



Real time clock with ST7 Timer Output Compare

By MCD Application Team

1 INTRODUCTION

The purpose of this note is to present how to use the ST7 Timer output compare function. As an application example, this document presents how to generate a real time clock with counters for seconds, minutes and hours, based on a fixed basic time base.

2 GENERATING A TIME BASE WITH ST7 TIMER

The ST7 timer output compare function can be used to generate the fixed time base.

2.1 TIMER CONFIGURATION AND INITIALIZATION

The application example is managed using the output compare interrupts. The ST7 timer has two output compare functions whose interrupts are both enabled by the OCIE bit in the CR1 register. In this case, the Output Compare 1 (OC1) is used for time base generation while the second one (OC2) is ignored when it generates an interrupt each time the free running counter value matches the value in the OC2 register.

To minimize the CPU load, we need to choose the maximum time base value that has to be multiplied to obtain one sec. For this reason the maximum timer clock divider ratio (1/8) is selected by the CC1 and CC0 bits in the CR2 register.

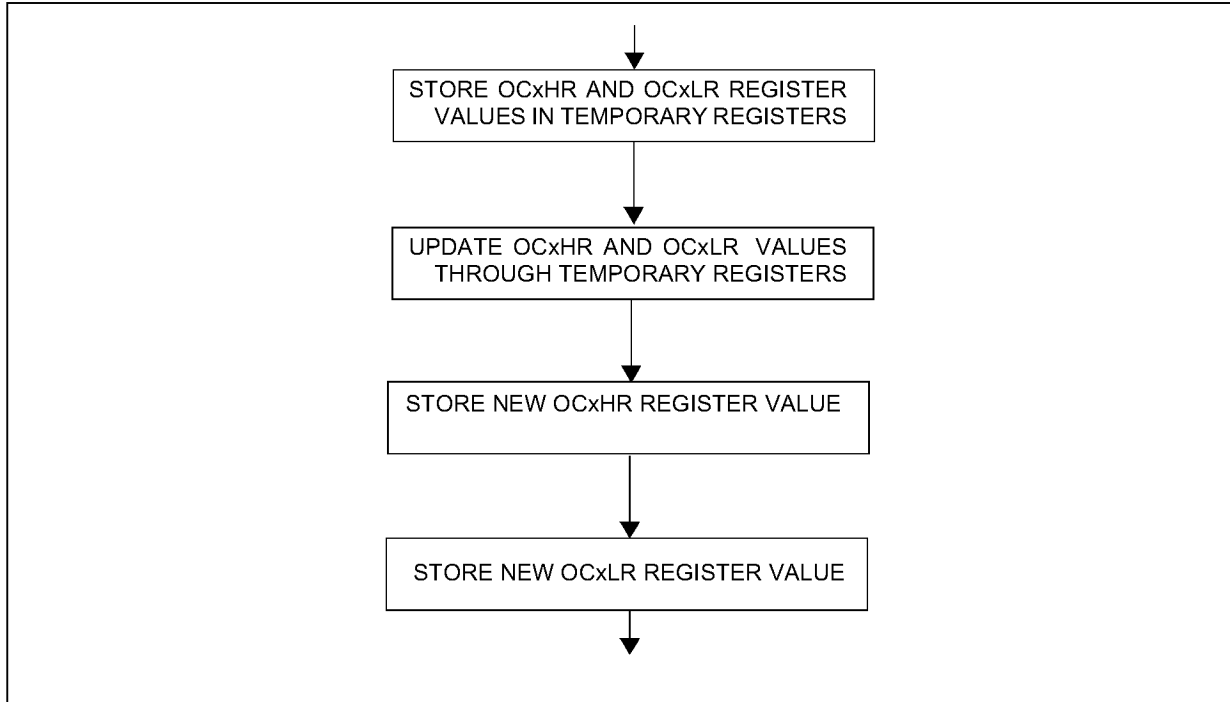
2.2 OUTPUT COMPARE UPDATE

To maintain a fixed elapsed time between each Output Compare 1 interrupt generation, the Output compare registers (OC1HR, OC1LR) have to be updated with a fixed offset time base at each interrupt.

$$(OCxHR, OCxLR) = (OCxHR, OCxLR) + (OCxHR, OCxLR)_{offset}$$

Caution: As the ST7 can only handles 8-bit data and as the output compare function is inhibited between the write in the high (OCxHR) and the low (OCxLR) output compare registers, special care has to be taken when the updating of the 16-bit compare register. A typical algorithm flowchart is shown in Figure 1.

