

Series MX4010 Discharge Air Temperature Control System

⚠ WARNING

Read these instructions carefully and completely before installing or operating. Failure to follow them could result in a fire or explosion causing property damage, personal injury, or loss of life. The product must be installed and operated according to all local regulations.

Service and installation must be performed by a trained/experienced service technician.

DESCRIPTION

The Series MX4010 discharge air temperature control system is for use with split manifold atmospheric indirect fired heaters. The split manifold operates as two independent manifold sections sharing a single inducer.

The controller senses and maintains a constant discharge air temperature by modulating one section of the manifold and staging the non-modulated section.

The Series MX4010 controller is used with the E42, E52, and E62 Series modulators. Typical applications achieve a turndown of approximately 10:1 during continuous operation.

SYSTEM FEATURES

A40-SM2 Series Amplifier

Controlled Start-Up

- Fixes the modulation voltage and inducer state for a predetermined time after receiving EST input.

Inducer State

- Energizes/de-energizes on board SPDT relay setting inducer in low/high speed position.

Temperature Modulation

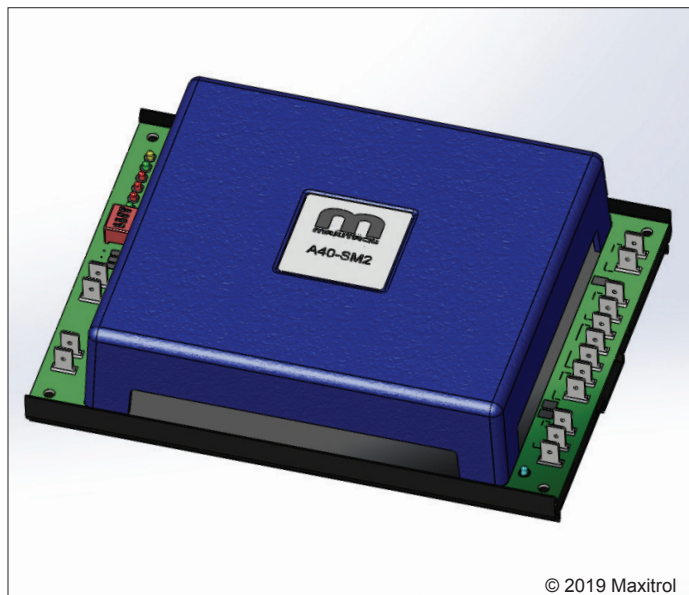
- Controls discharge air temperature by modulating Maxitrol E valve and setting relay states. Set point is selected with on board or remote temperature dial.

Minimum Input Limits

- Limits minimum VDC to E Valve when non-modulated section stages are operating.

Controlled Transition of Stage

- Adjustable timer used to delay transition of one relay stage to another. Eliminates or reduces unnecessary stage changes.



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Figure 1: A40-SM2A Series Amplifier

Minimum Temperature Rise

- Heater is cycled on-off at minimum rate to control a lower than continuous temperature rise.

Air Flow Switch (AFS)

- *A Model only:* Limits maximum modulation VDC and disables Relay 3 if 24 VDC AFS input is not present for a time greater than 3 seconds.

SYSTEM COMPONENTS

A40-SM2 Series Amplifier

E42, E52, and E62 Series modulating gas valves

TD114+ Remote Temperature Selector (optional)

TS194Q/MT1 Discharge air temperature sensor/mixing tube

Acronyms

AFS	Air Flow Switch
DAS	Discharge Air Sensor
E	EXA Series Modulating Valve
EST	Electronic Start Trigger
NC	Normally Closed
NO	Normally Open
RTS	Remote Temperature Selector
SPST	Single Pole Single Throw
SPDT	Single Pole Double Throw

SPECIFICATIONS

Dimensions:

Amplifier: 8.5" L x 3.25" W x 2" H
Temp Dial: 2.62" W x 3" H x 1.75" D
Mixing Tube Enclosure: 4.19" W x 4.19" H x 1.88" D
[Tube Lengths: 9", 12", 23"]

NOTE: Dimensions are to be used only as an aid in designing clearance. Actual production dimensions may vary from those shown.

