The Workbench Podcast

It has never been a better time to be a Ham…

Modes!

CW

AM

SSB

FM

Digital

Radio Technology!

Spark Gap

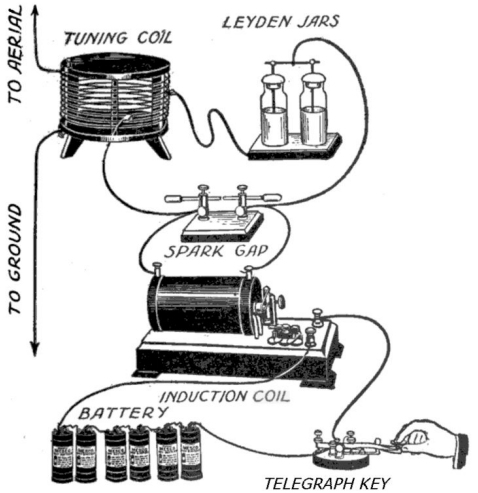
Valves

Transistors

VFOs

DDS

SDR



Hams don't build anything anymore.

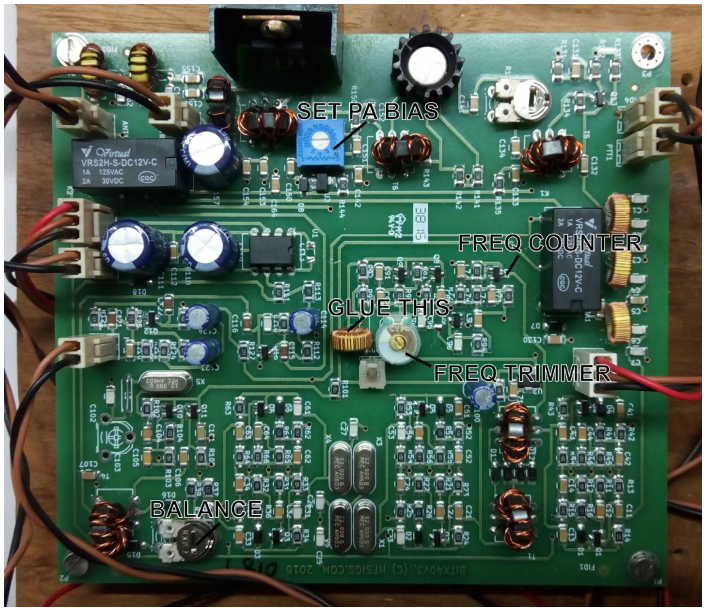
-Some Hams

Hams build radios…

Ashar Farhan
VU2ESE

BITX40
$59 7W 40M SSB Transceiver

http://www.hfsigs.com/



Hams build radios…

Hans Summers G0UPL

Ultimate3S
6-Band QRSS/WSPR
~200mW Transmitter

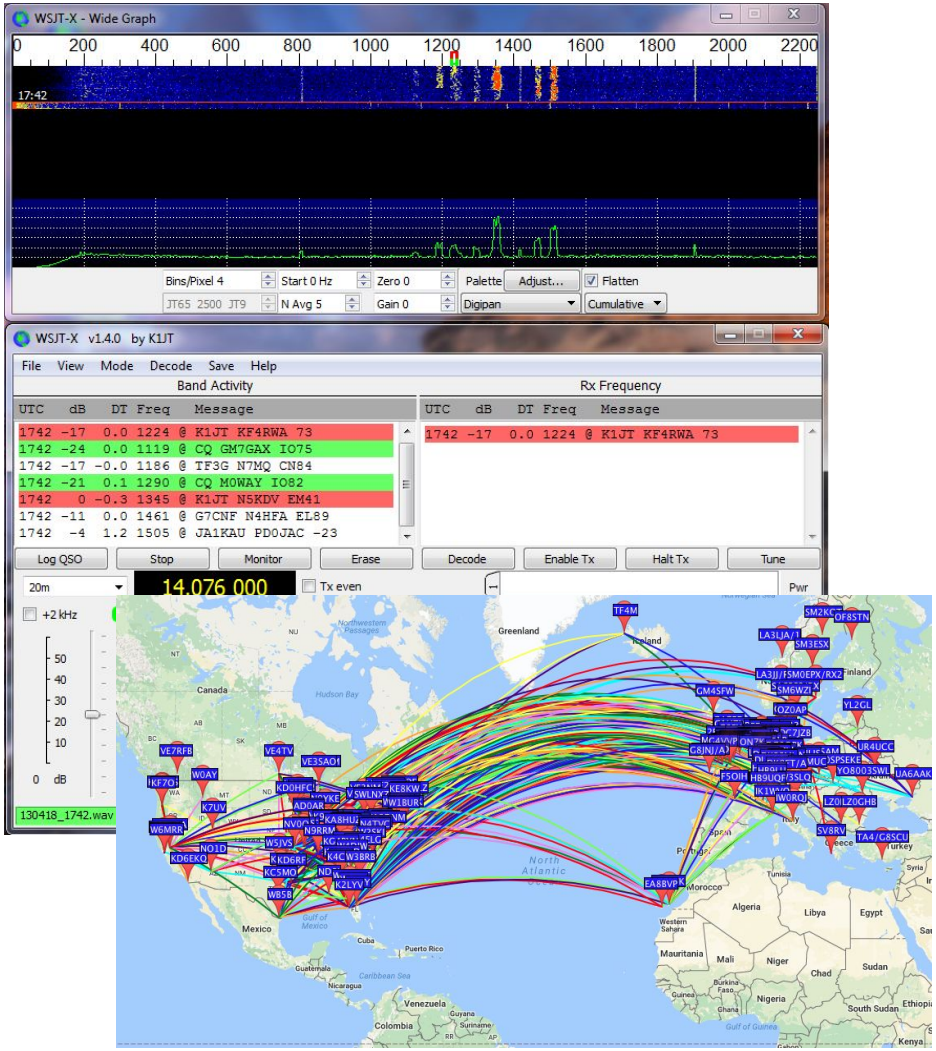
http://www.qrp-labs.com/

Hams build new ways of communicating…

Dr Joe Taylor K1JT

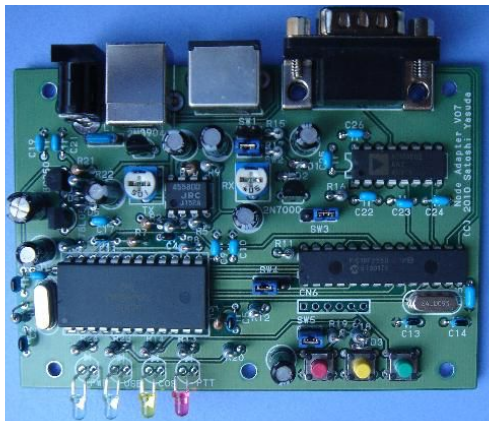
JT9
JK65
Weak Signal Propagation Reporting (WSPR)
WSJT-X

https://physics.princeton.edu/pulsar/k1jt/wsjtx.html



