

# Linotype Heater Controls

## Digital Replacements

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# Overview

General overview of the replacement of Microtherm controls and mechanical relays with digital PID process controller and Solid State Relays.

This is a general guide and basic electrical knowledge is assumed. Most components shown in the following slides can be replaced with other brands and models. It is the reader's responsibility to verify ratings.

**MOST IMPORTANT RULE - GROUND YOUR MACHINE!! THIS IS FOR YOUR SAFETY!**

**FOR 110V MACHINES - THE NEUTRAL CONDUCTOR IS NOT A SAFETY GROUND, RUN A GROUND WIRE BACK TO YOUR ELECTRICAL PANEL.**

# Microtherm Controls

- Original microtherm controls use a fluid filled bulb and bellows as a temperature sensor.
- Snap-action switches operated the main power relays.
- Main relays are mechanical open frame relays.
- Over-temperature safety is provided through a bimetal snap action switch made by Klixon. The device is connected to an auxiliary terminal on the master on/off switch which causes the master switch to open if the crucible gets too hot.
- Four heaters are used in the system
  - Two heaters in the crucible
  - Two heaters attached to the throat

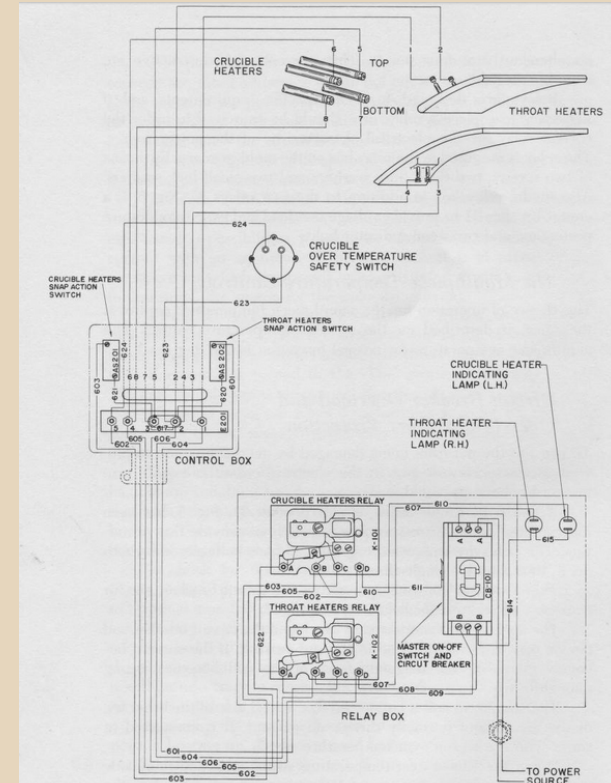


FIGURE 6-Comet Micro-Therm Electric Pot Wiring Diagram

# Replacement Overview

Individual component functions along with modern replacement part type are listed below:

- Fluid-filled Bulbs function as a temperature Sensor, replaced with K-Type Thermocouple
- Bellows / Snap Action Switches / Adjustment knobs function as the temperature controller, replaced with PID Controller
- Mechanical Relays function as the power switch can be replaced with solid state relays
- Klaxon bi-metal switch functioned as the overtemperature sensor, these are quite reliable and should be retained.

# Temperature Sensors

- A Stainless Steel clad K-Type Thermocouple can be placed directly in the crucible and mounted in the throat without any difficulty. These thermocouples are typically rated for use from -328 to 2282F, more than enough range for our equipment.
- These thermocouples can be purchased through eBay for under \$10 each. Search for “Stainless Steel K-Type Thermocouple”



# Digital PID Controller

- PID Controllers are “Proportional-Integral-Derivative” controllers
- These controllers are used frequently in industrial processes
- Inexpensive chinese-made units are available on eBay for under \$30 each, search for “TA4-SNR”
- The SNR model has a main output designed for driving SSRs, No aux output, and a Relay alarm output.
- Two PID Controllers are required for Linotype machines, one for the crucible heaters and one for the throat heater.



