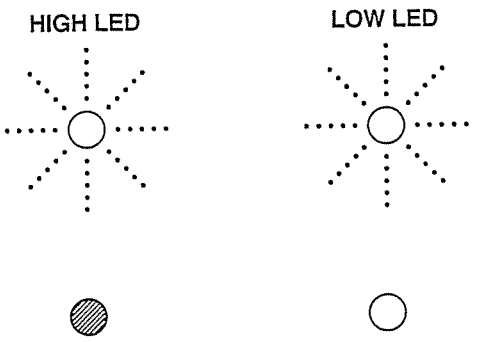
NO: Replace Controller.

NORMAL LOGIC PROBE LIGHT PATTERNS FOR:

S1 OUTPUT



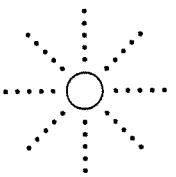
S2 OUTPUT



LED LIGHT CHART INDEX

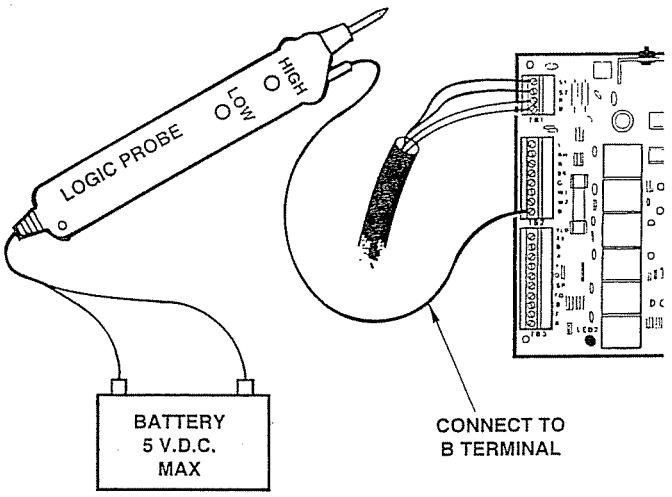
○ LED ON

● LED OFF



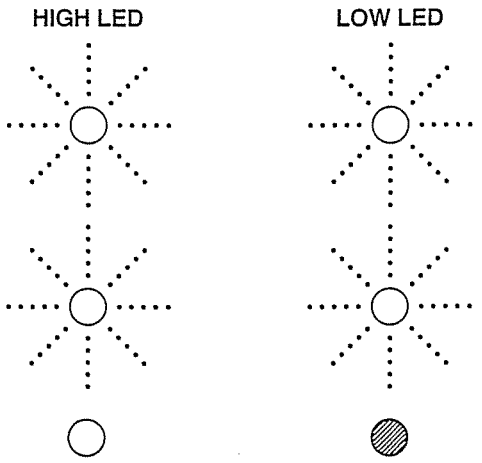
WINKING: Flash rate can not be counted manually, but is not on all the time. This indication will be used in troubleshoot thermostat/controller circuits S1 and S2 using field supplied logic probe.

CHECK SYSTEM

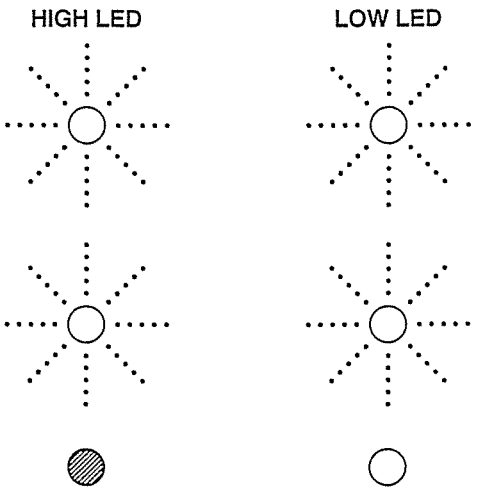


NORMAL LOGIC PROBE LIGHT PATTERNS FOR:

S1 OUTPUT



S2 OUTPUT



CHECK No. 1A6

Input and output S1 and S2 test.

STEP 1 – Remove controller fuse.

STEP 2 – Connect thermostat to controller with a short piece of thermostat wire.

STEP 3 – Thermostat batteries must be removed and address must be 01 for this test. Zoned system all zone boards must be turned off.

STEP 4 – Connect logic probe as pictured.

STEP 5 – Replace control fuse.

STEP 6 – Observe logic probe light patterns.

STEP 7 – Is light pattern observed correct for S1 and S2?

NO: Perform check No. 1A5 controller output test for S1 and S2.

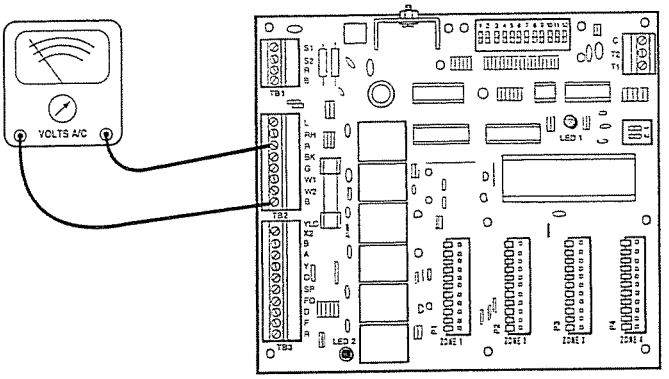
YES: S1 and S2 output and input appears to be OK. Does the thermostat Green status LED and system controller flash once per second?

YES: Control system should work.
Check each zone for operation.

NO: Replace thermostat first if no operation then replace controller.

continued

CHECK SYSTEM



CHECK No. 1B1

Is 24 V.A.C. present at system controller air handler terminal block terminals "R" and "B"?

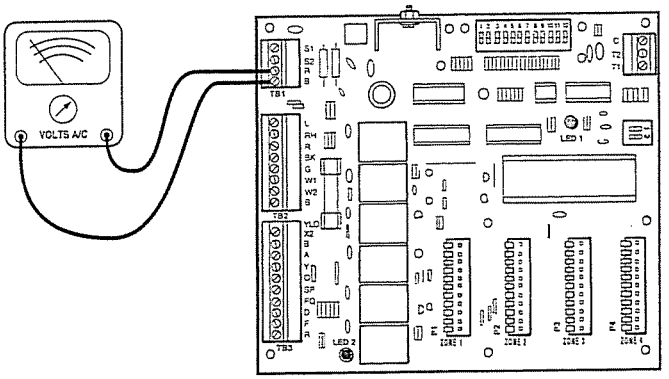
NO: Check for 24 V.A.C. at gas furnace or air handler terminal board. Repair as needed.

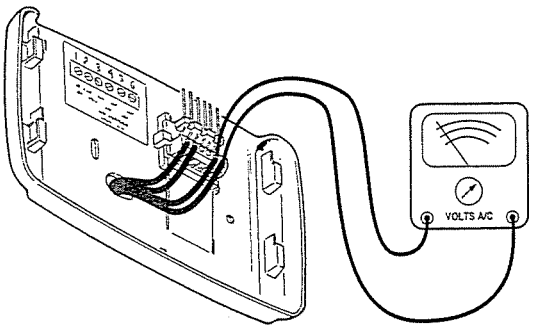
YES: Check for 24 V.A.C. at thermostat terminal block in controller. Is 24 V.A.C. present?

NO: Check controller fuse. If fuse OK, replace controller.

YES: Check for open field wiring "R" and "B" going to thermostat.

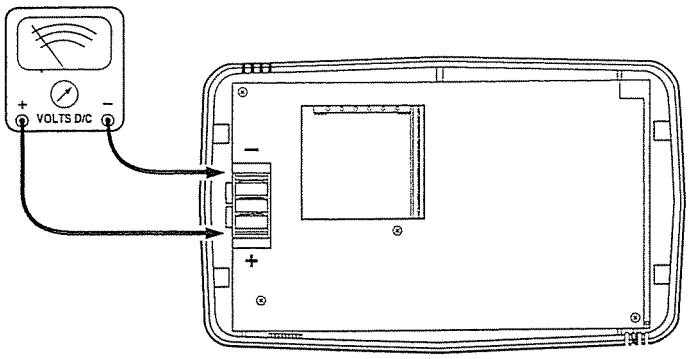
NOTE: When checking for 24 V.A.C. at thermostat sub base, a load (the thermostat or a 24 V.A.C. fan relay or 2000 ohms 1/2 watt resistor) must be connected to terminals "R" and "B" of sub base. If 24 V.A.C. is present and the thermostat display says OFF or is blank, nothing displayed, replace thermostat.





THIS IS NOT A VALID TEST
SEE NOTE THIS PAGE

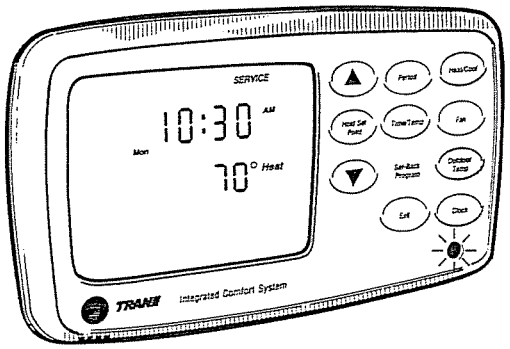
CHECK SYSTEM



Battery Number 357VP or A76
3 Required

CHECK No. 1C1

Checking batteries with a D.C. Voltmeter.



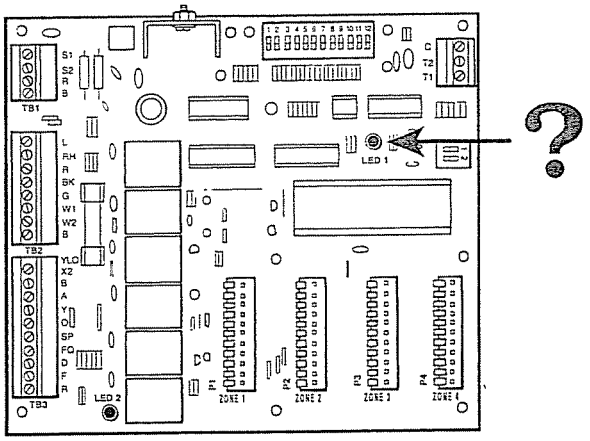
CHECK No. 1D1

The thermostat will display service only if there is a defrost fault reported by the defrost control or the compressor fault.

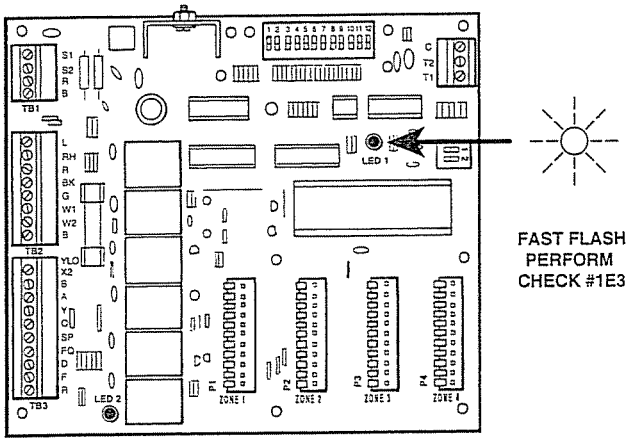
You can place the thermostat in the EP service mode. And check service events list.

Number 7 is for defrost faults or Number 8 for compressor faults. See EP service mode for full detail. Or you could look at the system controller fault LED and the defrost control's LED to check for its actual fault detected, A,B, or C. For a defrost fault use defrost control trouble shooting chart. The controller's fault LED will not show a compressor fault. For compressor fault perform check No. 2.

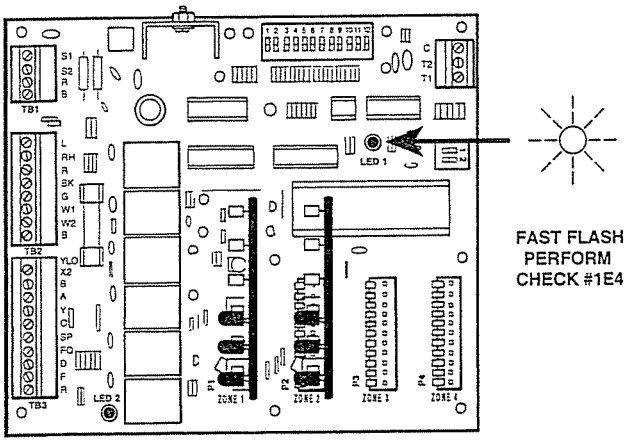
CHECK SYSTEM



NOT ZONED SYSTEM



ZONED SYSTEM



CHECK No. 1E1

If controller red status LED No. 1 is constantly on, not flashing, and outdoor section is running the status LED No. 1 is now indicating compressor is running under speed, or controller is in the service mode.

STEP 1 – Check controller DIP switch settings for correct position. They must be in the normal operation position for this test. Switch No. 1 on switch assembly SW1 must be turned off for this test.

STEP 2 – Turn off all thermostats and depower controller and repower controller. If controller red status is still on, replace controller. Is controller status LED No. 1 out?

