**Temperature Display Project How to determine the 3 digits to display from and ADC value**

**Temp sensor equations**

The datasheet for the MPC9700 temp sensor gives this equation for its voltage output:

*At room temp 25°C this would equal 0.75V*

If we can strip out that 0.5 volts we would have an output that is proportional to temperature

*which would be 0.25V at 25°C*

In order to do this for in the code, first we need to calculate the raw sensor voltage. To do that we use the formula:

*where Aref is the voltage on the pin (see appendix)*

In our case the Vref is 2V

*Where Vout is the actual output voltage from the sensor.*

*At room temp this will be around 0.75V.*

Now we can subtract the 0.5V to eliminate that voltage offset

T = Vout - 0.5

*Where T is the temperature/100*

*At room temp this will be around 0.25°.*

In other words .25V equals 25°C but if we multiply that by 100 it equals 25 which is exactly the temperature value.

T100 = T \* 100

To put all this together in one formula we make a new variable CENTS

*This gives us a number which we can display after extracting the digits..*

For instance let’s say that our ADC value is 654. Our CENTS value will be 77.85°. From this we can extract the 77 for our units and tens digits or we could round it up to 78 with a rounding routine.

For the Arduino program enter this last equation should be declared as a ***float*** because we want the decimal if we are going to round it later. It should also be entered like this with some decimals in the denominator or it is going to assume they are integers which will yield a different result. *It is easier to throw out the decimal later by making a variable an integer than it is to go back and create the decimals.*

From here we calculate from CENTS (in this case 77.85) the numbers for the display:

Int Digit1 = Cents/100 Result: 0

Int REM1 = Cents%100 result: 77

Int Digit2 = REM1/10 Result: 7

Int Digit3 = REM1%10 result: 7

Based on this the display will show 077

**Rounding:**

To round up, the value, CENTS, result needs to be multiplied by 100 one more time (put this after where CENTS is calculated.

CENTS100 = CENTS\*100

Then it gets modulo % divided by 100 to get what was the decimal.

CENTSREM = CENTS100%100

If CENTSREM is greater than 50 then

CENTS = CENTS + 1

Otherwise it stays the same.

**Appendix Relating ADC value to voltage**

The ADC reports a ratiometric value. This means that the ADC assumes its reference voltage is the maximum output of 1023 (210-1 or 2n-1 for a 10 bit ADC). Anything less than the reference voltage will be a ratio between that and 1023.

This can be algebraically rearranged to calculate anything the voltage based on the ADC value or vice-versa. For instance:

Or to calculate the voltage based on the ADC: