

# Selectra<sup>®</sup> SERIES 94 INSTALLATION INSTRUCTIONS and field service check list



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## Introduction

The Selectra SERIES 94 is for use with **either direct or indirect gas fired units** (furnaces, ovens, etc.). The system may be field installed on existing equipment or specified for new equipment installation.

This bulletin's information is often presented in terms of 'remote' or 'self-contained' system items, along with components common to either configuration. A remote system contains an amplifier with a separate temperature selector. A room override thermostat is optional with remote single dial

selector TD94E-0409. The self-contained system has the amplifier/selector combined as a single unit. Common items include temperature sensors, mixing tubes, and modulator/modulator-regulator valves.

The TD294E is a dual remote temperature selector used primarily for paint booth "spray/dry" applications. Both the TD294E and TD94E have LED digital readouts. A "K" thermocouple (not supplied by Maxitrol) may be used with "K" suffixed amplifier/selectors.

## System Components

### Remote System Items

#### Remote Temperature Selectors (with LED Display):

TD94E-0409 (40° to 90°F)  
TD94E-0616 (60° to 160°F)  
TD94E-1030 (100° to 300°F)  
TD294E-609/0818 (dual temp 60° to 90°F and 80° to 180°F)

#### Amplifiers:

A1094 (all temperature ranges)  
A1494 (all temperature ranges)

**Override Stat (optional)** - T115 (40° to 90°F)  
(use with TD94E-0409)

### Self-contained System Items

#### Amplifier/Selectors (with LCD Display):

AD1094C-1050 (100° to 500°F)  
AD1094C-2565 (250° to 650°F)  
AD1094CM-1234 (120° to 345°C)  
AD1494CK-60120 (600° to 1200°F)

## Common Items

#### Temperature Sensors:

TS194 (use with mixing tube)  
TS394-3B48FQ (3" x .19" dia. probe)

#### Mixing Tubes: (length)

MT1-9 or 2-9 (9" / 229 mm)  
MT1-12 or 2-12 (12" / 305 mm)  
MT1-23 or 2-23 (23" / 584 mm)  
MT1-28 or 2-28 (28" / 711 mm)  
MT1-57 (57" / 1448 mm)

#### Valves:

M411, M420, M420H, and M451 (3/8" and 1/2" pipe size)  
M511, M520, M520H, and M551 (1/2" and 3/4" pipe size)  
M611, M620, M620H, and M651 (3/4" and 1" pipe size)  
MR212D (1", 1-1/4", and 1-1/2" pipe size)  
MR212E (1-1/2" and 2" pipe size)  
MR212G (2-1/2" and 3" pipe size)  
MR212J (4" flanged)  
MR212D-2, E-2, G-2, and J-2 (same pipe sizes as above, but used for 2-speed blower or dual fuel operation).  
MR251D, E, and G (same pipe sizes as above, but used for positive pressure atmospheric burner applications).

**Note:** The M (modulator) valve requires a pressure regulator for high fire setting.  
The MR (modulator/regulator) valve requires no pressure regulator up to 5 psi.

*(See bulletin MT 2035 for additional M/MR valve information)*

# Specifications and Dimensions

## Pressure Adjustment Range: (Maximum Fire)

Normal (MR212) .....	2" - 5" w.c. / 5 - 12.5 mbar
Normal (MR212-2) .....	2" - 5" w.c. / 5 - 12.5 mbar
	reduced 0" - 3" w.c. / 0 - 7.5 mbar

Consult factory on valves for positive pressure applications.

## Pressure Limits:

### Maximum Discharge Pressure

(M411, M420, M511, M520, M620, M611) ...	7" w.c. / 17 mbar
(M420H, M520H, M620H) .....	11" w.c. / 27 mbar
(MR251, M451, M551, M651) .....	7" w.c. / 17 mbar

above low fire setting

Max. Operating Inlet Pressure (MR212) ..... 5.0 psi / 345 mbar  
 (M411, M420, M420H, M451, M511, M520, M520H,  
 M551, M611, M620, M620H M651) ..... 1.0 psi / 70 mbar

Max. Emergency Exposure\* (MR212) ..... 12.5 psi / 860 mbar  
 (M411, M420, M420H, M451, M511, M520, M520H,  
 M551, M611, M620, M620H, M651)..... 3.0 psi / 210 mbar

\*May not function properly at this pressure, but will suffer no internal damage.

## Power Supply:

24 VAC, 50/60 Hz Class II transformer

**Gases:** All fuel gases.

## Vent:

Models M411, M420, M451, M511, M520, M551, M611, M620,

M651 - vertical vent outlet 1/8" NPT - 12A06 installed.

Model MR212 - two vents located in upper housing, both equipped with vent limiting means.

