

# MAXITROL®

## Series MX40 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 MX40 discharge air temperature control system is for use with atmospheric indirect fired heaters using a two-stage inducer.

The controller senses and maintains a constant discharge air temperature by modulating the gas flow and staging the inducer.

The Series MX40 controller is used with the E42, E52, and E62 Series modulators. Typical applications achieve a turndown of approximately 5:1 during continuous operation.

### SYSTEM FEATURES

#### A40 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

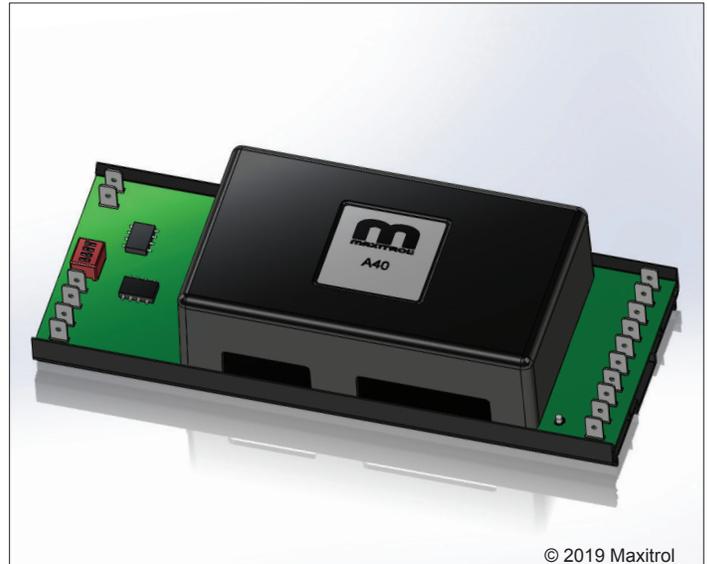
- Controls discharge air temperature by modulating Maxitrol E valve and setting inducer relay state. Set point is selected with on board or remote temperature dial.

##### 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 if 24 VDC AFS input is not present for a time greater than 3 seconds.



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Figure 1: A40 Series Amplifier

### SYSTEM COMPONENTS

#### A40 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
SPDT	Single Pole Double Throw
SPST	Single Pole Single 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

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 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 Impedence

### Performance

#### Relay 1 - Inducer

##### Trigger Voltage

2 - 5 VDC nominal (modulation voltage)

