Using 10K Thermistors

Effects: all ASIC/2 Devices
Date: June 30, 1998

Note No. TE003

The ASIC/2 controllers come with a built-in lookup table suitable for interfacing with a Type II 3,000 ohm thermistor. During project retrofits many installers have come across the Type III 10,000 ohm thermistor. This application note discusses setting up and input and lookup table to read and display degrees Fahrenheit of a 10,000 ohm thermistor. The temperature versus material resistance curve is attached for reference.

Set up the input as an analog with a convert type Lookup-1 (See Diagram Below).

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+-------------------------------------------------------------------------------+
| OBJECT 5 - ANALOG INPUT (05-INP1.SCP) Any Index                  SETSYS 1.4   |
| Index Name: Return Air Temperature          (ASIC/2-7040 FW740C Only)         |
| * STATUS                              Low Alarm Status       :     OK         |
| +Present Value            0       0   High Alarm Status      :     OK         |
| Previous Value            0       0   Low Limit Fault Status :     OK         |
| Scan Timer             :   0          High Limit Fault Status:     OK         |
| Input Override         :   No         Fail to Default        :     No         |
| Input OK               :   OK         Override to Default    :     No         |
|                                       +Action                :     0          |
| * CONFIGURATION                       (1=Override Input,2=Clear Override)     |
| Description:        Supply Air Temp                                           |
| Index Enable           :   Yes  Units       :    16 0.01 °C                   |
| Input Type(01 = Analog):     1  AI - Analog Input (0-5v)                      |
| Convert Type           :    81  Lk1 - 0 offset x1.0                          |
|                                       Utility Index Number   :     1          |
| Scan Interval (s)      :   1                                                  |
| Smoothing Coefficient  :   0          Fail to Default Enable :     No         |
| Input Offset           :   0          Override to Default Enable:  No         |
|                                       Default Value          :     0          |
| Low Alarm Enable       :   No         Low Limit Enable       :     No         |
| High Alarm Enable      :   No         High Limit Enable      :     No         |
| Low Alarm Setpoint     :   0          Low Limit Setpoint     :     0          |
| High Alarm Setpoint    :   0          High Limit Setpoint    :     0          |
+-------------------------------------------------------------------<Index 0 >--+
```

Convert Type is Lookup-1. Th
input uses information stored
Utility object to display correct
engineering units.

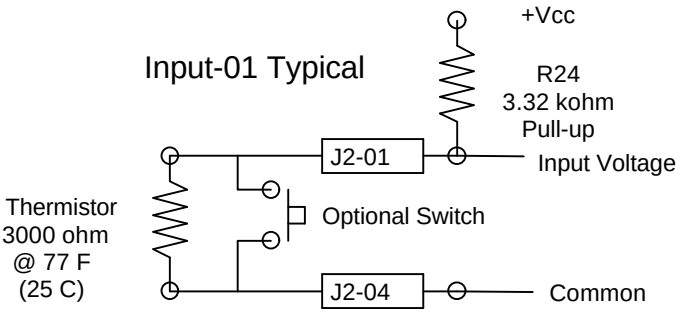
Utility Index number
that stores the lookup
table information.

You are now ready to fill in the lookup table with the temperature information.

