

# Мікропроцесорна техніка

(лекція 5)  
Благітко Б.Я.  
2019 р.

**PSoC Creator 4.2**  
**Designing with PSoC 3/5**

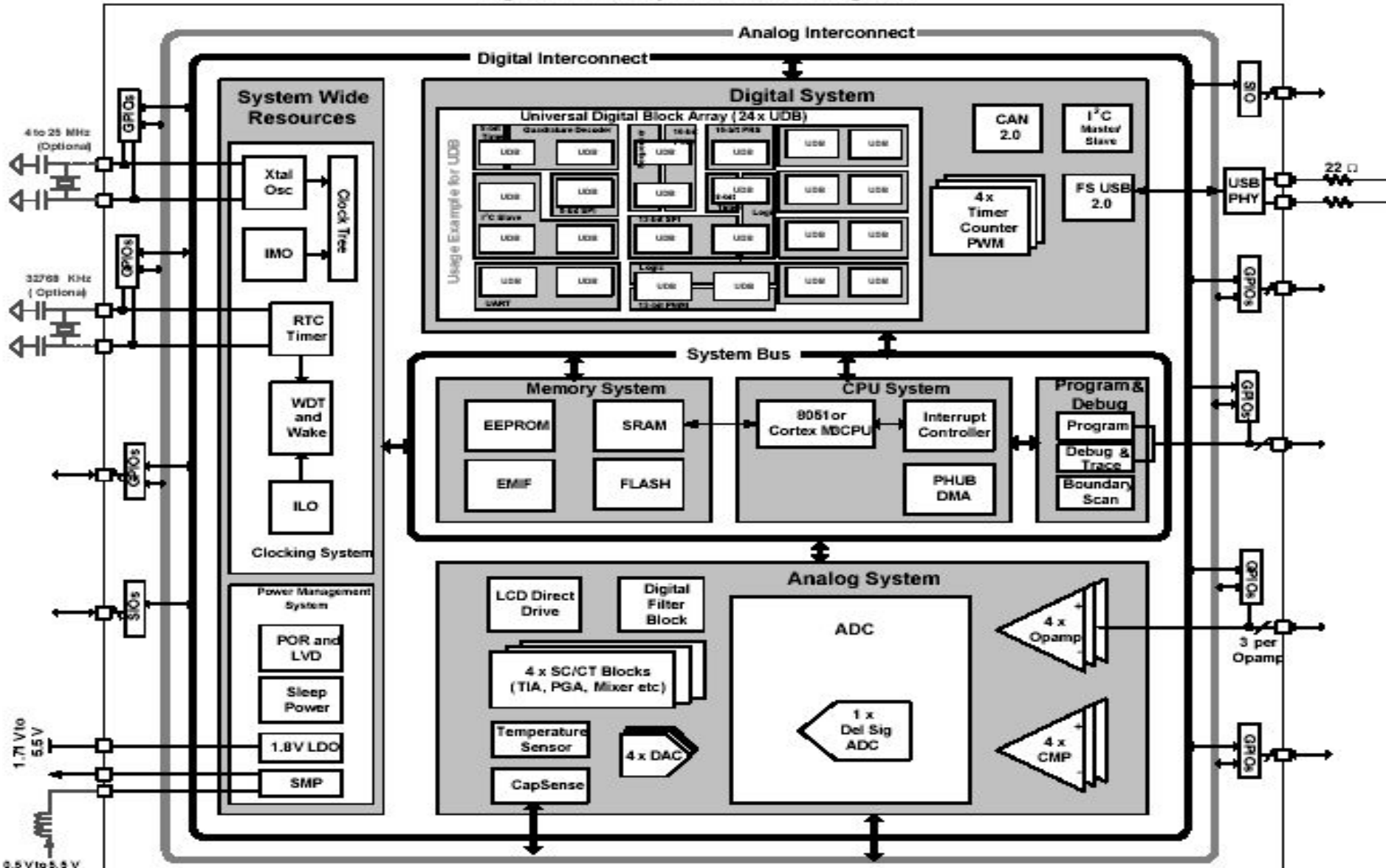


# PSoC@3/5 IDAC8

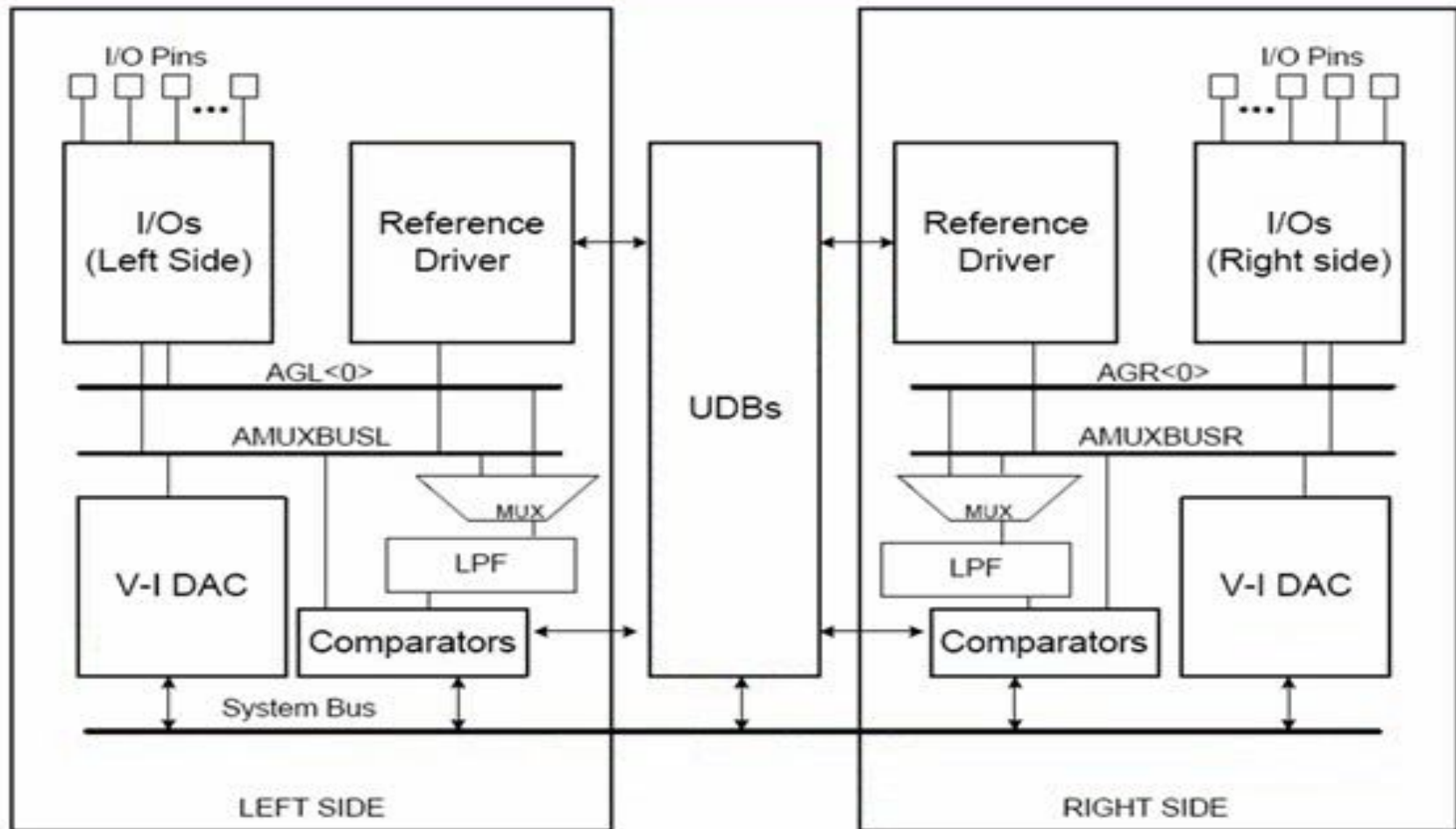
PSoC Creator 4.2  
Designing with PSoC 3/5

