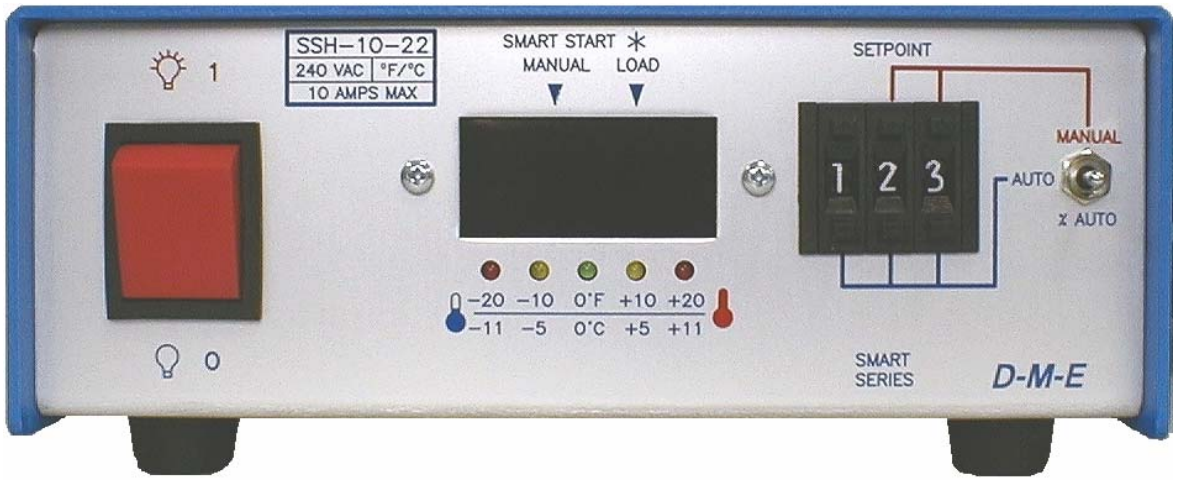
Smart Series®
ESH-10-22, SSH-10-21
& SSH-10-22



Microprocessor-Based
Single Zone
Temperature Control Unit
With Digital Display

User's Manual

DME Company

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Printed in the United States of America

DME Company
42827 Irwin Drive
Harrison Twp., MI 48045 USA

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WARRANTY

DME Company warrants that this product will be free from defects in materials and workmanship for a period of three (3) years from the date of shipment. If any such product proves defective during this warranty period, DME Company, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. D-M-E Company shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than DME Company representatives to repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

This warranty excludes replacement of fuses and damage to the unit from the use of improper styles of fuses. Use only ABC type replacement fuses. The maximum allowable fuse rating is 10 amps. Lower ratings may used for improved protection.

SAFETY

DME Company products have been designed to be safe and simple to operate. As with any electronic equipment, you must observe standard safety procedures to protect both yourself and the equipment.

To Prevent Injuries:

- To avoid electrical shock or fire hazard, do not apply voltage to a terminal that exceeds the range specified for that terminal.
- To avoid mechanical injury, electrical shock or fire hazard, do not operate this product with covers or panels removed.
- To avoid electrical shock or fire hazard, do not operate this product when wet.
- To avoid injury or fire hazard, do not operate this product in an explosive atmosphere.

To Prevent Product Damage:

- Do not operate this product from a power source that applies more than the voltage specified.

DME Standard
Smart Series® Microprocessor-Based
Single Zone
Temperature Control Unit
With Digital Display
ESH-10-22, SSH-10-21 & SSH-10-22

GENERAL DESCRIPTION

The Smart Series® SSH & ESH units are user-friendly temperature controllers of world-class caliber.
The SSH & ESH are based on one of the most widely used controllers in the hot runner control industry.
It has a large process temperature display, and it incorporates a 3-digit pushwheel for entering process temperature setpoints.
The illuminated display shows process temperature in Auto, and Manual modes.
Diagnostic fault codes for open ("OPE"), reversed ("bAC"), or shorted ("SHO") thermocouples are displayed digitally. The units automatically inhibit output power to the heater load in Auto mode until such faults are corrected, unless the new "Automatic Bumpless Transfer" option is enabled.
The units LED display indicators (located at the top left of each digit) show the mode of operation. The power to heater "load" LED doubles as a Smart Start® indicator by blinking during Smart Start. Five separate color-coded LED's located under the display indicate temperature deviation and over/under temperature conditions at a glance.

