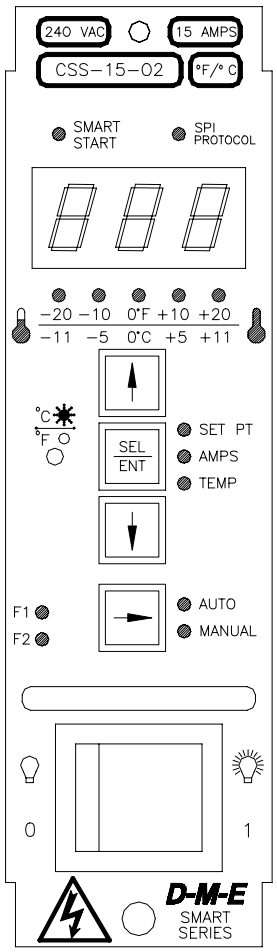
Smart Series®
CSS-15-02 & CSS-30-02



Microprocessor-Based
Temperature Control Module
With Digital Display

User's Manual

D-M-E Company

D-M-E Standard
Smart Series® Microprocessor-Based Temperature Control Modules with Digital Display
CSS-15-02 (15 AMP) & CSS-30-02 (30 AMP)

GENERAL DESCRIPTION

The CSS Communications Smart Series® module provides the molder with the first fully comprehensive temperature control module. This microprocessor based unit incorporates the most complete list of control features while providing full communications capability with a D-M-E® CIM (Computer Interface Module). The CSS is also compatible with the D-M-E TAS Module (Temperature Alarm Standby Heat).

The CSS® module is compatible with D-M-E's previous G-Series® Systems *(Main Frames only)*. While the CSS module was designed with computer integrated manufacturing in mind it also provides the highest level of performance as a stand-alone module. When operating independently the CSS offers these features: A multi-function display, advanced diagnostics, improved control and a new patented interactive Smart Start®. A setpoint memory feature also allow the user to power up the module with the same setpoint as the day before.

The advanced diagnostics will automatically alert the user to unusual fault conditions. This is done by multiplexing the following fault codes with the normal display in three second intervals: Shorted Thermocouple: **Shi** , Open Triac: **oPO**, Reversed Thermocouple: **bci**, Shorted Triac: **ShO**, Open Thermocouple: **oPi**, Ground Fault: **GFI**, Over and under temperature warnings are indicated by flashing LED's directly under the display.

With its unique Smart Start® function, the CSS® has the ability to dry out a heater which may have acquired moisture inside its case. Smart Start automatically applies low voltage to the heater after initial start-up. If a ground leakage is sensed, the module will go into a bake-out procedure which drives moisture from the heater.

When the Smart Start® bake-out function is in operation, the unit is monitored for leakage current. If the ground fault current becomes excessive, the module inhibits output power to the heater and signals a ground fault interrupt. When necessary, the module automatically repeats the bake-out procedure for a maximum of nine minutes. If at any time during the bake-out procedure the leakage current falls within acceptable limits, the module will automatically switch to normal operation.

OPERATION:

Automatic Mode: The microprocessor maintains temperature using a closed loop PID control method. Closed loop means the unit continuously looks at the process temperature to determine whether or not to adjust the power delivered to the heater. With PID control, it anticipates the system characteristics to make accurate adjustments and correct for errors.

Manual Mode: For open thermocouple or thermocouple failure, open loop-percent power is used. In manual mode, the microprocessor maintains a power level using an open loop power control method. Open loop means the process temperature is not used to determine whether or not adjustments should be made. This enables the user to continue production and override thermocouple wire breaks, short circuits, or lead reversal until the problem has been resolved. Manual mode overrides thermocouple break protection, reversed thermocouple, and any normal modes.

Smart Start®: Smart Start is automatic on start-up in the auto mode, and provides the application of low voltage for heater bake out. Smart Start® is completed upon detecting that the heater is dried out, to a maximum of nine minutes.

Power-Up: Upon power-up, the unit retains the same set point and operation mode as when the unit was turned off.