YES: Replace controller

NO: Is controller red status LED No. 1 flashing once per second, slow flash rate?

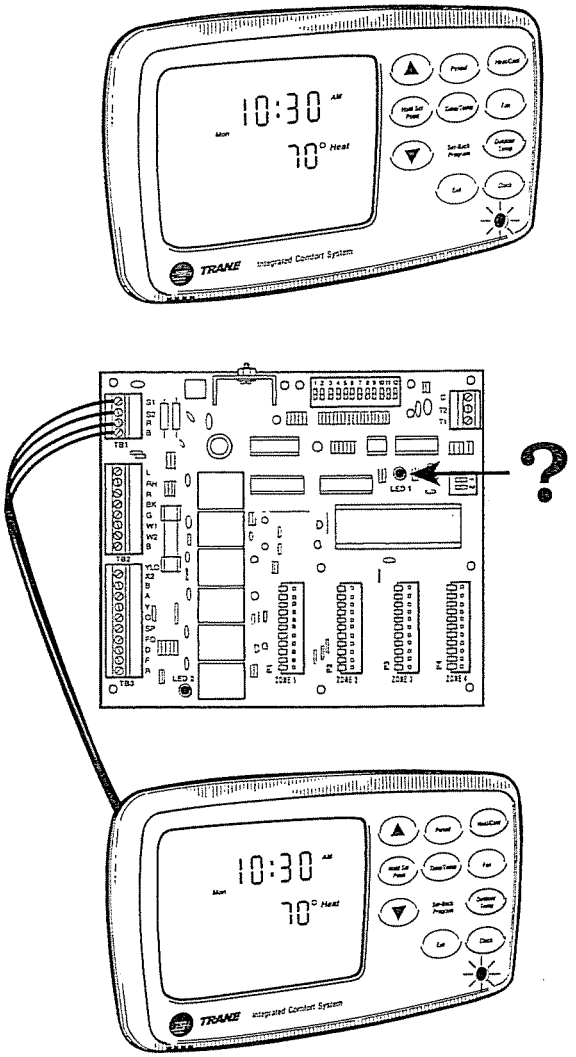
YES: Thermostat, or all zoned system thermostats are communicating with the controller. Perform check No. 1E2.

NO: Thermostat NON ZONED system or one or more thermostats in a zone system are not communicating with the system controller.

NON ZONED system perform check No. 1E3

ZONED system perform check No. 1E4.

CHECK SYSTEM



CHECK No. 1E2

Check set points and mode of operation, Heat, Cool or Auto of thermostat or thermostats in a zoned system. In a zoned system, add up all heating load values and cooling values. The higher of the two has priority. See thermostat load values section. If control system is satisfied, change set point for heating or cooling. Does the air conditioning system run?

YES: Zoned system check all zones.

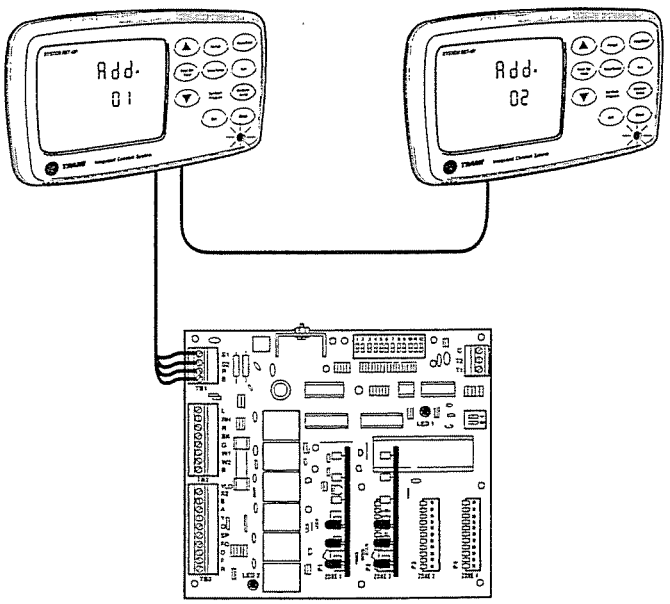
NO: Perform check No. 2.

CHECK No. 1E3

NON ZONED system the fault is with the thermostat, controller or field wiring wire No. S1 circuit. Remove thermostat and sub base and reconnect to controller with a short piece of thermostat wire. Does the control system work?

YES: Fault is in thermostat field wiring.

NO: Perform check No. 1A4.



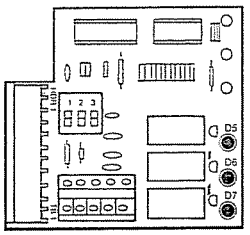
CHECK No. 1E4

ZONED SYSTEM – Check address on all thermostats. (see check No. 1A1) If two or more thermostats have the same address, the controller status LEDNo. 1 will flash fast. Are the addresses correct?

NO: Correct addresses if wrong and check for system operation.

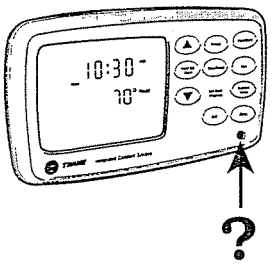
YES: address of each thermostat is correct. Perform check No. 1E5.

CHECK SYSTEM



ALL ZONE BOARDS
SWITCHES TURNED OFF

ZONE 1



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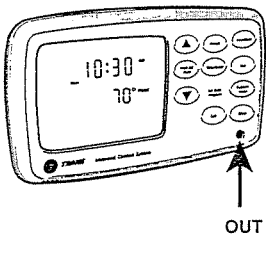
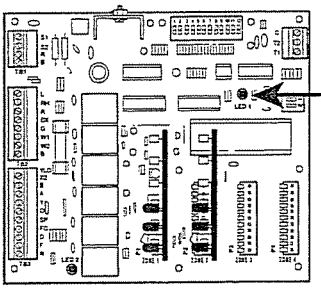
ZONE 2, 3 & 4



OUT



FLASH RATE

?

CHECK No. 1E5

Turn off all zone boards. (Dip switches 1,2,3 off on each zone board). The thermostat's Green status LED for zones No. 2, (No. 3, and No. 4 if installed) will go off. System is now set up as a NO ZONED system being controlled by thermostat in zone No. 1.

Is zone No. 1 thermostat Green status LED flashing?

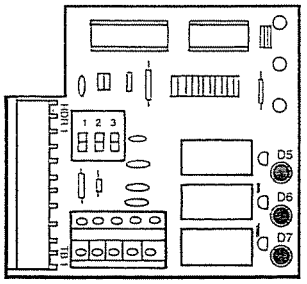
NO: Probably fault is with thermostat or field wiring for zone No. 1. Perform check No. 1E7.

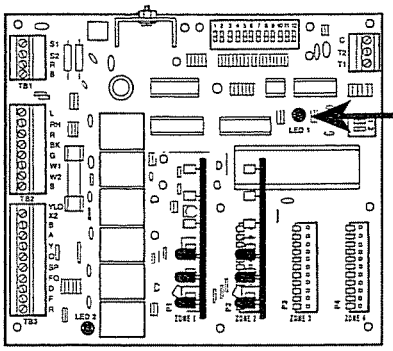
YES: Does the controller's red status LED flash once per second, slow flash rate?

NO: Perform check No. 1E7.

YES: Perform check No. 1E6.

CHECK SYSTEM



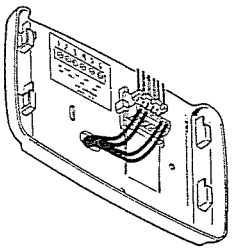


CHECK FLASH RATE

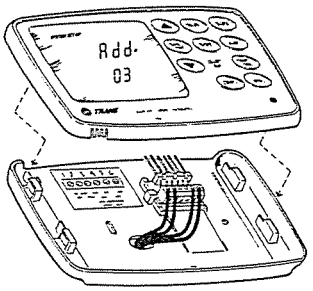
?

CHECK No. 1E6

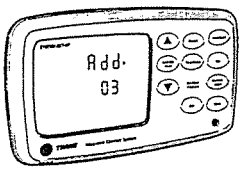
Turn on zone 1 and another zone board with its dip switches. System is now a zoned control system. Check controller's red status LED flash rate. If the red status LED flash is still slow, turn on another zone flash board. When the controller flash rate changes to fast, the fault is in that zone's control area. Its field wiring, zone board or its thermostat. Swap this zone board with one that is working and check for proper operation, if fault is corrected, replace defective zone board. If the zone board did not correct operation, put zone boards back in their original position and turn off the Zone Board dip switches of the inoperative zone. Controller status LED will return to slow flash rate.



THERMOSTAT TO BE TESTED BATTERIES REMOVED

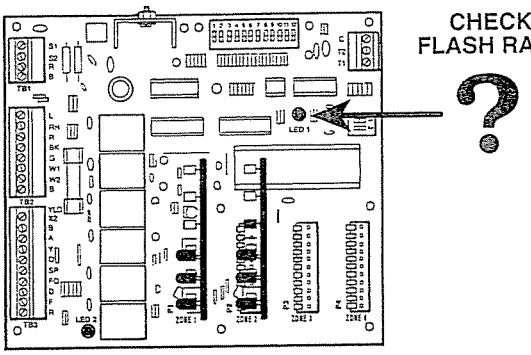


WORKING THERMOSTAT REMOVED



continued

CHECK SYSTEM



CHECK No. 1E6 continued

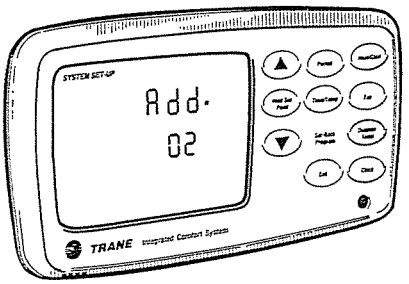
Step No. 2 – Remove inoperative thermostat, take out its batteries and install it in a sub base of a thermostat that is working. Change the address of the thermostat being tested to the same address of the working thermostat removed. Check controller's status LED flash rate.

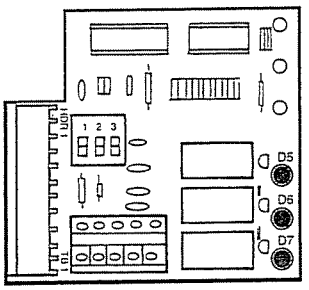
Is it flashing once per second?

YES: Thermostat being tested is OK.

Reinstall it in its original sub base, set its address and turn on its zone board. Check for thermostat operation. If the thermostat will not work in this location fault is in the field wiring of this zone.

NO: Thermostat is defective.

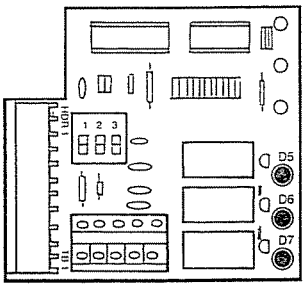




TURN ON ZONE BOARD

Thermostat Address must be set to it's Zone Board Number.

CHECK SYSTEM



TURN ON ONE ZONE BOARD AT A TIME

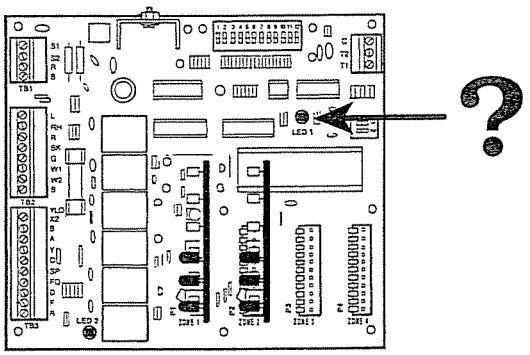
CHECK No. 1E7

When all zone boards are turned off, zone address 01 thermostat will control the system. If any other one zone board is turned on it will control the system, not zone No. 1. Turn on one zone board at a time, No. 2, No. 3, or No. 4 with their DIP switches.

Check all zones one at a time and answer YES or NO for each zone. Does the controller's red status LED flash once per second?

YES: Controller is OK and zone turned on is working. Turn zone board being tested off and check next zone.

NO: For Zone or Zones that do not work, perform check No. 1E6, STEP 2 to check for thermostat operation. If the controller red status LED will not show slow flash rate with any zone, perform check No. 1A4 controller input test.



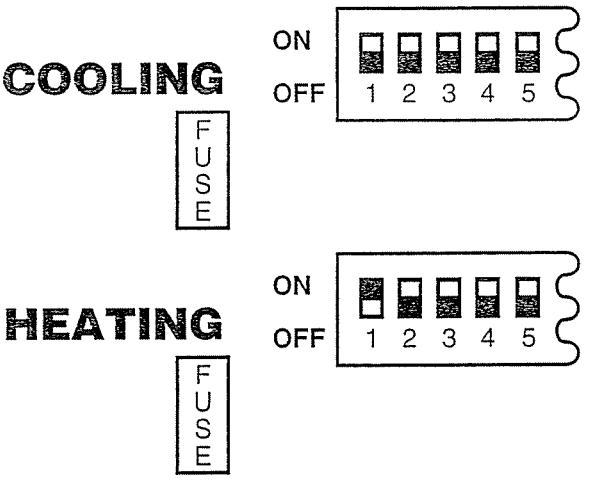
2. Set Dip switches in controller for full speed test operation. AYVCTRL100A Switches 6-12 must be checked for their proper position.

