Avalanche Transmitter User Manual

Program Setup

1. Download the Arduino IDE. This will be needed to upload the code to the Adafruit Trinket Pro. (https://www.arduino.cc/en/software)

2. Install and update (if needed)

3. Open Arduino

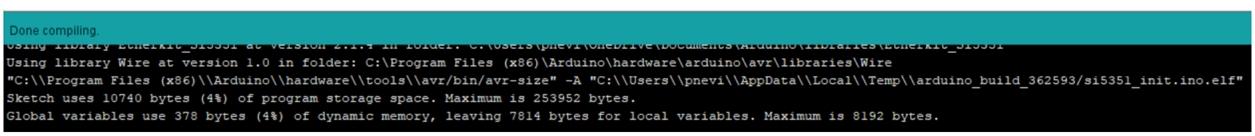
4. Connect the Adafruit Trinket Pros USB cord that came with it, from the Trinket to one of the USB ports on your PC

4. Copy the given code from the “AdafruitTrinketCode” file into the Arduino IDE window that is open

5. Now add the libraries for the SI5351. To do this, go to Sketch > Include Library > Manage Libraries… Search for and install: Etherkit SI5351.

6. Now go to Tools > Port: … This should be connected to your USB port, so it should be on any COM with a number. Select that one. It is different for each USB port on your PC.

7. Next, press the check mark to verify the code is correct. If there are no



errors, after compiling the sketch, you should see:

8. Next, if you see Done Compiling with a similar message about memory, press the upload code button . This may take a few minutes. You will see messages in red and scrolling text. When you see “Done Uploading” in place of “Done Compiling” on the IDE, you are ready to go. Now you can unplug your Adafruit Trinket Pro, and anytime you turn it back on, it will run the setup code we just uploaded. This setup code will program the SI5351 to produce a 457kHz square wave that is required for the Avalanche Transmitter to receive the signal. At this point, you should be able to receive the signal from the newly made transmitter, by your avalanche transceiver. If you are not picking up a signal, there was either an error that was missed while uploading the program to the Arduino Trinket, or there is a defect in one of the solder points made in

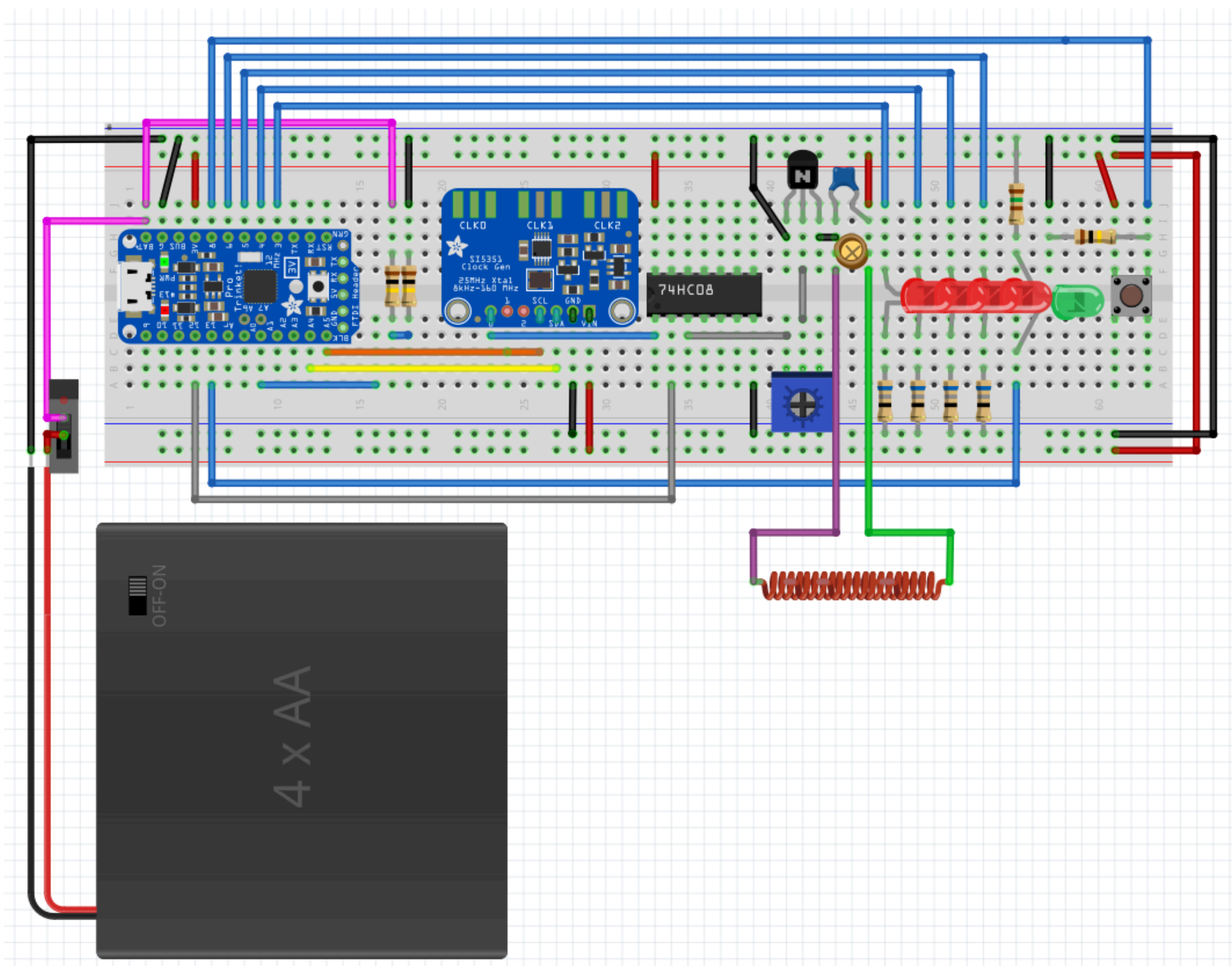
the previous steps. Double check all of the solder points and start over at Step 1 of the "How to program" section.

