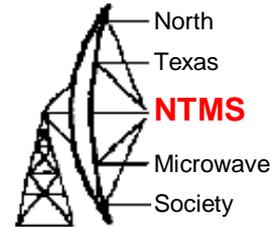


Using a breadboard to test a project

KM5PO – Jim McMasters

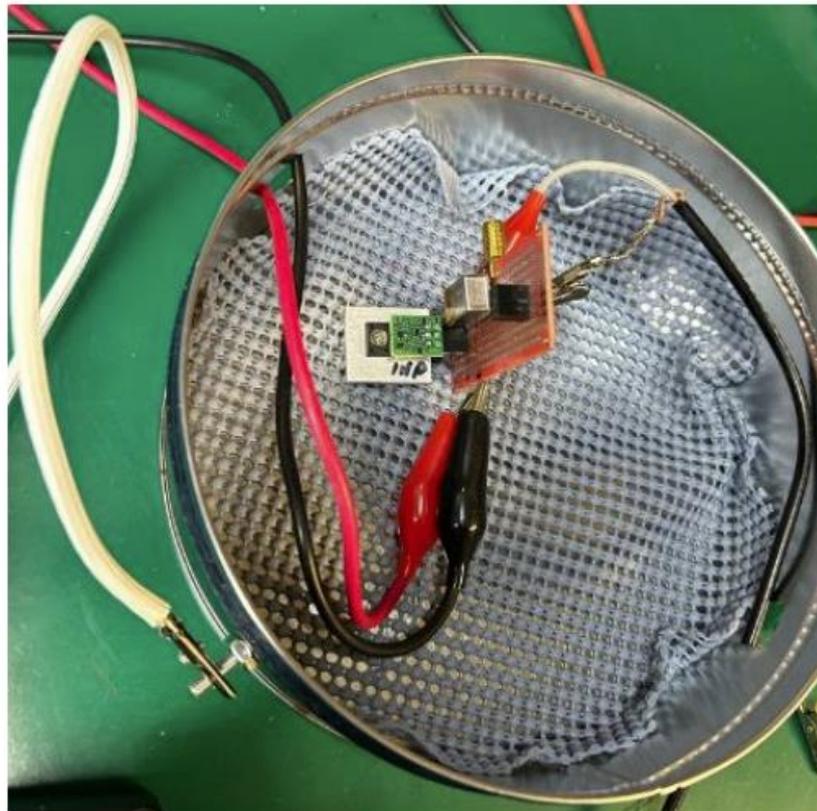
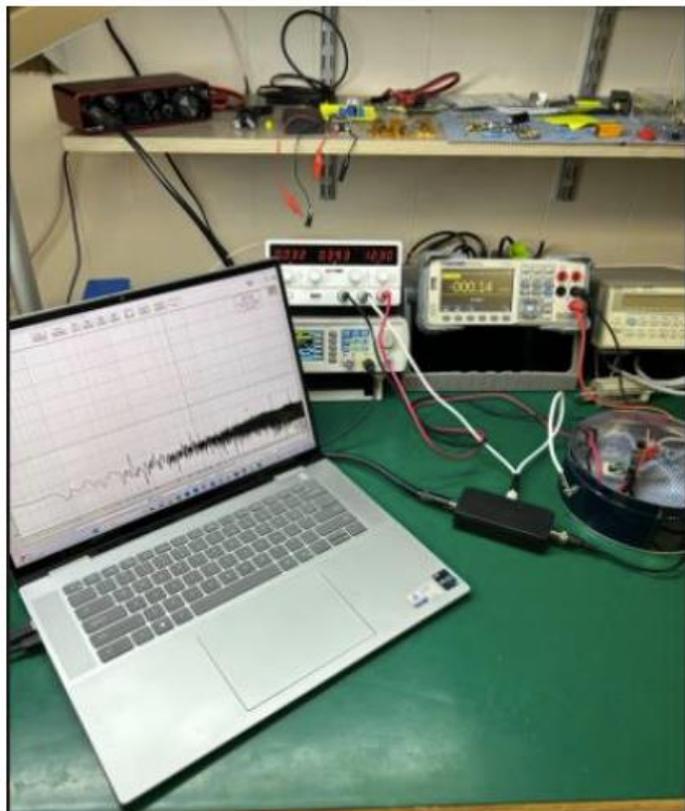
Breadboard features



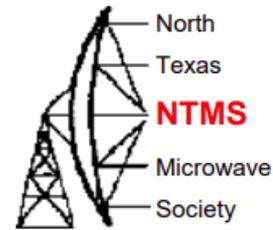
- Does not require soldering
- Build-up of parts is relatively fast
- Changing connections is easy
- Letting the smoke out is easy too
- Many projects such as basic DC
- Arduino and Raspberry Pi projects
- Be aware of the antennas in the breadboard

