

Lab Entry – 2026-01-31

Metadata

- Date: 2026-01-31
- Project: Off Grid Solar Battery Charger
- Board / Rev: Raspberry Pi Pico 1
- Scope: Figure paramters and equations needed to test PWM on Pico

Objective

Determine the parameters needed to implemetn the PWM on the Raspberry Pi Pico and equations to set desired PWM output.

Setup

Pico Parameters:

- We Will use the pwm.h file provided by pico C SDK
- System clock runs at 125 MHz.
- Let TOP be the value we count up to.
- phase-correct mode for PWM generation: where the counter starts to count downward after reaching TOP, until it reaches 0 again
- `pwm_clkdiv_mode = PWM_DIV_FREE_RUNNING`, which means: Free-running counting at rate dictated by fractional divider.
- `pwm_config_set_clkdiv()` set the clock divider value
- Note: we choose free running mode because: If the divide mode is free-running, the PWM counter runs at $\text{clk_sys} / \text{div}$.
- `pwm_set_counter()` is used to set the duty cycle.

Setting PWM Frequency:

NOTE: The PWM frequency is directly related to the TOP value. See Figure 1 for a quick visual reference.

The PWM period, denoted T_{PWM} in the phase phase-correct mode is: $[T_{\text{PWM}} = 2 \times (\text{TOP} + 1) \times T_{\text{clk}}]$

We can find a TOP value to generate 100 kHz signal by setting T_{PWM} to $10\mu\text{s}$, and solve for TOP (assuming clock is running at 125 MHz):

$$[\text{TOP} + 1 = \frac{T_{\text{PWM}}}{2 T_{\text{clk}}} = \frac{10 \times 10^{-6}}{2 \times 8 \times 10^{-9}} = 625]$$

Therefore we will set clock divider(PWM_CLK_DIV) to 1, and TOP to 624.

Setting PWM Duty Cycle:

Let **CounterCompareVal** be the value that set the PWM duty cycle (red line in Figure 1).

"Duty" = decimal representation of desired duty cylce percentage (Duty will be a float data type).

For the test, we will hardcode the Duty value we want. so 10% duty would be .1.

to set the desired duty cycle:

```
[ CounterCompareVal = TOP \times Duty ]
```

Pass CounterCompareVal into the pwm_set_counter().

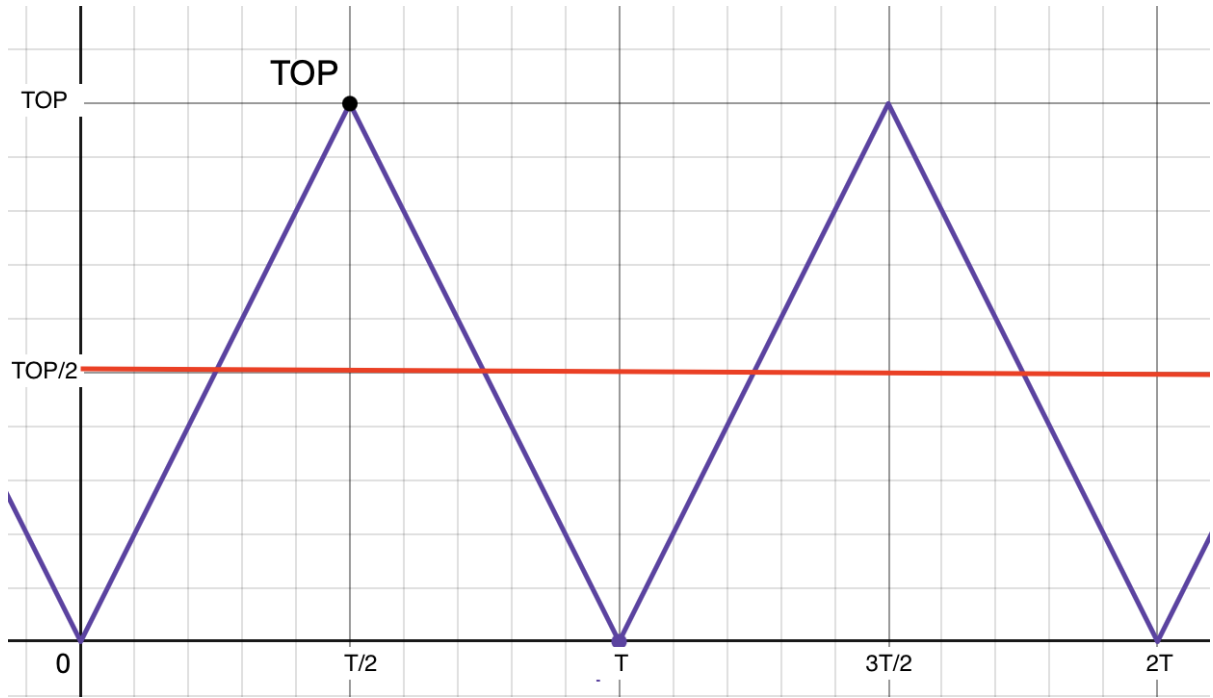


Figure 1: Visual of math used to set up PWM in phase corrected mode

Conclusions / Next Steps

Variable Name	Data Type	Value to use	Description	Pass to function pwm.h
TOP	Uint_16t	624	parameter to set PWM Frequency	pwm_config_set_clkdiv()
PWM_CLK_DIV	uint_8t	1	parameter to set PWM Frequency (how fast we count to TOP)	pwm_config_set_clkdiv()
CounterCompareVal	uint_8t	variable	compare value that sets pwm duty output	pwm_set_counter()
Duty	float	variable	parameter to set Duty cycle	N/A

Use these values, equations and functions in test_pwm.c file to generate a pwm output.

- GPIO can output 3.3V max, so at 50% we should expect to see 1.65 V. we can repeat this for multiple duty cycles. Use multimeter to verify this.
- We dont have an o-scope, so to verify the frequency, we will send the PWM signal to another GPIO pin and set an interrupt to occur on the rising edge of PWM. We will get the time stamp of this

interrupt and store it and then wait for another event to occur. We can calculate the period by subtracting the most recent time stamp from previous time stamp and then invert it to get the frequency. if this calculated frequency is reasonably close to the desired frequency we will consider the test successful.