Product Document

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Application Note

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AS702x AppNote

Using External Temperature Sensors

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Content Guide

1 Using an External NTC as Temperature Sensor 3

2 Revision Information 7

3 Legal Information 8

1 Using an External NTC as Temperature Sensor

The electrical analog front end allows the use of an external resistive divider consisting of a normal resistor and an NTC to sense temperature. For this purpose, we connect the divider between two GPIO pins and GND. The DAC is then set to output 1.9 V to the according GPIO pin e.g. GPIO0 in the drawing. The AFE gain stage is set to 1 and connected to the second GPIO pin (GPIO2 in the drawing) and the sequencer is configured to include the AFE in its sampling.

As a resistive divider we recommend a 100 k NTC together with a 100 k resistor.

Figure 1:
Electrical-Analog-Frontend Configuration for NTC Temperature Sensor

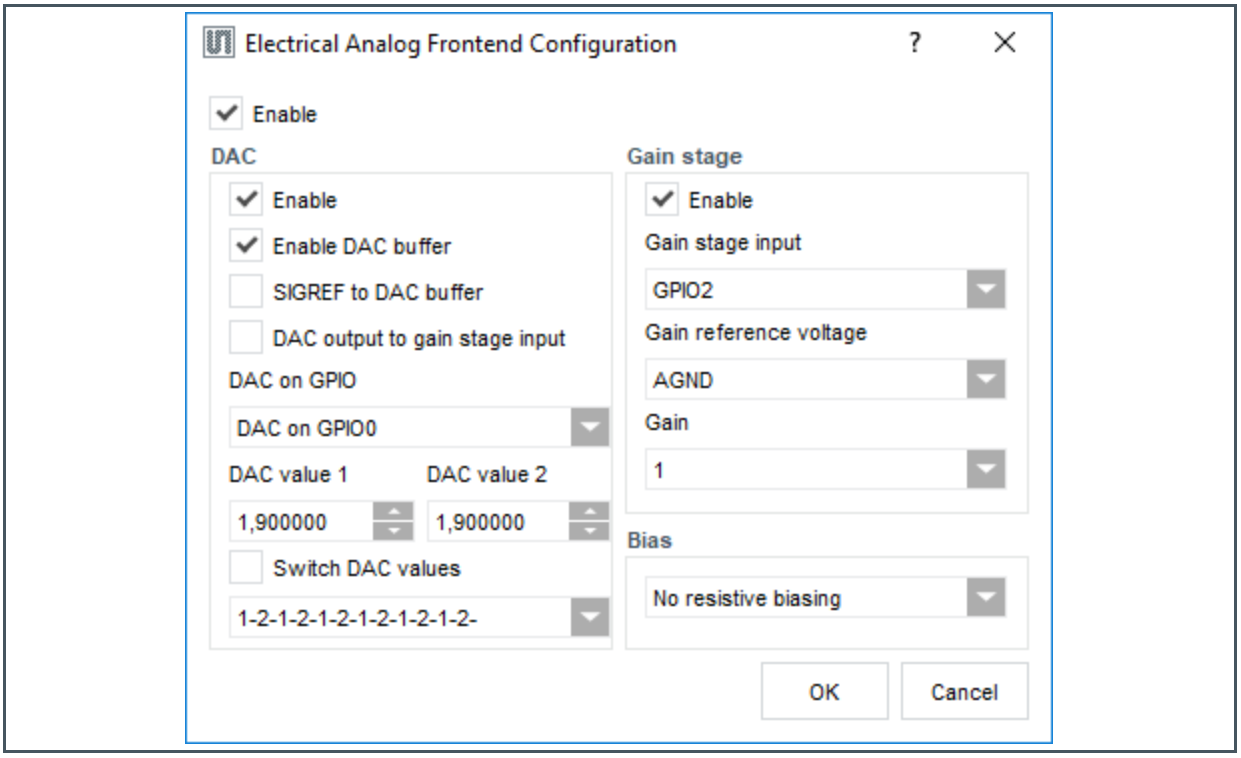

Figure 2:
Sequencer Configuration for NTC Temperature Sensor

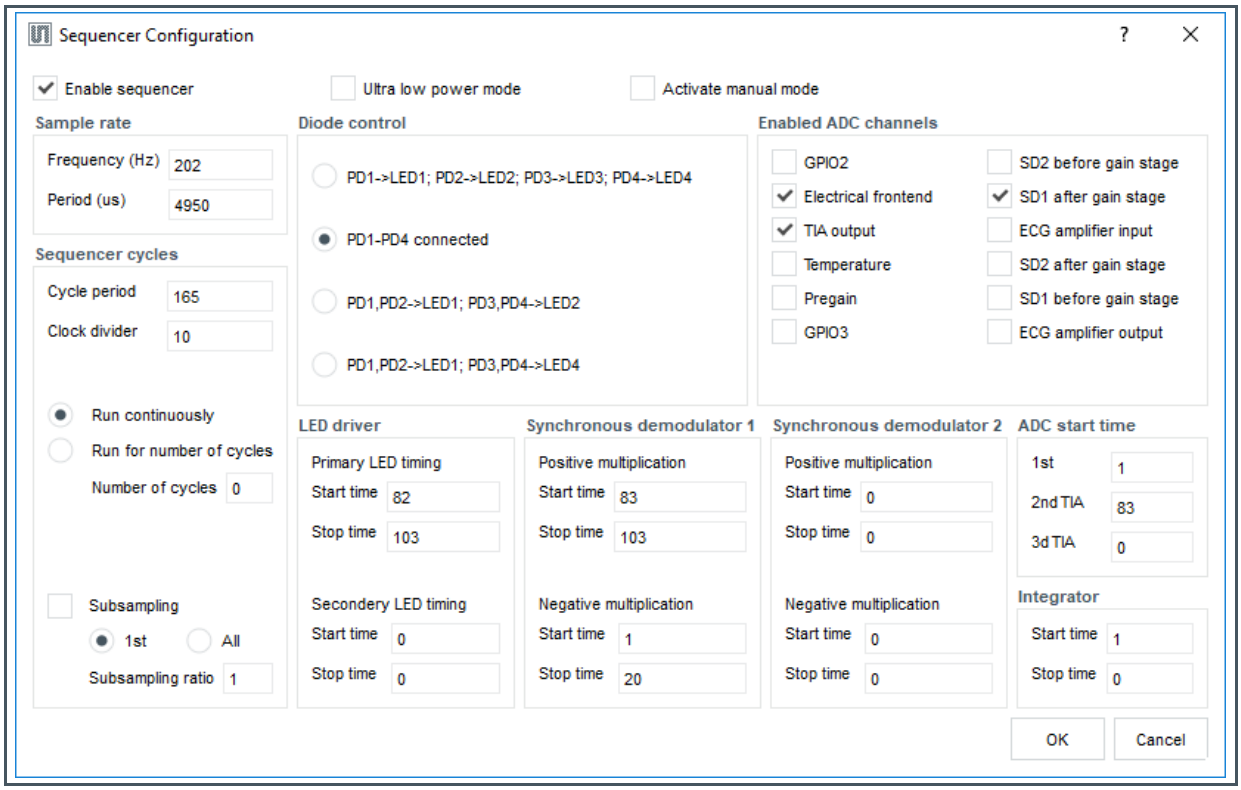

Figure 3:
Electrical-Analog-Frontend Block Diagram with External NTC (datasheet p.61)