Cooling: Switches 1, 2, 3, 4 and 5 on.

Heating: Switches 2, 3, 4 and 5 on 1 off.

After setting service switches, remove controller fuse, when controller status LED #1 light goes out, replace fuse. Controller only reads service switches on a power up. Controller status Red LED #1 will be on in the service mode.

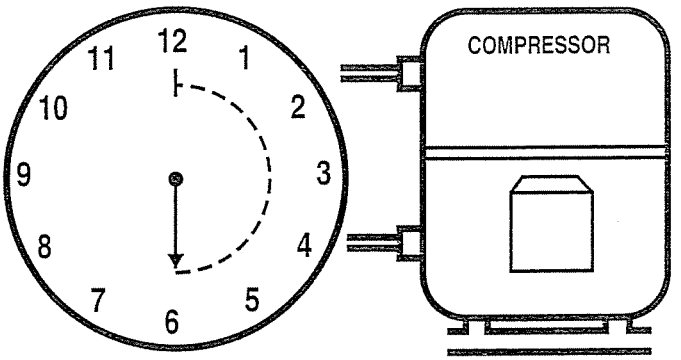
Note: *#1 Controller will only try to start the compressor one time for three to five seconds and then lock out if compressor operation is not detected by controller in the service mode. Reset controller by removing controller fuse and replacing fuse. #2 Zone System – all zone dampers will be power open during test operation.*



2A. Does compressor run?

YES: If compressor runs for at least 30 seconds, perform Check No. 2B. If compressor runs for only a few seconds, perform Check No. 4A.

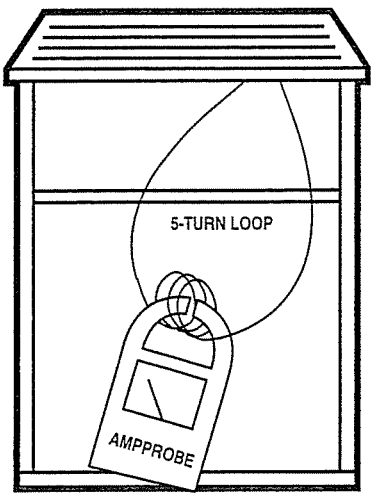
NO: Perform Check No. 3.



2B. Does outdoor fan run at full speed? At the 5 turn current loop in the outdoor unit full speed current will read 3.65 amps? Let fan run for at least one minute before taking current reading.*

YES: Perform Check No. 2C.

NO: Perform Check No. 18A.



*** Note:*** *Reading will vary depending on type of meter used.*

TROUBLESHOOTING

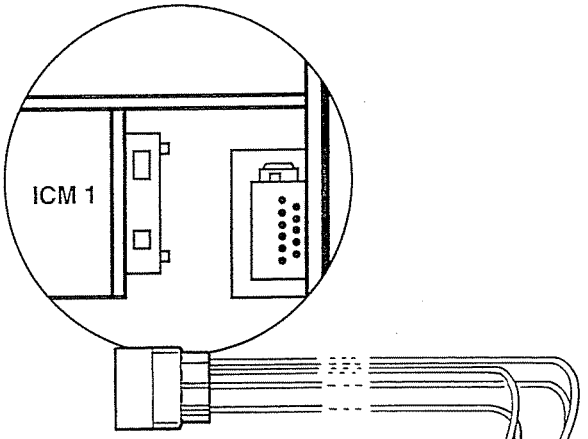
*2C. *Does indoor blower run at high speed? Count Green CFM LED on motor control board. ICM 2 only. Heating Flash CFM programmed by DIP switches Nos. 7 and 8 on motor control board.*

YES: Put controller service switches in their operating position depower controller and repower controller. Then check thermostat program and thermostat operation. Perform Check No. 13 if no thermostat operation is obtained.

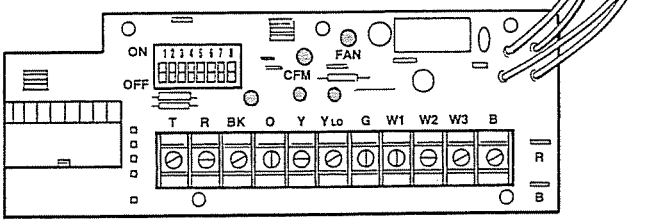
ICM 1 NO: Perform Check No. 13.

ICM 2 NO: If Red "BK" LED is on – Check Dip switch settings on motor control board. If Red "BK" is out Perform Check No. 14.

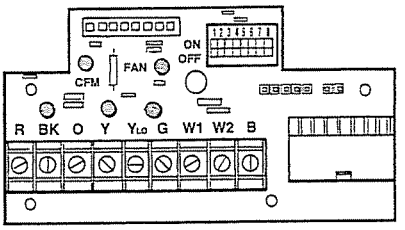
****Note:*** *indoor fan will come on and then go off if controller does not detect compressor operation at it's FQ terminal.*



ICM 2 AIR HANDLER



ICM 2 FURNACE

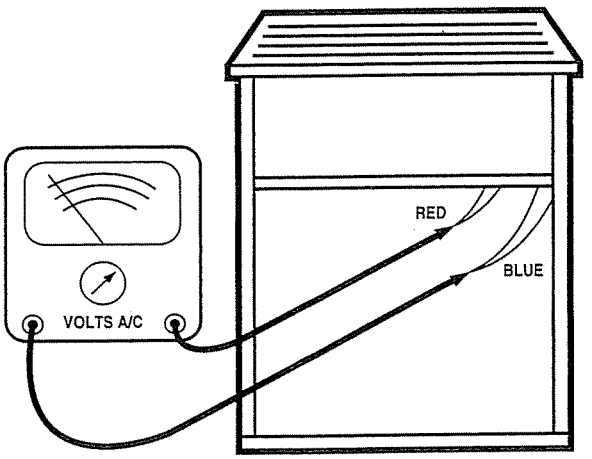


3. Is there 24 V.A.C. between "RD" and "BL" wires in outdoor unit?

On heat pumps a fair indication of 24 V.A.C. is the flashing L.E.D. on the Defrost Control. L.E.D. may still flash with only 15 V.A.C. present.

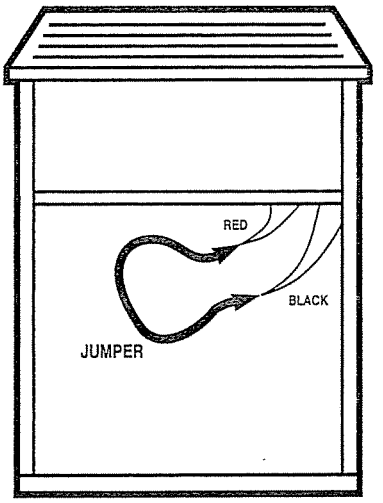
YES: Perform Check No. 4A.

NO: Check field wiring if 24 V.A.C. is present at controller.



TROUBLESHOOTING

4A. Jumper 24 V.A.C. "RD" wire to "BK" speed wire in outdoor unit. Does compressor run?

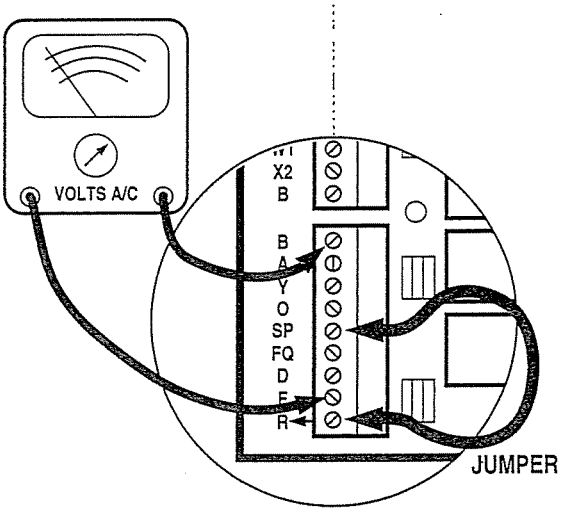


YES: Perform Check No. 4B. Outdoor compressor drive and compressor OK.

NO: Compressor may be locked out by compressor overload circuit. Perform Check No. 4C.

Note: *Fans will not run in this check. Do not let system run over two minutes.*

4B. Jumper "R" terminal to "SP" terminal at controller. Does compressor run?

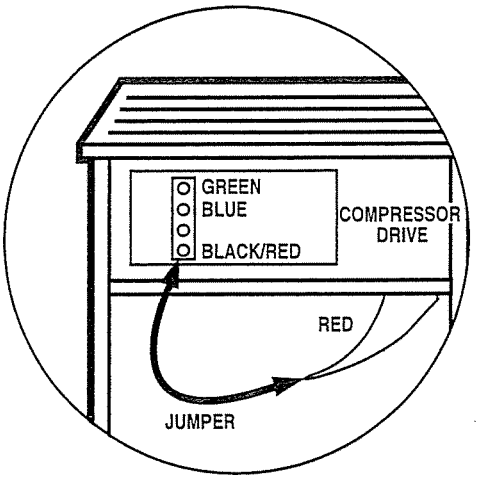


YES: Fault could be with controller. Heat pump models check voltage between Terminals "F" and "B" at controller. If 24 V.A.C. is present, controller has locked compressor out. If outdoor temperature is above +3° F, the fault is with the Defrost Control or it's air temperature sensor. If no voltage Perform Check No. 19.

NO: Fault is in SP field wire.

4C. Jumper 24 V.A.C. "RD" wire to "BK/RD" control wire at compressor drive control plug. Plug must be connected to drive for this test.

Does compressor run?



YES: Relay RO switch not closed. Perform Check No. 7.

NO: Perform Check No. 8.

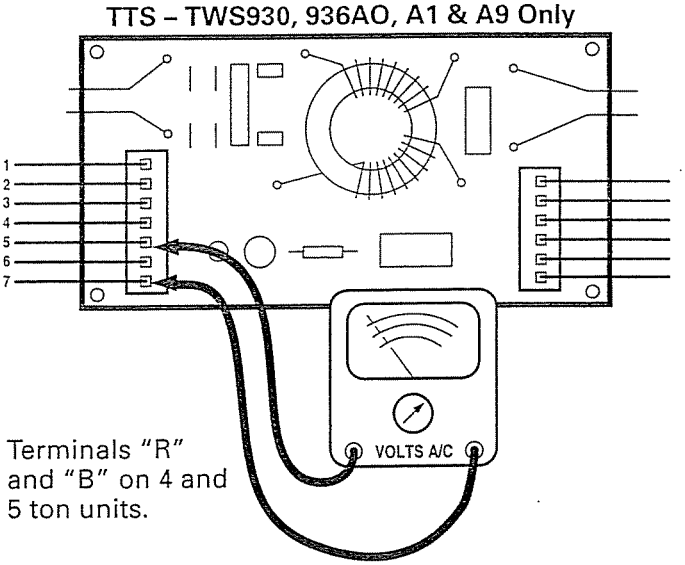
TROUBLESHOOTING

5. Does relay RO Bridge Rectifier, on the Relay Filter Board, have 24 V.A.C. across its input pins? Measure voltage at the 7 pin plug on the relay filter board between "BK" pin No. 5 and "BL" wire pins No. 6 and No. 7 on 2.5 and 3 ton units. On A2 models of the 2.5 and 3 ton units and all 4 and 5 ton units measure voltage at terminals "R" and "B".

YES: RO Relay Switch should be closed. Perform Check No. 7.

NO: Overload circuit open. Perform Check No. 6.

TTS – TWS930, 936AO, A1 & A9 Only



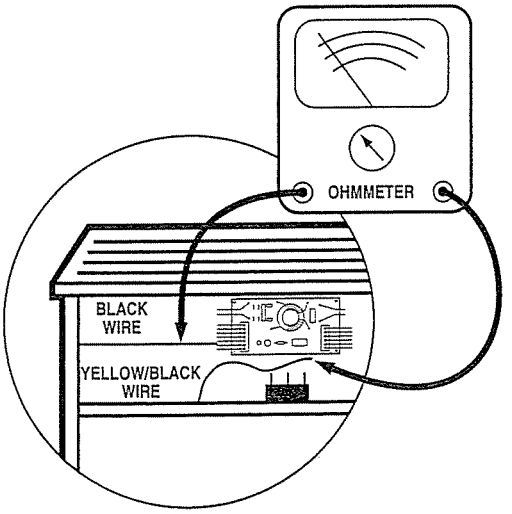
Terminals "R" and "B" on 4 and 5 ton units.

6. Do the overload circuit components, L.P.C.O., H.P.C.O., fusible link and compressor shell thermostat have continuity?

YES: Relay RO bridge rectifier should have 24 V.A.C. as in Check No. 7. Check unit wiring and plugs on rela filter board. On A2 models of the 2.5 and 3 ton units and all 4 and 5 ton units the wire going to the R.F.B. i a Red/Black wire connected to the "R" terminal.

