

TECHNICAL PUBLICATION

INTEGRATED DSI CONTROL (IIC) GMC PART# B18099-18 UTECPART# 1068-400

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I. THEORY OF OPERATION

System Configuration

- 0 Control of heating, cooling, and fan functions in response to a standard thermostat.
- 0 Direct Spark Ignition using a microprocessor to control timing, flame sensing, and ignition retries.
- 0 Monitoring of system end switch and limit switches.
- 0 Control of gas valve, indoor fan, and induced draft motor based on thermostat demand and the status of safety inputs.
- 0 Control of a compressor contactor.
- 0 Diagnostic indicator to provide information on power to the control and control status.

Inputs

- o POWER SUPPLY-Class I Line voltage to the equipment, shall be 170 to 270 VAC (230 VAC nominal). Line voltage is applied between the "L1" and "L2" quick connect terminals. Note: For 460 VAC 5 ton units and larger commercial equipment (All input voltages), "L1" and "L2" are supplied with 24 VAC nominal (ie. pilot duty, see wiring diagram). Class II Transformer secondary voltage supplied to the control shall be 18.0 to 30.0 VAC, 50/60 Hz. Power requirements of the control is 12.0 VA max at 24 VAC plus external loads. Voltage is applied between pins 1 and 2 of connector P1.
- o LIMIT SWITCH-The limit switch is connected to the control of pins 4 and 5 of P1. The limit switch is electrically between fused 24 VAC and thermostat "R". A nominal 20mA resistive load is provided for the limit switch.
- o END SWITCH -The end switch is connected on pins 6 and 8 of P1. The end switch is electrically between thermostat "W" and gas valve relay contacts. A nominal 20mA resistive load is provided for the end switch.
- o THERMOSTAT CALL FOR HEAT, 'W' - 24 VAC thermostat input. Connection is made via pin 10 of P1. A call for heat is recognized when the thermostat connects "W" to "R". A minimum 20mA current load at 24 VAC is provided in addition to gas valve current for thermostat heating anticipators. This input will sink up to 10mA in the "off" state.
- o THERMOSTAT CALL FOR COOL, 'Y' - 24 VAC thermostat input. Connection is made via pin 11 of P1. A call for cooling is recognized when the thermostat connects 'Y' to "R". This input provides a 1000 ohm load for electronic thermostats and will sink up to 10mA in the "off" state. Power for the compressor output is drawn from the "Y" input.
- o THERMOSTAT CALL FOR FAN, "G" - 24 VAC thermostat input. Connection is made via pin 7 of P1. A call for continuous fan is recognized when the thermostat connects "G" to "R". This input provides a 1000 ohm load for electronic thermostats and will sink up to 10mA in the "off" state.
- o FLAME SENSE - The control shall use flame rectification as the flame sensing means. Flame sense is connected via a 0.187x0.020" male quick connect terminal. Open circuit flame sense voltage shall be approximately 100 VAC. The control requires at least 0.5 microamperes DC flame current to guarantee flame is sensed.

- ° BLOWER OFF DELAY SELECT - A moveable jumper wire is provided with 3 connection posts to select between 3 heat blower off delay times. The times are 120, 135, and 150 seconds. If the wire is not connected, the control defaults to 150 second delay. The control is shipped with the jumper wire on the 150 position.
- ° TEST/SPEED-UP INPUT - Two pins shall be provided that when shorted together cause the control to bypass the compressor short-cycle time. If pins are shorted together for more than 5 minutes, the control shall ignore the short and provide normal compressor operation.
- ° CONFIGURATION TAB - A break-away tab shall be provided to configure the compressor output. When left intact, the compressor output shall function as a single-stage anti-short cycle timer. When the tab is broken, the compressor output shall function as a 2nd stage compressor sequencer. See section Compressor (Single / Dual) for detailed operation description.

