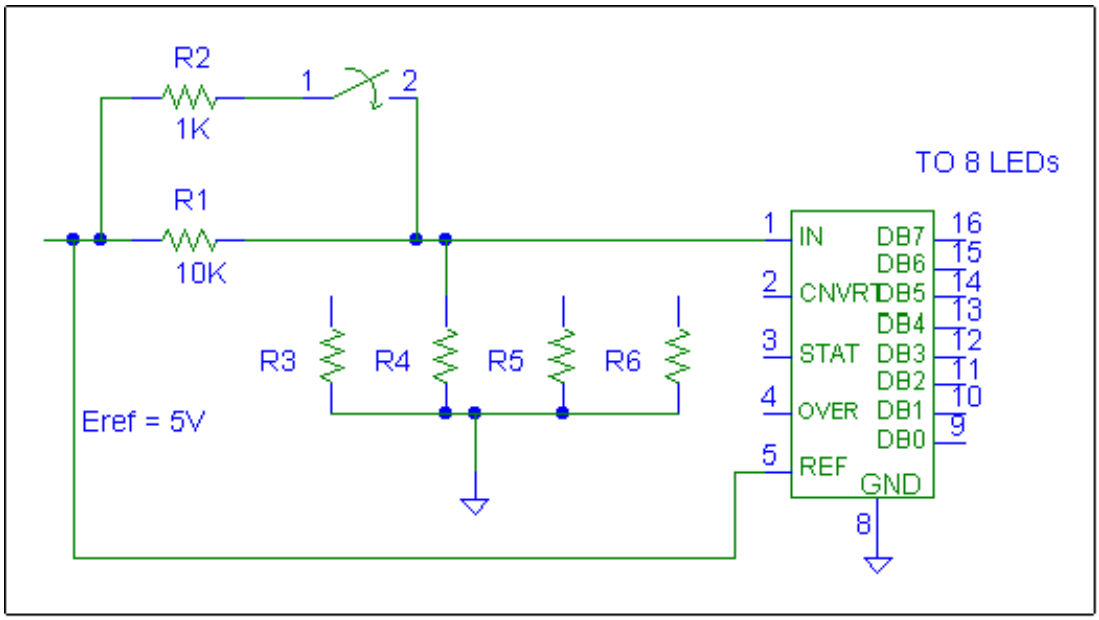
Temperature Sensing Test Circuit



In this circuit, R3 thru R6 simulate an RTD at various tempertures and are located in a test adapter. Reference voltage Eref, the CMOS switch, R1, R2, & the ADC are all on the circuit card. The test technician was required to monitor the A-to-D output at eight LED's. (This function would normally be automated using ATE test software; however the binary test limits must still be calculated.)

Run the following MATLAB M-file: temptest.m

The MATLAB output is as follows:

Va is the voltage divider output into the ADC for all 2 x 4 switch combinations (5V max):

```
Va =
       4.4172         2.1190         0.9184         0.1900
       4.9407         4.4500         3.5612         1.5145
```

nu is the conversion of Va to 8-bit decimal (5V = 255):

```
nu =
       225    108    47     10
       252    227    182    77
```

nvlo is the EV low of nu; includes -1 LSB ADC error:

```
nvlo =
       223    105    45     9
       251    225    179    75
```

nvhi is the EV high of nu; includes +1 LSB ADC error:

```
nvhi =
       227    111    49     10
       253    229    184    80
```

The output display is binary (bin array) vs Rx & Rin. The first two rows of array bin are EV low for both Rin values of 10 and 0.909, while the last two rows of bin are EV high. For example, for Rx = 0.395 (395 Ω), and Rin = 0.909 (909 Ω), the min LED display allowed in bin(2,4) or 1001011b = 75d = 4Bh; the max LED display is bin(4,4) or 1010000b = 80d = 50h.

```
Rx =
       75.7900        7.3550         2.2500         0.3950
bin =
       11011111       1101001        101101         1001
       11111011       11100001       10110011       1001011
       11100011       1101111        110001         1010
       11111101       11100101       10111000       1010000

Rin =
       10.0000
       0.9091
       10.0000
       0.9091
```

M-file listings:

```
% Temperature Sensing Test Circuit
% File: c:\M_files\bookupdate\temptest.m
% Circuit function: tc.m
% Updated 11/08/06
clear;clc;
R1=10;R2=1;
% RTD values
R3=75.79;R4=7.355;R5=2.25;R6=0.395;
Rx=[R3 R4 R5 R6];
Nrtd=size(Rx,2);
Eref=5;D=255;
Tr=0.02;Tad=1/D; % 1 LSB error
T=[-Tr -Tr -Tad;Tr Tr Tad];
Rp=R1*R2/(R1+R2);Rin=[R1 Rp];
Nc=size(T,2);Sen=[-1 1 1]; % sensitivity signs obvious from circuit
% create M array
for p=1:Nc
   if Sen(p)>0
      M(1,p)=1+T(1,p);M(2,p)=1+T(2,p);
   else
      M(1,p)=1+T(2,p);M(2,p)=1+T(1,p);
   end
end
for w=1:Nrtd
   for u=1:2
      Va(u,w)=tc(Rin(u),Rx(w),Eref);
      nu(u,w)=floor(Va(u,w)*D/Eref+0.5);
      nvlo(u,w)=round(D*M(1,3)*tc(Rin(u)*M(1,1),Rx(w)*M(1,2),1));
      nvhi(u,w)=round(D*M(2,3)*tc(Rin(u)*M(2,1),Rx(w)*M(2,2),1));
   end
end
b1=str2num(dec2bin(nvlo(1,:)));
b2=str2num(dec2bin(nvlo(2,:)));
b3=str2num(dec2bin(nvhi(1,:)));
b4=str2num(dec2bin(nvhi(2,:)));
bin=[b1 b2 b3 b4];
Rin=[Rin';Rin'];
% Display results
Va
nu
nvlo
nvhi
Rx
bin
Rin

function y=tc(Ra,Rb,Eref)
% Voltage divider test circuit
y=Eref*Rb/(Ra+Rb);
```