Product Document

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Application Note

AN000619

AS702x Galvanic Skin Resistance

AS702x GSR Implementation

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Content Guide

1 Introduction

The AS702x can be configured to measure changes in a person's skin resistance also called Galvanic Skin Resistance (GSR). This app note explains applications for GSR measurements, the circuit needed, how to configure the device, and what type of data to expect.

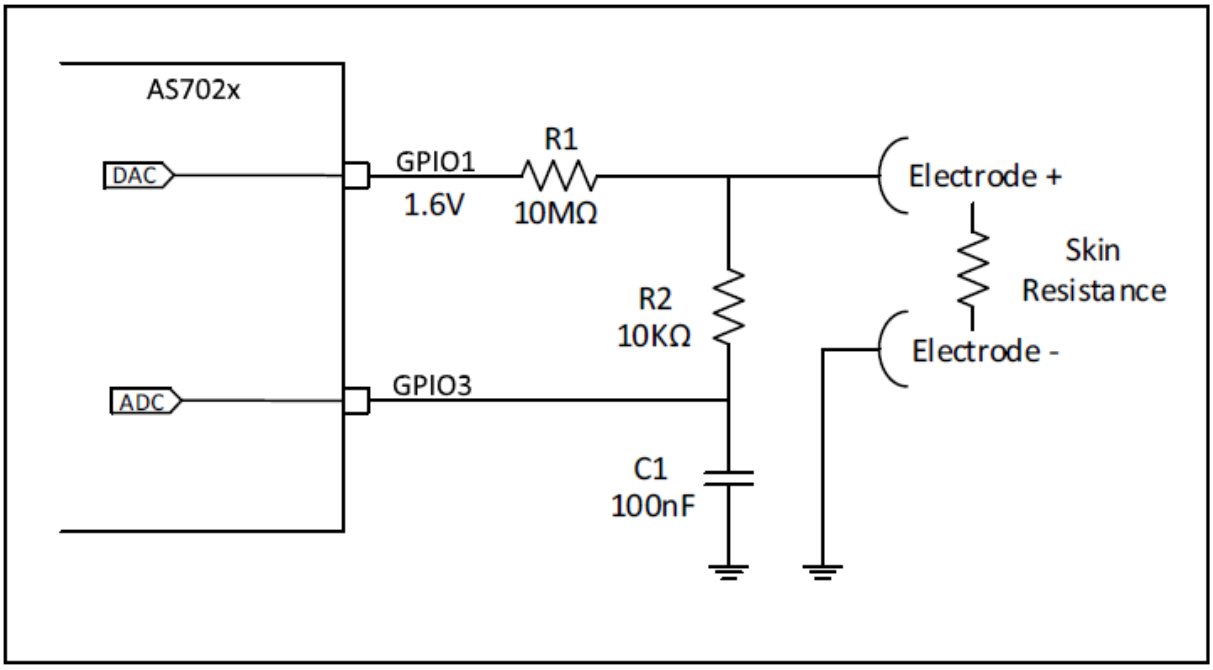
GSR is a part of a set of measurements of electrical activity in the skin known as Electro-dermal activity (EDA). The impedance of the skin changes in part due to the amount of sweat and blood flow that are present in the skin. These are affected by the person's physical and mental stress level as well as environmental conditions. EDA and GSR are highly responsive to a person's emotional state, health, and the autonomic nervous system. They are widely used in psychophysiological research, biofeedback, and are also used in polygraphs or lie detectors.

The skin resistance is measured by applying a small stimulus thru an electrode to one part of a person's skin and measuring the impedance from another part of the skin. The amount of change observed can vary depending on where the electrodes are placed due to variations in the density of sweat glands throughout the body. The palm contains up to 2000 sweat glands per square centimeter and provides for convenient placement of electrodes on the fingers. Placing of the electrodes on the wrist is also possible, but due to fewer sweat glands, the resistance is much higher as compared to the palm.