Input Fault: Thermocouple break protection, and shorted or reversed thermocouple all override Smart Start® and normal modes. Output is inhibited, unless automatic bumpless transfer is selected.

CSS® COMMUNICATIONS:

The DME® CSS® module has the capability to communicate with a DME® CIM module. The CIM module enhances the product from a manufacturing, quality control and management perspective. This combination of CSS/CIM association allows the user a platform designed specifically for runnerless molding systems. Any DME® mainframe that has a communications strip installed can utilize the extra built-in features of a CSS module. When the CSS module is used in conjunction with a DME CIM module communication between modules and a molding machine is made possible. This combination of state-of-the-art temperature controllers enables the user to remotely monitor and control up to 8 CSS/CIM systems each containing up to 63 CSS modules each. The user

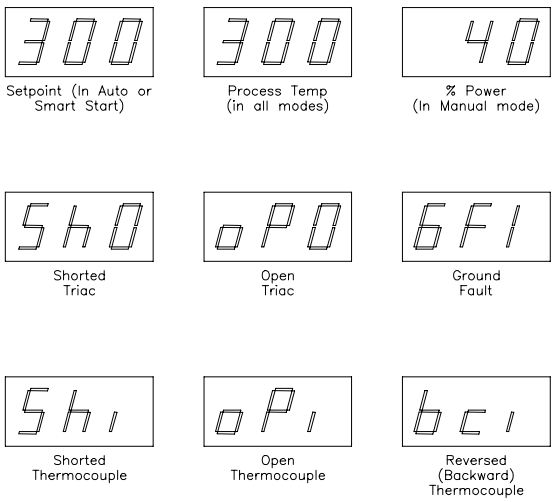


Figure 1 - CSS Digital Display

can set setpoint temperatures and monitor on-line conditions of any system at any time all from a single remote location. It can also remotely alarm the user of certain diagnostic fault conditions that may exist while on-line. For example: open or shorted or reversed thermocouple, ground-fault detection, open or shorted triac (output device). It can also monitor the % power, current, process temperature and setpoint temperature of any CSS module in any given system. The CIM communicates to a molding machine via a software protocol called SPI-3.01, which has been adopted by The Society of the Plastics Industry and is now considered the standard protocol for the plastic molding industry in the USA.

The CSS® controller modules can control temperatures without any communications or CIM module present. The CSS has its own microprocessor, which tunes the PID control algorithm with parameters designed for the characteristics of plastics processing. It also has the ability to run diagnostics on the heater, which includes our Smart Start® heater moisture dry-out routine. The diagnostics also places the heater output in the safest mode, as well as alerting the molder to the problem. This module plugs into a DME® mainframe that has a communication strip installed and enables the CSS modules to communicate with a DME CIM module. The CIM module then communicates with a personal computer or molding machine in one of three different communications methods; RS-232 (EIA-232), RS-422 (EIA-422), or RS-485 (EIA-485). DME recommends the use of RS-485 (EIA-485) as the most secure method for communication.

The CSS/CIM communicates on a DME® mainframe equipped with a communications strip (e.g., part number MFCP-XX-G... the "C" stands for communications strip installed). You will also need one CIM-10-G module for each main frame. If the main frame is a stack frame, such as MFCP-24-G, it has two frame units wired together as one, then only one CIM module is required.

DIAGNOSTICS: (See figure 1)

The CSS® diagnostics automatically alert the user to a fault condition.

