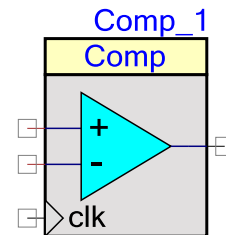


Comparator (Comp)

1.0

Features

- Low input offset
- User controlled input offset calibration
- Multiple speed modes
- Low power mode
- Output routable to digital logic blocks or pins
- Selectable output polarity



General Description

The Comparator (Comp) provides a hardware solution to compare two analog input voltages. The output may be sampled in software or digitally routed to another component. Three speed levels are provided to enable you to optimize for speed or power consumption. Other references or external voltages may be connected to either inputs as well.

When to use a Comparator

The Comparator can provide a fast comparison between two voltages compared with an ADC. Although an ADC can be used with software to compare multiple voltages levels, applications requiring fast response or little software intervention are good candidates for this comparator. Some example applications include CapSense™, power supplies, or simple translation between an analog level and a digital signal.

One common configuration is to connect a voltage DAC to the Neg_Input terminal, which provides an adjustable comparator.

Input/Output Connections

This section describes the various input and output connections for the Comp. An asterisk (*) in the list of I/O's states that the I/O may be hidden on the symbol under the conditions listed in the description of that I/O.

Pos_Input – Analog

This input is usually connected to the voltage that is being sampled and the reference is connected to the Neg_Input. The reverse orientation will also work, but with an inverted output.

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The input is routable to GPIOs and internal signals through analog globals, and to a selection of references.

Neg_Input – Analog

This input is usually connected to the reference voltage and the sampled voltage is connected to the Pos_Input. The input is routable to GPIOs and internal signals through analog globals, and to a selection of references.

Comp_Out – Digital Output

If the polarity is set to non-inverting, this output goes high when the Pos_Input voltage is greater than the Neg_Input voltage. If the polarity is set to inverting, the output will go high when the Neg_Input voltage is greater than the Pos_Input voltage. The output is routable to the digital interconnect and interrupt structure.

Clock – Digital Input *

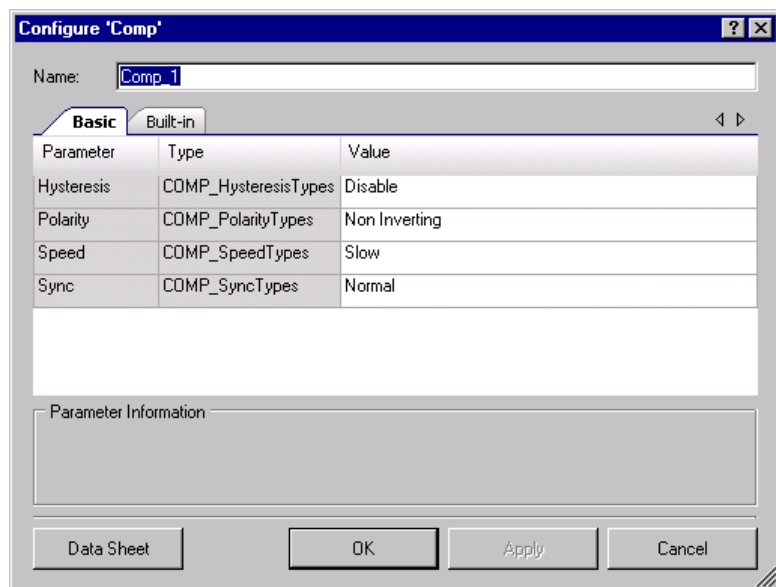
Synchronizes the comparator output to the rising edge of the clock when the Sync parameter is set to “Normal.” This forces the comparator output to be sampled on the rising edge of the clock.

When the Sync parameter is set to “Bypass,” then the output is not synchronized and the clock input terminal no longer displays on the component.

Parameters and Setup

Drag a Comparator onto your design and double-click it to open the Configure dialog.

Figure 1 Configure Comp Dialog



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The Comparator provides the following parameters.

Hysteresis

This parameter enables the user to add approximately 10mV of hysteresis to the comparator. This will help to ensure slowly moving voltages or slightly noisy voltages will not cause the output of the comparator to oscillate when the voltages are near equal.

Function	Description
Disable	Disable hysteresis
Enable	Enable hysteresis

Polarity

This parameter enables the user to invert the output of the comparator. This is useful for peripherals that require an inverted signal from the comparator. The sampled signal state returned by the software API will not be affected when Inverting mode is selected.

Polarity Options	Description
Inverting	Output goes high when Pos_Input is less than Neg_Input
Non Inverting	Output goes high when Pos_Input is greater than Neg_Input

Speed

This parameter provides a way for the user to optimize speed verses power consumption.

