MSPM0 timer module introduction
— MSPM0 peripheral training series

Presented by Johnson He
### MCU level overview — MSPM0Lxx series

#### MSPM0L13x3/4/5/6

<table>
<thead>
<tr>
<th>Feature</th>
<th>MSPM0L13x3/4/5/6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CPU</strong></td>
<td>ARM Cortex-M0+ 32 MHz</td>
</tr>
<tr>
<td><strong>ARM Cortex-M0+ 32 MHz</strong></td>
<td>NVIC / 3-ch DMA</td>
</tr>
<tr>
<td><strong>On-chip Memory</strong></td>
<td>8, 16, 32 or 64 kB flash</td>
</tr>
<tr>
<td><strong>2 or 4 kB SRAM</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Data Integrity &amp; Security</strong></td>
<td>CRC accelerator (16 and 32 bit)</td>
</tr>
<tr>
<td><strong>Programming &amp; Debug</strong></td>
<td>ARM SWID interface</td>
</tr>
<tr>
<td><strong>ROM UART &amp; I2C BSL</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Power &amp; Clocking</strong></td>
<td>POR / BOR / SVS</td>
</tr>
<tr>
<td><strong>Internal LF 32kHz (5%)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Internal HF 4-32MHz (1%)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>UART w/ LIN (1)</td>
</tr>
<tr>
<td><strong>UART (1)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>SPI (1)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>12C (2) w/ FastMode+</strong></td>
<td></td>
</tr>
<tr>
<td><strong>IO</strong></td>
<td>Up to 28 GPIO</td>
</tr>
<tr>
<td><strong>Up to 2 low I/O PA inputs</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Precision Analog</strong></td>
<td>12-bit SAR ADC 1Mps (1)</td>
</tr>
<tr>
<td><strong>ULP/HS Comparator (1)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>8-bit reference DAC (1)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Zero-drift chopper op-amps (2)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>General purpose amp (1)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Internal ADC reference (2.5%)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Temperature sensor</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Timers</strong></td>
<td>General purpose 16-bit 2CC (4)</td>
</tr>
<tr>
<td><strong>Windowed watchdog</strong></td>
<td></td>
</tr>
</tbody>
</table>

**32 MHz MCU with up to 64kB flash, 32 pins, 12-bit ADC, dual zero-drift OPA/PGA, COMP**
**MCU level overview**  
---**MSPM0Gxx series**

<table>
<thead>
<tr>
<th>Timer Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced control 16-bit 4CC (1)</td>
</tr>
<tr>
<td>Advanced control 16-bit 2CC (1)</td>
</tr>
<tr>
<td>General purpose 16-bit 2CC (2)</td>
</tr>
<tr>
<td>Low power 16-bit 2CC(2)</td>
</tr>
<tr>
<td>General purpose 32-bit 2CC (1)</td>
</tr>
</tbody>
</table>

**MSPM0G350x/310x/150x/110x**  
**CPU**  
Arm Cortex-M0+ 80 MHz  
NVIC / MPU / 7-ch DMA  

**Power & Clocking**  
- POR / BOR / SVS  
- External LF 32kHzXTAL  
- External HF 4-48MHzXTAL  
- Internal LF 32kHz (3%)  
- Internal HF 4-32MHz (1%)  
- PLL (up to 80 MHz)  

**Precision Analog**  
- 12-bit ADC 4Mps (9-ch)  
- 12-bit ADC 4Mps (8-ch)  
- Comparators w/ 8-bit DACs (3)  
- 12-bit 1Mips buffered DAC (1)  
- Zero-drift chopper op-amps (2)  
- Internal reference (1.5%)  

**Communication**  
- UART w/ LIN (1)  
- UART (3)  

**On-chip Memory**  
- 32, 64, or 128 kB flash [ECC]  
- 16 or 32 kB SRAM [ECC]  

**Data Integrity & Security**  
- SPI (2)  
- CRC accelerator (16 and 32 bit)  
- AES256 accelerator + TRNG  

**Programming & Debug**  
- ARM SWD interface  
- UART & i2C bootloader  

**PIO**  
- Up to 60 GPIO  

**Up to 2*TIMA, 5*TIMG**  

**80 MHz MCU with up to 128kB flash, 64 pins, advanced analog, AES/TRNG, CAN-FD**
# MSPM0 timer module introduction

## Flexible power domain
- Instance: TIMA0, TIMA1, TIMG0, TIMG1, TIMG2, TIMG3, TIMG4, TIMG5, TIMG6, TIMG7, TIMG8, TIMG9, TIMG10, TIMG11, TIMG12, TIMG13
- Power Domain: PD1, PD0
- Counter Resolution: 16-bit, 8-bit
- Prescaler: 8-bit, 2
- Repeat Counter: 8-bit, 2
- CCP Channels: 4
- External PWM: Yes
- Phase Load: Yes
- Shadow Load: Yes
- Shadow CCP: Yes
- Dead band: Yes
- Fault Handler: Yes
- QEI: No