OPERATION

Auto Mode: The microprocessor maintains temperature using a proprietary closed loop control method. The microprocessor anticipates the heater load characteristics to make accurate adjustments and correct for errors.
"Fuzzy logic" is used to minimize overshoot of setpoint on start-ups, and to prevent over and undershoots when changing setpoints.
The SSH & ESH units can also display the average percent output power when running in Auto mode.
("% Auto" setting)
Smart Start®: Smart Start® is automatic on start-up in Auto mode if the process temperature is below 212°F (100°C), and provides a linear power output ramp to ensure safe heater dry out.
Smart Start® is completed after four minutes and thirty seconds has elapsed, or when process temperature exceeds the lesser of either the setpoint or 212°F (100°C) in Auto mode.
Input Fault: Thermocouple break protection, and reversed thermocouple protection, override Smart Start® when in Auto mode. (Output power is inhibited)
Shorted thermocouple protection, thermocouple break protection, and reversed thermocouple protection, inhibit output power in normal Auto mode operation.
If a thermocouple fault occurs when the "Automatic Bumpless Transfer" feature is ON (after operating at setpoint temperature for >10 Minutes), the unit will simulate manual mode using the average percent power learned during normal Auto operation.

Manual Mode: For no thermocouple, or a thermocouple failure, open loop percent output power is used.
In Manual mode, the microprocessor maintains a power level using an open loop power control method. This enables the user to continue production, and override thermocouple faults until the problem has been resolved. Manual mode overrides thermocouple break protection, shorted thermocouple protection, reversed thermocouple protection, and any other normal automatic modes.

FEATURES

- Fully self-tuning, fuzzy logic, microprocessor-based control.
- Selective Cycle® and Smart Start® to prolong heater life.
- Zero crossing triac triggering for minimum Radio Frequency Interference. (RFI)
- Process temperature display operational even in Manual mode as long as the thermocouple (T/C) is intact.
- Automatic T/C fault protection and cold junction compensation.
- High impedance potentiometric input allows for long distance T/C wiring.
- 100% solid-state circuitry, no mechanical relays.
- Completely self contained, no external output devices or power supplies required.
- Fast acting heater load fuses are provided on both sides of the AC line.
- Electrically isolated, and grounded front panel for operator safety.
- °F/°C configurable.
- J-type, or K-type thermocouple configurable.
- New Lights Out feature can be enabled to shut off the digital LED display during stable Auto control.
- Adjustable response time to shorted thermocouple faults.

NOTE: The SSH and the ESH units have a few functional differences.

- The ESH connector on the back panel is wired differently from the SSH. (See "Wiring The Load" on page 7)
- The ESH operates in degrees Celsius and the SSH operates in degrees Fahrenheit, however either unit can be re-configured to the other mode of operation. (See "Temperature Mode" on page 6)

