AVR128: Setup and Use the Analog Comparator

8-bit AVR® Microcontroller

Application Note

Introduction

This application note serves as an example on how to set up and use the AVR's On-chip Analog Comparator. The following program examples are given in the assembly file "avr200.asm":

- Detect a positive edge on the comparator output by polling the ACO-bit in the Analog Comparator Control and Status Register – ACSR.
- Detect a positive edge on the comparator output by polling the Analog Comparator Interrupt Flag – ACI in ACSR.
- Initialize interrupt on comparator output toggle. An interrupt routine which increments a 16-bit counter each time it is executed is given as an example.

Detecting a Positive Edge by Polling ACO

This part of the code shows the trivial way of detecting a positive edge on the comparator output. Even though it uses only four words of code and no initial setup, this approach to the task might cause problems. If a short pulse on the output occurs while the program is administrating the wait loop, the pulse could be missed as ACO is directly connected to the comparator output. If the user wants to insert code within the wait loop, the probability of detecting a short pulse will increase. Such code might be time-out if no edge occurs within a specific period. The procedure for detection is as follows:

1. If output is high, wait for output to go low.
2. Wait until output goes high.

Figure 1. ACO Polling Flow Chart

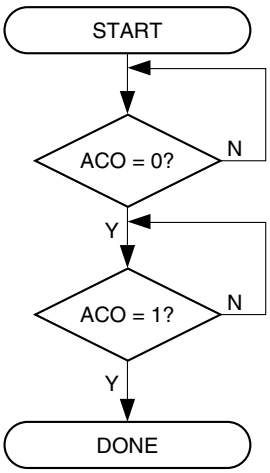

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Table 1. ACO Polling Performance Figures

Parameter	Value
Code Size (Words)	4
Response Time (Cycles)	3 - 5
Initialization Time (Cycles)	0
Register Usage	Low Registers :None High Registers :None Pointers :None
Interrupts Usage	None
Peripherals Usage	Analog Comparator

Detecting a Positive Edge by Polling ACI

This part of the code shows a far more secure and flexible way of detecting a positive edge on the comparator output. Even though the Analog Comparator Interrupt is disabled, the interrupt flag will still be set when events on the comparator output matches the settings of the ACIS1/ACIS0 bits in ACSR. E.g., a positive edge will always set the ACI bit in ACSR if ACIS1/ACIS0 both are one (refer to the databook for details). The ACI flag will reflect whether the event to look for has occurred since the last ACI Reset. In this application note, positive edge detection by polling ACI is implemented according to the following procedure:

Setup

1. Set ACIS0 and ACIS1 = 1.

Polling

1. Clear the ACI bit by writing an logical “1” to it.
2. Wait until ACI goes high.

Figure 2. ACI Polling Flow Chart

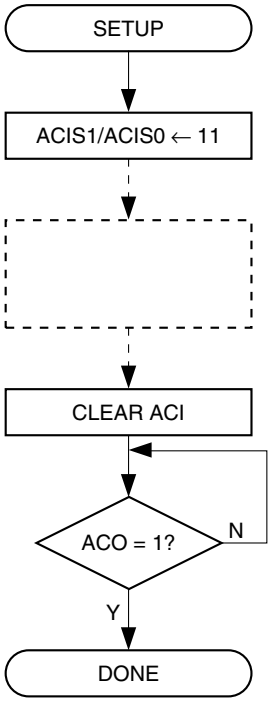

Table 2. ACI Polling Performance Figures

Parameter	Value
Code Size (Words)	5
Initialization Time (Cycles)	2
Response Time (Cycles)	3 - 5
Register Usage	Low Registers :None High Registers :None Pointers :None
Interrupts Usage	None
Peripherals Usage	Analog Comparator

Using the Analog Comparator Interrupt

The application note program shows an example on how to enable the comparator interrupt. In the example, interrupt on comparator toggle is shown. The following procedure is followed:

1. Clear interrupt flag and ACIS1/ACIS0. The interrupt flag must be cleared first. If not, and the flag for some reason already is set, the MCU will start executing the interrupt routine immediately when the interrupts is enabled. Clearing ACIS1/ACIS0 selects interrupt on toggle.
2. Enable Global Interrupts.
3. Enable the Analog Comparator Interrupt by setting the ACIE bit in ACSR.

Note that since the ACSR Register is one of the lower 32 I/O, registers, the “SBI” instruction can be used to set, clear and test bits.

Table 3. Analog Comparator Interrupt Enable Performance Figures

Parameter	Value
Code Size (Words)	4
Execution time (Cycles)	5
Register Usage	Low Registers :None High Registers :1 Pointers :None
Interrupts Usage	None
Peripherals Usage	Analog Comparator

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