

---

## AVR128: Setup and Use of the AVR Analog Comparator

---

### APPLICATION NOTE

### Introduction

---

This application note serves as an example on how to set up and use the Atmel® AVR® 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.

## Table of Contents

---

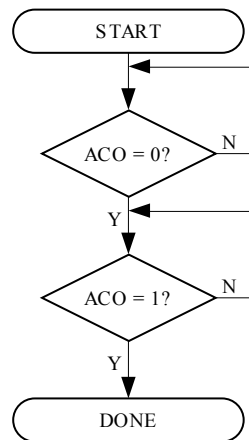
Introduction.....	1
1. Detecting a Positive Edge By Polling ACO.....	3
2. Detecting a Positive Edge by Polling ACI.....	4
3. Using the Analog Comparator Interrupt.....	6
4. Revision History.....	7

## 1. 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 administering 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 1-1. ACO Polling Flow Chart**



**Table 1-1. 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

## 2. 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 datasheet 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 a logical "1" to it.
2. Wait until ACI goes high.

Figure 2-1. ACI Polling Flow Chart

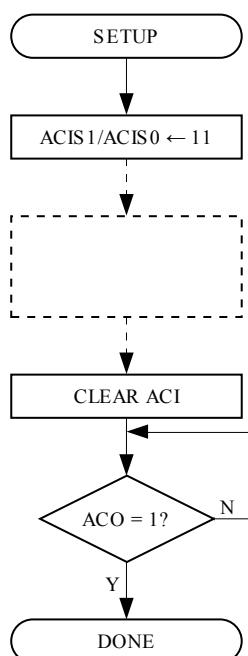


Table 2-1. ACI Polling Performance Figures

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

Parameter	Value
Interrupts Usage	None
Peripherals Usage	Analog Comparator

### 3. 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 3-1. 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

## 4. Revision History

Doc. Rev.	Date	Comments
0934C	07/2016	New template
0934B	05/2002	
0934A		Initial document release.

Atmel®, Atmel logo and combinations thereof, Enabling Unlimited Possibilities®, AVR® and others are registered trademarks or trademarks of Atmel Corporation in U.S. and other countries. Other terms and product names may be trademarks of others.

**DISCLAIMER:** The information in this document is provided in connection with Atmel products. No license, express or implied, by estoppel or otherwise, to any intellectual property right is granted by this document or in connection with the sale of Atmel products. EXCEPT AS SET FORTH IN THE ATMEL TERMS AND CONDITIONS OF SALES LOCATED ON THE ATMEL WEBSITE, ATMEL ASSUMES NO LIABILITY WHATSOEVER AND DISCLAIMS ANY EXPRESS, IMPLIED OR STATUTORY WARRANTY RELATING TO ITS PRODUCTS INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT. IN NO EVENT SHALL ATMEL BE LIABLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, PUNITIVE, SPECIAL OR INCIDENTAL DAMAGES (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS AND PROFITS, BUSINESS INTERRUPTION, OR LOSS OF INFORMATION) ARISING OUT OF THE USE OR INABILITY TO USE THIS DOCUMENT, EVEN IF ATMEL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Atmel makes no representations or warranties with respect to the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and products descriptions at any time without notice. Atmel does not make any commitment to update the information contained herein. Unless specifically provided otherwise, Atmel products are not suitable for, and shall not be used in, automotive applications. Atmel products are not intended, authorized, or warranted for use as components in applications intended to support or sustain life.

**SAFETY-CRITICAL, MILITARY, AND AUTOMOTIVE APPLICATIONS DISCLAIMER:** Atmel products are not designed for and will not be used in connection with any applications where the failure of such products would reasonably be expected to result in significant personal injury or death ("Safety-Critical Applications") without an Atmel officer's specific written consent. Safety-Critical Applications include, without limitation, life support devices and systems, equipment or systems for the operation of nuclear facilities and weapons systems. Atmel products are not designed nor intended for use in military or aerospace applications or environments unless specifically designated by Atmel as military-grade. Atmel products are not designed nor intended for use in automotive applications unless specifically designated by Atmel as automotive-grade.