Ambient Temperature Limits

Operating: -40° F to 150° F (-40° C to 66° C)
RH: 95% non-condensing

Mounting

Snap Track, multipoise

Power Supply

24 VAC +10-15% (50/60 Hz), Class II Transformer
20 VA - Rating for Maxitrol electronics and modulating gas valve only
Half-Wave Rectified

NOTE: Polarity is specified - Transformer can be externally grounded

External Wiring

Gauge: 18-22 AWG, copper only – meets application temperature rating

Connection: 1/4" male spade .032 thk

Relays: 1, 2, 3, 4

A: When relay common voltage input is externally supplied (dry contact), the voltage should not exceed 24 VAC, VDC nominal
B: When relay common 24 VAC input is internally supplied, the circuit load through shunt jumper J1, J2, or J3 should not exceed 1A

Rated load: 2A Max. @ 24 VAC (Resistive load)
Max switching capacity: 50 VA (Resistive load)

Discharge Air Temperature Sensor (DAS)

TS194Q
1000Ω PRTD

DAS Mixing Tube

MT1 or MT2 Series

Discharge Air Temperature Selector

TD114+ Remote Temperature Selector or on-board dial interface

Temperature Ranges:

40° to 90° F (4° to 32° C)
80° to 130° F (26° to 54° C)
120° to 170° F (49° to 76° C)
160° to 210° F (71° to 99° C)

EXA Modulating Gas Valve

Power: 24 VAC, VDC
Rated load: 0.3 A max
Control Voltage: 0 - 10 VDC (Polarity Sensitive)
100kΩ Input Impedance

Performance

Relay 1 - Inducer

Trigger Voltage

2 - 5 VDC nominal (modulation voltage)

Span (Total)

0.1 - 0.4 VDC

Relay 2 & 3 - Stage Transition

Delay Time

60 - 360 seconds

Relay 4 - Thermostat Interrupt (Min. Temp Rise)

Trigger Voltage [Descending]

0.05 - 0.10 VDC nominal output

Span (De-energize) [Ascending]

0.05 - 0.10 VDC above trigger voltage

Timer

5 - 55 seconds

IMPORTANT:

The MX40 Series is a discharge air temperature control, not a safety limit or safety control. A separate safety and/or limit control must be used when required by the application.

SPECIFICATIONS

EST Input

24 VAC continuous source (must share common with 24 VAC power)

NOTE: Commonly tied to gas valve 24 VAC input

Start-up Timer

5 - 55 seconds

Start-up Modulator Voltage

1 - 10 VDC

Minimum Voltage - Stage 3 & 4

0.5 - 5 VDC

AFS Fault Maximum Modulation Voltage (A suffix only)

2 - 10 VDC

NOTE: Shunt Jumper (J4) To Disable Feature

Reliability/Durability

100% duty cycle

Sensitivity Adjustment

The sensitivity control will allow the user to control the response of the system. Caution should be exercised in the use of this adjustment. Under normal usage the pointer should be located at approximately 2 o'clock.

If hunting is encountered (rapid oscillation), rotating the sensitivity adjustment counter-clockwise will dampen the oscillation – stabilizing the flame.

DO NOT adjust unless necessary, decreasing the sensitivity will increase the temperature "DROOP" of the system.