- Shorted thermocouple displays flashing **Shi** in the auto mode (output inhibited), or is on steady in the manual mode.
  - **Troubleshooting-** Check for damage to the thermocouple lead wire. Also, check for bare, twisted or pinched leads. Excessive distance between heaters and thermocouples or excessive interaction between neighboring manifold zones may trigger this diagnostic also, as could undersized heaters or low voltage.
- Open thermocouple indicated by **oPi** flashing while in the auto mode (output inhibited), or on steady in the manual mode.
  - **Troubleshooting**- Check the thermocouple connections and wires for broken leads or check for damage to the sensor.
- Reversed thermocouple displays flashing **bci** while in the auto mode (output inhibited), or on steady in the manual mode.
  - **Troubleshooting**- Check thermocouple wiring for reversed leads.
- Shorted triac warning is indicated by **ShO** flashing while in auto mode.
  - **Troubleshooting**- Check triac for short or replace.
- Open output is indicated by **oPO** flashing while in auto mode.
  - **Troubleshooting**- Check heater wiring for open connections. Check for defective heater. Check for defective triac (open) device.
- Excessive heater current flowing to ground is indicated by **GFI** flashing in auto mode.
  - **Troubleshooting**- Replace damp heater. Check for possible problems with deteriorating wire insulation or moisture in wire channels.
- Over/Under temperature. The red deviation LED on the left, flashes when the process temperature is below set point by 30°F or more. The red deviation LED on the right flashes when the process is above set point by 30°F or more.

- **Troubleshooting**- Check for:
  Under temperature; heater failure, low line voltage, t/c problem.
  Over temperature; output failure, shorted triac, interacting zones.

FEATURES:

- Fully self-tuning, microprocessor-based PID control
- Selective Cycle® power drive for reliable and precise control
- Zero crossing triac triggering for minimum RFI
- Patented, closed loop low voltage Smart Start® to prolong heater life
- Process temperature readout operational even in manual mode as long as thermocouple (T/C) is intact
- Automatic T/C break protection and cold junction compensation
- High impedance potentiometric input allows 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 fuses, or circuit breaker in the CSS-30, are provided on both sides of the AC line
- Electrically isolated with grounded front panel for operator safety
- Plug in design for module interchangeability
- Compatible with all 10 and 15 amp G-Series® and Smart Series® Main Frames. The CSS-30 is compatible with G-Series® and Smart Series® High Power Mainframes.

FRONT PANEL CONTROLS AND INDICATORS: (See figure 2)

1. DIGITAL LED DISPLAY: Indicates setpoint temp, percent power, process temp, load current, and fault conditions.

2. TEMPERATURE DEVIATION INDICATORS: Show deviation from setpoint.

3. SMART START® LIGHT: Indicates Smart Start® is on.

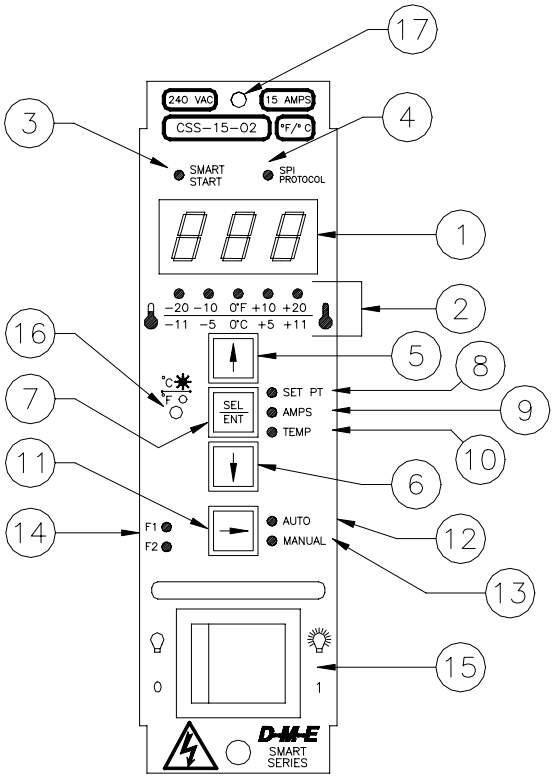


Figure 2 - CSS-15 Module (Note: CSS-30 Module is twice as wide as above; has circuit breaker instead of items 14 and 15)

4. SPI PROTOCOL LIGHT: Indicates control is from a remote computer or molding machine, disabling the user from making changes to setpoint or auto/manual operation.

5. UP ARROW KEY: Increases the desired setpoint value.

6. DOWN ARROW KEY: Decreases the desired setpoint value.

7. SELECT/ENTER KEY: Selects either Setpoint (temperature/percent power), Amps (load current) or Process Temperature. Also allows for immediate entry of setpoint after making a change. Setpoint is automatically entered after 2.5 seconds if this button is not pressed.