In the shop

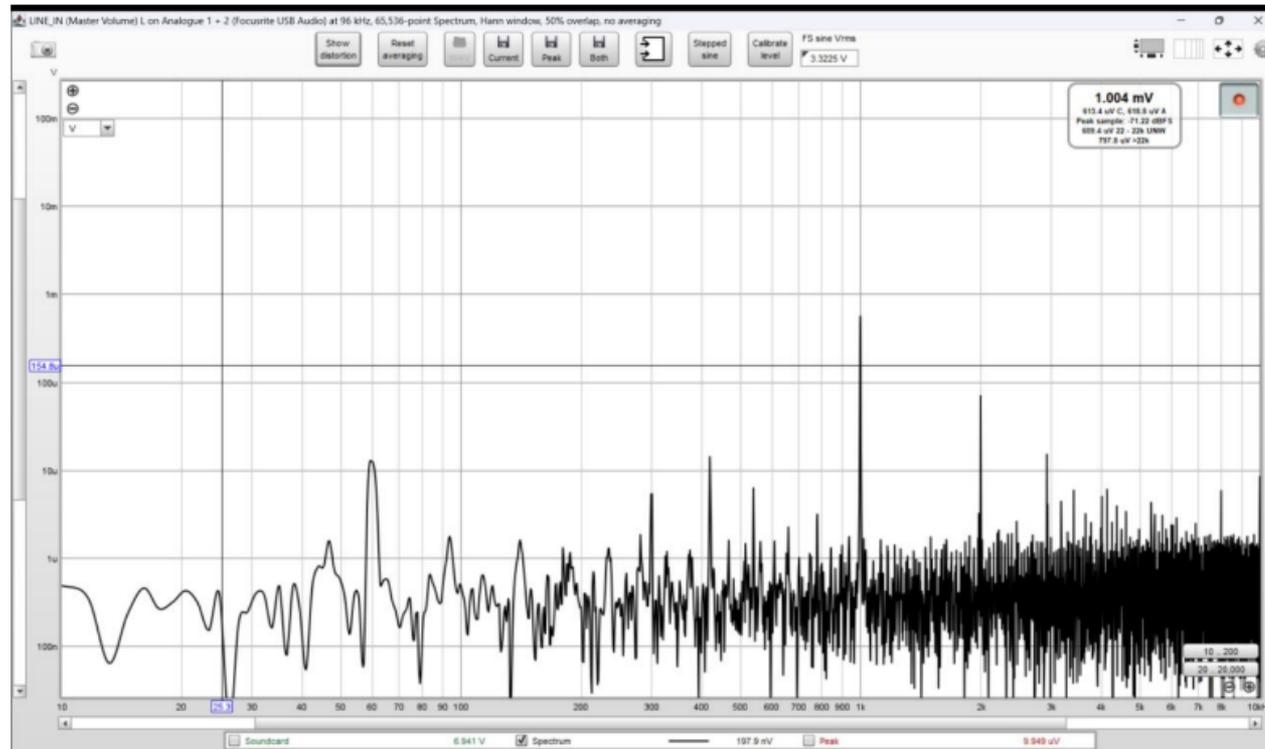
Ready to measure



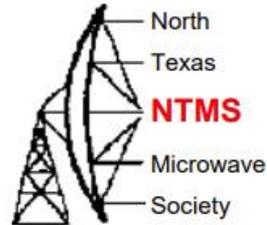
Noise measures



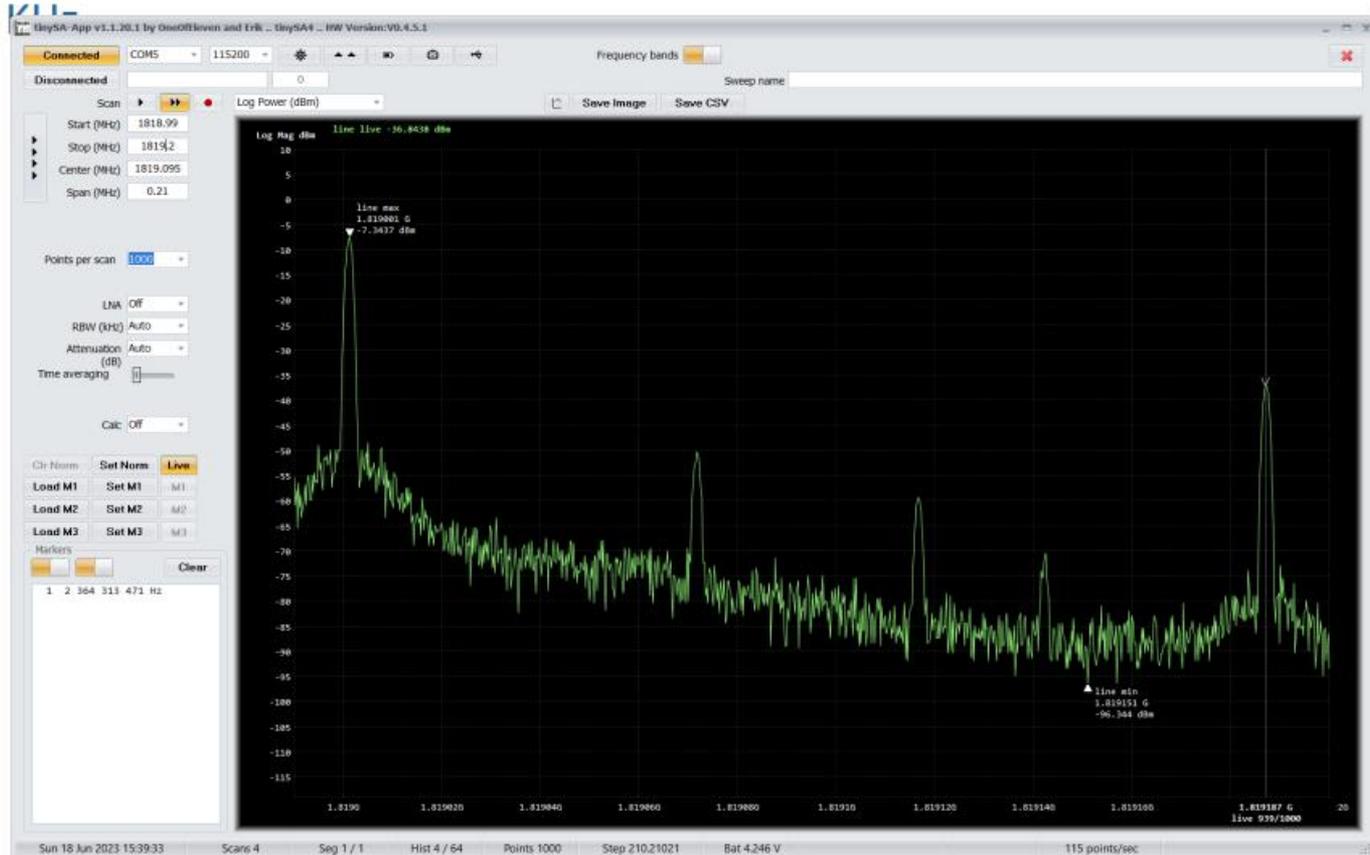
Calibrated system – laptop powered 6-10-23
Measurement of 1 KHz at .001v (1 mV) in the tin can



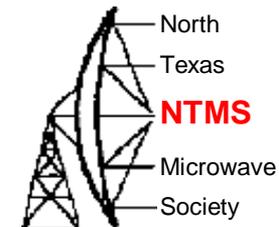
Spectrum effects



Wavelab 1819 MHz LO - McCoy 10 MHz OCXO (12 vDC) sharing PDU with 24 GHz system (uses XL4016 buck conv) – spur is -37 ~+184

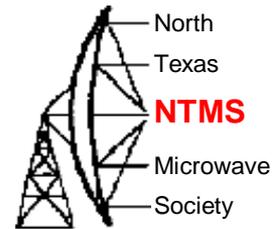


Breadboarding usage



- Prototyping
 - Testing all new design
 - Iterate between schematic/board
 - Verifying behavior
 - Other soldered circuit is broke?
- Making a temporary solution
 - You need something for a few days/weeks- laser transmitter (2017)

