EE 458-533

Experiment 1 : ADC and EPWM

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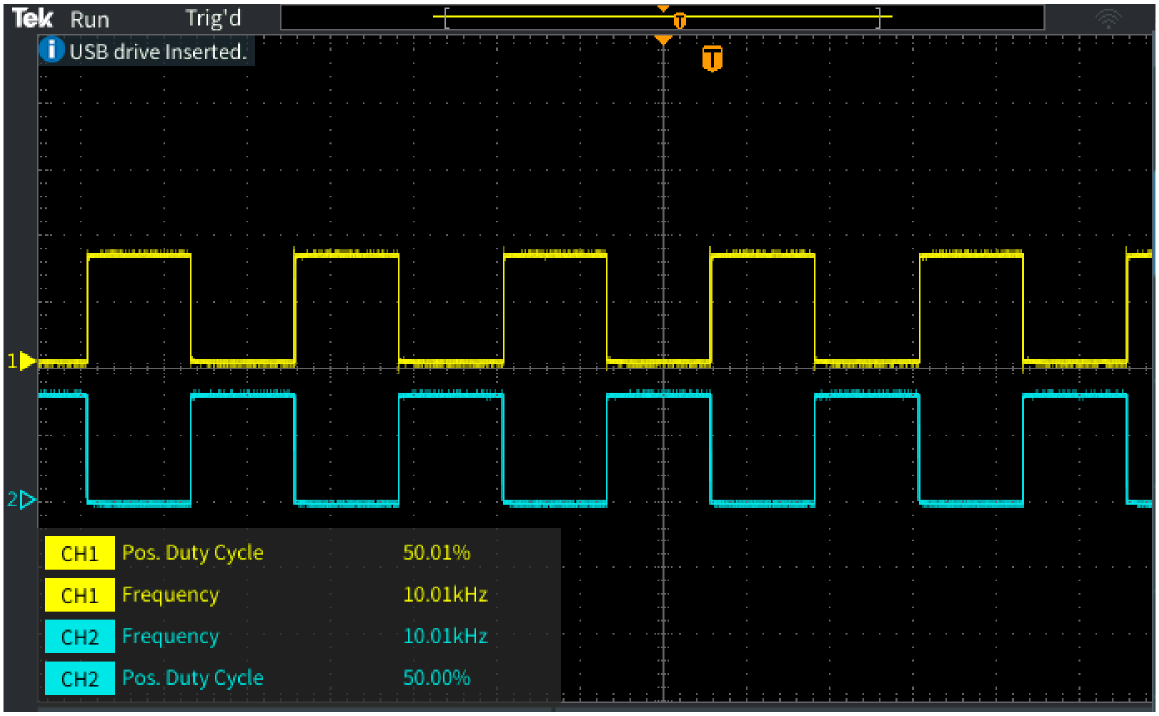
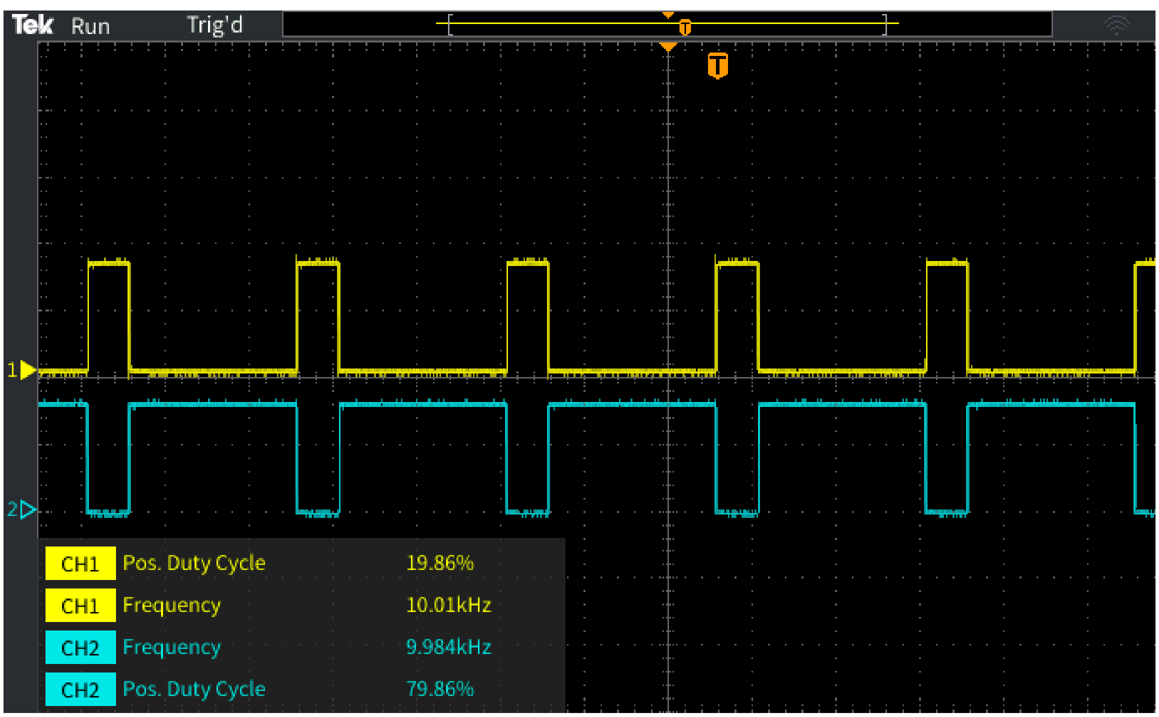
Section 3 - Task 4

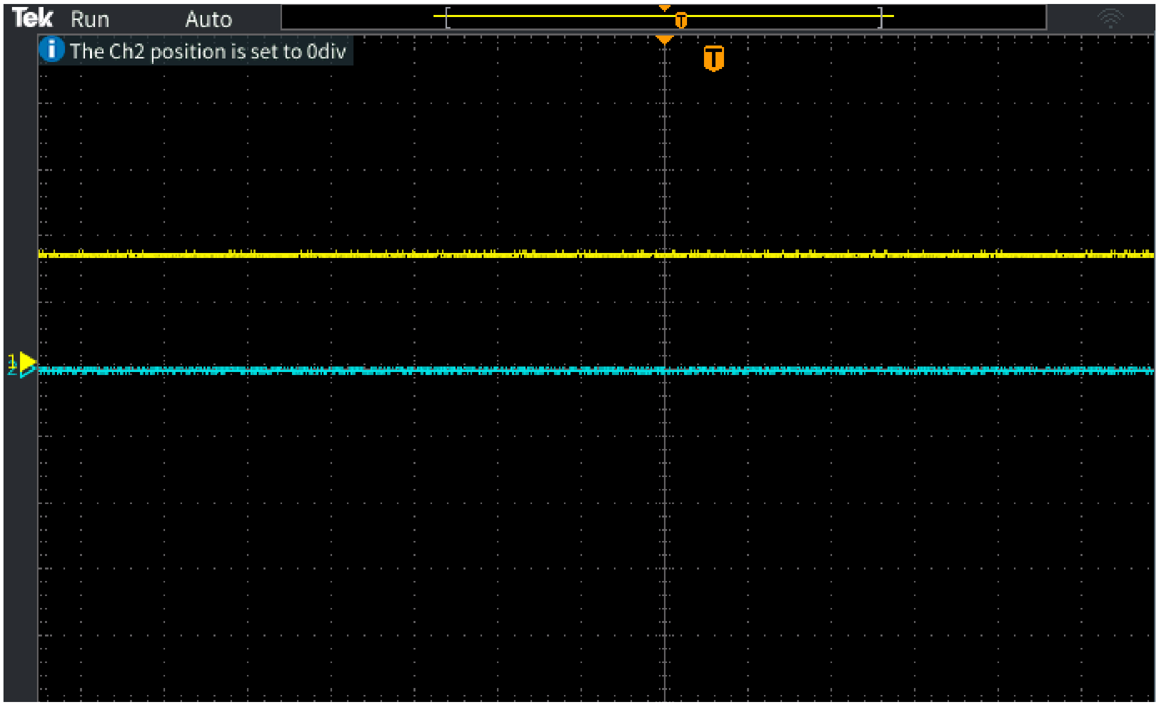
Record EPWM1A and B waveforms on the same capture for duty = 0.2, 0.5 and 1. (30pts)