Outputs

- ° BLOWER MOTOR - The integrated DSI control shall control a two speed indoor blower motor. (Exception: larger commercial equipment has single speed blower motor.) Rating shall be 6.9 FLA, 26 LRA @ 230 VAC. Connections are made via 1/4" quick connects and are labeled "HEAT", "COOL", and "L2". "HEAT" is energized when the heat speed blower is to run. "COOL" is energized when the cool speed blower is to run. Note: For 460 VAC 5 ton units and larger commercial equipment (All input voltages), "HEAT", "COOL" and "L2" supply 24 VAC nominal (ie. pilot duty, see wiring diagram) to an external relay or contactor that supplies line voltage to the motor.
- ° INDUCER MOTOR - The control shall provide an output for the induced draft motor. Rating shall be 1.25 FLA, 2.5 LRA @ 230 VAC. Connections are made via 1/4" male quick connect terminals labeled "DI" and "L2". Note: For 460 VAC 5 ton units and larger commercial equipment (all input voltages), "DI" and "L2" supply 24 VAC nominal (ie. pilot duty, see wiring diagram) to an external relay or that supplies line voltage to the combustion motor.
- ° GAS VALVE - The control shall provide an output for the main gas valve. Rating shall be 1.5 Amps @ 24 VAC, 0.6 power factor, 3.0 Amp inrush for 16mS. Connection is made on pins 2 and 3 of P1.
- ° COMPRESSOR OUTPUT - The control shall provide a pilot duty output for a compressor contactor coil. Rating shall be 1.0 Amps @ 24 VAC. Connection is made on pin 12 of P1.
- ° SPARK OUTPUT - Spark output shall provide a minimum of 22KV open circuit voltage.

II. CONTROL STATES

Manual Fan

- ° When the thermostat calls for continuous fan (G) without a call for heat or cooling, the indoor fan has a 7 second delay on make and energizes the "HEAT" speed. The fan remains energized as long as the call for fan remains without a call for heat or cooling. The fan call "G" has a 60 second delay on break. Note: When the Configuration tab is broken, the continuous fan mode "G" will have a 7 second delay on make and a 60 second delay on break and the "COOL" speed tap will be energized.
- ° If a call for cool (Y) occurs during continuous fan, the blower will switch over to "COOL" speed.

- ° If a call for heat (W) occurs during continuous fan, the blower will remain energized through the heat cycle or until "G" is de-energized.
- ° The continuous fan operation will function while the control is in heat mode lockout.

Cool Mode

Indoor Blower Operation

- ° When the thermostat calls for cooling ("Y"), the control energizes the cooling speed fan after a 7 second on delay. When the thermostat removes the call for cooling ("Y") the control de-energizes the cooling speed fan after a cooling off delay period of 60 seconds.
- ° A call for cooling has priority over continuous fan. If G is energized while Y is energized, during the cooling fan on delay, the fan will remain off until the delay is over.
- Q The cooling fan operation continues to function while the control is in heat lockout.
- ° If a call for heat exist with a call for cooling, the call for heat shall proceed as normal except the fan remains energized on cool speed.

Heat Mode

- ° CALL FOR HEAT - The thermostat calls for heat by energizing the "W" terminal. The control checks to see if the end switch is open. If the end switch is closed, the control will flash code "3" on the LED and wait indefinitely for the end switch to open. The control will lockout the call for heat if the end switch is closed before the induced draft motor is energized.
- a PRE-PURGE - The control energizes the induced draft motor, flashes code "2" on LED, and waits for the end switch to close. When the pressure switch has closed, the control stops flashing the LED and begins timing the 15 second pre-purge period. (Note: Under normal operation, the LED will not flash if the end switch closes immediately after energizing the induced draft motor.)
- a IGNITION - The control energizes the gas valve and spark. If flame is not established within 7 seconds, the gas valve and spark is de-energized and the control goes to an inter-purge. If flame is established, the spark is de-energized and the control goes to heat blower on delay.
- ° Heat Blower On Delay - The control waits for 30 second heat fan on delay and then energizes the indoor blower heat speed. If the blower is already energized by a call for cooling or continuous fan, or in a blower off delay period, the on delay is skipped and control goes to steady heat.
- ° STEADY HEAT - Control inputs are continuously monitored to ensure limit and end switches are closed, flame is established, and the thermostat call for heat remains.
- D POST PURGE - When the thermostat demand for heat is satisfied, the control immediately de-energizes the gas valve. The inducer output remains on for a 29 second post-purge period.
- ° Heat Blower Off Delay - The indoor blower motor is de-energized after the selected blower off delay time. Blower timing begins when the thermostat is satisfied.

Compressor

Single Compressor

- 0 If the configure break-away tab is intact, the compressor output is for a single stage compressor contactor. The control provides a 3 minute anti-short cycle protection for the compressor. If the compressor has been off for 3 or more minutes, the compressor immediately energizes when the thermostat calls for cool. If the compressor has not been off for at least 3 minutes when a call for cool occurs, the control waits until 3 minutes has elapsed from the time the compressor was last de-energized before re-energizing the compressor.
- 0 The 3 minute timer is activated by a power interruption. The compressor output will not energize within the first 3 minutes after power is applied unless the "SPEED-UP" test pins are shorted together.

