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## Objective

This code example uses a programmable voltage reference and a single comparator to determine if an input voltage is between two specified voltages.

## Requirements

**Tool:** PSoC Creator 3.3 SP2 or higher

**Programming Language:** C (Arm® GCC 4.9.0) or higher

**Associated Parts:** PSoC Analog Coprocessor

**Related Hardware:** CY8CKIT-048

## Overview

This code example demonstrates how to use the Programmable Voltage Reference found in the PSoC CY8C4Axx devices. The reference is alternated between a high and low value, so you can determine if the input voltage is within a given window, below the minimum, or above the maximum voltage. The tri-color LED will display red if the input voltage is above the maximum value, blue if the input is below the low limit, and green if input is between the high and low limits.

## Hardware Setup

The resistors and LEDs shown [Figure 1](#) are mounted on the CY8CKIT-048 kit. The three Off-Chip LEDs are part of a single RGB (Red, Green, Blue) LED on the development board. You must connect a potentiometer between  $V_{SS}$  and  $V_{DD}$ . Instead of a potentiometer, you can use any voltage source between  $V_{SS}$  and  $V_{DD}$ .

## Software Setup

None.

## Operation

To evaluate this code example, perform the following steps:

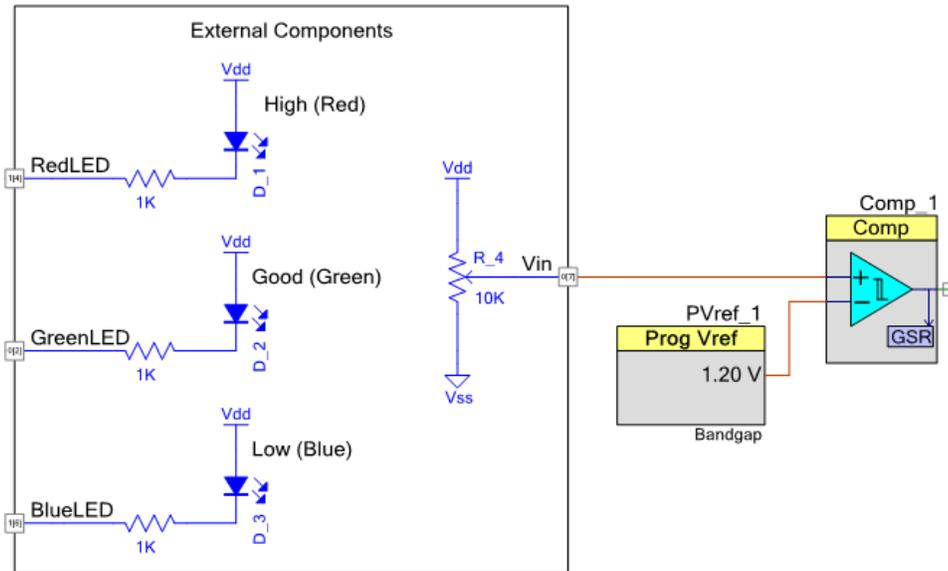
1. Attach a potentiometer as shown on the schematic in [Figure 1](#) or apply an external voltage source to port P0[7]. Make sure that the external voltage source stays within the range of the PSoC's supply of  $V_{SS}$  to  $V_{DD}$ .
2. Slowly adjust the input voltage from 0 V to above 1.5 V.
3. Monitor the LED status with respect to the input voltage:
  - Blue LED should be ON when the input voltage is below 0.5 V.
  - Green LED should be ON when the voltage is between 0.5 V and 1.0 V.
  - Red LED should be ON when voltage exceeds 1.0 V.

The levels at which the different LEDs are ON may be adjusted in the source code found in *main.c*. Modify the "HIGH\_LIMIT" and "LOW\_LIMIT" #define statements to adjust the high and low limits of the window comparator.

## Design and Implementation

This design uses a single comparator (Comp\_1) in conjunction with a programmable voltage reference (PVref\_1) to create a window comparator. A window comparator indicates when a voltage is between two set points. Normally two comparators would be required, but since the programmable voltage reference is adjustable, only one comparator is required. The firmware adjusts the voltage reference, checks the comparator output, and then turns ON the correct LED to signal if the voltage is between the set points, above the high set point, or below the low set point.

Figure 1. Project Schematic



## Components and Settings

Table 1 lists the PSoC Creator Components used in this example, as well as the hardware resources used by each.

Table 1. PSoC Creator Components

Component or User Module	Version	Hardware Resources
Comp_1	1.20	½ of a CTB/CTBm
PVref_1	1.0	¼ of the programmable reference block
Vin (Analog Pin)	2.20	GPIO ( P0[7] )
RedLED	2.20	GPIO ( P1[4] )
GreenLED	2.20	GPIO ( P0[2] )
BlueLED	2.20	GPIO ( P1[6] )

## Parameter Settings

Both the programmable voltage reference (PVref\_1) and the comparator (Comp\_1) components use their default configuration for this code example.

## Related Documents

<b>Application Notes</b>	
<a href="#">AN211293</a>	Getting Started with PSoC® Analog Coprocessor
<b>PSoC Creator Component Datasheets</b>	
<a href="#">Comp</a>	PSoC 4 Voltage Comparator (Comp)
<a href="#">PVref</a>	PSoC 4 Programmable Voltage Reference
<a href="#">Pins</a>	General Purpose IO Pins
<b>Device Documentation</b>	
<a href="#">Cy8C4Axx Datasheet</a>	PSoC® Analog Coprocessor: CY8C4Axx Family Datasheet
<b>Development Kit (DVK) Documentation</b>	
<a href="#">CY8CKIT-048 PSoC® Analog Coprocessor Pioneer Kit</a>	
<b>PSoC® Family Web Page</b>	
<a href="#">PSoC® Analog Coprocessor</a>	

## Document History

Document Title: CE203972 – PSoC CY8C4Axx Comparator with Programmable Voltage Reference

Document Number: 002-03972

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	5101225	MEH	1/22/2016	New Code Example
*A	6586014	MEH	06/11/2019	Sunset Review Updated the PVref link in Related Documents Updated Template

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