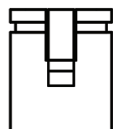
SHUNT JUMPER AND DIP SWITCH SETTINGS

Table 1: SW1 DIP Switch Settings

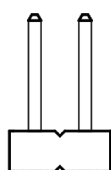
SW	Temperature Range			
	40-90 °F	80-130 °F	120-170 °F	160-210 °F
1	OFF	ON	OFF	OFF
2	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	ON
		On-Board Dial		Remote Dial
4	ON		OFF	

Table 2: Shunt Jumper Settings

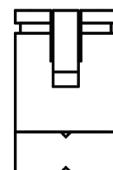
J1	Connects T2 to T5	24 VAC - shunt jumper installed 0 VAC - shunt jumper not installed
J2	Connects T2 to T8	
J3	Connects T9 to T10	
J4	Connects T2 to T18	



Shunt



Pin Header on
PCB



Jumper
(Shunt Installed)

Figure 2: Shunt Jumper

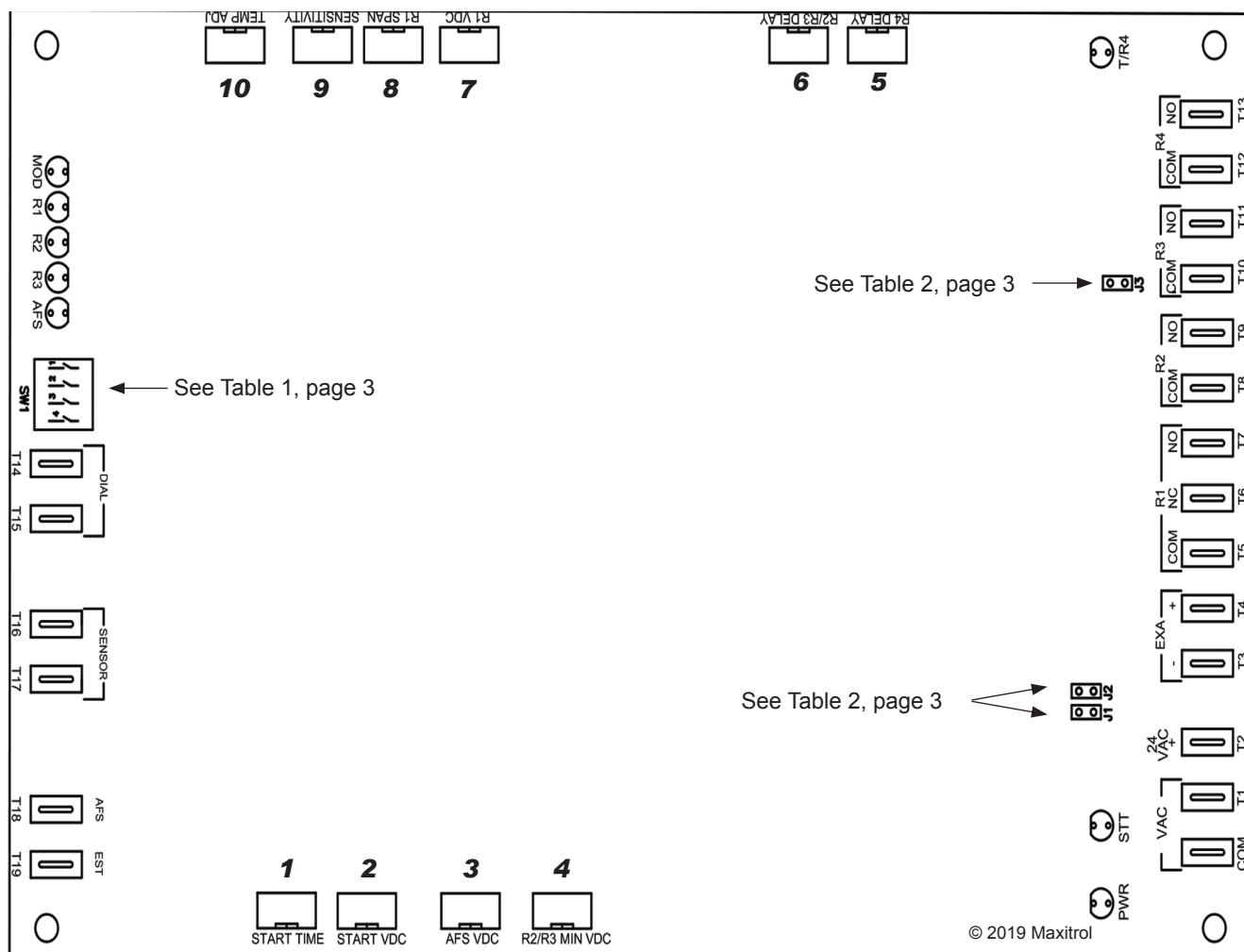


Figure 3: A40-SM2 Trimpot, LED, Dip Switch and Shunt Jumper Locations

Setting			
1	Start Time	6	Stage 3, 4 Time Delay
2	Start Voltage	7	Relay 1 Trigger
3	AFS Limit ("A" Suffix)	8	Relay 1 Deadband
4	Stage 3, 4 Min VDC	9	Sensitivity
5	Relay 4 Timer	10	Integral Temperature Dial

