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Fujitsu Microelectronics Europe
Application Note

MCU-AN-391024-E-V11

FR FAMILY

32-BIT MICROCONTROLLER

MB91F369, MB91F364

UPDATE RTC

APPLICATION NOTE

Revision History

Date	Issue
2003-06-23	V 1.0, first draft, DFi
2003-06-27	V1.1, added description of RTC start/stop behaviour, introduced PRESCALER_FAST macro, added runtime table and timing diagram, DFi

This document contains 10 pages.

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Contents

1 Introduction

The hour, minute and second values of the RTC module in the MB91360 series can be set/updated immediately by usage of the UPDT bit in the WTCR control register. However there are two restrictions with this approach:

1. For MB91360 series devices other than MB91F364G and MB91F369GA, the RBUS clock must be higher than the oscillation clock when using the UPDT bit (e.g. RBUS clock=2MHz, oscillation clock=4MHz is not allowed).
2. The time from updating the RTC value until the new value can be read out from the WTSR, WTMR, WTHR registers, is up to one second (until the next subsecond overflow) in MB91F364G and MB91F369GA.

For these cases, a workaround is described in this document in order to update the RTC quickly. In the workaround, only the WTCR.ST and WTCR.RUN bits are used to update the hour, minute and second registers. With the described routine, the RTC update takes approx. 15 µs. For detailed runtimes, refer to Table 1.

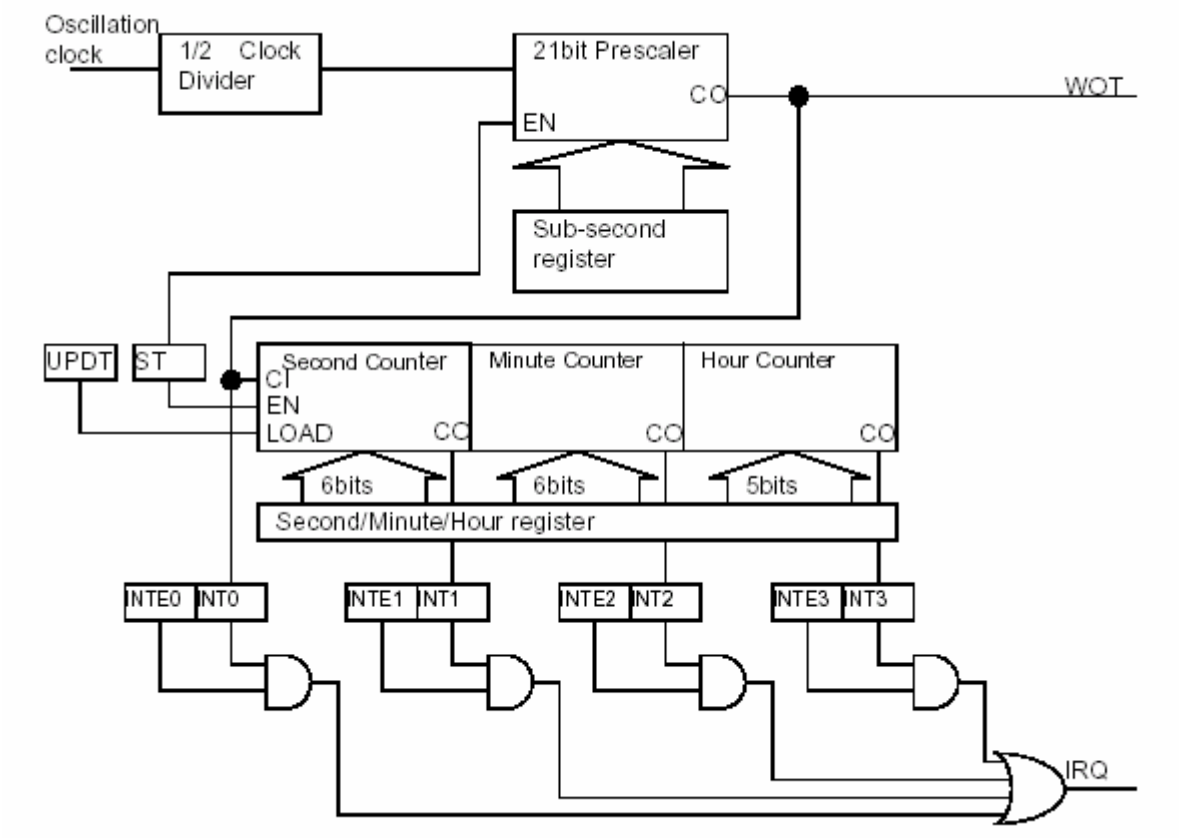
2 RTC update mechanism

This section describes the behaviour of the RTC during start/stop.