Hams build new capabilities

- Robin Cutshaw AA4RC – Dplus, DVAP
- Satoshi Yasuda - 7M3TJZ – DV node adapter board
- Jonathan Naylor – G4KLX – MMDVM, ircDDB, pcrepeatercontroller
- Guus van Dooren – PE1PLM – DVMega
- BrandMeister Development Team – BrandMeister DMR Network



Hams build knowledge…

- Podcasts
    - HamRadio360
    - QSO Today
    - ARRL: The Doctor is In
    - The Phasing Line
    - Ham Talk LIVE!
    - Linux in the Ham Shack
    - Everything Ham Radio
    - Solder Smoke

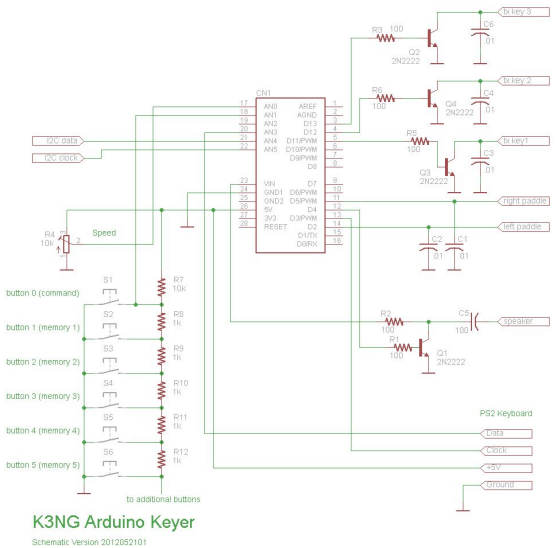
- YouTube / Video
    - Ham Radio NOW
    - Ham Radio 2.0
    - Ham Nation
    - Smoke and Solder
    - K7AGE

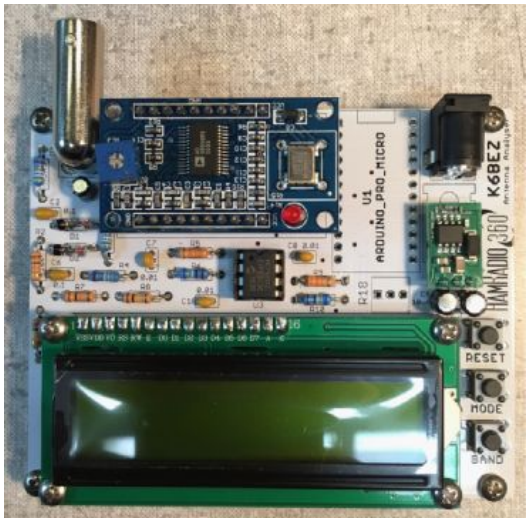
It has never been a better time to be a Ham…
(especially if you like to build stuff)

