

## Precision Rectifier Using Mixer – PSoC<sup>®</sup> 3/PSoC 5

**Project Name:** Precision Rectifier

**Programming Language:** C

**Associated Part Families:** CY8C38xx/CY55xx

**Software:** PSoC<sup>®</sup> Creator™

**Related Hardware:** CY8CKIT-001

**Prerequisites:** Example Project: Using System Wide Resources

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### Project Objective

This project demonstrates full wave rectifier implementation using mixer component.

### Overview

The sine wave is given to the input of the Multiplying mixer. The mixer operates as follows:

- As an Inverting amplifier when its local oscillator input is Low (-1).
- And as a Non-inverting amplifier when its local oscillator input is High (+1).

The local oscillator input of the mixer receives the square wave of the same frequency as an input sine wave. A rectified wave is thus obtained at the mixer output.

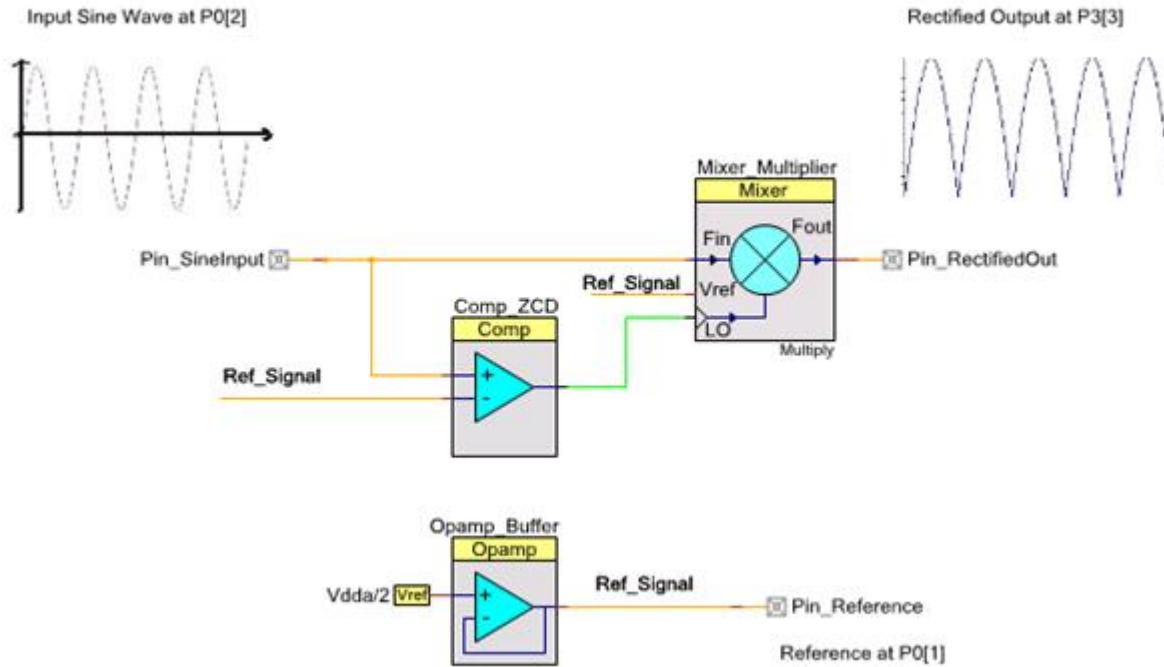
### Component List

Instance Name	Component Name	Version	Component Category	Comments
Mixer_Multiplier	Mixer	1.10	Analog	Configured as Multiplier
Comp_ZCD	Comparator	1.10	Analog	--
Opamp_Buffer	Opamp	1.10	Analog → Amplifiers	The opamp buffers the reference voltage (Vdda/2) before it is brought out on the pin
Pin_SineInput	Analog Pin	1.20	Ports and Pins	--
Pin_RectifiedOut	Analog Pin	1.20	Ports and Pins	--
Pin_Reference	Analog Pin	1.20	Ports and Pins	--
Vdda/2	VRef	1.0	System	--

## Top Design

The following figure shows the Components and its Routing.

Mixer Multiplies input sine wave with square wave of same frequency (as sine wave) results in rectification. Comparator generates the square wave from the input sine signal.



