General Purpose Timers

on the Tiva C Series TM4C123x Cortex-M Microcontroller

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Overview and Key Features

- The General Purpose Timer Module (GPTM) has 12 total timers
  - Six 16/32-bit timers
  - Six 32/64-bit ‘wide’ timers
- Each timer has 2 associated Capture and Compare Pins (CCP) for PWM
- Can count up or down
- Timer clock inputs have prescalers
  - 8 bit prescaler for 16/32 bit GPTM
  - 16 bit prescaler for 32/64 bit GPTM
- Timer synchronization - start counting on the same clock cycle

Pin Assignments

- Pin mux in action - multiple pins able to be assigned to the same internal timer endpoint
- Two Capture Compare Pins for each timer
- Several timer pins broken out on our LaunchPad

Pin Name	Pin Number	Pin Mux / Pin Assignment	Pin Type	Buffer Type[a]	Description
T1CCP0	30 58	PF2 (7) PB4 (7)	I/O	TTL	16/32-Bit Timer 1 Capture/Compare/PWM 0.
T1CCP1	31 57	PF3 (7) PB5 (7)	I/O	TTL	16/32-Bit Timer 1 Capture/Compare/PWM 1.
T2CCP0	5 45	PF4 (7) PB0 (7)	I/O	TTL	16/32-Bit Timer 2 Capture/Compare/PWM 0.
T2CCP1	46	PB1 (7)	I/O	TTL	16/32-Bit Timer 2 Capture/Compare/PWM 1.
T3CCP0	47	PB2 (7)	I/O	TTL	16/32-Bit Timer 3 Capture/Compare/PWM 0.
T3CCP1	48	PB3 (7)	I/O	TTL	16/32-Bit Timer 3 Capture/Compare/PWM 1.
T4CCP0	52	PC0 (7)	I/O	TTL	16/32-Bit Timer 4 Capture/Compare/PWM 0.
T4CCP1	51	PC1 (7)	I/O	TTL	16/32-Bit Timer 4 Capture/Compare/PWM 1.
T5CCP0	50	PC2 (7)	I/O	TTL	16/32-Bit Timer 5 Capture/Compare/PWM 0.
T5CCP1	49	PC3 (7)	I/O	TTL	16/32-Bit Timer 5 Capture/Compare/PWM 1.
WT0CCP0	16	PC4 (7)	I/O	TTL	32/64-Bit Wide Timer 0 Capture/Compare/PWM 0.
WT0CCP1	15	PC5 (7)	I/O	TTL	32/64-Bit Wide Timer 0 Capture/Compare/PWM 1.
WT1CCP0	14	PC6 (7)	I/O	TTL	32/64-Bit Wide Timer 1 Capture/Compare/PWM 0.
WT1CCP1	13	PC7 (7)	I/O	TTL	32/64-Bit Wide Timer 1 Capture/Compare/PWM 1.
WT2CCP0	61	PD0 (7)	I/O	TTL	32/64-Bit Wide Timer 2 Capture/Compare/PWM 0.
WT2CCP1	62	PD1 (7)	I/O	TTL	32/64-Bit Wide Timer 2 Capture/Compare/PWM 1.
WT3CCP0	63	PD2 (7)	I/O	TTL	32/64-Bit Wide Timer 3 Capture/Compare/PWM 0.
WT3CCP1	64	PD3 (7)	I/O	TTL	32/64-Bit Wide Timer 3 Capture/Compare/PWM 1.
WT4CCP0	43	PD4 (7)	I/O	TTL	32/64-Bit Wide Timer 4 Capture/Compare/PWM 0.
WT4CCP1	44	PD5 (7)	I/O	TTL	32/64-Bit Wide Timer 4 Capture/Compare/PWM 1.
WT5CCP0	53	PD6 (7)	I/O	TTL	32/64-Bit Wide Timer 5 Capture/Compare/PWM 0.
WT5CCP1	10	PD7 (7)	I/O	TTL	32/64-Bit Wide Timer 5 Capture/Compare/PWM 1.