##### Span (Total)

0.1 - 0.4 VDC

#### Relay 2 - 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

**AFS Fault Maximum Modulation Voltage (A suffix only)**

2 - 10 VDC

**NOTE:** Shunt Jumper (J2) 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 T3	

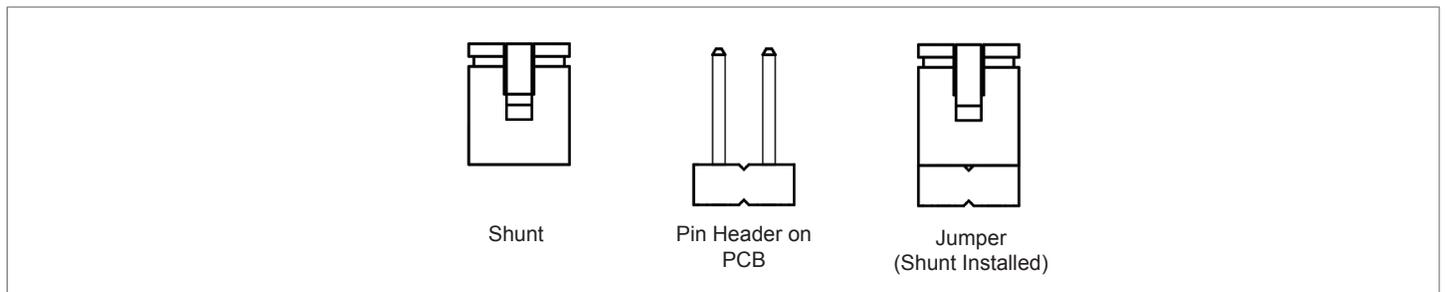


Figure 2: Shunt Jumper

# Series MX40 Discharge Air Temperature Control System

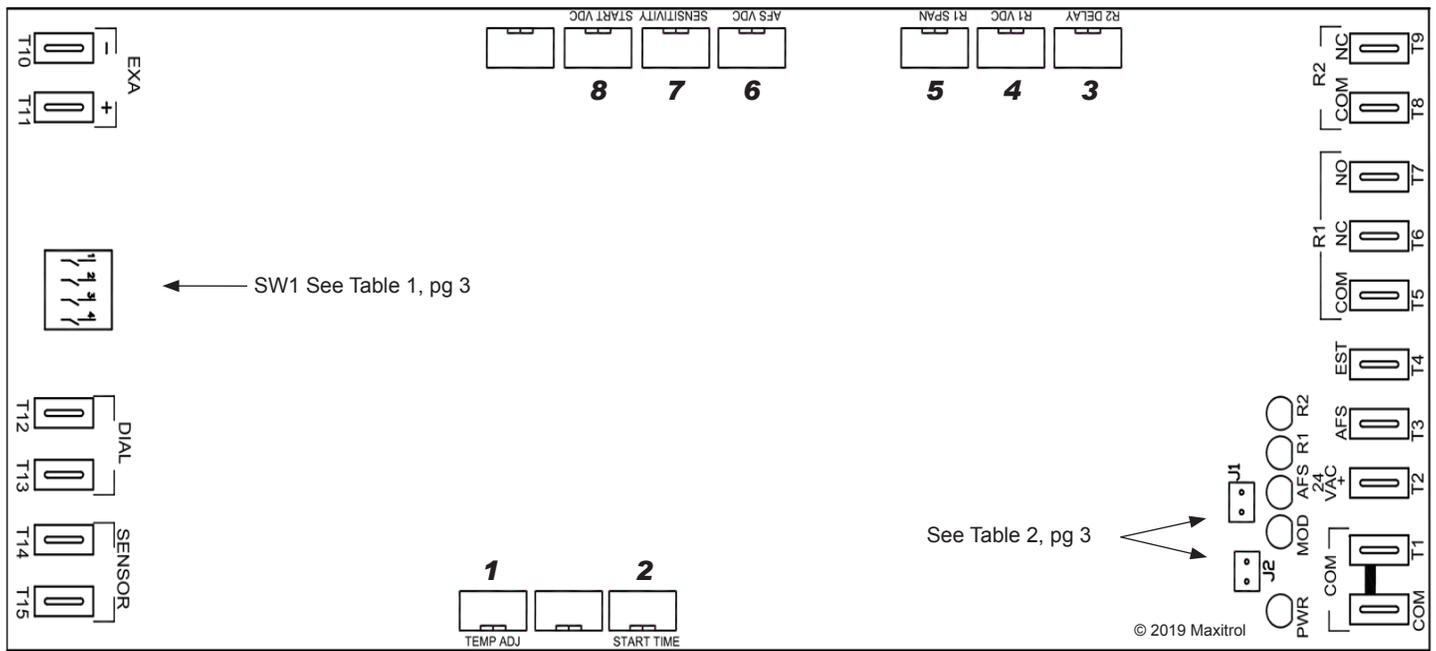


Figure 3: A40 Trimpot, LED, Dip Switch, and Shunt Jumper Locations

Setting			
1	Integral Temperature Dial	5	Relay 1 Deadband
2	Start Time	6	AFS Limit ("A" Suffix)
3	Relay 2 Timer	7	Sensitivity
4	Relay 1 Trigger	8	Start Voltage