## Ambient Limits:

Amplifier:	Operating .....	-40° to 125°F / -40° to 52°C
	Non-operating .....	-50° to 185°F / -46° to 85°C
Selector:	Operating .....	15° to 140°F / -9° to 60°C
	Non-operating .....	-5° to 155°F / -21° to 68°C
Amp/Selector:	Operating .....	15° to 125°F / -9° to 52°C
	Non-operating .....	-5° to 155°F / -21° to 68°C

## Modifications:

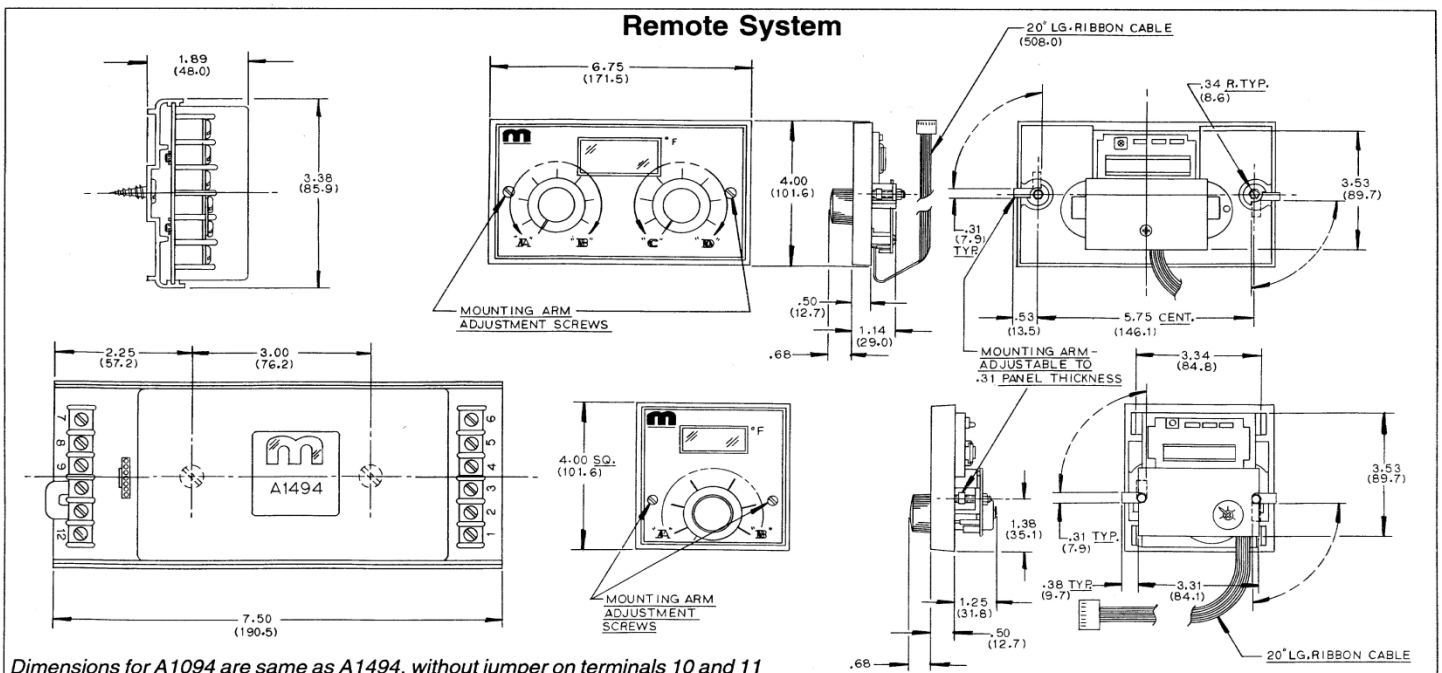
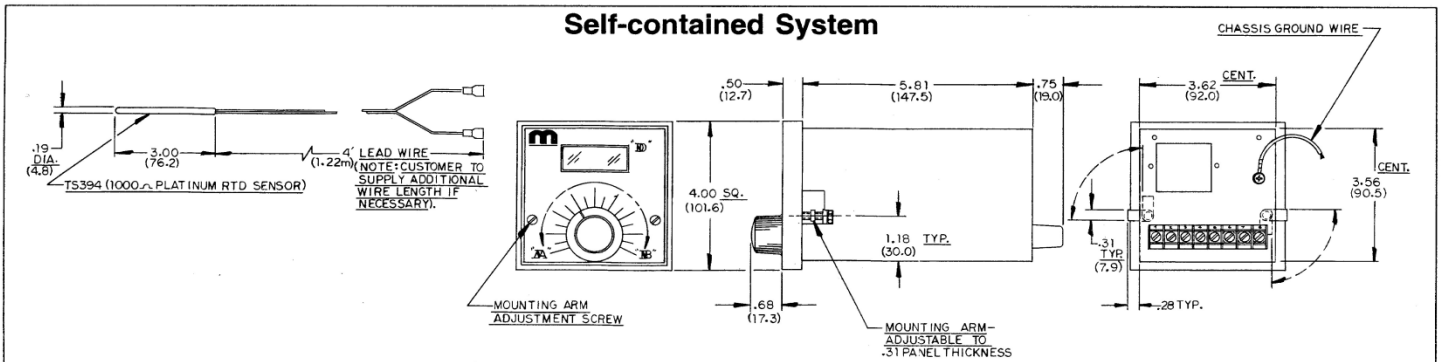
Models M411, M420, M451, M511, M520, M551, M620, M651 are available as "W" models - indicates covered wire terminal connections (same as M611).

Models M411, M420, M511, M520, M611, and M620 are available with side pressure tap for reading outlet pressure - on side opposite of minimum adjustment mechanism.

Models M451, M551, and M651 available on either side.