Overflow Periods of Prescaler Settings

- Time values assume 80MHz System Clock

16/32 Bit Timers

Prescale (8-bit value)	# of Timer Clocks (Tc)[a]	Max Time	Units
00000000	1	0.8192	ms
00000001	2	1.6384	ms
00000010	3	2.4576	ms
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11111101	254	208.0768	ms
11111110	255	208.896	ms
11111111	256	209.7152	ms

32/64 Bit Timers

Prescale (16-bit value)	# of Timer Clocks (Tc)[a]	Max Time	Units
0x0000	1	53.687	s
0x0001	2	107.374	s
0x0002	3	214.748	s
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0xFFFD	65534	0.879	10^6 s
0xFFFE	65535	1.759	10^6 s
0xFFFF	65536	3.518	10^6 s

Available Timer Modes

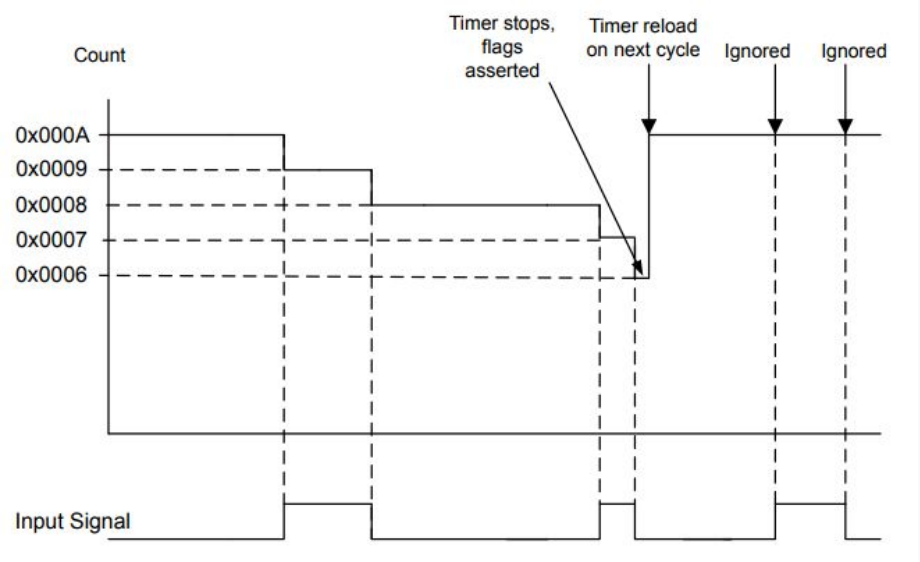
- One Shot/Periodic
- **Edge Count**
- **Edge Time**
- **PWM**
- RTC

Mode	Timer Use	Count Direction	Counter Size		Prescaler Size[a]		Prescaler Behavior (Count Direction)
			16/32-bit GPTM	32/64-bit Wide GPTM	16/32-bit GPTM	32/64-bit Wide GPTM	
One-shot	Individual	Up or Down	16-bit	32-bit	8-bit	16-bit	Timer Extension (Up), Prescaler (Down)
	Concatenated	Up or Down	32-bit	64-bit	-	-	N/A
Periodic	Individual	Up or Down	16-bit	32-bit	8-bit	16-bit	Timer Extension (Up), Prescaler (Down)
	Concatenated	Up or Down	32-bit	64-bit	-	-	N/A
RTC	Concatenated	Up	32-bit	64-bit	-	-	N/A
Edge Count	Individual	Up or Down	16-bit	32-bit	8-bit	16-bit	Timer Extension (Both)
Edge Time	Individual	Up or Down	16-bit	32-bit	8-bit	16-bit	Timer Extension (Both)
PWM	Individual	Down	16-bit	32-bit	8-bit	16-bit	Timer Extension

