



# AN1254 APPLICATION NOTE

## How to Measure the Period of an External Signal with ST52x420

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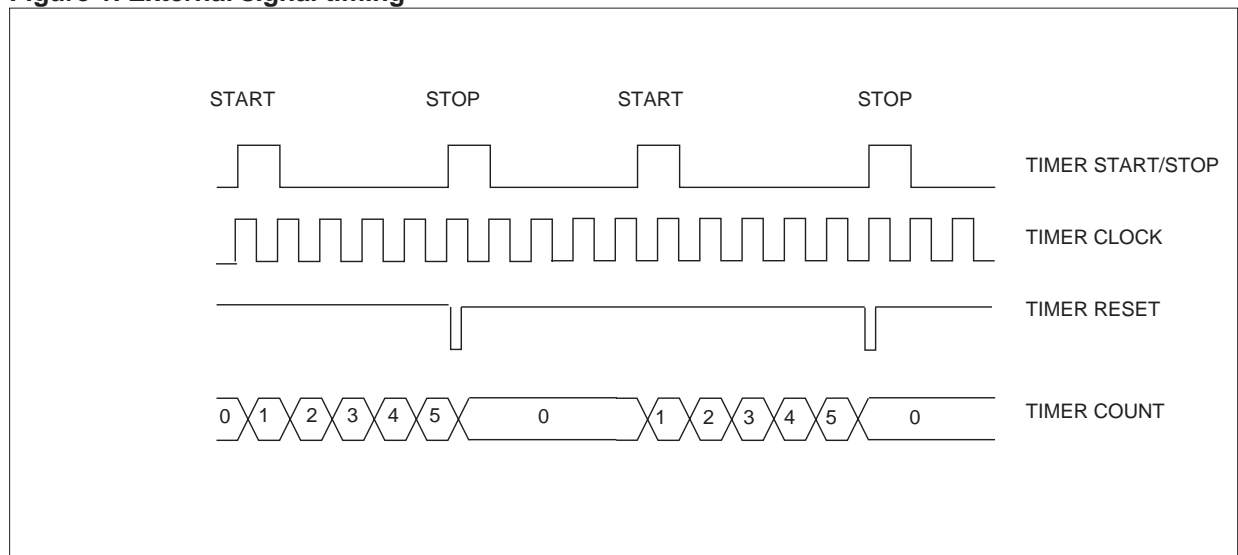
### 1. Introduction

This application note shows an example of how to measure the period of an external signal, by using TIMERO, one of the three on-chip PWM Timers available on ST52x420. This application can be used in fields like motor speed control, Encoder Pulse Width measurement.

In order to obtain such a measure, you have to configure the TIMERO with external start/stop and internal reset. The clock can be internal or external, in our application it is internal.

In figure1 is shown the timing of the interested signal.

Figure 1. External signal timing

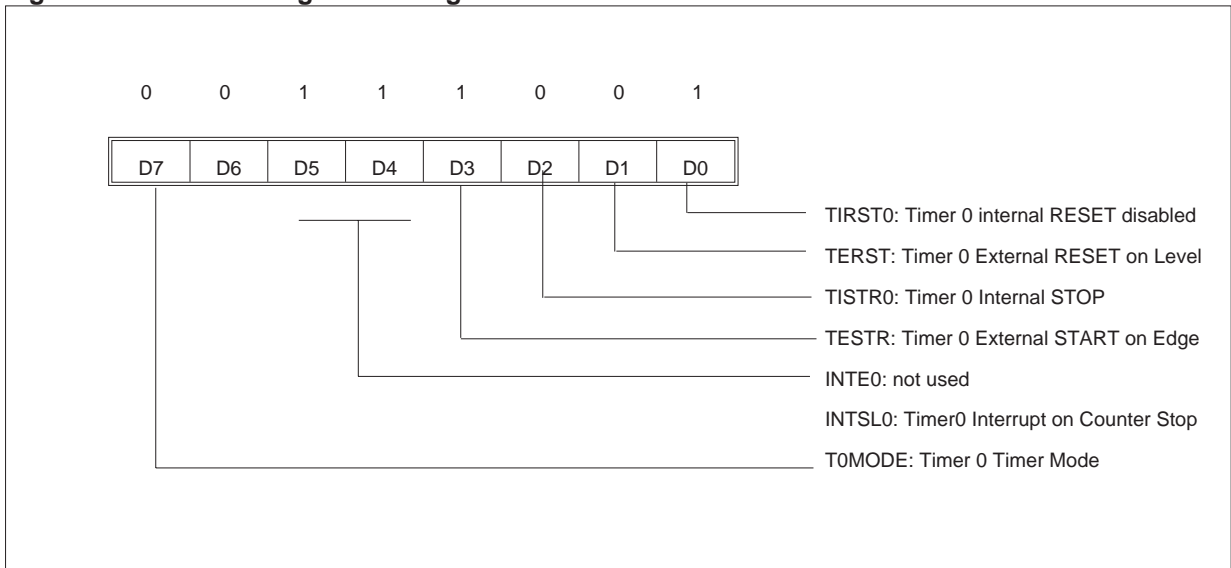


### 2. TIMERO configuration

TIMERO has two different working modes: Timer Mode and PWM Mode. These can be selected by setting the correspondent T0MODE bit of REG\_5. In this applications, the peripheral PWM/TIMERO works in Timer Mode.