## Mounting:

Must be mounted in upright position in horizontal pipe run, downstream of all other controls except high pressure cut-off switch if used.



# Installation of Components

## Remote System Items

**Remote Selector:** Cut hole in chosen panel location (TD94 - 3 5/8" x 3 5/8" / 92.1 x 92.1 mm, TD294 - 3 5/8" x 6 3/8" / 92.1 x 161.1 mm) - retract mounting brackets - insert selector into panel cut out - turn mounting screws until controller is rigidly mounted. Ambient temperature at selected location should be between 15° and 140° F / -9° and 60° C.

**Amplifier:** Slide or snap out circuit board from amplifier base. Mount base with two screws in chosen location protected from weather or contaminated atmosphere. (Ambient temperature at this location must be between -40° and 125° F / -40° and 52° C) Amplifier is ready for wiring when circuit board is replaced on base - protective cover need not be removed. **Control wires connecting the remote temperature selector to the amplifier must not be run close to or inside conduit with power or ignition wires. Doing so may cause the unit to function erratically or may destroy the amplifier.**

**Power Supply:** Modulating power to terminals 1 and 2 should be supplied by a 24V AC, 50/60 Hz, transformer. Modulating current requirements: .8 amp maximum / 1.2 amp maximum for "H" models.

Automatic control valves requiring more than a 24V AC 20 VA transformer, are to use an independent power supply. The amplifier relay has the capacity to handle required loads up to a maximum of 10 amps. If exceeding 10 amps, an auxiliary relay with contact rating sufficient to handle the automatic gas valve will be necessary.

**Optional Room Override Thermostat (T115):** For use with TD94E-0409 single dial remote selectors only. Mount in heated area out of direct path of discharge air stream. The T115 thermostat senses space temperature and should the temperature drop below the T115 setting, the discharge air is automatically reset to a higher temperature. This override temperature is adjustable from 0° - 40° F above the TD94E setpoint and is set with a dial located on the back of the TD94E. When the T115 temperature setpoint is satisfied, the discharge air temperature returns to the normal TD94E setting.

## Self-contained System Items

**Amplifier/Selector:** Install 1/4 DIN box in chosen location - cut hole in panel (3 5/8" x 3 5/8" / 92.1 x 92.1 mm) - retract mounting brackets - insert controller into panel cut out - turn mounting screws until controller is rigidly mounted. Ambient temperature at selected location should be between 15° and 125° F / -9° and 52° C.

**Power Supply:** Modulating power to terminals 7 and 8 should be supplied by a 24V AC, 50/60 Hz, transformer. Modulating current requirements: .8 amp maximum / 1.2 amp maximum for "H" models.

Automatic control valves requiring more than a 24V AC 20 VA transformer, are to use an independent power supply. The amplifier relay has the capacity to handle required loads up to a maximum of 10 amps. If exceeding 10 amps, an auxiliary relay with contact rating sufficient to handle the automatic gas valve will be necessary.