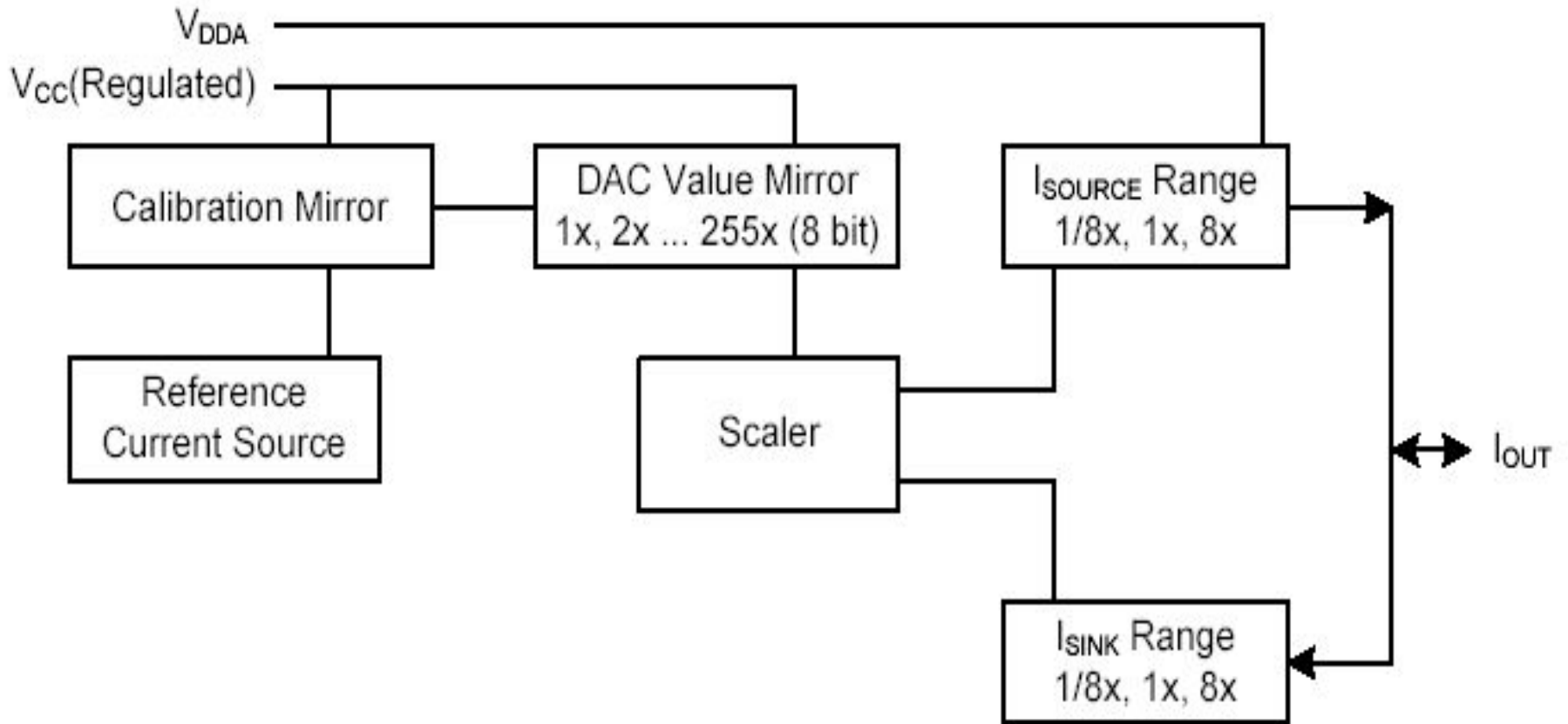


Figure 1-1. Simplified Block Diagram

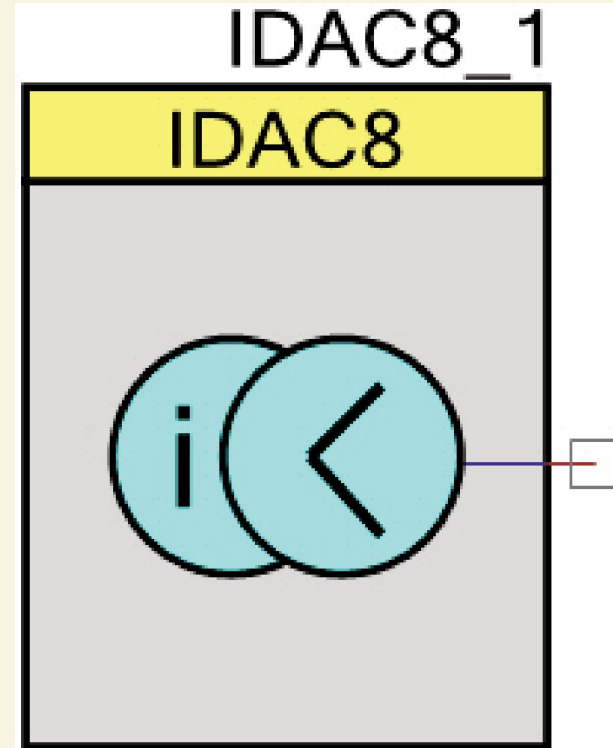
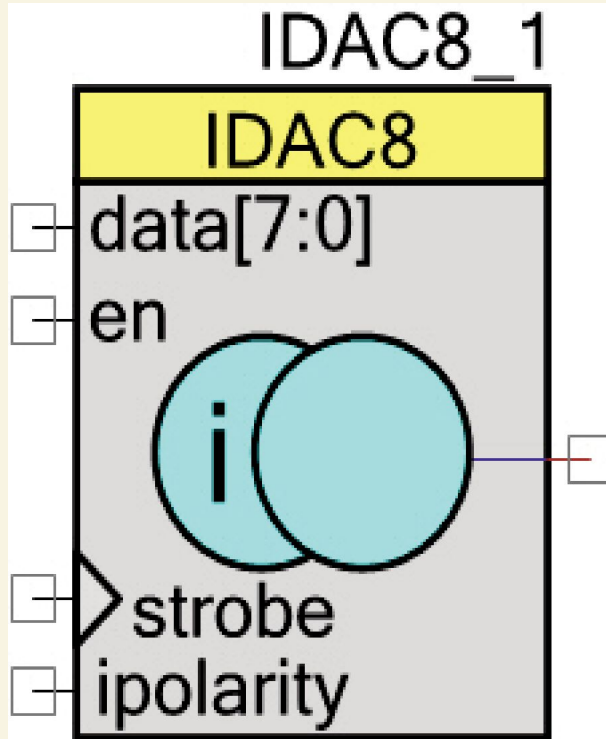


## CapSense in PSoC 3 / PSoC 5





**Block Diagram IDAC8**



Range	Lowest Value	Highest Value	Step Size
0 – 31.875 $\mu\text{A}$	0.0 $\mu\text{A}$	31.875 $\mu\text{A}$	0.125 $\mu\text{A}$
0 – 255 $\mu\text{A}$	0.0 $\mu\text{A}$	255 $\mu\text{A}$	1 $\mu\text{A}$
0 – 2040 $\mu\text{A}$	0.0 $\mu\text{A}$	2040 $\mu\text{A}$	8 $\mu\text{A}$

## **void IDAC8\_SetRange(uint8 range)**

**Description:** Sets full-scale range for IDAC8

**Parameters:** uint8 range: Sets full-scale range for IDAC8. See the following table for ranges.

Option	Description
IDAC8_RANGE_32uA	Set full scale range to 31.875 $\mu$ A
IDAC8_RANGE_255uA	Set full scale range to 255 $\mu$ A
IDAC8_RANGE_2mA	Set full scale range to 2.040 mA



Parameter	Description	Conditions	Min	Typ	Max	Units
	Resolution		–	–	8	bits
$I_{out}$	Output current at code = 255	Range = 2.040 mA, code = 255, $V_{DDA} \geq 2.7$ V, $R_{LOAD} = 600 \Omega$	–	2.040	–	mA
		Range = 2.040 mA, High mode, code = 255, $V_{DDA} \leq 2.7$ V, $R_{LOAD} = 300 \Omega$	–	2.040	–	mA
		Range = 255 $\mu$ A, code = 255, $R_{LOAD} = 600 \Omega$	–	255	–	$\mu$ A
		Range = 31.875 $\mu$ A, code = 255, $R_{LOAD} = 600 \Omega$	–	31.875	–	$\mu$ A
	Monotonicity		–	–	Yes	
$E_{zs}$	Zero scale error		–	0	$\pm 1$	LSB
$E_g$	Gain error	Range = 2.04 mA, 25 °C	–	–	$\pm 2.5$	%
		Range = 255 $\mu$ A, 25 °C	–	–	$\pm 2.5$	%
		Range = 31.875 $\mu$ A, 25 °C	–	–	$\pm 2.5$	%

## IDAC8 DC Characteristics

## Iout – Analog

The Iout terminal, the terminal on the right side of the symbol, is the connection to the DAC's current source/sink.

It can be routed to any analog-compatible pin on the device.

When the highest current range is selected (2040  $\mu\text{A}$ ) the output should only be routed to a specific set of pins that provide a direct low resistive path. These port pins are P0[6], P0[7], P3[0], or P3[1].

## **ipolarity – Input\***

The ipolarity input is an optional signal input pin. This pin can be controlled by Digital components or control register. This is used to control the direction of the current, either source or sink to its load.