Dual Compressor

- 0 If the configure break-away tab is broken, the compressor output is for a second stage compressor contactor. The first stage compressor is energized externally. The 'Y' input (pin 11) of the control now comes from the second stage thermostat call for cool. The control energizes the compressor output (2nd stage) after a fixed 60 second time has elapsed from the second stage thermostat energizing ("Y2").

III. TROUBLESHOOTING

Diagnostic Indicator

- 0 A red LED is provided to indicate system fault as follows:
 - Steady ON - Control OK in Standby, Call for heat, cool, or fan modes
 - Steady OFF - No power, open fuse or internal control fault
 - 1 flash - Lockout due to failed ignition or flame dropouts
 - 2 flashes - Open end switch
 - 3 flashes - End switch closed without induced fan motor on
 - 4 flashes - Limit switch is open
 - 5 flashes - Flame detected with gas valve closed
 - 6 flashes - Compressor output delayed from short cycle/staging timer
- 0 The flash rate is 0.25 seconds on, 0.25 seconds off, with 2.0 second pause between flash codes.

Interrupted Call for Heat

- 0 If the thermostat demand for heat is removed before the ignition period, the control will immediately de-energize the inducer.
- 0 If the thermostat demand for heat is removed after ignition has begun, the induced draft motor will run through a post purge and the indoor blower motor will run on heat speed for the delay off time.

Ignition Re-try

- 0 If flame is not established on the first trial for ignition period, the induced draft motor remains energized and the control de-energizes the gas valve. The control waits for a 15 second inter-purge period then attempts an ignition re-try. This sequence repeats up to 2 re-tries.

- 0 If flame is not established on the third trial for ignition , the control de-energizes the gas valve and goes into "soft" lockout. The LED flashes a fault code of " 1 " to indicate lockout is due to failed ignition.

Ignition Re-cycle

- D If flame is established and maintained during the trial for ignition period and then flame is lost, the gas valve is de-energized, the induced draft motor continues to run, and the control begins timing the pre-purge delay. The indoor blower motor will be energized and/or remain energized on heat speed for the delay off time.
- 0 When the pre-purge delay is over, the control energizes the spark and gas valve for an ignition attempt. If ignition is unsuccessful, the control will attempt up to 2 more re-tries as described previously. The control will re-cycle up to 5 flame losses (4 re-cycles) within a single call for heat before going to "soft" lockout. The control flashes an error code of " 1 " if lockout is due to too many flame losses. (This is the same flash code as failed ignition,)

End Switch (Induced Draft Motor)

- 0 The end switch is ignored unless a call for heat is present. When a call for heat occurs and the end switch is closed before the inducer is energized, the inducer will remain off and the control will flash an error code of "3" on the LED until the end switch opens.
- 0 If the end switch does not close before the ignition period, the induced draft motor will remain on and the control will stay in pre-purge until the end switch remains closed for the full pre-purge period. The LED will flash an error code of "2".
- 0 If the pressure switch opens after the gas valve has been energized, the control will de-energize the gas valve and run the indoor blower on heat speed through the fan off delay . The inducer remains energized as long as the call for heat remains. When the end switch re-closes, the control begins the pre-purge period and re-ignites.

Limit Switch Operation

- 0 If the limit switch opens, the indoor fan is energized on heat speed and the inducer is energized. The gas valve is de-energized if it was energized. The status LED will flash "4" times indicating the limit switch is open. The blower and inducer will remain energized as long as the limit is open. Power to the indoor thermostat "R" is removed while the limit switch is open.
- a When the switch re-closes, the induced draft motor will run through post-purge and the indoor blower will run through the heat fan off delay. The status LED will return to steady on. If a call for heat exists when the post purge is complete, the control will re-ignite with the indoor blower remaining on (for the delay off time) through the re-ignition attempt.

Undesired Flame

- 0 If flame is sensed longer than 2 seconds while the gas valve is de-energized, the control shall energize the induced draft motor and indoor blower motor on heat speed. When flame is no longer sensed, the induced draft motor and indoor blower motor de-energize. The control will do a soft lockout, but will still respond to open limit and flame. The status LED shall flash a code of "5" when lockout is due to undesired flame. If there is no call for heat, or the call for heat is removed, lockout will reset.

