



The following document contains information on Cypress products. The document has the series name, product name, and ordering part numbering with the prefix “MB”. However, Cypress will offer these products to new and existing customers with the series name, product name, and ordering part number with the prefix “CY”.

How to Check the Ordering Part Number

1. Go to www.cypress.com/pcn.
2. Enter the keyword (for example, ordering part number) in the **SEARCH PCNS** field and click **Apply**.
3. Click the corresponding title from the search results.
4. Download the Affected Parts List file, which has details of all changes

For More Information

Please contact your local sales office for additional information about Cypress products and solutions.

About Cypress

Cypress is the leader in advanced embedded system solutions for the world's most innovative automotive, industrial, smart home appliances, consumer electronics and medical products. Cypress' microcontrollers, analog ICs, wireless and USB-based connectivity solutions and reliable, high-performance memories help engineers design differentiated products and get them to market first. Cypress is committed to providing customers with the best support and development resources on the planet enabling them to disrupt markets by creating new product categories in record time. To learn more, go to www.cypress.com.

FR Family, MB91460 Microcontroller Alarm Comparator

This application note describes the functionality of the Alarm Comparator and gives some examples. The Alarm Comparator is used for detection of under-voltage or over-voltage conditions.

Contents

1	Introduction	1	2.4 Standby Modes	2
1.1	Key Features	1	2.5 Registers	3
2	The Alarm Comparator	1	3 Alarm Comparator Example	4
2.1	Introduction	1	3.1 Under-Voltage and Over-Voltage with $AVDD$ and $AVSS$ as Reference Voltage	4
2.2	Block Diagram	2	4 Additional Information	6
2.3	Voltage Detection Areas	2		

1 Introduction

This application note describes the functionality of the Alarm Comparator and gives some examples. The Alarm Comparator is used for detection of under-voltage or over-voltage conditions.

1.1 Key Features

- Detection of Under-Voltage and Over-Voltage by comparison of external voltage input with $AVDD/AVSS$
- Generation of Interrupt on detection of Under-Voltage or Over-Voltage condition
- Controlled power consumption by choosing appropriate power mode
- Run Mode by default (after power-on)