Figure 1. Output Compare Register Update Flowchart



Based on the assumption that f_{CPU} is 4-MHz, Table 1 gives some basic possible time bases with the Output compare register offset value (OCxHR, OCxLR).

$$f_{timercnt} = \frac{f_{CPU}}{(cc1, cc0)} = \frac{4 \text{ MHz}}{8} = 500 \text{ KHz} \longrightarrow T_{timercnt} = 2 \text{ us}$$

$$(OCxHR \text{ OCxLR})_{offset} = \frac{TimeBase}{T_{timercnt}} = \frac{TimeBase}{2 \text{ us}}$$

Table 1. Output Compare Register and Timebase Values with $f_{timercnt}$ at 500KHz

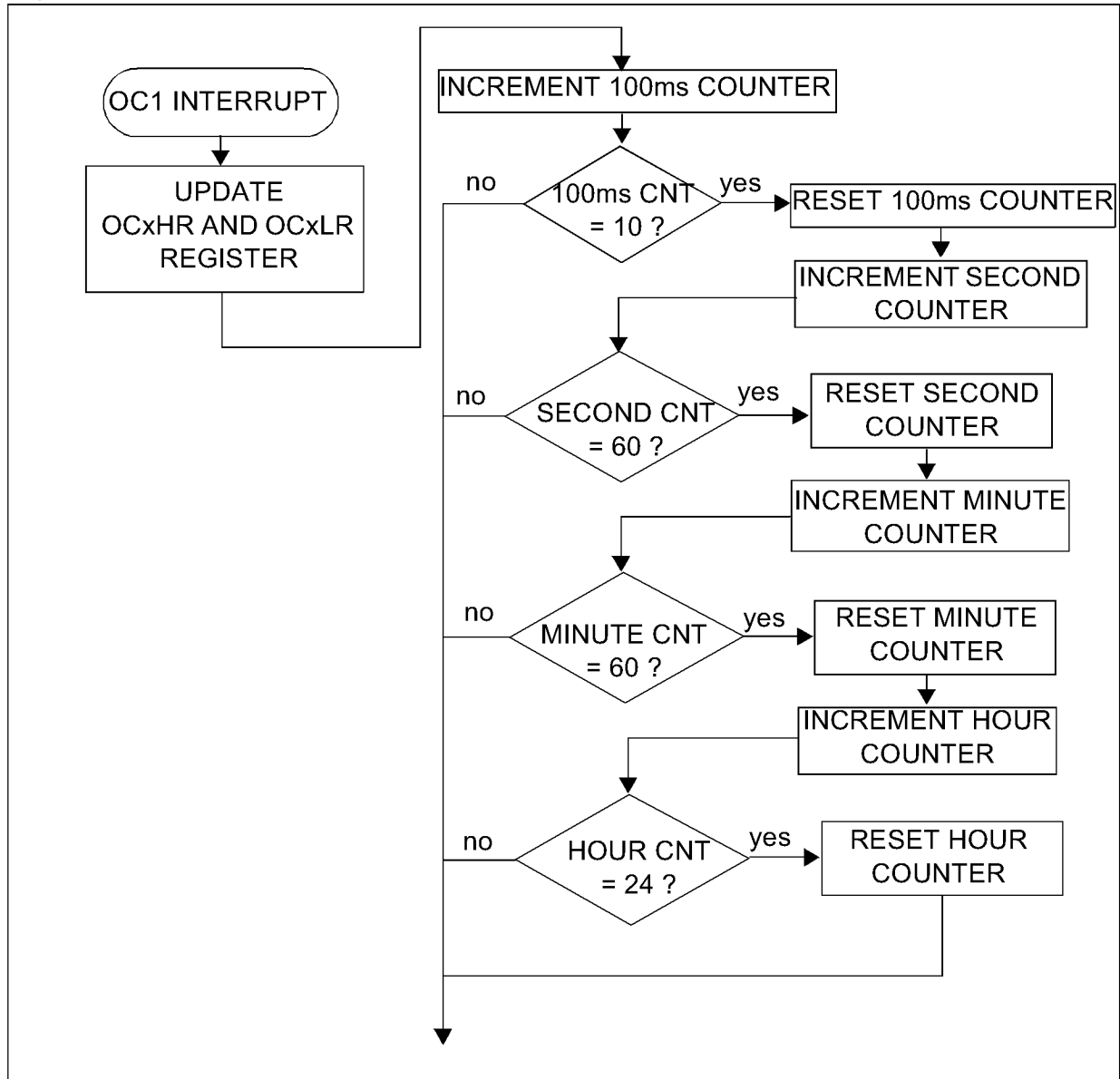
| Time Base [ms] | 2 | 10 | 20 | 50 | 100 | 131.07 |
|--------------------------|------|------|------|------|------|--------|
| OCxHR OCxLR offset [hex] | 03E8 | 1388 | 2710 | 61A8 | C350 | FFFF |