When this pin is connected to logic .0. (source), the output of the DAC sources current to a load that is connected to VSS or other voltage that is at least 1.0 V below VDDA.

If the pin is connected to logic .1. (sink), it supplies current to a load that is connected to VDD or other voltage at least 1.0 V above VSS.

Function	Description
IDAC8_Start()	Initializes the IDAC8 with default customizer values. Enables and powers up the IDAC8.
IDAC8_Stop()	Disables the IDAC8 and sets it to the lowest power state.
IDAC8_SetSpeed()	Sets DAC speed.
IDAC8_SetPolarity()	Sets the output mode to current sink or source.
IDAC8_SetRange()	Sets full-scale range for IDAC8.
IDAC8_SetValue()	Sets value between 0 and 255 with the given range.
IDAC8_Sleep()	Stops and saves the user configuration.
IDAC8_Wakeup()	Restores and enables the user configuration.

**Follow the below steps to do this:**

- **The Lab already has the LCD Character component installed and configured.**
- **Add a IDAC8 component from the component catalog.**
- **In the general tab, configure the IDAC8 component as in the image below**

PSoC Creator 2.1

File Edit View Debug Project Build Tools Window Help

Workspace Explorer

Source Components Datasheets Results

**Start Page**

PSoC® Creator™

简体中文 日本語 한국어 English

**Recent Projects**

- HelloWorld\_Blinky01.cywrk
- CapSense\_CSD\_Design01...
- CapSense\_CSD\_Design01...
- CharLCD\_CustomFont01.c...
- CharLCD\_CustomFont01.c...

Create New Project...  
Open Existing Project...

**Getting Started**

- PSoC Creator Start Page
- Quick Start Guide
- Intro to PSoC
- Intro to PSoC Creator
- PSoC Creator Training
- Help Tutorials
- Getting Started With PSoC 3
- Getting Started With PSoC 5

**Examples and Kits**

- Find Example Project...
- No Kit Packages Installed

**PSoC Creator News and Information**

**Happy Lunar New Year!**  
Posted on 02/11/2013

Gong Xi Fa Cai! As many of my friends and colleagues are celebrating the New Year and welcoming in the year of the water snake, I wanted to take a minute and wish you all well. May the New Year bring each of you prosperity, good luck and a new PSoC design. ....  
[Read More](#)

**Tips + Tricks: Menu Customization**  
Posted on 01/24/2013

Did you know you can create a customized menu in PSoC® Creator? Right click in a blank area of the top menu and select customize from the

Notice List

0 Errors 0 Warnings

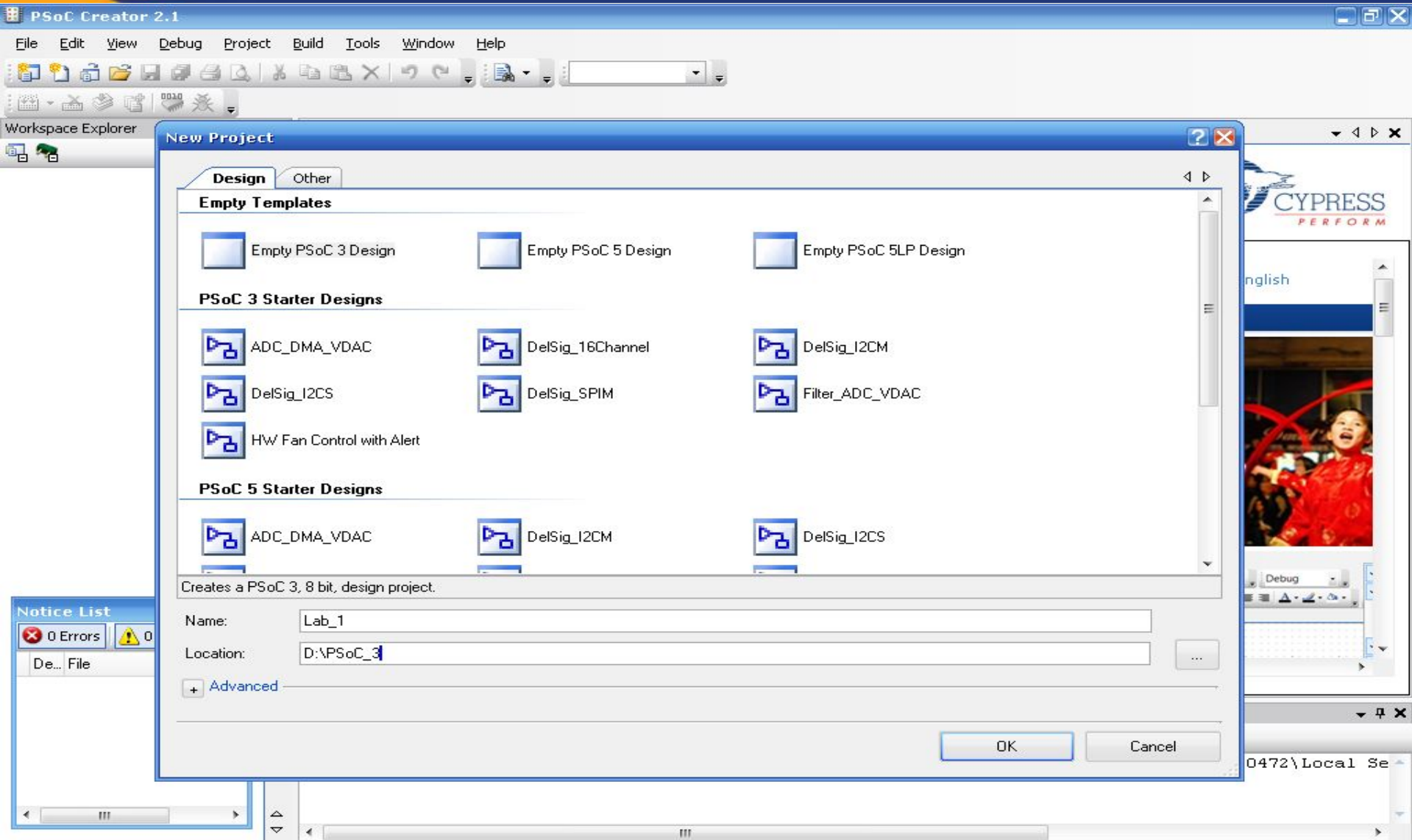
De... File Error L

Output

Show output from: All

Log file for this session is located at: C:\Documents and Settings\Admin.MICROSOFT-7D0472\Local Se

