DSADC_1
for KIT_AURIX_TC275_LK
Delta-Sigma ADC conversion
The DSADC is used to convert an external signal to a stream of discrete digital values.

The Delta-Sigma ADC (DSADC) continuously measures an external signal on channel 1, connected to port pin AN0. It converts the analog signal to a data stream and then a global variable is updated to the current conversion result. The input value is determined by the potentiometer on the board.
Introduction

- The Delta-Sigma Analog-to-Digital Converter module (DSADC) of the AURIX™ TC27x provides a set of six analog input channels.

- Each converter channel is controlled by a dedicated set of registers, which enables the independent operation of the channels.

- The results of each channel can be stored in a channel-specific result register. They are signed values stored in a 16-bit two’s complement format.
Hardware setup

This code example has been developed for the board KIT_AURIX_TC275_LITE.

In this example, the pin AN0, connected to the board’s potentiometer, is used.
Implementation

Configuration of the DSADC module:

Configuration of the DSADC module is done once in the setup phase by calling the initialization function `init_DSADC()`, which contains the following steps:

1. The module configuration is filled with default values using an instance of the structure `IfxDsadc_Dsadc_Config` and the function `IfxDsadc_Dsadc_initModuleConfig()`. The DSADC module is then initialized with the function `IfxDsadc_Dsadc_initModule`.
2. The channel configuration is created with an instance of the structure `IfxDsadc_Dsadc_ChannelConfig` and filled with default values using the function `IfxDsadc_Dsadc_initChannelConfig()`.
3. The default configuration of the DSADC is modified using the parameters `combFilter` and `firFilter` of the structure `IfxDsadc_Dsadc_ChannelConfig`.
4. The channel is initialized with the function `IfxDsadc_Dsadc_initChannel()` and the function `IfxDsadc_Dsadc_startScan()` starts the conversion.

All the previous functions are provided by the iLLD header `IfxDsadc_Dsadc.h`.

Copyright © Infineon Technologies AG 2021. All rights reserved.
Implementation

The conversion function:

- The `run_DSADC()` function is called in the while loop and continuously converts the analog voltage level on channel 1 to a digital value.

- The function `IfxDsadc_Dsadc_getMainResult()` from the iLLD header `IfxDsadc_Dsadc.h` is used to get the latest analog to digital conversion. Digital result of DSADC is stored in two’s complement format. The final digital result is determined by the gain factor of the input stage, the gain and the data shifter of CIC and the gain and the data shifters of FIR0/1.
  - The total gain factor of the digital filter chain is
    \[ G_{\text{TOT}} = G_{\text{CIC}} \times G_{\text{SC}} \times G_{\text{FIR0}} \times G_{\text{SF0}} \times G_{\text{FIR1}} \times G_{\text{SF1}} \]
    e.g. \[ G_{\text{TOT}} = 0.953674316 \times 8 \times 0.580078125 \times 1 \times 0.642578125 \times 2 = 5.687645168 \]
    where \( G_{\text{CIC}} \) is the gain of the CIC filter, \( G_{\text{FIR0}} \) is the gain of the FIR0 filter and \( G_{\text{FIR1}} \) is the gain of the FIR1 filter. \( G_{\text{SC}} \), \( G_{\text{SF0}} \) and \( G_{\text{SF1}} \) are the gains associated to the data shifting.
  - For AURIX™ TC27x, the full-scale value produced by the on-chip modulator is typically 3800. As a result, the output range is
    \[ 3800_D \times G_{\text{TOT}} = 3800_D \times 5.687645168 = 21613 \]
    which is stored in the code as `g_maxValue`.
  - As the board is supplied in 3.3 V, 0 represents 0 V and +21613 represents 3.3 V.

*Note:* The final output range (`g_maxValue`) is a theoretical one and it does not consider the gain or offset error.
Run and Test

After code compilation and flashing the device, perform the following steps:

› The signal to be measured (0 V to +3.3 V) is controlled via the potentiometer
› In order to get the global variable in a stable state, the debugger should be paused or a breakpoint should be inserted in the function `run_DSADC()`
› The measured value can be watched through the debugger in the `g_resultDSADC` variable and the converted value in the `g_resultVoltage` variable
References

› AURIX™ Development Studio is available online:
  › https://www.infineon.com/aurixdevelopmentstudio
  › Use the „Import...“ function to get access to more code examples.

› More code examples can be found on the GIT repository:
  › https://github.com/Infineon/AURIX_code_examples

› For additional trainings, visit our webpage:
  › https://www.infineon.com/aurix-expert-training

› For questions and support, use the AURIX™ Forum:
  › https://www.infineonforums.com/forums/13-Aurix-Forum
IMPORTANT NOTICE

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics ("Beschaffenheitsgarantie").

With respect to any examples, hints or any typical values stated herein and/or any information regarding the application of the product, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights of any third party.

In addition, any information given in this document is subject to customer's compliance with its obligations stated in this document and any applicable legal requirements, norms and standards concerning customer’s products and any use of the product of Infineon Technologies in customer’s applications.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer’s technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (www.infineon.com).

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies’ products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.