NO: If a cutout or thermostat is defective, replace. If it is open due to pressure or temperature, check charge and fan motor operation. Are fans running at the correct RPM?

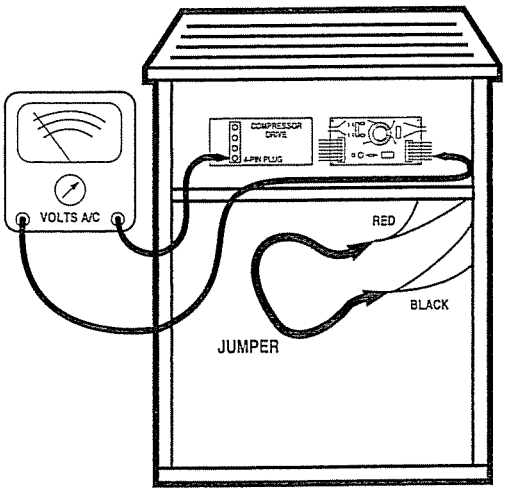
Note: *#1 A broken compressor discharge valve could cause compressor shell thermostat to open, also a sump heater relay not working. #2 Some 2 1/2 and 3 ton models may have a fusible links compressor drive.*



7. Jumper 24 V.A.C. "RD" wire to "BK" speed wire in the outdoor unit. Is there 24 V.A.C. across RO-1 switch. Take voltage reading at relay filter board "BK" wire, which is Pin 3 of the 6 pin plugon 2.5 and 3 ton units, and the "BK/RD" wire at the compressor drive control plug. Is there 24 V.A.C.? On A2 models of the 2.5 and 3 ton units and all 4 and 5 ton units connect meter to R.F.B. terminals "IN" and "OUT".

YES: When 24 V.A.C. is present and 24 V.A.C. was present in Check No. 7, RO Relay switch is not closing and the relay filter board must be replaced.

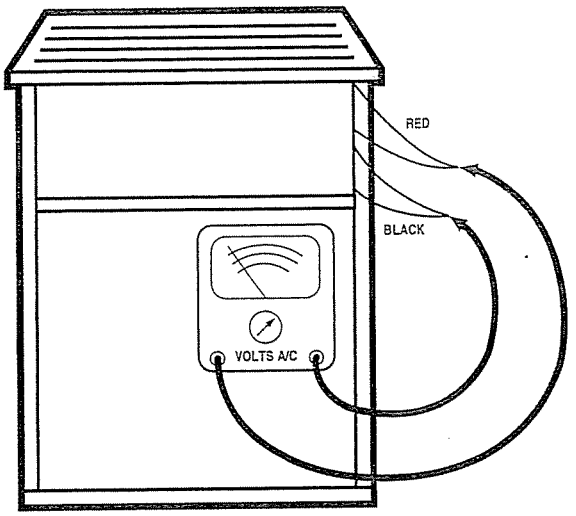
NO: Check for 24 V.A.C. at compressor drive control plug between "BL" wire and "BK/RD" wire. If voltage is present and compressor will not run, perform Check No. 10.



8. Is there 230 V.A.C. to outdoor unit?

YES: Perform Check No. 9.

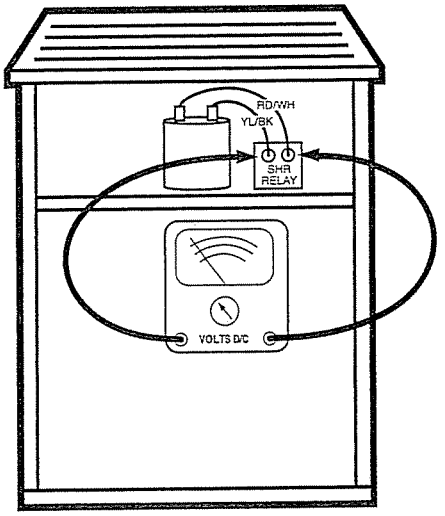
NO: Restore power to outdoor unit. If fuse blows or breaker trips, check the following items. Bridge rectifier, DC capacitor, Sump Heat Relay, E.M.I. filter, LC line choke, compressor drive, and compressor.



9. Is the D.C. voltage across the D.C. capacitor correct? Correct D.C. voltage is A.C. volts times 1.414.

YES: Perform Check No. 12.

NO: Check sump heater relay, rectifier, DC capacitor, E.M.I. filter, LC line choke, and compressor drive. On 4 and 5 ton models only, check contactor inrush and inrush resistor.

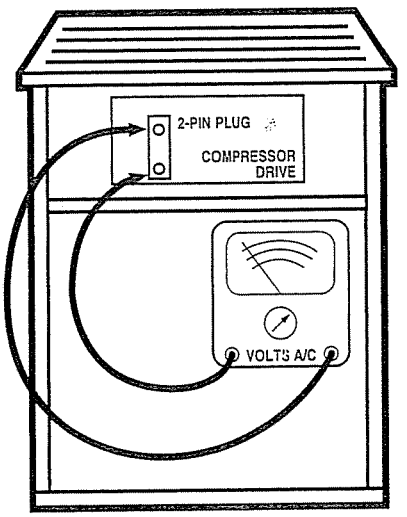


10. Caution high voltage present at these plugs to ground. Is there 20 V.A.C. to the compressor drive low voltage plug. This is the 2 pin plug on the drive.

On FLD and A1 Models there is no 2 pin low voltage plug on the drive unless the original drive has been replaced.

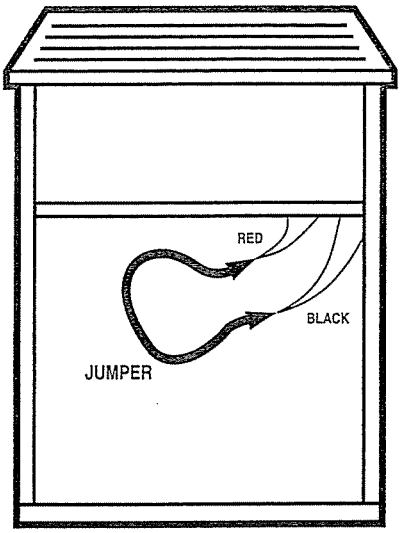
NO: Check compressor drive transformer in outdoor unit.

YES: Perform Check No. 10A.



TROUBLESHOOTING

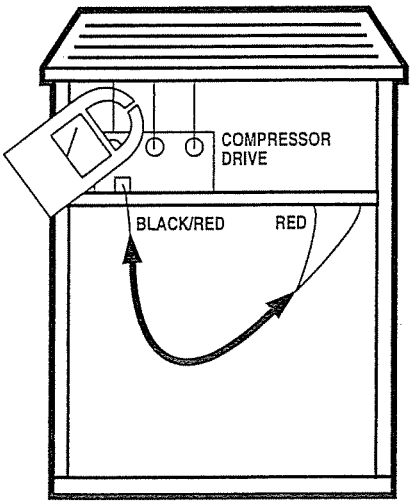
10A. Turn power off to outdoor unit for at least two minutes and then turn power back on. Jumper 24 V.A.C. "RD" wire to "BK" speed wire in outdoor unit. Will the compressor run?



YES: Compressor was locked out by compressor drive. Remove jumper and depower 24 V.A.C. to controller and repower controller. Controller is still in the service position from Check No. 2. If system operates, check charge and performance of system. If system will not run in service mode, perform Check No. 19.

NO: Perform Check No. 13A.

11A. Connect an amp-probe around one compressor motor wire at a time. Jumper 24 V.A.C. "RD" wire to "BK/RD" speed wire, at the compressor drive control plug "BK/RD". Is the current reading continuous in each leg?

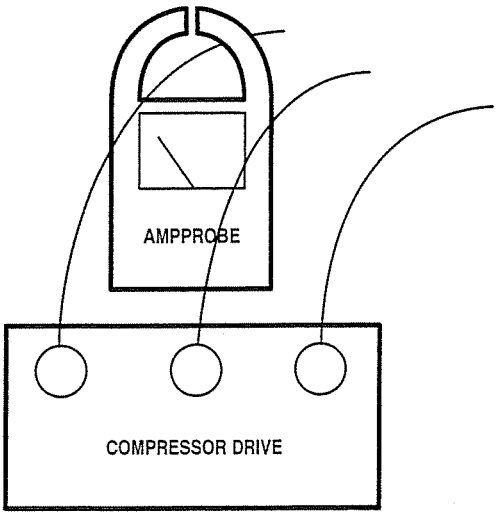


YES: Perform Check No. 12. Note: Compressor may be locked up due to a high head condition, etc. and cannot start. If head and suction pressure are equal, drive is likely good. Replace compressor after performing Check No. 12.

NO: Perform Check No. 11B.

Note: *Each motor wire must be measured. Unhook jumper and rehook jumper for each motor leg test. AO, A1 and A9 models of the 2.5 or 3 ton unit the current will be continuous. All current 2.5, 3, 4 and 5 ton units the current will only be present for a few seconds if compressor does not start.*

11B. Was a short pulse of current measured in each leg in Step 11A.



YES: Perform Check No. 12.

Note: *Drive is probably OK if compressor windings are shorted together (not grounded) or open, If compressor motor resistance check #12 is OK, replace drive first.*

NO: Drive or compressor could be defective. Compressor must be checked out. If compressor motor resistance is correct, change drive. If compressor resistance is not correct, change compressor. To check compressor motor resistance perform Check No. 12.

12. Measure compressor motor resistance and motor winding resistance to the compressor shell.

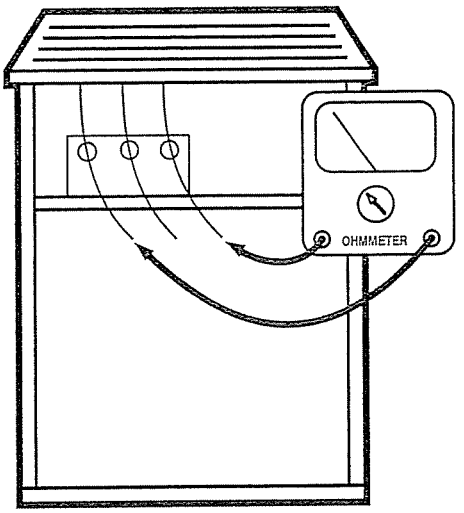
Are readings correct?

Note: *Leg to leg motor resistance at 70°F for the 2.5 and 3 ton model is .5 ohm, and 4 and 5 ton models are .3 ohm.*

YES: Replace drive if you are coming from Check No. 11B. Replace compressor if you are coming from Check No. 11A. Yes, compressor locked up.

NO: Replace compressor.

Note: *Before removing old compressor if motor resistance is OK set new compressor next to unit and wire it up to the drive. Remove compressor discharge line cap and see if new compressor will run. If new compressor runs replace compressor. If new compressor will not run, replace drive and check system out.*



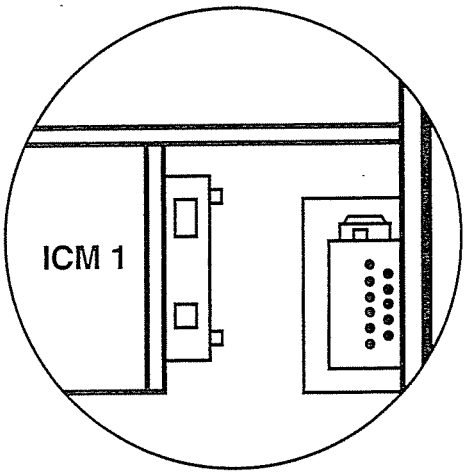
13. ICM 1 to check for motor operation use jumper as follows.

Step 1 Unhook wire on "BK" terminal.
Step 2 Jumper "R" to "G" and "BK". Blower should run at cooling high speed. black tap.
Step 3 Jumper "R" to "G". Blower should run at low speed, white tap.
Step 4 Jumper "R" to "G" and "W1". Blower should run at red heat speed tap.

Will motor run and change speed?

YES: Motor runs and changes speed, perform check No. 14.

NO: If motor will not run, check all motor to terminal board wiring. If wiring is OK, perform check No. 15.



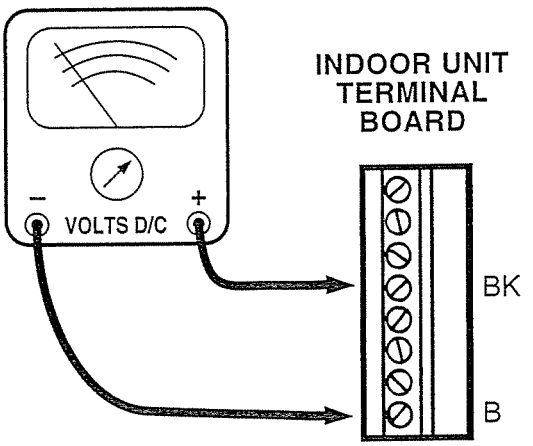
14. Check for blower speed signal at "BK" terminal at furnace or air handler.