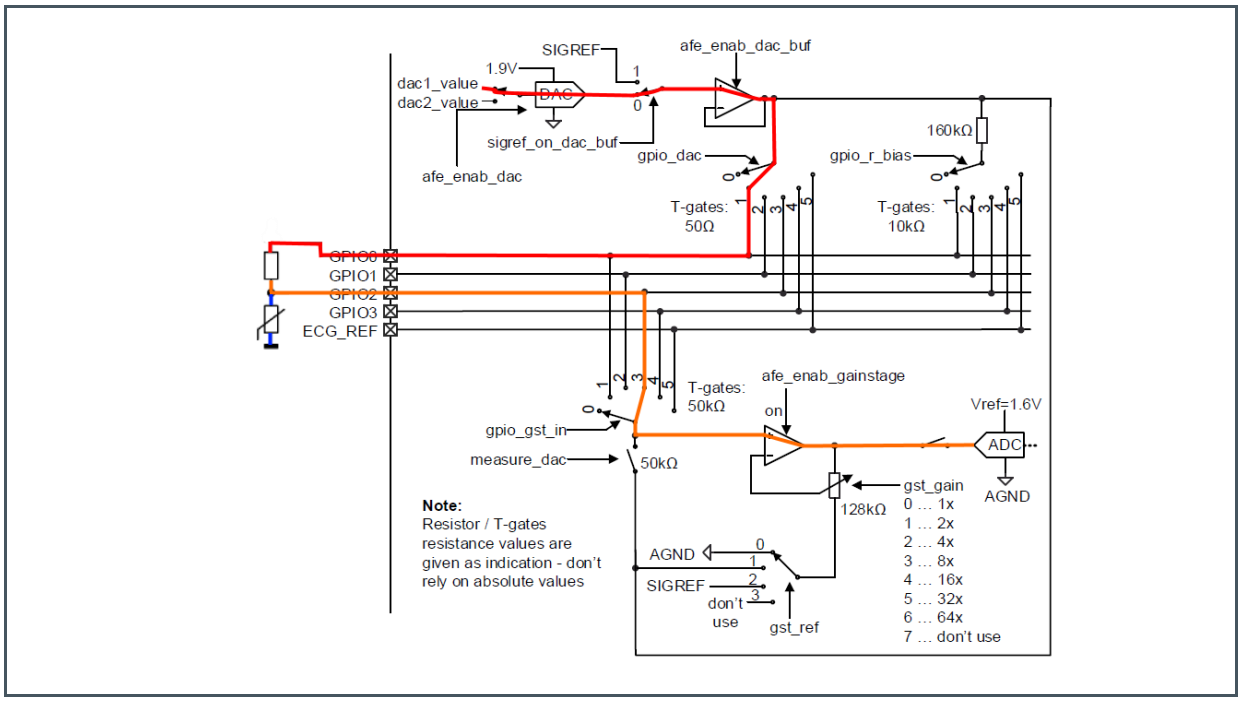

Figure 4:
Data Displayed in the Electrical Analog Frontend Graph.

