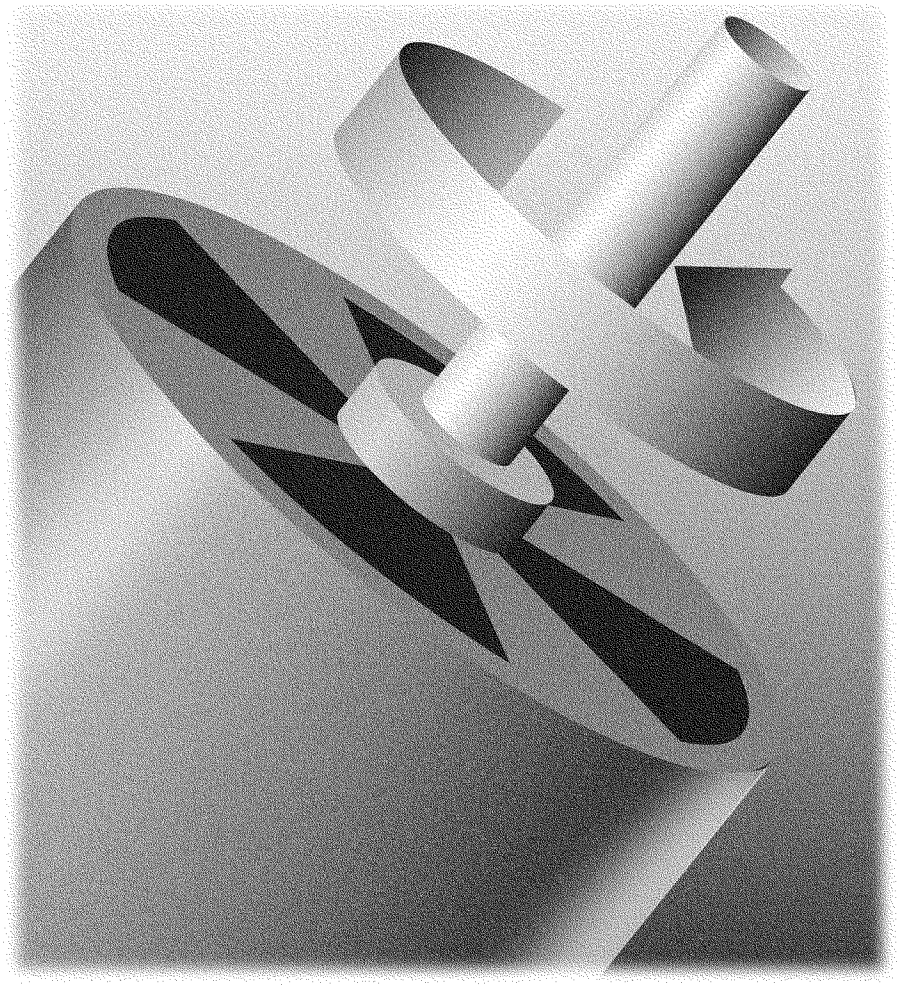
Electronically Commutated Motors

1996 Revision



Theory of Operation | ICM-1 Troubleshooting | ECM Outdoor Fan Motor
ICM-2 Inputs and Dip Switch Functions | Quick Check Motor Will Not Run
Cooling Air Flow | Heating Air Flow | Trouble Shooter

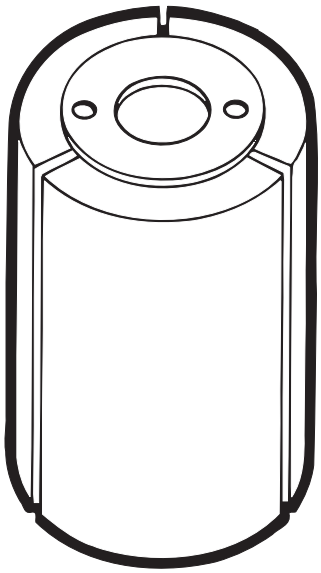
Contents

Theory of Operation

WHAT IS ECM?

Motor

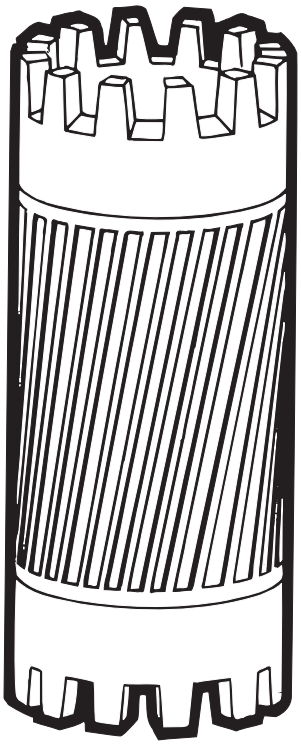
- An Electronically Commutated Motor
- Three Phase Wound Stator
- Permanent Magnet Rotor



PERMANENT MAGNET

AC MOTOR THEORY

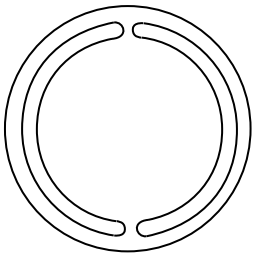
- Rotating Magnetic Fields
- Squirrel Cage Rotor
- Efficiency



SQUIRREL CAGE

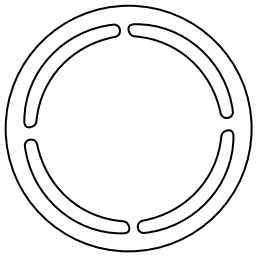
MOTOR SPEED

• 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. = $\frac{\text{AC Frequency in Hertz x 120}}{\text{Number of Poles in Motor}}$
- Motor Impedance
- Synchronous Torque
- Slip
- Maximum Current
- Motor Speed Varied by Changing Power and Frequency

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 Under Abnormal Load Conditions

VARIABLE SPEED
ELECTRIC SYSTEM BLOCK DIAGRAM

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

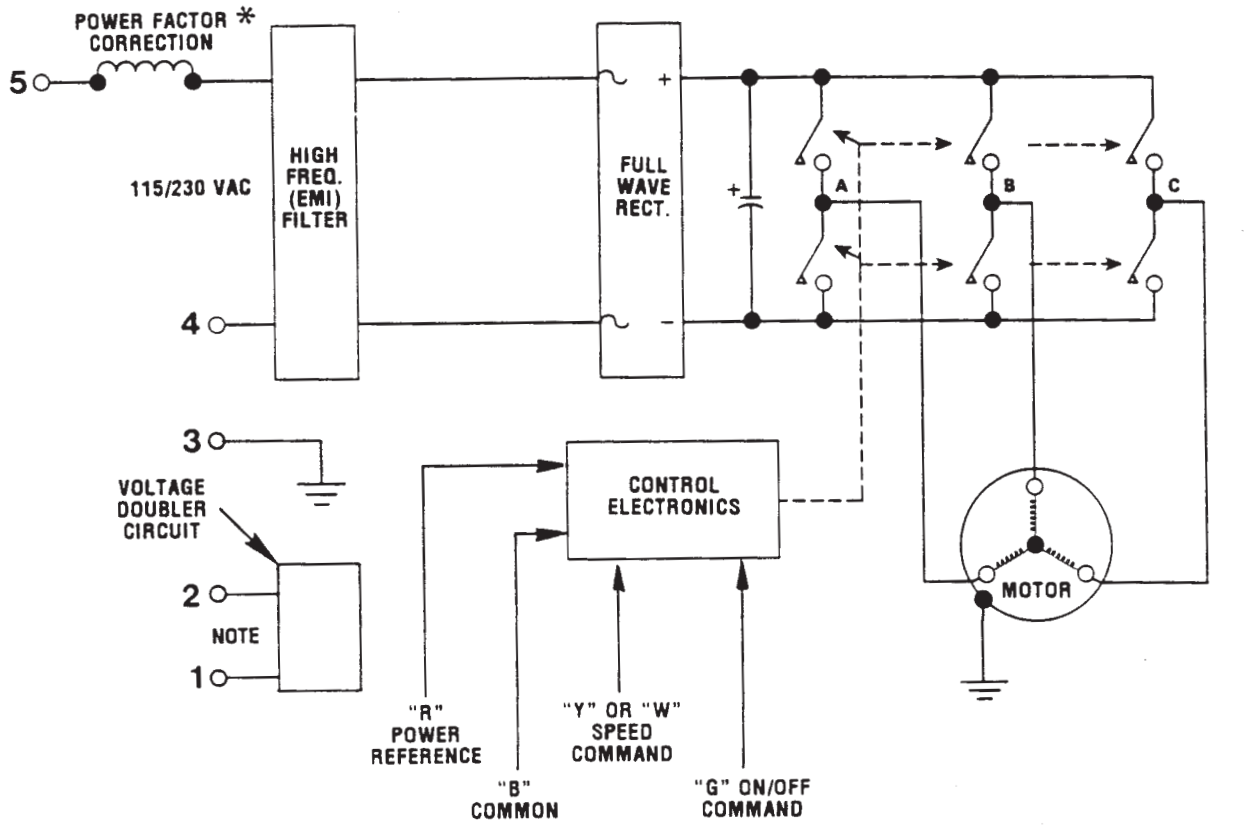
The power switches are drawn as mechanical switches for ease of explanation only. To show current flow through motor, start at the power switch A and close its switch to the negative terminal and close power Switch B to the positive terminal and current can flow through two legs of the motor windings. 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 times 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.

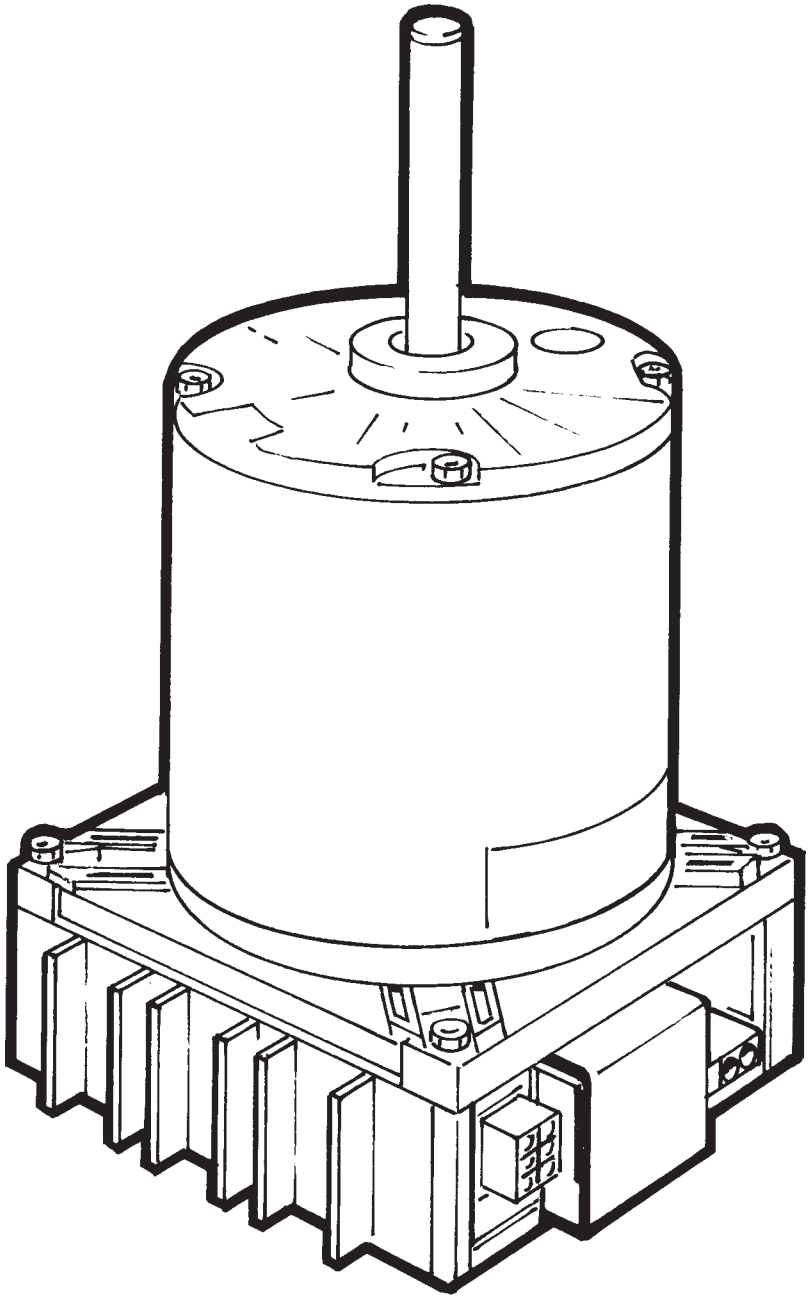
When in operation, the power electronic switches will be operated at different speeds to generate the frequency (in Hertz) to cause the motor to run at different speeds.

ICM-2 VARIABLE SPEED
ELECTRICAL SYSTEM BLOCK DIAGRAM



* USED ON 1 HP FURNACE MODELS ONLY

NOTE: FURNACE ONLY PIN # 1 & # 2 JUMPERED TOGETHER



ICM-1

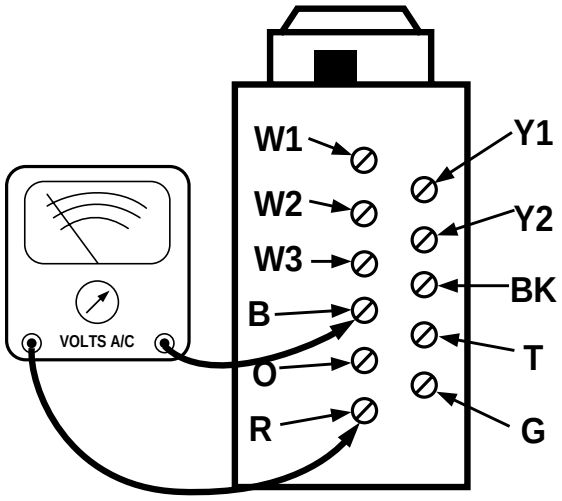
ICM-1 Troubleshooting

1. Is there 24 V.A.C. between terminals "R" and "B" at air handlers, or furnace?

YES: #2.

NO: Check 24 V.A.C. fuse and power to air handler. Repair as required.

Possible component faults which could cause fuse to blow.
- Field wiring.
- Indoor fan relay.
- Thermostat.
- Switchover valve coil.
- O.D.S in the outdoor unit.



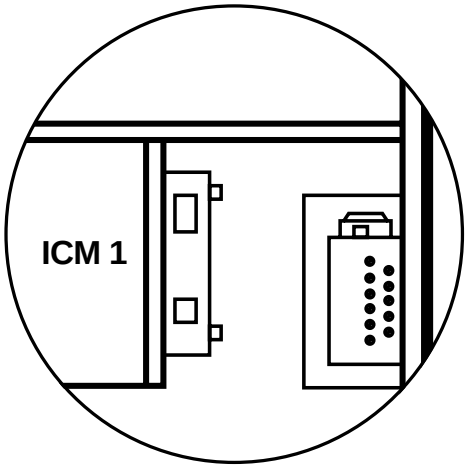
2. ICM 1 to check for motor operation use jumper as follows.

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

Will motor run and change speed?

YES: Motor runs and changes speed, fault is in the field wiring or thermostat.

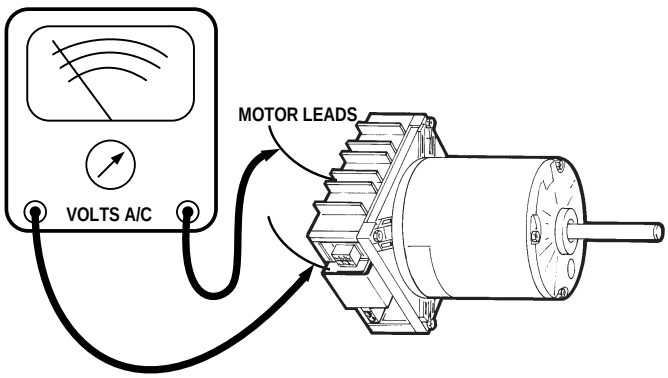
NO: If motor will not run, check all motor to terminal board wiring. If wiring is OK, perform check No. 3.



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

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

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



TROUBLESHOOTING

1. Fan motor will not run.
   Use Chart # 1.

2. Fan will not change speeds or is running at the wrong speed.
   Use Chart # 2.

3. Fan motor is changing speeds up and down and the fan thermostat is not switching back and forth.
   Go to Chart # 1, Step # 5.

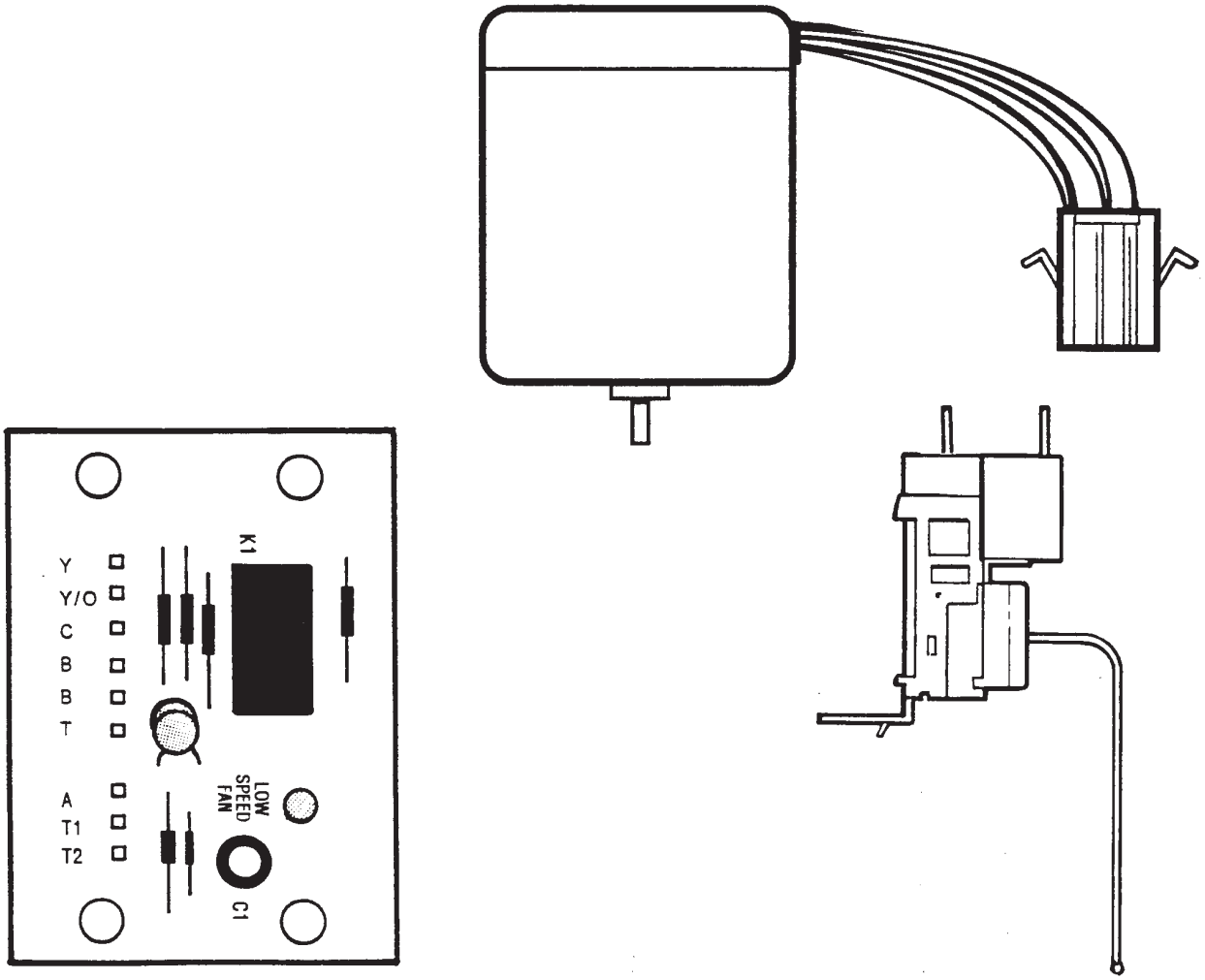


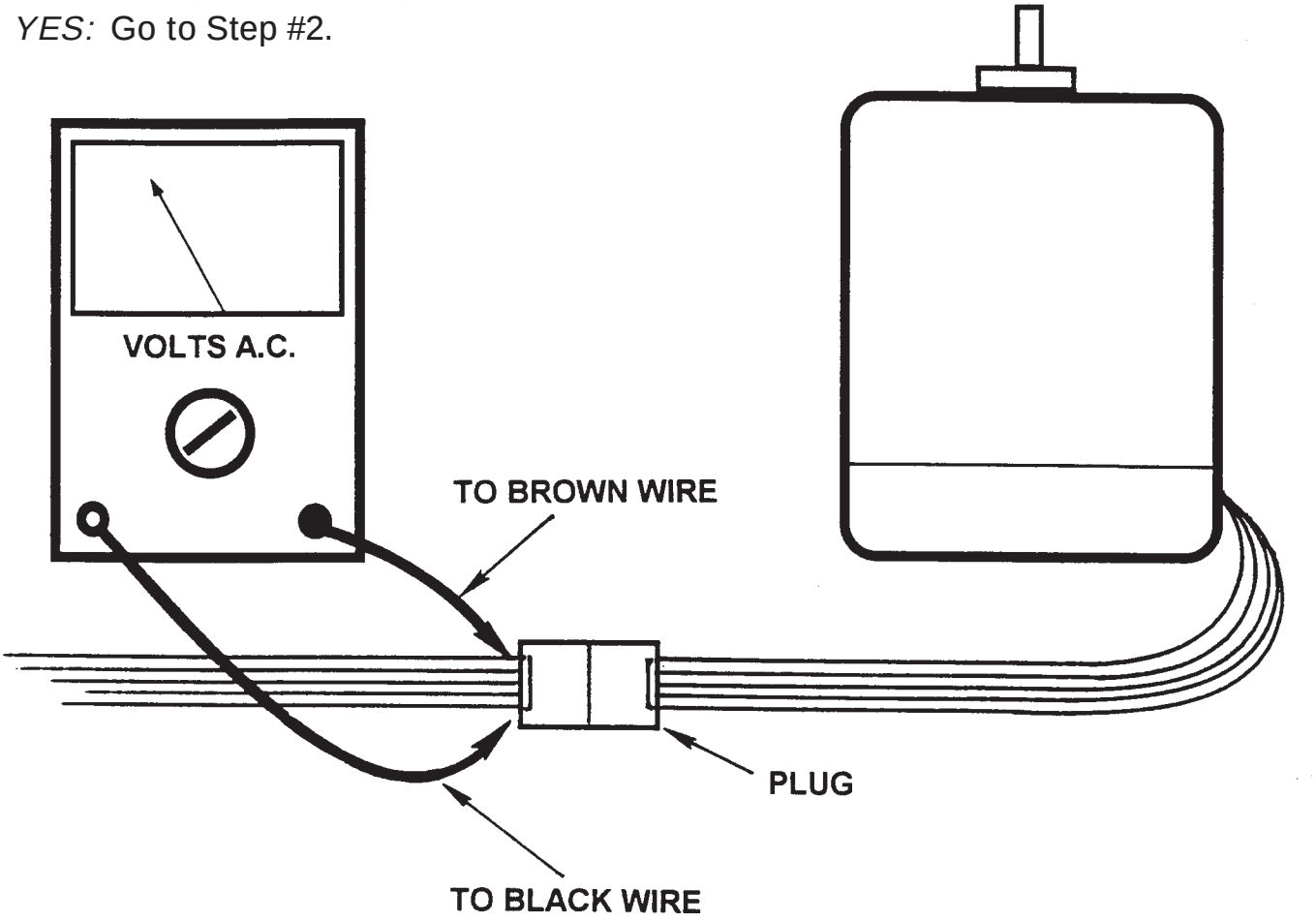
CHART #1

ECM Outdoor Fan Motor Will Not Run

1. Is the motor shaft free?

NO: Free up motor or replace.

YES: Go to Step #2.



2. Caution – line voltage is not switched by the contactor. Check line voltage to motor brown and black wires.
Is the correct line voltage present?