High speed should read 9 volts D.C.

Is voltage at terminal board?

NO: Perform check No. 14A.

YES: ICM 1 – Perform Check No. 15.
ICM 2 – Perform Check No. 16.



TROUBLESHOOTING

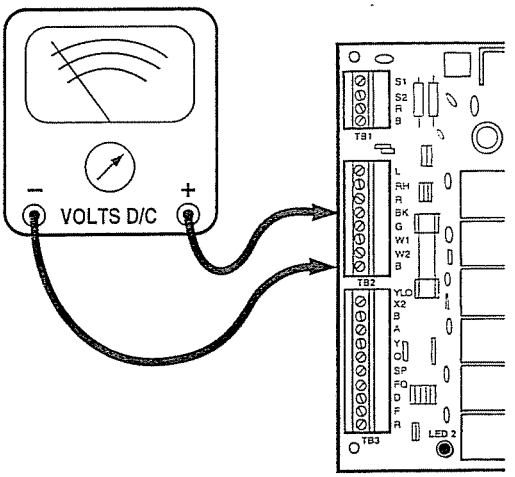
14A. Check for blower speed signal on "BK" terminal of controller. System controller set up in service mode. High speed "BK" should read 9 volts D.C.

Is voltage present?

Allow time for start up cycle to be completed.

YES: Fault is in field wiring going to indoor unit.

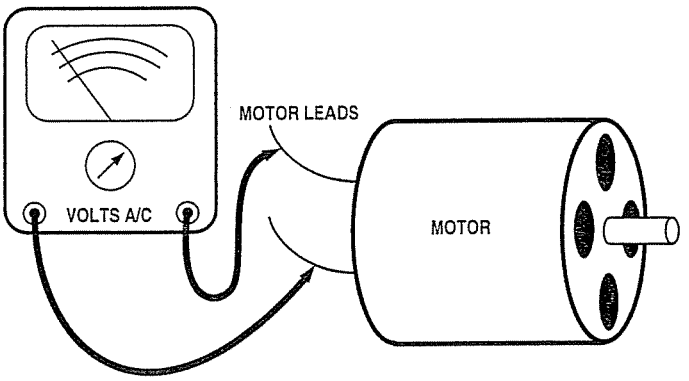
NO: Check Dip switch setting. If Dip switch settings are correct and no voltage is present, replace controller. If voltage is low, remove field wiring from "BK" and recheck "BK" voltage.



15. Check for power to fan motor drive assembly, and can fan or blower be freely spun. 115 V.A.C. for furnaces. 230 V.A.C. for air handlers.

YES: If the voltage is correct and fan or blower will spin freely, replace motor and drive assembly.

NO: Restore power or free-up motor and check for proper operation.



Note: *ICM 2 motor on furnace has a jumper for 115 operation in the motor power harness plug. If jumper is not making contact, motor will run erratically.*

16. Check motor control board (ICM-2).

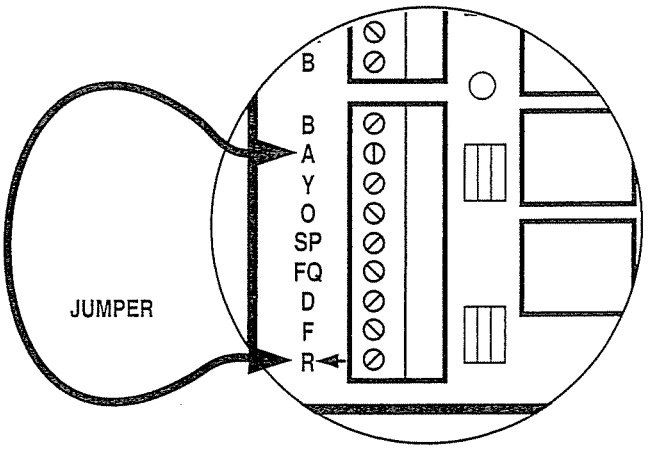
17. Blank at this time

18A. Jumper "R" terminal to "A" terminal at the controller. Will the outdoor fan run?

Outdoor fan should run at about 1/2 speed.

YES: Perform Check No. 19.

NO: Perform Check No. 18B.



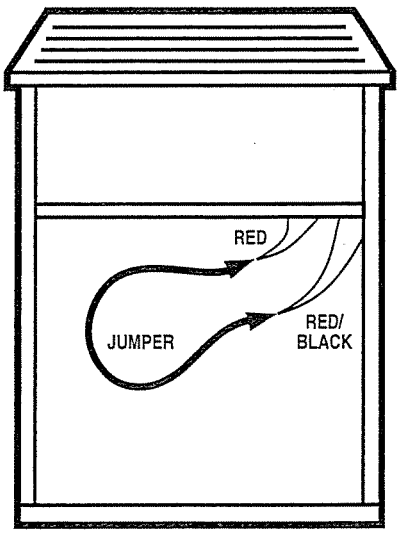
CONTROLLER BOARD

18B. Jumper "RD" wire to the RD/BK wire in the outdoor unit.

Outdoor fan should run at about 1/2 speed.

YES: Fault is in the field wiring "A" wire.

NO: Perform Check No. 18C.

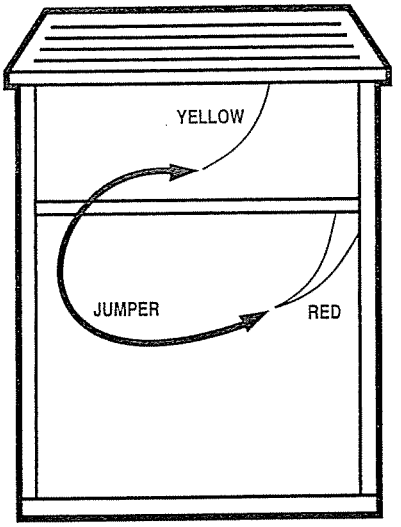


18C. Jumper "RD" wire to the "YL" O.D. fan lead. Does the outdoor fan motor run?

Outdoor fan should run at about 1/2 speed.

YES: Heat Pumps Only. Fault is in the defrost control relay K2. Replace defrost control. Cooling Units Only. Fault is in the plugs or wiring going to the RFB board.

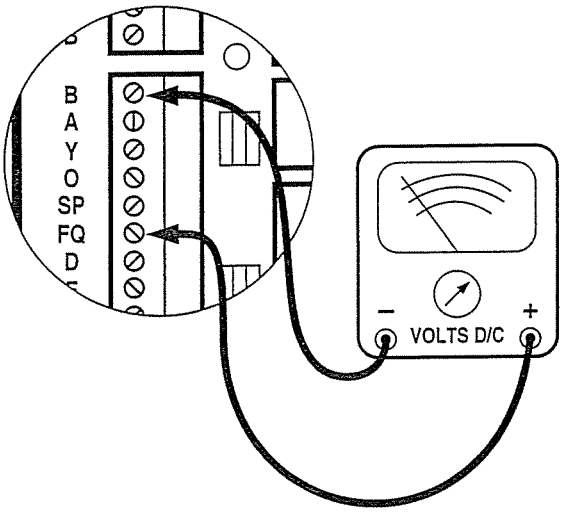
NO: Perform Check No. 15.



*19. * Connect D.C. volt meter to terminals "B" and "FQ" at controller. Is 12 – 16 V.D.C. present?*

YES: FQ D.C. power OK from controller. Perform Check No. 20.

NO: If low voltage or no voltage field wiring or compressor drive may be at fault. Perform Check No. 21.

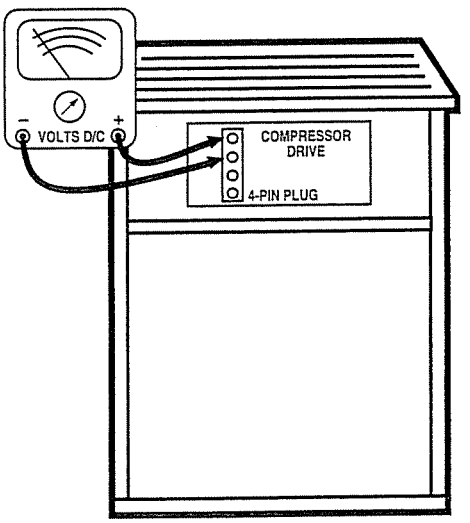


** **Note:** Compressor **not** to be running for this test.*

*20. * Connect D.C. volt meter to compressor drive control plug in outdoor unit between "BL" wire and "GR" wire. Is 12 – 16 V.D.C. present?*

YES: FQ DC power and field wiring OK. Perform Check No. 24.

NO: If voltage is not present which was measured in Check No. 19, fault is in field wiring or outdoor unit wiring.



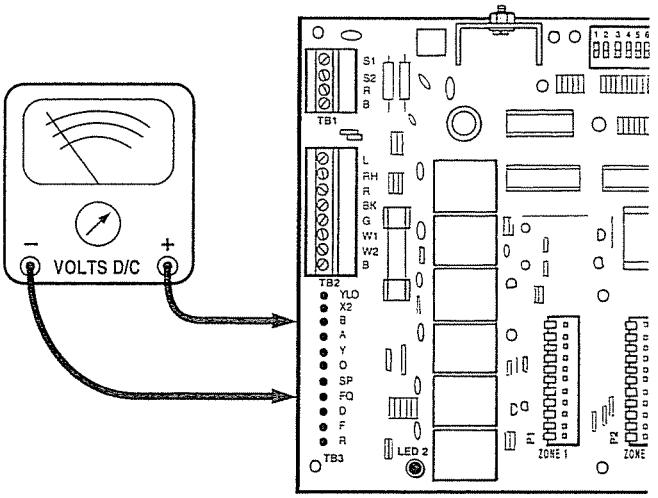
** **Note:** Compressor **not** to be running for this test.*

TROUBLESHOOTING

21. Unplug connector going to the outdoor unit. Connect D.C. volt meter to pins "B" and "FQ" on controller. Is 12 – 16 V.D.C. present?

YES: Fault could be in field wiring to the compressor or drive. Connect plug back on controller. Perform Check No. 22.

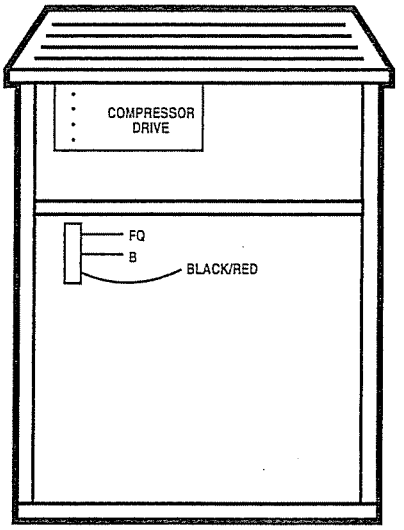
NO: If 24 V.A.C. is between terminal "R" and "B" and 5 amp controller fuse is ok, the controller is defective and must be replaced.



22. Unplug 4 pin compressor drive control plug in the outdoor unit. Connect a D.C. volt meter to pins "B" and "FQ" at this plug. Is the 12 – 16 V.D.C. still present as was seen in Check No. 21?

YES: Perform Check No. 23.

NO: Fault is in field wiring or unit wiring going to 4 pin compressor drive control plug.

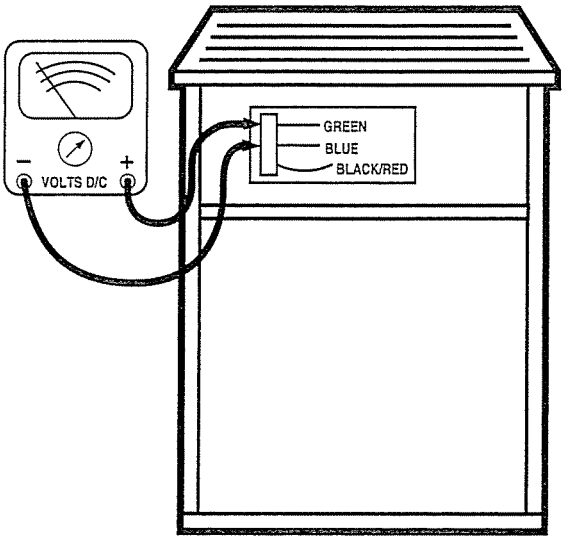


23. Connect D.C. volt meter to compressor drive control plug "GR" and "BL" wires in outdoor unit. The 12 – 16 V.D.C. measured in Check No. 22 will still be present. Re-plug compressor drive control plug-in to drive. Does the D.C. voltage remain the same?

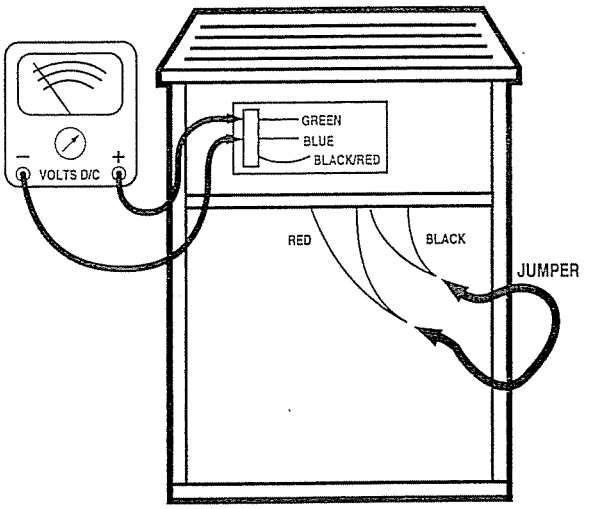
YES: Perform Check No. 24.