NOTE: Turn trimpot clockwise to increase, counter-clockwise to decrease

WIRING DIAGRAM

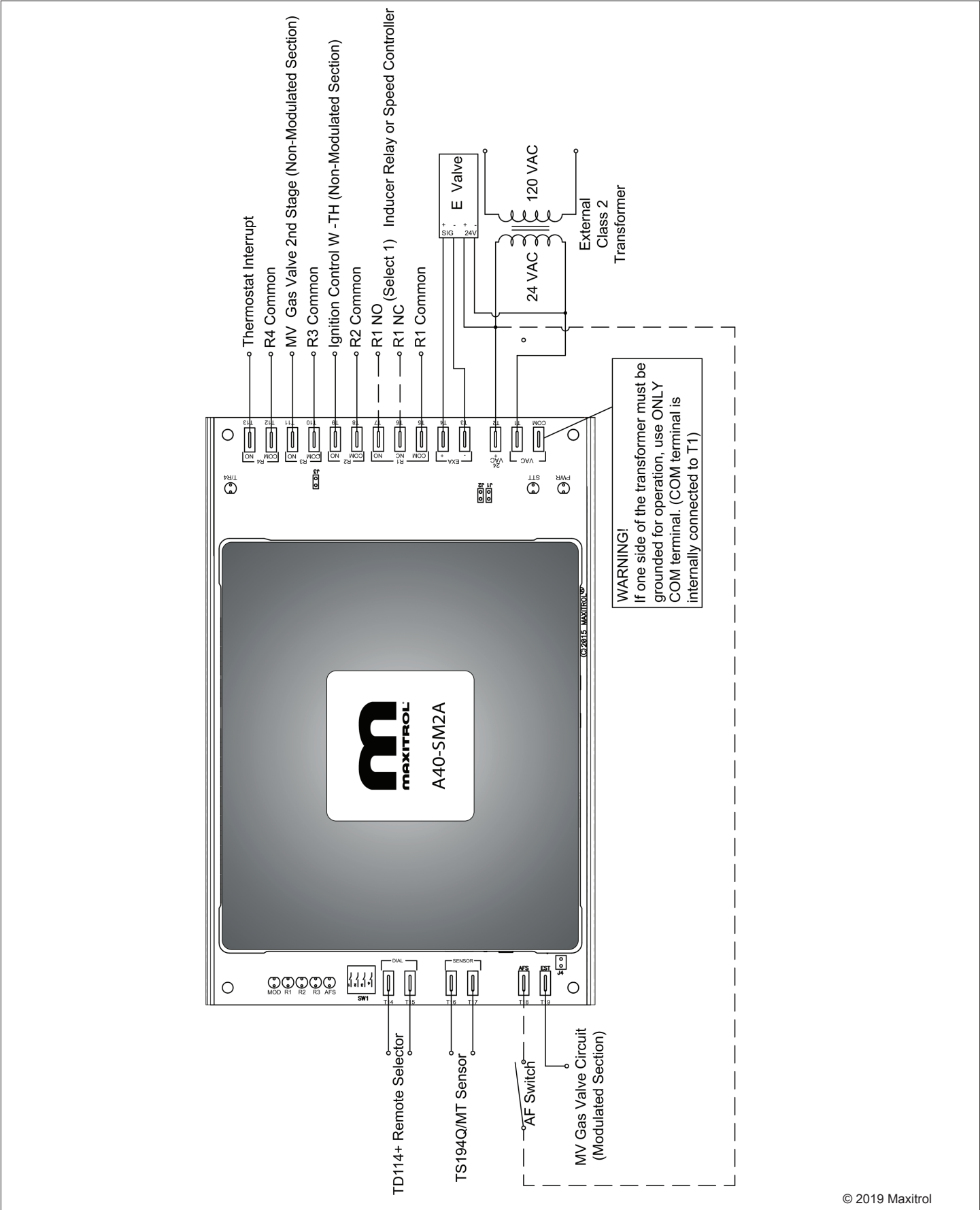


Figure 3: A40-SM2 Wiring Diagram

PCB CONNECTIONS

No	PCB Label		Description	Notes
COM	COM		Power Common	Internally connected to T1
T1			Power Common	Polarity Sensitive
T2	24 VAC	+	Power Input	
T3	EXA	-	0-10 VDC	Modulation Voltage - Polarity Sensitive
T4		+		
T5	R1	COM	Relay 1- SPDT	24 VAC - internal (J1)
T6		NC		Inducer Speed Stage
T7		NO		
T8	R2	COM	Relay 2 - NO	24 VAC - internal (J2)
T9		NO		
T10	R3	COM	Relay 3 - NO	24 VAC - internal (J3)
T11		NO		
T12	R4	COM	Relay 4 - NC	Thermostat Interrupt (Min temp rise mode)
T13		NC		
T14	SENSOR		Discharge Air Sensor	TS194Q DAS
T15				
T16	DIAL		Remote Temp Selector	TD114+ Series RTS
T17				
T18	AFS		Air Flow Switch	24 VAC input (A model), shares COM ground
T19	EST		Start Trigger	24 VAC - Start trigger, shares COM ground

LED STATUS INDICATORS

Status	PCB Label	Color
Main Power	PWR	Blue
Start Up/Modulating	MOD	Green
Relay #1 Energized	R1	Red
Relay #2 Energized	R2	Red
Relay #3 Energized	R3	Red
Relay #4 Timer/Energized	T/R4	Red
AFS ("A" Suffix)	AFS	Green
Stage Transition Timer	STT	Yellow

OPERATION

Call For Heat (IDLE) Mode

- Thermostat relay is energized (completes W input)
- A40-SM2 is powered with 24 VAC
- E Valve is powered with 24 VAC
- Inducer relay (R1) is de-energized, inducer operates in high speed
- Thermostat Interrupt relay (R2) is de-energized

LED: PWR, AFS (A Model)

Burner Start Up Mode

EST receives 24 VAC input from the ignition control gas valve (MV) circuit

- Timer Starts and modulation voltage is fixed
- Inducer Relay remains de-energized, inducer operates in the high speed state

NOTE: The system remains in this mode throughout Start up Timer duration

LED: PWR, MOD (Flashes), AFS (A Model)

Operational Mode

- Start up Timer expires
- Set point temperature relative to sensed discharge air temperature determines modulation VDC and mode
- Relays are energized or de-energized based on modulation voltage and stage timing in order to control set-point temperature

LED: PWR, MOD, R1, R2, R3 when energized
AFS (A Model)

Minimum Temperature Rise Mode (Stage 0)

The heater can be cycled (on and off) to control a temperature rise lower than the minimum continuous temperature rise. Cycling is typically controlled by adding the NC Relay #4 into the burner control thermostat input circuit (W or TH).