Gas Valve Fault

- ° If the control senses the gas valve is energized for more than 1 second when the control is not attempting to energize the gas valve, or if the gas is sensed as not energized when it is supposed to be energized, then the control will lockout with the LED off. The control assumes either the contacts of the relay driving the gas valve have welded shut, or the sensing circuit has failed. The inducer is forced off to open the end switch to stop gas flow unless flame is present.

Lockout

Soft Lockout

- ° The control shall not initiate a call for heat while in lockout. A call for cooling or continues fan operates as normal. The control will still respond to an open limit and undesired flame.
- ° Lockout shall automatically reset after 1 hour, Lockout may be manually reset by removing the thermostat call for heat for more than 3 seconds or removing power from the control for more than 5 seconds.

Hard Lockout

- ° If the control detects a fault on the control board, the status LED will be de-energized and the control will lockout as long as the faults remain. Hard lockout may be reset by removing power to the control for more than 5 seconds. Faults detected within the microcontroller continually re-test to see if they are hard failures. Failures detected within the flame sense or gas valve drive circuits re-test every 1 hour.

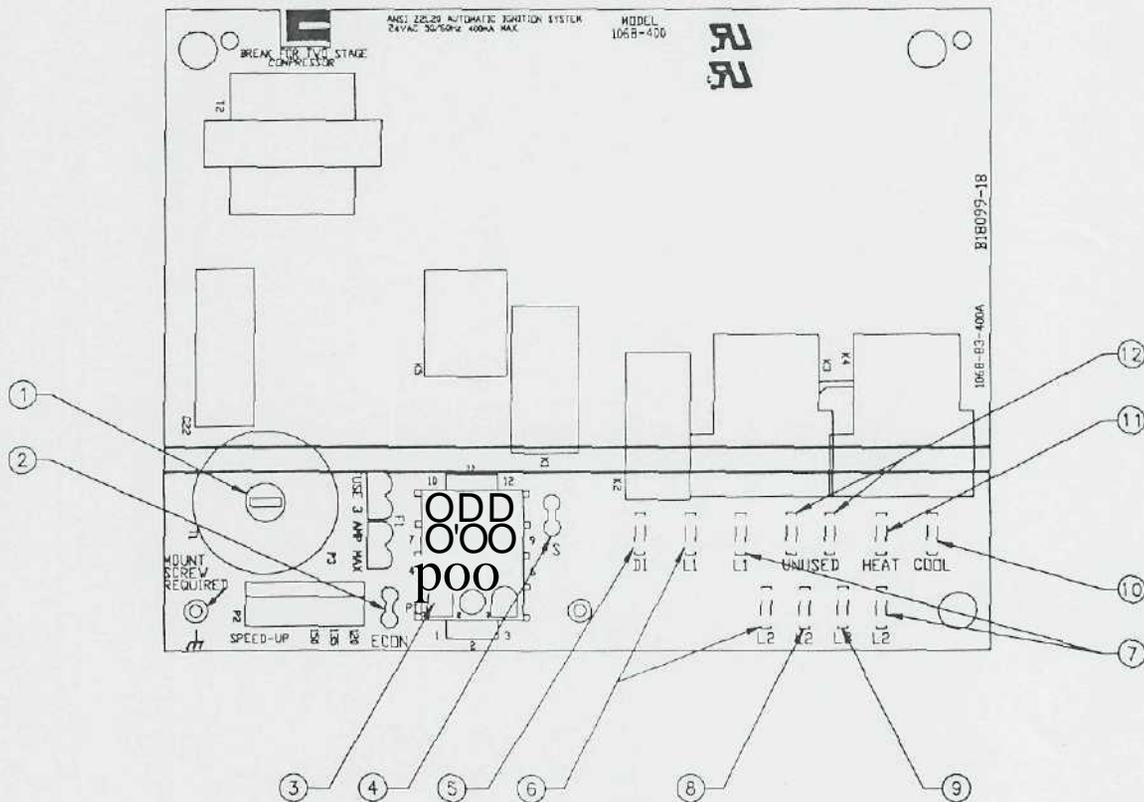


Figure 1

IV. DESCRIPTION OF CONTROL BOARD LAYOUT (Figure 1)

- 1) SPARK - High voltage spark output.
- 2) ECON - Common with fan operation (G).
- 3) CONNECTOR P1 - 12 - Pin female socket shall accept AMP 1-480708-0 connector.

