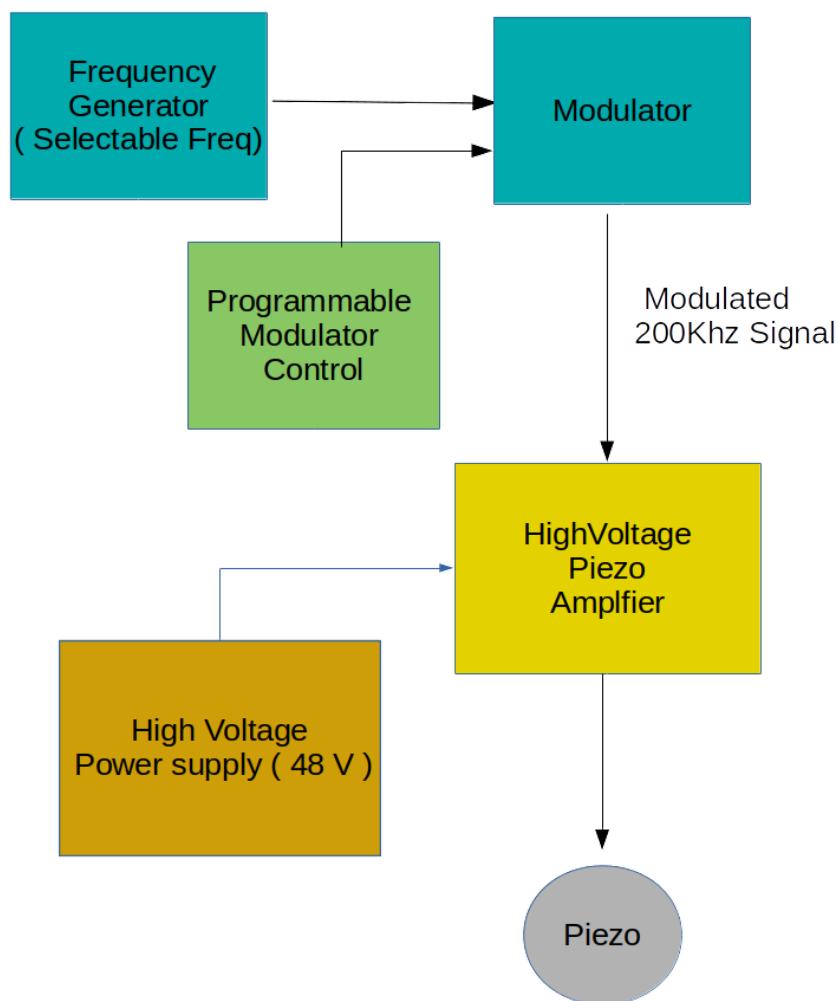


Scope of work:

Create a driver circuit which is capable of driving a Piezo transducer using a modulated control signal of frequency at ~200 KHz.

The modulation frequency is 500Hz with an ON time of 1 ms and OFF time of 1 ms.

Circuit blocks



Frequency Generator

This module is based on a digital DDS signal generator, which has an adjustable frequency dial and outputs a Sine Wave output. This requires a 9V power supply to operate and is provided by an AC switched mode adaptor.

Programmable Modulator Control

This module is implemented in a programmable Atmel controller which creates the modulation signal which is used to modulate the output of the Frequency Generator.

Modulator

The modulator is an MOSFET, which takes inputs from the Modulator controller and Frequency generator to produce a low voltage modulated signal, which is fed as input to the High Voltage Piezo driver.

High Voltage Piezo Driver

This module takes the low voltage modulated signal of approx 5-6V p-p and amplifies it to 41-44V peak to peak signal for driving the Piezo.

The High Voltage Piezo Driver is powered by a dual polarity power supply +/- 24V, which takes 230V as input.

Since the power output of the Piezo should be controlled, there is a gain control designed into the Driver which can be adjusted for fine-tuning during experimentation.

Power supply

The power supply is a dual polarity +/- 24V transformer based design. It takes in 230V input and Provides the power for the Piezo Driver



Drive Signal characteristics:

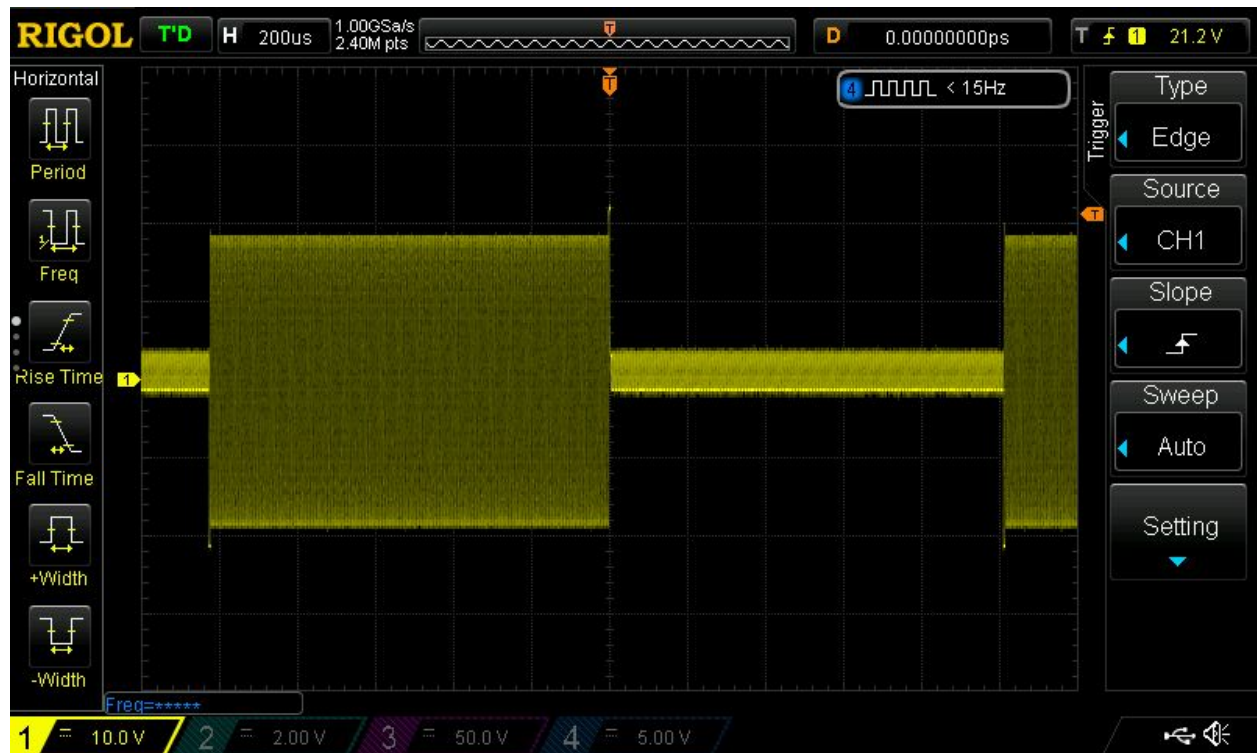


Fig: Modulated signal with ON time of 1ms

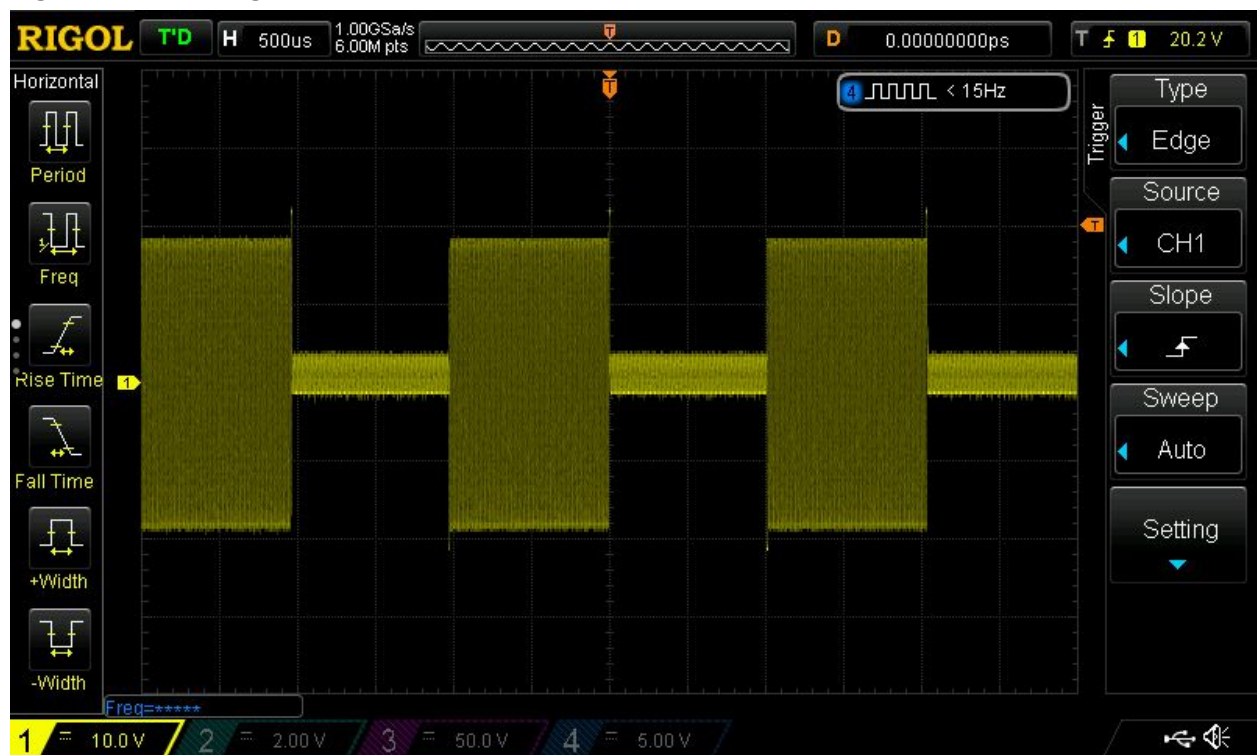


Fig: Modulated signal output from Piezo Driver with peak to peak voltage of ~44Volts

- The modulated signal is 42-44V peak to peak
- Modulation frequency is 500Hz

Design Notes:

The Piezo output power measured (ISPPA) cannot be measured and approximations of the same was based on 2 papers listed below:

<https://www.sciencedirect.com/science/article/abs/pii/S1350453315000235>

<https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0178476>

The data from the papers for the power drive required was contradicting and attempts to contact the authors were not fruitful.

Hence, the approach to design a Driver Circuitry, which can be scaled to operate up to 350V supply, was taken. Also, a variable gain knob is designed into the driver to allow fine control of the Piezo output.

Due to procurement difficulties, a power supply of 48V (the max available from digikey in NZ) is used in this test setup.

If it's found from experimental data that the power output needs to be increased, it should be straightforward to swap the power supply for a higher voltage one to achieve increased power.

Important:

1. The Piezo Driver power supply is a transformer based setup and needs 230V input