AVR092: Replacing ATtiny11/12 by ATtiny13

Features

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Introduction

This application note is a guide to help current ATtiny11/12 users convert existing designs to ATtiny13.

In addition to the differences described in this document, the electrical characteristics of the devices are different. Check the datasheets for detailed information.

Improvements or added features in the ATtiny13 that are not in conflict with those in ATtiny11 and ATtiny12 are not listed in this document.

8-bit AVR® Microcontrollers

Application Note

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ATtiny11 Errata Corrected in ATtiny13

The following items from the ATtiny11 Errata sheet do not apply to the ATtiny13.

Releasing Reset Condition Without Clock

The ATtiny13 reset circuit has been redesigned so that any External Reset pulse exceeding the minimum pulse width t_{RST} causes an internal reset even though the condition disappears before any valid clock is present.

Error in Writing Reset Status Bits

The External Reset flag (EXTRF) is cleared independently from the Power On Reset Flag (PORF).

Frequency Range of External RC Oscillator

The ATtiny13 has no support for external RC oscillator.

ATtiny12 Errata Corrected in ATtiny13

The following items from the ATtiny12 Errata sheet do not apply to the ATtiny13.

BOD Detection Level Too Low

The ATtiny13 operates correctly down to the BOD levels matching the device specifications.

Changes to Names

The following control bits have changed names, but have the same functionality and placement when accessed as in ATtiny11/12. These ATtiny11/12 bit definitions can therefore be added to the ATtiny13 definitions file, so no rewriting of the application code is necessary.

Table 1. Changed Bit Names

Bit Name in ATtiny11	Bit Name in ATtiny12	Bit Name in ATtiny13	I/O Register Name in ATtiny11/ ATtiny12
SM	SM	SM1	MCUCR
WDTOE	WDTOE	WDCE	WDTCR
-	AINBG	ACBG	ACSR

The following I/O registers have changed names. The functionality and location is unchanged.

Table 2. Changed Register Names.

Register name in ATtiny11	Register name in ATtiny12	Register name in ATtiny13
TIMSK	TIMSK	TIMSK0
TIFR	TIFR	TIFR0
TCCR0	TCCR0	TCCR0B

Changes to Interrupt Vector

Changes have been made to the Interrupt vector table from ATtiny11 and ATtiny12 to ATtiny13. These changes mainly consist of addition of new interrupt vectors. Incompabilities are marked with bold face.

Table 3. Changes to Interrupt Vector Tables.

Vector No.	Program Address	ATtiny11	ATtiny12	ATtiny13
1	0x0000	RESET	RESET	RESET
2	0x0001	INT0	INT0	INT0
3	0x0002	PIN_CHANGE	PIN_CHANGE	PCINT0
4	0x0003	TIM0_OVF	TIM0_OVF	TIM0_OVF
5	0x0004	**ANA_COMP**	EE_RDY	**EE_RDY**
6	0x0005		ANA_COMP	ANA_COMP
7	0x0006			TIM0_COMPA
8	0x0007			TIM0_COMPB
9	0x0008			WDT
10	0x0009			ADC

Oscillator Options

The ATtiny13 can be clocked from either external digital clock or one of the internal RC oscillators. Crystal, ceramic resonator or external RC oscillator is not selectable.

Internal RC Oscillators

The device clock can be provided from one of three internal RC oscillators: The 128 kHz RC Watchdog oscillator, the 4.8 MHz RC oscillator or the 9.6MHz internal RC oscillators. The 9.6 MHz oscillator is selected by default.

The CKDIV8 fuse can be used to divide the system clock by 8. This prescaler is by default enabled. In this way the default clock for the ATtiny13 is 1.2 MHz, which equals the frequency of the internal RC of the ATtiny12.

The ATtiny13 does not offer the possibility to select an internal 1 MHz RC as the ATtiny11.

Refer to the ATtiny13 datasheet for further details on clock settings and configuration.

Enhanced Watchdog Timer

The ATtiny13 has the Enhanced Watchdog Timer (WDT) and is improved compared to the one in ATtiny11/12.