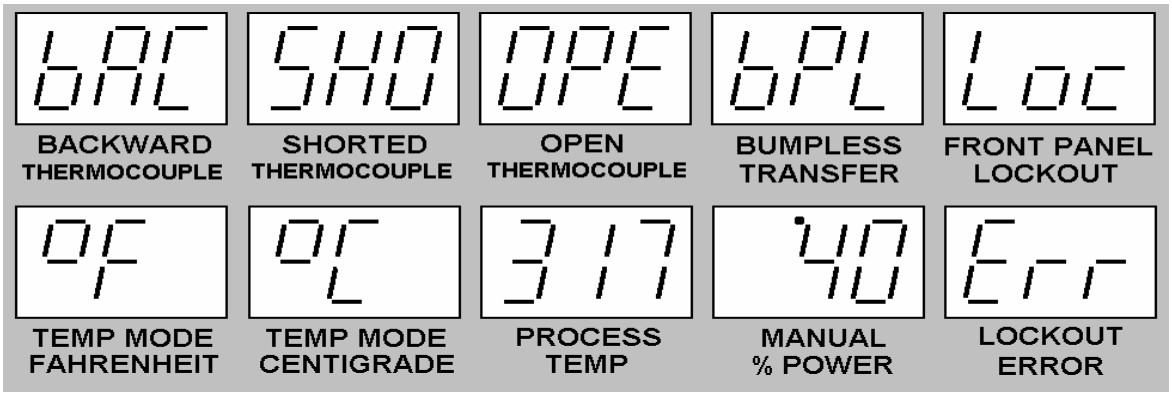


Figure 1 - Display

PERFORMANCE SPECIFICATIONS

Auto and Manual Control Modes: Selective Cycle: high speed time proportioning.
Temperature Range: Ambient to 999°F (537°C) with J-type, and K-type thermocouples.
Control Accuracy: +/-1°F (0.5°C), dependent on the total thermal system.
Temperature Stability: +/-0.5% of full scale over the ambient range of 32 to 120°F. (0 to 50°C)
Calibration Accuracy: Better than 0.2% of full scale.
Power Response Time: Less than 0.13 seconds.
Reset: Automatically corrects reset to no more than +/-1°F (1°C) at all settings.
Manual Control: Adjustable from 0-99%. Maintains output power to within 1% of setting.
Diagnostics Indicators: LED's and 3-digit, 7-segment display.
Smart Start® (SS): Linear power output ramp from an initial temperature (< 212°F in Auto mode) to ensure safe heater dry out.
SS Duration: 4-1/2 minutes.
SS Override Temperature: 212°F (100°C) Auto mode only.
Operational Mode Priority:

- Smart Start precedes Auto mode if process temperature is < 212°F.
- Thermocouple (T/C) break, or reversed T/C overrides Auto mode Smart Start, and normal Auto mode.
- Shorted T/C overrides normal Auto mode.
- Manual mode overrides T/C break, T/C open, and reversed T/C.
- The output is inhibited during all T/C fault conditions in Auto mode unless Automatic Bumpless Transfer is enabled.

DIAGNOSTICS AND OTHER DISPLAY CODES (See figure 1)

The SSH® & ESH diagnostics automatically alert the user to a fault condition.

- Shorted thermocouple indicated by flashing ***SHO***.
  - ◊ **Troubleshooting-**
    Check for damage to the thermocouple lead wire. Also check for bare, twisted or pinched leads, open load fuse (F1, F2), or excessive distance between the heater and thermocouple.
- Open thermocouple indicated by flashing ***OPE***.
  - ◊ **Troubleshooting-**
    Check the thermocouple connections and wires for broken leads, check for damage to the sensor, or check for open fusible link resistor (R9, see figure 8)
- Reversed thermocouple indicated by flashing ***bAC***.
  - ◊ **Troubleshooting-**
    Check thermocouple wiring for reversed leads.
- Over/Under temperature. The red deviation LED on the left, flashes when the process temperature is below setpoint by 40°F or more. The red deviation LED on the right flashes when the process is above setpoint by 40°F or more.
  - ◊ **Troubleshooting-**
    Under temperature;
    Open heater, low line voltage, t/c problem,
    Open load fuse (F1,F2).
    Over temperature;
    Output failure, shorted triac, interacting zones,
    Heater shorted to ground.
- A flashing ***Loc*** is an indication that the Smart Start Override option is ON, and that the unit is in Smart Start. The Auto/Manual and Setpoint controls will be "locked out" while this mode is active.
- A flashing ***Loc Err*** is an indication someone has changed the front panel settings prior to the completion of Smart Start when the Smart Start Override Disable option is ON. The Auto/Manual and Setpoint controls will be "locked out" when the ***Loc Err*** diagnostic is active.
  - ◊ **Troubleshooting-**
    If the unit is operating in Auto mode with a process temperature above 212°F (100°C), turn the unit off, and change the settings back to their initial positions, then turn the unit back on. The unit will resume controlling to the entered setpoint.
    If the process temperature is below 212°F, (100°C) the unit will restart the Smart Start process.
    If the unit is operating in Manual mode, turn the unit off, and change the settings back to their initial positions, then turn the unit back on. The unit will restart the Smart Start process.

- A flashing ***bPL*** is an indication that the Automatic Bumpless Transfer option is ON, the thermocouple has failed, and the unit has invoked an Automatic Bumpless Transfer.
  - ◊ **Troubleshooting-**
    Either shut down and repair the broken thermocouple, or:
    Press the AUTO% switch to display and record the average percent power value being output. Then place the unit in Manual mode, and enter the percent power previously recorded.