EPWM1A & EPWM1B: 50% Duty Cycle at 10kHz



EPWM1A & EPWM1B: 20% Duty Cycle at 10kHz

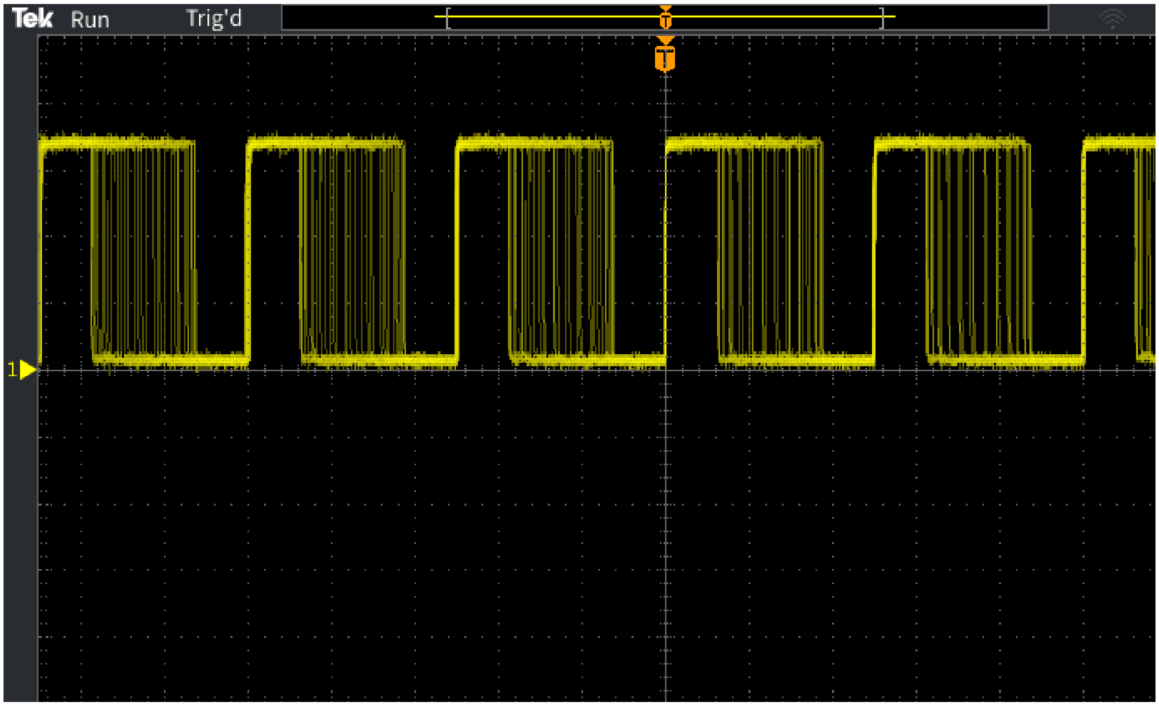


EPWM1A & EPWM1B: 100% Duty Cycle

The PWM signals show complementary behavior as expected. Note that at 100% duty cycle, PWMA is always on and PWMB is always off.

Section 3 - Task 5

Sinusoidally varying duty ratio: Set the CMPA register to achieve this sinusoidal duty ratio. Vary the value of the variable W_n and m and observe the PWM outputs.



EPWM1A: Modulating Duty Cycle [$m = 0.5$ and $Wn = 2\pi100$]