The following figure shows the Pin Configuration (as in .cydwr file)

Alias	Name	Pin	Lock
Pin_SineInput	P0[2]	72	<input checked="" type="checkbox"/>
Pin_RectifiedOut	P3[3]	51	<input checked="" type="checkbox"/>
Pin_Reference	P0[1]	72	<input checked="" type="checkbox"/>

## Component Configuration

### Mixer\_Multiplier

Configure 'Mixer'

Name:

**Basic** Built-in

Parameter	Type	Value
LO_Freq	LO_FreqType	LO Freq less than 100 kHz
Minimum_Vdda	MinimumVddaType	2.7 V or greater
Mixer_Type	MixerType	Multiply (Up) Mixer
Power	PowerType	High Power

[Parameter Information](#)

Data Sheet OK Apply Cancel

### Opamp\_Buffer

Configure 'OpAmp'

Name:

**Basic** Built-in

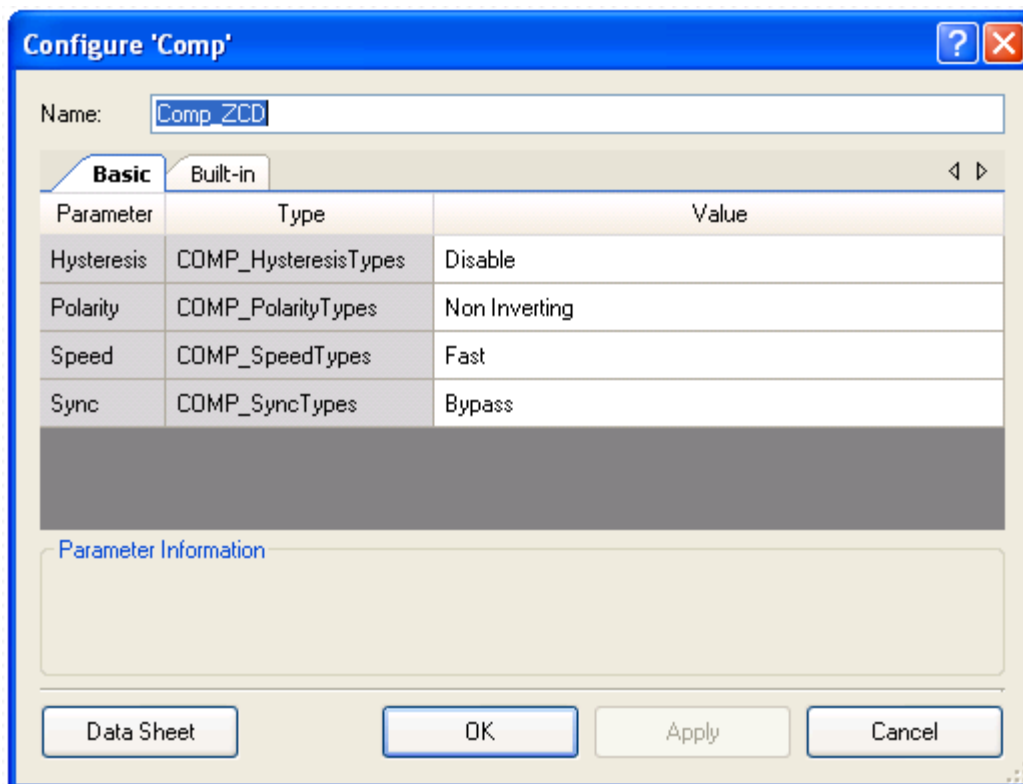
Parameter	Type	Value
Mode	ABufModeTypes	Follower
Power	ABufPowerTypes	High Power

[Parameter Information](#)