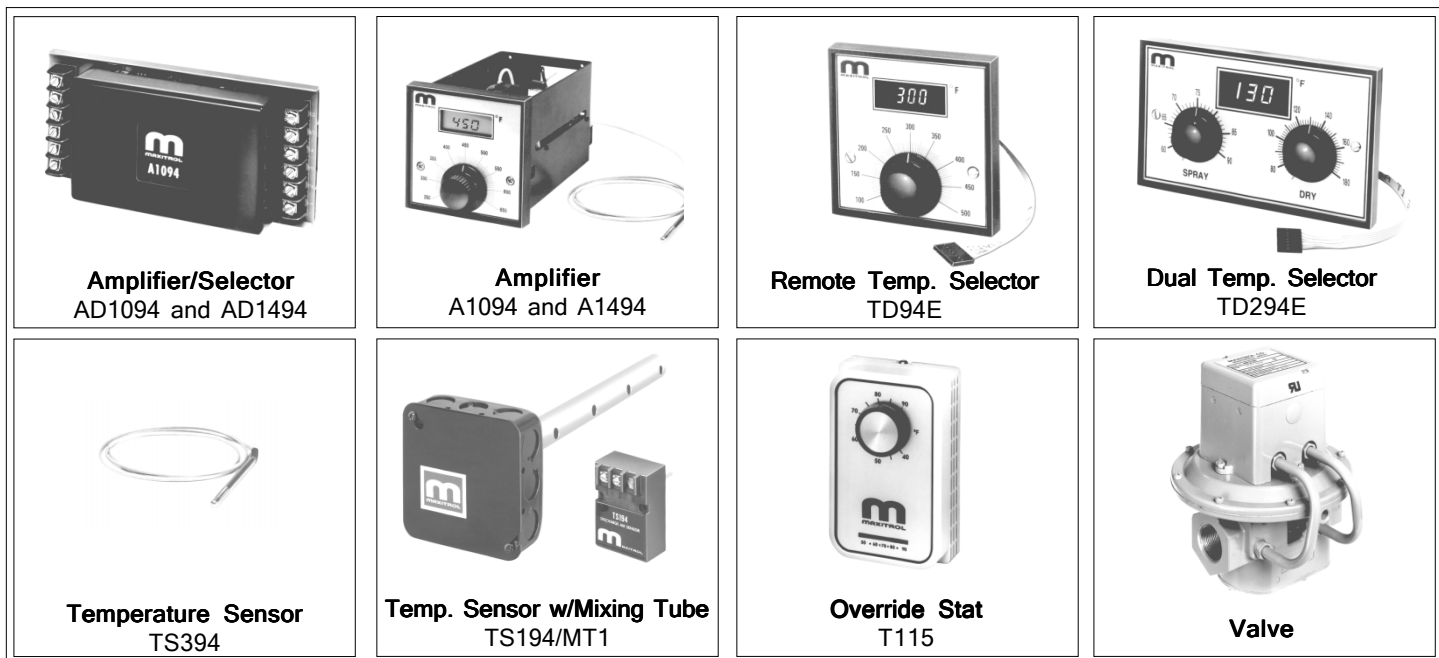
## Common Items

**TS394 Temperature Sensor:** Locate where average (mean) temperature can be sensed. Ensure that it is not touching side of unit. (Sensor and wire are able to withstand 700° F / 371° C ambient temperature.) If sensor location is beyond its 4 ft. / 1.22 m lead length from the controller, complete the connection using 18-22GA fiberglass insulated wire (see note below) or 18-22GA standard copper wire.

**NOTE:** Use fiberglass insulated wire if in direct contact with heated air or surfaces. Avoid use of fiberglass insulated wire beyond heated air or surface areas.

**TS194 Temperature Sensor w/ Mixing Tube:** Sensor contained within mixing tube assembly - installed in discharge airstream. (Sensor is able to withstand 300° F / 149° C maximum temperature.)

**Modulator / Modulator-Regulator Valve:** Mount in upright position in horizontal run of pipe, downstream of other controls.



