Introduction

The NUCLEO-8S208RB (built around the STM8S208RBT6 device) and the NUCLEO-8L152R8 (built around the STM8L152R8T6 device) are boards that allow the evaluation of the main features of all the STM8S Series and STM8L Series microcontrollers.

This application note provides a short description on how to use the TIM peripheral to generate three PWM signals.

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<th>Table 1. Applicable products</th>
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<tr>
<td>Type</td>
</tr>
<tr>
<td>Evaluation boards</td>
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Reference documents

- STM8 Nucleo-64 boards data brief (DB3591)
- STM8L152R8T6 Nucleo-64 board user manual (UM2351)
- STM8S208RBT6 Nucleo-64 board user manual (UM2364)
1 Application description

This section describes the hardware requirements, the application's schematics and the application's principle to use the TIM peripheral to generate three PWM signals on the NUCLEO-8S208RB or the NUCLEO-8L152R8 boards.

1.1 Hardware requirements
No additional hardware is required on the NUCLEO-8S208RB or the NUCLEO-8L152R8 boards. An oscilloscope is needed as an external resource.

1.2 Application schematics
The application schematics of both boards are illustrated in the figures below.

Figure 1. STM8S Series application schematic

Figure 2. STM8L Series application schematic

1.3 Application principle
This application is based on the use of the TIM in PWM (pulse width modulation) mode to generate three PWM signals.
- TIM2 for STM8S Series devices
- TIM1 for STM8L Series devices
The generation process is presented in the figure below.

Figure 3. PWM generation principle

TIM counts up from 0 to the auto-reload register value (TIM_ARR) according to the timer counter clock.

- When the counter value equals the compare/capture register (TIM_CCRx) value, channel x signal is set to 0.
- When the counter value reaches the TIM_ARR value the counter is reset and channel x signal is set to 1.

By configuring the TIMx_CCRx and TIMx_ARR registers the user can easily modify the duty cycle and the frequency of the PWM signals generated (see Section 2 Software description). By default the application provides the three PWM signals as specified in the table below.

Note: it is possible to configure the AFR option byte to get channel 3 also on PD2.

Table 2. Default PWM signals

<table>
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<tr>
<th>Signal</th>
<th>Duty cycle</th>
<th>Frequency</th>
<th>STM8S Series</th>
<th>STMSL Series</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>I/O pin</td>
<td>Header connector</td>
</tr>
<tr>
<td>Channel 1 PWM</td>
<td>50%</td>
<td>2 KHz</td>
<td>PD4</td>
<td>CN5.6</td>
</tr>
<tr>
<td>Channel 2 PWM</td>
<td>25%</td>
<td></td>
<td>PD3</td>
<td>CN5.21 /CN6.1</td>
</tr>
<tr>
<td>Channel 3 PWM</td>
<td>75%</td>
<td></td>
<td>PA3</td>
<td>CN4.27</td>
</tr>
</tbody>
</table>
2 Software description

This example uses the STM8S Series and STM8L Series standard firmware libraries to control the general purpose functions.

To generate the PWM signals the TIMx peripheral must be configured as follows:

- Output state enabled for each channel
- Output compare active low for each channel
- Preload register enabled for each channel
- PWM output signal frequency = 2 KHz:
  - The timer source clock frequency is 2 MHz (\(f_{CPU}\) by default) and the prescaler is set to 1 to obtain a TIMx counter clock of 2 MHz.
  - PWM output signal frequency can be set according to the following equation:
    \[
    \text{PWM output signal frequency} = \frac{\text{TIMx counter clock}}{(\text{TIMx\_ARR} + 1)}
    \] (in our case TIMx\_ARR = 999, so PWM output signal frequency is 2 KHz)
- PWM mode for each channel. To obtain a different PWM duty cycle value on each channel the TIMx\_CCRx register must be set according to this equation:
  \[
  \text{Channel x duty cycle} = \left[\frac{\text{TIMx\_CCRx}}{(\text{TIMx\_ARR} + 1)}\right] \times 100
  \]
  By default we have:
  - Channel 1: TIMx\_CCR1x register value is 500, so channel 1 of TIMx generates a PWM signal with a frequency of 2 KHz and a duty cycle of 50%.
  - Channel 2: TIMx\_CCR2x register value is 750, so channel 2 of TIMx generates a PWM signal with a frequency of 2 KHz and a duty cycle of 75%.
  - Channel 3: TIMx\_CCR3x register value is 250, so channel 3 of TIMx generates a PWM signal with a frequency of 2 KHz and a duty cycle of 25%.

Note: TIMx = TIM2 for STM8S Series devices and TIM1 for STM8L Series devices

2.1 Application software flowchart
2.1.1 Main loop flowchart

Figure 4. Main loop flowchart

- **Start**
  - Set timer frequency
  - Configure channel 1
    - Programs TIMx_ARR auto-reload register to 999.
    - Programs TIMx_CCRx capture/compare registers.
    - Enables PWM mode 2.
    - Enables output state.
    - Selects output compare polarity to low.
    - Enables preload register.
  - Configure channel 2
  - Configure channel 3
  - Enable TIMx_ARR
  - Enable timer
  - **Generation of PWM signals on PA3, PD3, PD4 for STM8S Series or PD2, PD4, PD5 for STM8L Series**
- **End**
**Revision history**

**Table 3. Document revision history**

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<tr>
<th>Date</th>
<th>Version</th>
<th>Changes</th>
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<tr>
<td>29-Jun-2018</td>
<td>1</td>
<td>Initial release.</td>
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