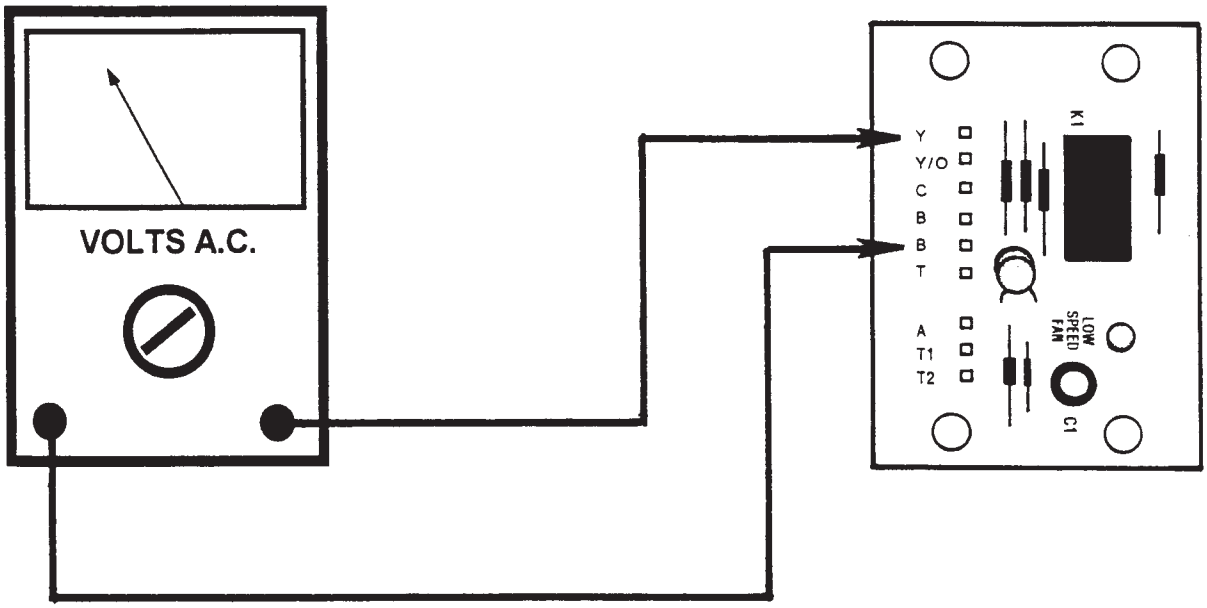
NO: Repair as needed.

YES: Go to Step #3.

3. Is there 24 V.A.C. present between pins Y and B on the fan control board?

NO: Is the compressor contactor picked up? If not, repair as needed.

YES: Go to Step #4.



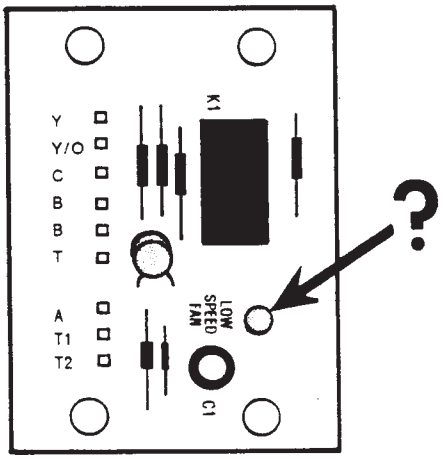
4. Is the red L.E.D. on the fan control board on?

NO: Outdoor fan thermostat is in the hot position or the L.E.D. circuit on the fan control board has failed. D.C. voltage in Steps #5 and #6 should be 16 – 24 V. D.C.

Go to step #5.

YES: Outdoor fan thermostat is in the cold position. D.C. voltage in Steps #5 and #6 should be 8 – 12 V. D.C.

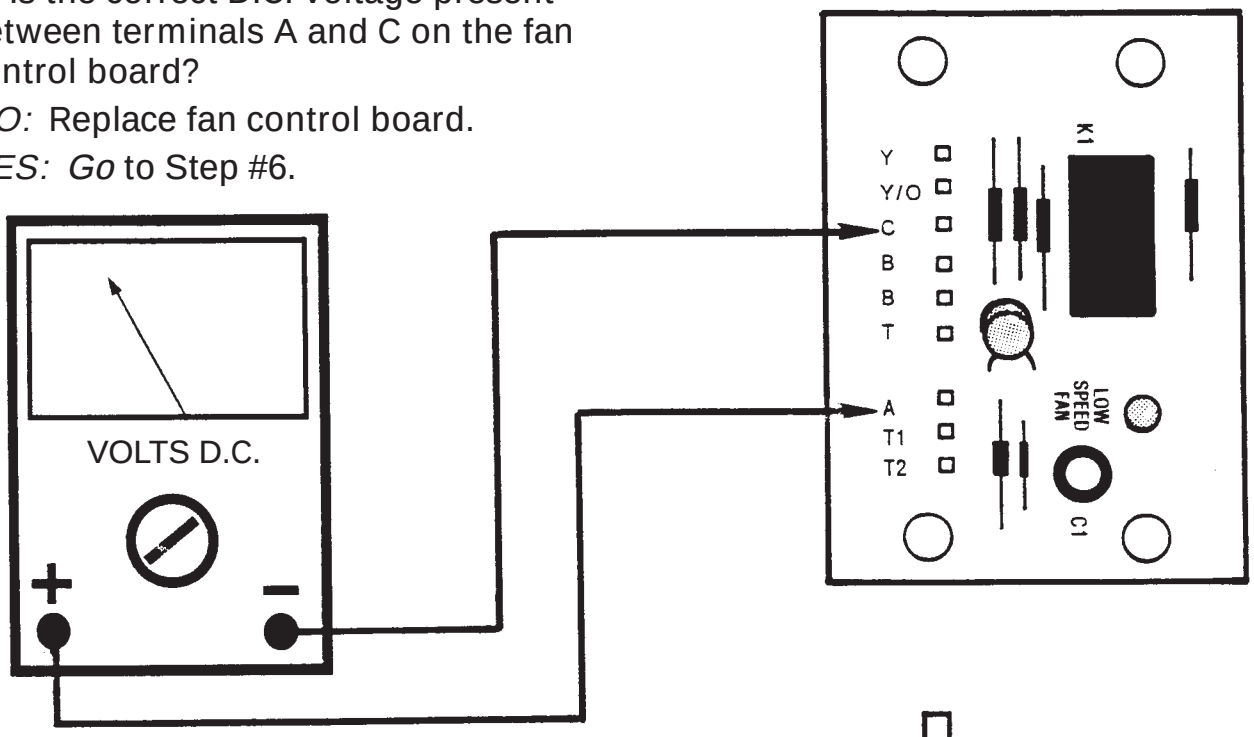
Go to Step #5.



5. Is the correct D.C. voltage present between terminals A and C on the fan control board?

NO: Replace fan control board.

YES: *Go* to Step #6.



6. Is the correct D.C. voltage present between the blue and yellow motor leads?

NO: Repair motor plug or wires going to the fan control board terminals A and C.

YES: Replace motor.

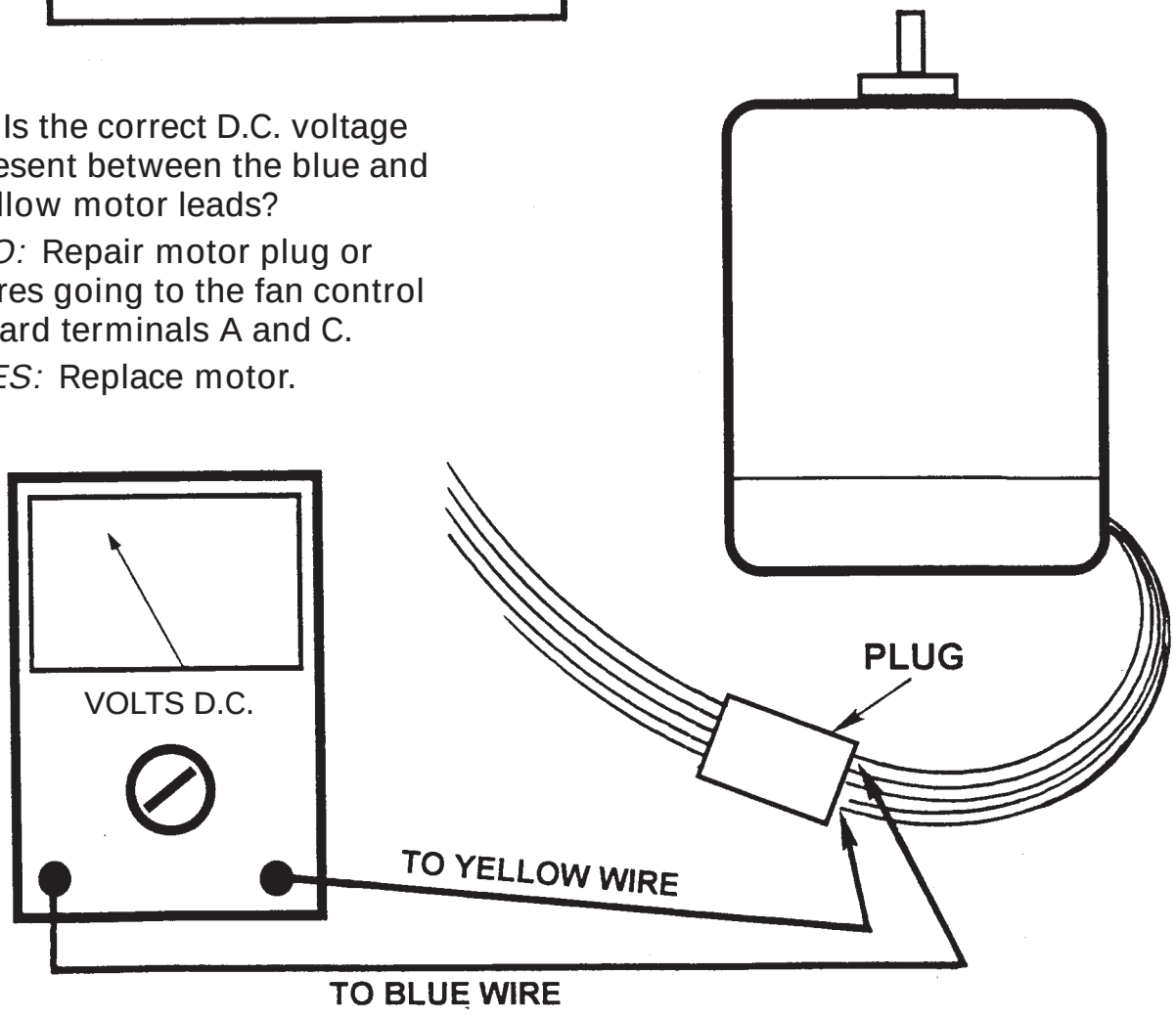


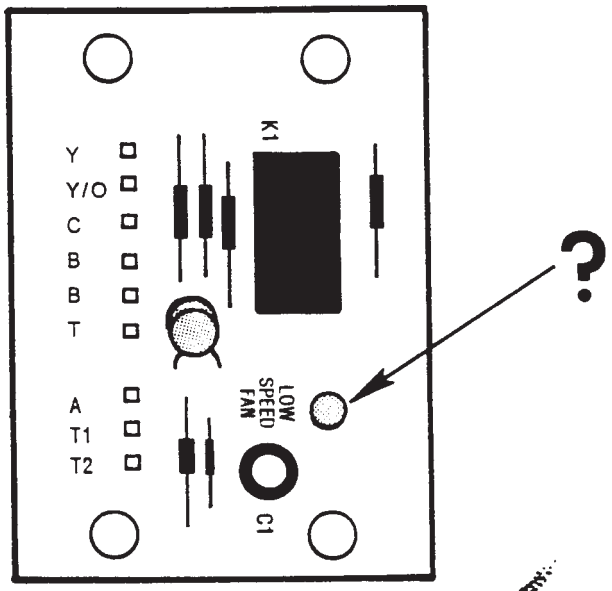
CHART #2

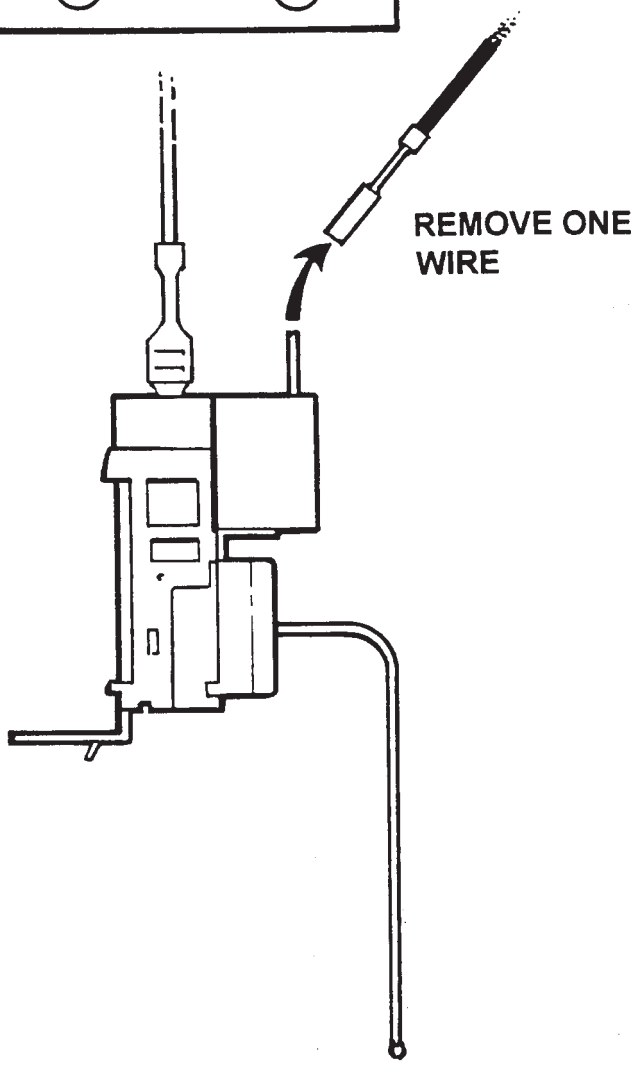
ECM Outdoor Fan Motor Will Not Change Speeds

1. Outdoor fan motor must be running for the test. Is the red L.E.D. on the fan control board on?

NO: Outdoor fan thermostat is in the hot position, or has failed, or the L.E.D. circuit on the fan control board has failed. Go to Step #4.

YES: Outdoor fan thermostat is in the cold position switch closed. Go to Step #2.





2. Take one of the wires off the outdoor fan thermostat. The red L.E.D. on the fan control board will go out. Does the outdoor fan motor go to high speed?

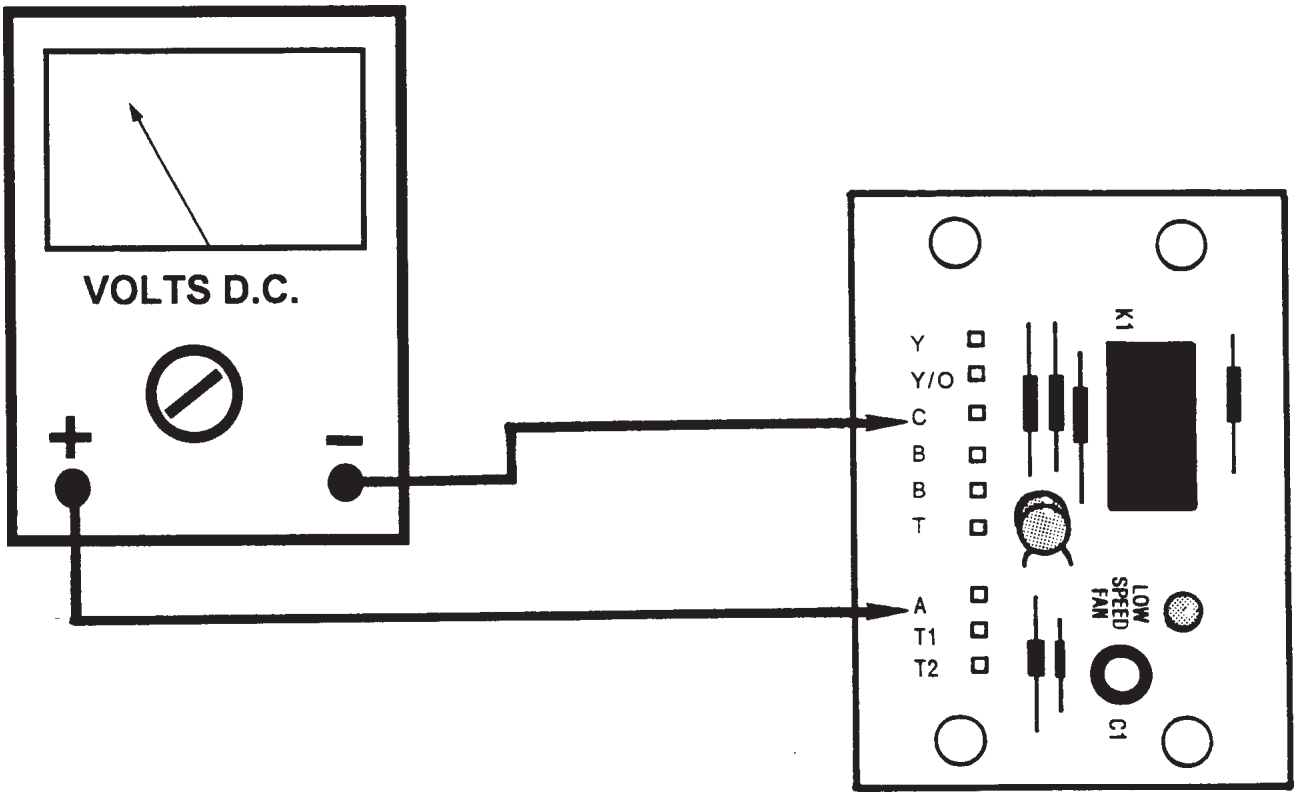
NO: If the red L.E.D. is still on, fault is in the unit's wiring going to the fan control board. If the red L.E.D. is out, Go to Step #3.

YES: Check the outdoor fan thermostat for proper operation.

3. Read the D.C. voltage between terminals A and C on the fan control board. Plug the wire removed from the thermostat in Step #2 back on the outdoor fan thermostat. The red L.E.D. must come on again, if not jumper both wires together on the outdoor fan thermostat. Again, read the D.C. voltage between terminals A and C on the motor control board. Did the D.C. voltage drop to about half?

NO: Replace motor control board.

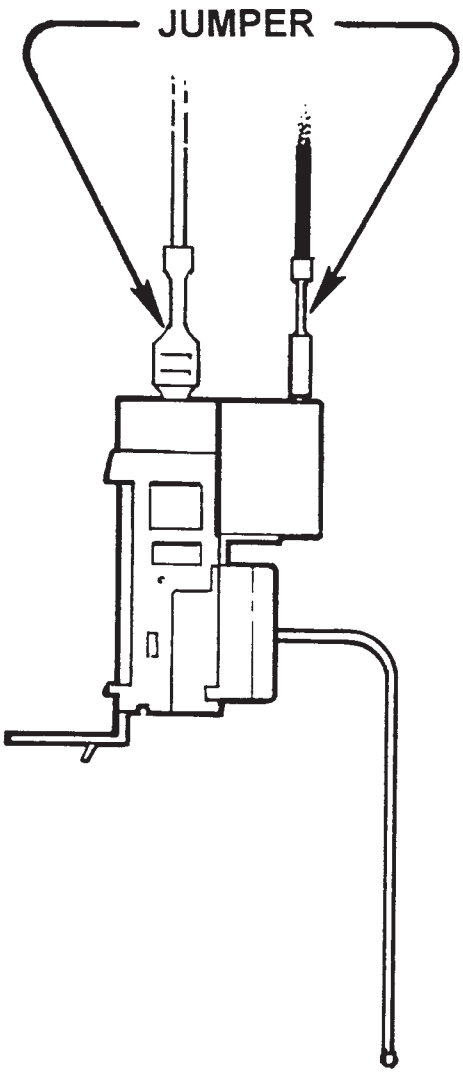
YES: Replace the outdoor fan motor.

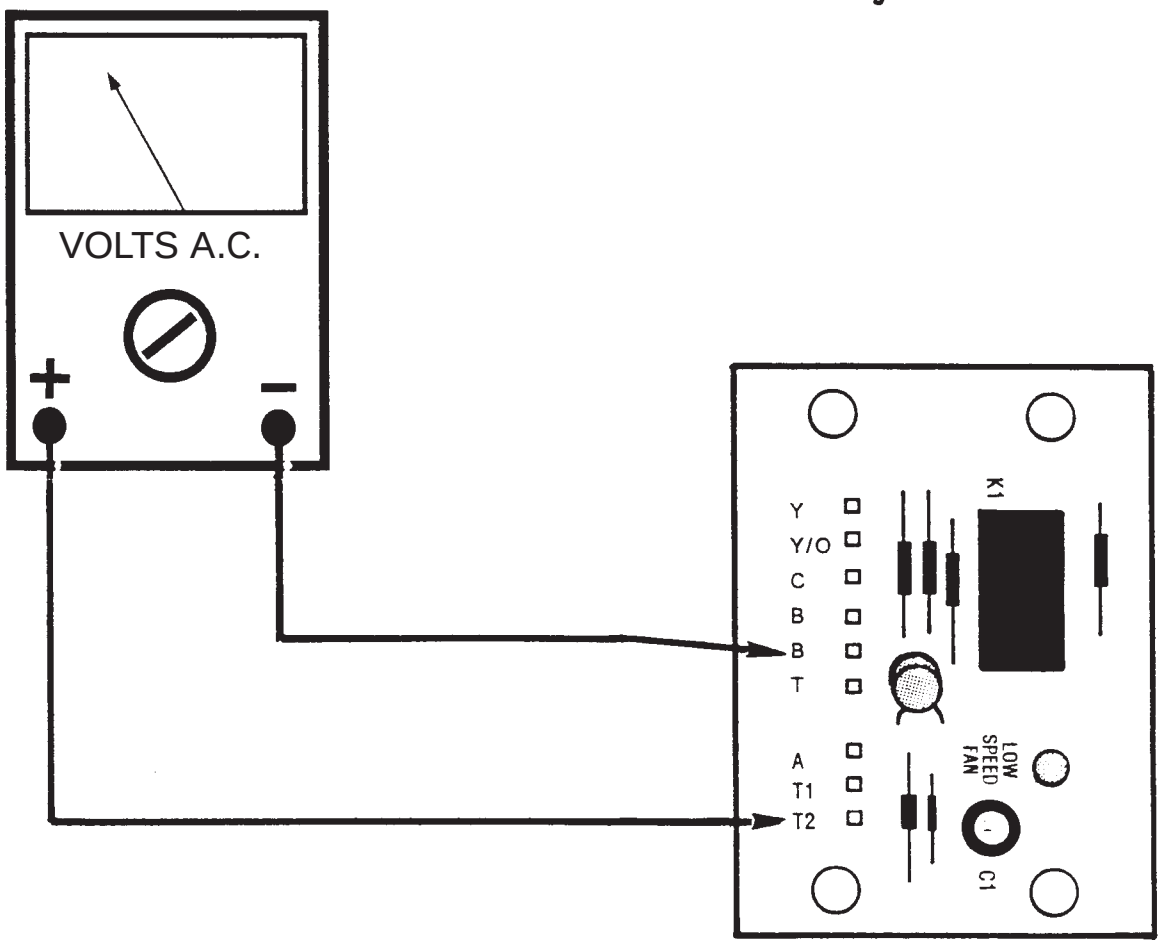


4. Jumper the two wires together on the outdoor fan thermostat. Does the red L.E.D. on the fan control board come on?

NO: Check for 24 V. A.C. between terminals T2 and B on the fan control board.
If 24V. A.C. is present and the L.E.D. is out, replace the fan control board.
If 24V. A.C. is not present at terminals T2 and B, fault is in the unit's wiring.

YES: If the outdoor fan motor changes speed, check the outdoor fan thermostat for proper operation. If the outdoor fan motor does not change speed, go to Step #5.