8. SETPOINT LIGHT: Indicates Setpoint is on display. Setpoint has been changed but not entered if flashing.

9. AMPS LIGHT: Indicates load current is on display.

10. TEMP LIGHT: Indicates process temperature is on display.

11. SIDE ARROW KEY: Auto/manual select. To enable automatic bumpless transfer, depress side arrow key while simultaneously turning the power on. When power to the CSS® is turned off then on, Smart Start® will automatically be reactivated.

12. AUTO LIGHT: Auto mode selected.

13. MANUAL LIGHT: Manual mode selected.

14. F1/F2 LIGHTS: Illuminate when fuse has blown.

15. POWER ON/OFF SWITCH.

16. °F/°C LIGHT: Illuminates when the °C switch is closed or ON (see figure 5.)

17. Screw location for an M3 x 10MM screw used to make module conform to CE requirements. Secure module with supplied screw to conform to CE requirements.

PERFORMANCE SPECIFICATIONS:

Auto and Manual Control Modes: Time proportioning/Selective Cycle®

Temperature Range: Ambient to 999°F (537°C)

Control Accuracy: +/-0.5°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

Cycle Time: 0.0166 seconds at 60 Hz, 0.020 seconds at 50 Hz.

Power Response Time: 0.0083 seconds at 60 Hz, 0.010 seconds at 50 Hz

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 using the Selective Cycle® power drive

Advanced Diagnostics Indicators: LED's and 3-digit, 7-segment display

Smart Start® (SS): Variable voltage steps from 0 to 240 volts repeatable over a 9 minute period. Will escape from this mode if leakage falls below 120 mA limit. If dry out is not required then a fast pass check of voltage is implemented over 30 seconds.

SS Duration: 30 seconds to 9 1/2 minutes

SS Override Temperature: 200°F (93°C)

Operational Mode Priority:

- Ground fault overrides all modes
- SS precedes auto mode
- Shorted output overrides SS and Auto mode
- Thermocouple (T/C) break overrides SS and Auto modes
- Reversed or shorted T/C overrides SS and Auto modes
- Open output overrides SS and Auto modes
- Manual control overrides T/C break, reversed T/C and Auto modes
- The output is inhibited during all fault conditions in the auto mode, (unless automatic bumpless transfer is invoked)
- Remote control overrides local control

INPUT SPECIFICATIONS:

Thermocouple (T/C) Sensor: Type "J", 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)

T/C Break Protection: Automatically inhibits power to heater, (unless automatic bumpless transfer is invoked)

Reversed T/C Protection: Automatically inhibits power to heater, (unless automatic bumpless transfer is invoked)

Shorted T/C Protection: Automatically inhibits power to heater, (unless automatic bumpless transfer is invoked)

Input Type: Potentiometric

Input Impedance: 22 Megohms

Input Protection: Diode clamp, RC filter

Input Amplifier Stability: 0.02°F/°F (0.01°C/°C)

Input Dynamic Range: 1000°F (550°C)

Common Mode Rejection Ratio: Greater than 100 dB

Power Supply Rejection Ration: Greater than 90 dB

Communication Inputs: Data alliance is optically coupled at 2500 volts isolation

OUTPUT SPECIFICATIONS:

Voltage/Power Capability:
15 AMP: 240 VAC nominal, single phase. 120 VAC available, 3600 watts @240 VAC (1800 watts @120 VAC)
30 AMP: 240 VAC nominal, single phase. 120 VAC available, 7200 watts @240 VAC (3600 watts @120 VAC)

Output Drive: Internal solid state triac, triggered by zero AC crossing pulses

Overload Protection:
15 AMP: Fuses are provided on both sides of AC line
30 AMP: Fast acting circuit breaker 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 that 2500 volts

CONTROLS AND INDICATORS:

Auto/Manual Selection: Push-button switch toggles mode. LED indicates mode of operation.

