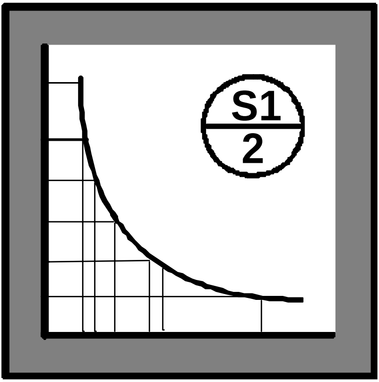
TREND
SENSOR SCALING
REFERENCE CARD



TREND

REFERENCE LIST OF TREND SENSORS AND IQ SCALING PARAMETERS

Sensor		Input	U	L	+20mA T	-20mA B	+10 V T	-10 V B	+5 V T	-5 V B
AQ/D		V	100	0			100	-100	50	-50
AQ/S		V	100	0			100	-100	50	-50
CO2		I	2000	0	2000	-3000				
		V	2000	0			2000	-2000	1000	-1000
CTX	100	V	100	3			100	-100	50	-50
CTX	500	V	500	3			500	-500	250	-250
DP/IM	-100	I	100	-100	100	-400				
DP/IM	25	I	25	0	25	-37.5				
DP/IM	50	I	50	0	50	-75				
DP/IM	100	I	100	0	100	-150				
DP/IM	250	I	250	0	250	-375				
DP/IM	500	I	500	0	500	-750				
DP/IM	1000	I	1000	0	1000	-1500				
DP/IM	2500	I	2500	0	2500	-3700				
DP/IM	5000	I	5000	0	5000	-7500				
DP/VK	100	V	100	0			100	-100	50	-50
DP/VK	150	V	150	0			150	-150	75	-75
DP/VK	500	V	500	0			500	-500	250	-250
DP/VK	1000	V	1000	0			1000	-1000	500	-500
DP/VK	1500	V	1500	0			1500	-1500	750	-750
DP/VL	0.5	V	0.5	0			0.5	-0.5	0.25	-0.25
DP/VL	1	V	1	0			1	-1	0.5	-0.5
DP/VL	2	V	2	0			2	-2	1	-1
DP/VL	4	V	4	0			4	-4	2	-2
DP/VL	7	V	7	0			7	-7	3.5	-3.5
H/D		I	100	0	100	-150				
H/DT	H	I	100	0	100	-150				
	T	I	70	-10	70	-130				
H/OT	H	I	100	0	100	-100				
	T	I	50	-40	50	-175				
H/S		I	100	0	100	-150				
H/ST	H	I	100	0	100	-150				
	T	I	40	0	40	-60				
L/LO	2K	I	2000	10	2000	-2975				
L/LO	4K	I	4000	10	4000	-5975				
L/LO	20K	I	20000	10	20000	-29975				
L/LS	2K	I	2000	10	2000	-2975				
L/LS	4K	I	4000	10	4000	-5975				
OCC		V	10	0			10	-10	5	-5
P/XL	4	I	4	0	4	-6				
P/XL	10	I	10	0	10	-15				
P/XL	16	I	16	0	16	-24				
P/XL	20	I	20	0	20	-30				

REFERENCE LIST OF TREND SENSORS AND IQ SCALING PARAMETERS

Sensor		Input	U	L	+20mA T	-20mA B	+10 V T	-10 V B	+5 V T	-5 V B
T/201		T	See linearisation tables							
T/202		T	See linearisation tables							
T/320	Temp	I	40	-10	40	-85				
	Knob	T	See 10 kohm potentiometer table							
T/AV		I	110	-10	110	-190				
T/FG		I	400	0	400	-600				
T/PC	160	I	160	-10	160	-265				
T/PC	110	I	110	-10	110	-190				
T/PC	40	I	40	-10	40	-85				
T/PC	R	I	40	-40	40	-160				
T/PD	110	I	110	-10	110	-190				
T/PD	40	I	40	-10	40	-85				
T/PI	110	I	110	-10	110	-190				
T/PI	40	I	40	-10	40	-85				
T/PI	HT	I	160	-10	160	-265				
T/PI	R	I	40	-40	40	-160				
T/PO		I	50	-40	50	-175				
T/TFR		T	See linearisation tables							
T/TS		T	See linearisation tables							
T/TW		T	See linearisation tables							
TE/TC		T	See linearisation tables							
TE/TI		T	See linearisation tables							
TE/TD		T	See linearisation tables							
TE/TO		T	See linearisation tables							
TE/TS	T	T	See linearisation tables							
	Knob	T	See 10 kohm potentiometer table							
	O	T	Requires special strategy, see installation instructions							
	F	V	10	0			10	-10	5	-5
WS/SD		Requires special strategy, see installation instructions for details								