# Field Service Checklist

SYMPTOM	POSSIBLE CAUSE	FIELD TEST	REMEDY
<b>A. No gas flow.</b>	<ol style="list-style-type: none"> <li>1. Modulating valve improperly installed.</li> <li>2. See symptom "K."</li> </ol>	<ol style="list-style-type: none"> <li>1. Arrow on side of valve point in direction of gas flow.</li> </ol>	<ol style="list-style-type: none"> <li>1. Install properly.</li> </ol>
<b>B. Continuous Low Fire (Electronic Problem).</b>	<ol style="list-style-type: none"> <li>3. No voltage to the controller/amplifier</li> <li>4. Open circuit in temperature sensor wiring.</li> <li>5. Open circuit in modulator coil.</li> <li>6. No voltage to the modulator.</li> <li>7. Short circuit in temperature sensor wiring.</li> </ol>	<ol style="list-style-type: none"> <li>3. Check for 24V AC at terminals (amplifier -1 and 2, amplifier/selector -7 and 8).</li> <li>4. Perform temperature sensing function test outlined in "Preliminary Circuit Analysis."</li> <li>5. Measure resistance across modulator terminals with lead wires disconnected.</li> <li>6. Perform modulating function test as outlined in "Preliminary Circuit Analysis."</li> <li>7. Perform temperature sensor function as outlined in "Preliminary Circuit Analysis."</li> </ol>	<ol style="list-style-type: none"> <li>3. Prove the source.</li> <li>4. If modulating voltages are obtained, check sensor for open circuit. Correct wiring.</li> <li>5. Replace modulator head (if available) or modulator if resistance is not approximately 45-55 ohms for M611, M620, and M651; 50-65 ohms for M511, M620, and M551; and 60-80 ohms for M411, M420, M451, and MR212.</li> <li>6. Prove the power source, and if it checks out, and modulating function test determines no modulating voltages, controller or amplifier with remote temperature selector may be at fault. Replace.</li> <li>7. If modulating voltages are obtained, check sensor wiring and sensor for short circuit. Correct wiring.</li> </ol>
<b>C. Continuous Low Fire (Electronics OK).</b>	<ol style="list-style-type: none"> <li>8. Heat load requires low fire only.</li> <li>9. Inadequate supply pressure.</li> <li>10. Plunger missing, jammed, misinstalled.</li> </ol>	<ol style="list-style-type: none"> <li>8. Increase temperature setting 10 degrees.</li> <li>9. Read pressure at inlet to modulating valve using a manometer with unit operating at full fire. Pressure should be greater or equal to the sum of outlet pressure setting plus pressure drop of the valve (See Maxitrol capacity chart - bulletin MT2035).</li> <li>10. Inspect. Plungers should be installed as illustrated and operate freely in solenoid sleeve.</li> </ol>	<ol style="list-style-type: none"> <li>8. If heater goes to high fire, system is working correctly.</li> <li>9. Increase inlet pressure if possible.</li> <li>10. Clean or replace plunger if necessary. Installed as illustrated.</li> </ol>
<b>D. Incorrect Low Fire.</b>	<ol style="list-style-type: none"> <li>11. Incorrect by-pass metering valve adjustment.</li> <li>12. Excessive negative burner pressure (direct-fired only).</li> </ol>	<ol style="list-style-type: none"> <li>11. See valve adjustments on page 8.</li> <li>12. Close main gas supply and measure manifold pressure with blower operating. Reading should be less negative than 1.5 inches w.c. (3.7 mbar) negative pressure. (MR212D, E, G, J, M411, 511, M611)</li> </ol>	<ol style="list-style-type: none"> <li>11. Adjust to proper minimum fire.</li> <li>12. If reading is more negative than 1.5 inches negative pressure, check for clogged filters or other inlet air restrictions. (MR212D, E, G, J - are field adjustable to 3.5 inches w.c. [9 mbar] negative pressure. Check manufacturer's design requirements to ensure proper setting.) Consult factory for other solutions.</li> </ol>
<b>E. Continuous High Fire (Electronics OK).</b>	<ol style="list-style-type: none"> <li>13. Foreign object holding valve open.</li> <li>14. Improper diaphragm installation.</li> <li>15. Plunger jammed.</li> </ol>	<ol style="list-style-type: none"> <li>13. Remove bottom plate and inspect valve and seat.</li> <li>14. If main diaphragm gasket &amp; diaphragm replaced, check for proper installation/alignment.</li> <li>15. Inspect. Plunger should be smooth and clean, and operate freely in solenoid sleeve.</li> </ol>	<ol style="list-style-type: none"> <li>13. If necessary, clean seat and valve, or replace if applicable.</li> <li>14. Install and align properly.</li> <li>15. Clean, or if necessary, replace plunger.</li> </ol>
<b>F. Incorrect High Fire.</b>	<ol style="list-style-type: none"> <li>16. Inadequate supply pressure.</li> <li>17. Incorrect outlet pressure adjustment of pressure regulator.</li> </ol>	<ol style="list-style-type: none"> <li>16. Read pressure at inlet to modulating valve using a manometer with unit operating at full fire. Pressure should be equal to the sum of outlet pressure plus pressure drop of the valve (see Maxitrol capacity chart - bulletin MT2035)</li> <li>17. Read manifold pressure using manometer and compare with recommendation of heater manufacturer.</li> </ol>	<ol style="list-style-type: none"> <li>16. Increase inlet pressure if possible.</li> <li>17. See valve adjustments on page 8.</li> </ol>
<b>G. Erratic or Pulsating Flame.</b>	<ol style="list-style-type: none"> <li>18. Hunting.</li> <li>19. Erratic air patterns or improper temperature sensor location.</li> <li>20. Controller/amplifier wiring is run next to high voltage switching circuits causing induced voltages.</li> <li>21. Erratic voltage supply.</li> <li>22. Erratic inlet pressure.</li> </ol>	<ol style="list-style-type: none"> <li>18. Controller/amplifier may require "sensitivity" adjustment.</li> <li>19. Perform temperature sensor function test as outlined in "Preliminary Circuit Analysis."</li> <li>20. Connect with temporary wiring clear of induction source, or when possible turn "off" source of induced voltage.</li> <li>21. Connect AC voltmeter across terminals (amplifier -1 &amp; 2, amplifier/selector -7 &amp; 8).</li> <li>22. Measure inlet during operation.</li> </ol>	<ol style="list-style-type: none"> <li>18. Contact Maxitrol Service Manager.</li> <li>19. If the flame is steady throughout the entire modulating range, the sensor must be moved.</li> <li>20. If smooth operation results, isolate wiring from source of induced voltage.</li> <li>21. If erratic operation is noted only over a small range of 2 or 3 volts, the voltage source may contain surges. Consult Maxitrol.</li> <li>22. Investigate regulator upstream of modulator.</li> </ol>
<b>H. Incorrect Air Temperature.</b>	<ol style="list-style-type: none"> <li>23. Improper temperature sensor location.</li> </ol>	<ol style="list-style-type: none"> <li>23. Sensed temperature (thermometer next to sensor) does not represent average air temperature.</li> </ol>	<ol style="list-style-type: none"> <li>23. Move sensor to location where desired temperature can be sensed.</li> </ol>
<b>I. Burned-out Transformer.</b>	<ol style="list-style-type: none"> <li>24. Short circuit in modulator coil.</li> <li>25. Coil shorted to ground.</li> <li>26. Short circuit - controlled/amplifier and modulator.</li> </ol>	<ol style="list-style-type: none"> <li>24. Measure resistance across modulator terminals with lead wires disconnected.</li> <li>25. Measure resistance from each terminal to ground.</li> <li>26. Inspect wiring.</li> </ol>	<ol style="list-style-type: none"> <li>24. Replace modulator head (if available) or modulator if resistance is not approximately 45-55 ohms for M611, M620, and M651; 50-65 ohms for M511, M520, and M551; and 60-80 ohms for M411, M420, M451, and MR212.</li> <li>25. Replace modulator head (if available) or modulator.</li> <li>26. Correct wiring if short is found (shorted modulator/modulator-regulator valve will damage amplifier).</li> </ol>
<b>The following items do not apply to remote system amplifier model A1494.</b>			
<b>J. Automatic Control Valve will not close despite full range of modulating voltage at terminals 3 &amp; 4.</b>	<ol style="list-style-type: none"> <li>27. Faulty automatic control valve.</li> <li>28. Installation wiring error.</li> <li>29. Controller/amplifier wiring is faulty.</li> </ol>	<ol style="list-style-type: none"> <li>27. Remove wire from valve. If valve doesn't close, valve is faulty.</li> <li>28. Remove wire from terminal (amplifier -5 [or 1 - common power supply], amplifier/selector -5 [or 8 - common power supply]). If valve remains open, check for mis-wiring.</li> <li>29. Perform auto valve function test as outlined in "Preliminary Circuit Analysis."</li> </ol>	<ol style="list-style-type: none"> <li>27. Replace automatic control valve.</li> <li>28. Correct wiring.</li> <li>29. Replace controller/amplifier.</li> </ol>
<b>K. Automatic Control Valve will not open despite full range of modulating voltage at terminals 3 &amp; 4.</b>	<ol style="list-style-type: none"> <li>30. Faulty automatic control valve.</li> <li>31. Open wire to automatic valve.</li> <li>32. Controller/amplifier relay is faulty.</li> </ol>	<ol style="list-style-type: none"> <li>30. Read voltage across auto valve terminals. If 24 AC, valve is faulty.</li> <li>31. Read voltage across terminals 5 and 6. If 24V AC, check for open circuit to automatic valve.</li> <li>32. Perform auto valve function test as outlined in "Preliminary Circuit Analysis."</li> </ol>	<ol style="list-style-type: none"> <li>30. Replace automatic control valve.</li> <li>31. Correct wiring.</li> <li>32. Replace controller/amplifier.</li> </ol>