# Overcurrent Protection

- Circuit breakers or fuses must be used to protect the system from over current conditions.
- Individual machine current ratings will vary depending on the heater elements installed in the machine.
- It is best if you measure the cold resistance of your heaters to determine the current draw. Current is voltage divided by resistance.
- If you have the original heaters and the rating plate is intact you can use the information on the chart in the Microtherm manual:
  - 120V - Crucible: 12A, Throat: 12A
    - 100-125V Crucible Heaters
    - 100-125V Throat Heaters
  - 240V - Crucible: 6A, Throat: 6A
    - 200-250V Crucible Heaters
    - 221-250V Throat Heaters
  - 208V - Crucible: 5.2A, Throat: 6.4A
    - 200-250V Crucible Heaters
    - 200-220V Throat Heaters

CRUCIBLE HEATERS					
Voltage	Top Crucible Heater		Bottom Crucible Heater		
	Part No.	Resistance	Part No.	Resistance	
100-125 volts	F-6956 A	20 ohms	F-6957 A	20 ohms	
200-250 volts	F-6956 B	80 ohms	F-6957 B	80 ohms	
140-165 volts	F-6956 C	37 ohms	F-6957 C	37 ohms	
180-200 volts	F-6956 D	60 ohms	F-6957 D	60 ohms	

THROAT HEATERS					
Voltage	Upper Throat Heater		Lower Throat Heater		
	Part No.	Resistance	Part No.	Resistance	
100-125 volts	F-8437 A	25.8 ohms	F-8438 A	17 ohms	
221-250 volts	F-8437 B	103 ohms	F-8438 B	68.8 ohms	
140-165 volts	F-8437 C	43 ohms	F-8438 C	28.8 ohms	
180-200 volts	F-8437 D	67.5 ohms	F-8438 D	45 ohms	
200-220 volts	F-8437 E	81.7 ohms	F-8438 E	54.4 ohms	

**NOTE:** Resistances given are for when heaters are at room temperature. Hot resistance is approximately 110 percent of cold resistance. Resistances given are approximate and may vary within plus-minus 10 percent of figures given without noticeably affecting operation.

# Overcurrent Protection (cont'd)

- For most machines the suggested circuit breaker sizes are listed below, but if you have nonstandard elements you will need to determine the appropriate size.
  - @120V: 30A Main, 25A Crucible, 25A Throat, 1A PID
  - @240V: 20A Main, 15A Crucible, 15A Throat, 1A PID
  - @208V: 20A Main, 15A Crucible, 15A Throat, 1A PID
- Circuit breakers should be UL489 “branch circuit” listed breakers.
- Eaton FAZ-NA series is UL489 listed and is DIN rail mountable.



# Overtemperature Protection

- Existing crucible klixon can be used in conjunction with a shunt trip for the main input circuit breaker.
- Eaton offers a FAZ-XAA-NA110-415VAC shunt trip for the FAZ-NA series of circuit breakers which operates from 110-415V

# Solid State Relays (SSR)

- Any SSR that will accept a +24V control signal will work with the TA4-SNR PID controller
- Many different varieties are available from eBay
- For a resistive heater a “Zero Cross” SSR is highly recommended.
- A "Random" SSR will be more electrically noisy and more prone to burning out the heater elements.
- Most high amperage (30A) SSRs will require a heatsink, some will have a built-in heatsink.
- An example is the Crydom CKRD2430 (240V 30A)



# Main switch (disconnect)

- A main input disconnect should be installed at the service entrance to the machine
- Either a UL98 or UL508 listed disconnect is acceptable
- This will function as the power switch
- REMEMBER: A circuit breaker is NOT a power switch



# Part costs (as of August 2014)

Breakdown of individual parts cost:

- TA4-SNR PID Controller: eBay - 2@ \$24/ea
- K-Type Thermocouple: eBay - 2@ \$7/ea
- Crydom CKRD2430 SSR: eBay - 4@ \$35/ea
- ABB OT30F3 Rotary Disconnect: eBay - \$50
- 30A Double Pole Main Breaker (Eaton FAZ-30/2-NA): Allied Electronics - \$80
- Main Breaker Shunt Trip (Eaton FAZ-XAA-NA110-415VAC): Allied Electronics - \$59
- 25A Single Pole Heater Breaker (Eaton FAZ-C25/1-NA): Allied Electronics - \$36
- High Temperature Wire (Omega HTMG-1CU-312S/C 12AWG): Omega Engineering - \$3.35/ft
- Enclosure: \$100
- Misc. Hardware: \$50

Total: Approximately \$550 for all new, reuse of the existing microtherm control main switch is a lower cost option.

# Example Installation



Notes:

PID Controllers in this example are calibrated in degrees celsius.

I didn't take a good picture of the throat heater prior to putting the machine back together.

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