# File – New - Projekt



The screenshot displays the PSoC Creator 2.1 application window. The main menu bar includes File, Edit, View, Debug, Project, Build, Tools, Window, and Help. The toolbar contains various icons for file operations and project management. The 'New Project' dialog box is open, showing the 'Design' tab. It lists several project templates under three categories: 'Empty Templates', 'PSoC 3 Starter Designs', and 'PSoC 5 Starter Designs'. The 'Name' field is set to 'Lab\_1' and the 'Location' field is set to 'D:\PSoC\_3'. The 'Advanced' section is expanded. The 'Notice List' on the left shows 0 errors and 0 warnings. The status bar at the bottom indicates 'Ready' and shows 0 errors, 0 warnings, and 0 notes.

**PSoc Creator 2.1**

File Edit View Debug Project Build Tools Window Help

Workspace Explorer

**New Project**

Design Other

**Empty Templates**

- Empty PSoC 3 Design
- Empty PSoC 5 Design
- Empty PSoC 5LP Design

**PSoC 3 Starter Designs**

- ADC\_DMA\_VDAC
- DelSig\_16Channel
- DelSig\_I2CM
- DelSig\_I2CS
- DelSig\_SPIM
- Filter\_ADC\_VDAC
- HW Fan Control with Alert

**PSoC 5 Starter Designs**

- ADC\_DMA\_VDAC
- DelSig\_I2CM
- DelSig\_I2CS

Creates a PSoC 3, 8 bit, design project.