```
+-------------------------------------------------------------------------------+
| OBJECT 16 - UTILITY CONFIGURATION (16-UTL2.SCP) Any Index        SETSYS 1.3   |
| Index Name: 10K Ohm Lookup Table                ASIC/2-7040                   |
|      Unsigned    Signed  Hex              Unsigned    Signed  Hex       Char  |
| Attr-00:      0        0  0     h      Attr-03:      0        0  0     h     |
| Attr-01:      0        0  0     h      Attr-04:      0        0  0     h     |
| Attr-02:      0        0  0     h                                             |
| Attr-05:     33       33  21    h      Attr-22:   7700     7700  1E14  h     |
| Attr-06:  19709    19709  4CFD  h      Attr-23:   7171     7171  1C03  h     |
| Attr-07:  19709    19709  4CFD  h      Attr-24:   6615     6615  19D7  h     |
| Attr-08:  19709    19709  4CFD  h      Attr-25:   6063     6063  17AF  h     |
| Attr-09:  19709    19709  4CFD  h      Attr-26:   5523     5523  1593  h     |
| Attr-10:  17730    17730  4542  h      Attr-27:   4941     4941  134D  h     |
| Attr-11:  16229    16229  3F65  h      Attr-28:   4381     4381  111D  h     |
| Attr-12:  14981    14981  3A85  h      Attr-29:   3787     3787  ECB   h     |
| Attr-13:  13930    13930  366A  h      Attr-30:   3141     3141  C45   h     |
| Attr-14:  13010    13010  32D2  h      Attr-31:   2484     2484  9B4   h     |
| Attr-15:  12176    12176  2F90  h      Attr-32:   1771     1771  6EB   h     |
| Attr-16:  11430    11430  2CA6  h      Attr-33:    969      969  3C9   h     |
| Attr-17:  10741    10741  29F5  h      Attr-34:     49       49  31    h     |
| Attr-18:  10085    10085  2765  h      Attr-35:  64470    -1066  FBD6  h     |
| Attr-19:   9445     9445  24E5  h      Attr-36:  63034    -2502  F63A  h     |
| Attr-20:   8861     8861  229D  h      Attr-37:  60784    -4752  ED70  h     |
| Attr-21:   8287     8287  205F  h      Attr-38:  60784    -4752  ED70  h     |
+-------------------------------------------------------------------<Index 1 >--+
```

The Magic Behind the setup

Through the input circuitry the sensors varying resistance is read as a varying voltage at the controllers input. The sensed voltage is converted, by way of an analog-to-digital (A/D) converter to a “bit count”. The ASIC/2-7040, FW740A.. uses 10 bit conversion on all Inputs. The value is linear to the voltage and varies from 0 - 1023 as the voltage varies from 0 - 5 Vdc.



The pull-up resistor along with the thermistor create a voltage-dividing circuit to the input. In the case of a 10,000 ohm, replace the standard 3.32Kohm or 1.82Kohm resistor with a 10Kohm resistor. We have calculated the resistance that needs to exist and various voltages points through out the range of the input. Using the chart provided by the manufacture we find the temperature value associated with the resistance and enter that in the lookup table.

Lookup-1; Table Lookup Conversion

If the analog input has a convert type 81, Lookup-1, then the raw value 0..1023. is converted using a 33 entry lookup table that is in Utility Object. The coefficients are kept in an index of the Utility Object as identified by Utility Index (Attr-17 LO Byte). The present value is obtained by linear interpolation of the table.

The 33 word look up table conversion Y = LOOK_UP(Raw) has:
Attr-5 = 33 - Number of entries

Attribute No.	**Entry No.**	**Bit Count**	**Voltage**
Attr-6	1	0	0
Attr-7	2	31	0.15625
…			
Attr-21	16	479	2.34375
Attr-22	17	511	2.5
Attr-23	18	543	2.65625
…			
Attr-37	32	991	4.84375
Attr-38	33	1023	5

Note: Smoothing is done after conversion.

Any input using a 10 Kohm thermistor can refer to the same utility index for the conversion information.

ASIC/2-7040.

Pull-up resistors

Pull-up resistors are used to pull the input in the direction of the +5 Vdc supply voltage. The location of the pull-up resistors and other details are described in the ASIC/2-7040 Installation Manual.

Factory Pull-up Resistors

R24 = 3.32 kohm IN-01 Pull-up R16 = 1.82 kohm IN-09 Pull-up
R23 = 3.32 kohm IN-02 Pull-up R15 = 1.82 kohm IN-10 Pull-up
R22 = 3.32 kohm IN-03 Pull-up R14 = 1.82 kohm IN-11 Pull-up
R21 = 3.32 kohm IN-04 Pull-up R13 = 1.82 kohm IN-12 Pull-up
R20 = 3.32 kohm IN-05 Pull-up R12 = 1.82 kohm IN-13 Pull-up
R19 = 3.32 kohm IN-06 Pull-up R11 = 1.82 kohm IN-14 Pull-up
R18 = 3.32 kohm IN-07 Pull-up R10 = 1.82 kohm IN-15 Pull-up
R17 = 3.32 kohm IN-08 Pull-up R09 = 1.82 kohm IN-16 Pull-up

ASIC/2-8040.

Pull-up resistors

Pull-up resistors are used to pull the input in the direction of the +5 Vdc supply voltage. The location of the pull-up resistors and other details are described in the ASIC/2-8040 Installation Manual.
All inputs have pin sockets. Inputs that are not used for sequence control can be assigned to other functions with the proper pull-up resistors installed.

The factory pull-up resistors for the ASIC/1-8040.

IN-01 Pull-up R13 =3.32 kohm 1% 1/4
IN-02 Pull-up R14 =3.32 kohm 1% 1/4
IN-03 Pull-up R11 =3.32 kohm 1% 1/4
IN-04 Pull-up R12 =3.32 kohm 1% 1/4
IN-05 Pull-up R9 =1.82 kohm 1% 1/4
IN-06 Pull-up R10 =1.82 kohm 1% 1/4
IN-07 Pull-up R7 =1.82 kohm 1% 1/4
IN-08 Pull-up R8 =1.82 kohm 1% 1/4

Remember to replace the pull-up resistor for the input using the 10K thermistor.