Setpoint Control:
Two buttons up and down, one button used to enter setpoint
Range: 0 to 999°F (0 to 537°C)
Resolution: 1°F (1°C)

Manual (% Power) Control: Two buttons up and down, one button used to enter setpoint Digital display indication
Range: 0 to 99%

Power On-Off: 16 amp rocker switch, UL, CSA, VDE approved. On the CSS-30 a 30 amp circuit breaker that is UL, CSA, VDE approved is used.

Process Temp Selection: One push button with one LED indicator. Selected by select/enter push button.

Load Current Selection: One push button with one LED indicator. Selected by select/enter push button.

Multi-function Display: (3) 7-segment LED's, 0.6 inch digital displays with decimal point used in load current display. Alarm characters also display.

Smart Start® Indicator: LED above display window illuminates

°F/°C Indicator: LED illuminates indicating °C mode

Blown Fuse Indicator: 2 neon indicators.

Shorted Thermocouple (T/C): Digital display (**Shi**) alternates with normal display

Reverse Thermocouple (T/C): Digital display (**bci**) alternates with normal display

Open Thermocouple (T/C): Digital display (**oPi**) alternates with normal display

Shorted Output (Triac): Digital display (**Sho**) alternates with normal display

Open Output (Triac): Digital display (**oPO**) alternates with normal display

Ground Fault: Digital display (**6Fi**) alternates with normal display

SPI Protocol Indicator: LED above display window illuminates

Temperature Deviation Indicators: Five separate LED's:
+/-20°F/11°C=(Red),
+/-10°F/5°C=(Yellow),
0°F/0°C=(Green)

BUMPLESS TRANSFER:

"Bumpless transfer" is defined as a thermocouple failure causing the module to automatically switch into manual percent power mode, if the module has learned the percent power. The CSS requires approximately 2 minutes of stable temperature control before the bumpless feature is enabled. To force the module into this mode, press the "AUTO/MAN" key simultaneously while turning the power on. The display will show "AUt" indicating that automatic bumpless transfer mode has been selected. This mode will now be stored in the modules permanent memory. To deactivate the bumpless transfer mode - repeat the power on procedure while pressing the "AUTO/MAN" key. This will cause the module to display, "inh" in the display, indicating that the output power will be inhibited upon thermocouple failure. The user will have to then place the unit in the manual mode to gain control of the output power.

Once the Auto mode setpoint is reached, and the controller is placed in the Standby Heat mode, if a T/C failure occurs, the CSS will set power level to 3%, (no output.) When the CSS is released from the Standby Heat mode, the unit will use the last valid percent power it learned prior to entering the Standby Heat mode and it will continue to control power in the Manual percent power mode.

If the module has not reached setpoint in the Auto mode, and the T/C fails, the unit will switch to Manual percent power mode and continue with the last valid Manual percent power stored before the T/C failure occurred, or the factory setting of 0%. If the unit is now instructed to switch to the Standby Heat mode, the unit will set the power level to 0%, (no output.) If the module is in Standby Heat mode and the T/C fails, the CSS will set the power level to 3%. Upon release from Standby Heat mode, the unit will use the last valid percent power it learned prior to entering the Standby Heat mode and it will continue to control power in the Manual percent power mode.

ACTIVATING SHI:

Shorted Input override, Shi, 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 thermocouple is shorted and the temperature rise does not change at a rate of more than 1 degree F in 65 seconds, this is interpreted as a Shorted Input and the unit will automatically switch to the manual mode and set the percent power to a previously learned percent power, if one was learned (with automatic bumpless transfer.) When automatic bumpless transfer is not selected, the output will be inhibited.

If position 2 of dip switch 1, (DS1), on the main circuit board is in the ON position, this means Shi override is inhibited. If the switch is in the OFF position, this means the module is in the factory setting or normal operation mode.

STANDBY HEAT:

When the DME TAS-05-02 module initiates a Standby Heat signal, any CSS modules in the Auto mode will immediately set the set-point temperature to 200°F/93°C. The function is useful for the continuous application of low power to heaters to prevent moisture build-up and initiate quick start-ups.*

If a thermocouple failure occurs while in standby heat, then 3% power will be output.

* A communication style mainframe is required to support this feature.