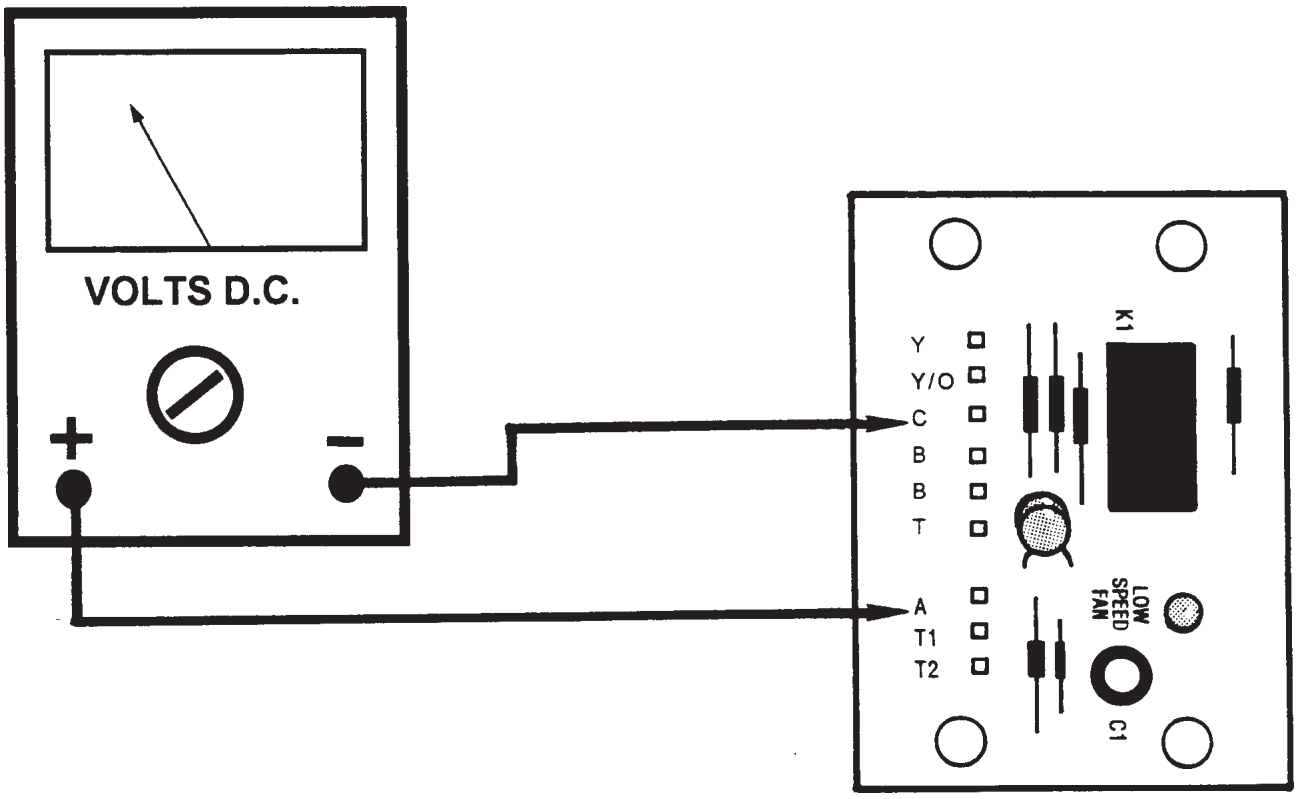




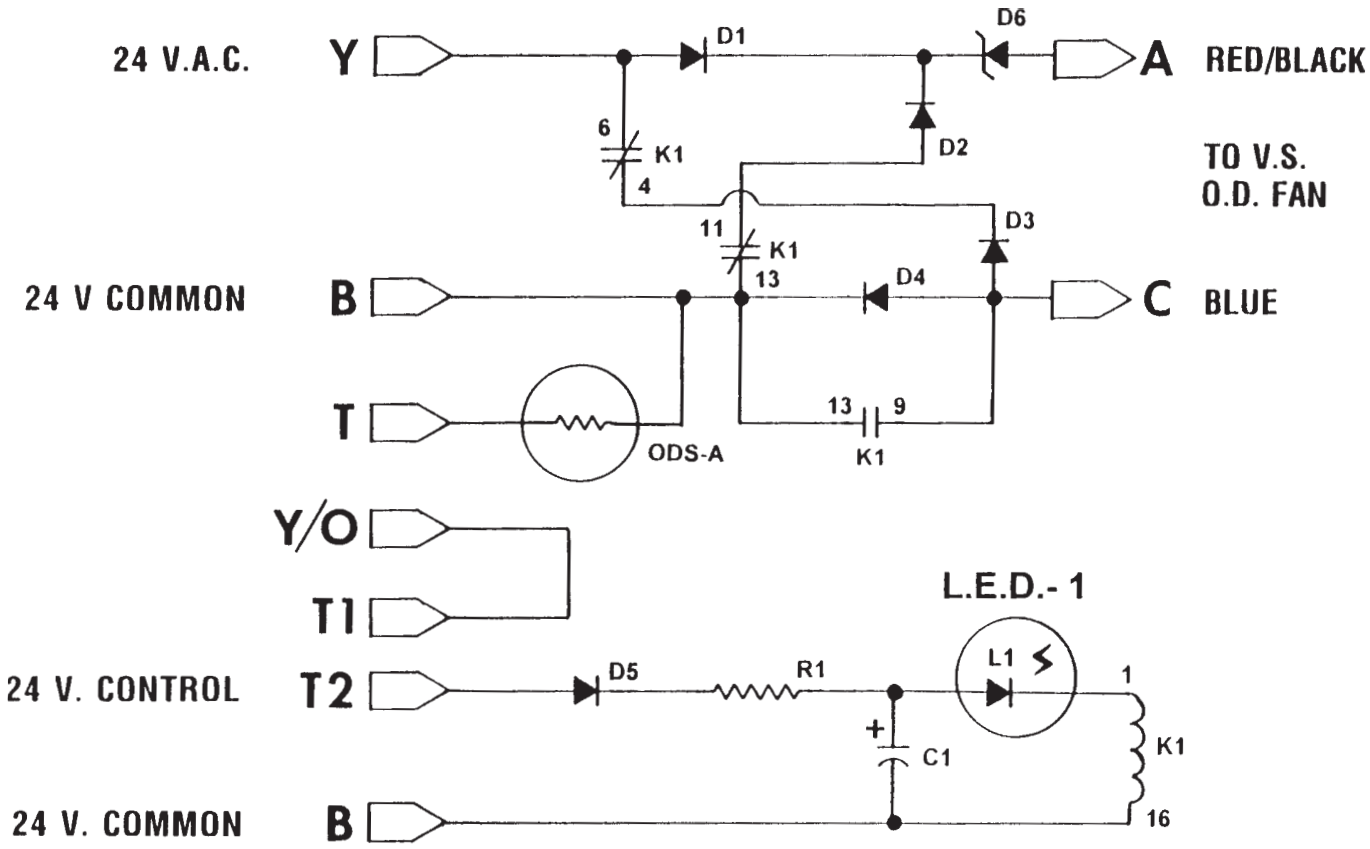
5. Read the D.C. voltage between terminals A and C on the fan control board, record this voltage. Remove the jumper installed in Step #4 on the outdoor fan thermostat. Again read the D.C. voltage between terminals A and C on the fan control board. Is the D.C. voltage now about double the recorded voltage?

NO: Replace fan control board.

YES: Replace fan motor.

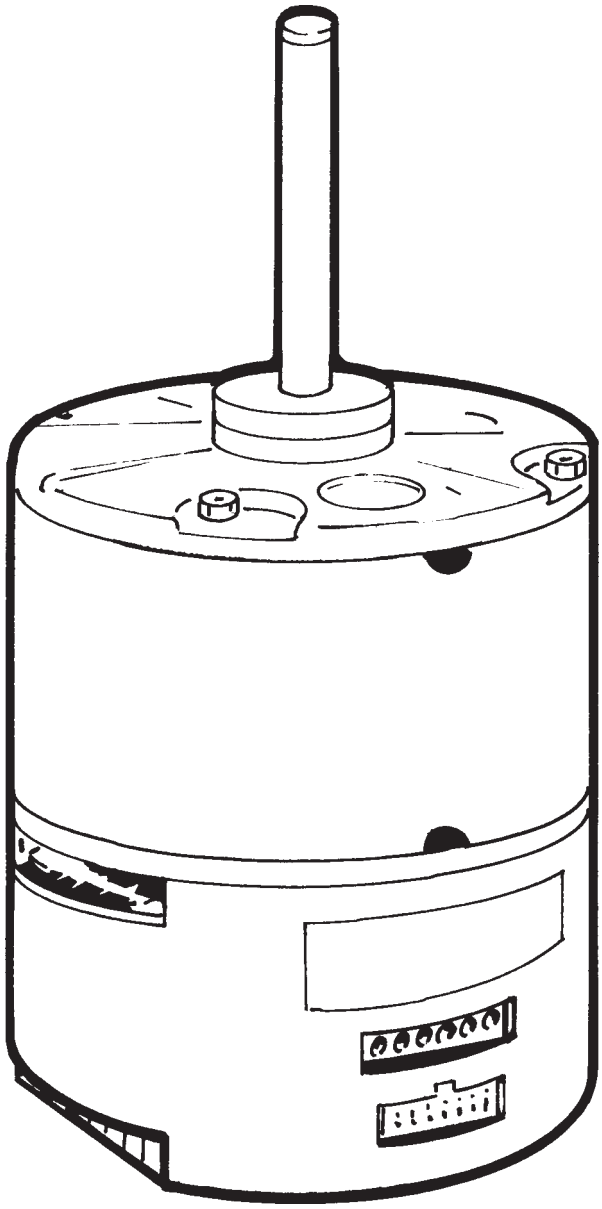


OUTDOOR ECM FAN MOTOR CONTROL BOARD



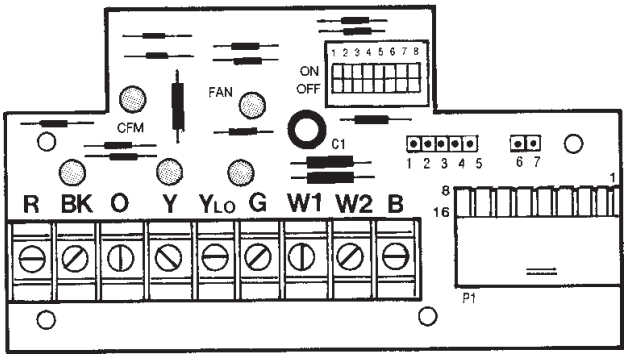
NOTE: 32 % PWM = 520 RPM
84 % PWM = 820 RPM

ICM-2 Inputs and Dip Switch Functions

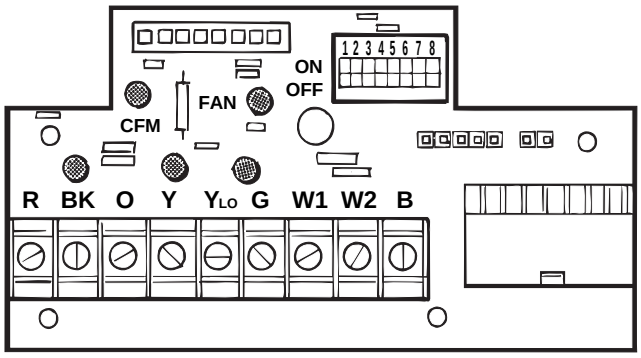


ICM-2

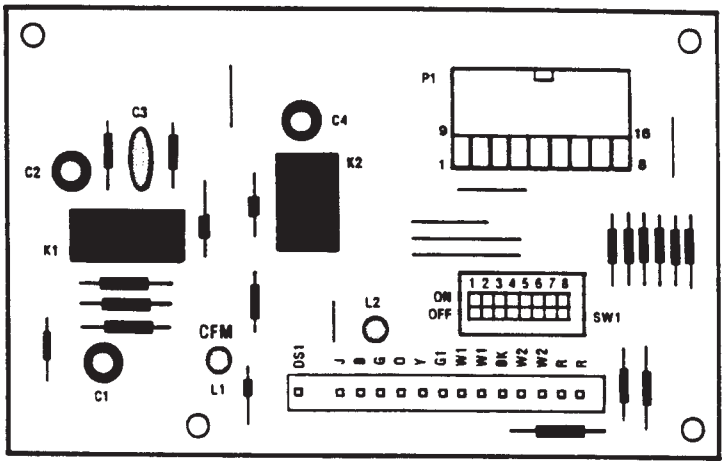
MOTOR CONTROL BOARDS



RETRO FIT KIT – CNT 1654

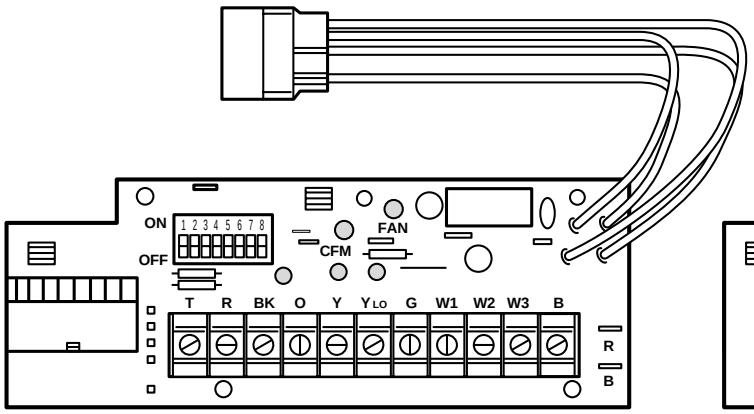


FURNACE – CNT 1537

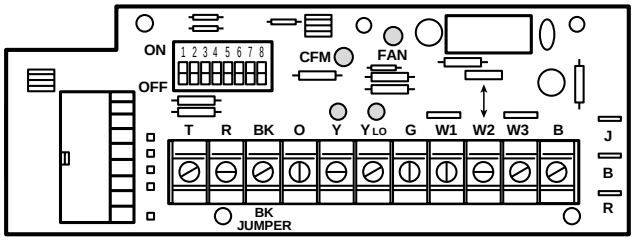


PACKAGE UNIT
BRD 0986

AIR HANDLER



CNT 1538

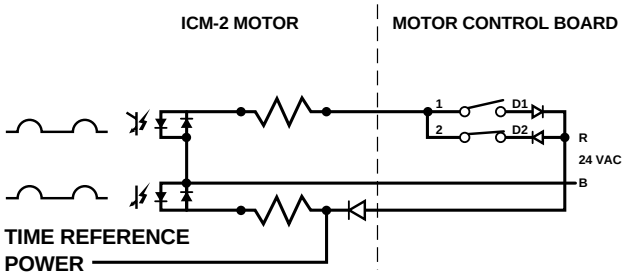


CNT 1866

ICM-2 Inputs and Dip Switch Functions

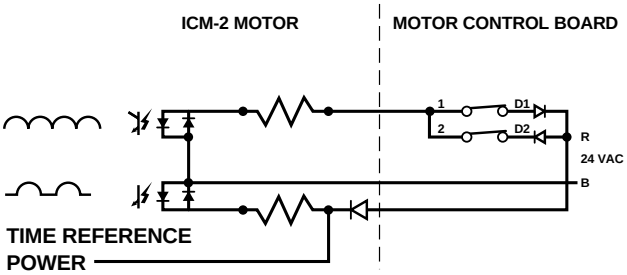
The ICM-2 motor is a Field Programmable Motor. The field programming is done with eight Dip Switches on the motor control board. The motor's computer has eleven inputs and one output. The eight Dip Switched and four of the computer inputs are used to program the cooling airflow, heating airflow and a time delay or ramp cycle. The other seven inputs are used to turn the motor on or off, and command to run at a programmed CFM for heating or cooling. The one output from the computer is used to turn the green CFM L.E.D. on and off on the motor control board. By counting the number of flashes the CFM program can be checked. Four different input commands can be sent to the motor computer with 24 V.A.C. by using the Dip switches on the motor control board. 24 volts A.C. is supplied to the motor computer for power and it is also used as a timing reference.

1. IN TIME COMMAND



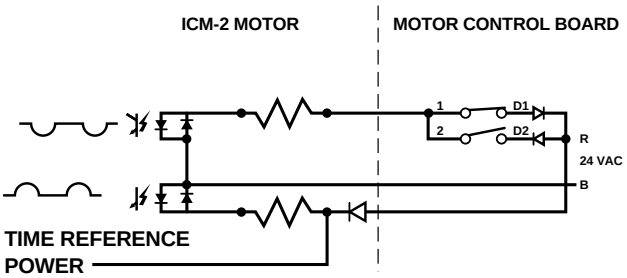
Dip Switch #2 will cause an in time command to be received by the motor computer. The motor will now run at it's factory program for an in time command.

2. DOUBLE COMMAND



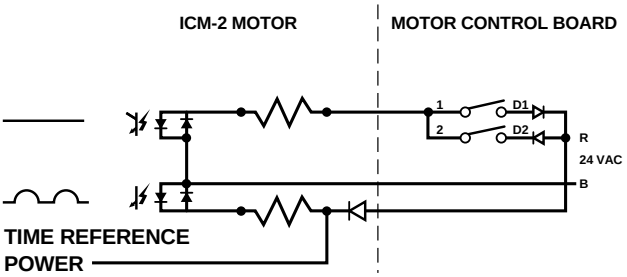
Dip Switches #1 and #2 closed will cause a double time command to be received by the motor computer, it will then run at it's factory program for a double time command.

3. OUT OF TIME COMMAND



Dip Switch #1 closed will cause a out of time command to be received by the motor computer, it will then run at it's factory program for a out of time command.

4. NO COMMAND



When Dip Switch #1 and #2 are open no command will be received on this input by the motor computer, it will then run at it's factory program for a no command input.

ICM-2 CONTROL IMPUT

Air Flow Priority

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

A furnace or package gas electric W1, and W2 have priority over Y.

TERMINAL	*PIN NO.*	*FUNCTION*
BK	***#10***	Humidistat input for single, or two speed systems. Two speed system may be a two speed compressor or a two compressor system. If a humidistat is not installed, a jumper must be installed between “R” and “BK”. A XV 1500 variable speed system BK is the input for the PWM blower speed command not humidistat.
W1	***#2***	CFM, blower speed, for low heat. Packaged Gas/Electric W1 and W2 are also used for a on or off command for the motor.
W2	***#13***	CFM, blower speed for high heat. W2 on gas furnaces or W3 on air handlers. Packaged Gas/Electric only blower on/off common is also W2.
G	***#15***	On or off command for the motor. Air flow will be 50% of cooling Y CFM programmed.
YLO	***#6***	CFM, blower speed, for low speed cooling on a two speed system.
G1	***#6***	Package unit air flow will be 100 % cooling Y CFM programmed.
Y	***#14***	CFM, blower speed, for high speed cooling on a two speed system, or cooling CFM for a single speed system.
CFM	***#16***	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	***#1, 3, & 8***	Common 24 VAC.
O	***#9***	Cooling cycle humidistat enable. Single or two speed system only. On a cooling system, “Y” must be jumpered to “O” for humidistat operation.
R	***#12***	Power and timing reference for ICM-2 motor computer and power to the Dip switches.

ICM-2 CONTROL IMPUT

Dip Switches

SWITCH	*PIN NO.*	*FUNCTION*
#1 & # 2	***#5***	Tonnage of outdoor unit.
# 3 & # 4	***#7***	CFM per ton. 350, 400 or 450 CFM.
# 5 & # 6	***#4***	Are used to set up indoor blower time delay at the end of a cooling cycle. If a delay or ramped on cycle is programmed, a heat pump or cooling only installation, the heating cycle blower off cycle will also be affected. The cooling air flow, CFM, will be reduced by 50%. A gas furnace or Package gas electric installation, the ignition control will control the amount of time the blower is on at the end of the heating cycle. See ICM-2 Motor Operation Chart for type equipment installed. On a variable speed system # 5 & # 6 must be in their off position.
# 7 & # 8	***#11***	CFM for low heat and high heat, 2 stage gas furnace or three stage electric heat.

HEAT PUMP & COOLING PACKAGE UNIT ICM-2 MOTOR OPERATION

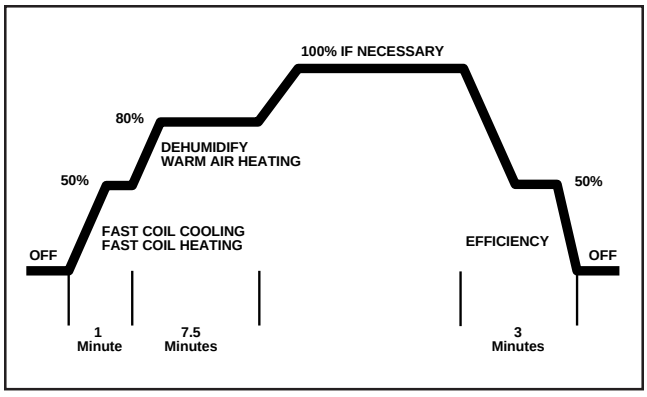
RAMPED OPERATION – Dip Switch No. 5 and No. 6 ON, works in both the cooling and heating cycle. A call on "Y" and "G" is all that is needed to get a ramped ON and OFF cycle in either the heating or cooling cycle.

COOLING HUMIDISTAT OPERATION – Will be enabled when a call on "O" is received by the motor computer. Cooling only units - a jumper must be installed between "Y" an "O" at the Motor Control Board (ICMC) plug. "BK" terminal is jumpered to "R" terminal on the Motor Control Board and this jumper must be cut to connect a cooling humidistat.

AIR FLOW PRIORITY is the highest speed call it is receiving, "Y" or "W". If "Y" and "W" are both turned ON at the same time (heat pump operation), the air flow will be the highest of the two and the "W" will cause the ramped ON cycle to be canceled.

BLOWER TIME DELAY to OFF is controlled by the ICM-2 motor and Dip Switch No. 5 and No. 6 on the (ICMC) Motor Control Board. If a delay is programmed, 90 or 180 seconds, it will work in both the heating and cooling cycles if the ICM-2 motor sees a call on "Y" and "G". When the ICM-2 motor sees a call on "W" and "G", the time delay to OFF is canceled.

FAN CONTINUOUS OPERATION – The airflow is 50% of the cooling air flow. If cooling air flow is required for continuous fan operation, jumper G1 pin to G pin at the (ICMC) motor control board plug. A factory installed jumper pigtail, (BK), is connected to G1 pin for this purpose.



AIR HANDLER ICM-2 MOTOR OPERATION

AIR HANDLERS BUILT BEFORE JUNE, 1994 – "O" is the ramp, on time delay and humidistat enable input.

AIR HANDLERS BUILT AFTER MAY, 1994 – "O" is needed only for the cooling humidistat enable input.

RAMPED OPERATION – Dip Switch No. 5 and No. 6 ON, works in both the cooling and heating cycle. A call on "0", "Y" and "G" on air handlers built before 6/94 or a call on "Y" and "G" on air handlers built after 5194, is all that is needed to get a ramped ON and OFF cycle in either the heating or cooling cycle. If a cooling humidistat is not installed on air handlers built before June, 1994, a jumper must be installed between "R" and "BK" terminals.

COOLING HUMIDISTAT OPERATION – Will be enabled when a call on "O" is received by the motor computer. Cooling only units – a jumper must be installed between terminals "Y" and "O" at the Motor Control Board. When the humidity is high, the humidistat's switch will be open and the blower air flow will be reduced 20%.

AIR FLOW PRIORITY is the highest speed call it is receiving, "Y" or "W". If "Y" and "W" are both turned ON at the same time (heat pump operation), the air flow will be the highest of the two and the "W" will cause the ramped ON cycle to be cancelled. "W1" and "W3" are the heating air flow input terminals.

BLOWER TIME DELAY to OFF is controlled by the ICM-2 motor and Dip Switch NO. 5 and No. 6 on the Motor Control Board. If a delay is programmed, 90 or 180 seconds, it will work in both the heating and cooling cycles if the ICM-2 motor sees a call on "Y" and "G". When the ICM-2 motor sees a calls on "W" and "G", the time delay to OFF is cancelled.

FAN CONTINUOUS OPERATION – The airflow is 50% of the cooling airflow. If cooling air flow is required for continuous fan operation, remove field installed wires from "Y" terminal on the low voltage terminal board and wire nut them together. Then connect "G" terminal to "Y" terminal with a jumper.

PACKAGE GAS ELECTRIC ICM-2 MOTOR OPERATION

BLOWER ON/OFF OPERATION, is "G", "W1" or "W2".

RAMPED OPERATIONS, Dip Switch No. 5 and No. 6 ON, will work in the Cooling Cycle Only. A call on "Y" and "G" together is all that is needed to get a ramped ON and OFF cycle. This motor computer program is different from a furnace for it does not need "O" input to enable a ramped cycle.

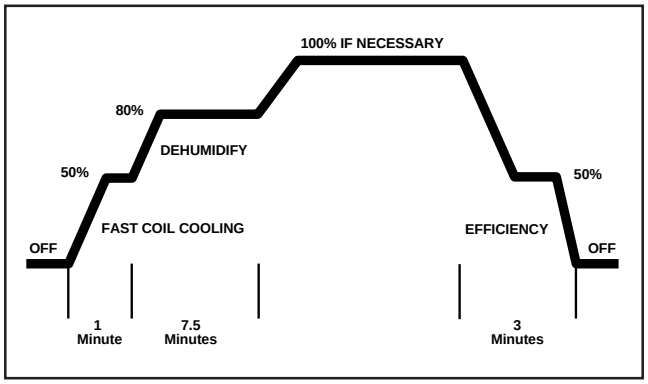
COOLING HUMIDISTAT OPERATION – "BK" terminal is jumpered to "R" terminal, at the (ICMC) Motor Control Board plug. This jumper must be cut to install a cooling humidistat.

AIR FLOW PRIORITY is W1 or W2, not the highest air flow of "Y" or "W" programmed.

HEAT EXCHANGER COOL-DOWN CYCLE – Air flow will go to 50% of the cooling air flow. The heating cool-down time is controlled by the ignition module.

COOLING CYCLE – Blower Time Delay to off is controlled by the ICM-2 Motor and Dip Switch No. 5 and No. 6 on the (ICMC) Motor Control Board. The ignition module cooling time delay dip switch must be set to O seconds if ramped operation or a time-delay cycle is selected.

FAN CONTINUOUS OPERATION – The airflow is 50% of the cooling air flow. If cooling air flow is required for continuous fan operation, jumper G1 pin and G pin at the (ICMC) motor control board plug. A factory installed jumper pigtail, (BK), is connected to G1 pin for this purpose.



