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.

### 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

**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

**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

**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

**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

### 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

<table>
<thead>
<tr>
<th>SW</th>
<th>Temperature Range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40-90 °F</td>
</tr>
<tr>
<td>1</td>
<td>OFF</td>
</tr>
<tr>
<td>2</td>
<td>OFF</td>
</tr>
<tr>
<td>3</td>
<td>OFF</td>
</tr>
<tr>
<td>4</td>
<td>ON</td>
</tr>
</tbody>
</table>

Table 2: Shunt Jumper Settings

<table>
<thead>
<tr>
<th>J1</th>
<th>Connects T2 to T5</th>
</tr>
</thead>
<tbody>
<tr>
<td>J2</td>
<td>Connects T2 to T3</td>
</tr>
</tbody>
</table>

24 VAC - shunt jumper installed
0 VAC - shunt jumper not installed

Shunt Jumper (Shunt Installed)

Figure 2: Shunt Jumper
Figure 3: A40 Trimpot, LED, Dip Switch, and Shunt Jumper Locations

<table>
<thead>
<tr>
<th>Setting</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Integral Temperature Dial</td>
<td>Relay 1 Deadband</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Start Time</td>
<td>AFS Limit (&quot;A&quot; Suffix)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Relay 2 Timer</td>
<td>Sensitivity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Relay 1 Trigger</td>
<td>Start Voltage</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Turn trimpot clockwise to increase, counterclockwise to decrease
### PCB CONNECTIONS

<table>
<thead>
<tr>
<th>No</th>
<th>PCB Label</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>COM</td>
<td>COM</td>
<td>Power Common</td>
<td>Internally connected to T1</td>
</tr>
<tr>
<td>T1</td>
<td>Power Common</td>
<td>Polarity Sensitive</td>
<td></td>
</tr>
<tr>
<td>T2</td>
<td>24 VAC [+</td>
<td>Power Input</td>
<td></td>
</tr>
<tr>
<td>T3</td>
<td>AFS</td>
<td>Air Flow Switch</td>
<td>24 VAC input (A model), shares COM ground</td>
</tr>
<tr>
<td>T4</td>
<td>EST</td>
<td>Start Trigger</td>
<td>24 VAC - Start trigger, shares COM ground</td>
</tr>
<tr>
<td>T5</td>
<td>R1 COM</td>
<td>Relay 1- SPDT</td>
<td>24 VAC - internal (J1)</td>
</tr>
<tr>
<td>T6</td>
<td>R1 NC</td>
<td>Relay 1 - SPDT</td>
<td>Inducer Speed Stage</td>
</tr>
<tr>
<td>T7</td>
<td>R1 NO</td>
<td>Relay 2 - NC</td>
<td>Thermostat Interrupt (Min temp rise mode)</td>
</tr>
<tr>
<td>T8</td>
<td>EXA</td>
<td>0-10 VDC</td>
<td>Modulation Voltage - Polarity Sensitive</td>
</tr>
<tr>
<td>T9</td>
<td>DIAL</td>
<td>Remote Temp Selector</td>
<td>TD114+ Series RTS</td>
</tr>
<tr>
<td>T10</td>
<td>SENSOR</td>
<td>Discharge Air Sensor</td>
<td>TS194Q DAS</td>
</tr>
</tbody>
</table>

### LED STATUS INDICATORS

<table>
<thead>
<tr>
<th>Status</th>
<th>PCB Label</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Power</td>
<td>PWR</td>
<td>Blue</td>
</tr>
<tr>
<td>Start Up/Modulating</td>
<td>MOD</td>
<td>Green</td>
</tr>
<tr>
<td>Relay #1 Energized</td>
<td>R1</td>
<td>Red</td>
</tr>
<tr>
<td>Relay #2 Timer/Energized</td>
<td>T/R2</td>
<td>Red</td>
</tr>
<tr>
<td>AFS (“A” Suffix)</td>
<td>AFS</td>
<td>Green</td>
</tr>
</tbody>
</table>
**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:**

<table>
<thead>
<tr>
<th>Stage</th>
<th>EXA Modulation Voltage</th>
<th>R</th>
<th>Mode</th>
<th>% of total (Approx)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0 VDC</td>
<td>R2 energized</td>
<td>Heater OFF</td>
<td>&lt;20%</td>
</tr>
<tr>
<td>I</td>
<td>&gt;0-4.5* VDC</td>
<td>R1 energized, R2 de-energized</td>
<td>Inducer Low</td>
<td>20-60%</td>
</tr>
<tr>
<td>II</td>
<td>4.5*-10 VDC</td>
<td>R1, R2 de-energized</td>
<td>Inducer High</td>
<td>60-100%</td>
</tr>
</tbody>
</table>

*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.