NO: Unplug and replug several times and if voltages drop off each time by several volts or goes to zero, replace compressor drive.

Note: *Compressor is not to be running during this test.*



24. Connect D.C. volt meter to 4 pin compressor drive control plug "GR" and "BL" wires in outdoor unit. 4 pin compressor drive plug connected to drive. Jumper the "RD" wire to the "BK" wire in the outdoor unit. Compressor must start and continue to run for this test. Does the voltage measured in Check No. 20 go down?

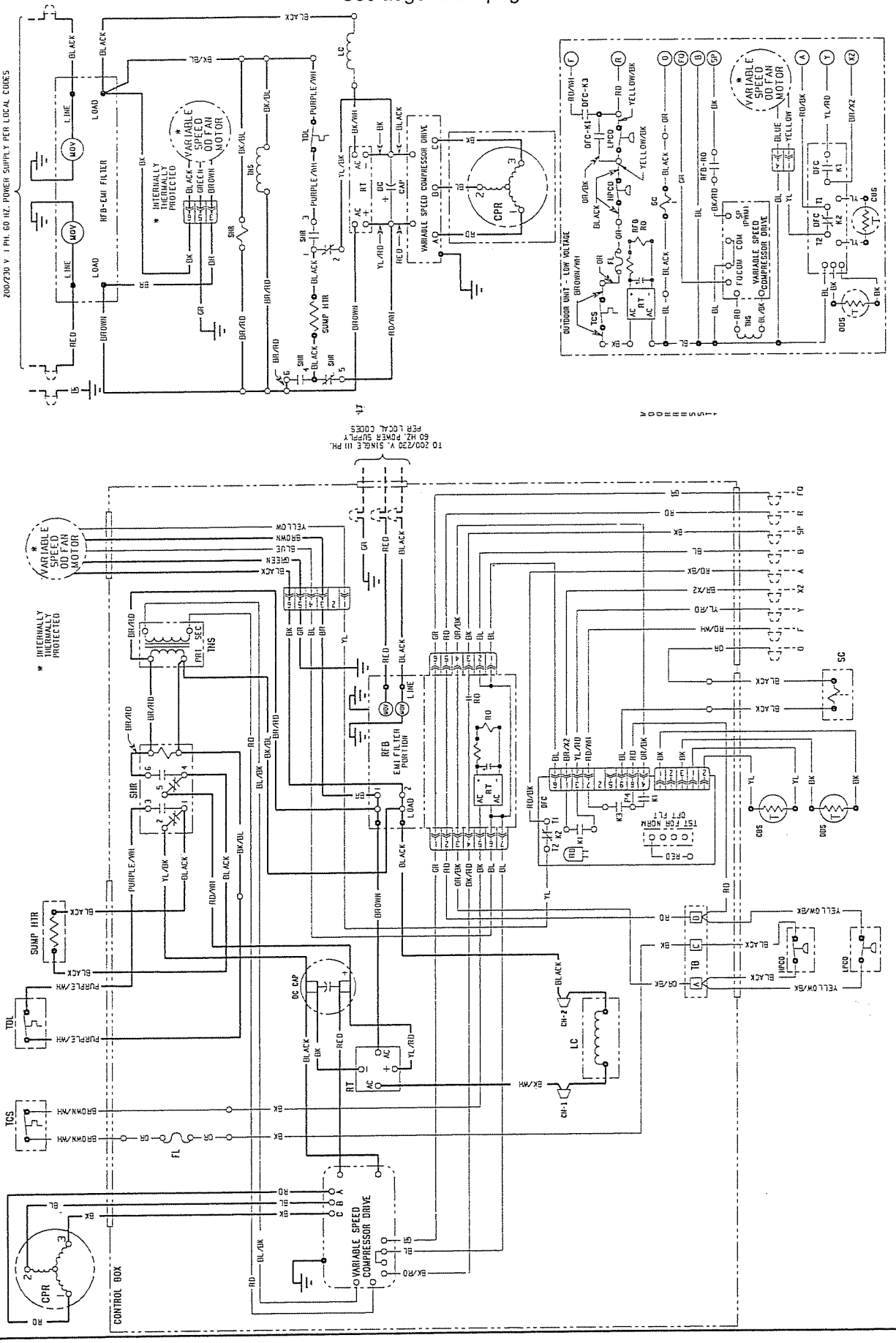


YES: Controller not reading compressor R.P.M. or controller not sending correct speed call to drive. Replace controller.

NO: Compressor R.P.M. output section defective and compressor drive must be replaced.