FURNACE ICM-2 MOTOR OPERATION

A Call on "Y" and "G" together. The indoor blower will run at 100%. "O" is the ramp, or time delay and humidistat enable input. This "O" input must be received by the ICM-2 Motor Computer for these cycles to operate. Cooling only units jumper "Y" to "O" at the low voltage Motor Control Board.

RAMPED OPERATION, Dip Switch No. 5 and No. 6 ON, will work in the cooling cycle only. A call on the "Y", "G" and "O" together must be present for a ramped ON and OFF cycle. If a humidistat for cooling is not used, "BK" terminal must be jumpered to "R" terminal. If not, only 80% of the cooling airflow will be delivered.

COOLING HUMIDISTAT OPERATION – "BK" and "R" terminals are connected to the humidistat. When the indoor humidity is high, the humidstat's switch will be open and the blower air flow will be reduced 20%.

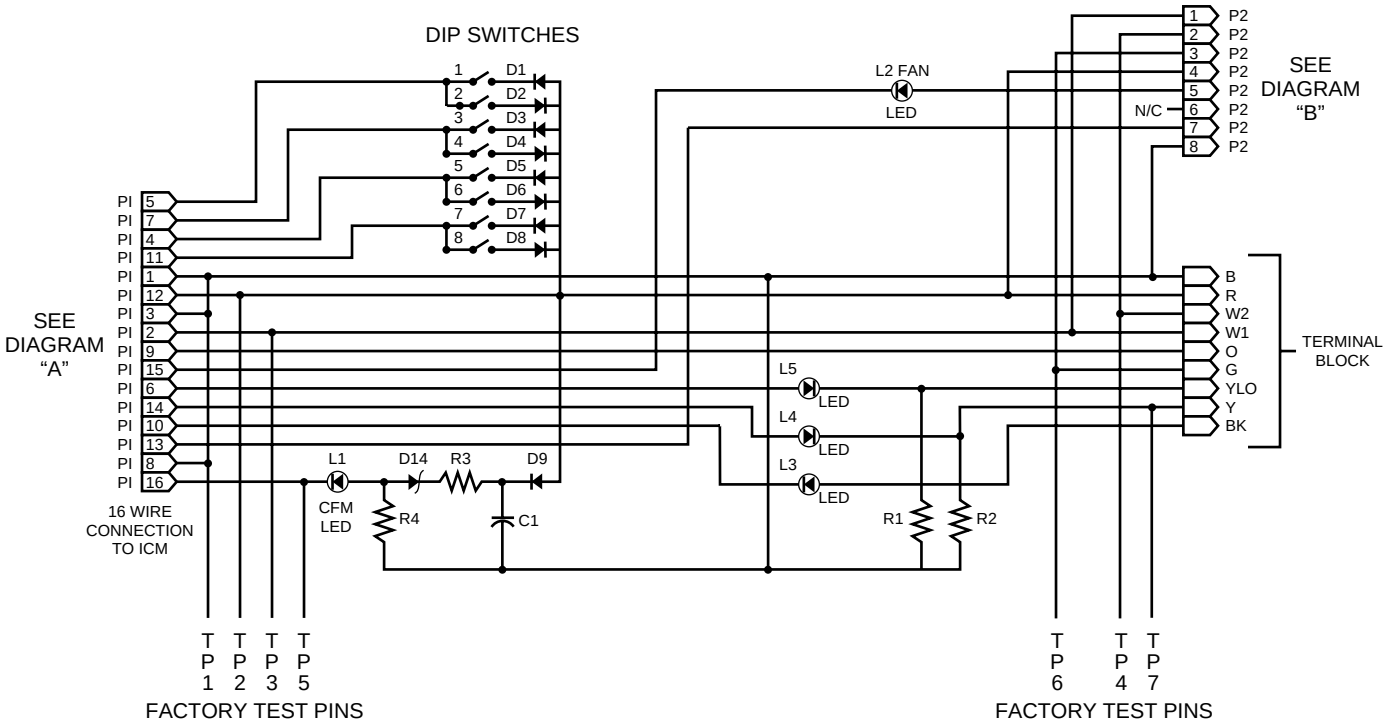
AIR FLOW PRIORITY is "W1" or "W2", not the highest air flow of "Y" or "W1" or "W2". A Dual Fuel installation, a furnace and a heat pump, the airflow is compressor "Y" airflow except during the defrost cycle. Then the blower will run at W1 airflow when the furnace is on.

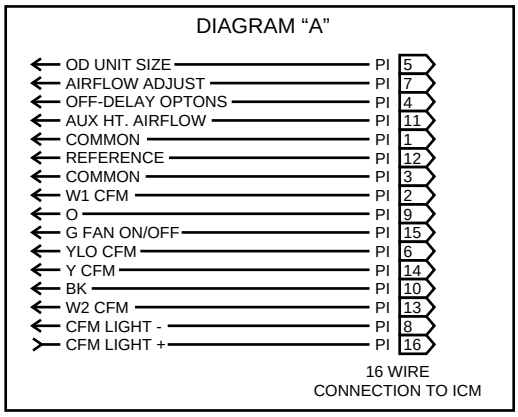
COOLING CYCLE – Blower Time Delay to off is controlled by the ICM-2 Motor and Dip Switch No. 5 and No. 6 on the Motor Control Board. The White-Rodgers Ignition Control Dip Switch #1 must be turned on, O seconds, when a ramped or time-delay cycle is selected.

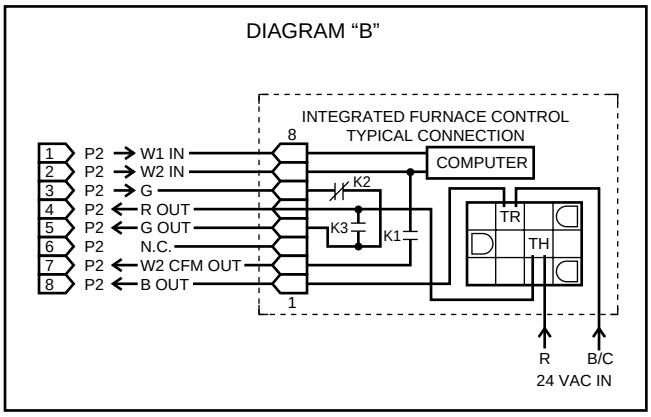
HEAT EXCHANGER COOL-DOWN CYCLE – The air flow will go to 50% of the cooling air flow. Heating cool-down time is controlled by the White-Rodgers Ignition Control, Dip Switches No. 2 and No. 3.

FAN CONTINUOUS OPERATION – The air flow is 50% of the cooling air flow. If cooling air flow is required for continuous operation, remove field installed wires from "Y" terminal on the low voltage terminal board and wire nut them together. Then connect "G" terminal to "Y" terminal with a jumper.

FURNACE MOTOR CONTROL BOARD SCHEMATIC
CNT 1537

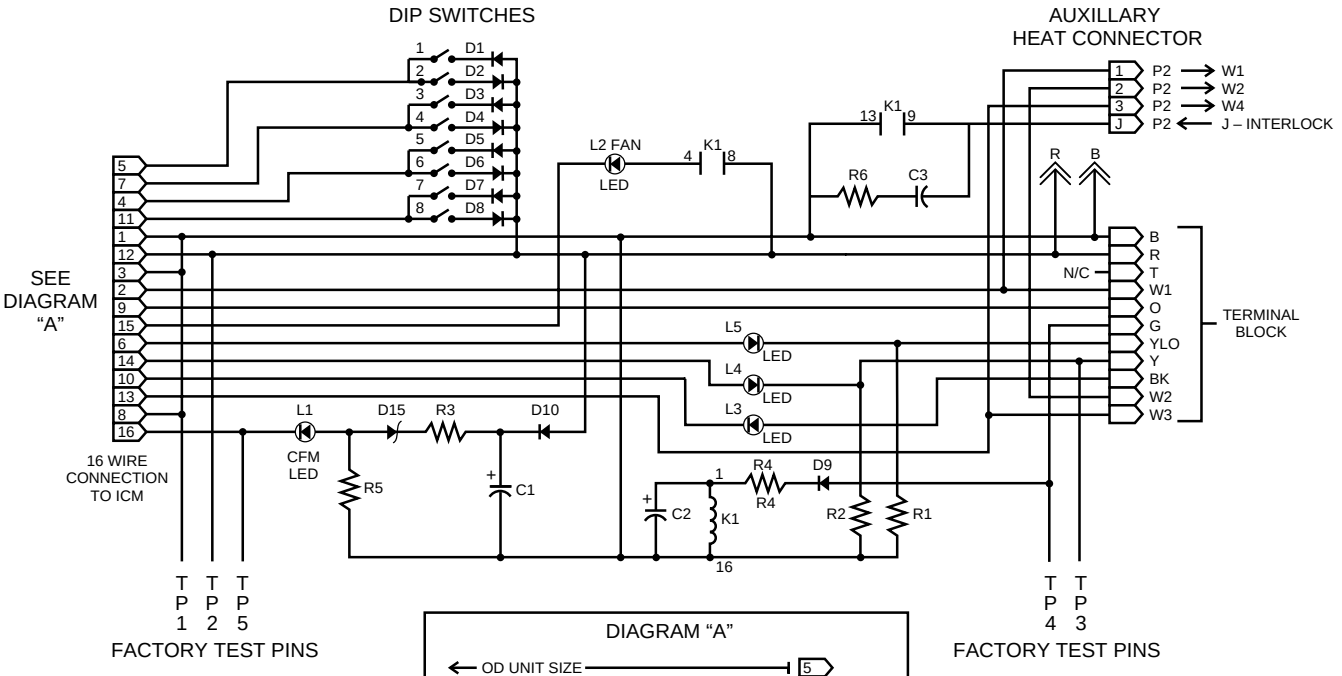


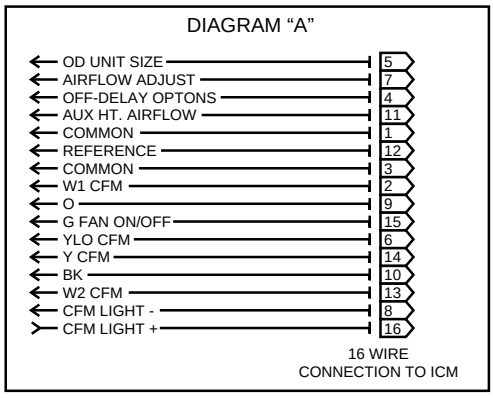




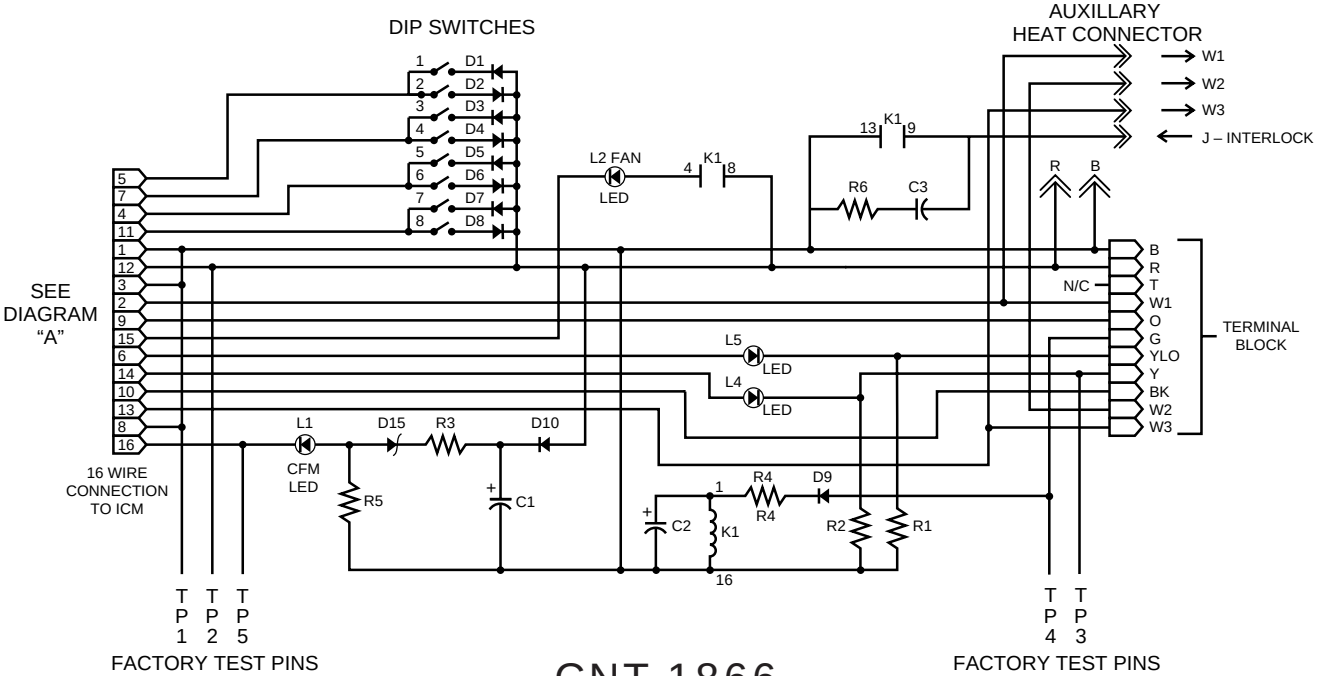
From Dwg 21B860551

AIR HANDLER MOTOR CONTROL BOARD SCHEMATIC
CNT 1538





From Dwg 21B800338



CNT 1866

PACKAGE UNIT MOTOR CONTROL BOARD SCHEMATIC
BRD 0986

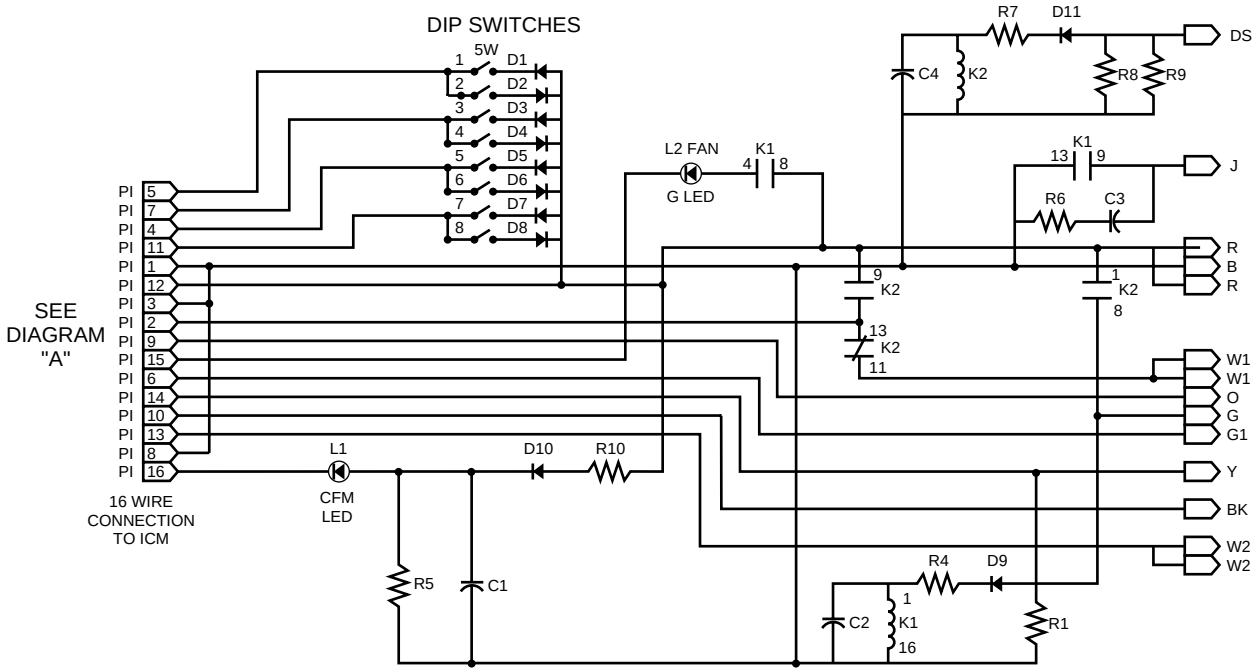


DIAGRAM "A"

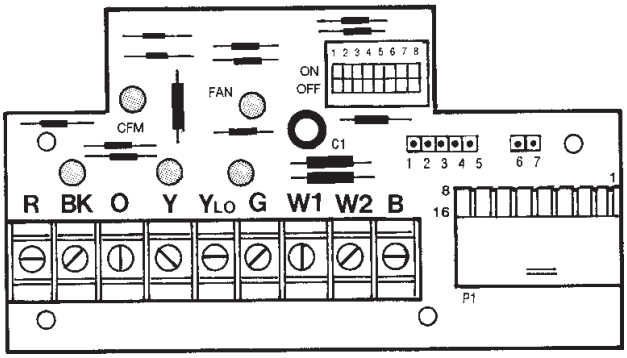
OD UNIT SIZE	PI 5
AIRFLOW ADJUST	PI 7
OFF-DELAY OPTONS	PI 4
AUX HT. AIRFLOW	PI 11
COMMON	PI 1
REFERENCE	PI 12
COMMON	PI 3
W1 CFM	PI 2
O	PI 9
G FAN ON/OFF	PI 15
Y G1 CFM	PI 6
Y CFM	PI 14
BK	PI 10
W2 CFM	PI 13
CFM LIGHT -	PI 8
CFM LIGHT +	PI 16

16 WIRE CONNECTION TO ICM

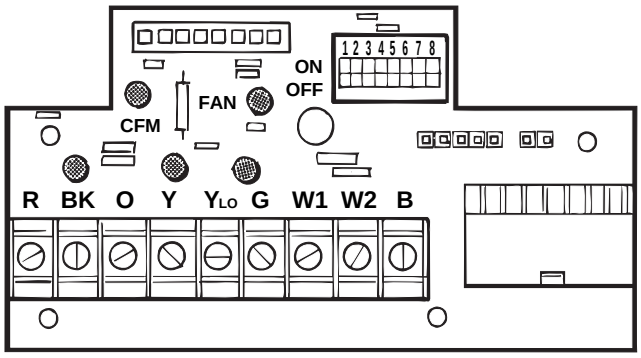
From Dwg 21B664167

ICM'S CANNOT BE TESTED UNLESS UNDER LOAD!

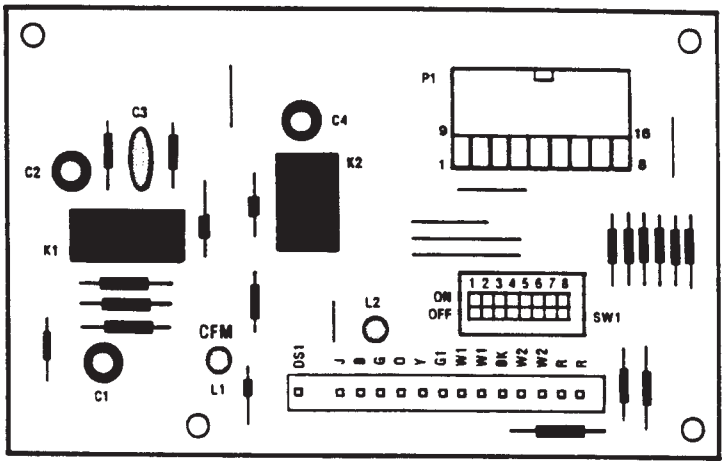
MOTOR CONTROL BOARDS



RETRO FIT KIT – CNT 1654

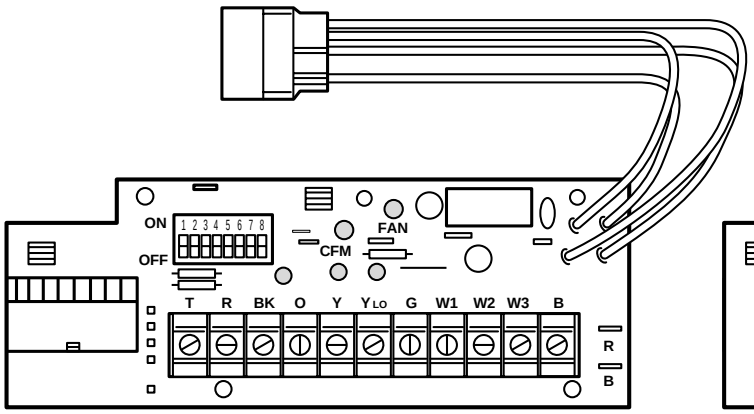


FURNACE – CNT 1537

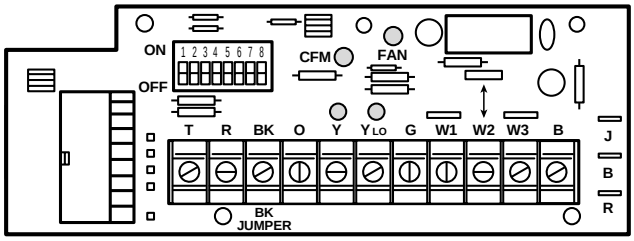


PACKAGE UNIT
BRD 0986

AIR HANDLER



CNT 1538



CNT 1866

ICM-2 QUICK CHECK

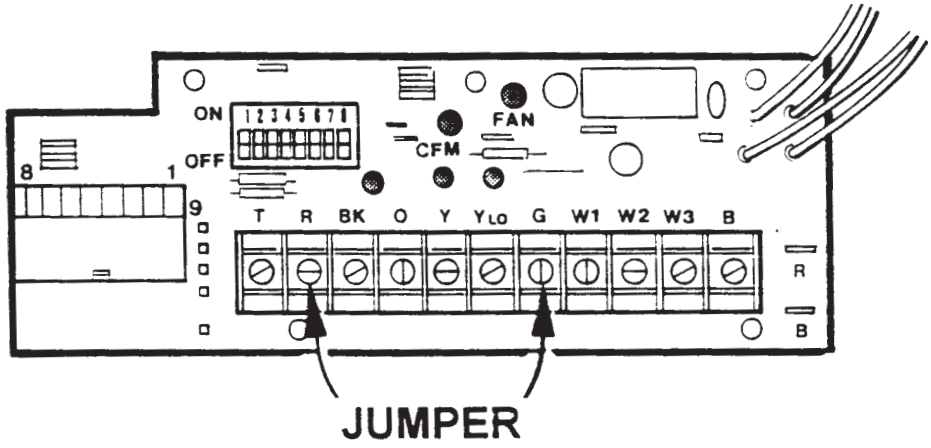
Blower Motor Will Not Run

1. Jumper 24 Volt A.C "R" Terminal to "G" terminal on the Low Voltage Terminal board.

Does motor run?

NO: Go to step #2.

YES: Motor runs, check thermostat and thermostat wire.

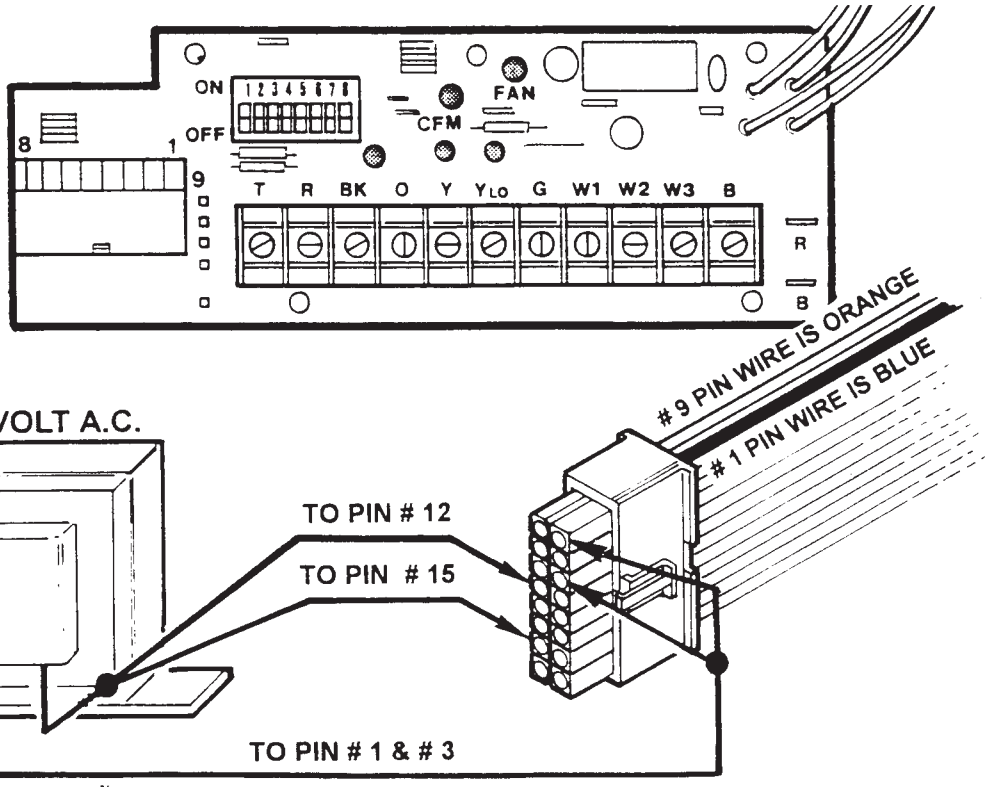


2. Unplug 16 wire low voltage harnass from the motor control board. Jumper 24 Volts A. C, to pins #12, #15 and common pins #1 and #3.