Speed Options	Description
Low Power	Use this setting for very low power applications.
Slow	Use this setting for signals less than xxx kHz
Fast	Use this setting for signals greater than xxx kHz

Sync

This parameter selects between synchronizing the output with a clock or connecting directly to the comparator output. When Normal is selected, the output will change on the rising edge of the clock input.

Sync Options	Description
Normal	Sync the comparator output with the clock input.
Bypass	Connect the analog comparator directly to the output signal.



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Placement

There are no placement specific options.

Resources

The Comparator component uses one analog comparator block.

Application Programming Interface

Application Programming Interface (API) routines allow you to configure the component using software. The following table lists and describes the interface to each function. The subsequent sections cover each function in more detail.

By default, PSoC Creator assigns the instance name "Comp_1" to the first instance of a component in a given design. You can rename the instance to any unique value that follows the syntactic rules for identifiers. The instance name becomes the prefix of every global function name, variable, and constant symbol. For readability, the instance name used in the following table is "Comp".

Function	Description
void Comp_Start(void)	Turn on Comparator
void Comp_Stop(void)	Turn off Comparator
void Comp_SetSpeed(uint8 speed)	Set speed of comparator.
uint8 Comp_ZeroCal(void)	Zero the input offset of comparator.
uint8 Comp_GetCompare(void)	Return compare result.

void Comp_Start(void)

Description: Enable and power up the comparator.

Parameters: None

Return Value: None

Side Effects: None

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void Comp_Stop(void)

Description: Disable and power down the comparator.

Parameters: None

Return Value: None

Side Effects: None

void Comp_SetSpeed(uint8 speed)

Description: This function selects one of three speed modes for the comparator. The comparator power consumption increases for the faster speed modes.

Parameters: (uint8) speed: Speed parameter, see table below for valid settings.

Speed Options	Description
Comp_LOWPOWER	Use this setting for very low power applications.
Comp_SLOWSPEED	Use this setting for signals less than xxx kHz
Comp_HIGHSPEED	Use this setting for signals greater than xxx kHz

Return Value: None

Side Effects: None

uint8 Comp_ZeroCal(void)

Description: Calibrates the input offset to minimize the error for the current supply voltage and temperature.

Parameters: None

Return Value: (uint8) The value held in the comparator trim register will be returned.

Side Effects: During the calibration procedure, the comparator input switches will be reconfigured, and the comparator output may behave erratically. When calibration is complete all routing and mode registers will be returned to their state before calibration occurred.

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uint8 Comp_GetCompare(void)

Description:	This function returns a non-zero value when the voltage connected to the Pos_Input is greater than the Neg_Input voltage. The sampled signal state returned is not affected by the polarity parameter when Inverting mode is selected. It assumes non-inverted output.
Parameters:	None
Return Value:	(uint8) If Pos_Input is greater than Neg_Input, then value returns a non-zero value, otherwise the output is zero.
Side Effects:	None

Sample Firmware Source Code

The following is a C language example demonstrating the basic functionality of the Comp. This example assumes the component has been placed in the schematic and renamed to “Comp”.

```
#include <device.h>

void main()
{
    uint8 cmpVal;
    Comp_Start( );           /* Turn on comparator */
    Comp_SetSpeed(Comp_HIGHSPEED); /* Set high speed mode */
    cmpVal = Comp_GetCompare(); /* Return comparator state */
}
```

Functional Description

The Comparator component is no different than most common analog comparators on the market, except it offers a few more options such as speed/power, optional hysteresis, and clock synchronization.

DC and AC Electrical Characteristics

The Comp will operate at all valid supply voltages.

5.0V/3.3V DC and AC Electrical Characteristics

Parameter	Typical	Min	Max	Units	Conditions and Notes
Vos uncalibrated	2.0		8.0	mV	
Vos (calibrated)	0.25		1.0	mV	

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Parameter	Typical	Min	Max	Units	Conditions and Notes
Input Range					
Low Power			$V_{dd} - 0.3$	V	$2.4V < V_{dd} < 5.5V$
Low Power			$V_{dd} - 0.1$	V	$1.65 < V_{dd} < 2.4V$
Slow			V_{dd}	V	
Fast			$V_{dd} - 0.1$		
Current					
Off	0			uA	
Low Power	5	22		uA	$V_{dd} < 3.3V$
Low Power	5	38		uA	$3.3V < V_{dd} < 5.5V$
Slow		100		uA	
Fast		400		uA	
CMRR			55	dB	
			55	dB	
Input Voltage Range	---		V_{ssa} to V_{dda}	V	
Leakage	---		---	nA	
Input Capacitance	---		---	pF	

5.0V/3.3V AC Electrical Characteristics

Parameter	Typical	Min	Max	Units	Conditions and Notes
Response Time					
Low Power	10		50	uS	
Slow	80		110	nS	50 mV overdrive
Fast	25		30	nS	



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