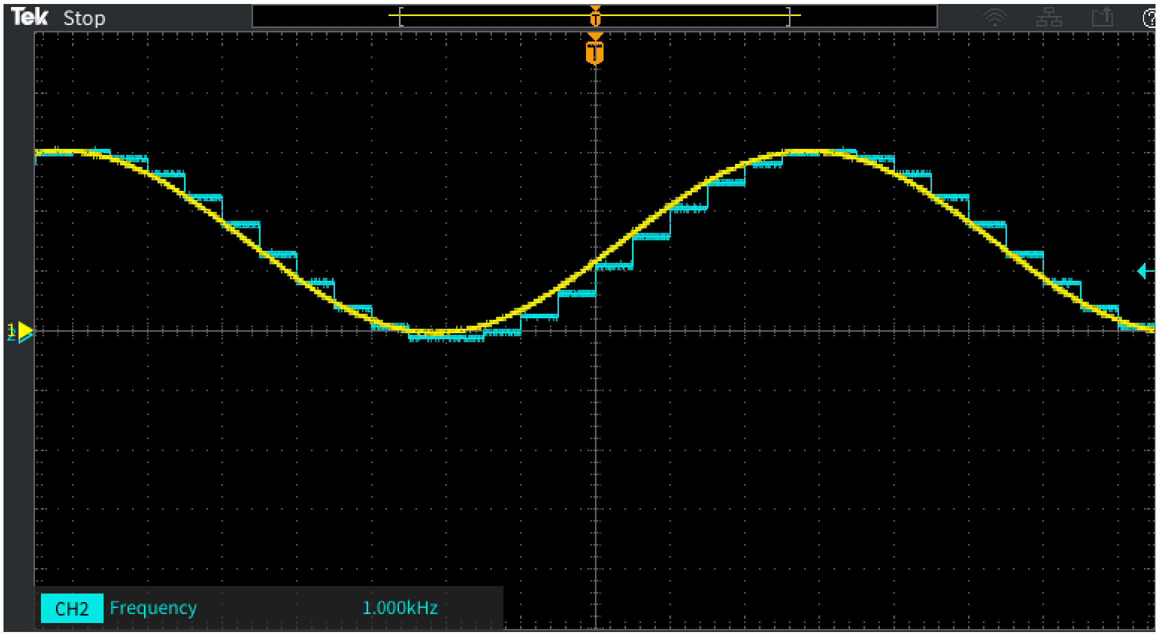
The CMPA register is updated to achieve this sinusoidal duty ratio. The PWM signal appears to be chattering, however the effect is due to the modulating duty cycle.

```
// Interrupt Call

Ts = 1/fsamp;
dt = dt + Ts;
if (0.5 * Wn*dt >= 2*pi){
    dt=0;
}
duty = 0.5*(1 + m*cos(0.5*Wn*dt));
EPwm1Regs.CMPA.bit.CMPA = duty * N_r;
```

Section 4 - Task 3

Do you see the exact same signal that you had input or is this different? Explain why/why not? Show a capture to prove this



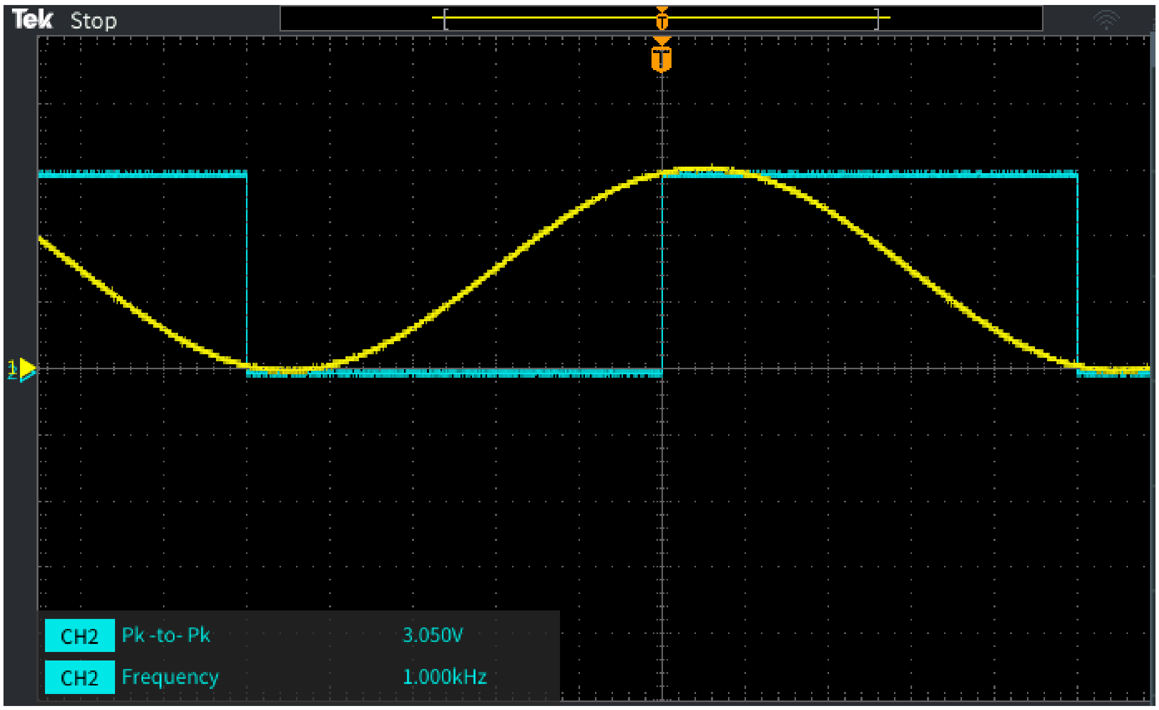
Blue: 3V, 1 kHz Sinusoidal Waveform Input
Yellow: DAC Sinusoidal Waveform Output

The output waveform achieves a similar approximation to the 3V, 1kHz sinusoidal input. It has distinct quantization steps that show the discrete measurements from a 20kHz sampling frequency. Because of the limited amount of N_{PWM} bits, there is an inherent quantization error.