2 Hardware

GSR is measured with the AS702x using the Electrical Analog Frontend and GPIO pins to both create the signal and measure the results. As shown in Figure 1 below, GPIO 1 is connected to the DAC which generates 1.6V and the resulting voltage level is measured on GPIO 3. The circuit is basically a resistor divider with the person's skin resistance as half the divider network.

Figure 1:
External Hardware for GSR Measurement



The DAC is then set to output 1.6 V to the according GPIO pin e.g. GPIO1 in the drawing. The AFE gain stage is set to 1 and connected to the second GPIO pin (GPIO3 in the drawing) and the sequencer is configured to include the AFE in its sampling.

Figure 2:
Electrical-Analog-Frontend Configuration for GSR Measurement

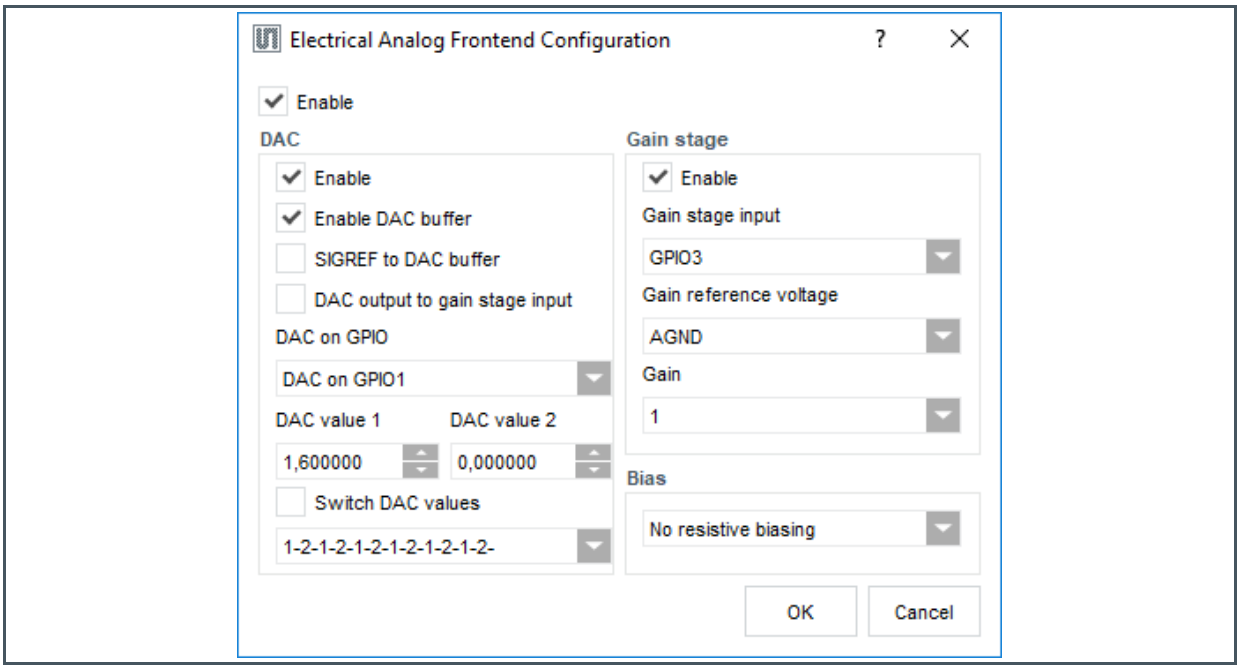


Figure 3:
Sequencer Configuration for NTC Temperature Sensor

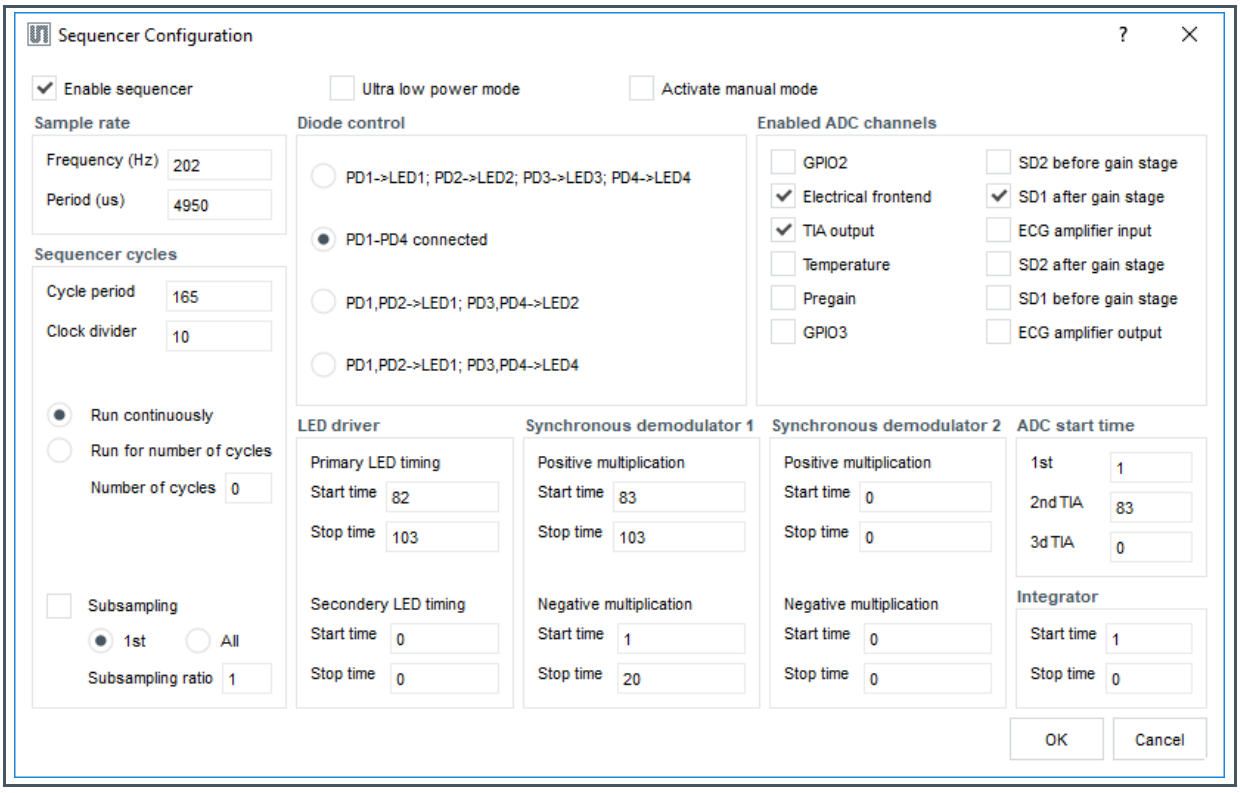


Figure 4:
Data Displayed in the Electrical Analog Frontend Graph.