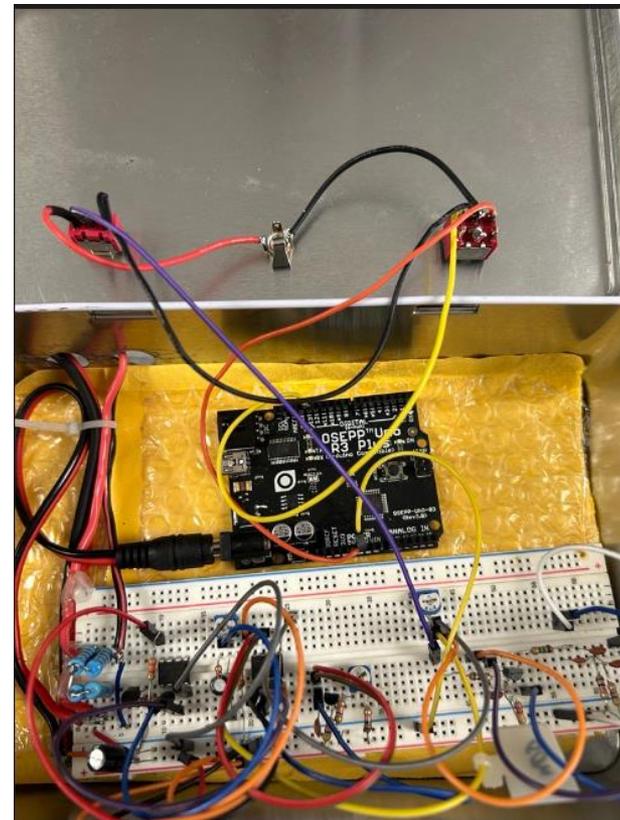
Laser transmitter 2017



- Holds a 17 mile record from Cedar Hill to Alvarado

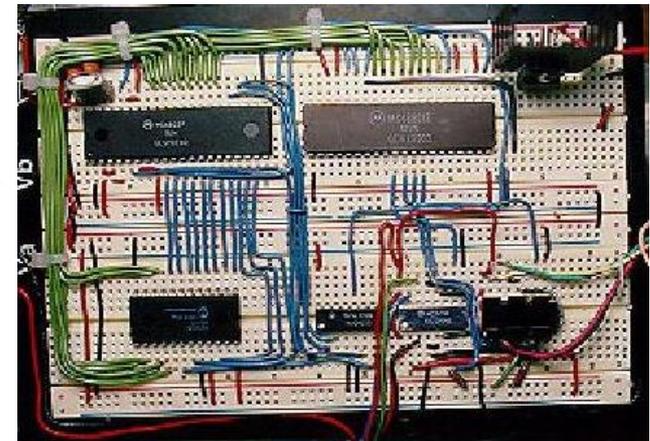
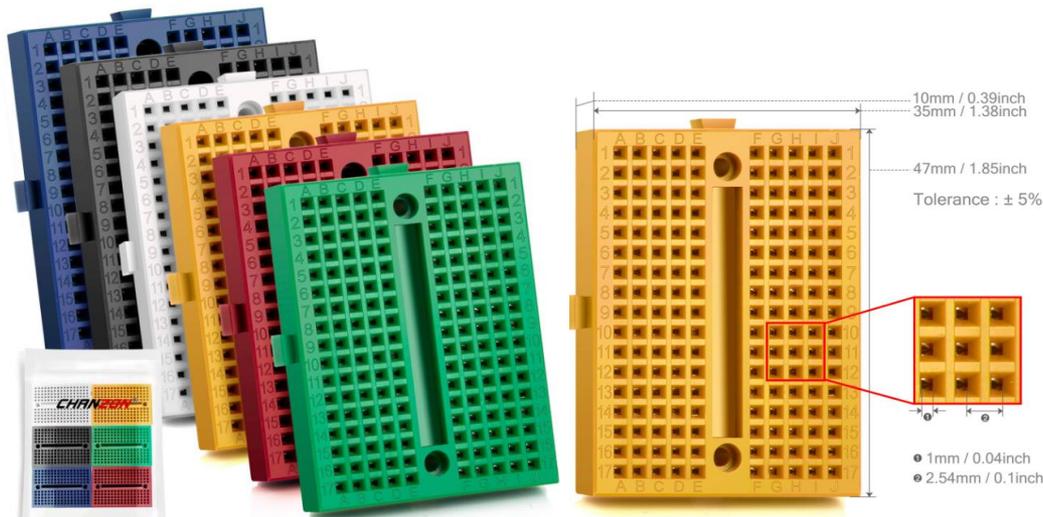


PWM modulated transmitters built in small tin boxes

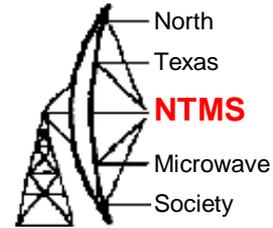


Breadboarding basics

- All sizes, shapes and even colors
 - Bigger, Big, Small, Tiny
 - Most can be daisy chained

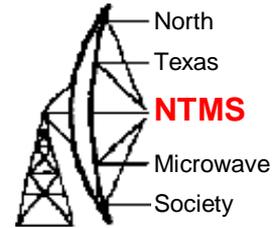


Breadboarding basics



- Powering the board
 - Plug in power supply module \$10 bucks
 - External supply
 - Bench PSU
 - Battery – plus dc-dc converter
 - Portability needs?
 - Solar – NTMS future beacon controller prototype will be built on breadboard

Breadboarding basics

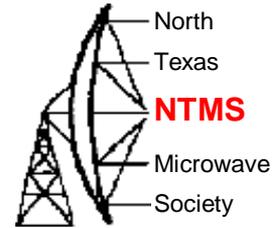


- Plug in power supply module

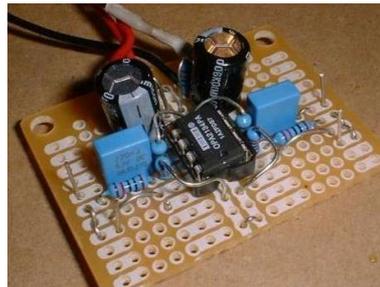


9 v AC-DC power supply
 3.3v or 5v reg pin selectable
 Power via USB
 Power by 9 v battery
 Different voltages or zero via rails
 On/off switch
 Built test leads with banana
 For < 700 ma use

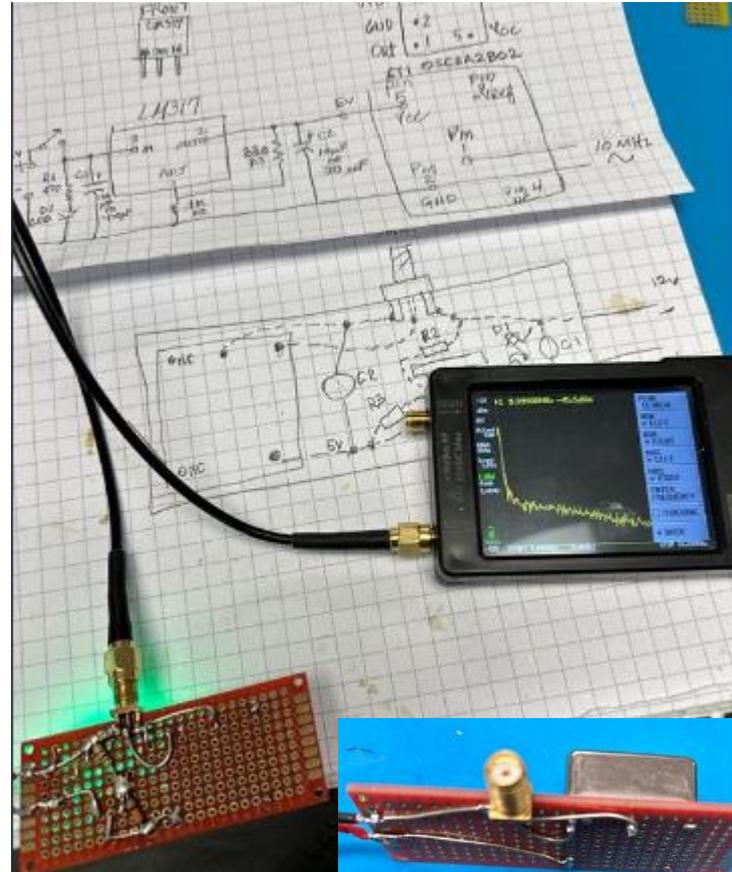
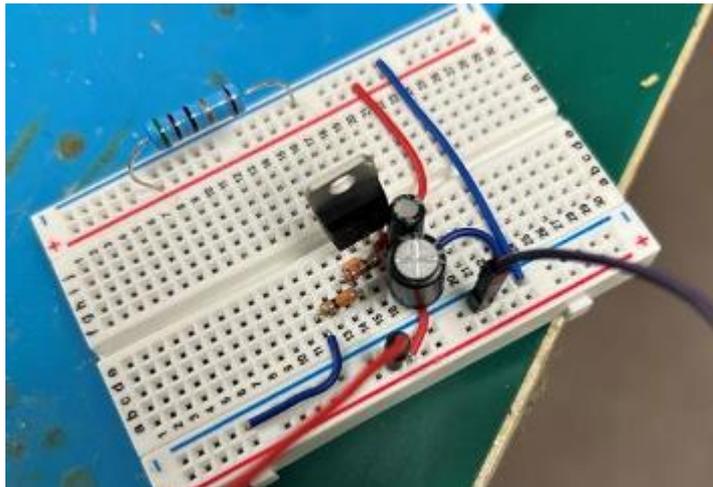
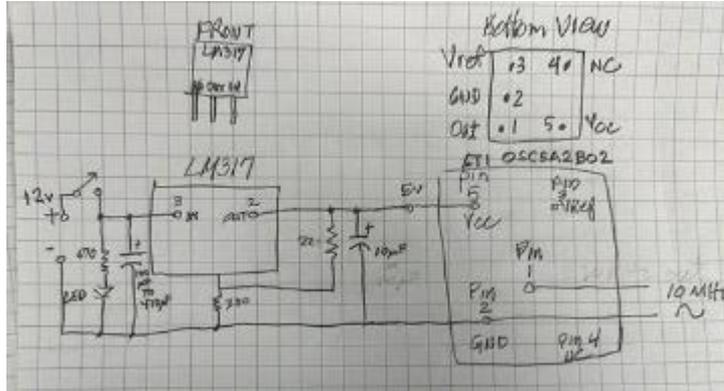
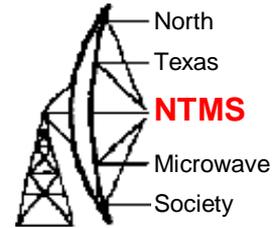
Breadboarding basics