2 The Alarm Comparator

THE BASIC FUNCTIONALITY OF THE ALARM COMPARATOR

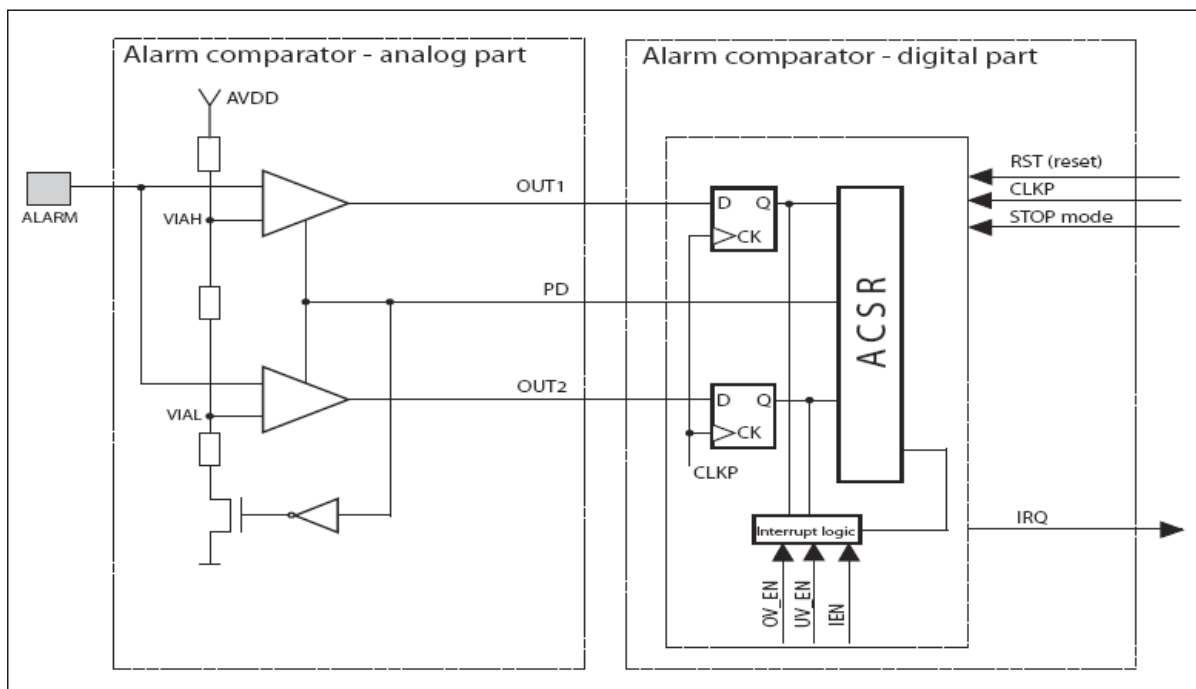
2.1 Introduction

The Alarm Comparator is used to detect under-voltage and over-voltage at an external analog input pin. It can be compared with $AVDD/AVSS$. It can be switched to fast or slow detection mode. The slow mode reduces the power consumption of this module. By default, the alarm comparator is in run mode.

2.2 Block Diagram

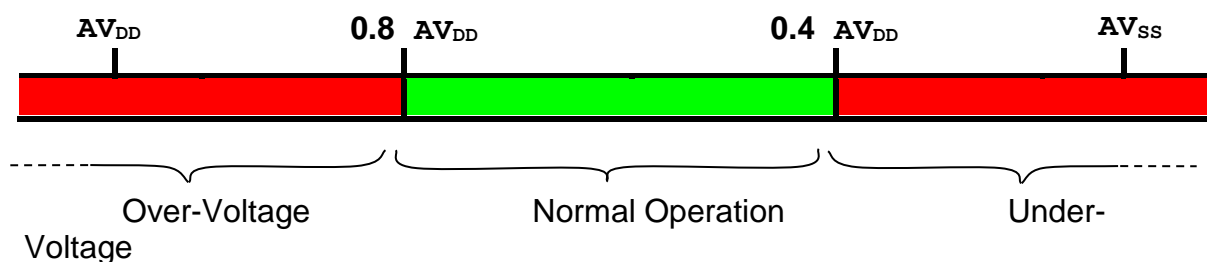
Figure 1 shows the internal block diagram of the Alarm Comparator.

Figure 1. Alarm Comparator block diagram



2.3 Voltage Detection Areas

Figure 2. Voltage Detection Areas



2.4 Standby Modes

It should be noted that the digital part of the alarm comparator is stopped in STOP or TIMER mode and it's operating in SLEEP mode. The analog part status is dependent on the PD bit of the ACSRn register. Hence it is possible to wake up only from the SLEEP mode (and not from STOP or TIMER mode) in the event of under / over voltage interrupts (if the analog comparator is in RUN mode and these interrupts are enabled).

Before switching to these modes it is advisable to put the alarm comparator in the power down mode, if the current consumption is critical for the application. For this purpose the interrupt should be disabled first and then alarm comparator should be put to power down mode.

2.5 Registers

2.5.1 Alarm Comparator Control/Status Register (ACSRn)

Table 1. ACSRn

Bit No.	Name	Explanation	Initial Value	Value	Operation
7	MD	Mode Select	0	0	Slow Mode (less power consumption)
				1	Fast Mode (high power consumption)
6	OV_EN	Over-Voltage Interrupt Enable	1	0	No Interrupt in case of Over-Voltage
				1	Interrupt in case of Over-Voltage
5	UV_EN	Under-Voltage Interrupt Enable	1	0	No Interrupt in case of Under-Voltage
				1	Interrupt in case of Under-Voltage
4	OUT2	Output of Alarm Comparator UV	X	0	$ALARMn < 0.4 * AVDD$
				1	$ALARMn > 0.4 * AVDD$
3	OUT1	Output of Alarm Comparator OV	X	0	$ALARMn < 0.8 * AVDD$
				1	$ALARMn > 0.8 * AVDD$
2	IRQ	Interrupt Request	X	0	No Under-Voltage or Over-Voltage Condition detected
				1	Under-Voltage or Over-Voltage Condition detected ¹
1	IEN	Interrupt Enable	0	0	Disable Interrupt
				1	Enable Interrupt
0	PD	Power Down Mode	0	0	Run Mode (Analog Part)
				1	Power Down Mode (Analog Part)