INPUT SPECIFICATIONS

Thermocouple (T/C) Sensor: Type "J" (default) or Type "K" (optional), grounded or ungrounded.
External T/C Resistance: High impedance potentiometric input allows long distance T/C wiring.
T/C Isolation: Isolated by control circuit power supply.
Cold Junction Compensation: Automatic, better than 0.02°F/°F. (0.01°C/°C)
Open T/C Protection: Automatically inhibits power to heater in Auto mode.
(Unless Automatic Bumpless Transfer is enabled)
Reversed T/C Protection: Automatically inhibits power to heater in Auto mode.
(Unless Automatic Bumpless Transfer is enabled)
Shorted T/C Protection: Automatically inhibits power to heater in Auto mode.
(Unless Automatic Bumpless Transfer is enabled)
Input Type: Potentiometric
Input Impedance: 20 Meg ohms.
Input Protection: Diode clamp, RC filter, and fusible link resistor R9. (see figure 8)
Input Amplifier Stability: 0.02°F/°F (0.01°C/°C)
Input Dynamic Range: 1000°F (550°C) with J-type, 1000°F (550°C) with K-type.
Common Mode Rejection Ratio: Greater than 100 db.
Power Supply Rejection Ratio: Greater than 90 db.

OUTPUT SPECIFICATIONS

Voltage/Power Capability:
10 AMP: Power capacity
SSH-10-22: 2400 watts @240 VAC
SSH-10-21: 1200 watts @120 VAC
ESH-10-22: 2400 watts @240 VAC
Output Drive: Internal solid-state triac, triggered by AC zero crossing pulses.
Overload Protection:
10 AMP: Fuses are provided on both sides of AC line.
Transient Protection: dv/dt and transient pulse suppression included.
Power Line Isolation: Optically, and transformer isolated from AC lines. Isolation voltage is greater than 2500 volts.

ELECTRICAL POWER SPECIFICATIONS

Supply Voltage: 240 or 120 VAC +10% -20%
Frequency: 50/60 Hz
DC Power Supplies: Internally generated, regulated and compensated.
Unit power usage: Less than 5 watts, excluding load.
Dimensions:
10 AMP: 7.2"W x 2.7"H x 8.6"D (18.29 x 6.86 x 21.84cm)
NOTE: Use SSH-10-21 for 120 VAC operation.
Use SSH-10-22 or ESH-10-22 for 240 VAC operation.

FUSE REQUIREMENTS: (2) ABC-10 fuses, F1 & F2 (Note: (2) spare fuses included with unit).
(1) 160 mA sub-miniature fuse. (F3) (see figure 8)

FRONT PANEL CONTROLS AND INDICATORS (See figures 1, 2 and 3)

1. DIGITAL LED MULTI-FUNCTION DISPLAY & DISPLAY MODE INDICATORS: Indicators are located in the display at the top left of each digit. Three 7-segment, (0.56-inch tall) digital displays indicate process temperature, % power output, operational modes, and advanced diagnostic codes.
Load Indicator: LED in display window illuminates when power is being supplied to the heater.
(also blinks during Smart Start®).
Manual Control Indicator: LED in display window illuminates when in Manual mode.
(also blinks after an Automatic Bumpless Transfer)

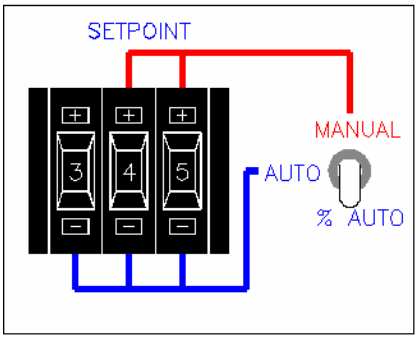


Figure 2 - Pushwheel & Auto / Manual Switch

Shorted Thermocouple (T/C) Indicator: Digital display alternates "SHO" with process temperature.
Open T/C Indicator: Digital display alternates "OPE" with process temperature. (typically "999")
Reversed (Backward) T/C Indicator: Digital display alternates "bAC" with process temperature.
Degrees F/C Indication: At power up, the unit will display "°F" or "°C" for three seconds, depending on the position of function enable switch SW2-6.
Bumpless Transfer Indication: If a thermocouple fault occurs with the Automatic Bumpless Transfer feature enabled, (SW2-3 switched ON) the unit will display "bPL" alternating with the process temperature, and the appropriate thermocouple fault code.
("SHO", bAC", or "OPE")
Smart Start Override Disable: Digital display alternates "Loc" with process temperature during Smart Start if SW2-1 is ON.
The display will alternate "Loc" "Err" with process temperature after the completion of Smart Start, if the front panel settings were changed during Smart Start.