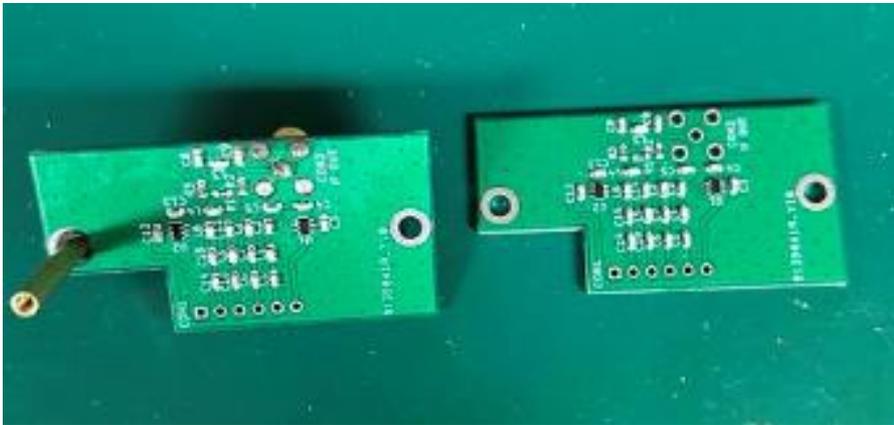
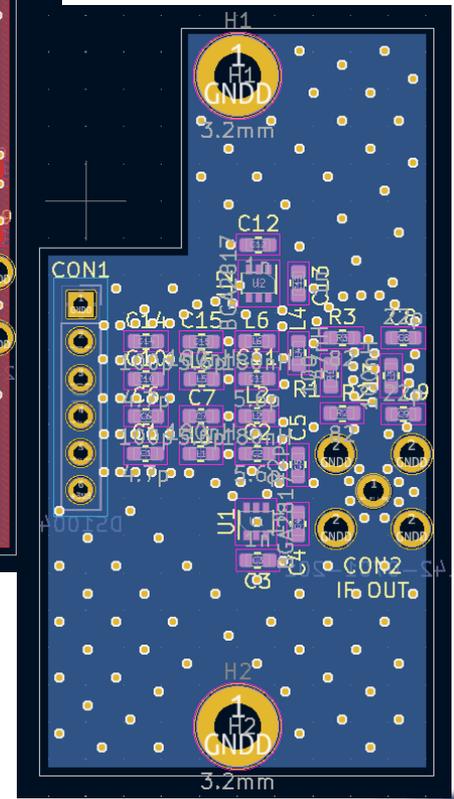
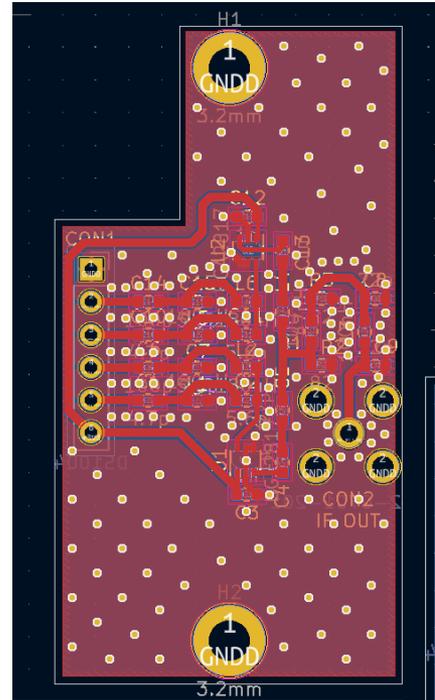
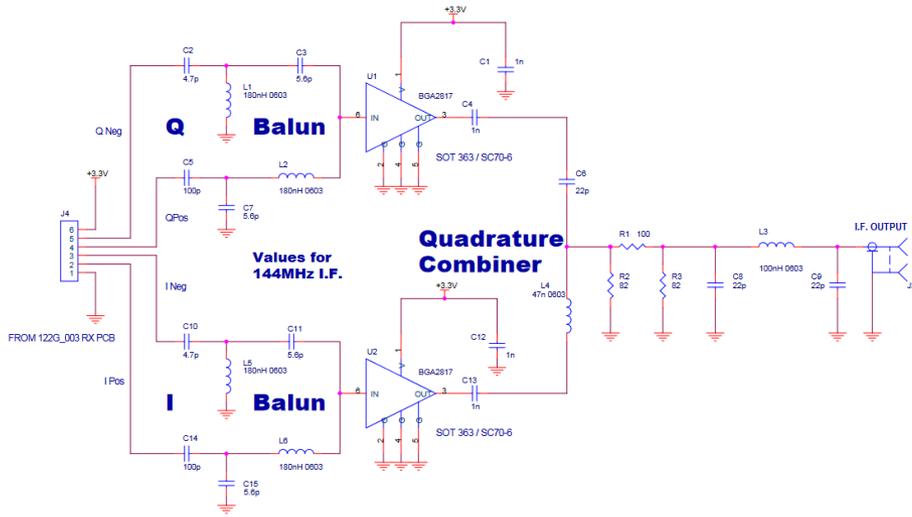
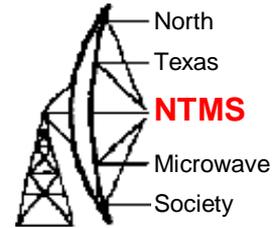
- Sketch a schematic by hand
- Test/improve the circuit on the breadboard
- Create schematic using tools for sharing
- Build a permanent circuit
 - Perfboard
 - Or...
- Export schematic for gerber, position, bom files. Use PCB manufacturer