Data Sheet OK Apply Cancel

**Note** The Opamp component buffers the reference voltage ( $V_{dda}/2$ ) before it is brought out on the pin.

## Comp\_ZCD

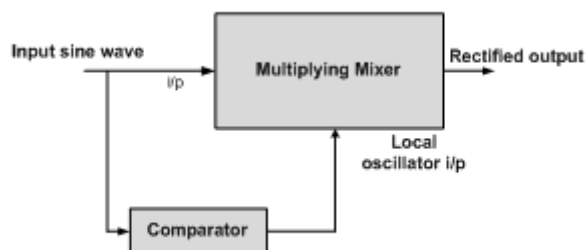


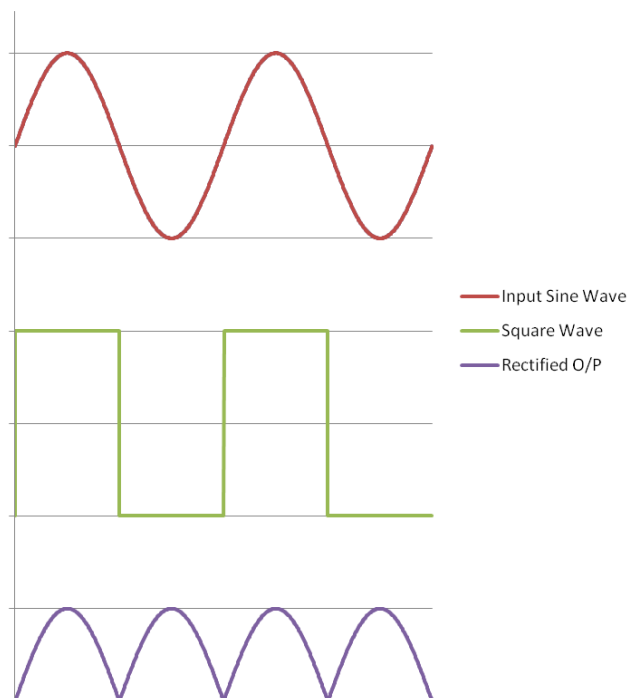
## Design Wide Resources

This project uses the default configuration. Refer to the .cydwr file for the default settings.

## Operation

A multiplying mixer acts as a unity gain amplifier alternating its gain between high (+1) and low (-1) based on the local oscillator input level. So, when the input wave's comparator output is fed as a local oscillator input, a rectified output is obtained. The waveform depicts the input signal, comparator output and the mixer output. As shown in the figure, whenever the sine wave goes below zero, the comparator output also goes low which alternates the gain to -1 and hence the negative half of the incoming sine wave is always given a gain of -1, positive half given a gain of +1 leading to rectification. The comparator's response time is 30 ns. For an input signal frequency of 333 kHz, the period is 100 times the response time and the response time do not cause a big impact.