In order to configure the TIMERO, you have to set three configuration registers: REG\_CONF5, REG\_CONF6 and REG\_CONF7, how is shown in the following figure.

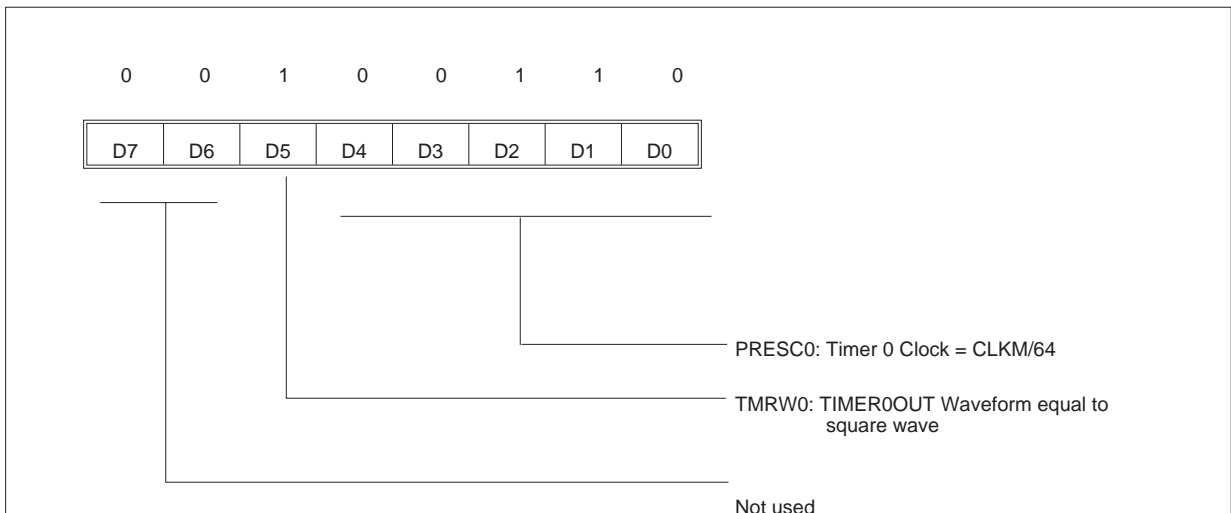
Figure 2. TIMER0 Configuration Register 5



The PWM/TIMER0 gives an interrupt on counter stop, and the external start\_stop is active on edge, in order to have, on the first rising edge of the signal which you want to measure the period, the start of the timer, and, at the next rising edge, the stop.

Note that, if the LSB of REG\_CONF5 is '1', the Timer is not reset, if it is '0' is reset; after the counter stop, signalled by the interrupt of the peripheral, you have to read the TIMER\_COUNT\_0 value, that constitutes the measure of the period, and to reset the Timer, putting to '0' the LSB of REG\_CONF5, as you can see in the assembler code, particularly in the TIMER0 interrupt routine.

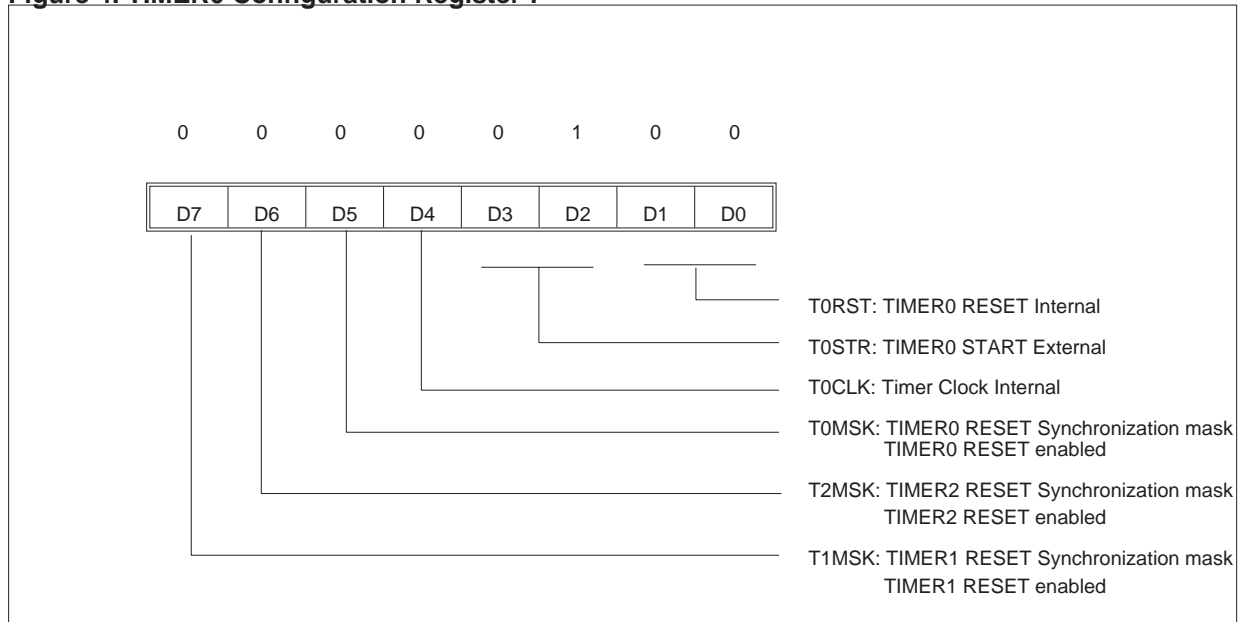
Figure 3. TIMER0 Configuration Register 6