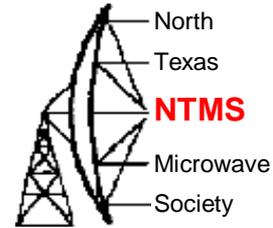
Breadboarding basics



"Kicad" schematics/PCB manufactured



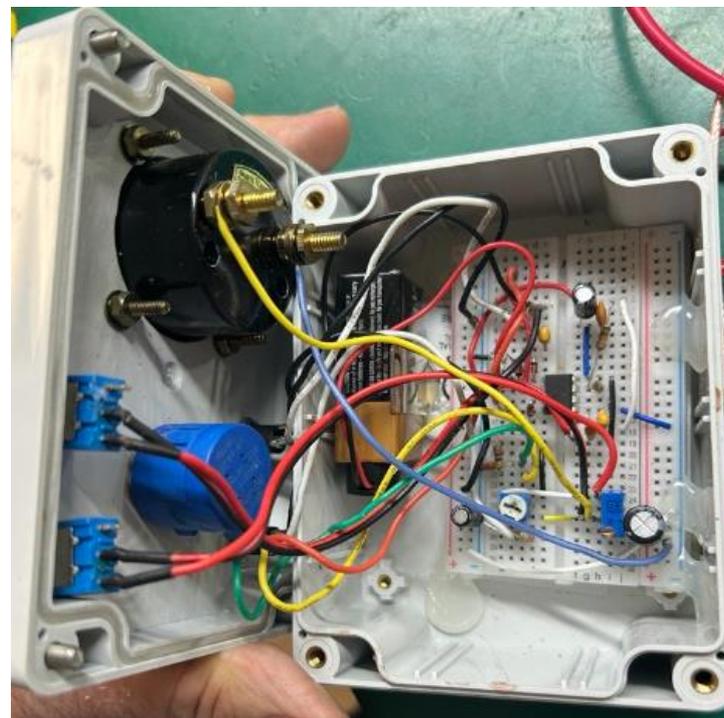
Some project examples



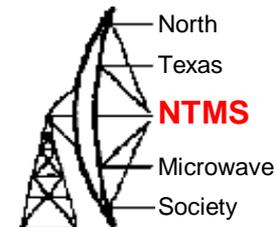
- Audio meter
- LED transmitter
- Waveguide transfer switch controller
- Sequencer MOSFET drive tests
- Wavelab 24GHz board part replacement
- Wavelab 24GHz board part failure?

Some project examples

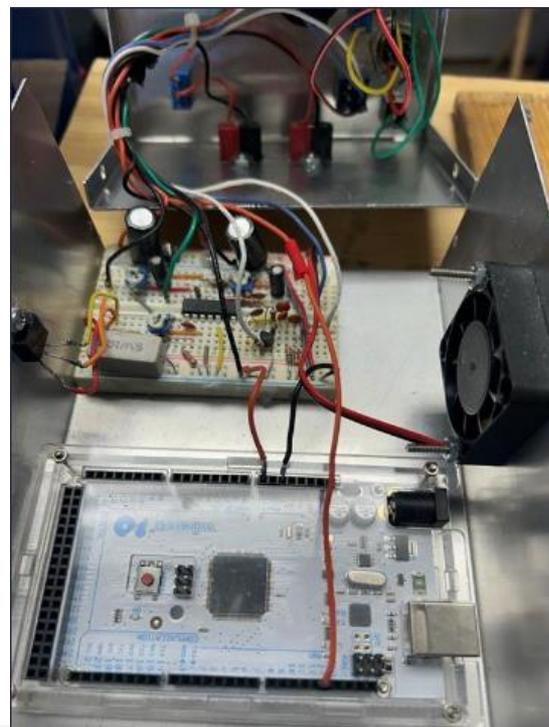
- Audio meter



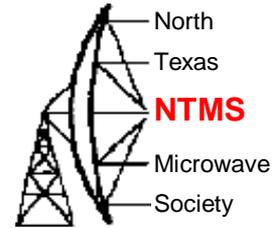
Some project examples



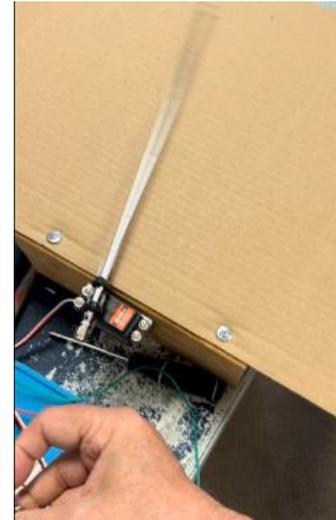
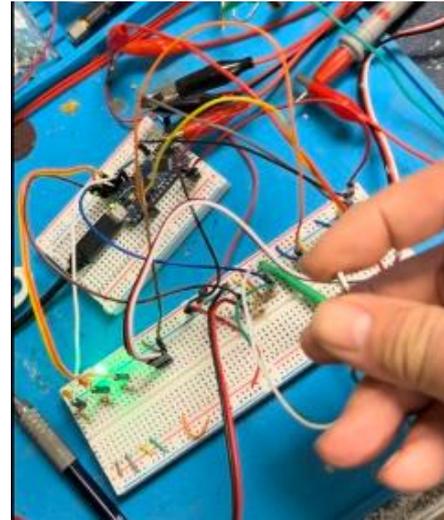
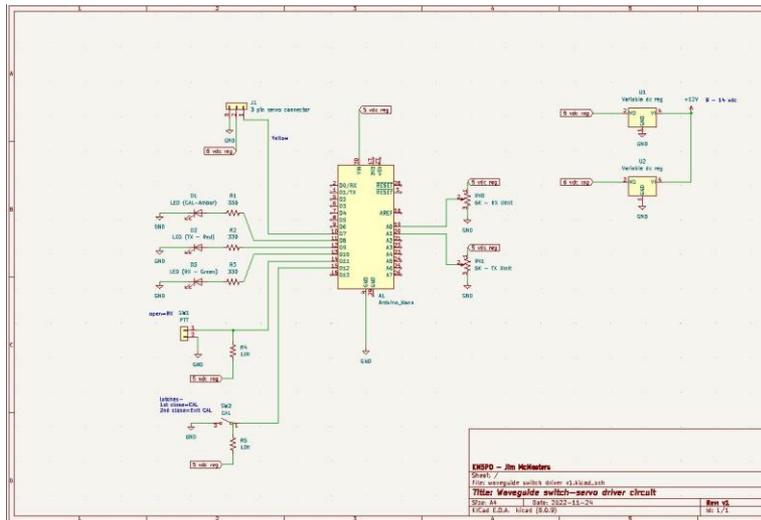
- LED transmitter, analog modulated, 800 hz tone generator, Arduino beacon msg/keyer.



