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TECH MEMO

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Re: **HLS-II Measuring Circuit Change - 08/27/96**

Background:

The HLS-II Heat Limit Controller originally used the industry standard OP-27 operational amplifier in its measuring circuit. Units of current issue now make use of the more conventional OP-07 chip. For most practical purposes, these two chips are interchangeable, the OP-27 often being viewed as an updated version of the OP-07.

Certain other controls using an OP-227 chip, which is simply a dual version of the OP-27, have demonstrated a rather unique susceptibility radio-frequency energy in the cellular telephone range (approx. 800-900MHz). That situation was ultimately corrected by applying a very simple modification at the input of the amplifier circuit.

On August 27, 1996 the HLS-II circuit board was revamped, mainly for the purpose of accommodating an improved set point potentiometer, and to increase the current-carrying capability of the output conductors. At this same time, the "RFI fix" mentioned above was added at the input of the OP-07 chip.

The measuring circuit change was incorporated as part of a general program of updating all products using the "OP" family of devices in

their measuring circuits. The RFI problem mentioned above had never, as far as we were aware, been observed with the HLS-II product in the field, and engineering bench tests were inconclusive as to whether or not any such problem actually existed with respect to the HLS-II. Moreover, the OP-07 chip has a more conventional input section than the OP-27 (OP-227) version, and already includes input compensation similar to our scheme as a secondary effect of its resistor/diode input protection networks.

The HLS-II can be, and often is, used as a *latching* controller. In the latching mode it, like any other latching control, becomes inordinately susceptible to spurious and transient sources of interference that might hardly produce a noticeable "glitch" in a non-latching system. The possible sources of such interference in practical applications are extremely difficult to predict, and for this reason, all sorts of precautions have been incorporated in the HLS-II circuitry. The addition of the input compensation network at the amplifier was considered just one more such precaution.

Our records do not clearly indicate the date at which we replaced the OP-27 with the OP-07 in production units. Units exhibiting "noise problems" that are found to have the OP-27 chip might be easily fixed simply by replacing the OP-27 with an OP-07.

It is not clear that any actual improvement would be realized through the modification of OP-07 based controls that shipped before the 08/27/96 issue. On the other hand, if problems arise where cellular frequency devices appear to be bothering these units, earlier units can be very easily modified in an attempt to diagnose and solve the problem.

Design/Engineering Changes:

To add the input compensation network to the OP-07 circuit, install a 1KΩ resistor between pins 2 and 3 of the OP-07 chip and the circuitry originally connected to these pins. Secondly, connect a 47pF ceramic disc capacitor across the ends of these input compensation resistors, at the nodes connected to the original other circuitry.

The existing 1.0uF input compensation capacitor connected to pin 3 should be removed, and discarded.

Field Modifications

Material Required:

RESISTOR, CARBON FILM, 1/4w 2% 1.0KΩ 2 EA
CAPACITOR, CERAMIC DISC, 25v 10% 47pF 1 EA

1. **Remove the printed circuit board from the chassis by first loosening the set point knob's set screw, then the four screws which hold the circuit board.**

2. **Remove C14, the existing 1.0uF tantalum input compensation capacitor found at pin 3 of U5, the OP-07 chip.**

3. **Remove any excess solder from U5's pin 2 and pin 3 pads on the foil side of the printed circuit board.**

4. **Using a small x-act-o blade, sever the connection between U5-2 and R10 (1.00KΩ).**

5. **Similarly, carefully sever the connection between U5-3 and the external circuitry.**

6. **Connect a 1KΩ resistor across the two open circuits created in the above two steps:**

   a. **between U5-2 and R10**
   b. **between U5-3 and the line going to Sensor (+)**

7. **Connect a 47pF ceramic disc or (low inductance/low ESR film capacitor) between the "R10" and "Sensor (+)" ends of the 1KΩ resistors.**

   NOTES:

   1. Good RFI layout practice places these components as close as possible to U5's (the OP-07) socket, with lead lengths kept to a minimum. Experience at the factory suggests, however, that the layout is not critical, and *good results can be achieved without close control of the procedure.*

   2. *Early versions may have minor circuit board layout variations, however the schematic is the same.*

   3. Since none of the original component values are altered by this modification, and since none of the parts added are located in significant bias paths, the calibration of the instrument is not significantly affected by this procedure. *Recalibration is therefore optional.*

8. **To reassemble the unit …**

- **Mount the circuit board inside the chassis and replace, but do not tighten, the four screws.**
- **Momentarily place the control knob on the shaft of the set point potentiometer and center the knob's skirt on the temperature scale.**
- **While holding the circuit board in this position, tighten its four retaining screws.**
- **Replace the four fiber spacing washers on the shaft of the set point potentiometer, and rotate the shaft fully counter-clockwise (fully to the left).**
- **Place the set point knob on the shaft, orienting its index line to the asterisk (*) below the 0°F mark on the temperature scale.**
- **Carefully tighten the knob's set screw, permitting its cupped point to "find" the gall it originally impressed in the shaft (in most cases, this will obviate any need to recalibrate the set point potentiometer).**

9. **If you wish to verify the calibration of the unit, refer to the instructions in its instruction booklet (HB451024).**

Step 4: Open the connection between pin 2 and R10 (1.00KΩ)

Step 5: Open the connection between pin 3 and C14 (1.0µF)