TEMPERATURE MODE °F/°C:

To operate the CSS module in the °F (degrees Fahrenheit) mode, move position 1 of dip switch 1 (DS1) to the OFF position. To operate the CSS module in the °C (degrees Centigrade) mode, move position 1 to the ON position (see figure 5.) When the °C mode is selected, the temperatures displayed will be in °C and the °F/°C LED on the front panel will be illuminated.

ALARM OUTPUT:

When the DME TAS-05-02 module is installed in the DME mainframe, this output feature will activate the alarm output feature on the TAS-05-02 module. The TAS module will produce an audio alarm and provide a relay contact closure when a temperature alarm occurs. This feature is disabled upon power-up until the process temperature is within 10°F of set-point temperature, or until an error occurs. It is also disabled when changing to or from the Standby Heat mode *. Once the set-point temperature is reached, a deviation of +/-30°F will activate the alarm.

When standby heat is engaged, the alarm is inactive until the process falls to 210°F. When leaving standby heat the alarm is also inactive until the process is within 10°F of set-point. This prevents alarms during ramping.

In the manual mode the alarm is inactive except for errors. Errors always cause an alarm. If the unit is in output inhibit mode, the alarm occurs during an error and is cleared by placing the unit in the manual mode. If the CSS is in the auto-bumpless mode, the alarm will stay on even though the unit goes to the manual mode. The user can silence the alarm by pressing the auto/manual key. When auto-bumpless occurs, the automatic setpoint will continue to be displayed until the user acknowledges the alarm condition by pressing the auto/manual key. After acknowledgment, the manual setpoint is displayed. When errors are corrected and the unit is back in auto mode the alarm is inactive until the process reaches +/-10°F of set-point.

* A communication style mainframe is required to support this feature.

ELECTRICAL POWER SPECIFICATIONS:

Input Voltage: 240/120 VAC +10% -20%

Frequency: 50/60 Hz

DC Power Supplies: Internally generated, regulated and compensated

Module power usage: Less than 5 watts, excluding load

Dimensions:
15 AMP: 2"W x 7"H x 7 1/2"D (5.08 x 17.78 x 19.05cm)
30 AMP: 4"W x 7"H x 7 1/2"D (10.06 x 17.78 x 19.05cm)

NOTE: Standard (240 VAC) modules are compatible with main frames wired for either 240 VAC three phase (standard), or 240 VAC single phase.

FUSE REQUIREMENTS: (2) ABC-15 fuses (Note: (2) spare fuses included with module, applies to CSS-15 only)

CIRCUIT BREAKER: A special 30 Amp circuit breaker is used in 30 Amp modules to protect the module.

CALIBRATION PROCEDURE

1. Insert controller into the calibration jig and turn power on.

2. Set the simulation temperature to 200 degrees F.

3. Press the CSS "SEL/ENT" key to select "TEMP".

4. Adjust the OFFSET trimpot, R48, to get 200 degrees on the display.

5. Set the simulation temperature to 800 degrees F.

6. Adjust the GAIN trimpot, R24, to get 800 degrees on the display.

7. Repeat steps 2 thru 6 until no further trimpot adjustment is needed.

8. Turn power off. Thread a #16 insulated stranded wire through the GFI transformer, T3.

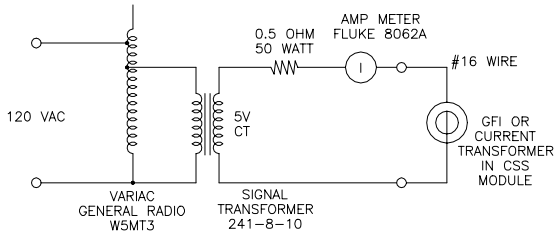


Figure 3 - Calibration Setup

9. Turn power on.

10. Send a variable AC GFI current through the #16 wire. The CSS should display GFI for a GFI current within the range of 1.5 amp +/-20% (1.2 - 1.8 A). See test current

setup diagram below. If GFI is not activated, reduce R14; If GFI is activated below 1.2 A, reduce R15.