By setting the bits b4-b0 of REG\_CONF6 it is possible to select the Prescaler in order to obtain the TIMER\_CLOCK, by dividing the clock master or the external clock provided on the T0CLK pin. All of this allows to have a great flexibility to measure signals to different frequencies.

If you use the clock master, for example 20MHz, by the configuration given in the example, the TIMER\_CLOCK obtained is  $20\text{MHz}/64=312.5\text{KHz}$ , correspondent to a period of  $3.2\mu\text{s}$ . In this way you can measure a period in the range  $3.2\mu\text{s}-3.2\mu\text{s}\cdot 255=816\mu\text{s}$ .

Figure 4. TIMER0 Configuration Register 7



Naturally you have to select the Prescaler (or eventually to use an external clock), in reason for the range of frequency in which the signal that you have to measure can vary.

The configuration register 7 allows to select the source signal for the ST52x420 TIMER0 peripheral. By setting to '00' the last significative bits of REG\_CONF7, you can reset the Timer counter internally while by setting to '01' the bits 3 and 2 you have the start and the stop of the Timer on the rising edge of the external signal. Finally, by setting to '0' the bit 4 you select the internal clock (but you can also select the external clock putting it to '1').

For more details on the Timer's functions and configurations please refer to ST52x420 Data Sheet.

## Appendix 1

In this appendix is shown the source program written in Assembler language generated with FUZZYSTUDIO™4.0, the software development tool to program and quickly develop applications with all the ST52 family of fuzzy microcontrollers.

```

.*****
;
; PURPOSE:   Test Timer0
; DATE:     16/02/2000
;
;
.*****
;
; Start/stop external (on edge), clock and reset internal

.*****
;

irq 0 AD_INT
irq 1 TIM0
irq 2 TIM1
irq 3 TIM2
irq 4 EXT_INT

.***** Peripherals and Chip configurations *****

ldrc    0      00000000b      ; interrupt mask configuration
ldcr    0      0              ; all interrupts masked
ldrc    0      00111001b      ; interrupt priority configuration
ldcr    1      0              ; from the top: PWM0, PWM1, PWM2, ADC

ldrc    0      00110001b      ; Port A configuration
ldcr    4      0              ; PA5, PA4, PA0 input

ldrc    0      00111000b      ; PWM-Timer 0 configuration
ldcr    5      0              ; Interrupt on counter stop, ext. start on edge

ldrc    0      00100110b      ; PWM-Timer 0 configuration
ldcr    6      0              ; Prescaler 00110 (CLKM/64=20MHz/64=312,5KHz)

ldrc    0      00000100b      ; PWM-Timer 0 configuration
ldcr    7      0              ; Internal reset, external start, internal clock
ldrc    0      00000001b      ; Port A mode configuration
ldcr    12     0              ; Port A 7 bits, pin22-PA3, pin23-PA2, pin24-T0out\
ldrc    0      00000000b      ; Port B direction configuration
ldcr    13     0              ; PB7-PB0 output
ldrc    0      00000000b      ; Port B mode configuration

```



```
ldcr 14 0 ; PB7-PB0 digital
ldrc 0 00000000b ; Port C direction configuration
ldcr 15 0 ; PC3-PC0 output
ldrc 0 00000110b ; Port C mode configuration
ldcr 16 0 ; pin8-PC3, pin7-PC2, pin6-T0out
```

\*\*\*\*\*

Start:

```
ldrc 0 255
ldpr 3 0 ; PWM_0_COUNT=255 (255 x 3.2us=816us)

ldrc 0 00111001b ; PWM-Timer 0 configuration
ldcr 5 0 ; internal reset disabled

ldrc 0 00000100b ; interrupt mask configuration
ldcr 0 0 ; TM0 not masked
```

loop:

jp loop

\*\*\*\* INTs Subroutines \*\*\*\*

EXT\_INT:

reti

AD\_INT:

reti

TIM0:

```
ldri 20 12 ; read Timer0_count and send it in RAM20
ldpr 1 20 ; send RAM20 into PORTB
ldrc 0 00111000b ; PWM-Timer 0 configuration
ldcr 5 0 ; internal reset enabled
ldrc 0 00111001b ; PWM-Timer 0 configuration
ldcr 5 0 ; internal reset disabled
reti
```

TIM1:

reti

TIM2:

reti

\*\*\*\*\*

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