Voltage Scaling Key

±10V (T, B): IQ70, 90, 100, 100+, 111+, 131+, 90+, 8xe, 9xe, IQ2 series

±5V (T, B): IQ111, 131, 151, 151+

TREND THERMISTOR LINEARISATION IQ SCALING PARAMETERS

LINEARISATION TABLES

Trend thermistor sensors all exhibit the same characteristics, although the packaging may limit the temperature range. Thus the same set of linearisation tables may be used for any sensor.

To use these tables:
1. Select required temperature range
2. Select required IQ type

For IQ1 series controllers, use sensor type scaling mode 2, linearise (thermistor volts), and the table below:

	-10°C to +110°C				-10°C to +40°C			
	10V(A)	10V(B)	LK/D	2.55V	10V(A)	10V(B)	LK/D	2.55V
B	-10	-10	-10	-10	-10	-10	-10	-10
T	110	110	110	110	40	40	40	40
F	8.66	8.47	4.61	2.15	8.66	8.47	4.61	2.15
G	5.68	5.55	3.63	1.41	7.58	7.42	4.3	1.89
H	2.71	2.65	2.17	0.68	6.24	6.11	3.83	1.56
I	1.14	1.12	1.05	0.28	4.83	4.73	3.28	1.21
J	0.5	0.49	0.49	0.12	3.55	3.48	2.66	0.89
	-40°C to +50°C				-10°C to +70°C			
	10V(A)	10V(B)	LK/D	2.55V	10V(A)	10V(B)	LK/D	2.55V
B	-40	-40	-40	-40	-10	-10	10	-10
T	50	50	50	50	70	70	70	70
F	9.92	9.71	4.93	2.48	8.66	8.47	4.61	2.16
G	9.13	8.94	4.74	2.28	6.8	6.67	4.04	1.69
H	7.33	7.17	4.22	1.83	4.56	4.46	3.16	1.13
I	4.83	4.73	3.29	1.21	2.71	2.65	2.17	0.69
J	2.71	2.65	2.17	0.68	1.52	1.49	1.36	0.38

10V(A) **All new IQ1 series (IQ7xv3, IQ8xe, IQ91/93ev4, IQ92ev3, IQ10x+, IQ104+, IQ111+v3, IQ131+ and all newer versions)**

10V(B) **All IQ2 and IQ1 series except new IQ1s (see 10V(A) above), those without thermistor links, and IQ90s**

LK/D **Where LK/D link header is used, i.e. on IQs without links and IQ90s**

2.55V **For IQ90 series controllers only**

For IQ2 series controllers, use sensor type scaling mode 4, linearise thermistor ohms, and the table below:

	-10 °C to 110 °C	-10 °C to 40°C	-40 °C to 50°C	-10 °C to 70°C
U	-10	-10	-40	-10
V	2.5	-5	-28.5	0
W	16.5	4.5	-14	12.5
Y	42	19	8.5	33
Z	110	40	50	70
K	540.6	55.34	328.87	54.44
L	28	40.5	157.9	32.49
M	14.06	25.26	64.35	16.93
N	3.9	12.63	19.18	6.38
O	0.51	5.32	3.6	1.75

10 kΩ POTENTIOMETER LINEARISATION IQ SCALING PARAMETERS

10 kΩ POTENTIOMETER TABLE

It is recommended that a 10 kΩ potentiometer, connected to a thermistor input, is connected in series with a 1kΩ resistor. This arrangement eliminates the occurrence of a Low alarm when the potentiometer is set to zero resistance. The table shows sensor type scaling mode 2, linearise (thermistor volts), settings. The controller types are as defined on page 4 above.

	10V(A)	10V(B)	LK/D	2.55V
B	-3	-3	-3	-3
T	3	3	3	3
F	0.93	0.91	0.88	0.23
G	2.65	2.59	2.13	0.66
H	3.84	3.75	2.80	0.95
I	4.69	4.59	3.22	1.17
J	5.36	5.24	3.50	1.34

The T and B values define the range of the value produced by the sensor configuration module as the potentiometer is moved over its full range. In this case T and B have been chosen to give a trim over the range -3 to +3.

