

# ATmega328P - Analog Comparator

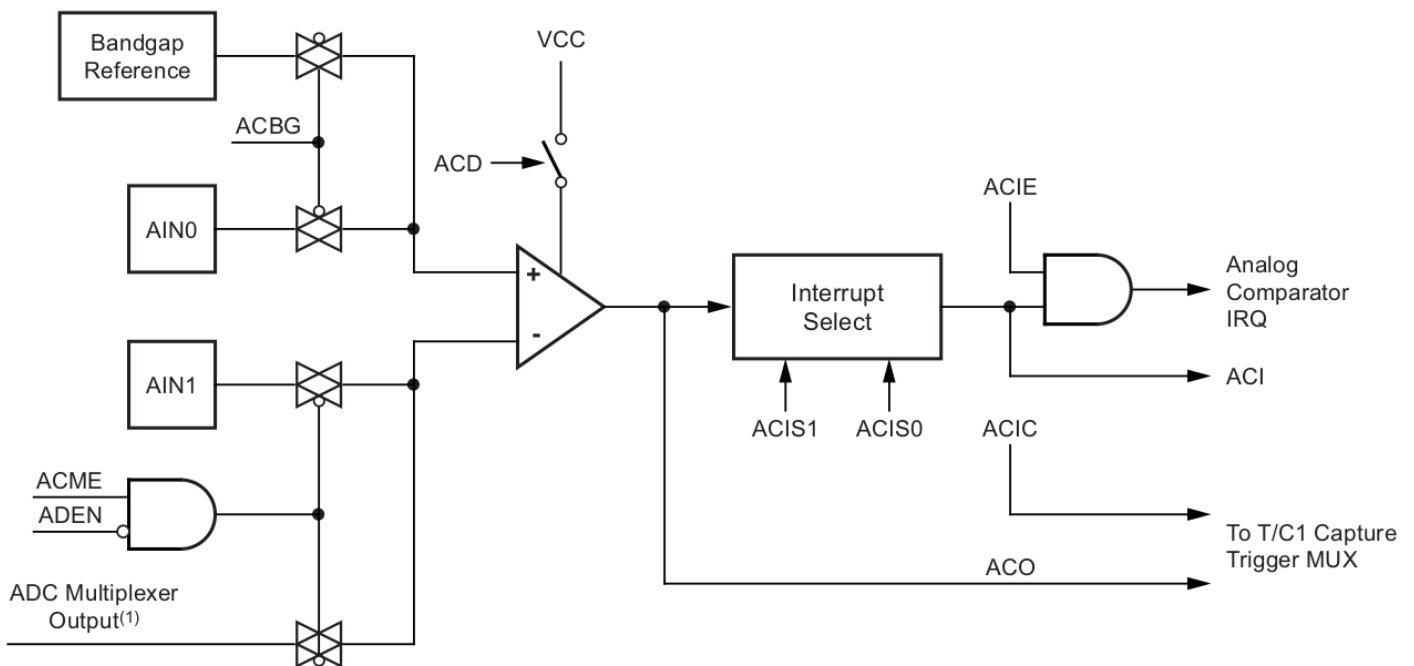
Narendiran S

July 28, 2020

## 1 Overview

- The analog comparator compares the input values on the positive pin *AIN0* and negative pin *AIN1*.
- When the voltage on the positive pin *AIN0* is higher than the voltage on the negative pin *AIN1*, the analog comparator output, *ACO* bit is set.
- The comparator's output can be set to trigger the Timer/Counter1 input capture function.
- In addition, the comparator can trigger a separate interrupt, exclusive to the analog comparator.

## 2 Block Diagram



## 3 Analog Compartors Input

- One input is either be *AIN0* positive pin or Bandgap reference selected by *ACBG* bit.
- The other input can be either *AIN1* negative pin or any one of ADC multiplexed output selected by *ACME*, *ADEN* and *MUX[2:0]* pins.

<i>ACME</i>	<i>ADEN</i>	<i>MUX[2:0]</i>	Analog Compartor Negative Input
0	x	xxx	AIN1
1	1	xxx	AIN1
1	0	000	ADC0
1	0	001	ADC1
1	0	010	ADC2
1	0	011	ADC3
1	0	100	ADC4
1	0	101	ADC5
1	0	110	ADC6
1	0	111	ADC7

## 4 Register Description

### ADCSRB – ADC Control and Status Register B

7	6	5	4	3	2	1	0
-	ACME	-	-	-	ADTS2	ADTS1	ADTS0

### ACSR – Analog Comparator Control and Status Register

7	6	5	4	3	2	1	0
ACD	ACBG	ACO	ACI	ACIE	ACIC	ACIS1	ACIS0

- *ACD* - Analog Comparator Disable - The power to analog comparator is switched off when this bit is set to one.
- *ACBG* - Analog Comparator Bandgap Select - [1 - Selects Bandgap reference as positive input to analog comparator; 0 - Selects *AIN0* as positive input to analog comparator]
- *ACO* - Analog Comparator Output - The actual output of Analog Comparator.
- *ACI* - Analog Comparator interrupt Flag - Set by hardware when compartor output event triggers the interrupt mode.
- *ACIE* - Analog Comparator interrupt Enable - Enabled the analog comparator interrupt.
- *ACIC* - Analog Comparator Input Capture Enable - Enables the input capture function in Timer/Counter1 to be triggered by analog comparator.

<i>ACIS[1:0]</i> - Analog Comparator Interrupt Mode Select	Interrupt Mode
00	Comparator interrupt on output toggle.
01	Reserved
10	Comparator interrupt on falling output edge.
11	Comparator interrupt on rising output edge.

## 5 Configuring the Analog Comparator

### 5.1 Using AIN1 as positive input and AIN0 as Negative Input

- First, the Analog Comparator Multiplexer Enable bit (*ACME*) in *ADCSRB* Register is disabled to select *AIN1* pin as positive input.
- Next, the Analog Comparator Bandgap Select bit (*ACBG*) in *ADCSRB* Register is disabled to select *AIN* pin as negative input.
- Next, the interrupt mode is selected by Configuring the *ACIS[1:0]* bit in *ADCSRB* register.
- The interupt for analog comparator is enabled by setting the *ACIE* bit in *ADCSRB* register.
- Finally, the Analog Comparator is switchched on by clearing the *ACD* bit in *ADCSRB* register.

- Also, the ISR is written for handling the interrupt.
- The code can be seen below:

```
// Disabling the Analog Comparator Multiplexer Enable bit so that AIN1 is selected as positive
↪ input
ADCSRB &= ~(1<<ACME);

// Disabling the Analog Comparator Bandgap Select bit so that AINO is selected as negative input
ACSR &= ~(1<<ACBG);

// Choosing the interrupt mode to toggle ACD bit
// By selecting 00 to ACIS[1:0]
ACSR &= ~(1<<ACIS1);
ACSR &= ~(1<<ACISO);

// Enabling the Analog Comparator interrupt Enable to see the output
ACSR |= (1<<ACIE);

// enabling the Analog Comparator by clearing the Analog Comparator Disable bit
ACSR &= ~(1<<ACD);
sei();

ISR(ANALOG_COMP_vect)
{
    PINC |= (1<<0);
}
```