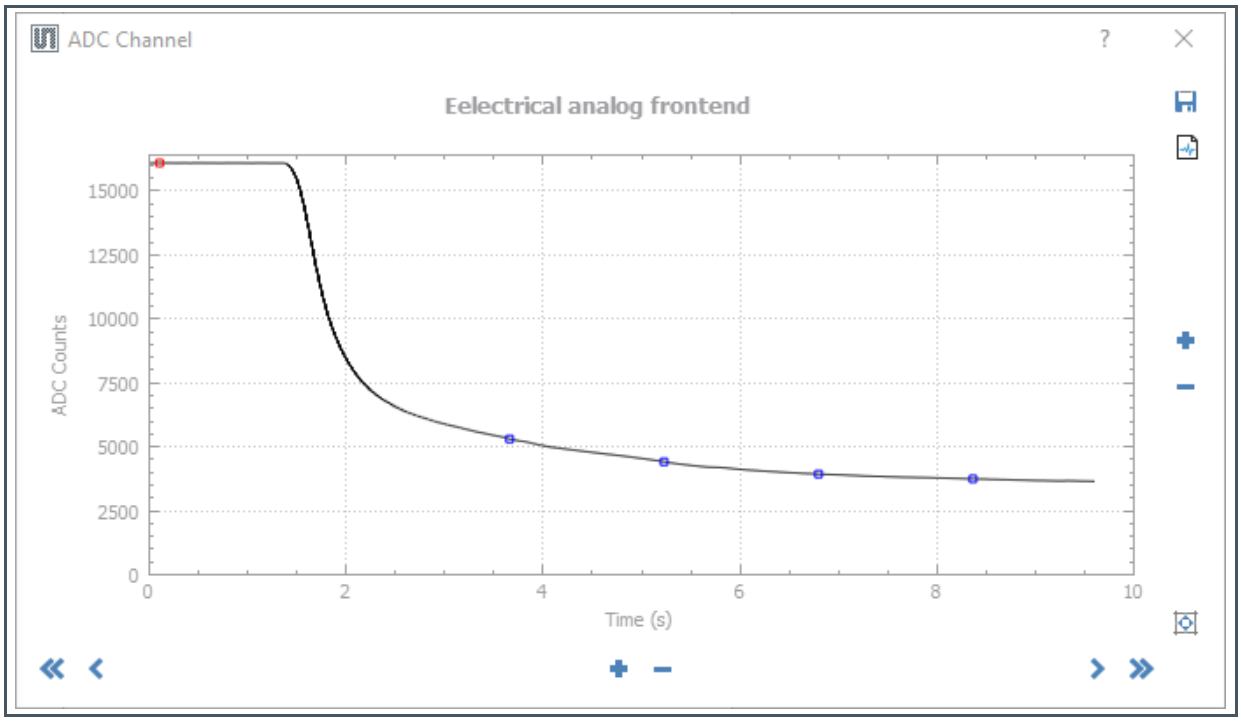


Figure 5:
Register Settings for NTC Temperature Sensor

EAF_GST	0x80	1	0	0	0	0	0	0	0	0x80
EAF_BIAS	0x81	0	0	0						0x00
EAF_DAC	0x82				0	0	0	1	0	0x02
EAF_DAC1_L	0x83	1	0							0x80
EAF_DAC1_H	0x84	1	1	0	1	0	1	1	1	0xD7
EAF_DAC2_L	0x85	0	0							0x00
EAF_DAC2_H	0x86	0	0	0	0	0	0	0	0	0x00
EAF_DAC_CFG	0x87							0	0	0x00

3 Data

The GSR circuit uses a 14 bit ADC to measure the voltage with a range from 0 to 16383. The data is read from the FIFO. To calculate the measured GSR use the following equation:

Equation 1:

$$VADC = \frac{ADC\ Value}{16{,}384} * VREF\ (1.9V)$$

The skin resistance is dependent on the resistor value used.
Based on the circuit in Figure 1, the skin resistance can be calculated with the following equation:

Equation 2:

$$RSkin = \frac{\frac{V_{ADC}}{V_{DAC(1.6V)}} * R1\ (10M\Omega)}{1 - \frac{V_{ADC}}{V_{DAC(1.6V)}}}$$

V_{DAC} is the voltage generated on GPIO1 and is usually set to 1.6V and the suggested value for R1 is 10MOhm. Since the rate of change of skin resistance is not very fast the data sample rate should be set according to the needs of the application.

4 Summary / Results

This document explains how with only a few components and a simple configuration, the AS702x can measure a person's GSR giving insight into their autonomic nervous system and monitor their stress level or even detect if someone is being truthful or other emotional responses.

5 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.

6 Legal Information

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

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