DSADC_1

Delta-Sigma ADC conversion

AURIX™ TC2xx Microcontroller Training
V1.0.0

Scope of work

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 0, connected to port pin AN2. It converts the analog signal to a data stream and then a global variable is updated to the current conversion result.

Introduction

- The Delta-Sigma Analog-to-Digital Converter module (DSADC) of the AURIX™ TC29x provides a set of ten 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.

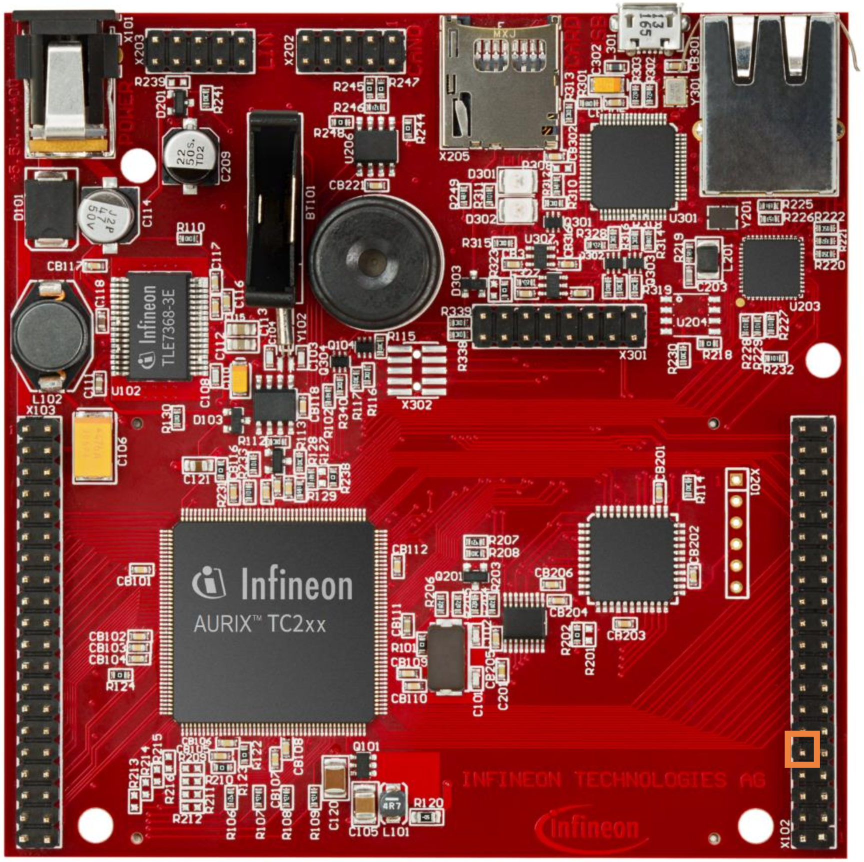
Hardware setup

This code example has been developed for the board KIT_AURIX_TC297_TFT_BC-Step.

The signal to be measured has to be connected to channel 0 of the DSADC (port pin AN2).

X102

	P14.5	40	39	P14.4
	P20.10	38	37	P20.9
	P15.7	36	35	P15.6
	P15.5	34	33	P15.4
	P15.3	32	31	P15.2
	P22.3	30	29	P22.2
	P22.1	28	27	P22.0
	P33.11	26	25	P23.4
	P23.3	24	23	P23.2
	P23.1	22	21	P23.0
	P33.6	20	19	P33.8
	P33.12	18	17	P33.1
	P33.2	16	15	P33.3
	P33.4	14	13	P33.5
	AN0	12	11	AN8
Channel 0	AN2	10	9	AN3
	AN32	8	7	AN33
	AN20	6	5	AN21
	GND	4	3	GND
	V_UC(+5V)	2	1	VCC_IN



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***.

Implementation

The conversion function:

- The ***run_DSADC()*** function is called in the while loop and continuously converts the analog voltage level on channel 0 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

    $$G_{TOT} = G_{CIC} \times G_{SC} \times G_{FIR0} \times G_{SF0} \times G_{FIR1} \times G_{SF1}$$

    e.g. $G_{TOT} = 0.953674316 \times 8 \times 0.580078125 \times 2 \times 0.642578125 \times 2 = 11.375290337$

    where G_{CIC} is the gain of the CIC filter, G_{FIR0} is the gain of the FIR0 filter and G_{FIR1} is the gain of the FIR1 filter. G_{SC} , G_{SF0} and G_{SF1} are the gains associated to the data shifting.
  - For AURIX™ TC29x, the full-scale value produced by the on-chip modulator is typically 1900. As a result, the output range is

    $$1900_D \times G_{TOT} = 1900_D \times 11.375290337 = 21613$$

    which is stored in the code as ***g_maxValue***.
  - As the board is supplied in 5 V, 0 represents 0 V and +21613 represents 5 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 +5 V) should be connected to the port pin AN2.
- 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.

Expression	Type	Value
g_resultDSADC	float	21812
g_resultVoltage	float	5.046037
Add new expression		

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

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Edition 2019-10
Published by
Infineon Technologies AG
81726 Munich, Germany

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Document reference
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