Edge Count Mode

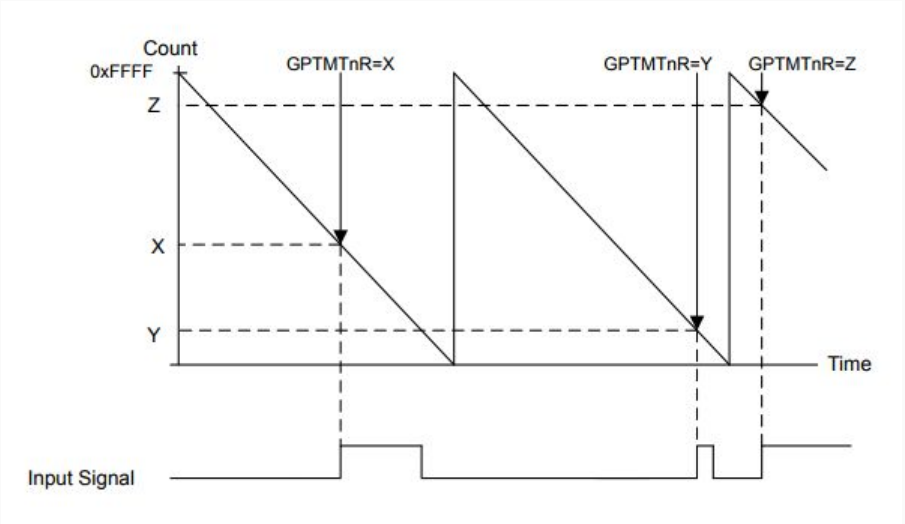
- **GPTMTnILR** =0x000A
  - Starting value to count up/down from
- **GPTMTnMATCHR** =0x0006
  - Match value to stop at

- Where n represents the timer number



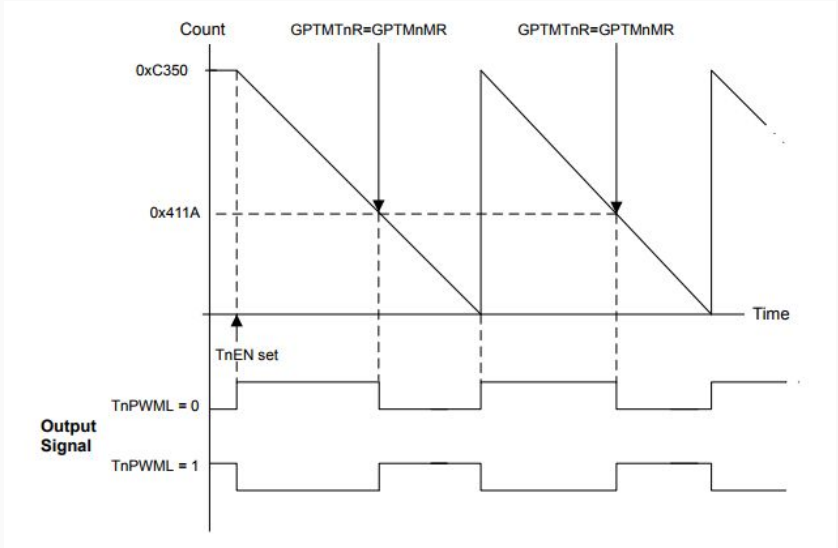
Edge Time Mode

Each time a rising edge event is detected, the current count value is loaded into the **GPTMTnR** and **GPTMTnPS** registers, and is held there until another rising edge is detected.



PWM Mode

- Choose certain operating frequency with prescaler
- Output pin is toggled on compare match
- Varying compare value changes duty cycle (pulse width) of the output PWM signal.



Example TivaWare API Calls

Main functions necessary to set up an edge counting timer module with corresponding interrupt handler routine.

```
ROM_TimerConfigure (TIMER4_BASE, (TIMER_CFG_SPLIT_PAIR | TIMER_CFG_A_CAP_COUNT));
ROM_TimerControlEvent (TIMER4_BASE, TIMER_A, TIMER_EVENT_POS_EDGE);
ROM_TimerLoadSet (TIMER4_BASE, TIMER_A, 9);
ROM_TimerMatchSet (TIMER4_BASE, TIMER_A, 0);
ROM_IntEnable (INT_TIMER4A);
ROM_TimerIntEnable (TIMER4_BASE, TIMER_CAPA_MATCH);
ROM_TimerEnable (TIMER4_BASE, TIMER_A);
```