3 REAL TIME CLOCK APPLICATION

The real time clock application is based on four software counters (100ms, seconds, minutes and hours) updated by a 100ms ST7 timer output compare 1 interrupt.

These four counters are coded on one byte each and are updated by the Output Compare 1 interrupt routine as shown in Figure 2.

Figure 2. Software Counter Update Flowchart

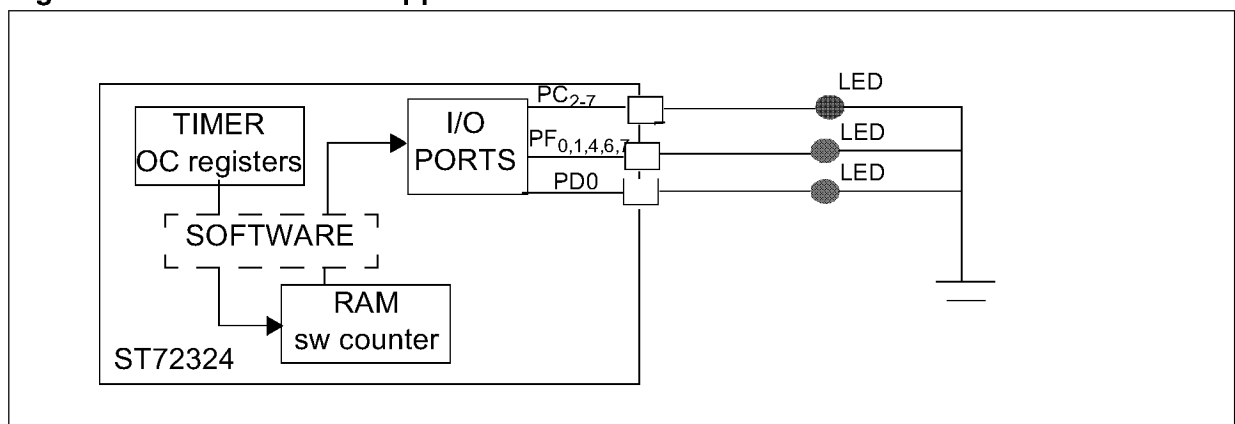


3.1 HARDWARE CONFIGURATION

The real time clock application hardware is made of a ST72324 microcontroller timer which generates a 100ms time base through the Timer B Output Compare 1 function . Two of the software counters (seconds and minutes) are output by the microcontroller through I/O ports (PC, PF and PD) and displayed on LEDs as shown in Figure 3. The Seconds counter is shown with a red LED and the Minutes counter is shown with a pink LED.

The selected crystal for this example has 8 MHz frequency which gives $f_{CPU}=4$ MHz because the PLL is disabled and slow mode is not selected.

Figure 3. Real Time Clock Application



The RTC accuracy depends on the clock source (e.g. Resonator Oscillator) accuracy. Care should be taken especially for time critical applications.

4 SOFTWARE

All the source files in assembly code as well as in C code are given in the zip file with this application note. The C code uses the software library (ST7 software library version 1.1).

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