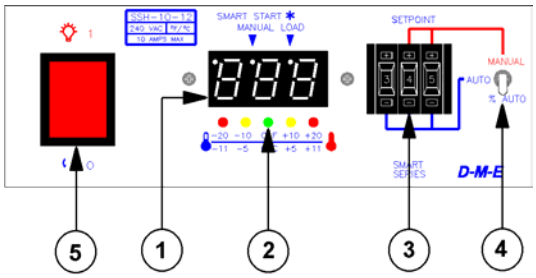


Figure 3 – Front Panel Controls

2. TEMPERATURE DEVIATION LIGHTS: Indicate amount of deviation from setpoint temperature. An outer light blinks when extreme over or under temperature condition (+/- 40°F) exists.
Temperature Deviation Indicators: Five separate LED's: +/-20°F/11°C=(Red), +/-10°F/5°C=(Yellow), 0°F/0°C=(Green)
3. SETPOINT / % POWER ADJUSTMENT: Three-digit pushwheel adjusts setpoint (Auto), or % power (Manual).
Auto Setpoint Control Range: 0 to 999°F, 0 to 537°C. Resolution: 1°F (1°C)
Manual (% Power) Control: Right two digits of three-digit pushwheel.
Manual (% Power) Control Range: 0 to 99%.
4. AUTO / MANUAL / % AUTO SWITCH: Toggle switch, selects Auto, (setpoint temp.) or Manual (% power) control modes.
Lower momentary position displays the percent power output in Auto mode, or percent power Automatic Bumpless Transfer value in the case of a thermocouple fault.
5. POWER ON/OFF SWITCH: Controls AC power to unit. 16 amp rocker switch, UL, CSA, VDE approved.

TEMPERATURE MODE °F/°C

To operate the SSH or ESH units in the °F (degrees Fahrenheit) mode, place switch SW2-6 in the OFF position. To operate the SSH or ESH units in the °C (degrees Centigrade) mode, place switch SW2-6 in the ON position. (see figures 4 and 8) The mode of operation is displayed on startup as either "°F" or "°C".

AUTOMATIC BUMPLESS TRANSFER

"Automatic Bumpless Transfer" is defined as a thermocouple failure causing the unit to automatically switch into manual percent power mode, if the unit has learned an average percent power. (The SSH or ESH requires approximately 10 minutes of stable temperature control to learn an average percent power) To enable Automatic Bumpless Transfer, place switch SW2-3 in the ON position. To disable the Automatic Bumpless Transfer option, place switch SW2-3 in the OFF position. If disabled, the power output will be inhibited after a thermocouple fault occurs. The user will then have to place the unit in Manual mode to gain control of the output power.
With an Automatic Bumpless Transfer active, the unit will also enter an alarm state. The display will alternate between "bPL" ("bumpless"), the diagnostic code for the thermocouple fault, and the process temperature. To clear the alarm, push the AUTO% switch to view the average percent power being used, place the unit in Manual mode and enter that percent power.
With Automatic Bumpless disabled, the unit will still learn the average percent power, but the user must press the AUTO% switch, and record the average percent power prior to a thermocouple failure. Upon a thermocouple fault, the unit will inhibit output power, and will enter an alarm state. The appropriate diagnostic code will alternate in the display with the process temperature. The user must then place the unit in Manual mode and enter the recorded percent power. This action will clear the alarm.

"LIGHTS OUT" FEATURE

The unit can be programmed to shut off the digital LED display during stable Auto mode operation.
To enable this option, set switch SW2-2 to ON. After the unit achieves stable operation about setpoint for 10 minutes, the digital LED display will turn off. Only the green deviation LED will be on.
The display will turn back on automatically should an alarm condition occur, if any of the front panel switch settings are changed, or if the process temperature deviates more than +/-10 °F in temperature.
It is recommended that the AUTO% switch be used to temporarily restore the display manually. The display will then turn off again after five minutes of stable operation about setpoint in Auto mode.