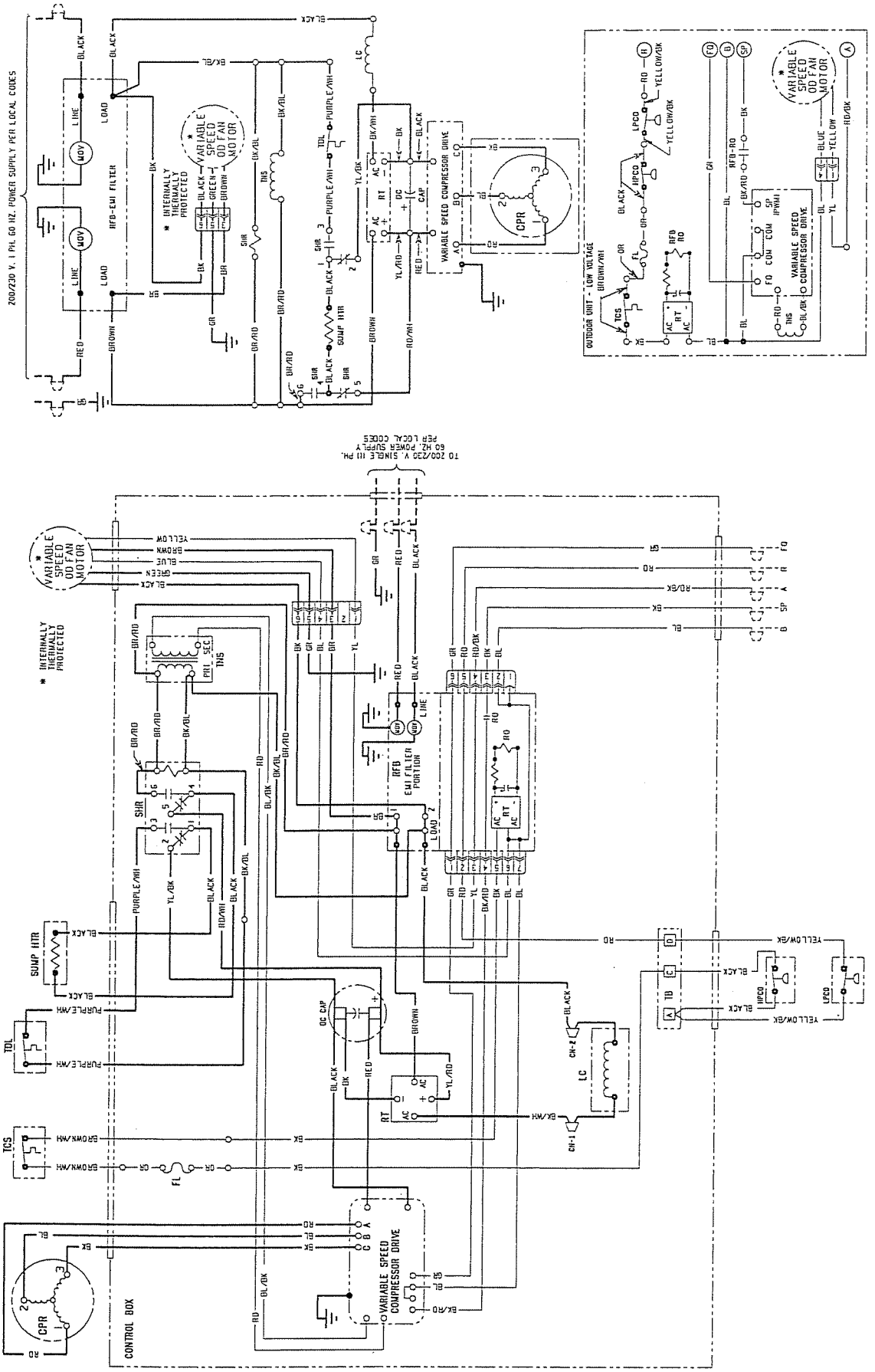
TWS730, 736A100A0- & A1

See Legend on page 86



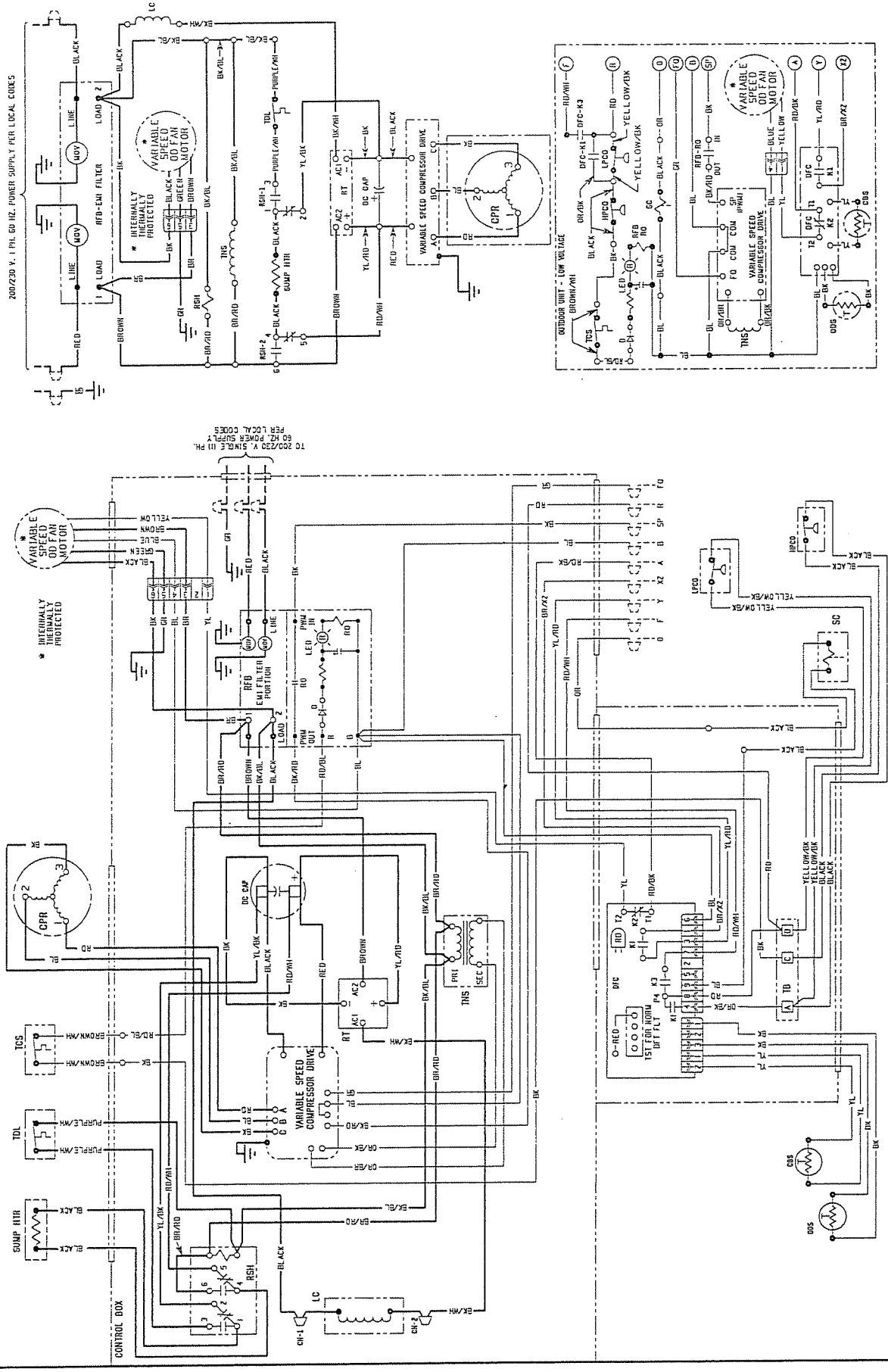
TTS730, 736A100A0, A1 & A9

See Legend on page 86



TWS730, 736A100A2

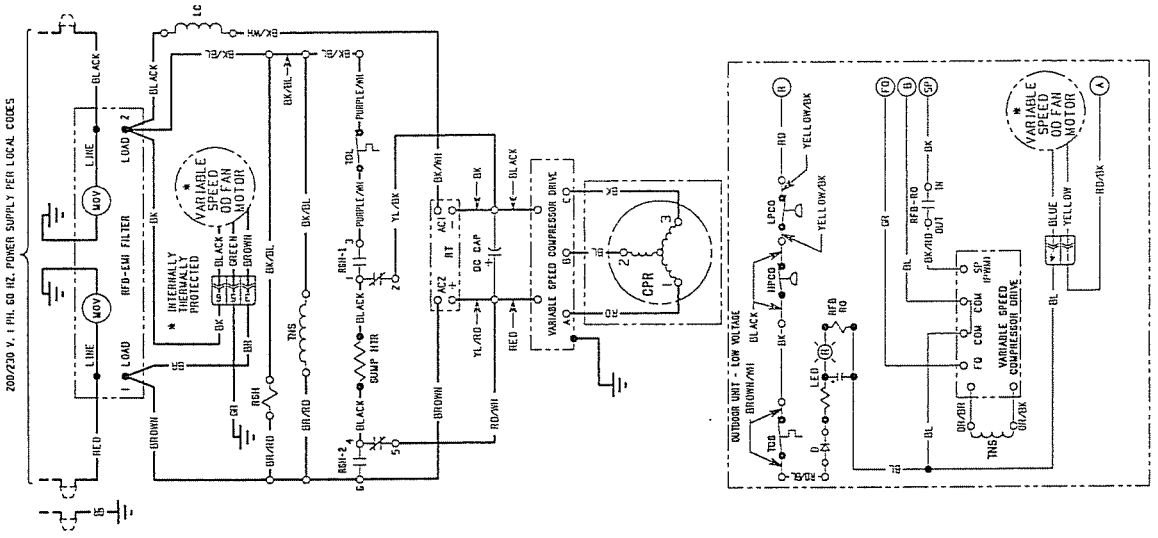
See Legend on page 86

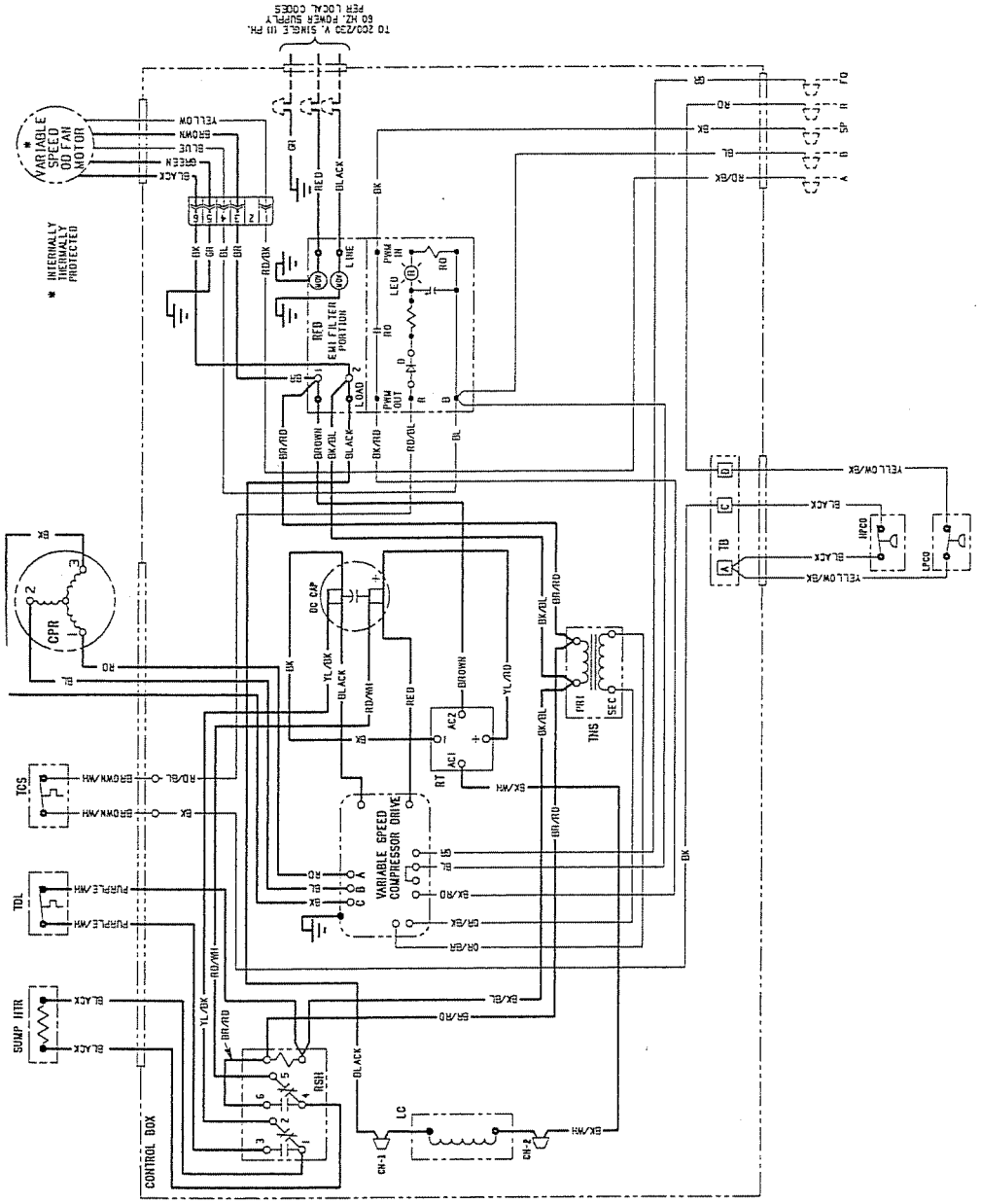


From Dwg. 21D145871 PO1

TTS730, 736A100A2

See Legend on page 86

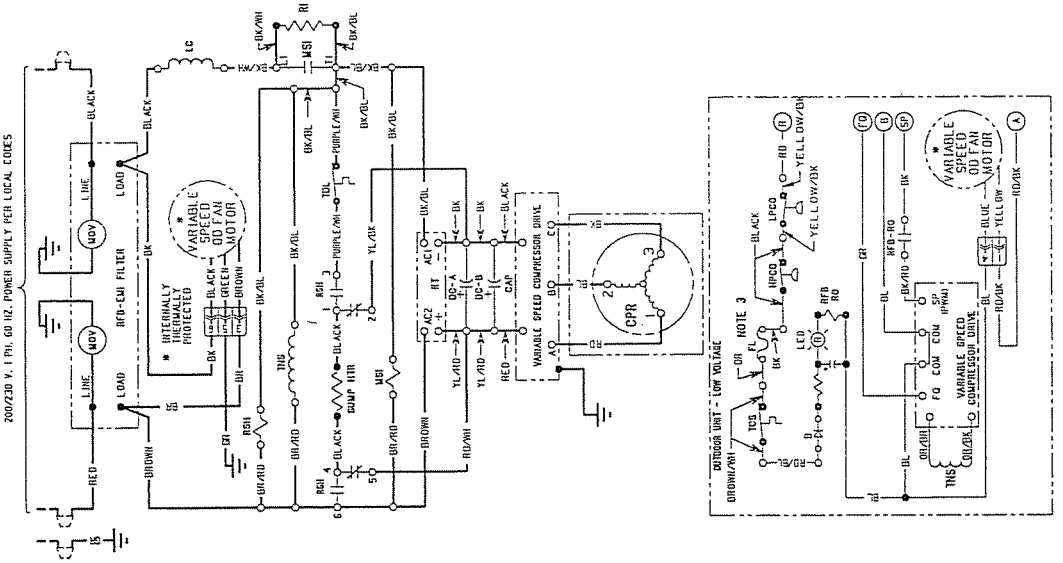


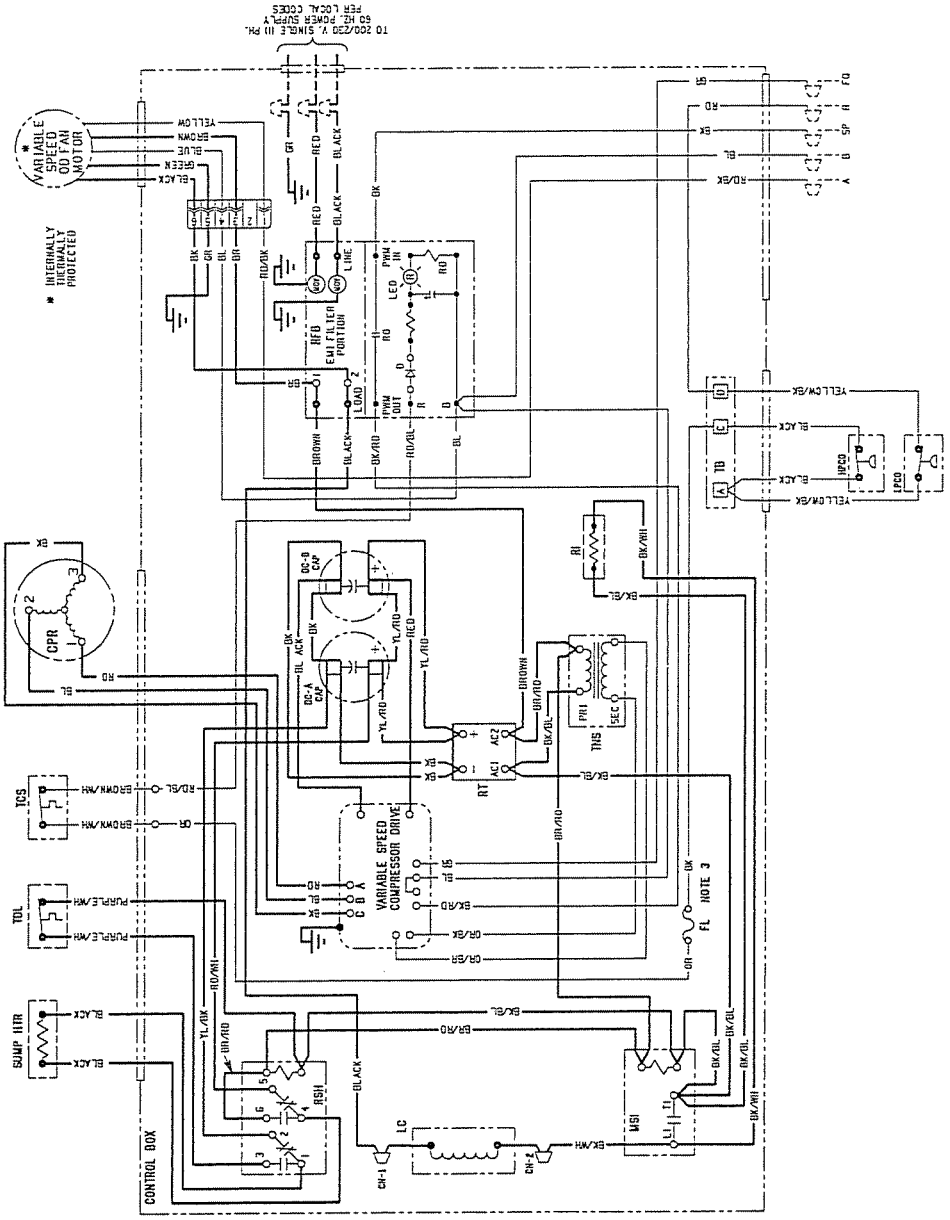


From Dwg. 21D1145872 PO1

TTS748A, 760A1

See Legend on page 86

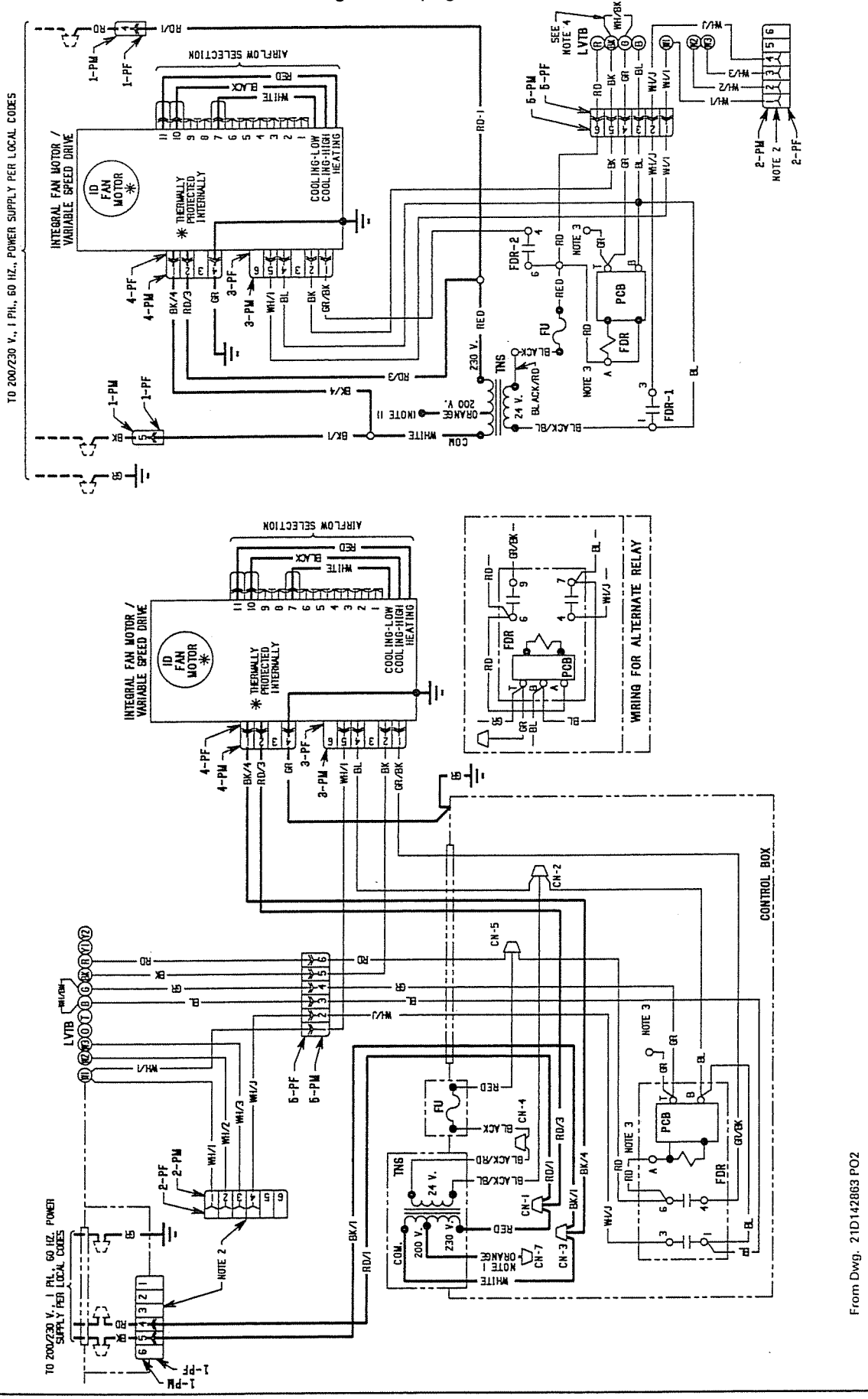




From Dwg. 21D145956 PO2

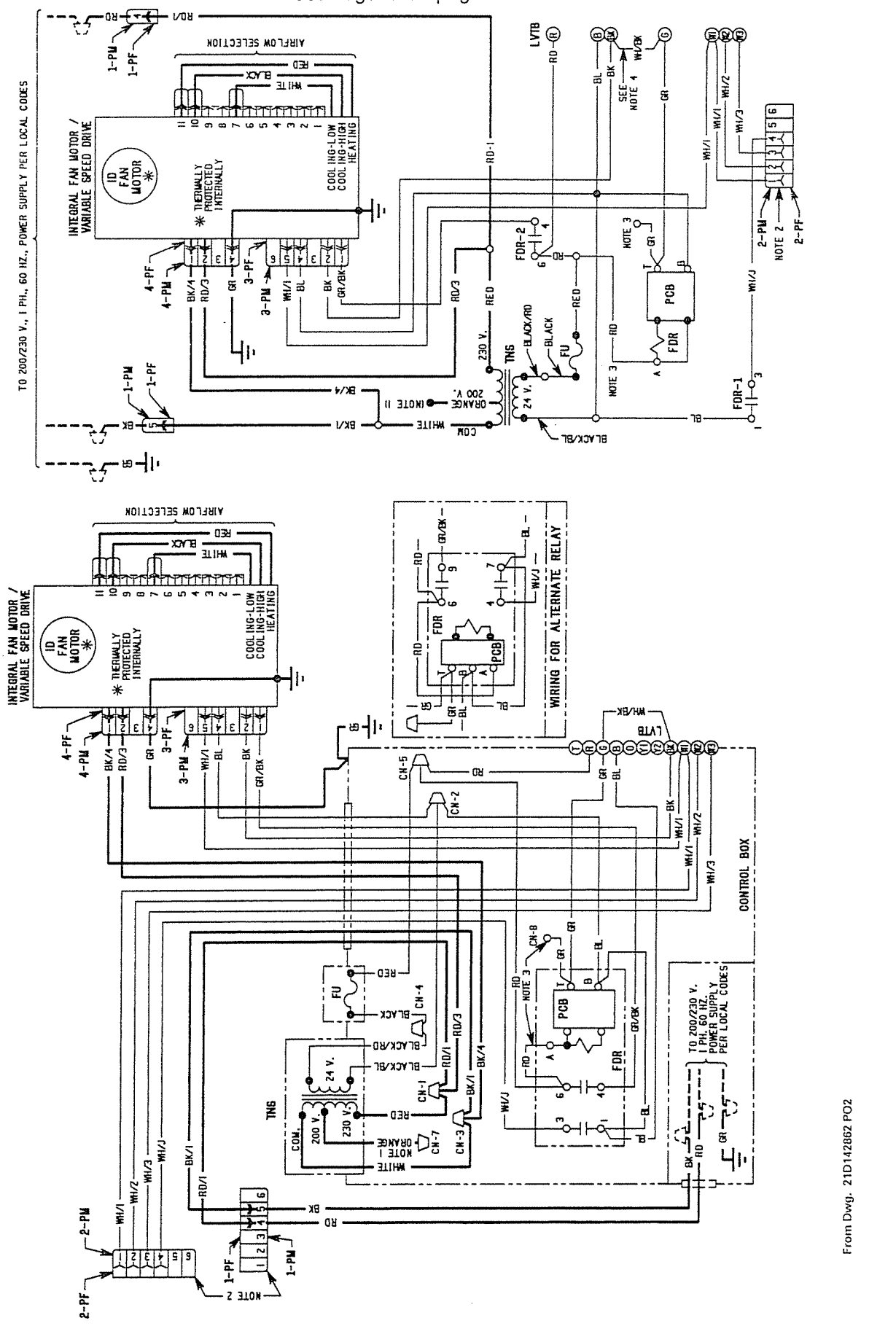
TWV739, 064E1

See Legend on page 86



TWH739, 064E1

See Legend on page 86

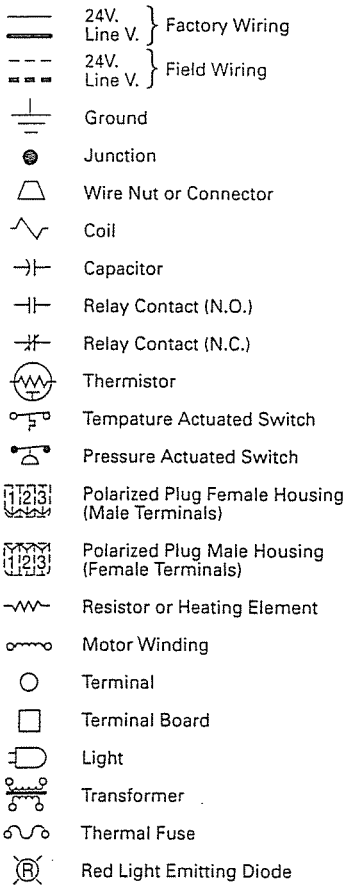


From Dwg. 21D142862 PO2

LEGENDS

TWS730, 736A100A0 & A1
TWS730A100A2
TWS748, 760A1

SYMBOLS



LEGEND

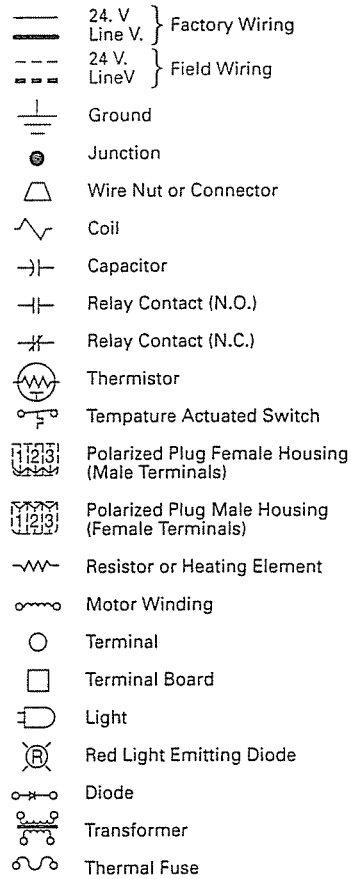
CAP	Capactor
CBS	Coil Bottom Sensor
D	Diode
DFC	Defrost Control Board
FL	Fusible Link
FS	Fan Speed Relay
HPCO	High Pressure Switch
K	Relay on Demand Defrost
LC	Line Choke
LED	Light Emitting Diode
LPCO	Low Pressure Switch
MOV	Varistor
MSI	Contactor Inrush
ODS	Outdoor Ambient Sensor
OFR	Outdoor Fan Relay
RI	Rrsistor Inrush
RFB	Relay/Filter Board
RO	Relay Overload
RT	Bridge Rectifier
SC	Switchover Valve Coil
SHR	Sump Heater Relay
TB	Terminal Board
TCS	Thermostat Compressor Shell
TDL	Thermostat Discharge Line
THS	Thermostat Heatsink
TNS	Transformer

NOTES

1. LOW VOLTAGE (24 V) FIELD WIRING MUST BE 18 A.W.G. MIN.
2. USE COPPER CONDUCTORS IF ALUMINUM OR COPPER-CLAD ALUMINUM POWER WIRING IS USED. CONNECTORS WHICH MEET ALL APPLICABLE CODES AND ARE ACCEPTABLE TO THE INSPECTION AUTHORITY HAVING JURISDICTION SHALL BE USED.
3. FUSIBLE LINK MAY NOT BE ON ALL UNITS.