Pin 1 - Continuous 24 VAC from transformer

Pin 2 - 24 VAC common (Chassis ground)

Pin 3 - Call for heat output to gas valve

Pin 4 - Limit switch output (continuous 24 VAC through on board fuse)

Pin 5 - Limit switch input (common to Pin 9)

Pin 6 - End switch input

Pin 7 - Thermostat fan input (G) (common with ECON)

Pin 8 - End switch output (common with Pin 10)

Pin 9 - Thermostat output (R) (common with Pin 5)

Pin 10 - Thermostat call for heat input (W) (common with Pin 8)

Pin 11 - Thermostat call for cool input (Y)

Pin 12 - Compressor contactor output

- 4) FS - Flame sense electrode.
- 5) DI - Draft inducer motor output. (See Note 1.)
- 6) POWER INPUT -These terminals are the line voltage inputs of the board. (See Note 1.)
- 7) TRANS PRI - These terminals are the line voltage outputs of the primary side of the Class 2 transformer. (See Note 1.)
- 8) COM - This terminal is the common blower motor tap. It is always "hot" (ie line voltage). (See Note 1.)
- 9) IND DFT -This terminal is the "common" lead for the IND DFT motor. (See Note 1.)
- 10) COOL-This terminal is the cool speed blower motor tap. It is energized by a call for cool through the thermostat. Y (24 VAC) is energized by a call for cool. (See Note 1.)
- 11) HEAT - This terminal is the heat speed blower motor tap. It is energized by a call for heat through the thermostat, MV (24 VAC) from the gas valve, or an open Hi limit. This motor speed tap is also energized by G (24 VAC) a call for constant fan "FAN ON" position on thermostat. Note: Y (24 VAC) is dominant over G (24 VAC), so when Y & G are energized simultaneously, the "COOL" speed tap is energized. (See Note 1. and also see Note in CONTROL STATES - Manual Fan).
- 12) UNUSED - This terminal is used to camp a blower or induced draft motor speed tap that is not currently being utilized.

Note 1: Control is used as pilot duty (24 VAC) for 460 VAC 5 ton units and larger commercial equipment (All input voltages).

V. TYPICAL LADDER DIAGRAM OF TIMED FAN CONTROL

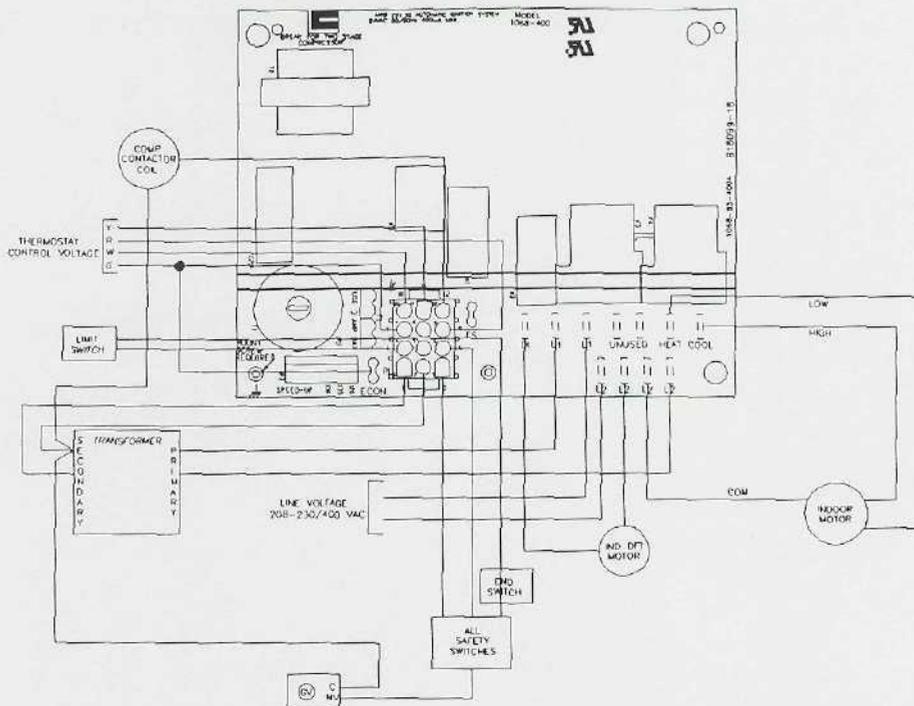


Figure 2

This diagram shows atypical connection scheme for Goodman package units that use B18099-18 integrated ignition control and direct spark gas valve.