States of OUT0 and OUT1 and Voltage Condition

Table 2. Analog Comparator Outputs in Different Voltage Conditions

OUT0	OUT1	Condition
0	0	Under-Voltage
0	1	Not possible
1	0	Normal Operation
1	1	Over-Voltage

¹ It should be noted that the IRQ bit will be set with the next positive transition of CLKP after detecting an interrupt event and it will remain set unless and until the under-voltage or over-voltage condition persists. In such situation if the IEN is set to 1, the interrupt service routine will be executed even after clearing the IRQ bit in it. Hence to clear an interrupt caused by a persistent Under-Voltage or Over-Voltage condition the OVEN and/or UVEN bits should be cleared first and then the IRQ bit should be cleared separately.

3 Alarm Comparator Example

EXAMPLE FOR THE ALARM COMPARATOR

3.1 Under-Voltage and Over-Voltage with AVDD and AVSS as Reference Voltage

In this example AVDD and AVSS are used for Reference Voltage. Please note that in this example the root cause for the Alarm Comparator interrupt is not reset. If under-voltage or over-voltage persists after the ISR, the interrupt is generated again. To prevent this, the IEN bit or OVEN and/or UVEN bits of the ACSR0 may be set to "0" in the ISR before clearing the interrupt flag (IRQ).

Main.c

```
/* SAMPLE CODE
/*-----*/

void InitAlarmComp (void)
{
    ACSR0 = 0x62; // Slow Mode, Over and Undervoltage, Interrupt enable, Run Mode
}

/*-----*/

void main(void)
{
    InitIrqLevels();
    __set_il(7); // allow all levels
    __EI(); // globally enable interrupts

    InitAlarmComp();

    while(1);
}

/*-----*/

__interrupt void AlarmISR (void)
{
    if (ACSR0_OUT1 && ACSR0_OUT2)
    {
        // Overvoltage (Vin > 0.8 * AVDD)
        //
        // Do something...
    }
    else
    {
        // Undervoltage (Vin < 0.4 * AVDD)
        //
        // Do something...
    }

    ACSR0 = 0x62; // clear Interrupt
}
```

vectors.c

```

/*SAMPLE CODE
/*-----
*/
void InitIrqLevels(void)
{
    . . .

    ICR60 = 30;    /* Alarm Comperator 0          */
    . . .
}

/* ISR prototype */
__interrupt void AlarmISR (void);

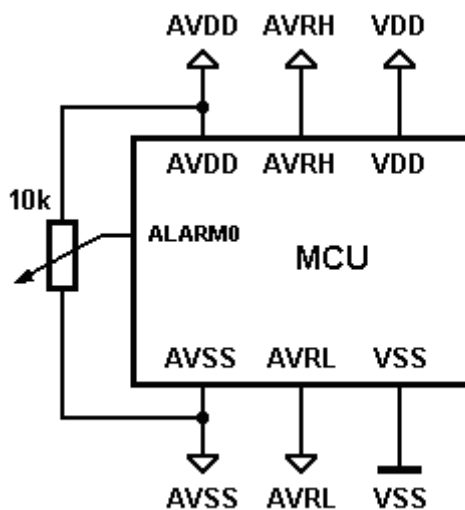
. . .

#pragma intvect AlarmISR 136 // Alarm Comparator of MB9634x Series

. . .
  
```

With the following schematic, the code above can be tested easily.

Figure 3. Example Test Schematic



4 Additional Information

Information about CYPRESS Microcontrollers can be found on the following Internet page:

<http://www.cypress.com/cypress-microcontrollers>

The software example related to this application note is:

91460_alarmcomp

It can be found on the following Internet page:

<http://www.cypress.com/cypress-mcu-product-softwareexamples>

Document History

Document Title: AN205322 - FR Family, MB91460 Microcontroller Alarm Comparator

Document Number: 002-05322

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	—	NOFL	04/22/2008	V1.0, First draft, HPI
*A	5120074	NOFL	04/14/2016	Converted Spansion Application Note “MCU-AN-300071-E-V10” to Cypress format
*B	5836821	MALI	07/28/2017	Updated Logo and Copyright

Worldwide Sales and Design Support

Cypress maintains a worldwide network of offices, solution centers, manufacturer's representatives, and distributors. To find the office closest to you, visit us at [Cypress Locations](#).