## Larger period

## Complementary PWM output

## Fault Handler

### Event to trigger load

### Hall/Encoder

### QEI

### High resolution
General purpose timer module introduction

Key Features

Counter:
• 16/32-bit up, down or up-down counter, with repeat-reload mode
• Shadow register mode for load register
• Synchronization and cross trigger among different TIM instances
• Interrupt trigger generation and cross peripherals trigger capability

Compare/Capture:
• Up to two independent channels for
  • Output compare
  • Input capture
  • PWM output
  • One-shot mode
• Pipelined compare mode for CC register

Others:
• Quadrature encoder/Hall interface (TIMG8 – TIMG11)
• 32-bit Counter (TIMG12-TIMG13)

Application
• General Purpose
• Motor Control
• Encoder, Position Sensing

Implemented in MSPM0G & MSPM0L Series MCU
Advanced control timer module introduction

**Key Features**

**Counter:**
- 16-bit up, down or up-down counter, with repeat-reload mode
- Shadow register mode for load register
- Synchronization and cross trigger among different TIM instances
- Interrupt trigger generation and cross peripherals trigger capability

**Compare/Capture:**
- Up to four independent channels for
  - Output compare
  - Input capture
  - PWM output
  - One-shot mode
- Pipelined compare mode for CC register
- Complementary PWM output with dead-band

**Others:**
- Fault handling mechanism

**Application**
- General Purpose
- Motor Control
- Power Inverter, PFC

Fault Mechanism

16-bit counter with phase load & shadow load

4 CC Channel with Dead-band Output support 4 pair PWM

*Implemented in MSPM0G Series MCU*
Timer module quick start

**Academy**
*Timer introduction lab*

**Driverlib Examples**
*MSPM0G350x:*
- timer_mode_periodic_repeat_count
- timer_mode_pwm_ded_and
- timer_mode_pwm_edge_sleep_shadow_load
- timer_mode_trigger fail mechanism
- timer_qei_mode
- timer_timer_mode_capture_edge_capture
- timer_timer_mode_compare_edge_count
- timer_timer_mode_one_shot_sleep
- timer_timer_mode_pwm_center_sleep
- timer_timer_mode_pwm_edge_sleep_shadow_load
- timer_timer_mode_pwm_capture_duty_and_period
- timer_timer_mode_capture_edge_capture
- timer_timer_mode_compare_edge_count
- timer_timer_mode_one_shot_standby
- timer_timer_mode_periodic_sleep
- timer_timer_mode_periodic_standby
- timer_timer_mode_periodic_stop
- timer_timer_mode_pwm_center_stop
- timer_timer_mode_pwm_cross_trigger_stop_restore
- timer_timer_mode_pwm_edge_sleep

*MSPM0L130x:*
- timer_mode_capture_duty_and_period
- timer_timer_mode_capture_edge_capture
- timer_timer_mode_compare_edge_count
- timer_timer_mode_one_shot_standby
- timer_timer_mode_periodic_sleep
- timer_timer_mode_periodic_standby
- timer_timer_mode_periodic_stop
- timer_timer_mode_pwm_center_stop
- timer_timer_mode_pwm_edge_sleep

**Launchpad**
*LP-MSPM0G3507*

*LP-MSPM0L1306*

**Related Links**
* MSPM0 online resource
* MSPM0 Quick start guide
* MSPM0 Sysconfig user's guide
* MSPM0G350x datasheet
* MSPM0L13xx datasheet
* MSPM0Gxx technical reference manual
* MSPM0Lxx technical reference manual
Timer module quick start

### Sysconfig Entrance for Timer Setting – MSPM0L Series

<table>
<thead>
<tr>
<th>Step 1:</th>
<th>Step 2:</th>
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<tbody>
<tr>
<td>TIMER - PWM (1 of 4 Added)</td>
<td>PWM_0</td>
</tr>
<tr>
<td>Name</td>
<td>PWM_0</td>
</tr>
<tr>
<td>Use Hardware</td>
<td>None</td>
</tr>
<tr>
<td>Selected Peripheral</td>
<td>TIM0</td>
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**Quick Profiles**

**Profile**

- Custom

**Step 2:**

1. Basic Configuration
2. Advanced Configuration
3. Interrupts Configuration
4. Event Configuration
5. PinMux Peripheral and Pin Configuration
6. Other Dependencies

### Sysconfig Entrance for Timer Setting – MSPM0G Series

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<td>TIM0</td>
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**Quick Profiles**

**Step 2:**

1. Basic Configuration
2. Advanced Configuration
3. Interrupts Configuration
4. Event Configuration
5. PinMux Peripheral and Pin Configuration
6. Other Dependencies
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• Bilibili
• 21IC