SMART START OVERRIDE DISABLE

This SSH and ESH units incorporate an option to override the Smart Start feature in Auto mode by toggling the Auto/Manual switch to Manual and then back to Auto. By setting switch SW2-1 to ON, this override can now be disabled. With switch SW2-1 set to ON, the unit will display "Loc" alternating with the process temperature during Smart Start. All front panel switch changes will be ignored during Smart Start. If the user changes any of the front panel settings during Smart Start, the unit will continue to display "Loc" to indicate that the front panel is still "locked out". After Smart Start is complete, the unit will check for front panel settings changes, and then display “Loc” “Err” alternating with the process temperature if any changes have occurred. Output power will still be active.
If the unit is operating in Auto mode with a process temperature above 212°F, (100°C) the user must turn the unit off, and change the settings back to their initial positions, then turn the unit back on. The unit will resume controlling to the selected setpoint. If the process temperature is below 212°F, (100°C) the unit will restart Smart Start.
If the unit is operating in Manual mode, turn the unit off, and change the settings back to their initial positions, then turn the unit back on. The unit will restart the Smart Start process.
Setting switch SW2-1 to ON also activates a new Smart Start feature in Manual mode. With SW2-1 ON, a unit in Manual mode will ramp from zero percent to setpoint percent power over a 4-1/2 minute period, thus mimicking Smart Start in Auto mode. "Loc" will be displayed in this mode also. “Loc” “Err” will also be displayed afterward, if the user attempts changes to the front panel settings.

GAIN ADJUSTMENT

Setting switch SW2-7 to on selects the normal PID gain which works with most loads. Setting SW2-7 to off cuts the gain whish allows the controller to better control small heaters and ungrounded thermocouples.

FUNCTION ENABLE SWITCHES

SW2-1 Smart Start (SS) Override Disable
SW2-2 Lights Out Enable
SW2-3 Auto Bumpless Enable
SW2-4 SHO Long
SW2-5 SHO Disable
SW2-6 Deg F/C (C=ON)
SW2-7 Fast Load PID (OFF), Normal PID (ON)

Figure 4 – Dip Switch Locations

DESENSITIZING "SHO"

Shorted Input override, SHO, is defined as a condition when the thermocouple is shorted and the unit does not detect a rising temperature that corresponds to the output power being delivered. If the temperature rise does not change at a rate of more than 2 °F in 90 seconds, this is interpreted as a Shorted Input.
Sometimes a 2-degree rise in 90 seconds is too sensitive. If this is the case, the unit can be desensitized to this situation, or the diagnostic can be totally shut off. Switch SW2-4 ("SHO Long") changes the sensitivity to 3 degrees in 255 seconds. Switch SW2-5 ("SHO Disable") turns this diagnostic totally off. It is highly recommended that normal sensitivity be tried first. It should be sufficient for all nozzles and most manifolds. Large hot runner manifolds and molds may require desensitization. The SHO Disable feature should only be considered as a final resort.

REAR PANEL (See figure 5)

The rear panel has several items of interest to the user. First, the line cord is international and has 3 colors of wires; these should be wired as follows: Blue (line L1), Brown (line L2), and Green/Yellow (earth ground).
Second, the unit has 2 fuse-holders, each has an ABC10 fuse installed. To access the fuse, disconnect power, insert a screwdriver into the plastic fuse holder slot, press inward slightly and turn counter-clockwise.
Third, the power/thermocouple connector is mounted on the rear panel. (See figure 6 for wire connections)

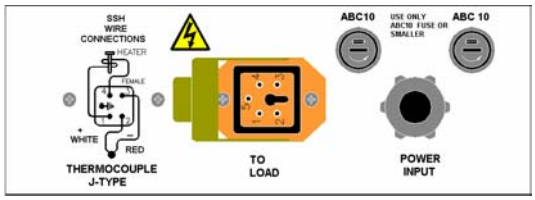


Figure 5 - Back Panel of SSH Unit

WIRING THE LOAD

Wiring the unit is simple. Remove the side screw on the mating connector, (included with the unit), and remove the insert from the hood shell. Then pull the wires through the rear side of the connector hood shell and attach them as shown below by securing each wire in the proper hole and turning the screw to tighten. Common mistakes in wiring can cause severe unit malfunctions. Please exercise caution when wiring the connector to the heating element and thermocouple. The ESH and SSH wiring diagrams are shown below.