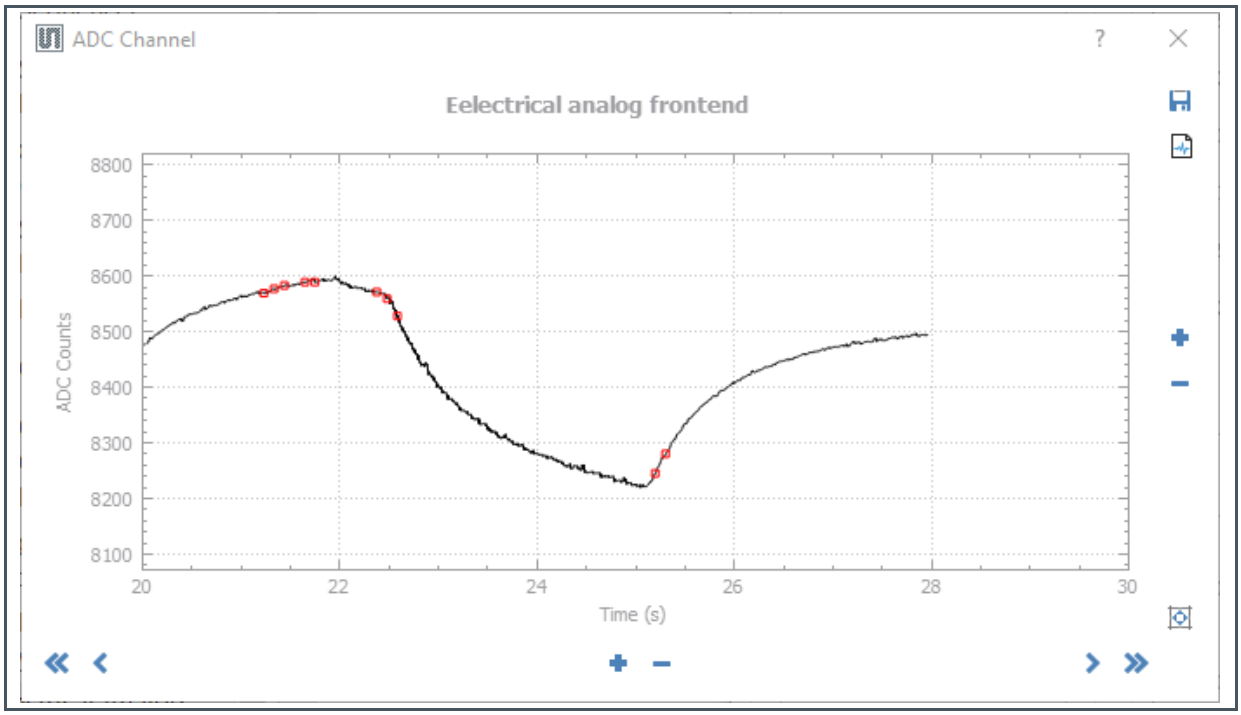

Figure 5:
Register Settings for NTC Temperature sensor

	Addr.	7	6	5	4	3	2	1	0	Value
EAF_GST	0x80	0	1	1	0	0	0	0	0	0x60
EAF_BIAS	0x81	0	0	0						0x00
EAF_DAC	0x82				0	0	0	0	1	0x01
EAF_DAC1_L	0x83	1	1							0xC0
EAF_DAC1_H	0x84	1	1	1	1	1	1	1	1	0xFF
EAF_DAC2_L	0x85	1	1							0xC0
EAF_DAC2_H	0x86	1	1	1	1	1	1	1	1	0xFF
EAF_DAC_CFG	0x87							0	0	0x00

Temperature changes act on the ADC value according to this formula:

RNTC=R0*exp-B*((1/(273+Tref))-(1/(273+Tnew)))

Vout = 1.9* RNTC/(Rfix+RNTC)

ADCout = Vout /1.6 *2^14

For our example with 100 k NTC and a B of 4190 we end up with

Vout25 = 0.95 V = 9728LSB

Vout35 = 0.74 V = 7577LSB

There are online tools that help with the calculation like:

https://www.electro-tech-online.com/tools/thermistor-resistance-calculator.php

or

http://www.giangrandi.ch/electronics/NTC/NTC.shtml

The temperature calculation can be done with these formulas:

Equation 1:

$$U_{adc} = \frac{ADC_{lsb} * 1.6}{2^{14}}$$

Equation 2:

$$R_{ntc} = \frac{R_{fix} * U_{adc}}{1.6 - U_{adc}}$$

Equation 3:

$$T = \frac{1}{\frac{\ln(\frac{R_{ntc}}{R_{25}})}{\beta} + \frac{1}{T_{25}}} - T_0$$

R_f is the fixed resistor (100 k), ADC_lsb is the digital output in lsb and T0 is 0°C in Kelvin (273).

2 Revision Information

Changes from previous version to current revision v1-00	Page
Initial version	

- Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
- Correction of typographical errors is not explicitly mentioned.

3 Legal Information

Headquarters
ams AG
Tobelbader Strasse 30
8141 Premstaetten
Austria, Europe
Tel: +43 (0) 3136 500 0

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