Does the motor run?

NO: Go to step #3.

YES: Replace the motor control board on Air handlers, or Package units.
On a furnace go to step #5.

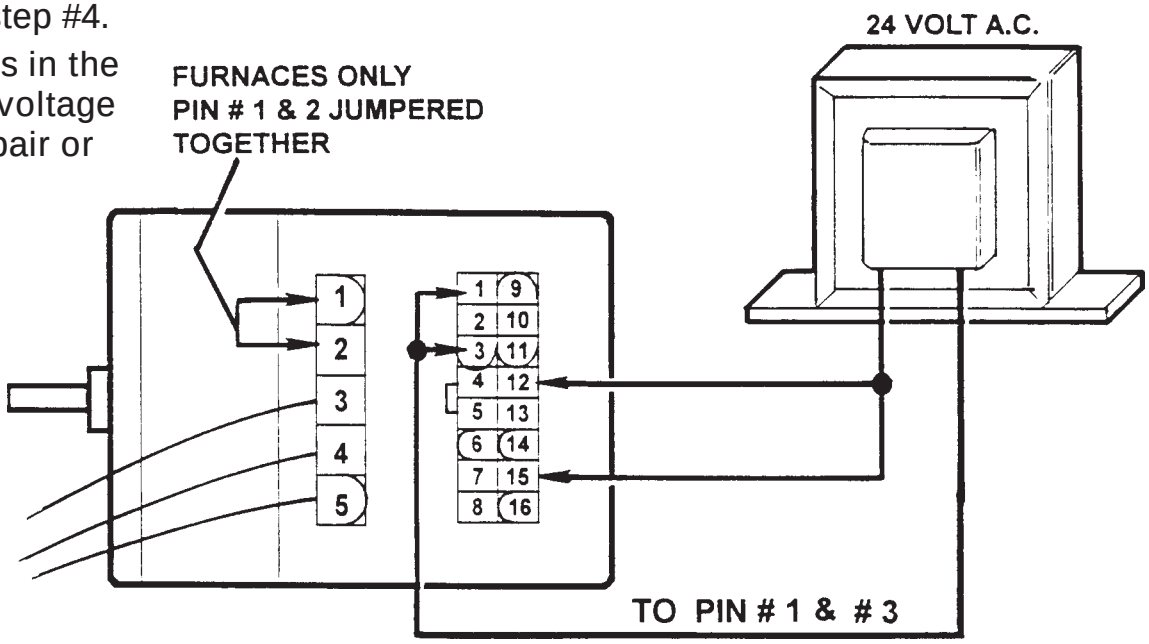


3. Unplug 16 wire low voltage harness from the motor. Jumper 24 Volts A.C. to motor low voltage plug pins #12 and #15 and pins #1 and #3 which are common.

Does motor run?

NO: Go to step #4.

YES: Fault is in the 16 wire low voltage harness. Repair or replace it.



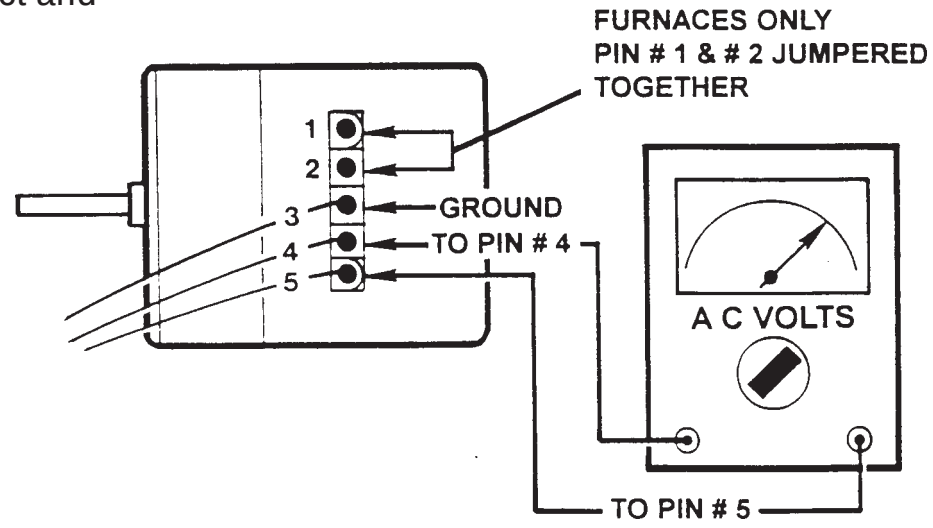
4. Is the line voltage to the motor high voltage power plug pin #4 and pin #5 correct?

Furnace ICM-2 motor correct voltage is 120 Volts A.C. and there must be a jumper wire in this plug between pins #1 and #2.

Air handler ICM-2 motor correct voltage is 220 volts A.C.

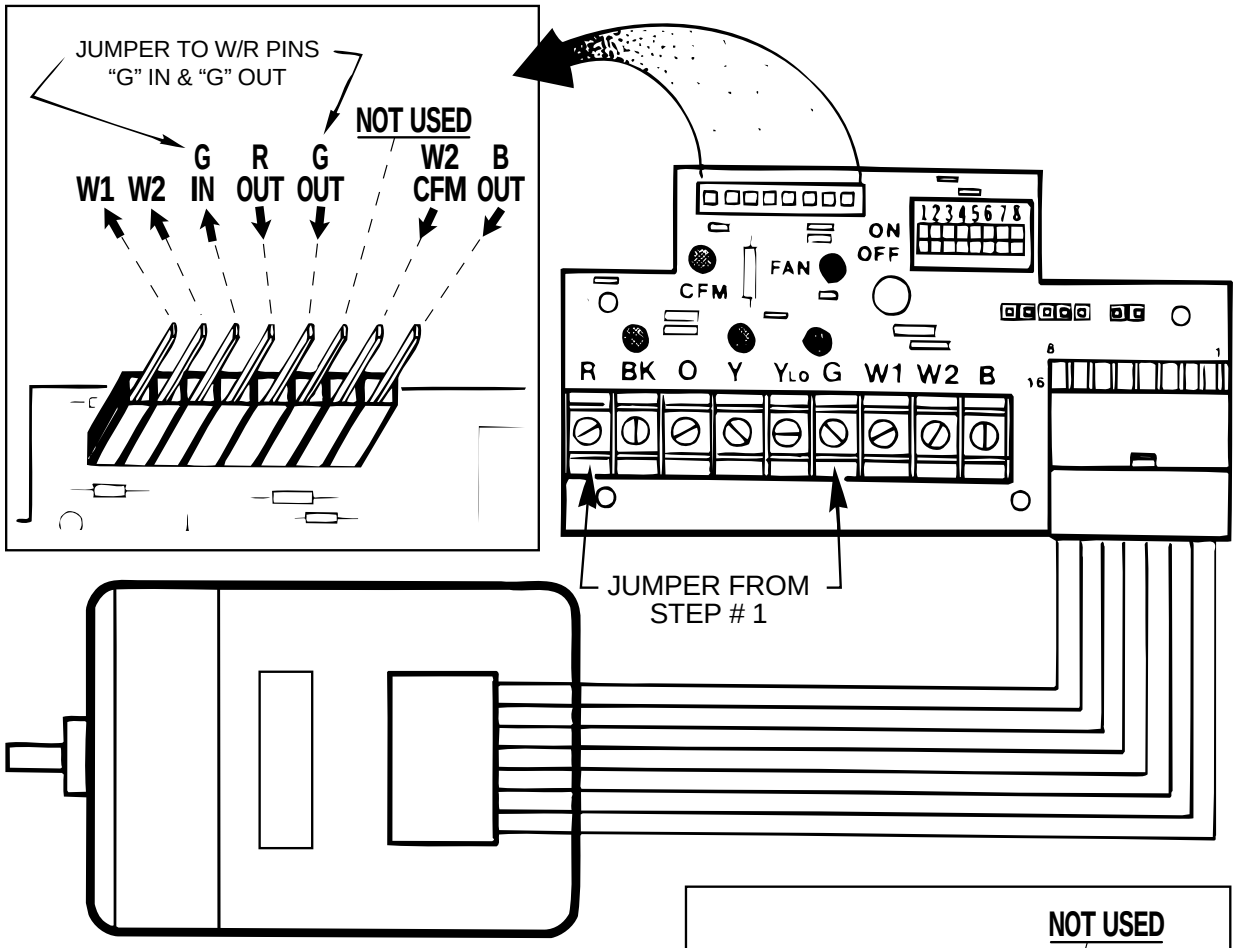
NO: Correct line voltage fault.

YES: Live voltage correct and motor will not run. Replace motor.

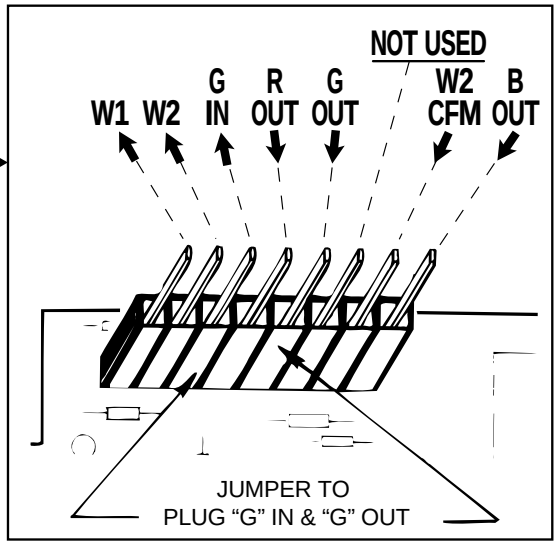


5. Plug the 16 wire low voltage harness from the motor back into the motor control board. Jumper "G" in pin to "G" out pin of the White-Rodgers module which plugs into the low voltage motor control board Does the motor run?

YES: Replace White-Rodgers ignition module.



NO: Move the jumper to the metal part of the low voltage motor control board plug. Does the motor run?



YES: White-Rodgers ignition module pins not making contact with motor control board plugs. Clean pins & plugs by unplugging and plugging board onto pins or replace both if necessary.

NO: Repair or replace the motor control board.

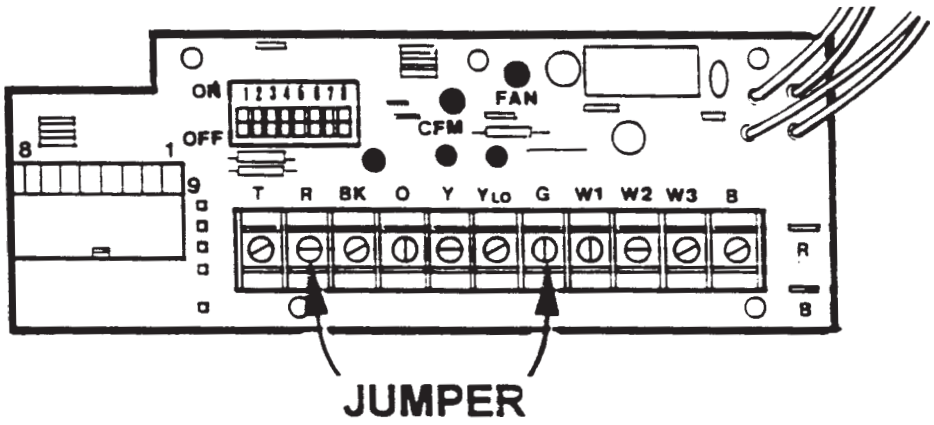
ICM-2
Blower Motor Will Not Run

1. Jumper "R" terminal to "G" on the motor control board

Is the Fan Red LED on?

NO: Go to step #2.

YES: Go to step #5.



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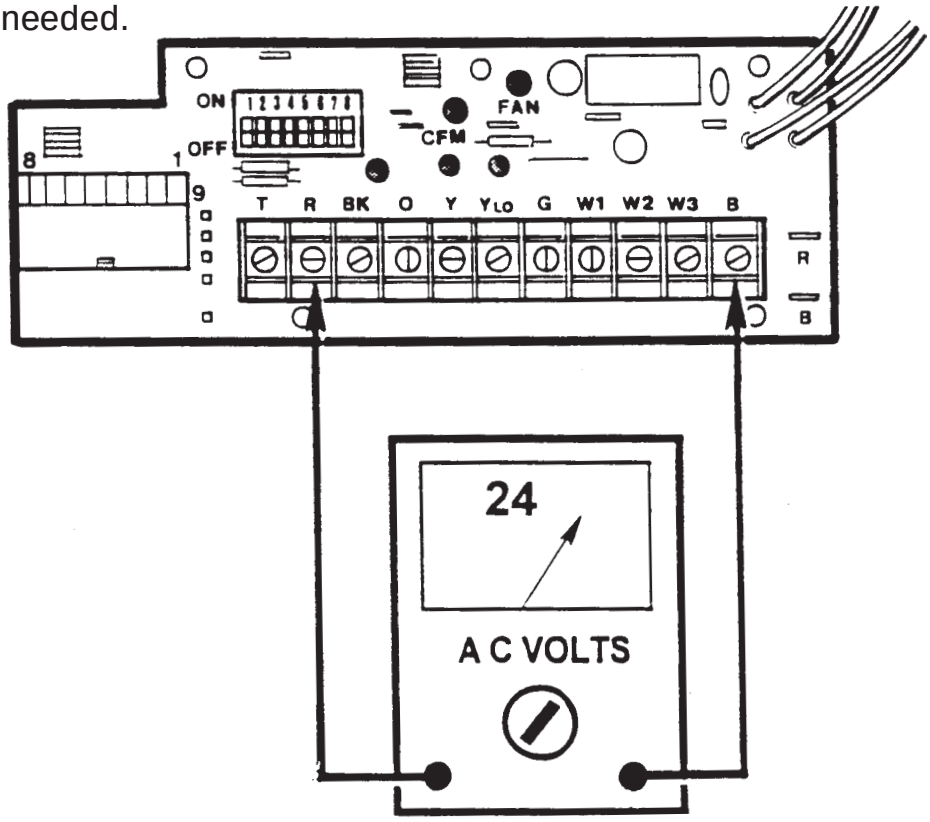
2. Is there 24 V.A.C. between terminal "R" and "B" on the motor control board?

NO: Check and repair as needed. Power to transformer, or transformer or fuse.

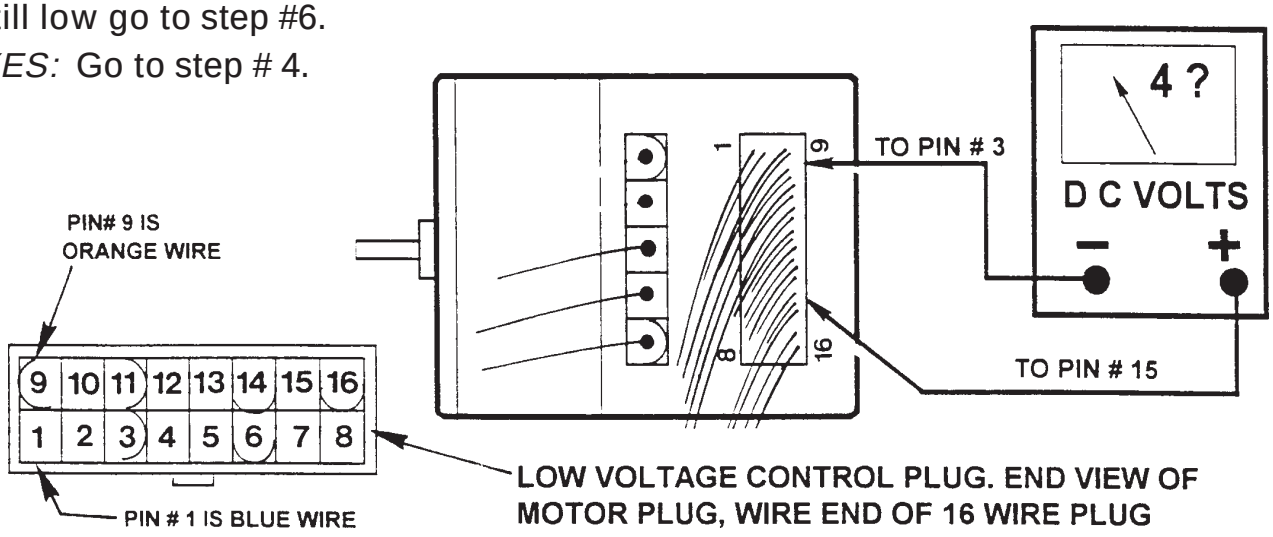
YES: Go to step #3.



3. Is there 4.0 Volts D.C. at the motor low voltage control plug pin #15, G Fan On/Off, and pin #3 common? If 7 to 8 Volts D.C. is read, check these low voltage control plug connections at the motor, if connections are O.K. replace motor. "R" terminal to "G" still jumpered from step #1.

NO: Go to step #6 if 0 volts is read. If voltage is low, less than 3 volts D.C., unplug low voltage control plug from the motor and again read the voltage between pin #15 and pin #3. If voltage now is 7 to 8 volts D.C., replace the motor, if Voltage is still low go to step #6.

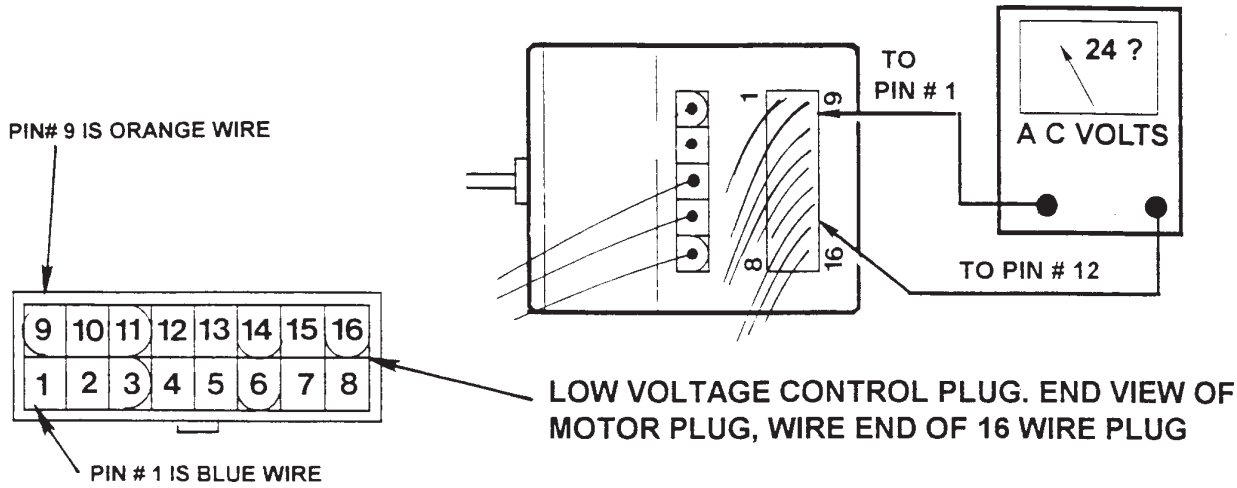
YES: Go to step # 4.



4. Is there 24 Volts A.C. at the motor low voltage control pin #12, R timing reference and pin #1 common.

NO: Check for 24 Volts A.C. at the other end of the low voltage control wire harness at the motor control board plug at pins #12, R timer reference and pin #1 common. If voltage is not present, replace motor control board, if 24 Volts A.C. is present at this end of the harness fault is with the harness, repair or replace.

YES: Go to step #5.

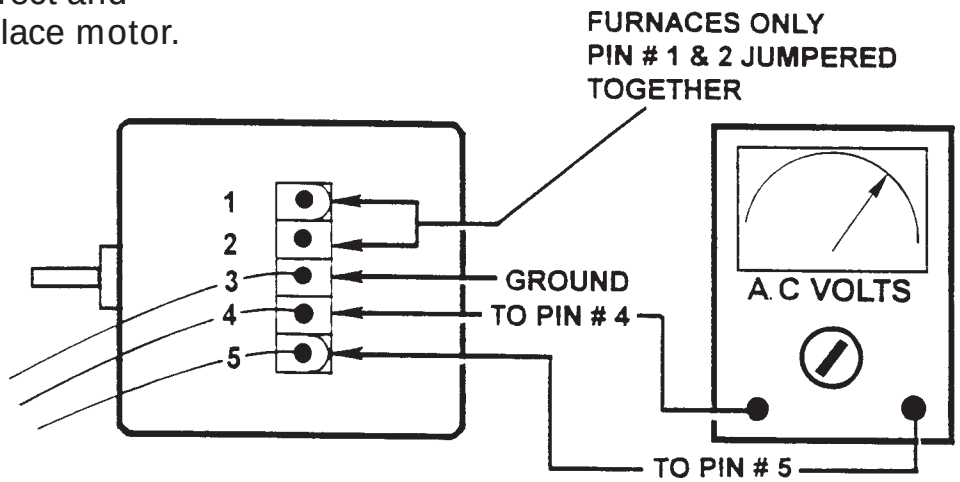


5. Is the line voltage to the motor high voltage power plug pin #4 and pin #5. correct?

Furnace ICM-2 motor correct voltage is 120 Volts A.C. and there must be a jumper wire in this plug between pins #1 and #2, Air handler ICM2 motor correct voltage is 220 Volts A.C.

NO: Correct line voltage fault.

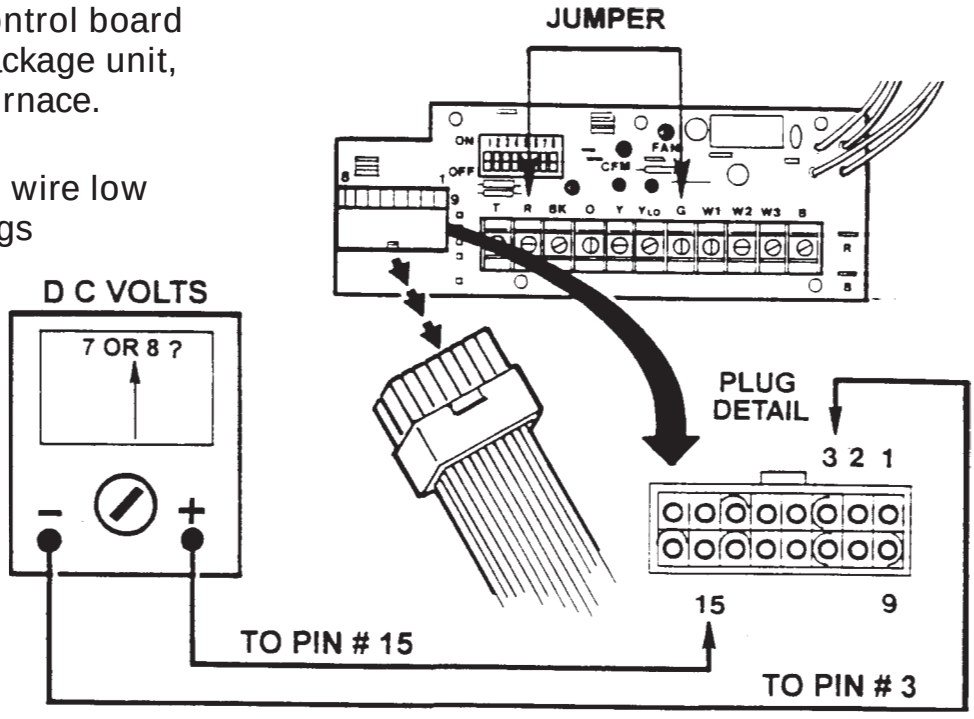
YES: Line voltage correct and motor will not run, replace motor.



6. Unplug the 16 wire low voltage harness from the motor control board. Is there 7 to 8 Volts D.C. at the motor control board plug between pin #15, G fan On/Off and pin #3 common? "R" terminal to "G" terminal still jumpered from step #1.