Note: For both 460V package equipment (2 through 5 tons) and commercial package equipment above 5 tons (All input voltages), 818099-18 is used as a pilot duty timer (i.e. no line voltage is used on control). Consult wiring diagram inside the control box panel for connection scheme.

VI. SUMMARY OF TIMING FUNCTIONS (in seconds)

Function	Signal Name	Delay On	Delay Off
Heat Speed	MV ¹	30	120, 135, 150 ²
Cool Speed	Y	7	60
Compressor	Y	60 ³	180*
Induced Draft	INDDFT	15 ⁵	29

¹ Heat Speed Delay On & Off occur only after flame has been sensed and main valve (MV) is energized

² Selectable with jumpers

³ Indicates timing when 'TWO STAGE COMP" tab is broken off, Timer becomes Delay on Make

⁴ Indicates timing when 'TWO STAGE COMP" tab is not broken off, Timer becomes Compressor Lockout between cycles (i.e. minimum timing between compressor cycles)

⁵ Prepurge timing (not Delay On)

VII. THERMOSTAT COMPATIBILITY

Most thermostats are completely compatible to B18099-18 (IIC). If operation is a problem, consult thermostat instructions. If a isolation relay is necessary, the following diagram reflects installation of field wiring. (Diagram of isolation relay in thermostat instructions takes precedence over diagram illustrated below.)