When starting the RTC by writing 1 to the WTCR_ST bit, the values, which were *written* into the hour, minute and second registers WTHR, WTMR and WTSR are transferred to the counter. Only after the next subsecond overflow (i.e. after one second), these values + 1 second can be read out by *read accessing* WTHR, WTMR and WTSR. However the WTHR, WTMR and WTSR input latches are not updated. I.e. if the RTC is stopped and restarted, the RTC is set to the hour, minute and second which was originally *written* into the WTHR, WTMR and WTSR register.

I.e. if 07:12:40 is written into the WTHR, WTMR and WTSR register and the RTC is started by writing 1 to the WTCR.ST bit, 07:12:41 can be read from WTHR, WTMR, WTSR *after* the next subsecond overflow. If the RTC is stopped after some time, e.g. at 07:13:58, by writing 0 into WTCR.ST, and restarted hereafter, the next value which can be read from WTHR, WTMR and WTSR (one subsecond overflow after WTCR.ST was set to 1) is 07:12:41.

2.1 RTC block diagram



3 Algorithm

This section describes the quick RTC update algorithm for MB91F364G and MB91F369GA. Although it can be used for all devices of the MB91360 series, the usage of the UPDT bit is more convenient, if certain requirements are fulfilled (please refer to section 1).

1) Start of set_rtc_routine (approx. time t1 in Figure 1)
2) Save prescaler register WTBR
3) Save control register WTCR
4) Stop RTC, disable interrupt (WTCR=0) (approx. time t1 in Figure 1)
5) Wait until RTC has stopped (wait until WTCR.RUN==0)
6) Write new value into hour, minute and second register (WTHR, WTMR and WTSR). Second value must be decremented by one, because the RTC runs until subsecond overflow occurs, thus incrementing the second register. Since the prescaler is set to PRESCALER_FAST (small prescaler value e.g 2), the susbescond overflow will occur some µs later and not one second later.
7) Set prescaler register WTBR to PRESCALER_FAST (small prescaler value e.g 2) in order to generate a subsecond overflow as fast as possible to update the WTHR, WTMR and WTSR output latch (read access value). Note that the prescaler must not be smaller than stated in Table 1, otherwise more than one subsecond overflow could occur before the RTC can be stopped by the software (step 11).
8) Disable interrupts in order to be able to stop RTC directly after subsecond overflow.
9) Start RTC (WTCR.ST=1) (approx. time t2 in Figure 1)
10) Wait for subsecond overflow (wait until WTCR.INT0==1) (overflow appearance approx. at time t3 in Figure 1)
11) Stop RTC (WTCR=0) (approx. time t3 in Figure 1)
12) Enable interrupts.
13) Wait until RTC has stopped (wait until WTCR.RUN==0)
14) Write new value into hour, minute and second register (WTHR, WTMR and WTSR) Second value must *not* be decremented by one. Since the prescaler is set to its original value, the second register is incremented automatically *after* one second.
15) Restore prescaler register WTBR (correct prescaler value e.g `0x1E847F` for 4MHz oscillation clock)
16) Restore control register WTCR (restart RTC) (approx. time t4 in Figure 1)
17) clear overflow flag WTCR.INT0

An implementation of this algorithm can be found in section 4. The runtime (time t4-t1 in Figure 1) of the `set_rtc_clock` function is listed in Table 1.

core clock CLKB [MHz]	resource clock CLKR [MHz]	oscillation clock [MHz]	PRESCALER_FAST	runtime `set_rtc_clock` [µs]
64	32	4	3	11 µs
64	16	4	3	12 µs
48	24	4	3	13,7 µs
48	16	4	3	14,2 µs
16	16	4	8	34,8 µs
2	2	4	50	269 µs