Breadboard/Protoboard Setup

Connect all components as shown in the diagram below. Using a breadboard is an excellent way to verify the layout and ensure component functionality. For a more secure and field-ready product, you can use a soldered protoboard. The diagram applies to both setups. Additionally, a PCB prototype version is available on GitHub and can be found in the appendix. Following either this diagram or the circuit schematic will yield the same results.

An extra switch is optional and can be used if mounting the case upside down to allow access to the batteries or if the battery pack does not include a switch.

The Fritzing file and a higher-quality image are available on GitHub.

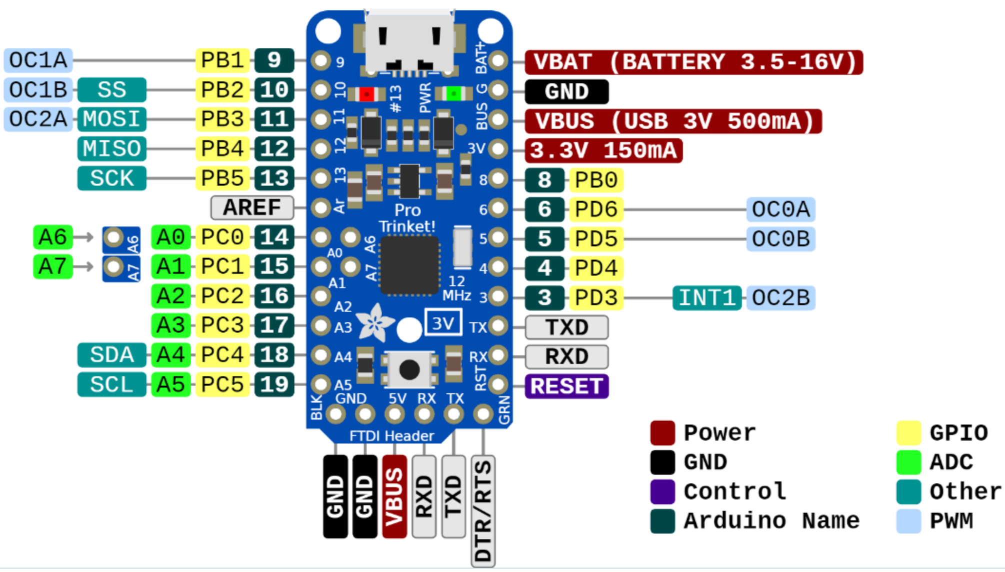


Adafruit Pro Trinket - 3V 12MHz

The trinket board is used to generate the required duty cycle, i.e. how frequent and long the “beeps” coming from the transmitter are. It also requests a particular signal frequency of 457 KHz from the frequency generator. Lastly, it operates the LEDs that indicate the battery charge and the optional switch to establish power supply to the rest of the circuit.

The pin that generates the duty cycle is Pin 12. This pin is connected to the AND gate, which performs a logical AND function on the duty cycle signal and the 457 KHz frequency signal, so that the 457 KHz frequency is toggled on and off.

