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Objective:

Create an RLC through-metal transmitter circuit with a voltage switch amplifier and a resonant frequency of 500 Hz.

List of Documents:

Sequence of 11111 at 500 Hz code

Sequence of 11111 at 250 Hz code

Sequence of 11111 at 1000 Hz code

Sequence of 101010 at 250 Hz code

Sequence of 101010 at 500 Hz code

Sequence of 101010 at 1000 Hz code

Voltage Switch Amplifier data sheet

Voltage Switch Amplifier Quick Start Guide

Inverter chip Data Sheet

Random 1 and 0 bit code

System overview:

Diagram

Description automatically generated

Materials and equipment:

Computer/laptop

Arduino Mega 2560

Breadboard

Wires (male – male)

Wires (male – female)

SN7404N Inverter Chip

LEDs (optional)

Voltage Switch Amplifier

Alligator Clip Wires

Alligator to Banana Wires

Oscilloscope

2 Power supplies

two 3.3 F Capacitors

2.2k Resistor

Inductor Wire Coil

Set Up Procedure:

First, upload the code for either a sequence of 101010 or 11111. The frequency used will depend on the delay time in the code. In the code, pin 11 is used as the output on the Arduino microcontroller. The next step is to invert the signal. On the breadboard, connect pin 11 to channel 1 on an oscilloscope. Then connect pin 11 to an inverter chip and channel 2 on the oscilloscope to the output of the inverter. Make sure that 5V and Ground are properly connected to the inverter and circuit. Verify that the signals are inverted and perfectly synchronized. Next, connect the voltage switch amplifier to the Arduino through the breadboard connections. On the Amplifier, INA connects to pin 11, INB connects to inverter output of pin 11, VCCI is connected to 5V, Ground is connected to Ground, and Disable is connected to Ground. The connection of the LEDs are completely optional, they are only used as visual indicators that circuit is properly connected. The first LED is connected to pin 11 and the second is connected to inverter output. After the Arduino is properly connected, start connecting the power supplies. It is recommended that you have 2 separate power supplies. On the Amplifier, connect the VCCB to power supply 1. Then connect the Ground of the amplifier (Ground B) to power supply 2. If you are viewing the result on an oscilloscope, connect the ground of the oscilloscope directly to Ground B as well. Next, connect the input drain source to the same power supply (power supply 2) as Ground B. After this create another circuit with a 2.2k Resistor and two 3.3 F Capacitors in parallel all to each other. Then connect the Output drain source and Output Ground A to the same input of the resistor and capacitors. The two outputs must be connected to the same input or else you will not receive the correct result. Connect oscilloscope input to the last capacitor. You should see an amplified square wave. The frequency of the signal is dependent on the delay time used in the code. The peak to peak voltage is dependent on the input voltage. The greater the input voltage, the greater the Vpp. Next, connect the wire coil in series to the capacitor. The wire coil will act as an inductor and turn the square wave into an amplified sine wave. The circuit is now complete and the signal is being transmitted by the inductor wire coil.

Results:

* A sequence of 11111111 with a delay time of 1 millisecond has a frequency of 500 Hz
* A sequence of 10101010 with a delay time of 1 millisecond has a frequency of 250 Hz
* Circuit has a Resonant Frequency of 506 Hz
* Circuit has a total capacitance of 6.6 F
* Inductive reactance is 47.12
* Capacitive Reactance is 47.12
* Inductance value of 15 mH
* Signal is able to be transmitted by the inductor wire coil to receiver.
* The larger the distance between the transmitter and receiver, the weaker the signal, larger input voltage is required.
* Vpp is dependent on input voltage, greater input voltage, greater Vpp value