**NOTE:** Turn trimpot clockwise to increase, counterclockwise to decrease

**WIRING DIAGRAM**

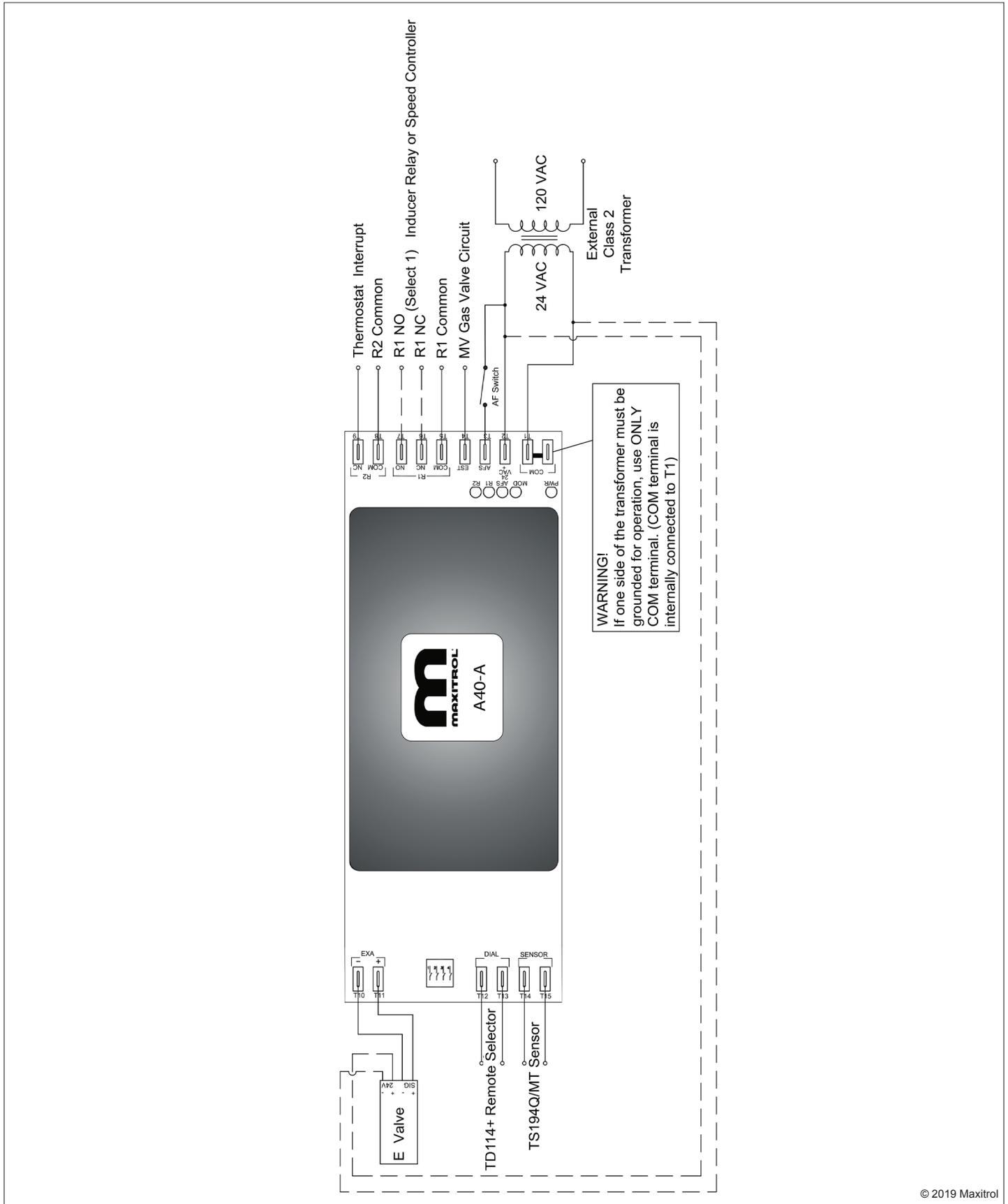


Figure 4: A40-A Wiring Diagram

## 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	AFS		Air Flow Switch	24 VAC input (A model), shares COM ground
T4	EST		Start Trigger	24 VAC - Start trigger, shares COM ground
T5	R1	COM	Relay 1- SPDT	24 VAC - internal (J1)
T6		NC		Inducer Speed Stage
T7		NO		
T8	R2	COM	Relay 2 - NC	Thermostat Interrupt (Min temp rise mode)
T9		NC		
T10	EXA	-	0-10 VDC	Modulation Voltage - Polarity Sensitive
T11		+		
T12	DIAL		Remote Temp Selector	TD114+ Series RTS
T13				
T14	SENSOR		Discharge Air Sensor	TS194Q DAS
T15				

## LED STATUS INDICATORS

Status	PCB Label	Color
Main Power	PWR	Blue
Start Up/Modulating	MOD	Green
Relay #1 Energized	R1	Red
Relay #2 Timer/Energized	T/R2	Red
AFS ("A" Suffix)	AFS	Green

## OPERATION

### Call For Heat (IDLE) Mode

- Thermostat relay is energized (completes W input)
- A40 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 timing in order to control set-point temperature

LED: PWR, MOD, R1, 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 #2 into the burner control thermostat input circuit (W or TH).

Modulation voltage drops to ~0 VDC:

- Result: Relay #2 timer starts, T/R2 led flashes

Modulation voltage gradually increases before timer expires:

- Result: Timer resets

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

- Result: Relay #2 is energized

Energizing Relay #2 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.

### Stage I Minimum to 60% of total rating

- Modulation Voltage: 0 - 4.5 VDC
- Inducer operates in low speed

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

### Stage II 60% - 100% of total rating

- Modulation Voltage: 4.5 - 10 VDC
- Inducer operates in high-speed

LED: PWR, MOD, AFS (A Model)

Table 3:

Stage	EXA Modulation Voltage	R	Mode	% of total (Approx)**
0	0 VDC	R2 energized	Heater OFF	<20%
I	>0-4.5* VDC	R1 energized R2 de-energized	Inducer Low	20-60%
II	4.5*-10 VDC	R1, R2 de-energized	Inducer High	60-100%

\*Adjustable VDC setting

\*\*Percentages are approximations of what one would expect to achieve

## OPERATION

### 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 Stage II.
- 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.
  - 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 J2

### AFS LED

- Lit when 24 VAC input is present or Shunt Jumper J2 is shunted.