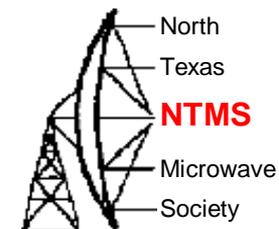
Some project examples



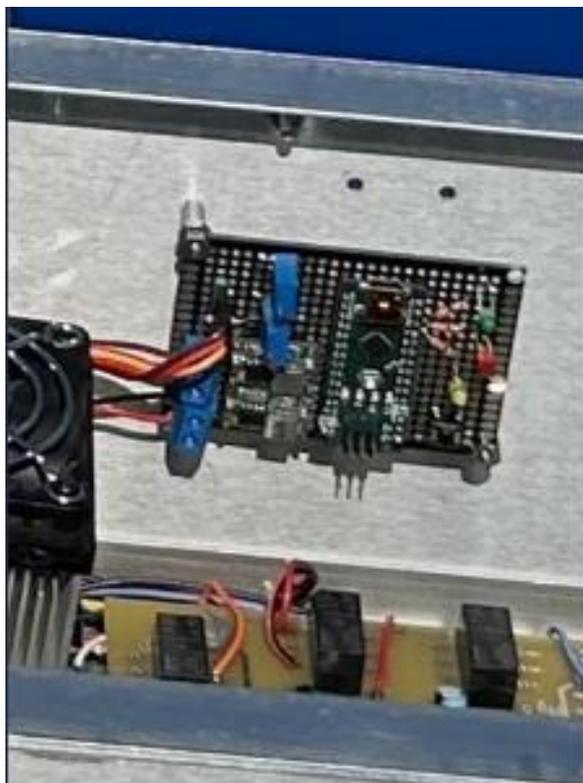
- Waveguide transfer switch controller



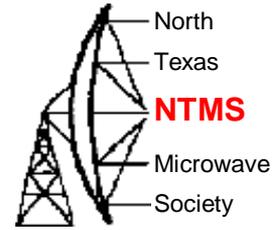
Some project examples



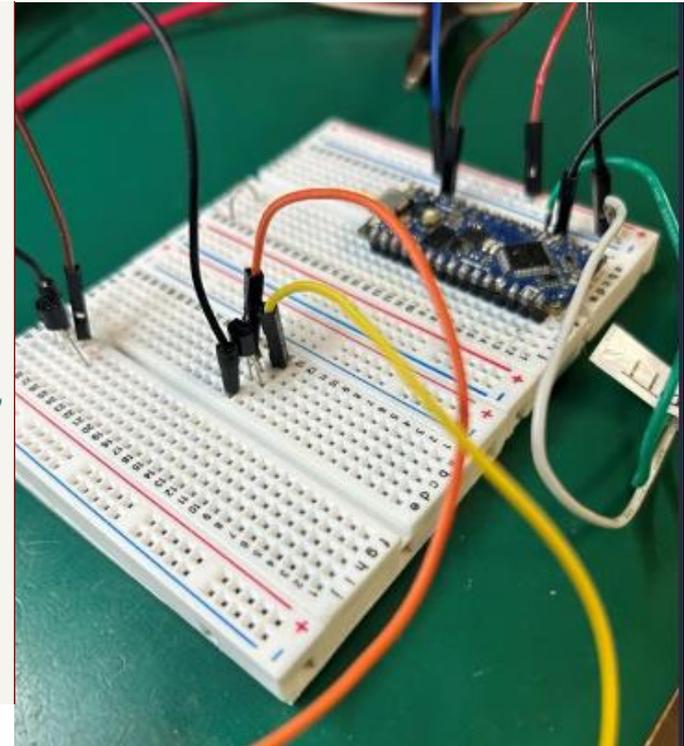
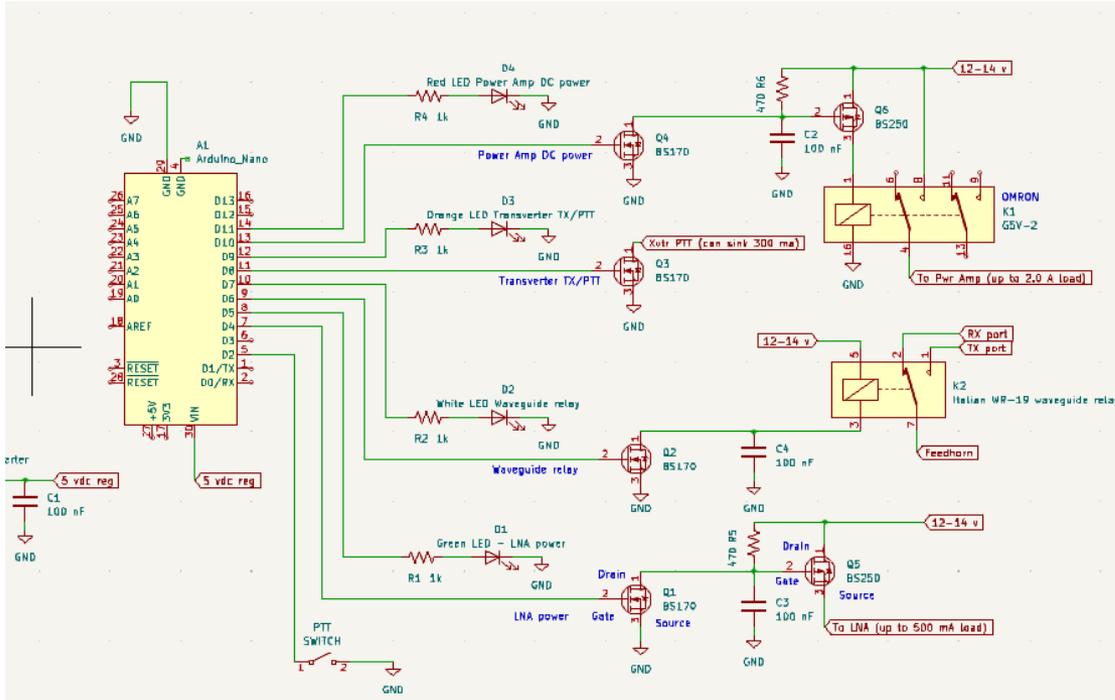
- Waveguide transfer switch controller - perfboard



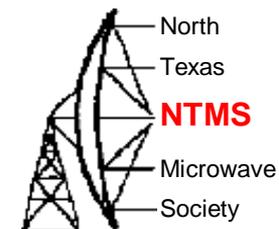
Some project examples



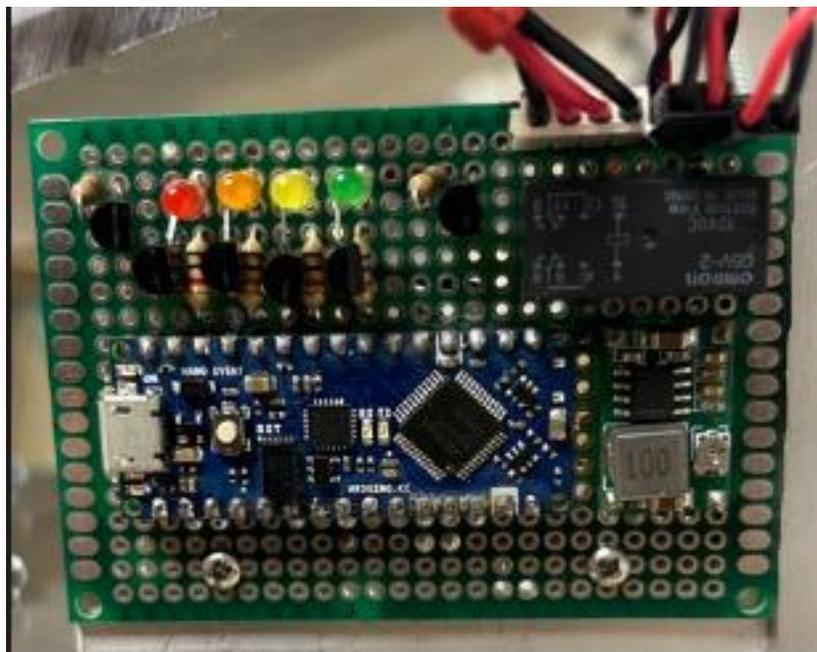
- Sequencer MOSFET drive/capacity tests



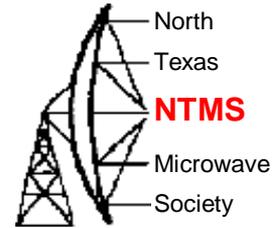
Some project examples



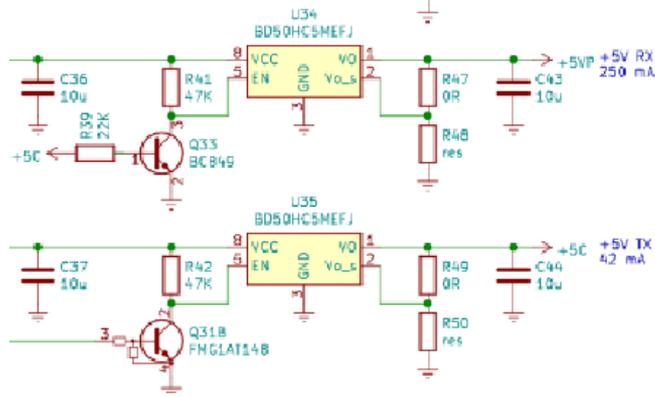
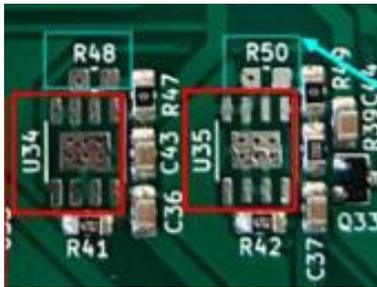
- Sequencer w/MOSFET drive on perfboard