Modulation voltage drops to ~0 VDC:

- Result: Relay #4 timer starts, T/R4 LED flashes

Modulation voltage gradually increases before timer expires:

- Result: Timer resets

Modulation voltage remains at 0 VDC long enough for timer to expire:

- Result: Relay #4 is energized

Energizing Relay #4 opens the thermostat circuit causing the heater to shutdown.

Shutdown removes the 24 VAC EST input and the system defaults to the "Call for Heat" mode or remains off if thermostat input is not present.

Table 3:

Stage	EXA Modulation Voltage	R	Mode		% of total (Approx)**
0	0 VDC	R4 energized R1, R2, R3 de-energized	Heater #1 OFF		<10%
I	>0-4.5* VDC	R1 energized R2, R3, R4 de-energized	Heater #1 ON Inducer-Low	Heater #2 OFF	10-30%
II	4.5*-10 VDC	R1, R2, R3, R4 de-energized	Heater #1 ON Inducer-High	Heater #2 OFF	30-50%
III	2*-10 VDC	R2 energized R1, R3, R4 de-energized	Heater #1 ON Inducer-High	Heater #2 ON Stage-Low	50-80%
IV	2*-10 VDC	R2, R3 energized R1, R4 de-energized	Heater #1 ON Inducer-High	Heater #2 ON Stage-High	80-100%

*Adjustable VDC setting

**Percentages are approximations

Heater #1 - Modulated section
Heater #2 - Non-modulated section

OPERATION

OPERATION: (see Table 3, page 7)

Stage I Minimum to 30% of total rating

- Modulation Voltage: 0-4.5 VDC
- Modulated section is operational
- Inducer operates in low speed

LED: PWR, MOD, R1, AFS (Model A)

Stage II 30%-50% of total rating

- Modulation Voltage: 4.5-10 VDC
- Modulating section is operational
- Inducer operates in high-speed

LED: PWR, MOD, AFS (Model A)

Stage II to Stage III Transition

- Modulation voltage remains at 10 VDC for preset time with no relays energized

LED: STT*

Stage III 50% to 80% of total rating

- Modulation Voltage: 2** - 10 VDC
- Modulating section is operational
- Relay 2 is energized and 24 VAC output voltage is supplied to non-modulated section start up relay
- Non-modulated section is operational (low stage)

LED: PWR, MOD, R2, AFS (Model A)

Stage III to Stage II Transition

- Modulation voltage remains at adjusted low VDC for preset time with Relay 2 energized

LED: STT*

Stage III to Stage IV Transition

- Modulation voltage remains at 10 VDC for a preset time with Relay 2 energized

LED: STT*

Stage IV 80% to 100% of total rating

- Modulation Voltage: 2** - 10 VDC.
- Modulating section is operational
- Relay 3 is energized and 24 VAC output is supplied to the non-modulated 2 stage gas valve's high input
- Non-modulated section is operational (high stage)

LED: PWR, R2, R3, MOD, AFS (Model A)

Stage IV to Stage III Transition

- Modulation voltage remains at adjusted low VDC for preset time with Relay 3 energized

LED: STT*

AFS (A Suffix Only) Models

- Operating Condition #1
Relay 1 is energized and 24 VAC input is present or not present.
Result: Normal operation of Stage I.
- Operating Condition #2
Relay 1 is de-energized and 24 VAC input is present.
Result: Normal operation of all stages.
- Operating Condition #3
Relay 1 is de-energized and 24 VAC input is not present for duration greater than 3 seconds.
Result:
 - AFS Fault.
 - VDC output to valve is limited to user-selected voltage.
 - Relay 2 dependent on operating state when fault occurs. Relay 3 is de-energized.
 - VDC output remains limited, even if the 24 VAC AFS signal is re-established, until reset.
- Resetting AFS Fault
Perform one of the following:
 - Cycle main power
 - Cycle EST input
 - Energize Relay 1

AFS Fault Override: Shunt Jumper J4

AFS LED

- Lit when 24 VAC input is present or Shunt Jumper J4 is shunted.

* In addition to current stage LED's

** Adjustable Min VDC