# Preliminary Circuit Analysis

In order to diagnose the cause of problems in this system it is necessary to determine certain values. It is helpful to have a volt/ohm multimeter.

**Modulation Function:** If sensed temperature (controller display) is less than minimum dial setting temperature, perform Step A below, otherwise continue on to Step B.

A. Disconnect the sensor wires to terminals (amplifier - 8 and 9, amplifier/selector - 1 and 2) and replace with supplied test resistor or with other means to obtain a resistance value falling within the temperature range to be tested, referencing temperature table below.\*

B. Connect a DC volt meter to terminals 3 and 4, or at the M/MR valve terminals. Do not disconnect existing wiring.

C. Rotate temperature dial knob to maximum setting - the DC volts should read at least 17.5V DC. Rotate temperature dial knob to minimum setting - the DC volts should read no more than 2.0V DC. DC voltage should gradually increase as the dial temperature setting is slowly rotated up to and past the controller's digital display temperature.

**Override Function:**  
(Amplifier w/Remote Selector, 40°-90° F range, ONLY)

A. Connect a DC volt meter to terminals 3 and 4, or at the M/MR valve terminals. Do not disconnect existing wiring.

B. Connect a jumper between terminals 11 and 12 - the approximate volts should read at least 17.5V DC.

**Automatic Valve Function:** (Indirect Fired units ONLY) If sensed temperature (controller display) is less than minimum dial setting temperature, perform Step A below, otherwise continue on to Step B.

A. Disconnect the sensor wires to terminals (amplifier - 8 and 9, amplifier/selector - 1 and 2) and replace with supplied test resistor or with other means to obtain a resistance value falling within the temperature range to be tested, referencing temperature table below.\*

B. Disconnect wires to terminals 5 and 6. Connect an ohmmeter to the terminals (use a voltmeter for remote system amplifier model A1094).

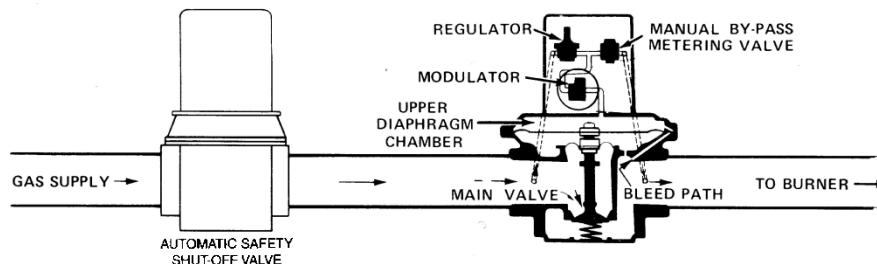
C. Rotate temperature dial knob to maximum setting. Volt/ohmmeter should indicate continuity. Rotate temperature dial to minimum setting. Volt/ohmmeter should indicate open circuit.

**Temperature Sensor Function:** Perform the entire "Modulation Function" analysis, implementing Step A. (Step A isolates the sensor function from the system)

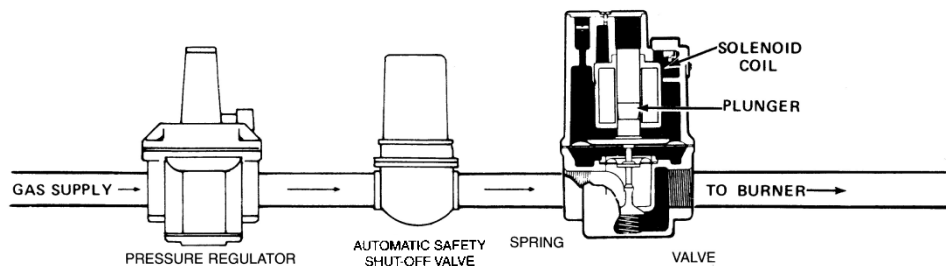
Temperature Table	
*Approximate controller display temperature with 1100 to 1800 ohms resistance across terminals (amplifier - 8 and 9, amplifier/selector - 1 and 2).	
R (ohms)	T (degrees)
1100	78°F (25°C)
1200	125°F (50°C)
1300	172°F (80°C)
1400	220°F (100°C)
1500	270°F (130°C)
1600	315°F (160°C)
1700	365°F (185°C)
1800	410°F (210°C)