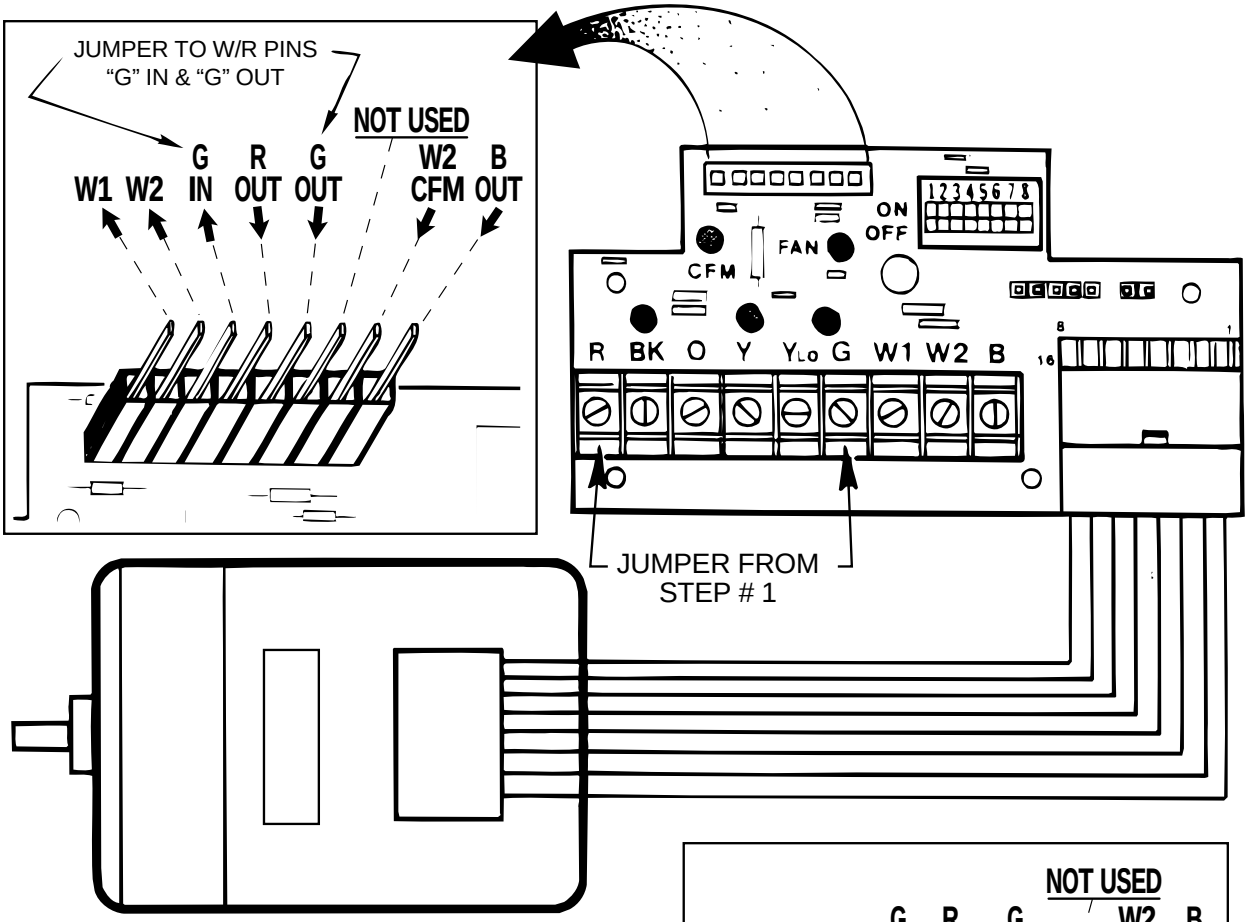
NO: Replace motor control board on an air handler or package unit, if trouble shooting a furnace. Go to step #7.

YES: Fault is in the 16 wire low voltage harness or plugs pin #15 or #3.

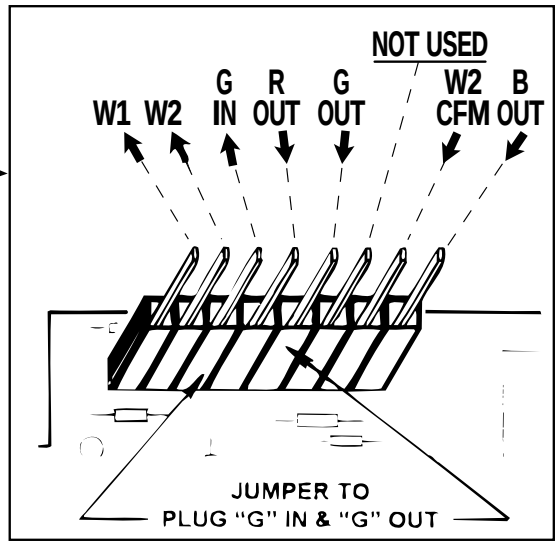


7. Plug the 16 wire low voltage harness from the motor back into the motor control board. Jumper "G" in pin to "G" out pin of the White-Rodgers module which plugs into the low voltage motor control board. Does the motor run?

YES: Replace White-Rodgers ignition module.



NO: Move the jumper to the metal part of the low voltage motor control board plug. Does the motor run?



YES: White-Rodgers ignition module pins not making contact with motor control board plugs. Clean pins and plugs by unplugging and plugging board onto pins or replace both if necessary.

NO: Leave this jumper in place and go back to step #6. If correct voltage is still not present repair or replace motor control board. If correct voltage is now read, fault is in 16 wire low voltage harness.

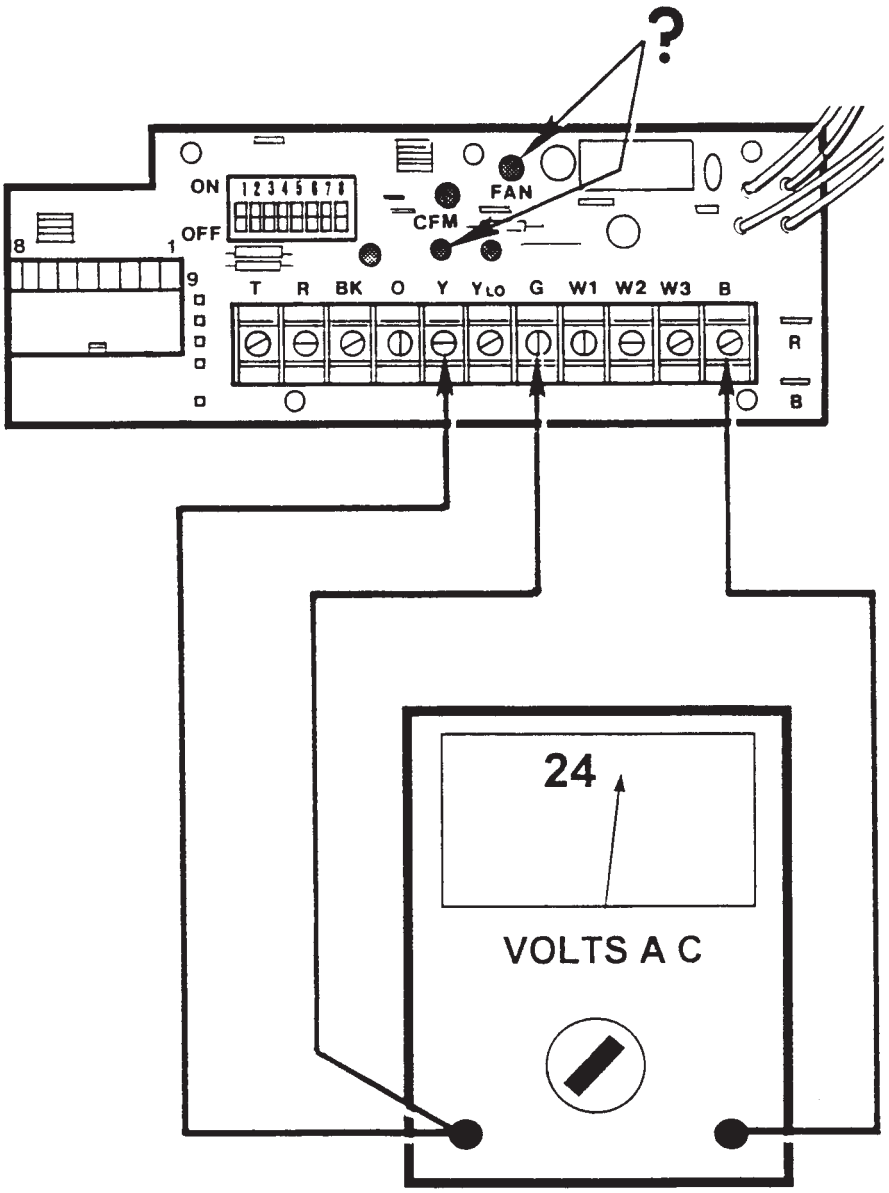
ICM-2

Correct Cooling Air Flow Can Not Be Obtained, Green CFM L.E.D. Will Not Flash The Correct Number Of Times Programmed. Ramped (Enhanced) Cycle Turned Off Or Has Timed Out.

1. Is there 24 Volts A.C. between terminals "B" and "G" and "B" and "Y" at the low voltage motor control board terminals? The red fan L.E.D. and red "Y" L.E.D. should be on. Package units do not have a "Y" L.E.D.

YES: Go to step #2 if the red "Y" L.E.D. is on. If the red "Y" L.E.D. is not on, go to step #6. Package units go to step #3.

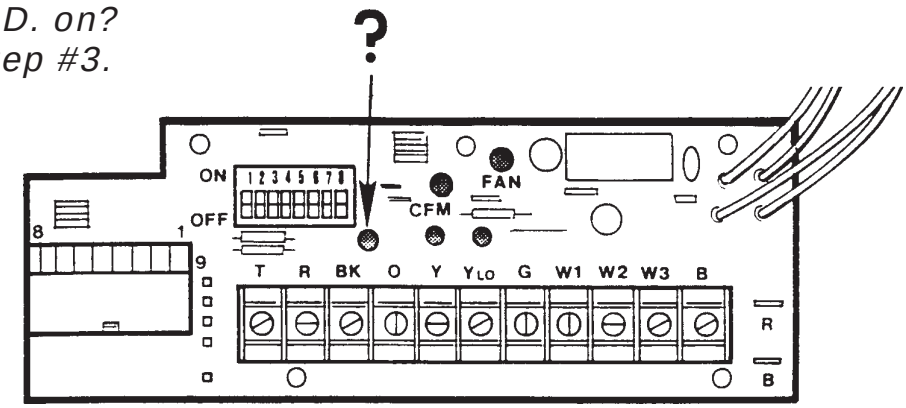
NO: Fault is in the thermostat or thermostat wires.



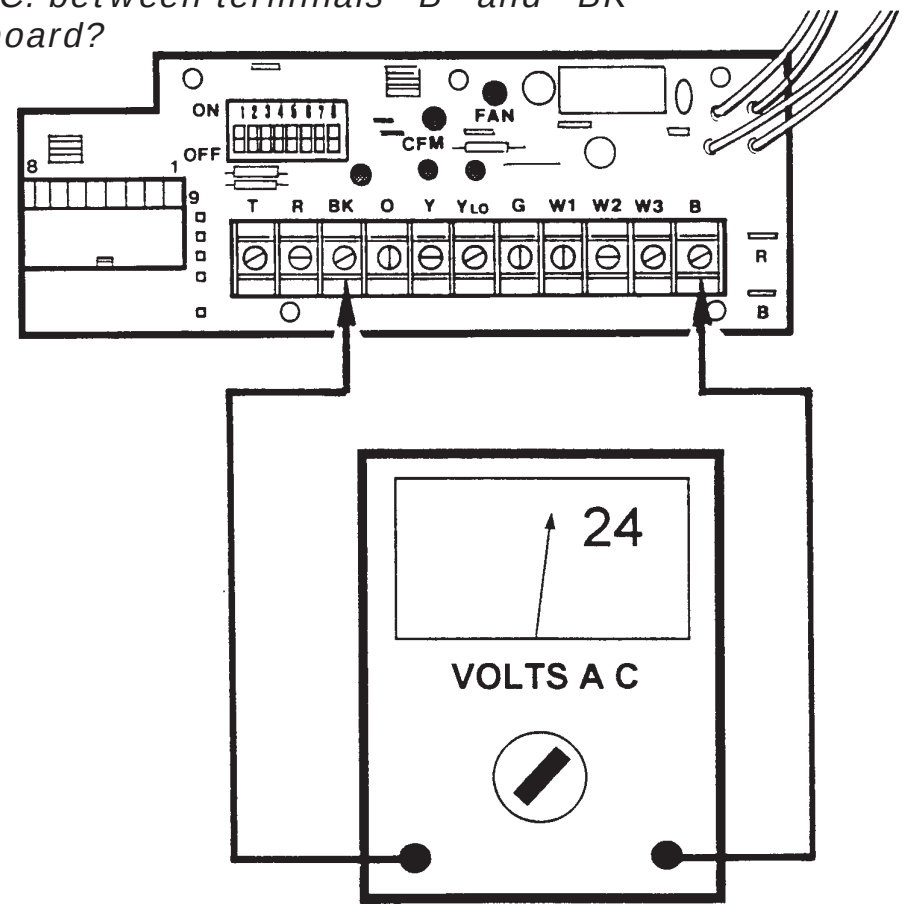
2. Is the red "BK" L.E.D. on? Package units go to step #3.

YES: Go to #5.

NO: Go to #3.



3. Is there 24 Volts A.C. between terminals "B" and "BK" at the motor control board?



YES: Go to step #4. If Humidistat operation or the ramped cycle does not work read #2 NO.

NO: If a humidistat is installed it's switch or it's wire is open and the cooling air flow will be reduced by 20%. If the outdoor unit is an air conditioner a jumper must be installed between "Y" and "O" terminals at the motor control board for humidistat or ramped cycle operation. Heat pump installation "O" from the thermostat must be connected to "O" terminal on the motor control board for humidistat or ramped cycle operation. If a humidistat is not installed a jumper must be installed between "R" and "BK" terminal at the motor control board.

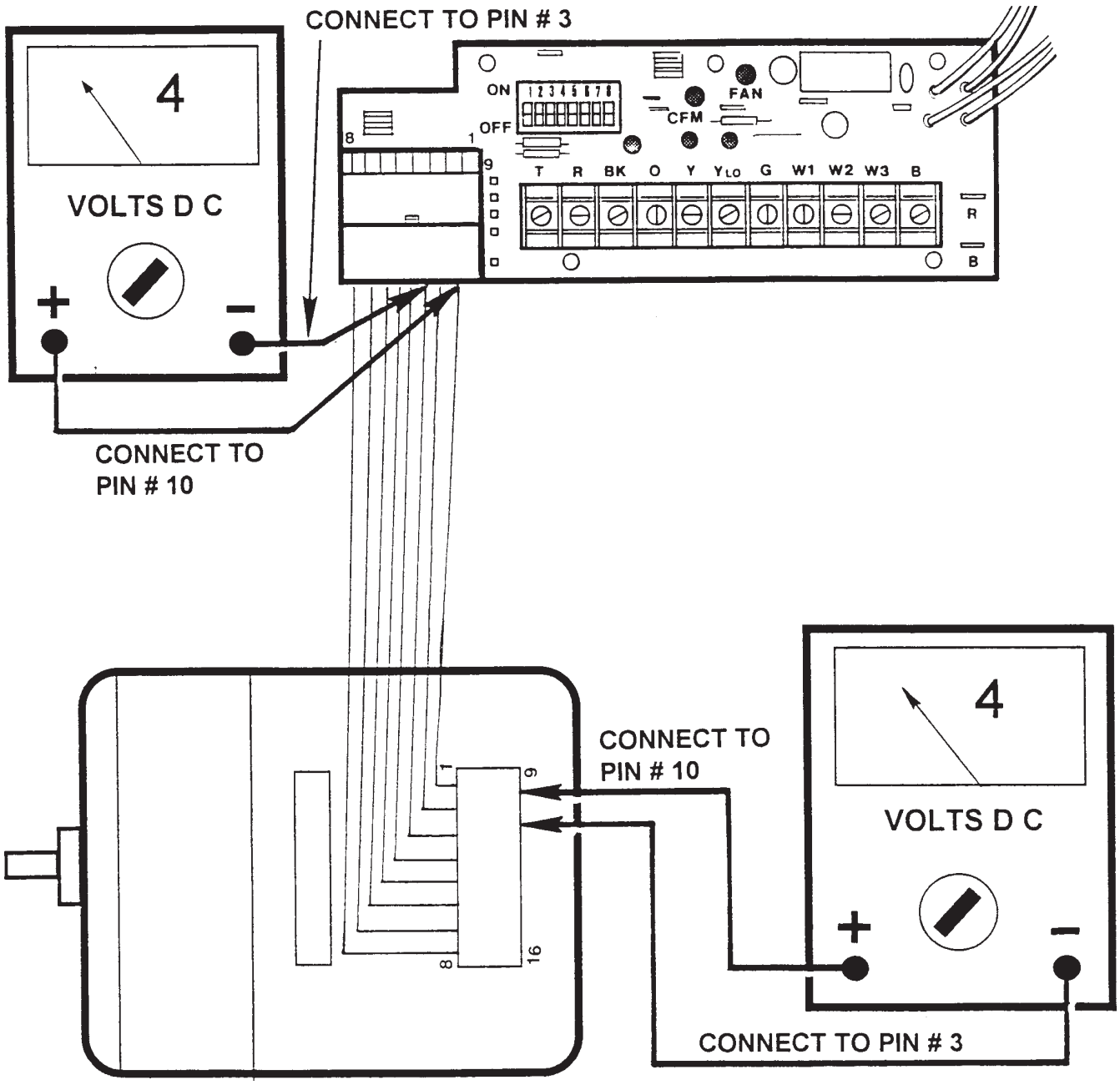
4. Is there +4 Volts D.C. between the motor low voltage control plug pin #10 humidistat input and pin #3 common?

YES: If air flow is low, go to step #6. If air flow is high (CFM will not go down when humidistat opens) or ramped cycle will not work, go to step #5.

NO: Is there +4 volts between the motor control board low voltage plug pin #10 and pin #3?

YES: Fault is in the 16 wire low voltage harness, repair or replace.

NO: Fault is in the motor control board, repair or replace the board.



5. Is there 24 Volts A.C. between the motor low voltage control plug pin #9 (Humidistat or ramp cycle enable) and pin #3 common?

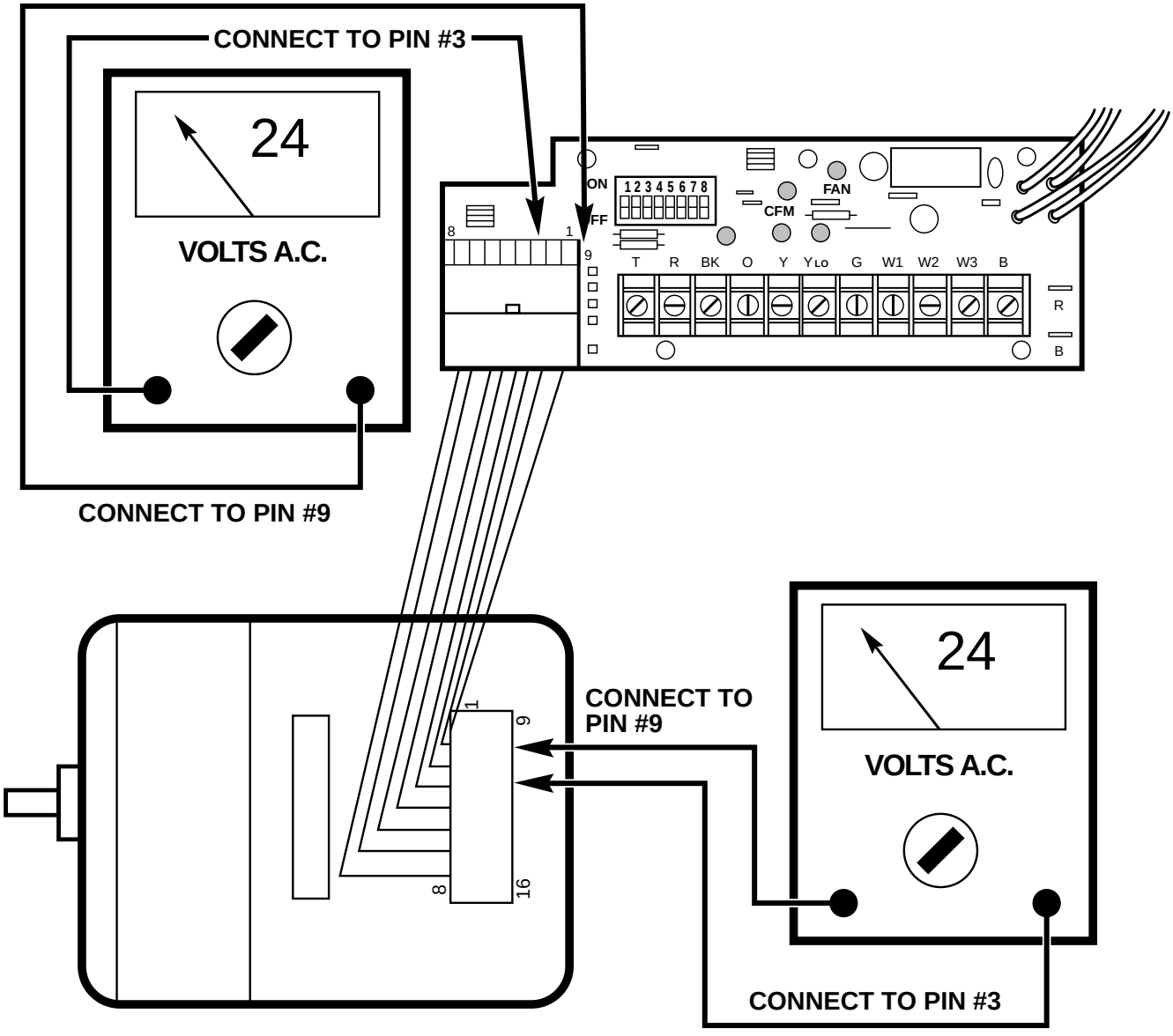
A Package Gas Electric unit: The voltage must be 0 volts A.C. at pin #9, for Humidistat or Ramp cycle operation. Air Handler manufactured after 6-1994 will not need 24 VOLT A.C. at pin #9 for ramp cycle enable.

YES: If air flow, CFM, will not go down any when humidistat opens or ramped cycle will not work, and motor low voltage control plug is clean and tight fitting, replace the motor. If air flow, CFM, is incorrect, go to step #6.

NO: Is there 24 volts A.C. between the motor control board low voltage plug pin #9 and pin #3?

YES: Fault is in the 16 wire low voltage harness, repair or replace.

NO: Fault is in the motor control board, repair or replace.



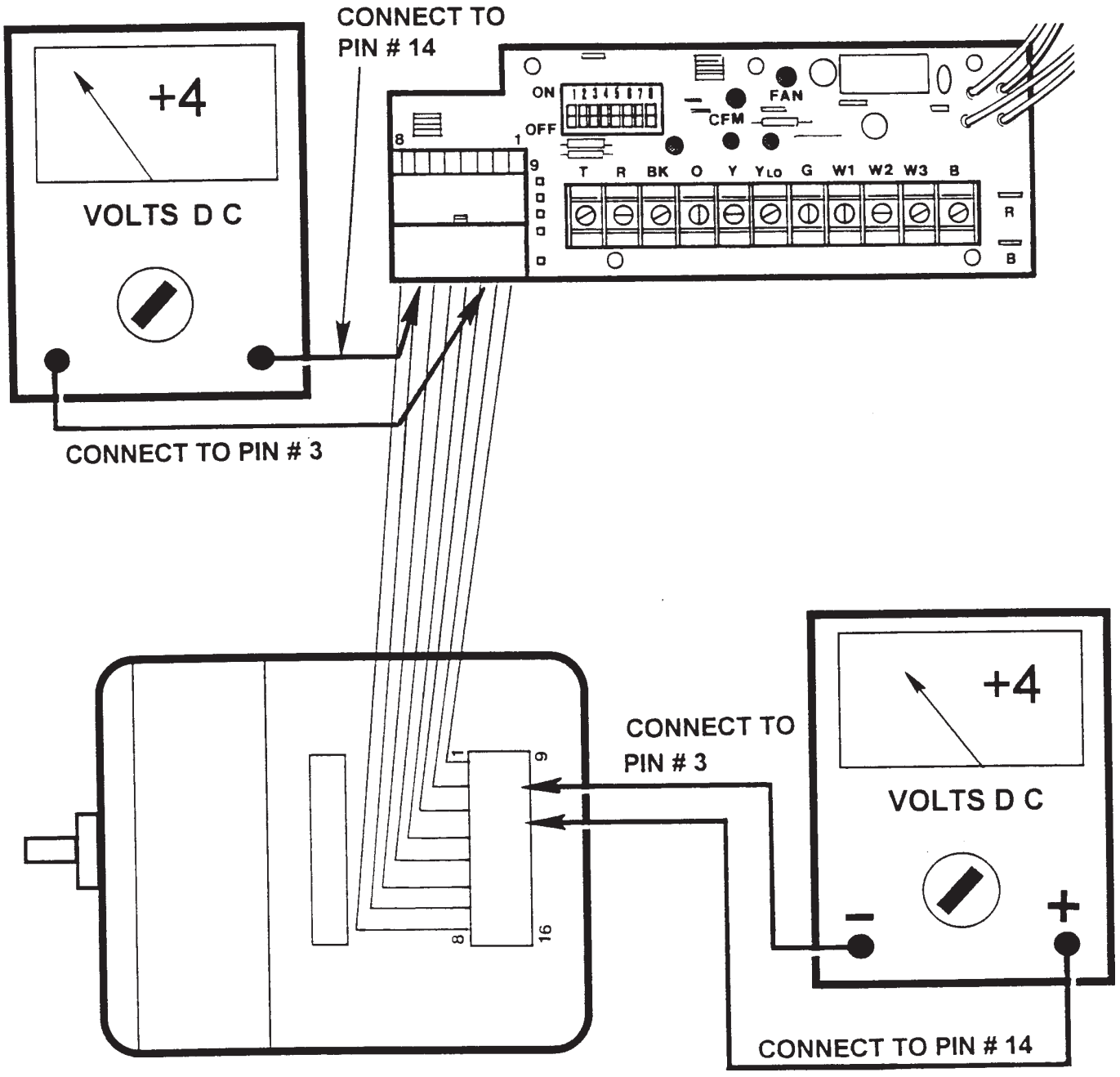
6. Is there +4 Volts D.C. between the motor low voltage control plug pin # 14 (cooling blower speed and pin #3 common?