If the WDT is not used, it is still recommended to disable it initially in the application code to clear unintentional WDT enabled events.

If the operation voltage is 5V and the WDTON fuse is left unprogrammed, the WDT will behave similar on ATtiny11/12 and ATtiny13.

The frequency of the Watchdog Oscillator in ATtiny13 is approximately 128 kHz for all supply voltages. The typical frequency of the Watchdog Oscillator in ATtiny11/12 is close to 1.0 MHz at 5V, but the time-out period increases with decreasing VCC. This

means that the selection of Time-out period for the Watchdog Timer (in terms of number of WDT Oscillator cycles) must be reconsidered when porting the design to ATtiny13.

In ATtiny11/12, the Watchdog Timer is either enabled or disabled, while ATtiny13 supports two safety levels selected by the WDTON Fuse.

Refer to the ATtiny13 datasheet or the Application note "AVR132 - Enhanced Watchdog Timer" for more information.

Changes to EEPROM Writing

In ATtiny12, the EEPROM write time is dependent on supply voltage, typically 3.1 – 6.8 ms. It is the internal RC oscillator that sources the EEPROM write time counter. The internal RC oscillator on ATtiny13 is close to the calibrated value for all supply voltages. In ATtiny13, the EEPROM write time will therefore always be 3.4ms.

Note: Changing the value in the OSCCAL Register affects the frequency of the calibrated RC Oscillator and hence the EEPROM write time.

Programming Interface

Changes have been made to the programming interfaces. The changes are valid for both serial programming (ISP) and parallel programming.

- Programming of both flash and EEPROM is now done in pages instead of per byte. The EEPROM can however also be programmed pr byte over the serial interface.
- Added support for new fuses.

See the ATtiny13 data sheet for details.

Fuse Bits

The fuse bits are different and are listed below. Refer to the ATtiny13 datasheet for a detailed description of the fuses.

Table 4. Fuse differences between ATtiny11, ATtiny12 and ATtiny13 and listing of default fuse setting and setting for best compatibility. Differences between ATtiny13 default fuse setting and best compatibility setting are marked with bold face

	Bit	ATtiny11	ATtiny12	ATtiny13	ATtiny13 default (1) (2)	ATtiny11 compatible ATtiny13 fuses (1)
High Fuse Byte	7	-	-	-	1	1
	6	-	-	-	1	1
	5	-	-	-	1	1
	4	-	-	SPMEN	1	1
	3	-	-	DWEN	1	1
	2	-	-	BODLEVEL1	1	1
	1	-	-	BODLEVEL0	1	1
	0	-	-	RSTDISBL	1	1
Low Fuse Byte	7	-	BODLEVEL	SPIEN	0	0
	6	-	BODEN	EESAVE	1	1
	5	-	SPIEN	WDTON	1	1
	4	FSTRT	RSTDISBL	CKDIV8	0	0
	3	RSTDISBL	CKSEL3	SUT1	1	**0**
	2	CKSEL2	CKSEL2	SUT0	0	**1**
	1	CKSEL1	CKSEL1	CKSEL1	1	1
	0	CKSEL0	CKSEL0	CKSEL0	0	0

Notes: 1. 0 = programmed, 1 = unprogrammed
2. Default fuse settings are those most compatible with the default fuse settings of ATtiny12.

Device Signature

As the ATtiny13 is a different product the unique device signature found in the signature row is different. The three-byte signature of the ATtiny13 is: 0x1E 0x90 0x07.

Device signatures

ATtiny11 has Signature Bytes: 0x1E 0x90 0x04.

ATtiny12 has Signature Bytes: 0x1E 0x90 0x05.

ATtiny13 has Signature Bytes: 0x1E 0x90 0x07.

Operational Voltage Ranges

ATtiny11 can operate from 2.7 - 6.0V.

ATtiny12 can operate from 1.8 - 5.5V.

ATtiny13 can operate from 1.8 - 5.5V.

Changes to Electrical Characteristics

The ATtiny13 is produced in a different process then the ATtiny11/12 and electrical characteristics will thus differ between these devices. Please consult the data sheets for details on electrical characteristics.

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