## Typical Gas Trains

**MR Valve: Modulator-regulator valve**



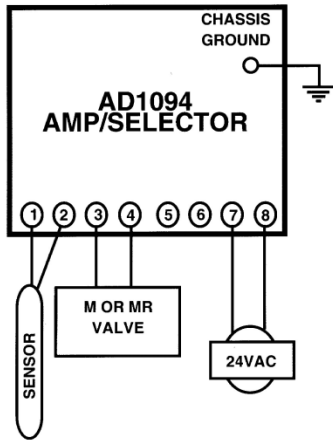
**M Valve: Regulator upstream of modulator valve**



# Wiring Diagrams

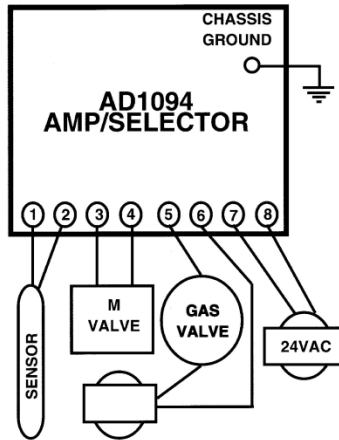
## Self-contained System Amplifier/Selectors:

### DIRECT FIRED

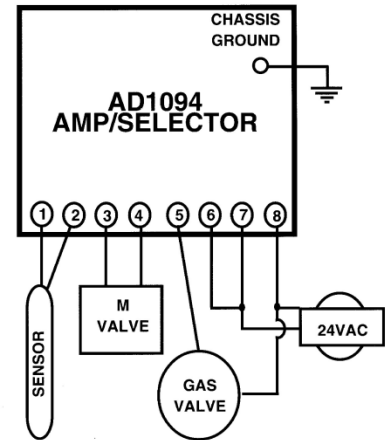


### INDIRECT FIRED

#### INDEPENDENT POWER SUPPLY

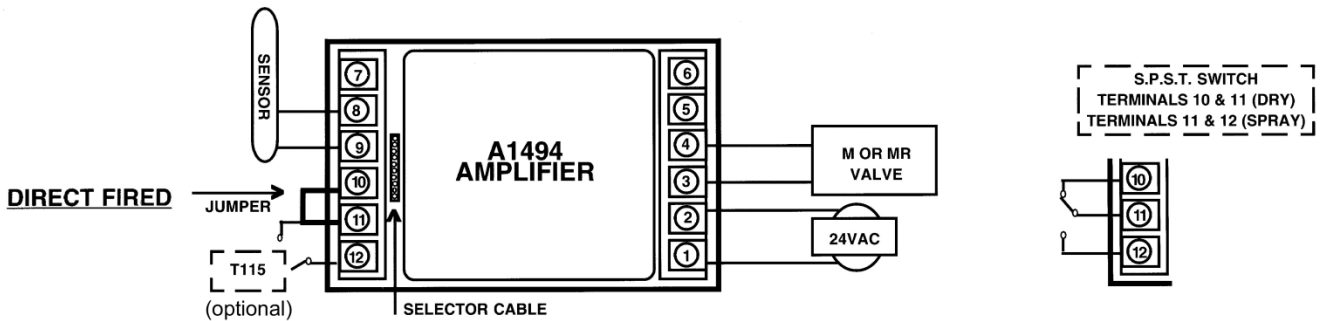


#### COMMON POWER SUPPLY

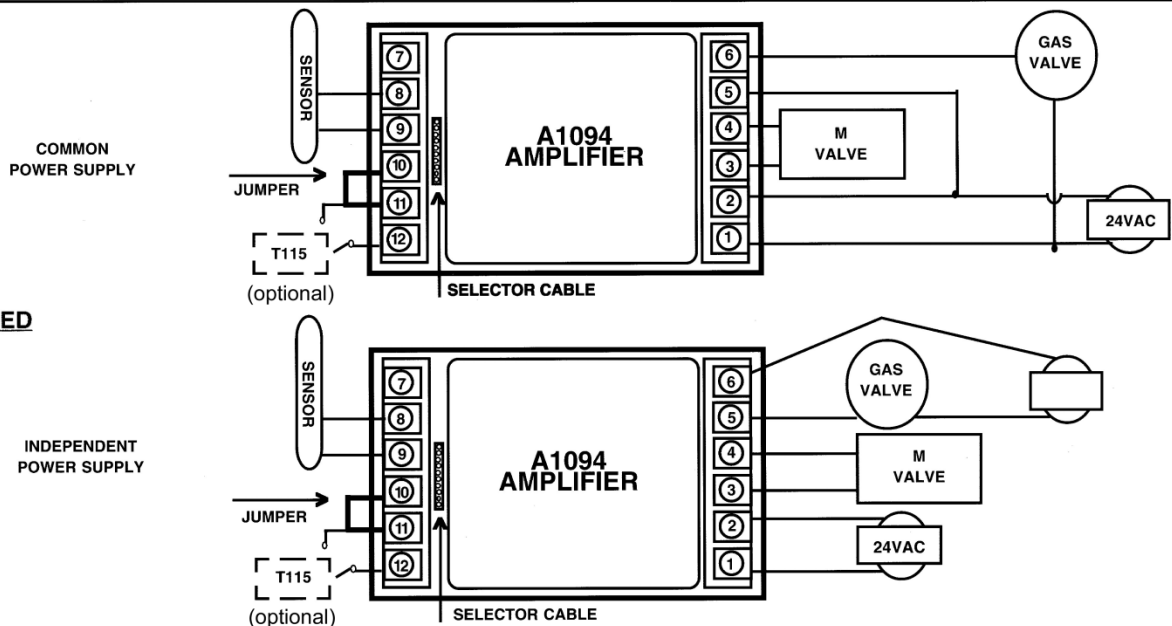


## Remote System Amplifiers:

### DIRECT FIRED



### INDIRECT FIRED



# Valve Adjustments

(See bulletin MT2035 for additional M/MR valve information)

**NOTE:** Low Fire Adjustment should be checked whenever High Fire Adjustment is changed.

## **High Fire Adjustments:**

Rotate selector dial to maximum temperature setting.  
NOTE: Voltage to the valve must be at least 18VDC.

M411, M420, M511, M520, M611, and M620 -  
Adjust separate pressure regulator to obtain desired manifold pressure.

M451, M551, and M651 -  
Adjust separate pressure regulator to obtain desired manifold pressure.

MR212D, E, and G - MR251D, E, and G - (see figure 1)  
Remove cap (A) and turn regulator pressure adjusting screw to obtain desired manifold pressure. Clockwise rotation increases pressure.