YES: Go to step #7.

NO: Is there +4 Volts D C between the motor control board low voltage plug pin #14 and pin #3?

YES: Fault is in the 16 wire low voltage harness, repair or replace.

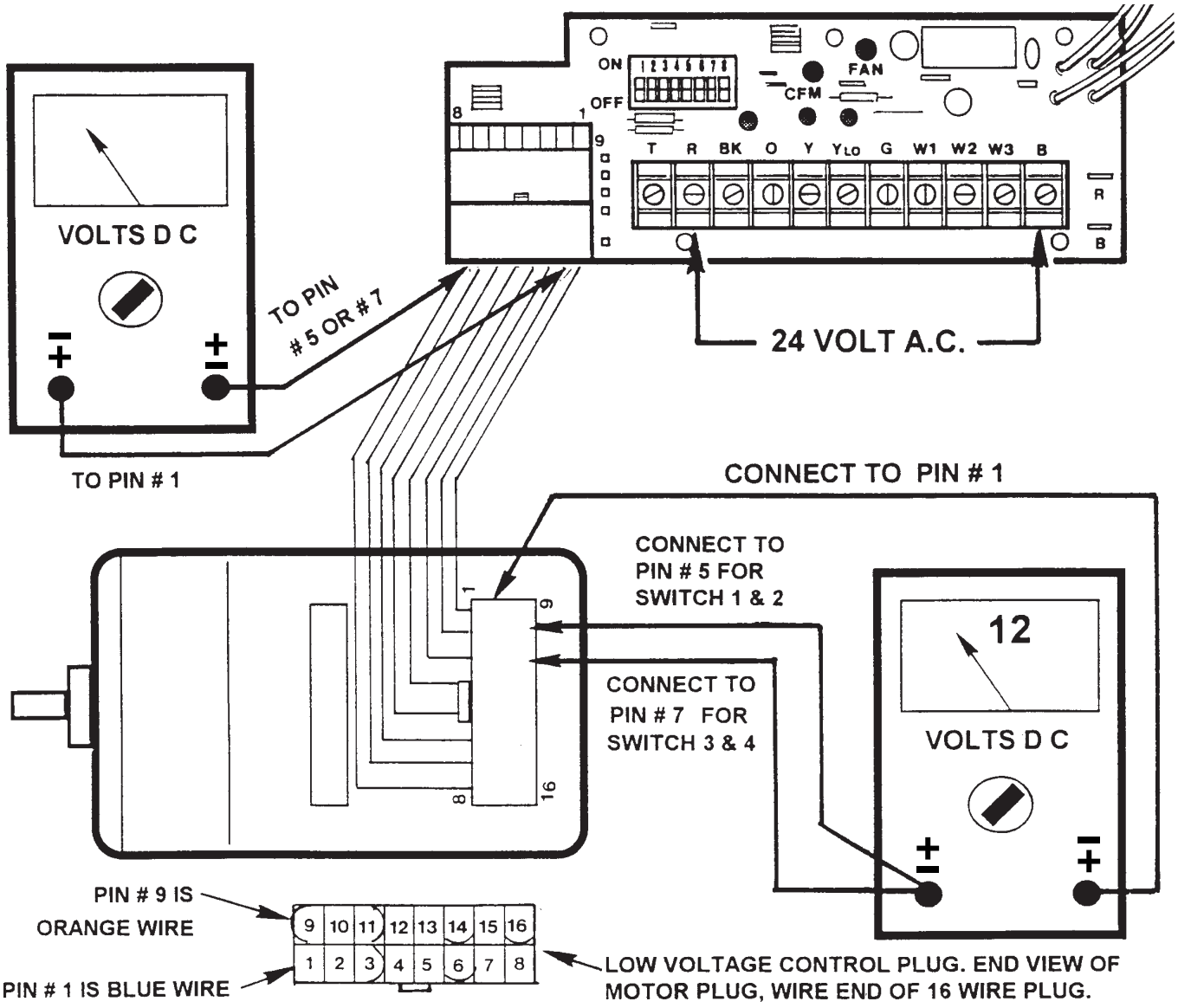
NO: Fault is in the motor control board, repair or replace.



Cooling Air Flow

7. Cooling air flow is programmed by dip switches number 1, 2, 3 and 4. Dip switches number 1 and 2 are used to program the tonnage and are connected to the motor by wire #5. Dip switches number 3 and 4 are used to set the CFM per ton and are connected to the motor by wire #7. 24 Volt A.C. must be present at the motor control board terminals "R" and "B" for this test. Turn one switch on at a time and then off. If the correct voltage cannot be read at the low voltage motor control plug, then check for voltage out of the motor control board. If voltage is present at the output pins at the motor control board plug, fault is in the 16 wire low voltage control harness. If no voltage can be read at the output of the motor control board then the board is defective. If the voltages are correct at the low voltage motor control plug and the switches are set to their correct position and the green L.E.D. does not flash the required number of times go to step #8.

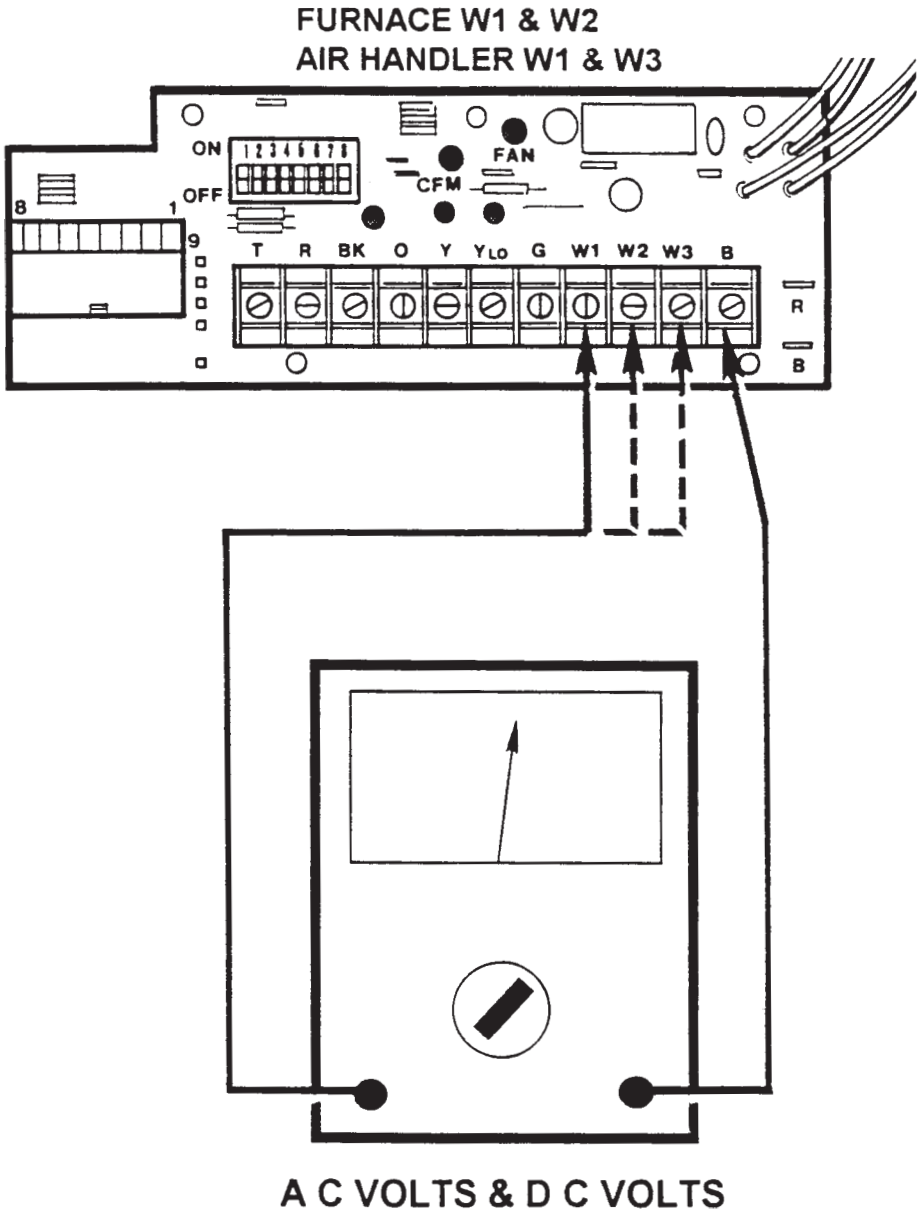
Switch #1 on +12 V.D.C. PIN #5
Switch #2 on –12 V.D.C. PIN #5
Switch #3 on +12 V.D.C. PIN #7
Switch #4 on –12 V.D.C. PIN #7



8. Is there any volfage, A.C. or D.C. present between terminal "B" and "W1" (W2 furnaces), (W 3 on air handlers) at the motor control board? If voltage is present, 1.5 volts or higher, the motor may be delivering the heating airflow. Air handlers and Package heat pumps ICM-2 motor will run at the highest air flow requested, if two or more air flows are being requested at the same time. A Furnace or Package Gas Electric unit the ICM-2 motor will run at the heating air flow requested, if two or more air flow are being requested at the same time.

YES: Fault is in the thermostat or thermostat wiring.

NO: Replace the motor.



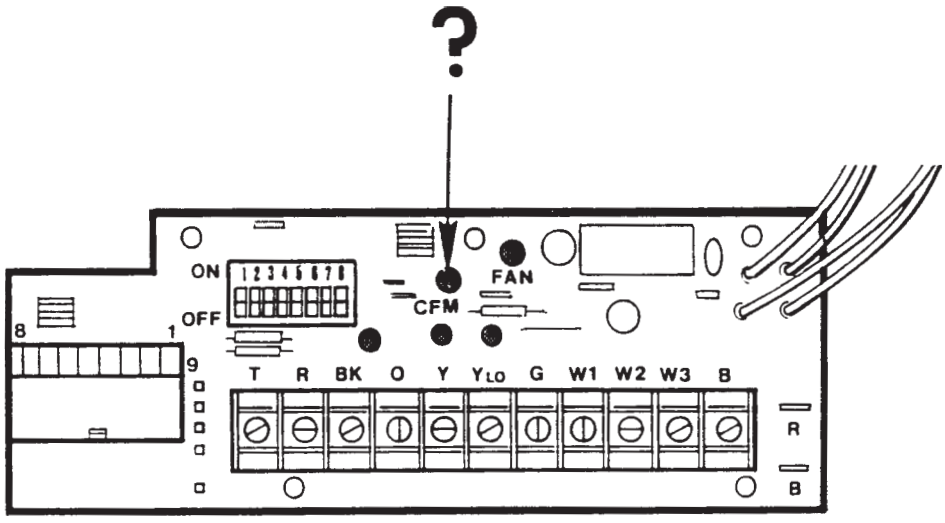
ICM-2

Correct Heating, W1 Or W2 Or W3 Airflow Cannot Be Obtained, Green L.E.D. Will Not Flash The Correct Number Of Times Programmed. The Ramped (Enhanced) Cycle Is Turned Off By The ICM-2 When Ever It Receives A Call On W1 Or W2 On A Furnace Or Package Gas Electric Or Heat Pump Unit Or A Call On W1 Or W3 On A Air Handler.

1. Is the Low heat CFM Green L.E.D. flash rate correct?

YES: Go to Step #2.

NO: Go to Step #3.

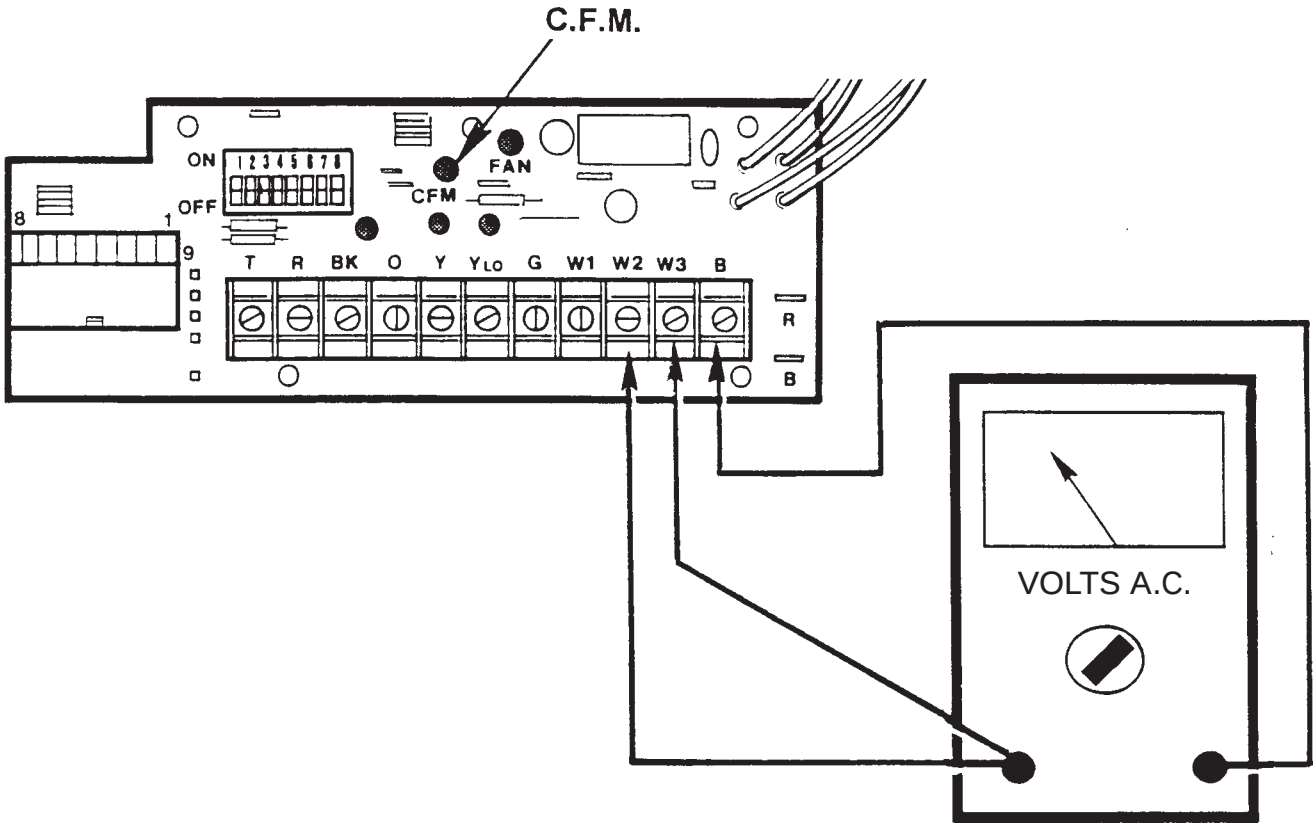


2. Is the High heat CFM Green L.E.D flash rate correct?

YES: If the Green CFM L.E.D. is flashing correctly but the motor is cutting off or airflow is low, check the total duct static. If total duct static is too high the motor may throttle back or cycle off.

NO: Is there 24 Volts V.A.C. between terminals "B" and W2, or W3 on an air handler, at the low voltage motor control board?

YES: Go to step #5.



NO: **AIR HANDLER**
FURNACE
PACKAGE HEAT PUMP

→ Fault is in the thermostat or thermostat wires.

PACKAGE GAS ELECTRIC: Check the indoor blower relay "F-HI" and the ignition control module for 24 Volts A C at it's terminal HI Voltage should be present at this terminal approximately 30 seconds after the burner has gone to high fire.

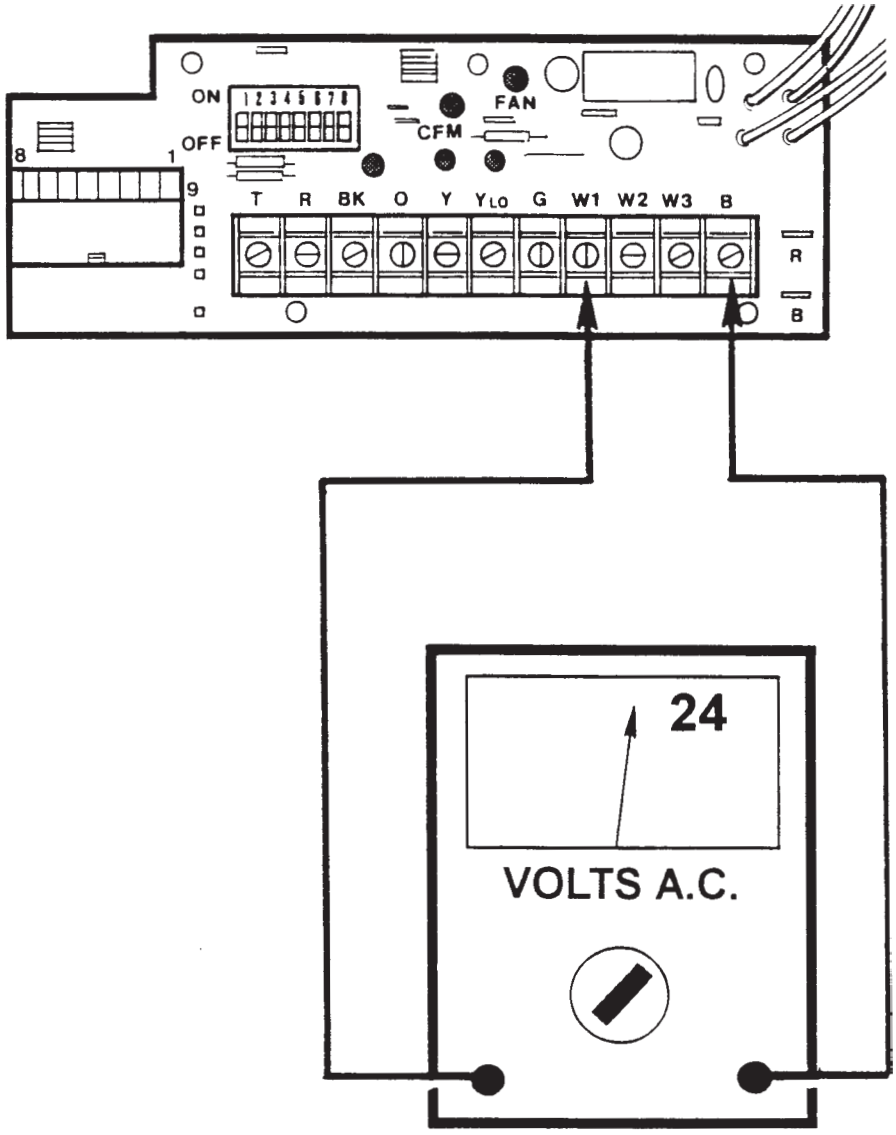
3. Is there 24 Volts A.C. between terminals "B" and "W1" at the low voltage motor control board?

YES: Go to step #4.

NO: **AIR HANDLERS**
FURNACE
PACKAGE HEAT PUMP

→ Fault is in the thermostat or thermostat wires.

PACKAGE GAS ELECTRIC: Check the indoor blower relay "F-LO" and the ignitor control module for 24 Volts A.C. at it's terminal LO. Voltage should be present at this terminal 45 seconds after ignition has been achieved.



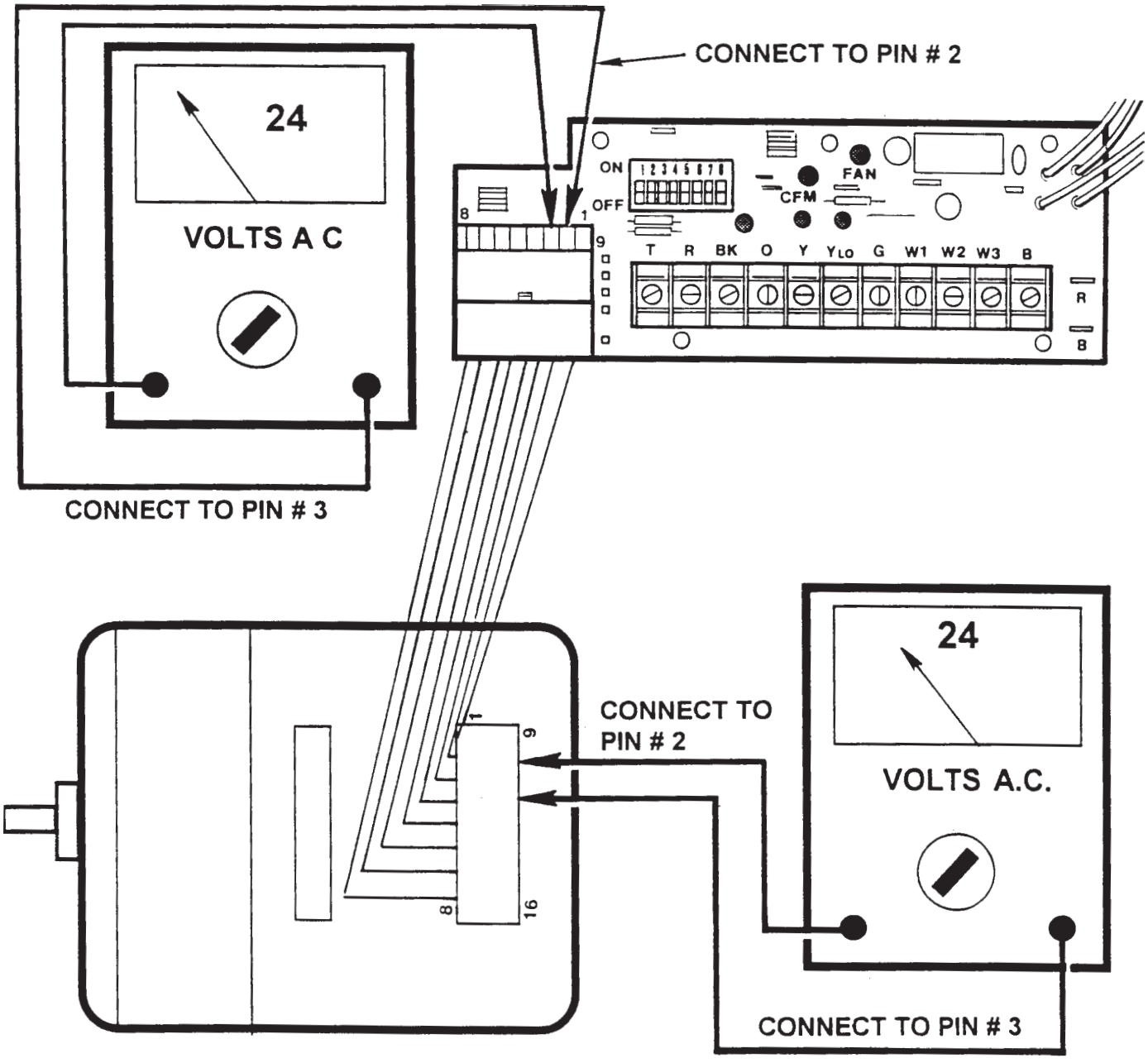
4. Is there 24 Volts A.C. between the motor low voltage control plug pin #2 (Low heat blower speed) and pin #3 common?

YES: Go to step #2 if problem is with high heat airflow. If problem is with low heat airflow, go to step #6.

NO: Is there 24 Volts A.C. between the motor control board low voltage plug pin #2 and pin #3?

YES: Fault is in the 16 wire low voltage harness, repair or replace.

NO: Fault is in the motor control board, repair or replace.



5. Is their 24 Volt A.C. between the motor low voltage control plug pin #13 (high heat blower speed) and pin #1 common?

YES: *Go* to step #6.