Name: Lab\_1

Location: D:\PSoC\_3

+ Advanced

OK Cancel

Notice List

0 Errors 0 Warnings

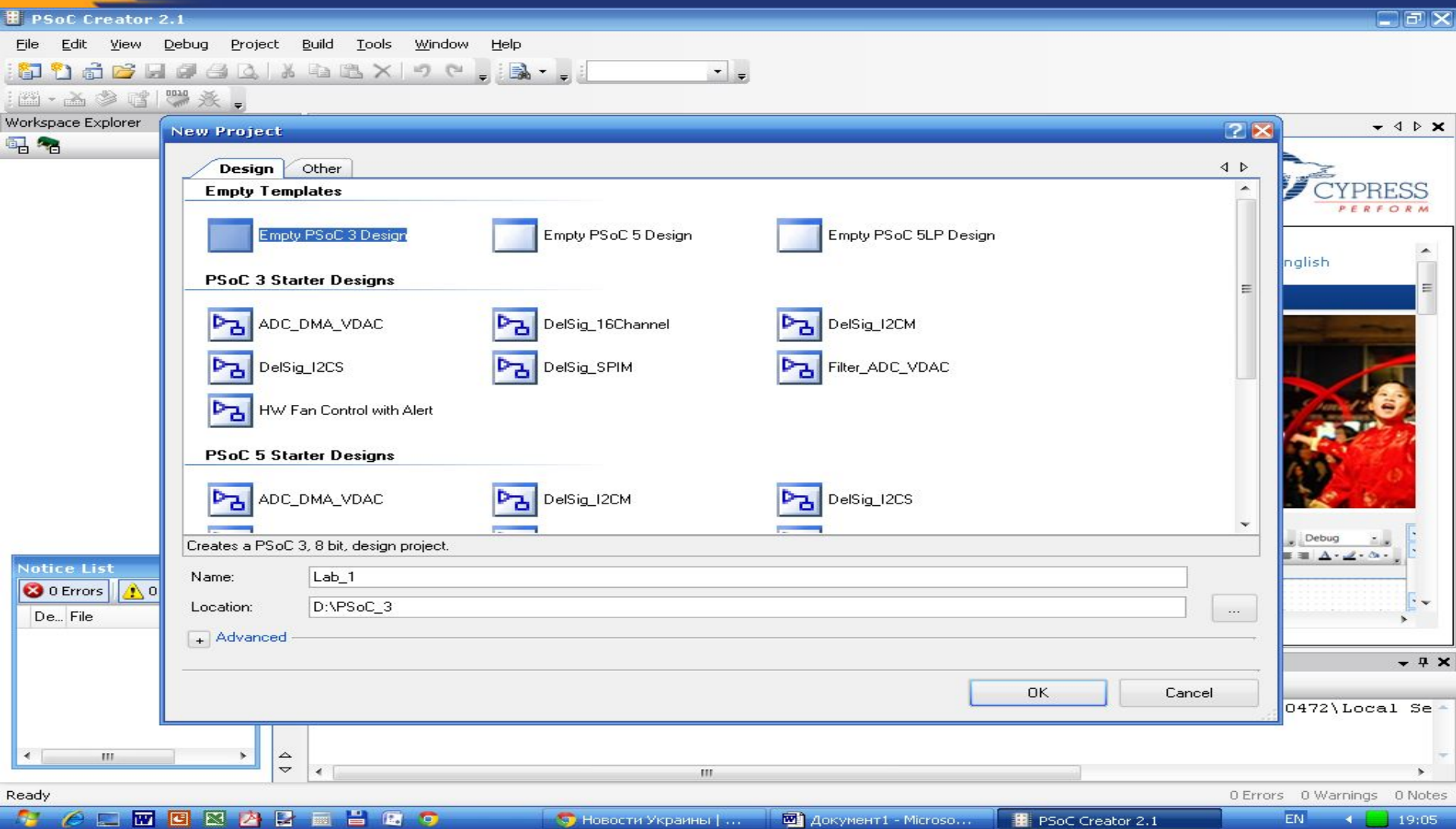
De... File

Ready

0 Errors 0 Warnings 0 Notes

EN 19:02

# Empty PSoC 3 Design



PSoC Creator 2.1

File Edit View Debug Project Build Tools Window Help

Workspace Explorer

**New Project**

Design Other

**Empty Templates**

- Empty PSoC 3 Design
- Empty PSoC 5 Design
- Empty PSoC 5LP Design

**PSoC 3 Starter Designs**

- ADC\_DMA\_VDAC
- DelSig\_16Channel
- DelSig\_I2CM
- DelSig\_I2CS
- DelSig\_SPIM
- Filter\_ADC\_VDAC
- HW Fan Control with Alert

**PSoC 5 Starter Designs**

- ADC\_DMA\_VDAC
- DelSig\_I2CM
- DelSig\_I2CS

Creates a PSoC 3, 8 bit, design project.

Name:

Location:  ...

Advanced

OK Cancel

Notice List

- 0 Errors
- 0 Warnings
- 0 Notes

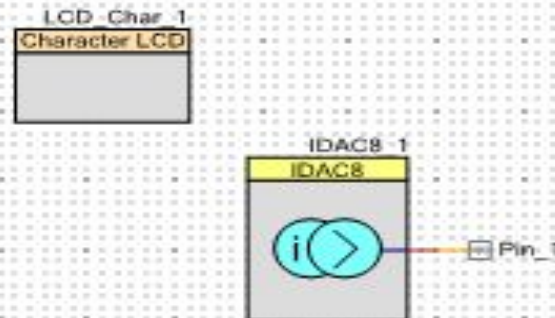