Some project examples

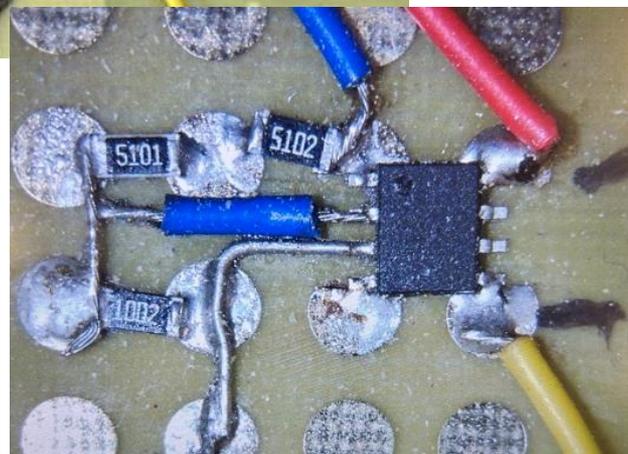
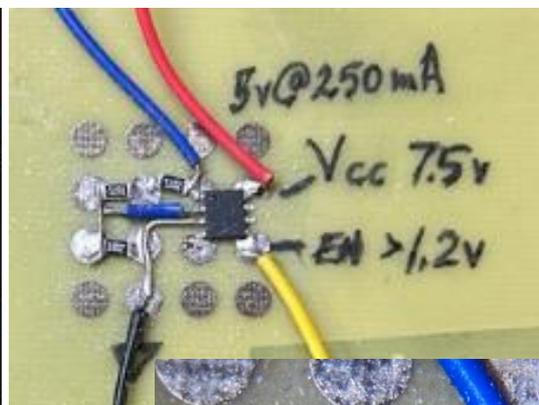
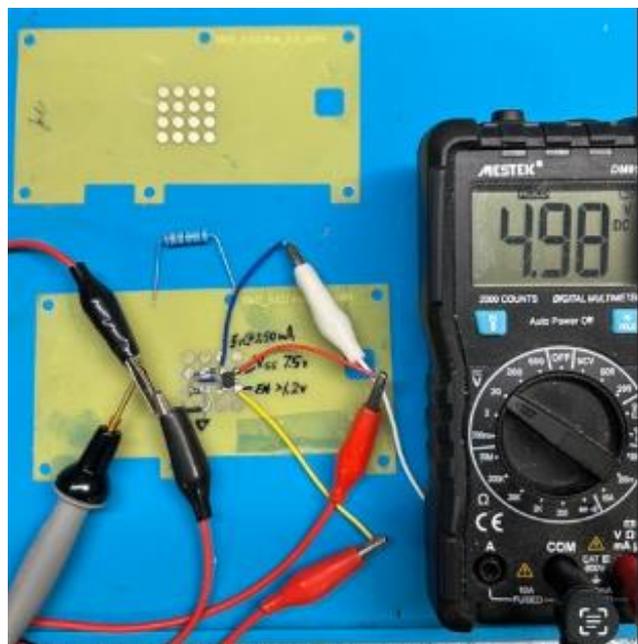


- Design calls for fixed 5v regulator
- Let's find a variable regulator, test it and then use it in BOM



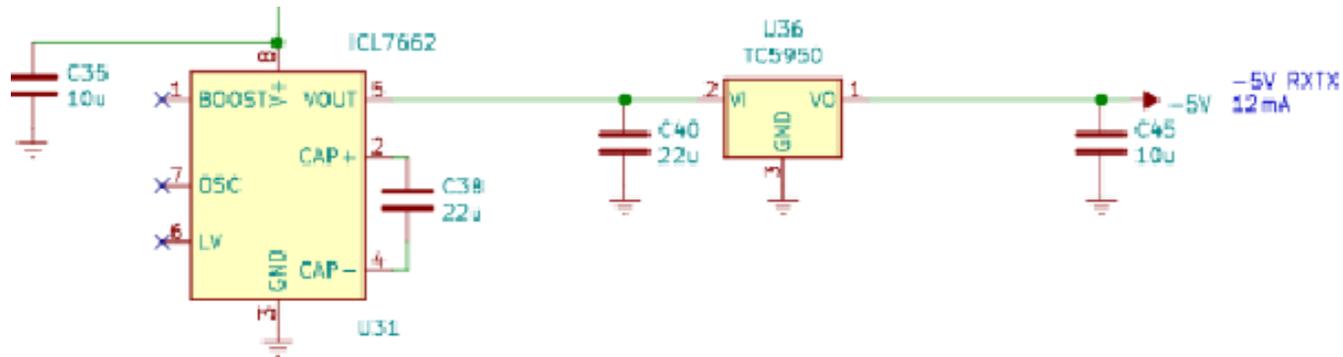
Some project examples

- Wavelab 24GHz board part replacement
- Manufacturer does not have source on the part



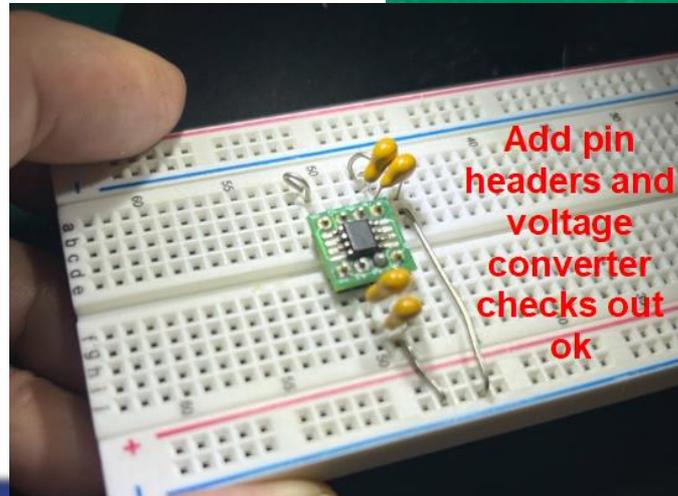
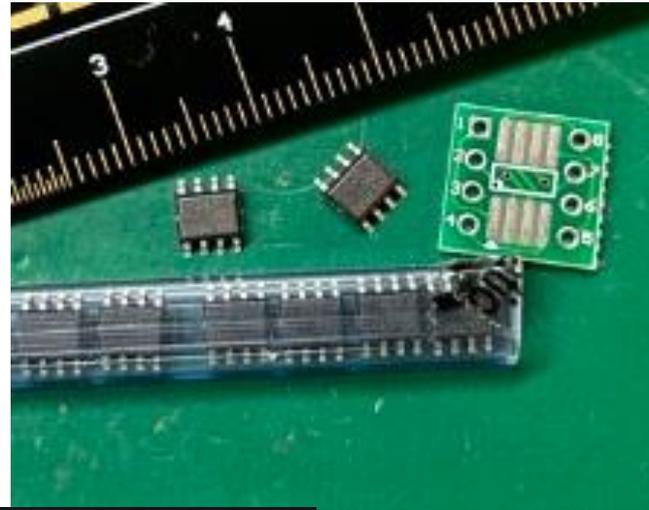
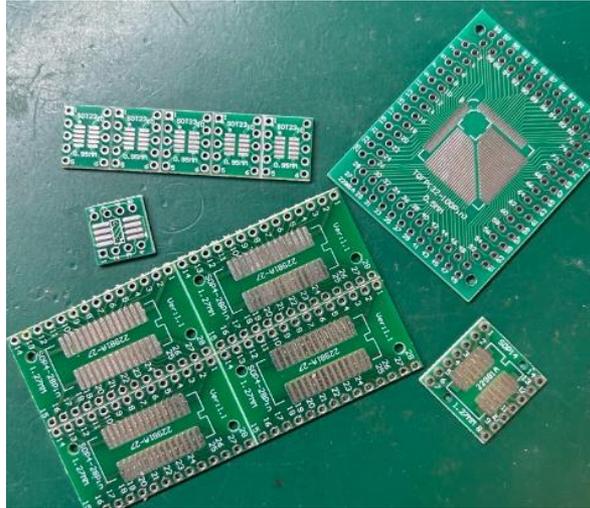
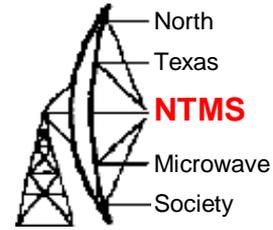
Some project examples