11. Turn power off.

12. Thread #16 wire through the current transformer, T2

13. Turn power on. Press "SEL/ENT" key to select "AMPS" display. Adjust simulation temperature to 800 degrees F then to 0 degrees.

14. Send 10 Amps through the #16 wire. The CSS should display 10.0 +/-0.5 Amp. If the displayed current is too low, reduce R20; if the current is too high, reduce R19.

15. Turn power off and remove from calibration fixture.

COMMUNICATION CONNECTOR COMPATIBILITY:

The Communication Connector strip in your mainframe communicates to all the other modules in the rack. If the communications connector in your mainframe has pins 3 & 4 missing, you must order a new communication strip from D-M-E to allow the alarm feature in this module to communicate properly with the TAS-05-02 module. It will not work without these pins installed. This does not affect communication with the CIM module.

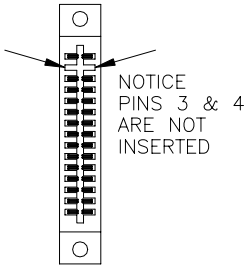


Figure 4 - Communication connector that is NOT compatible

RETURN POLICY:

The D-M-E® CSS® modules are warranted for 1 year parts and labor, excluding fuses.

Contact D-M-E Customer Service for return authorization for repairs or warranties. Replacement parts are also available through the Customer Service Department.

D-M-E Customer Service

In U.S., West Coast:	1(213)263-9261
Elsewhere in U.S.:	1(800)626-6653
In Canada:	1(416)677-6370

SERVICE CENTER U.S.A

D-M-E WORLD HEADQUARTERS
29111 STEPHENSON HIGHWAY
MADISON HEIGHTS, MICHIGAN 48071
PHONE: 1(800)626-6653
TELEFAX: 1(810)398-6174

REPLACEMENT PARTS LIST

To Meet Warranty Requirements, Use Only DME® Parts.	
Q10, Triac, 40 Amp, 600 Volt, Q6040P	RPM0023
S1, Power Rocker Switch, 16 Amp, 250 VAC	RPM0008
T1, Transformer, 240/120 Volt, DST-4-16	RPM0009
F1, F2, Fuse, 15 Amp, 250 Volt	ABC15
U14, Triac Driver, MCP3021Z	RPM0011
U1, Microprocessor for **15 AMP** modules(**DME proprietary software**)	CSS0003
U1, Microprocessor for **30 AMP** modules(**DME proprietary software**)	CSS0004
U9, U10, U11, Optocoupler, 4N26	RPM0012
U8, U13, Operational Amplifier, LM324	RPM0013
U3, Operational Amplifier, OP07	RPM0014
Circuit Breaker, 2 pole, 30 Amp (30 Amp module.)	RPM0039

EUROPEAN CONFORMITY (CE) REQUIREMENTS:

This module is shipped with a 3MM x 10MM screw that is used to secure the module to a mainframe for the purpose of satisfying CE requirements. When the module is screwed down securely, this module is considered to be CE certified (compliant). **NEVER REMOVE OR INSERT MODULES WHEN MAINFRAME CIRCUIT BREAKER IS ON.**

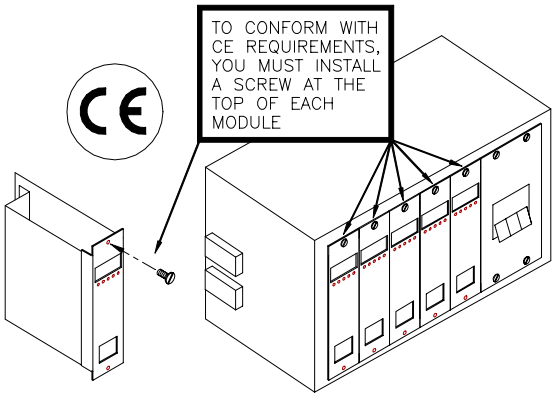


Figure 5 - CE Requirement (Add screw to the top of each module to conform to CE requirements)