0472\Local Se

Ready

0 Errors 0 Warnings 0 Notes

EN 19:05





To check the IDAC8, the initial value is given using IDAC8\_1\_SetValue() API.

#### Parameter Settings:

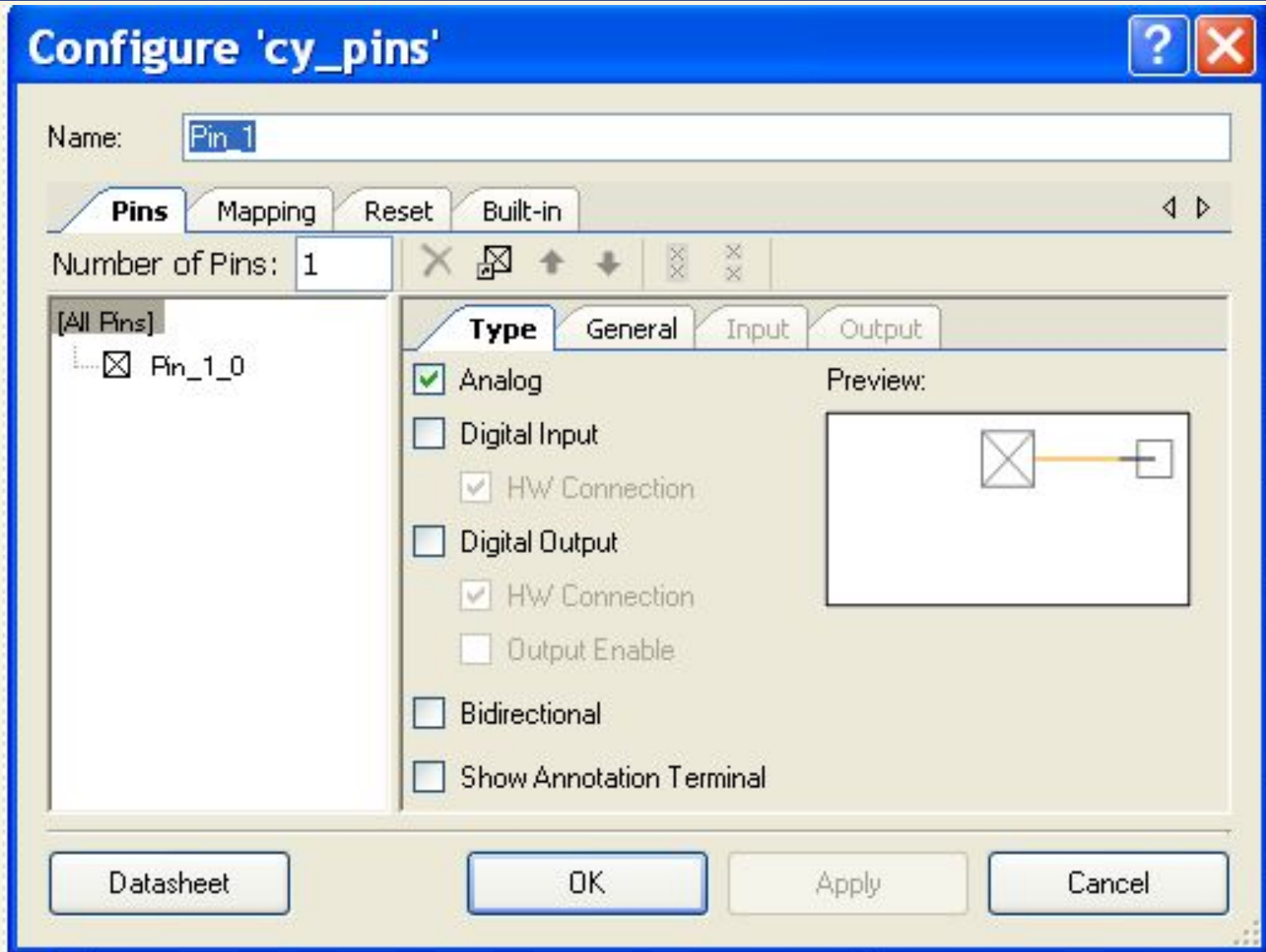
Data\_Source : CPU or DMA (Data Bus)  
 IDAC\_Range : 0 - 255  $\mu$ A (1 $\mu$ A/bit)  
 IDAC\_Speed : High Speed  
 Value : 100  
 Polarity : Positive (Source)  
 Strobe\_Mode : Register Write

#### Pin Mapping :

Pin\_1 (P0(6) of CY8CKIT-001) : IDAC8 output

#### Procedure :

1. This project is written for 2X16 display as the one available on CY8CKIT-001. It will require slight modifications to run on larger displays.
2. Build the project and program the hex file on to the target device.
3. Use a multimeter in current mode to check the output of IDAC. Expected output is 100 $\mu$ A.