- Wavelab 24GHz board part failure?

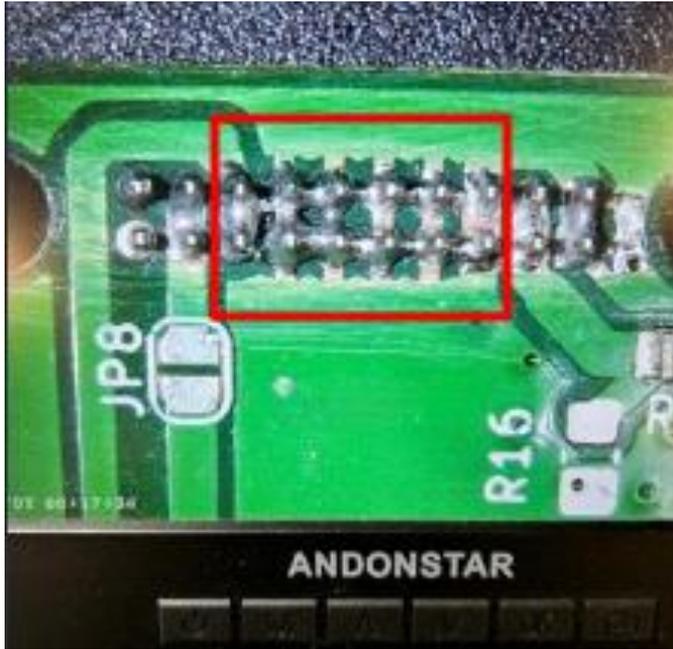
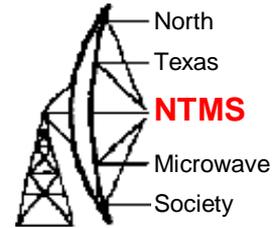


- Why does the part keep failing?
 - Test a new part from the batch..

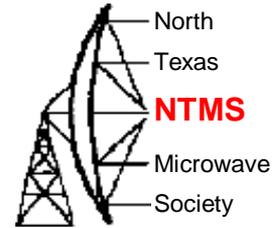
Wavelab 24GHz board part failure?



Located a short!



Some project examples



- Let's add the (negative) voltage regulator



MICROCHIP TC59

Low Dropout, Negative Output Voltage Regulator

Features

- Low Dropout Voltage
 - Typically 120mV @ 50mA; 380mV @ 100mA for -5.0V Output Part
- Tight Output Voltage Tolerance: $\pm 2\%$ Max
- Low Supply Current: 3.5 μ A, Typ
- Small Package: 3-Pin SOT-23A

Applications

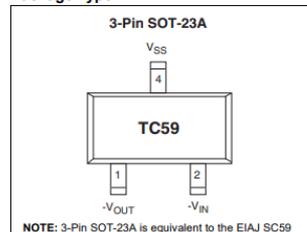
- Cellular Phones
- Battery Operated Systems
- Palmtops
- Portable Cameras

Device Selection Table

Part Number	Output Voltage	Package	Temperature Range
TC593002ECB	3.0V	3-Pin SOT-23A	-40°C to +85°C
TC595002ECB	5.0V	3-Pin SOT-23A	-40°C to +85°C

Other output voltages are available. Please contact Microchip Technology Inc. for details.

Package Type

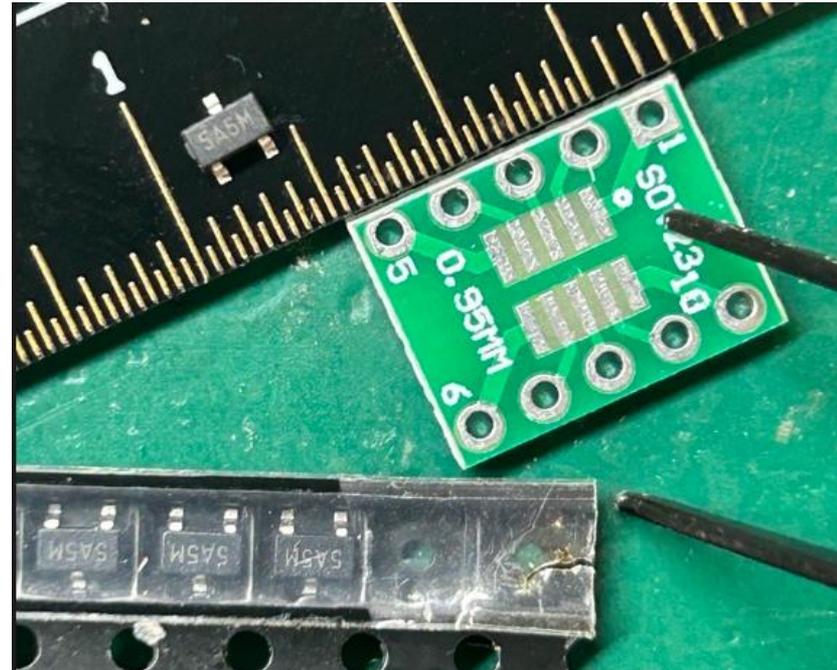
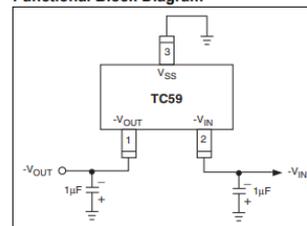


General Description

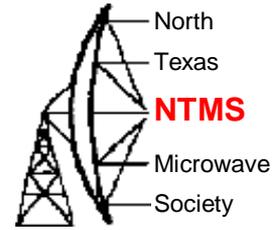
The TC59 is a low dropout, negative output voltage regulator designed specifically for battery-operated systems. Its full CMOS construction eliminates the wasted ground current typical of bipolar LDOs. This reduced supply current significantly extends battery life, particularly when the TC59 is operated in dropout.

Other TC59 key features include low supply current (typically 3.0 μ A) and low dropout operation (typically 120mV at 50mA). The TC59 is packaged in a small 3-Pin SOT-23A package.

Functional Block Diagram



Questions?



- Thank you for your interest