TTS730, 736A100A0 & A1
TTS736A100A2
TTS748A, 760A1

SYMBOLS



LEGEND

CBS	Coil Bottom Sensor
CAP	Capacitor
CPR	Compressor
D	Diode
DFC	Defrost Control
FL	Fusible Link
FS	Fan Speed Relay
HPCO	High Pressure Switch
K	Relay on Demand Defrost
LC	Line Choke
LED	Light Emitting Diode
LPCO	Low Pressure Switch
MOV	Varistor
MSI	Contactor Inrush
ODS	Outdoor Ambient Sensor
OFR	Outdoor Fan Relay
RFB	Relay/Filter Board
RI	Resistor Inrush
RO	Relay Overload
RSH	Relay Sump Heater
RT	Bridge Rectifier
SC	Switchover Valve Coil
SHR	Sump Heater Relay
TB	Terminal Board
TCS	Thermostat Compressor Shell
TDL	Thermostat Discharge Line
THS	Thermostat Heatsink
TNS	Transformer

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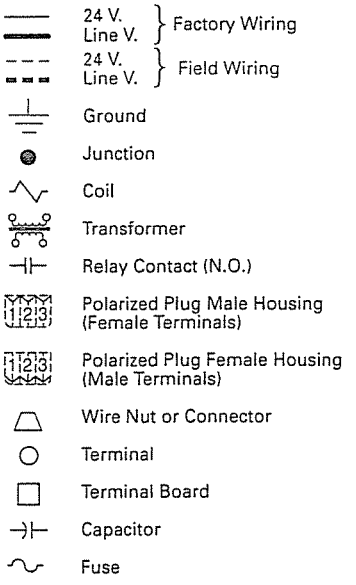
3. FUSIBLE LINK MAY NOT BE ON ALL UNITS.

TWH739, 064E1
TWV739, 064E1

SYMBOLS



LEGEND

CF	Fan Capacitor
FDR	Fan Delay Relay
FU	Fuse
HVTB	High Voltage Terminal Board
LVTB	Low Voltage Terminal Board
PCB	Printed Circuit Board
PF	Polarized Plug (Female Housing)
PM	Polarized Plug (Male Housing)
TNS	Transformer

NOTES

1. FOR 200 V OPERATION. DISCONNECT RED TRANSFORMER LEAD FROM CN-1 AND INSULATE CONNECT ORANGE TRANSFORMER LEAD TO REMAINING RD/1 AND RD/3 LEADS IN CN-1.
2. WHEN HEATERS ARE USED DISCARD 2-PF AND 1-PM WITH ATTACHED LEADS AND CONNECT 1-PF AND 2-PM TO THE MATING PLUGS IN THE HEATER CONTROL BOX.
3. AIR HANDLER IS FACTORY SET FOR FAN OFF-DELAY FOR INSTANT OFF OPERATION. DISCONNECT RD WIRE FROM FDR A AND INSULATE CONNECT GR WIRE TO FDR-A.

COLOR CODES

COLOR OF WIRE
BK/BL — BLACK WIRE WITH BLUE MARKER
COLOR OF MARKER

BK	BLACK	OR	ORANGE	YL	YELLOW
BL	BLUE	RD	RED	GR	GREEN
BR	BROWN	WH	WHITE	PR	PURPLE

The Trane Company
Unitary Products Group
6200 Troup Highway
Tyler, TX 75707