TREND THERMISTOR CHARACTERISTIC TABLE

Temperature °C	R_1 Ω
-30	177000
-25	130400
-20	97120
-15	72980
-10	55340
-5	42340
0	32660
5	25400
10	19900
15	15710
20	12490
25	10000
30	8058
35	6532
40	5326
45	4368
50	3602
55	2986
60	2488
65	2082
70	1751
75	1480
80	1256
85	1071
90	916.4
95	787.4
100	679.2
105	588.0
110	510.8

Accuracy ±0.2°C in the range 0 to 100 °C.

Note that the above table is for Trend thermistor sensors only. If a non-Trend sensor is used its own table or graph should be used for all calculations.

CALCULATION OF VOLTAGE MEASURED BY IQ (scaling mode 2)

For Sensor Type Scaling Mode 2, Linearise (thermistor volts)

These formulae are useful for calculating the F,G,H,I, and J for non-Trend Thermistor sensors. F,G,H,I,J should be used to set up the sensor type scaling mode 2 , linearise (thermistor volts), as explained in the IQ Configuration Reference Manual.

$$\text{Value in IQ (volts)} = 10.227\left(\frac{R_1}{R_1 + 10000}\right)$$

For all new IQ1 series (IQ7xv3, 8xe, 91/93ev4, 92ev3, 10x+, 104+, 111+v3, 131+, and all newer versions).

$$\text{Value in IQ (volts)} = 10\left(\frac{R_1}{R_1 + 10000}\right)$$

For all IQ2 and IQ1 series except new IQ1s (see above), those without thermistor links, and IQ90s.

$$\text{Value in IQ (volts)} = 5\left(\frac{R_1}{R_1 + 4700}\right)$$

IQ's without thermistor links (i.e using LK/D).

$$\text{Value in IQ (volts)} = 2.55\left(\frac{R_1}{R_1 + 10000}\right)$$

IQ90s only

R_1 is the resistance at the required temperature as defined in the thermistor characteristic table/graph.

For example, an IQ 111+ using Trend thermistor; what is the value at the IQ in volts at 80 °C?

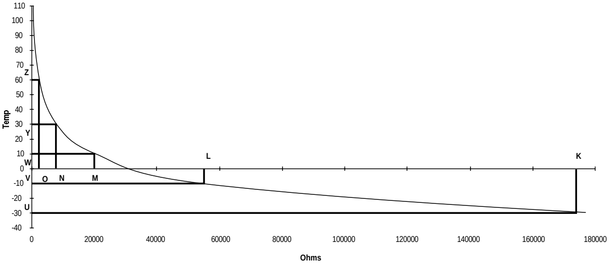
$$\text{for IQ111+, value} = 10\left(\frac{R_1}{R_1 + 10000}\right)$$

from the table at 80 °C, R=1256 Ω

$$\text{Value} = 10\left(\frac{1256}{1256 + 10000}\right) = 1.12\text{V}$$

SELECTION OF VALUES FOR LINEARISE THERMISTOR OHMS (scaling mode 4)

IQ2 series controllers have sensor type scaling mode 4, linearise thermistor ohms. This enables linearisation points to be chosen directly from the sensor characteristic, and at variable separations to suit the changes in slope of the characteristic.The standard Trend sensor ranges are shown on page 4, but for non-Trend sensors the appropriate resistance values and associated sensor units have to be entered.



This graph shows the temperature characteristic of a Trend temperature sensor as shown in the table on page 6.
The gradient changes most rapidly over the knee of the characteristic thus around this area the points should be closer together. The points are found by drawing four straight lines approximating as close as possible to the curve.In the above example for the range -30 to +60 °C the points are -30, -10, 10, 30, and 60°C. The corresponding resistance values are best found from a table as shown on page 6 for the Trend thermistor characteristic and are given in the table below:

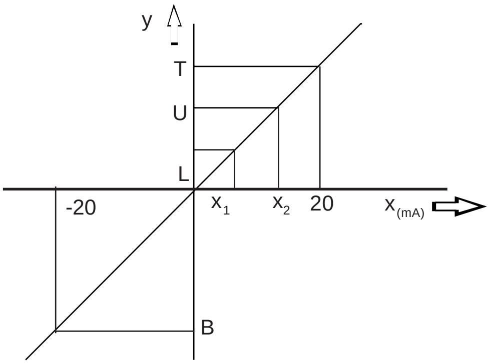
Temp parameter	°C	Res parameter	Ohms
U	-30	K	177000
V	-10	L	55340
W	10	M	19980
Y	30	N	8058
Z	60	O	2488

USING NON-STANDARD LINEAR RANGES (scaling mode 0)

If a non-standard range is being used for a sensor with a straight line (linear) characteristic, T and B may be calculated if two points are known. The exact calculation used depends on whether the sensor has a current or voltage output. The calculations are shown below, but more detail is given in the IQ Configuration Manual 90-1533.

SENSORS WITH CURRENT OUTPUT

For a current output sensor, T and B are the values of the measured value with sensor output +20mA and -20mA respectively. For example, using a sensor with the characteristic graph below, then U is the measured value at x_2 (mA), and L is the measured value at x_1 (mA).



First calculate slope, m, given by: $m = \frac{U - L}{X_2 - X_1}$

and constant, c: $c = L - x_1 m$

then $B = -20m + c$

and $T = 20m + c$

USING NON-STANDARD LINEAR RANGES (scaling mode 0)

SENSORS WITH CURRENT OUTPUT (continued)

For example, a sensor has a 4 to 20 mA output corresponding to a measured range of 0 to 80 °C. Hence U=80, L=0, x_2=20, x_1=4.

then $$m = \frac{U - L}{X_2 - X_1} = \frac{80 - 0}{20 - 4} = \frac{80}{16} = 5$$

and $c = L - x_1 m = 0 - 4 \times 5 = -20$

so $B = -20m + c = -20 \times 5 - 20 = -120$ °C

and $T = 20m + c = 20 \times 5 - 20 = 80$ °C

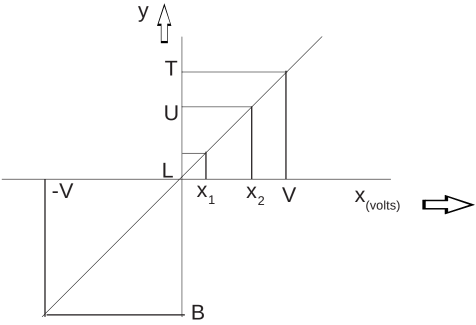
SENSORS WITH VOLTAGE OUTPUT

For a voltage output sensor, T and B are the values of the measured variable when the sensor output is +10 V (or 5 V) and -10 V (or -5 V) respectively. The table below shows which IQs require values at ±10 V, and which at ±5 V:

Table of IQs requiring T, B values at ±10 V or at ±5 V

	IQ70's, 90's, 100's, 100+, 111+, 131+, 90+, 8xe, 9xe, IQ2 series	IQ111, 131, 151, 151+
T	+10V	+5V
B	-10V	-5V

For example, using a sensor with the characteristic graph below, then U is the measured value at x_2 volts, and L is the measured value at x_1 volts.



USING NON-STANDARD LINEAR RANGES (scaling mode 0)

SENSORS WITH VOLTAGE OUTPUT (continued)

First calculate slope, m, given by: $m = \frac{U - L}{X_2 - X_1}$

and constant, c: $c = L - x_1 m$

then $B = -Vm + c$

and $T = Vm + c$

Note that V=10 or 5 according to the table above.

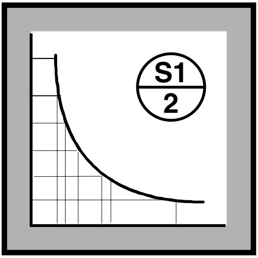
For example, a sensor has a 0 to 10 Vdc output corresponding to a measured range of 0 to 250 Pa, and is fitted to an IQ111+ (i.e. V=10). Hence U=250, L=0, x_2=10, x_1=0, V=10.

then $m = \frac{U - L}{X_2 - X_1} = \frac{250 - 0}{10 - 0} = 25$

and $c = L - x_1 m = 0 - 0x25 = 0$

so B = -10m+c = -10x25+0 = -250 Pa

and T = 10m+c = 10x25+0 = 250 Pa



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