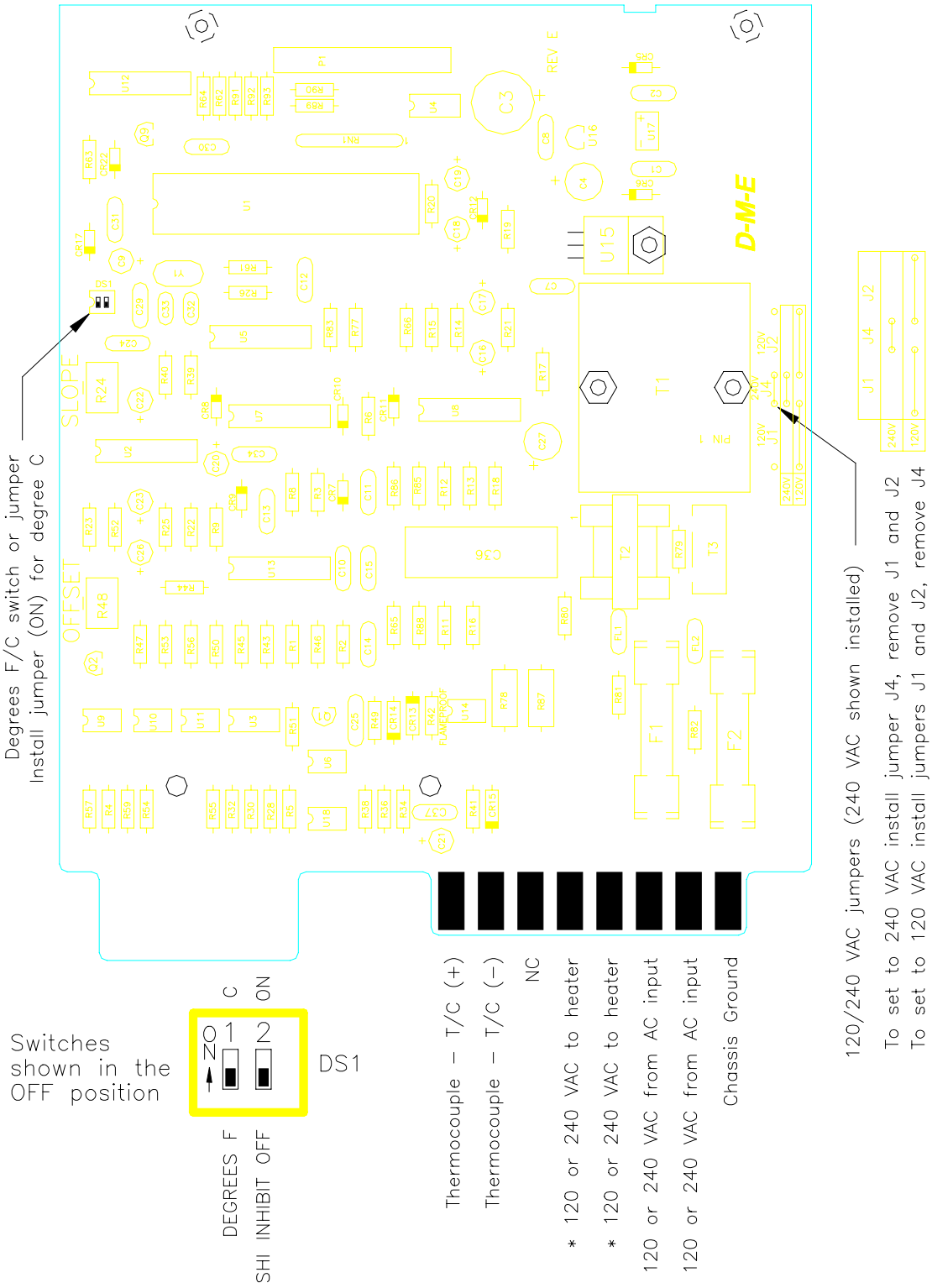


Figure 6 - Component Layout, CSS Main Board

ECN-0470 February 12, 1997 Add CE information and save as Word 6.0 document

APPR0VAL

_____ SENIOR PRODUCT ENGINEER _____ DATE

_____ MANAGER OF ENGINEERING _____ DATE