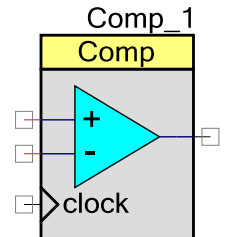


Comparator (Comp)

1.10

Features

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



General Description

The Comparator (Comp) component provides a hardware solution to compare two analog input voltages. The output can 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. A reference or external voltage may be connected to either input.

You can also invert the output of the comparator using the Polarity parameter.

When to use a Comparator

The Comparator can provide a fast comparison between two voltages as compared to using 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 from an analog level to a digital signal.

A common configuration is to create an adjustable comparator by connecting a voltage DAC to the negative input terminal.

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Input/Output Connections

This section describes the 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.

Positive Input – Analog

This input is usually connected to the voltage that is being compared. This input can be routed to GPIOs and internal signals through analog globals, and to a selection of references.

Negative Input – Analog

This input is usually connected to the reference voltage. This input can be routed to GPIOs and internal signals through the analog globals and to a selection of references.

Comparator Out – Digital Output

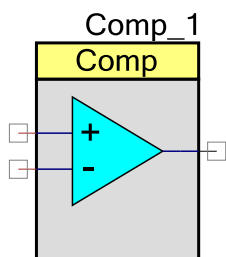
The output of the comparison. For the non-inverting configuration, this output goes high when the positive input voltage is greater than the negative input voltage. If the polarity is set to inverting, the output will go high when the negative input voltage is greater than the positive input voltage. The output can be routed to the digital interconnect and interrupt structures.

clock – Digital Input *

The clock input will synchronize 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” the output is not synchronized and the clock input terminal no longer displayed on the component symbol.

Sync set to Bypass



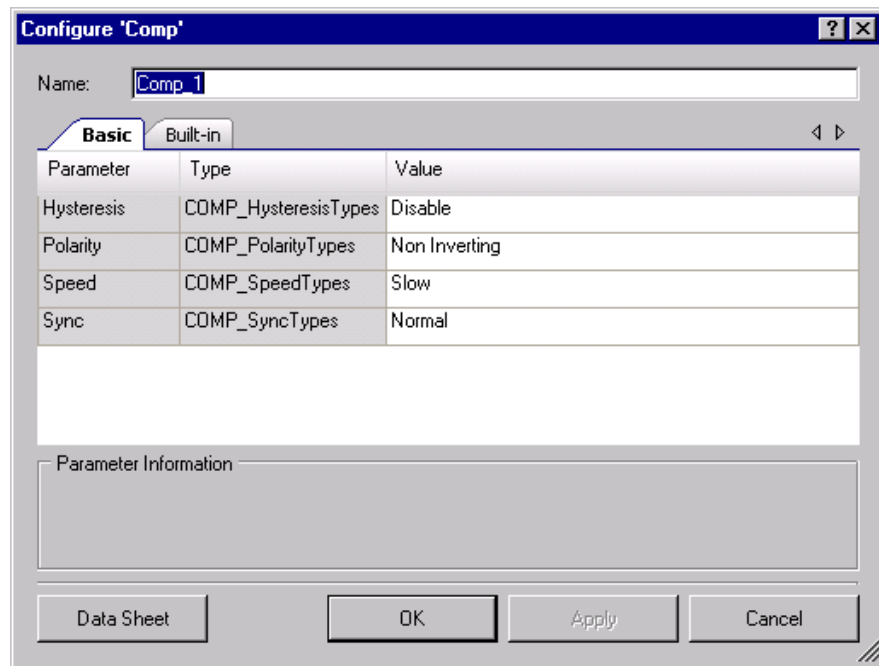
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Parameters and Setup

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

Figure 1 Configure Comp Dialog



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 that slowly moving voltages or slightly noisy voltages will not cause the output of the comparator to oscillate when the two input voltages are near equal.

Function	Description
Disable	Disable hysteresis
Enable	Enable hysteresis

Polarity

This parameter allows you 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 is not affected by this parameter.

Polarity Options	Description
Inverting	Output goes high when positive input is less than the negative input
Non Inverting	Output goes high when positive input is greater than negative 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 requiring response times slower than 80ns
Fast	Use this setting for signals requiring response times faster than 80ns

Sync

This parameter selects between synchronizing the output with a clock and 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.

Placement

There are no placement specific options.

Resources

The Comparator component uses one analog comparator block.

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Application Programming Interface

Application Programming Interface (API) routines allow you to configure the component using software. The following table lists 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)	Returns compare result.
void Comp_LoadTrim(uint8 trimVal)	Write a value to the comparator trim register

void Comp_Start(void)

Description:	Enable and power up the comparator.
Parameters:	None
Return Value:	None
Side Effects:	None

void Comp_Stop(void)

Description:	Disable and power down the comparator.
Parameters:	None
Return Value:	None
Side Effects:	None



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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 requiring response times slower than 80ns
Comp_HIGHSPEED	Use this setting for signals requiring response times faster than 80ns

Return Value: None

Side Effects: None

uint8 Comp_ZeroCal(void)

Description: Performs custom calibration of the input offset to minimize error for a specific set of conditions: comparator reference voltage, supply voltage and operating temperature. A reference voltage in the range at which the comparator will be used must be applied to the negative input of the comparator while the offset calibration is performed. The comparator component must be configured for Fast or Slow operation when calibration is performed. The calibration process will not work correctly if the comparator is configured in Low Power mode.

Parameters: None

Return Value: (uint8) the value from the comparator trim register after the offset calibration is complete.
This value has the same format as the input parameter for the Comp_LoadTrim() API routine. Refer to the *PSoC3, PSoC5 Technical Reference Manual* for a description of the comparator trim register.

Side Effects: During the calibration procedure the comparator output may behave erratically. During the calibration procedure the analog routing switches for the comparator positive input will be reconfigured. This reconfiguration may affect the analog signal routing for other components that are connected to the comparator positive input. When calibration is complete all routing and comparator configuration registers will be restored to the state they were in 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 positive input is greater than the negative input voltage. This value is not affected by the Polarity parameter. This value always reflects a non-inverted state.
Parameters:	None
Return Value:	(uint8) comparator output state – non zero value when the positive input voltage is greater than the negative input voltage, otherwise the return value is zero.
Side Effects:	None

void Comp_LoadTrim(uint8 trimVal)

Description:	This function writes a value into the comparator trim register.
Parameters:	(uint8) trimVal: Value to be stored in the comparator trim register This value has the same format as the parameter returned by the Comp_ZeroCal() API routine. Refer to the <i>PSoC3, PSoC5 Technical Reference Manual</i> for a description of the comparator trim register.
Return Value:	None
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_1”.

```
#include <device.h>

void main()
{
    uint8 cmpVal;
    Comp_1_Start( );           /* Turn on comparator */
    Comp_1_SetSpeed(Comp_HIGHSPEED); /* Set high speed mode */
    cmpVal = Comp_1_GetCompare(); /* Return comparator state */
}
```



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Functional Description

The Comparator component is similar to most common analog comparators on the market. The Comparator component offer greater flexibility in supporting the configuration of options such as speed/power, 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	
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	

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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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