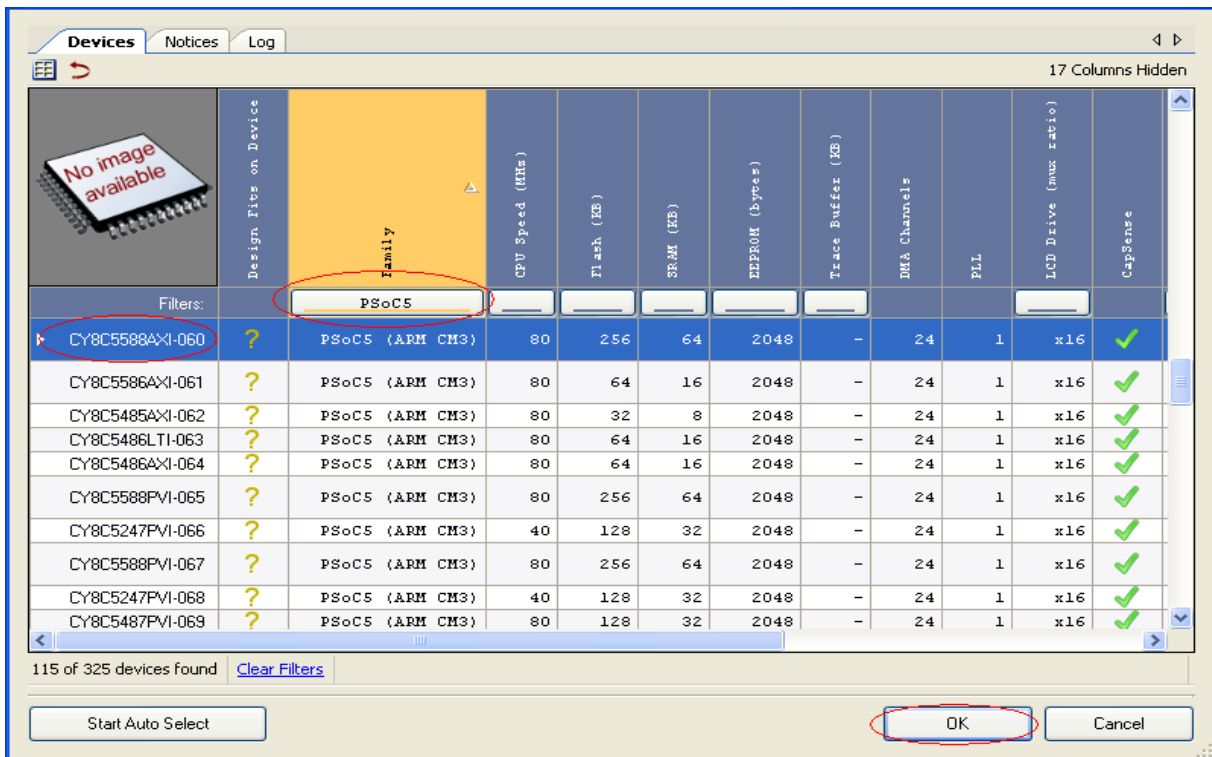
## Hardware Connections

- The external sine input signal needs to be reference with respect to  $V_{dda}/2$ . Hence, apply 1 V amplitude and 1 kHz sin wave signal to Pin P0[2] with respect to Pin P0[1]. Connect the signal generator output signal to P0[2] and the signal generator ground to Pin P0[1].
- Connect pin P0[2] and P3[3] to Oscilloscope to view input signal and rectified output signal respectively.
- For rest of the basic settings of the DVK, refer to the [CY8CKIT-001 PSoC Development Kit Board Guide](#) which is supplied with the kit.

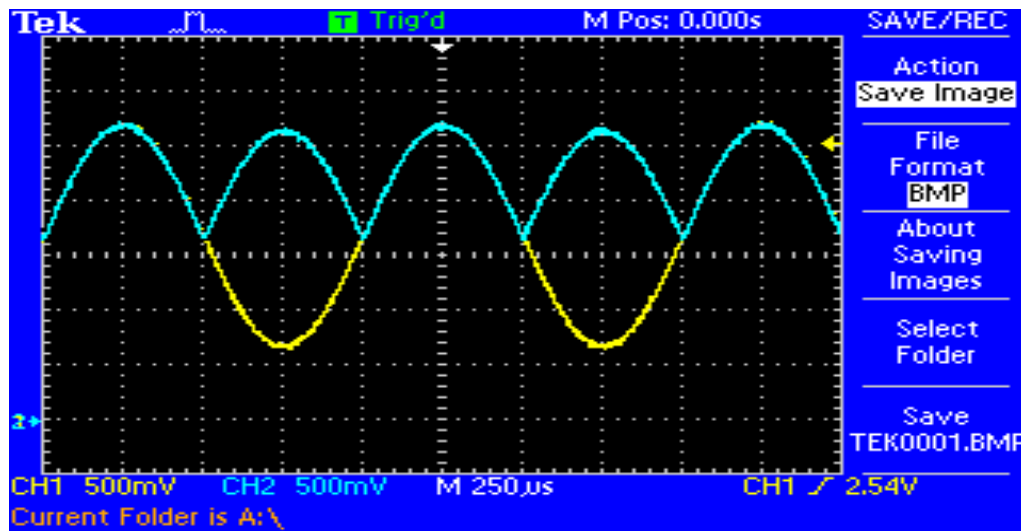
## Output

- Build the Project and Program the PSoC 3 device,  
**Note** The default device selection is PSoC 3 (CY8C3866AXI-040), for using this project with PSoC 5 Device follow the given steps.
- Go to **Project** → **Device Selector** → **Select PSoC 5 device** (CY8C5588AXI-060), build the project again and program the PSoC 5 device as shown in the [Figure 1](#) on Page 6.

Figure 1. Program PSoc 5 Device



- Press SW4 to reset the device. (Reset Switch)
- The following figure shows the Input Signal and Rectified Output.



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