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CE204022 - PSoC® 4 IDAC7 Sawtooth Waveform Generator

Objective

This code example shows the user the basics of using the IDAC7 found in some PSoC 4 devices. A simple sawtooth or voltage ramp waveform is generated using the IDAC7 current Digital to Analog converter.

Overview

This code example generates a linear voltage ramp (sawtooth) waveform by incrementing the current DAC's output until the maximum value, it then starts back at zero. Since the IDAC7 is a current DAC, an external load resistor is used to generate a voltage from the current source.

Requirements

Tool: PSoC Creator 4.1 SP2 or higher

Programming Language: C (GCC 4.9.0) or higher

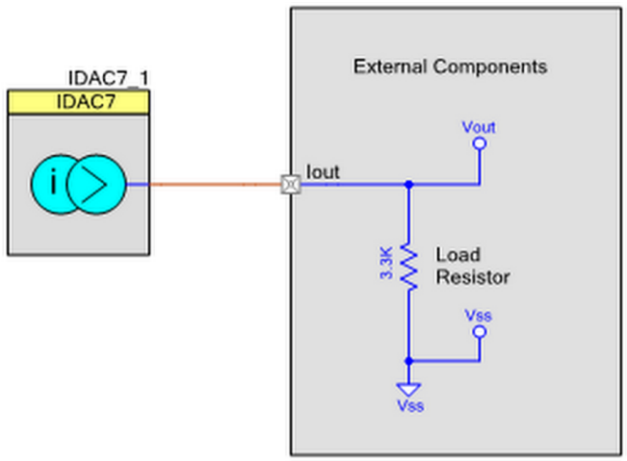
Associated Parts: PSoC 4000S, PSoC 4100S and PSoC Analog Coprocessor

Related Hardware: CY8CKIT-041-40XX, CY8CKIT-041-41XX and CY8CKIT-048

Design

This simple design demonstrates how to create a voltage waveform from a current source. The IDAC is used to source a current through an external resistor connected to Vss (see Figure 1). The waveform is seen across the resistor between Vss and Vout. The internal IDAC7 is connected to GPIO port P0[7]. The Load Resistor is connected between P0[7] and Vss as shown in Figure 1.

Figure 1. Voltage Ramp Generator Schematic



Design Considerations

Use Ohms law, R = V/I, to determine the load resistor or voltage range for a specific project. In this example the 3.3-kΩ load resistor was selected to generate a 2-V peak-to-peak signal using the highest current range (600 µA), as Equation 1 shows.

Equation 1 $$\text{RLoad} = \frac{2\text{V}}{600\text{uA}} = 3.3\ K\ Ohms$$

By either changing the load resistor and/or selecting one of 6 current ranges, any voltage range between the supply rails can be achieved. Additionally a waveform may be referenced to Vdda instead of Vss by changing the Polarity to “Negative (Sink)” and connecting the load resistor to Vdda instead of Vss. The IDAC’s range and polarity may also be changed during runtime with the IDAC7_1_SetRange() and IDAC7_1_SetPolarity() functions respectively.

Hardware Setup

For this code example a 3.3-K resistor needs to be connected from Port P0[7] to Vss as shown in Figure 1. Connect an oscilloscope across the resistor to observe the waveform. The attached project is configured for the CY8CKIT-048 but can easily be changed to accommodate the CY8CKIT-041 by simply changing the Device and Pin, see Table 1 below.

Table 1. Device and GPIO Configuration

Kit	PSoC Device	Output Pin (Iout)
CY8CKIT-048	CY8C4A45LGI-483	P0[7]
CY8CKIT-041	CY8C4045AZI-S413	P2[0]

Components

Table 2 lists the PSoC Creator Components used in this example, as well as the hardware resources used.

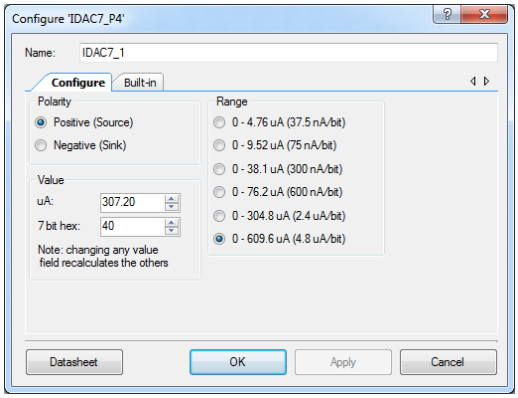
Table 2. List of PSoC Creator Components

Component or User Module	Version	Hardware Resources
IDAC7_1	1.0	CapSense® block
Iout	2.20	GPIO (P0[7])
Resistor	1.0	External Components

Parameter Settings

The IDAC7 component has three parameters, Polarity, Range, and Value. For this example, the Polarity should be set to “Positive (Source)” and the Range to “0-609.6 uA”. The Value does not matter since it will be changed during runtime in the code.

Figure 2. IDAC7 User Interface



Operation

1) Attach a 3.3-K load resistor between ports P0[7] and Vss.
2) Attach a scope probe across the load resistor.
3) Observe a 2-volt peak-to-peak sawtooth waveform on oscilloscope.

Related Documents

Table 3 lists all relevant application notes, code examples, knowledge base articles, device datasheets, and Component datasheets.

Table 3. Related Documents

Application Notes	
AN211293	Getting Started with PSoC Analog Coprocessor
PSoC Creator Component Datasheets	
IDAC7	IDAC7 Datasheet
Pins	General Purpose IO Pins
Device Documentation	
CY8C4Axx Datasheet	PSoC Analog Coprocessor: CY8C4Axx Family Datasheet
PSoC 4000S Datasheet	PSoC 4: PSoC 4000S Family Datasheet Programmable System-on-Chip (PSoC)
PSoC 4100S Datasheet	PSoC 4: PSOC 4100S Family Datasheet Programmable System-on-Chip (PSOC)
Development Kit (DVK) Documentation	
CY8CKIT-048 PSoC® Analog Coprocessor Pioneer Kit	
CY8CKIT-041-40XX PSoC® 4 S-Series Kit	
PSoC® Family Web Page	
PSoC Analog Coprocessor	
PSoC 4	

Document History

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Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	5265164	MEH	1/22/2016	New Code Example
*A	5723938	MEH	05/19/2017	Added links to 4000S and 4100S datasheet and kits. Added hyperlinks to PSoC Analog Coprocessor collateral

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