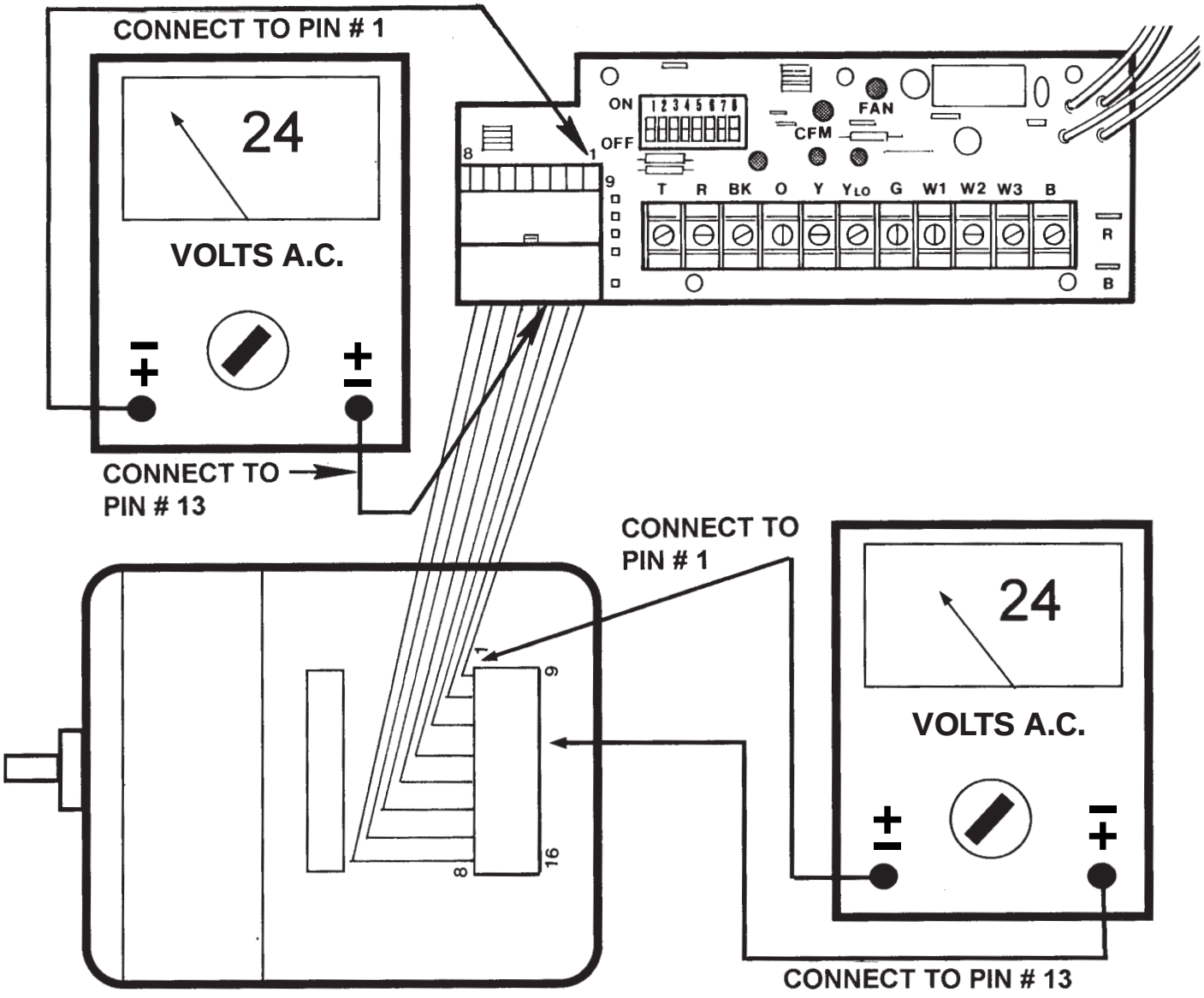
NO: Is there 24 Volts A.C. between the motor control board low voltage plug pin #13 and pin #1?

YES: Fault is in the 16 wire low voltage harness, repair or replace.

NO: **AIR HANDLER**
PACKAGE HEAT PUMP
PACKAGE GAS ELECTRIC

→ Fault is in the motor control board, repair or replace.

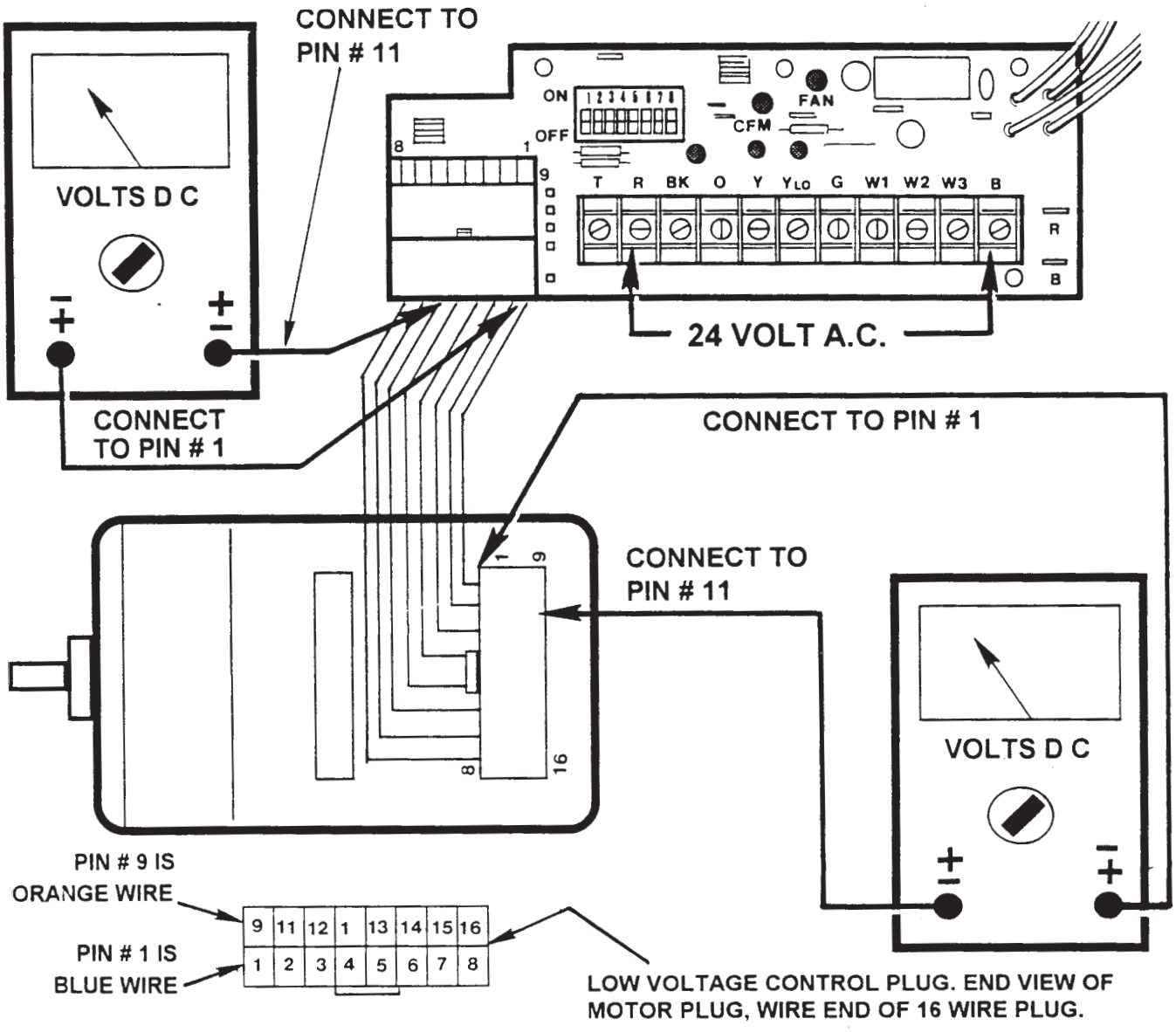
FURNACE: Go to step #8



6. Heating air flow is programmed by dip switches number 7 and 8. Dip switches number 7 and B are connected to the motor by wire #11. 24 Volt A.C. must be present at the motor control board terminals "R" and "B" for this test. Turn one switch on at a time and then off. If the correct voltage cannot be read at the low voltage motor control plug then check for voltage out of the motor control board. If voltage is present at the output pins at the motor control board plug, fault is in the 16 wire low voltage control harness. If no voltage can be read at the output of the motor control board then the board is defective. If the voltages are correct at the low voltage motor control plug and the switches are set to their correct position and the green L.E.D. does not flash the required number of times go to step #7.

Switch #7 on +12 V.D.C. PIN #11

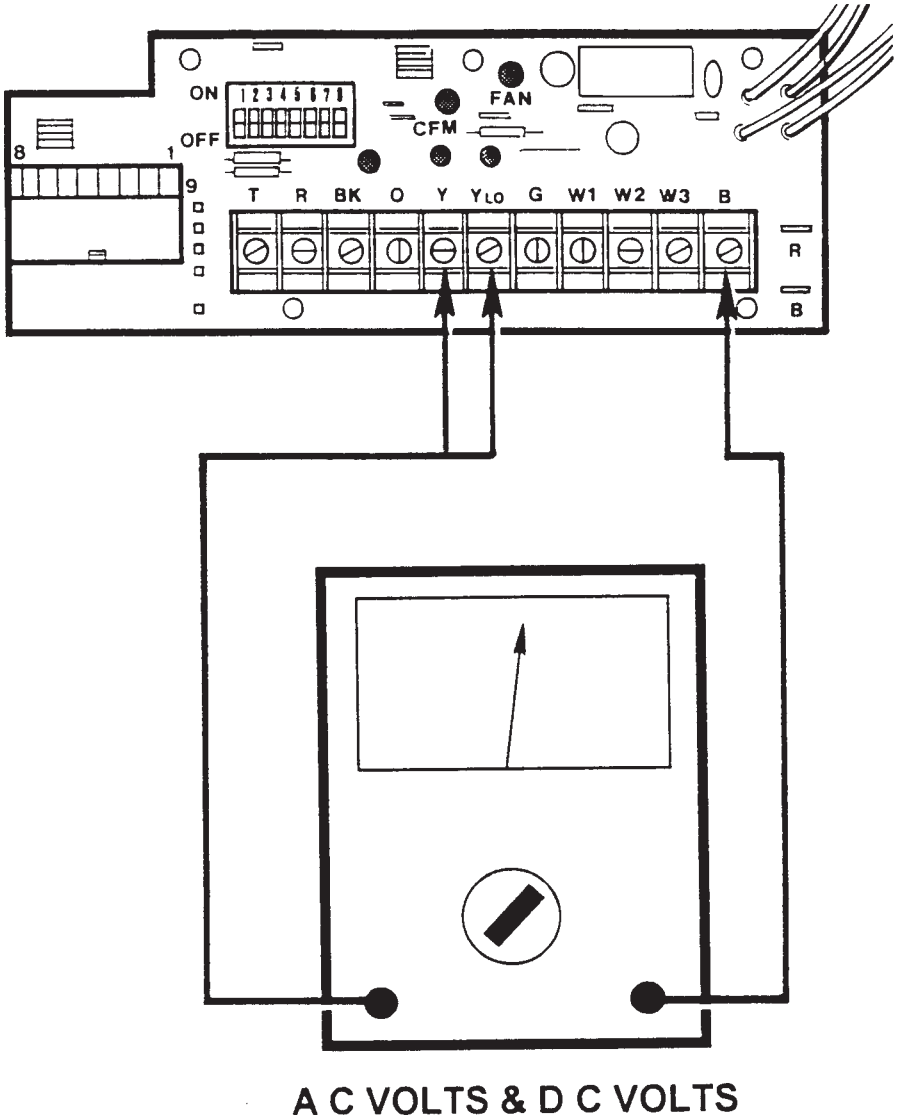
Switch #8 on –12 V.D.C. PIN #11



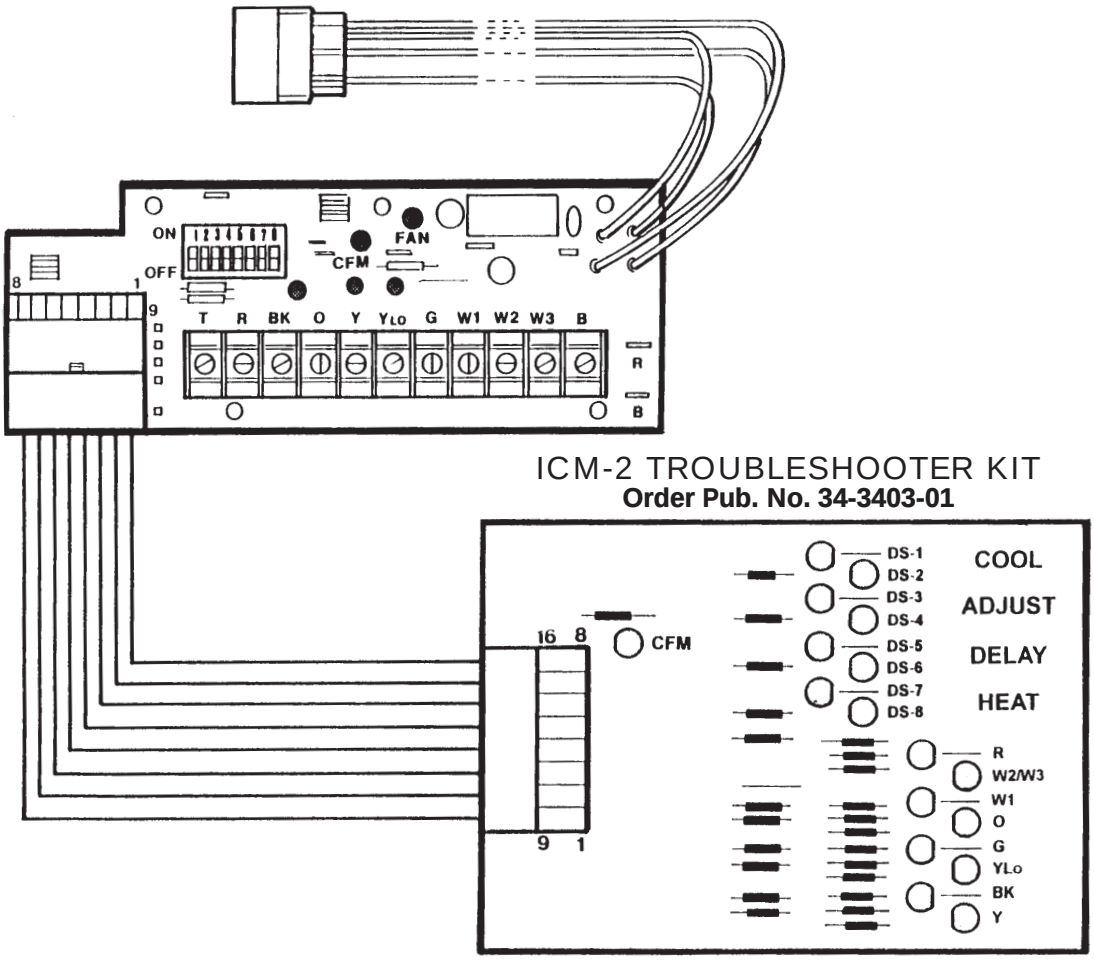
7. Is there any voltage, A.C. or D.C. present between terminal "B" and "YLO" "B" and "Y" at the motor control board? If voltage is present, 1.5 volts or higher, the motor may be delivering the cooling airflow. Air handlers and package heat pumps the ICM-2 motor will run at the highest air flow requested, if two or more air flow are being requested at the same time. A Furnace or Package Gas electric unit the ICM-2 motor will run at the highest heating air flow requested not the highest air flow requested if two or more air flow are being requested at the same time.

YES: Fault is in the thermostat or thermostat wiring.

NO: Replace the motor.



TROUBLESHOOTING ICM-2 MOTOR WITH TROUBLESHOOTING CIRCUIT BOARD AND 4 WIRE TEST CABLE



ICM-2 TROUBLESHOOTER KIT
Order Pub. No. 34-3403-01

Purpose: Verify proper signals are being received by the motor control board and are being sent to the ICM-2 Motor by the 16 wire low voltage motor harness.

1. Turn power off
2. Disconnect all low voltage field wiring, set all dip switches to "OFF."
3. Disconnect the 16-pin connector at the ICM-2 Motor. Plug in the "Troubleshooter" to the harness.
4. Turn on power.
5. The troubleshooter "R" L.E.D. on the board should be on.
6. If the troubleshooter "R" L.E.D. is not on, check for 24 volts A.C. at the motor control board.
7. If 24 volts A.C. is not present, troubleshoot and repair as needed.
8. If 24 volts A.C. is present, check the troubleshooter "R" L.E.D. and check continuity of the 16 wire cable, pin 1 to pin 1, through pin 16. If troubleshooter "R" L.E.D. is good and 16 wire cable pin #1 and pin #12 are good, repair or replace motor control board.
9. The green "C.F.M." L.E.D.'s should be flashing on the motor control board and troubleshooting board. If the green CFM L.E.D. on the motor control board does not flash, check the troubleshooter "CFM" L.E.D. and continuity of the 16 wire harness, pin #8 and #16. If troubleshooter "CFM" L.E.D. and harness are good, replace motor control board.

Dip Switch Operation

10. In order, turn on dip-switches 1 through 8, one at a time.

11. Verify that the corresponding L.E.D. on the troubleshooter is being turned on: Dip switch 1 on, L.E.D. DS-1 is on.

12. Turn off dip switches 1 through 8 and verify each LED goes off.

13. If the correct L.E.D.'s do not turn on and off in the proper sequence, check continuity of the 16 wire harness with ohmmeter: pin 1 goes to pin 1, pin 2 to pin 2, etc. through pin 16. If harness is good, replace motor control board. If harness is bad, repair or replace.

Low Voltage Thermostat Operation

14. Verify thermostat signals by jumping "R" to each of the low voltage terminal connections, on a package unit use the wire nut connectors, as follows: BK, O, Y YLO, G, W1, W2, W3. See exceptions below for air handlers, furnaces, package gas electric or retro fit motor control boards. The corresponding L.E.D. on the troubleshooter should light when "R" is applied. Verify L.E.D.'s on motor control board light according to the applied signal: BK, Y YLO, fan. If L.E.D. on motor control board does not light and 16 wire harness is good, replace board.

Furnace

W2 will not light W2 L.E.D. on the troubleshooter due to White-Rodgers ignition control's normally open switch.

Package Gas Electric Units

Package gas electric units L.E.D. W1 and W2 will not light due to the ignition control normally open switch. Jumper at the motor control board plug, pin W1 and W2, should cause L.E.D.'s on troubleshooter to light. If L.E.D. Y LO comes on when R to G is jumpered factory jumper 47B, G2 terminal to G terminal, has been connected. L.E.D. BK will come on when power is applied unless cooling humidistat is installed and it's switch is open.

Air Handler

Air handler W2 terminal board does not light L.E.D. W2 on the troubleshooter air handler – W3 terminal does.

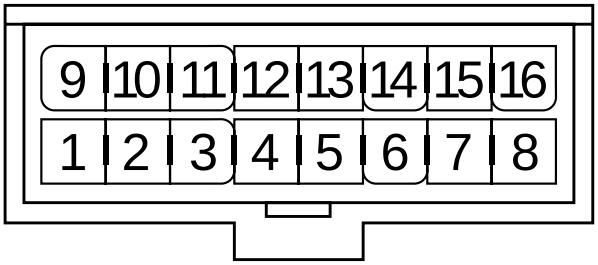
Retro Fit Motor Control Board

Retro fit motor control board W2 is not connected and will not light W2 on troubleshooter.

Package – Heat Pump or Cooling Units

If L.E.D. Y LO comes on when R to G is jumpered factory jumper 47B, G2 terminal to G terminal, has been connected. L.E.D. BK will come on when power is applied unless cooling humidistat is installed and it's switch is open.

To Check Troubleshooter L.E.D.s



End view of Socket on Troubleshooter

Jumper 24 Volts A.C. to the following Pin Numbers:

To Test L.E.D. No.	Jumper 24 V.A.C. To Pin No & Pin No.		Operation
DS-1 DS-2	5	1	Both L.E.D. ON
DS-3 DS-4	7	1	Both L.E.D. ON
DS-5 DS-6	4	1	Both L.E.D. ON
DS-7 DS-8	11	1	Both L.E.D. ON
R	12	1	R L.E.D. ON
W2/W3	13	1	W2/W3 L.E.D. ON
W1	2	3	W1 L.E.D. ON
O	9	3	O L.E.D. ON
G	15	3	G L.E.D. ON
YLO	6	3	YLO L.E.D. ON
BK Y	10 14	3 3	BK L.E.D. ON Y L.E.D. ON
CFM	16	8	CFM L.E.D. Flash ON/OFF

TROUBLESHOOTING WITH "4 – WIRE TEST" CABLE – GO/NO GO

1. Disconnect power to unit.

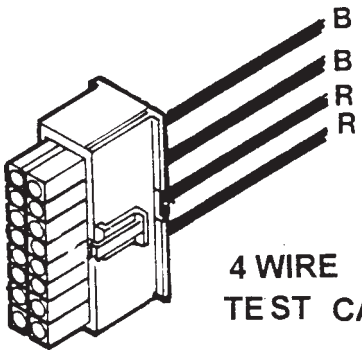
2. Remove 16 pin connection from ICM-2 motor.

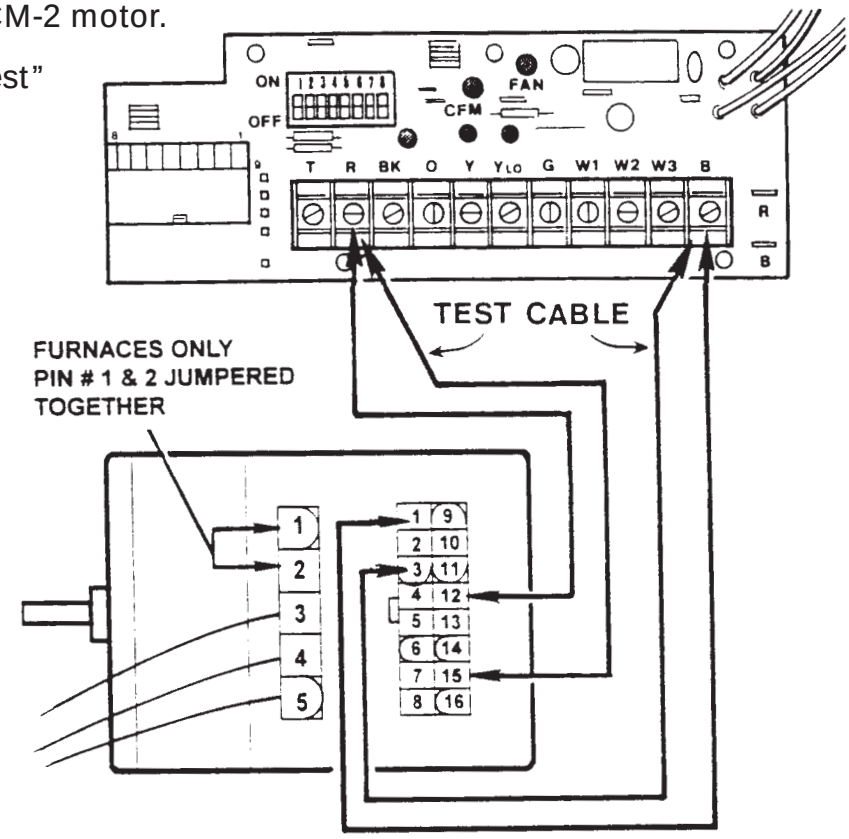
3. Plug in 16 pin connector "4 wire test" cable to ICM-2 motor.

4. Check power plug at motor and verify that it is installed and properly seated.

5. Connect Red wire to "R" at motor control board.

6. Connect Blue wire to "B" at motor control board.

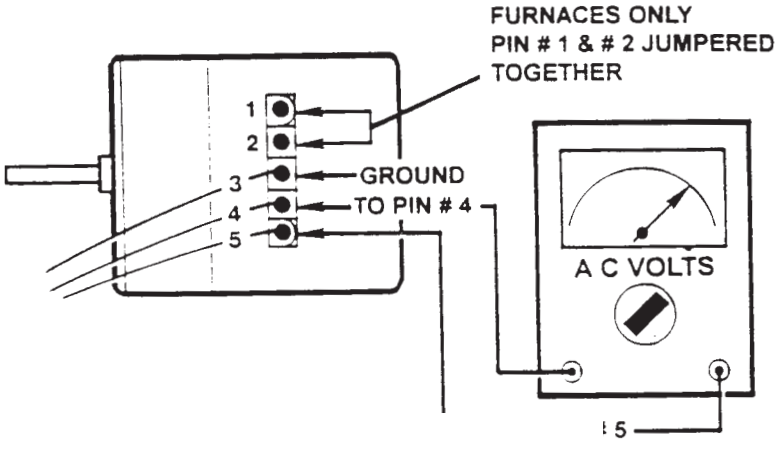




1. Turn on power to unit.

2. Motor should come on and run continuous fan speed.

3. If motor does not run, verify 24 volts A.C. is present between R & B. If 24 volts A.C. or correct line voltage is not present, troubleshoot and repair as needed.



Furnace ICM-2 motor correct voltage is 120 Volts A.C. and there must be a jumper wire in this plug between pins #1 and #2.

Air handler ICM-2 motor correct voltage is 220 volts A.C.

Pub. No. 34-3402-03