Table 1

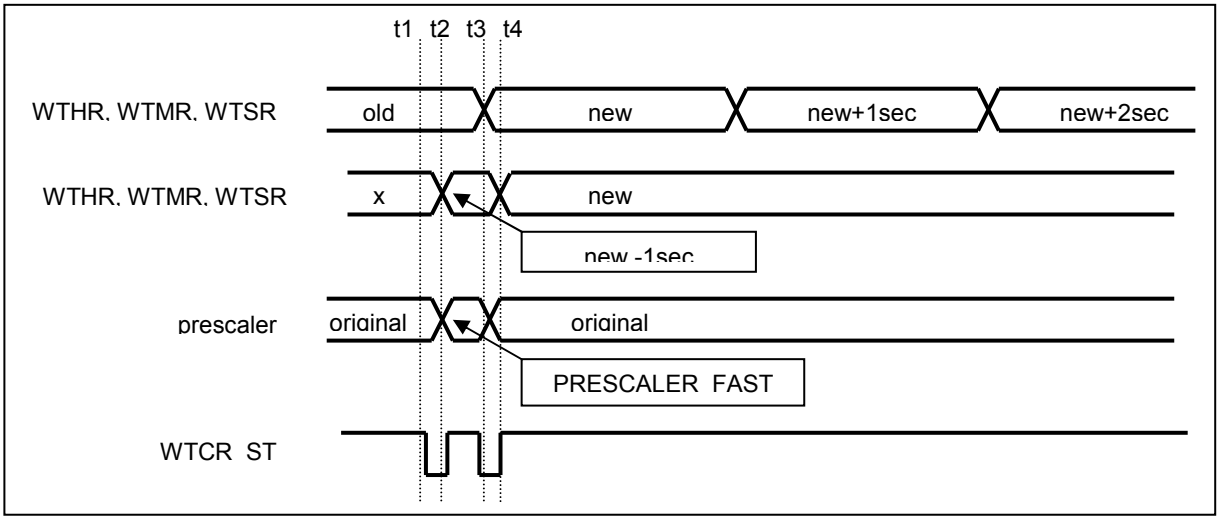


Figure 1 Note: The timescale of this figure is not exact.

4 Routines

```
/*****************************************************************************
 *     set rtc clock
 *     function :    set hour, minutes and second to RTC
 *                   For fast setting of the rtc the
 *                   prescaler is set to a minimum value to speed up
 *                   the clocking of the new values to RTC registers.
 *     par:
 *            in:    char h : hours for rtc
 *                   char m : minutes for rtc
 *                   char s : seconds for rtc
 *            out:   -
 *****************************************************************************/

#define PRESCALER_FAST 50

void set_rtc_clock (unsigned char h, unsigned char m, unsigned char s)
{

    WORD wtcr_original;
    DWORD prescaler_original;
    unsigned char hour, min, sec;

    sec=s;
    min=m;
    hour=h;

    prescaler_original = get_rtc_prescaler();
    wtcr_original = WTCR;            // save value before changing
    WTCR = 0x0000;                   // stop and disable interrupt reset int flag
    while (WTCR_RUN == 1);           // wait until rtc has stopped

    if (s!=0) s--;                   // subtract one second
                                     // to have the right time after clock
    else
    {
        s = 59;
        if (m!=0) m--;
        else
        {
             m = 59;
             if (h!=0) h--;
             else h=23;
        }
    }
    WTSR  = s;                       // set second (decremented by one)
    WTMR  = m;                       // set minute
    WTHR  = h;                       // set hour
    set_rtc_prescaler (PRESCALER_FAST);        // set fast clock
    __DI();                          // disable interrupts
    WTCR_ST = 1;                     // start rtc
    while (WTCR_INT0 == 0);          // wait for sec overflow
    WTCR_ST = 0;                     // stop rtc
    __EI();                          // enable interrupts
    while (WTCR_RUN == 1);           // wait until rtc has stopped

    WTSR  = sec;                     // set second
    WTMR  = min;                     // set minute
    WTHR  = hour;                    // set hour
    set_rtc_prescaler (prescaler_original);    // reload original settings
    WTCR = wtcr_original;                      // reload original settings
    WTCR_INT0 = 0;                   // clear overflow flag
    return;
}
```

```
/*****************************************************************************
 * set rtc prescaler
 * function : set the prescaler value to rtc
 *     par:
 *           in:          -
 *           out:   DWORD prescaler value
 *****************************************************************************/
void set_rtc_prescaler (DWORD x)
{
       WTBR_HIGH = (BYTE)(x / 0x10000) & 0xFF;
       WTBR_MID  = (BYTE)(x / 0x100) & 0xFF;
       WTBR_LOW  = (BYTE)(x / 0x1) & 0xFF;

}



/*****************************************************************************
 * get rtc prescaler
 * function : read out the prescaler value of rtc
 *     par:
 *           in:          -
 *           out:   DWORD prescaler value
 *****************************************************************************/
DWORD get_rtc_prescaler (void)
{
       return ((WTBR_HIGH&0x1F) *0x10000 + WTBR_MID * 0x100 + WTBR_LOW);
}
```