Section 4 - Task 4

At what frequency does the output waveform seem to stop being an (approximately) exact replica of the input?

The output waveform from the microntoller stops approximating the input signal at the sampling frequency $f_1 = 2\ kHz$.

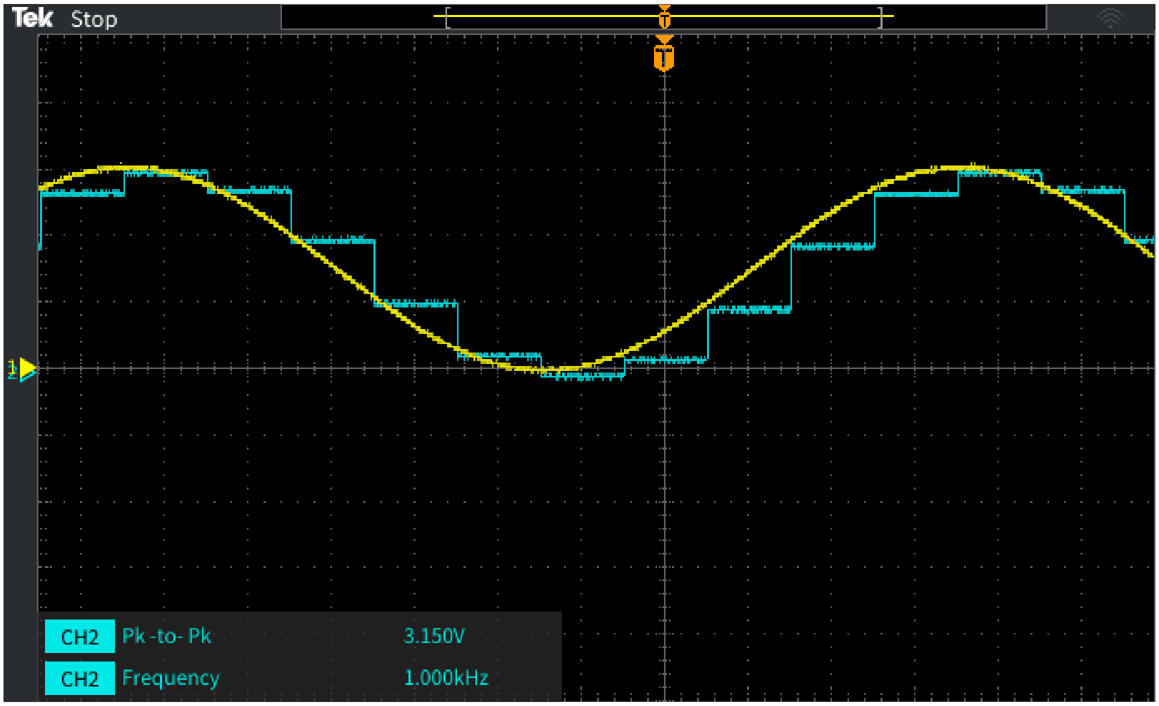


DAC Output: 3V, 1kHz Input and $f_{samp} = 2kHz$

Change the sampling frequency so that even at $5f_1$, the waveforms do overlap. Find the ratio of this sampling frequency to your original sampling frequency (20 kHz)

The ratio necessary such that the waveforms overlap is 0.5

$$ratio = \frac{5f_1}{f_{samp,\,original}} = \frac{5\ (2\ kHz)}{20\ kHz} = 0.5$$



DAC Output: 3V, 1kHz Input and $f_{samp} = 10kHz$

The nyquist theorem says, we can accurately represent a waveform (f) (a sinusoid at frequency of f_1) if we sample it at a frequency of $2f_1$ where $f_1 = f_{fundamental}$. Is it true in this case? Explain why or why not.

If we sample at a frequency of $2f_{fundamental} = 2\ kHz$, we can in fact accurately represent the waveform. At this sampling frequency, we are able to extract (i.e., sample) enough data from our sinusoide to be able to reconstruct it (i.e., reconstruct another sinusoide of the same amplitude and frequency).