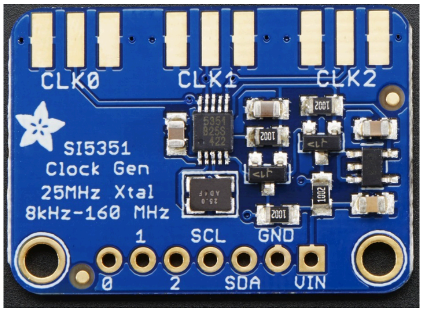
The SDA and SCL pins are connected to the SDA and SCL pins of the frequency generator. Pins 3, 4, 5, 6, 8 and 13 are connected to the battery indicator LEDs and the button that toggles the 3V supply to the rest of the circuit.Pin 20 reads the analog value from the batteries to determine the battery charge.



Adafruit Si5351A Clock Generator

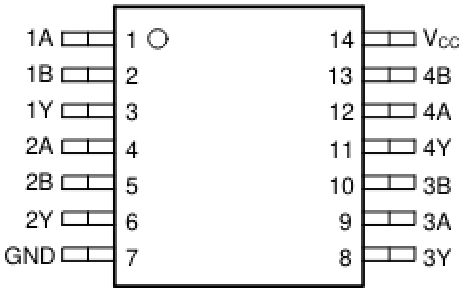
The clock generator outputs a consistent signal of 457 KHz. The programmed pin that outputs the signal is Pin 0. It is denoted as “1” on the schematic. This pin is connected to the AND gate, where it’s AND’ed with the duty cycle from the Trinket board.

The SCL and SDA pins are connected to the SCL and SDA pins of the Trinket.



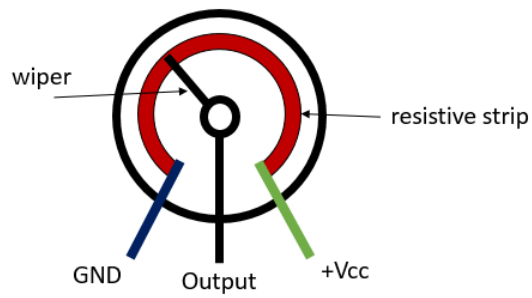
AND Gate

The AND gate used in this design is SN74HC08AN, but any other component that implements the AND function can be used. This component has 4 AND gates, so it can be swapped for a more compact component. The input pins of an AND gate are generally denoted as “A” and “B”, e.g. 1A and 1B for the design described in this manual. ANd output pins are denoted as “Y”. Reference the datasheet for the selected component to identify which pins of the physical package correspond to the inputs and output. For this design, the two input pins are 1 and 2, and the output pin is 3.



Potentiometer

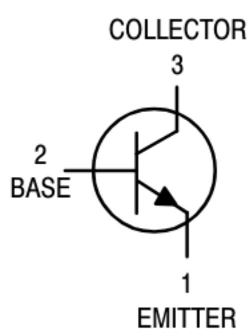
Potentiometers come in different packages. The potentiometer used for this design is 3296W-1-103, which can go up to 10 KOhm. It has a layout of three pins that go in the same row and fits well on a breadboard. When using a potentiometer, connect either of the outer pins to the input and the middle pin to the output. Make sure to ground the other outer pin.



Transistor

The transistor used in this design is 2N3904 - K51. This is a three pin NPN transistor. The pins are 1 - emitter, 2 - base, 3 - collector. When current is applied to the transistor base, it enables current from the collector to the emitter.

The collector pin (3) needs to be connected to the power supply through the antenna part of the circuit. The emitter pin (1) needs to be grounded. The base pin (2) need to be connected to the output from the potentiometer.



As the potentiometer is adjusted, it would range output resistance from 0 to 10 KOhm, which in turn would range the current to the transistor base.

The relationship between the base current and the collector-emitter current is defined by the formula below:

$I_{C \to E} = \beta \times I_B$

β is the scaling factor. For example, if current to base is 1 A and β is 10, the current through the transistor is going to be 10 A, actual possible values are provided in the transistor datasheet.

For the transistor used in this design, the scaling factor varies from 30 to 60. The design includes the potentiometer to adjust the base current which in turn changes the collector current and, consequently, the strength of the magnetic field the antenna generates.

Antenna

The ferrite rod used will be an uncoated 70mm length by 9.50mm width diameter height. The coils used will be a 36 AWG anamolized wire, and a 10pf capacitor.

To make the antenna you will need to use a mechanical counter to wrap the wire around the ferrite core. Wrap the wire around the core several times before you start so you have two leads when you are done wrapping the wire. Spin the mechanical counter about 500 with a coil length of about 3.5 inches across. Once you finish spinning the antenna you will detach the antenna from the spool and hand wrap the wire for your leads. After the antenna is built and measured add the capacitor to the board you are using in parallel with the antenna