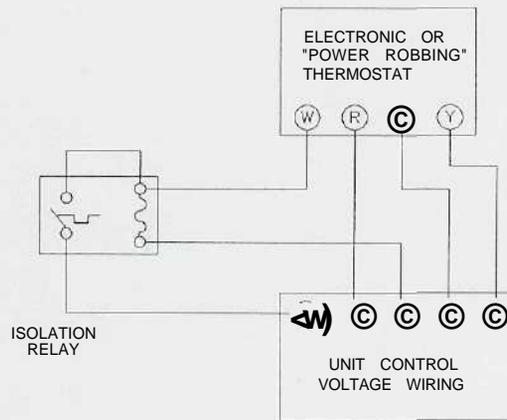


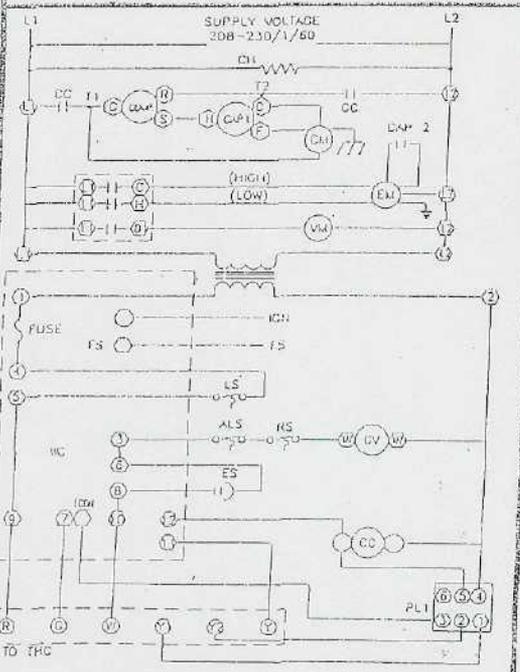
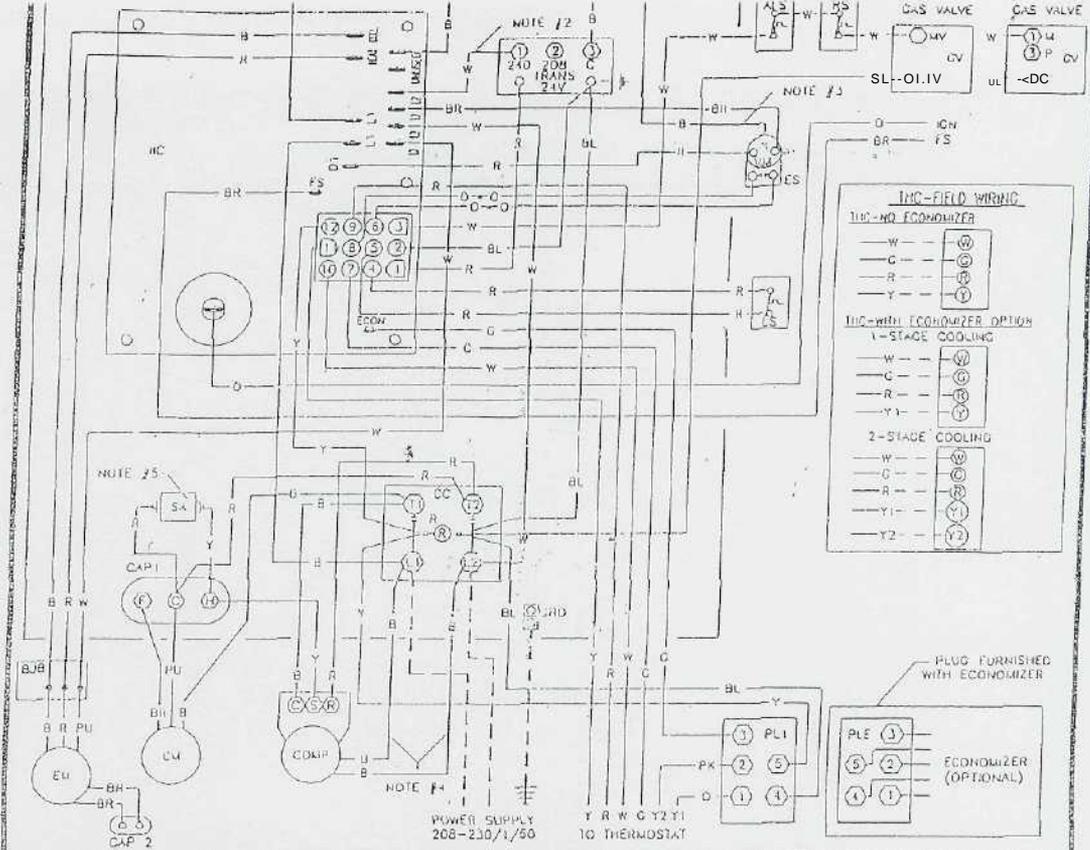
Figure 3

TABLE 1 THERMOSTAT INPUT RESPONSE IN CONTROL MODES

Input -> Mode I	"W" on	"W" off	"G" on	"G" off	"Y" on	"Y" off	
Standby	Goes to Call for Heat mode	Normal	Goes (o Steady Fan mode	Normal	Goes to Steady Cool	Normal	
Call for Heat	Normal	Goes to Standby	Indoor blower energized on heat speed, ignition cycle continues	Normal	Indoor blower energized on cool speed, ignition cycle continues	Normal	
Pre-Purge							
Ignition			Gas valve de-energized, blower energized on heat speed, goes to post-purge mode		Heat mode overrides "G". Blower shut off.		Indoor blower energized on cool speed, goes to steady heat mode
Heat warm-up			Indoor blower already energized on heat speed		Indoor blower energized on heat speed, heat cycle continues		
Steady Heat							
Post-Purge	Goes to call for Heat mode, blower remains on through re-ignition unless blower off delay expires	Normal	Normal	Goes to Standby Mode	Goes to Steady cool	Normal	
Heat off delay							
Steady Fan							
Steady Cool	Runs normal heat except blower on cool speed	Normal	"G" ignored, cooling has priority	Normal	Normal	Goes to Cool off delay	
Cool off delay						Goes to Steady Cool	Normal
Lockout	Remains in lockout for 1 hour	Resets lockout if "W" off more than 3 seconds	Runs Heat speed fan		Runs cool speed fan		