Products

ARM® Cortex® Microcontrollers	cypress.com/arm
Automotive	cypress.com/automotive
Clocks & Buffers	cypress.com/clocks
Interface	cypress.com/interface
Internet of Things	cypress.com/iot
Memory	cypress.com/memory
Microcontrollers	cypress.com/mcu
PSoC	cypress.com/psoc
Power Management ICs	cypress.com/pmic
Touch Sensing	cypress.com/touch
USB Controllers	cypress.com/usb
Wireless Connectivity	cypress.com/wireless

PSoC® Solutions

[PSoC 1](#) | [PSoC 3](#) | [PSoC 4](#) | [PSoC 5LP](#) | [PSoC 6](#)

Cypress Developer Community

[Forums](#) | [WICED IOT Forums](#) | [Projects](#) | [Videos](#) | [Blogs](#) | [Training](#) | [Components](#)

Technical Support

cypress.com/support

All other trademarks or registered trademarks referenced herein are the property of their respective owners.



Cypress Semiconductor
198 Champion Court
San Jose, CA 95134-1709

© Cypress Semiconductor Corporation, 2008-2017. This document is the property of Cypress Semiconductor Corporation and its subsidiaries, including Spansion LLC ("Cypress"). This document, including any software or firmware included or referenced in this document ("Software"), is owned by Cypress under the intellectual property laws and treaties of the United States and other countries worldwide. Cypress reserves all rights under such laws and treaties and does not, except as specifically stated in this paragraph, grant any license under its patents, copyrights, trademarks, or other intellectual property rights. If the Software is not accompanied by a license agreement and you do not otherwise have a written agreement with Cypress governing the use of the Software, then Cypress hereby grants you a personal, non-exclusive, nontransferable license (without the right to sublicense) (1) under its copyright rights in the Software (a) for Software provided in source code form, to modify and reproduce the Software solely for use with Cypress hardware products, only internally within your organization, and (b) to distribute the Software in binary code form externally to end users (either directly or indirectly through resellers and distributors), solely for use on Cypress hardware product units, and (2) under those claims of Cypress's patents that are infringed by the Software (as provided by Cypress, unmodified) to make, use, distribute, and import the Software solely for use with Cypress hardware products. Any other use, reproduction, modification, translation, or compilation of the Software is prohibited.

TO THE EXTENT PERMITTED BY APPLICABLE LAW, CYPRESS MAKES NO WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, WITH REGARD TO THIS DOCUMENT OR ANY SOFTWARE OR ACCOMPANYING HARDWARE, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. To the extent permitted by applicable law, Cypress reserves the right to make changes to this document without further notice. Cypress does not assume any liability arising out of the application or use of any product or circuit described in this document. Any information provided in this document, including any sample design information or programming code, is provided only for reference purposes. It is the responsibility of the user of this document to properly design, program, and test the functionality and safety of any application made of this information and any resulting product. Cypress products are not designed, intended, or authorized for use as critical components in systems designed or intended for the operation of weapons, weapons systems, nuclear installations, life-support devices or systems, other medical devices or systems (including resuscitation equipment and surgical implants), pollution control or hazardous substances management, or other uses where the failure of the device or system could cause personal injury, death, or property damage ("Unintended Uses"). A critical component is any component of a device or system whose failure to perform can be reasonably expected to cause the failure of the device or system, or to affect its safety or effectiveness. Cypress is not liable, in whole or in part, and you shall and hereby do release Cypress from any claim, damage, or other liability arising from or related to all Unintended Uses of Cypress products. You shall indemnify and hold Cypress harmless from and against all claims, costs, damages, and other liabilities, including claims for personal injury or death, arising from or related to any Unintended Uses of Cypress products.

Cypress, the Cypress logo, Spansion, the Spansion logo, and combinations thereof, WICED, PSoC, CapSense, EZ-USB, F-RAM, and Traveo are trademarks or registered trademarks of Cypress in the United States and other countries. For a more complete list of Cypress trademarks, visit cypress.com. Other names and brands may be claimed as property of their respective owners.