## Configure 'IDAC8'

Name:

IDAC8\_1

Configure

Built-in

IDAC

Polarity

- Positive (Source)  
 Negative (Sink)  
 Hardware Controlled

Range

- 0 - 31.875  $\mu$ A (1/8  $\mu$ A/bit)  
 0 - 255  $\mu$ A (1  $\mu$ A/bit)  
 0 - 2.04 mA (8  $\mu$ A/bit)

Speed

- Low Speed  
 High Speed

Data Source

- DAC Bus  
 CPU or DMA (Data Bus)

Strobe Mode

- External

Datasheet

OK

Apply

Cancel

IDAC8\_Example01 - PSoC Creator 2.1 [D:\...\Lab\_12\IDAC8\_Example01\IDAC8\_Example01.cydsn\ID...

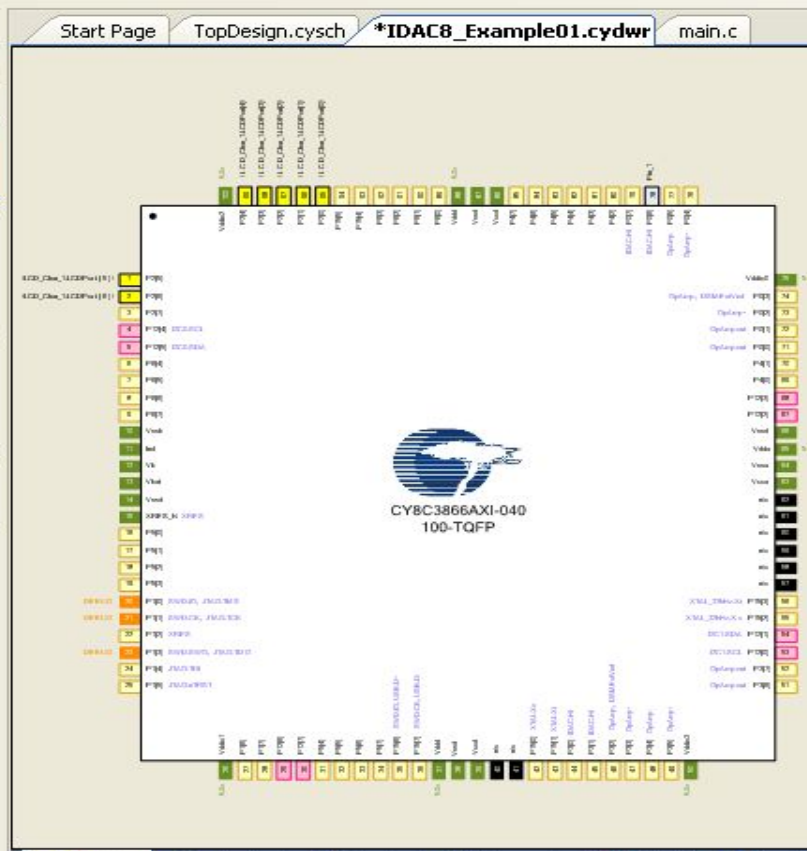
File Edit View Debug Project Build Tools Window Help

41% Debug

Workspace Explorer (1 p...)

Workspace 'IDAC8\_Example01'

- Project 'IDAC8\_Example01'
  - TopDesign.cysch
  - IDAC8\_Example01.cydw
  - Header Files
    - device.h
  - Source Files
    - main.c
  - IDAC8\_Example.pdf



Alias	Name	Port	Value
	\LCD_Char_1:LCDPort [6:0] \	P2[6:0]	95...
Pin_1		P0[6] IDAC:HI	78

LCD\_Char\_1\_LCDPort\_6 - Digital  
 LCD\_Char\_1\_LCDPort\_5 - Digital  
 LCD\_Char\_1\_LCDPort\_4 - Digital

Pins Analog Clocks Interrupts DMA System Directives Flash Security

Output

Show output from: All

```
1 /*****
2 * File: main.c
3 * Version: 1.2
4 * Description:
5 *   This is a source code for basic functionality of IDAC8.
6 *****/
7 * Copyright 2012, Cypress Semiconductor Corporation. All rights reserved.
8 * This software is owned by Cypress Semiconductor Corporation and is protected
9 * by and subject to worldwide patent and copyright laws and treaties.
10 * Therefore, you may use this software only as provided in the license agreement
11 * accompanying the software package from which you obtained this software.
12 * CYPRESS AND ITS SUPPLIERS MAKE NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED,
13 * WITH REGARD TO THIS SOFTWARE, INCLUDING, BUT NOT LIMITED TO, NONINFRINGEMENT,
14 * IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.
15 *****/
16
17 #include <device.h>
18
19 /*****
20 * Function Name: main
21 *****/
22 *
23 * Summary:
24 *   Main function performs following functions:
25 *   1: Initializes the LCD and clears the display
26 *   2: Start the IDAC
27 *   3: IDAC range is set to 255uA and value to 100
28 *   4: Prints test name on LCD
29 *
```