TABLE 2 OTHER INPUT RESPONSES IN CONTROL MODES

Inputs Mode 1	Limit Switch Open		Pressure switch open	Pressure switch closed	Flame not present	Flame present
Standby	Energize inducer and heat speed blower	LED flashes "4" while limit is open. When limit switch re-closes, inducer runs through post-purge and begin heat blower off delay. If call for heat is present when post purge complete, restart call for heat	Normal	Ignored while "W" is off	Normal	Energizes inducer and heat speed blower, LED flashes "5". Goes to Lockout.
Call for Heat			Goes to Pre-purge mode	Inducer off until P.S. open. Flash 3		
Pre-Purge	Energize heat speed blower		Flashes 2 until P.S. closes, Pre-purge time begins when P.S. closed.	Normal	Goes to inter-purge	Goes to heat on delay
Ignition	De-energize gas valve, energize heat speed blower		De-energize gas valve, energize heat speed blower, restart call for heat, (blower remains on for delay off period through re-ignition) LED flashes "2"			
Heat Warm-up						
Steady Heat	De-energize gas valve					
Post-Purge	Inducer and heat speed blower remain on.		Ignored while "W" is off.	Ignored while "W" is off	Normal	Energizes inducer and heat speed blower, LED flashes "5".
Heat Off delay						
Steady Fan						
Steady Cool	Runs Cool speed blower until off delay over, then switch to Heat speed					Energizes inducer. blower remains on cool speed. LED flashes "5"
Cool Off Delay						
Lockout	Heat blower and inducer energized					Inducer and heat speed on. LED 5



GENERAL LEGEND

ALS AUXILIARY LIMIT SWITCH
 LUB ELEVATOR JUNCTION BOX
 CAP CAPACITOR
 COUP COUPORESSOR
 Cu CONDENSER MOTOR
 CC CONTRACTOR
 CH CRANKCASE HEATER
 ES END SWITCH
 EM EVAPORATOR MOTOR
 FS FLAME SENSOR
 GV GAS VALVE
 IC INTEGRATED IGNITION CONTROL
 ICH IGNITOR
 LS LIMIT SWITCH
 PL PLUG
 RS ROOM SWITCH
 SA START
 THC THERMOSTAT HEAT & COOL
 TRANS TRANSFORMER
 VU MOTOR

WIRE SPLICE
 MARKED TERMINAL
 UNMARKED TERMINAL
 WIRE

LINE VOLTAGE
 LOW VOLTAGE
 FIELD INSTALLED POWER
 FIELD INSTALLED CONTROLS

WIRE CODE
 B BLACK
 BK BLUE
 BR BROWN
 C CREEK
 D ORANGE
 G GREEN
 PU PURPLE
 R RED
 W WHITE
 Y YELLOW

NOTES

- REPLACE WITH M (I) MUST BE THE SAME MAKE AND TYPE OF INSULATION AS ORIGINAL USE COPPER CONDUCTOR ONLY.
- FOR 208 VOLT TRANSFORMER OPEN-TENSION HOVE WHITE WIRE FROM TERMINAL (E) TO TERMINAL (2) OF TRANSFORMER.
- FOR 208 COMPRESSION UNIT OPERATION CONNECT BLACK LEAD IN PLACE OF RED LEAD AT (D).
- CRANKCASE HEATER (OPTIONAL).
- FIELD ASSETS: USED ON UNITS WITH FIELD "A" SHELL COMPRESSORS ONLY.

MAX FUSE SIZE	MAX. HALL	DIFF. PRESSURE
2 TON	25	2 IQu 20
2.5 TON	JS 2.5 TON	10
3 TON	*0 J TON	n
3.5 TON	50 2 5 TON	50
4 TON	50 1 TO	50
5 TON	10 5 TON	60

208-230/1/50

INSTALLER/SERVICEMAN

THE STATUS LIGHT ON THE FURNACE CONTROL (AY) IS USED AS A GUIDE TO TROUBLESHOOTING THIS APPLIANCE. STATUS LIGHT CODES ARE AS FOLLOWS:

STATUS LIGHT	EQUIP. STATUS	CHECK
ON	WORKING OPERATION	-
OFF	NO POWER OR INTERVAL CONTROL FAULT	CHECK INPUT WIRE CHECK GAS VALVE REPLACE CONTROL
1 BLINK	IGNITION FAILURE ON OPEN ROLLOUT SWITCH OR OPEN AUX-LIMIT SWITCH	GAS FLOW GAS PRESSURE GAS VALVE FLAME SENSOR FLAME ROLLOUT 6AO SWITCH AUX. LIMIT OPEN
2 BLINKS	CMO SWITCH OPEN	VENTER EHD SWITCH
3 BLINKS	END SWITCH CLOSED WITHIN 10 MINUTES ON	VENTER End SWITCH
4 BLINKS	OPEN LIMIT SWITCH	MAIN LIMIT OPEN BAD SWITCH
5 BLINKS	FALSE FLAME SENSED	STICKING GAS VALVE
6 BLINKS	COMPRESSOR DELAY	J UN, COP, AWI-CVCLC RIKIEU