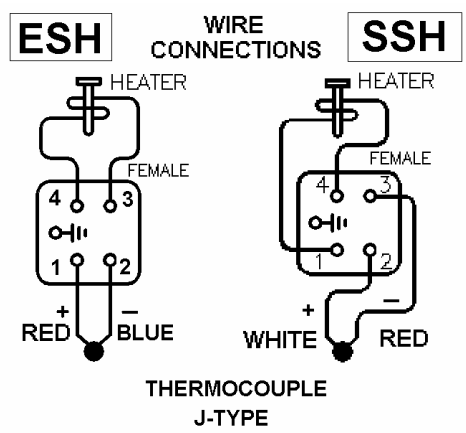


Figure 6 - Connector Wiring Diagrams

K TYPE THERMOCOUPLE SELECT

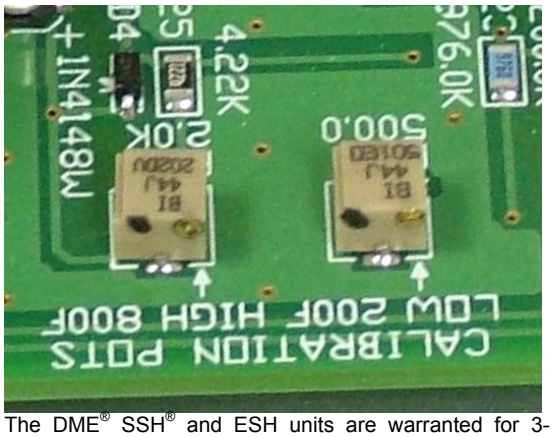
The SSH/ESH units can be converted for a K type thermocouple input by re-configuring the thermocouple type select jumpers. (see figures 7 and 8)
Remove jumpers J5 and J6, and install jumpers J7, J8, and J21 for a K type thermocouple input.
After converting the T/C to K type, or back to a J type, the module will require re-calibration.

CALIBRATION PROCEDURE – J OR K TYPE T/C (See figure 7 and 8)

1. Power the unit on, and wait 10-15 minutes for it to warm up.
2. Attach a thermocouple simulator (I.E. Omega model #CL25) to the thermocouple inputs and set the simulation temperature to 200°F (93°C) for J- type T/C. (400°F (205°C) for K-type T/C)
3. Adjust the ZERO trimpot, R14, to read 200°F (93°C) on the display for J-type T/C. (400°F (205°C) for K-type T/C)
4. Set the simulation temperature to 800°F (427°C) for J-type T/C. (650°F (344°C) for K-type T/C)
5. Adjust the GAIN trimpot, R24, to read 800°F (427°C) on the display for J-type T/C. (650°F (344°C) for K-type T/C)
6. Repeat steps 2 through 5 until no further trimpot adjustment is needed.
7. Turn power off and remove the thermocouple simulator.

Figure 7 - Calibration Potentiometers

RETURN POLICY



The DME® SSH® and ESH units are warranted for 3-year parts and labor, excluding fuses and triac. Contact DME Customer Service for return authorization for repairs, or warranties. Replacement parts are also available through the Customer Service Department.

DME Customer Service

In U.S., 800-626-6653
Global - 248-398-6000
In Canada: 800-387-6600

SERVICE CENTER U.S.A.
DME WORLD HEADQUARTERS
4287 RWIN DRIVE
HARRISON TWP. MICHIGAN 48045

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REPLACEMENT PARTS LIST

To meet warranty requirements, use only DME® parts.	
F1, F2, **Fuse**, 15 Amp, 250 Volt, ABC10 **The use of lower amperage fuses for increased protection is recommended.**	ABC10
Power Rocker Switch, 16 Amp, 250 VAC	RPM0008
T1, Transformer, 240/120 Volt	RPM0009
U5, Triac Driver	RPM0010
R9, Flameproof Fusible link resistor **WARNING! DO NOT SUBSTITUTE**	RPM0050
Setpoint pushwheel switch assembly, on front panel.	RPM0053
Q1, Triac, 40 Amp, 800 Volt	RPM0054
SW3, 3 position switch on front panel	RPM0056
F3, **Fuse**, 160 mA, 250 V, Sub-miniature	RPM0090
U8, Microprocessor, Pre-programmed, (DME proprietary software)	SSM0003

NOTE: If the microprocessor chip (replacement part number SSM0003) is replaced the unit will require re-calibration.