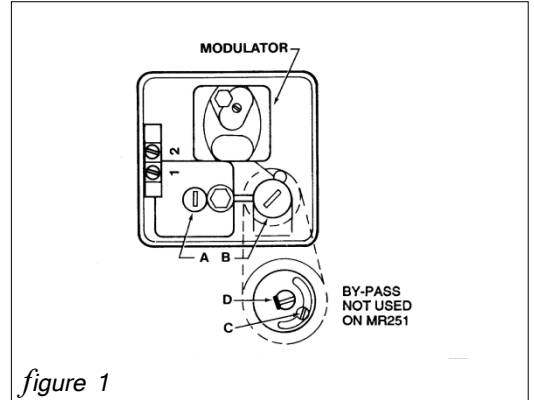


figure 1

**Low Fire Adjustments:** Disconnect a wire from M or MR valve terminal block.

NOTE: Be careful not to allow wire to come into contact with any other part.

MR212D, E, and G - (see figure 1)  
Remove cap (B) from by-pass metering valve and loosen lock screw (C).  
Turn adjusting screw (D) to desired low fire adjustment.

M411, M420, M511, M520, M611, and M620 - (see figure 2)  
Remove by-pass cap (A) and turn screw (B) using small screwdriver to desired low fire adjustment.

NOTE: Clockwise screw rotation reduces flow rate. Do not overtighten.

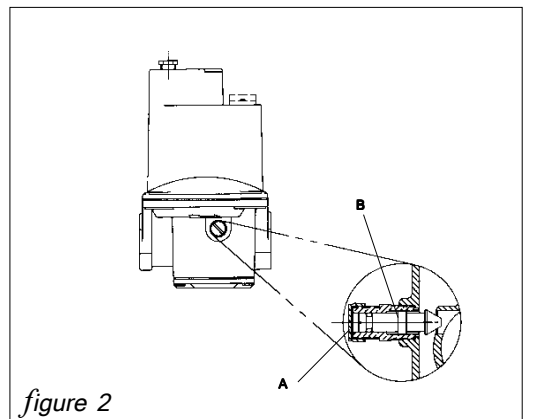


figure 2

M451, M551, M651 - MR251D, E, G, - (see figure 3)  
Remove cover plate (A). Using minimum adjusting screw (B), set manifold pressure to manufacturer's specifications.

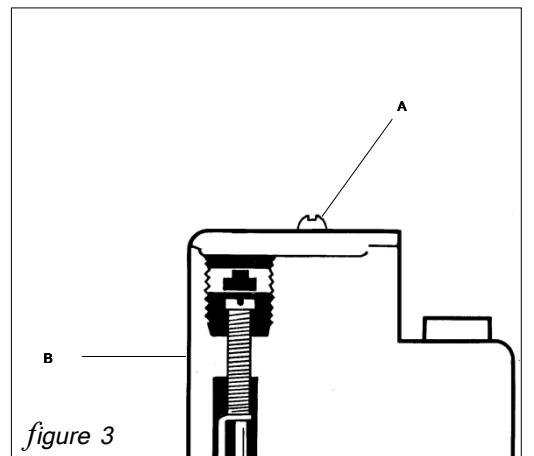


figure 3

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***www.maxitrol.com***

Maxitrol Company  
23555 Telegraph Rd., P.O. Box 2230  
Southfield, MI 48037-2230 U.S.A.  
248.356.1400 • Fax 248.356.0829

European Representatives  
Warnstedter Strasse 3 06502 Thale, Germany  
49.3947.400.0 • Fax 49.3947.400.200  
Industriestrasse 1 48308 Senden, Germany  
49.2597.9632.0 • Fax 49.2597.9632.99