Start Page

TopDesign.cysch

\*IDAC8\_Example01.cydwr

\*main.c



```
27 * 3: IDAC range is set to 255uA and value to 100
28 * 4: Prints test name on LCD
29
30 * Parameters:
31 * None.
32 * Return:
33 * None.
34
35 /*****
36 void main()
37 {
38     /* Start the LCD component */
39     LCD_Char_1_Start();
40
41     /* Clear LCD Display */
42     LCD_Char_1_ClearDisplay();
43
44     /* Start the IDAC component */
45     IDAC8_1_Start();
46
47     /* Sets the IDAC full scale range to 255uA */
48     IDAC8_1_SetRange(IDAC8_1_RANGE_255uA);
49
50     /* Sets the IDAC value to 100 */
51     IDAC8_1_SetValue(100u);
52
53     LCD_Char_1_Position(0u,0u);
54     LCD_Char_1_PrintString(" IDAC8 ");
55
```

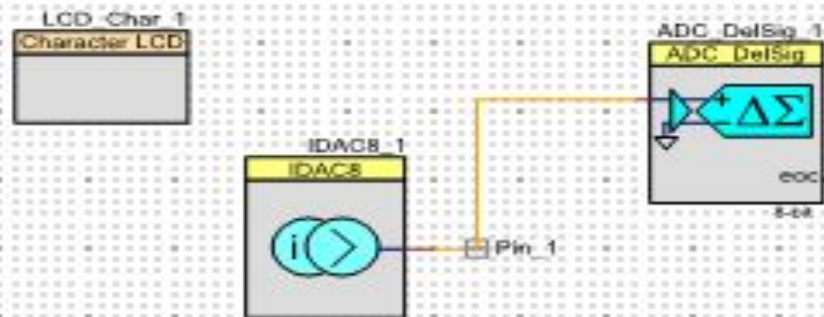
```
Start Page | TopDesign1.CySU1 | IDAC8_Example01.CyUWR | IDAC8.C  
35 | *****/  
36 | void main()  
37 | {  
38 |     /* Start the LCD component */  
39 |     LCD_Char_1_Start();  
40 |  
41 |     /* Clear LCD Display */  
42 |     LCD_Char_1_ClearDisplay();  
43 |  
44 |     /* Start the IDAC component */  
45 |     IDAC8_1_Start();  
46 |  
47 |     /* Sets the IDAC full scale range to 2040 uA */  
48 |     IDAC8_1_SetRange(IDAC8_1_RANGE_2mA);  
49 |  
50 |     /* Sets the IDAC value to 250 */  
51 |     IDAC8_1_SetValue(1u);  
52 |  
53 |     LCD_Char_1_Position(0u,0u);  
54 |     LCD_Char_1_PrintString(" 29 IDAC8 ");  
55 |  
56 |     for(;;)  
57 |     {  
58 |     }  
59 |  
60 | }
```

## **Overview:**

**Activate and use  
the IDAC8 on the DVK board  
and  
output the results  
to the LCD Character screen and Leds.**



## **Зняти вольт-амперну характеристику напівпровідникового діода**



To check the IDAC8, the initial value is given using IDAC8\_1\_SetValue() API.

**Parameter Settings:**

Data\_Source : CPU or DMA (Data Bus)  
 IDAC\_Range : 0 - 255  $\mu$ A (1 $\mu$ A/bit)  
 IDAC\_Speed : High Speed  
 Value : 100  
 Polarity : Positive (Source)  
 Strobe\_Mode : Register Write

**Pin Mapping :**

Pin\_1 (P0(6) of CY8CKIT-001) : IDAC8 output

**Procedure :**

1. This project is written for 2X16 display as the one available on CY8CKIT-001. It will require slight modifications to run on larger displays.
2. Build the project and program the hex file on to the target device.
3. Use a multimeter in current mode to check the output of IDAC. Expected output is 100 $\mu$ A.

На сайті фірми Cypress знаходиться більше **200** Application Notes і Reference Designs, які ілюструють області застосування мікроконтролерів PSoC.

Design Support - Microsoft Internet Explorer

Address: <http://www.cypress.com/portal/server.pt?space=CommunityPage&control=SetCommunity&Communi>

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Product Family	Descriptive Name	Date	Downloads
PSoC Mixed-Signal Array	AN2267a - Standard - Single Cell Li-Ion Battery Charger using CY8C21xxx	Apr 19, 2005	AN2267A.PDF AN2267A.ZIP
PSoC Mixed-Signal Array	AN2260 - Standard - Rapid NiCd/NiMH Battery Charger and DC Brushed Motor Controller for Autonomous Appliances	Apr 15, 2005	AN2260.PDF AN2260.ZIP
PSoC Mixed-Signal Array	AN2026b - Support - In-System Serial Programming Protocol CY8C24794 and CY8C29xxx	Apr 8, 2005	AN2026B.PDF
PSoC Mixed-Signal Array	AN2266 - Support - 16-Bit PWM/PWM-DACs using One Digital PSoC(TM) Block	Apr 8, 2005	AN2266.PDF AN2266.ZIP
PSoC Mixed-Signal Array	AN2279 - Support - Dynamic I2C Addressing Implemented with I2C Hardware User Modules	Apr 8, 2005	AN2279.PDF AN2279.ZIP
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PSoC Mixed-Signal Array	AN2233a - Support - Capacitive Switch Scan	Mar 31, 2005	AN2233A.PDF
PSoC Mixed-Signal Array	AN2276 - Support - Binary Weighted Single-Pole IIR Low-Pass Filters	Mar 29, 2005	AN2276.PDF AN2276.ZIP
PSoC Mixed-Signal Array	AN2277 - Support - Capacitive Front Panel Display Demonstration	Mar 29, 2005	AN2277.PDF AN2277.ZIP

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(лекція 5, кінець)  
Благітко Б.Я.  
2019 р.