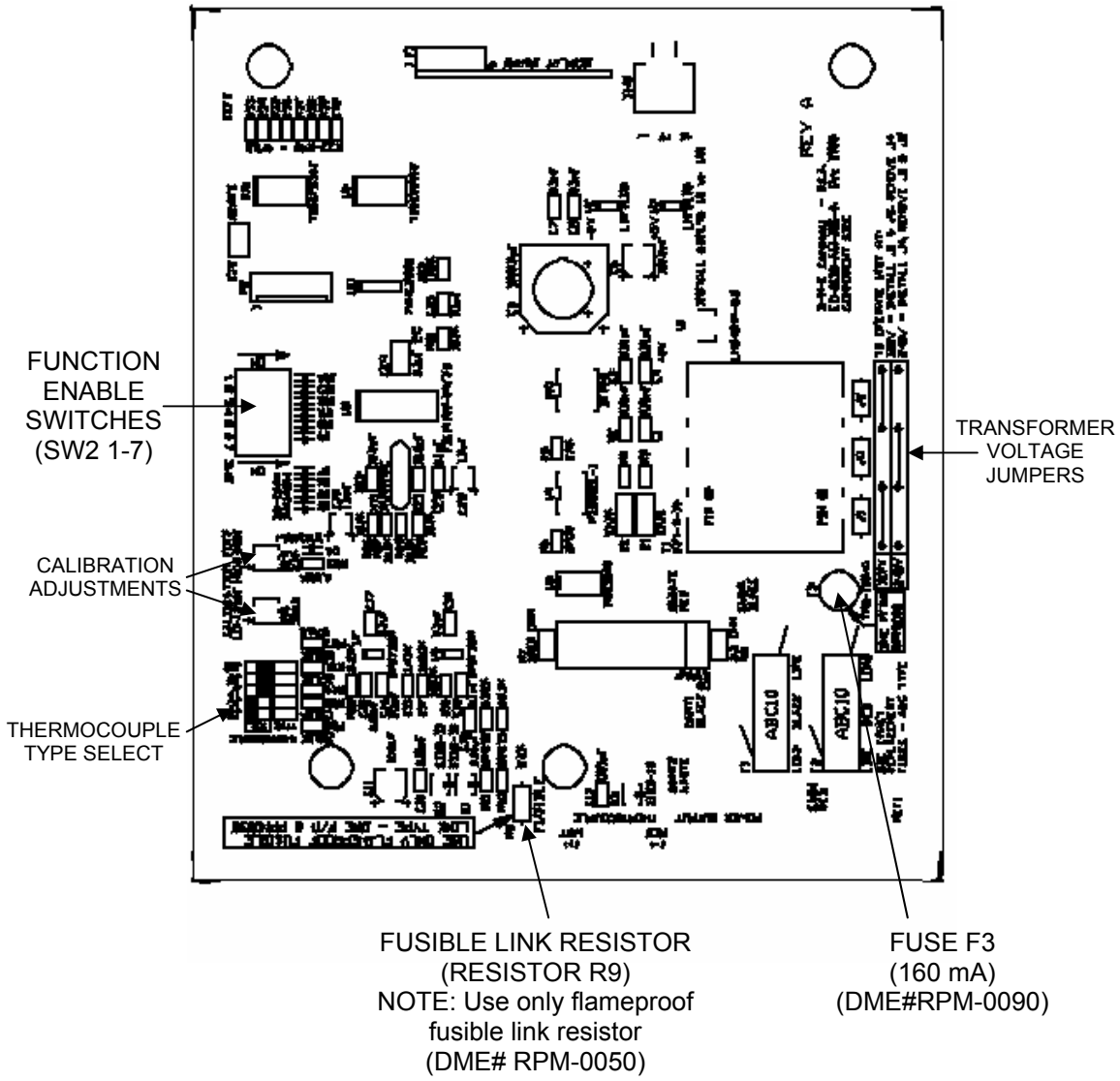

Figure 8 - Main Printed Circuit Board

APPROVAL

_____ SENIOR PRODUCT ENGINEER _____ DATE

_____ MANAGER OF ENGINEERING _____ DATE