Micro Controllers

- Arduino (Atmel AVR), Microchip PIC, STM32, ESP8266, Particle
    - Programmable logic device with many “real time” features with inputs and outputs

- K3NG CW Keyer
- K6BEZ Antenna Analyzer

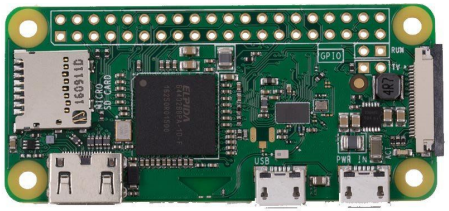


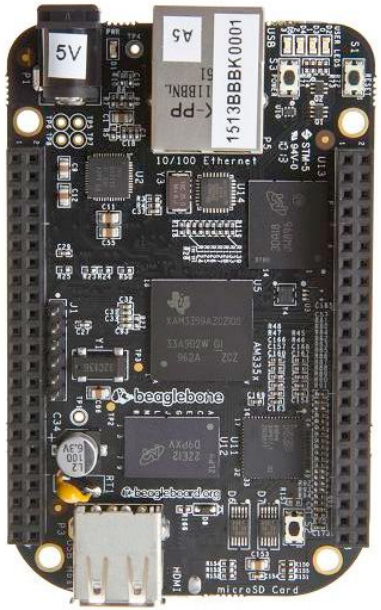


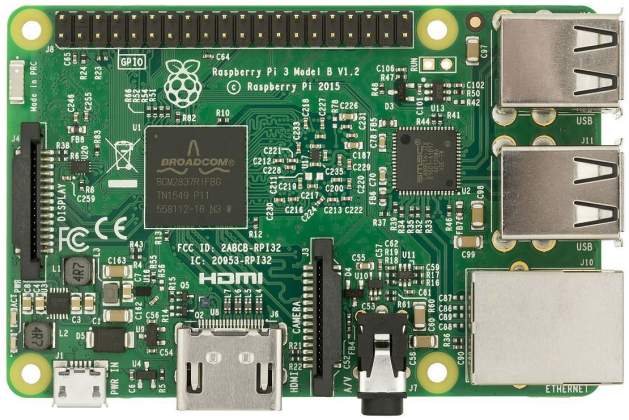
Single Board Computers

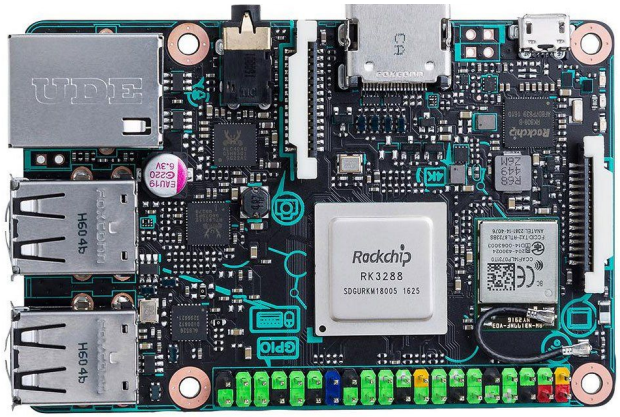
- Raspberry Pi, Beaglebone, ODROID, Tinker Board, etc
  - Small computers that run a full Linux or Android OS with programmable inputs and outputs
  - LOTS of accessories and can interface with stuff!

- Digital Radio Hotspot Hosts
- Portable FLDigit Terminals
- Portable Logging
- APRS Controllers









Components / Modules / PCBs

- Components – passives, mechanical, ICs, you name it!
    - Digikey.com
    - Mouser.com
- Modules – small pre-made boards that implement reference designs of complex parts
    - DDS Modules - SI5351a, AD9850
    - Sensors – Temperature, GPS, Motion, etc
    - eBay, Banggood, DX, Adafruit, SparkFun
    - LCDs
    - Analog and “Data” Radios!
- PCB Design and Manufacturing
    - Tools – Eagle PCB
    - Manufacturing – OSHPark, Seeed, PCBWay





Test Equipment

- Rigol, Siglent
  - Oscilloscopes
  - Spectrum Analyzer
  - Bench Power Supplies
  - Function Generators
  - Bench Multimeters

The Internet!

- Google.io, Yahoo Groups
- Twitter
- Facebook Groups
- Reddit
- Just plain Google

Doesn't have to involve soldering!

- Assembling Modules in to new things!
- Go Boxes
- Portable Power Modules
- Antennas

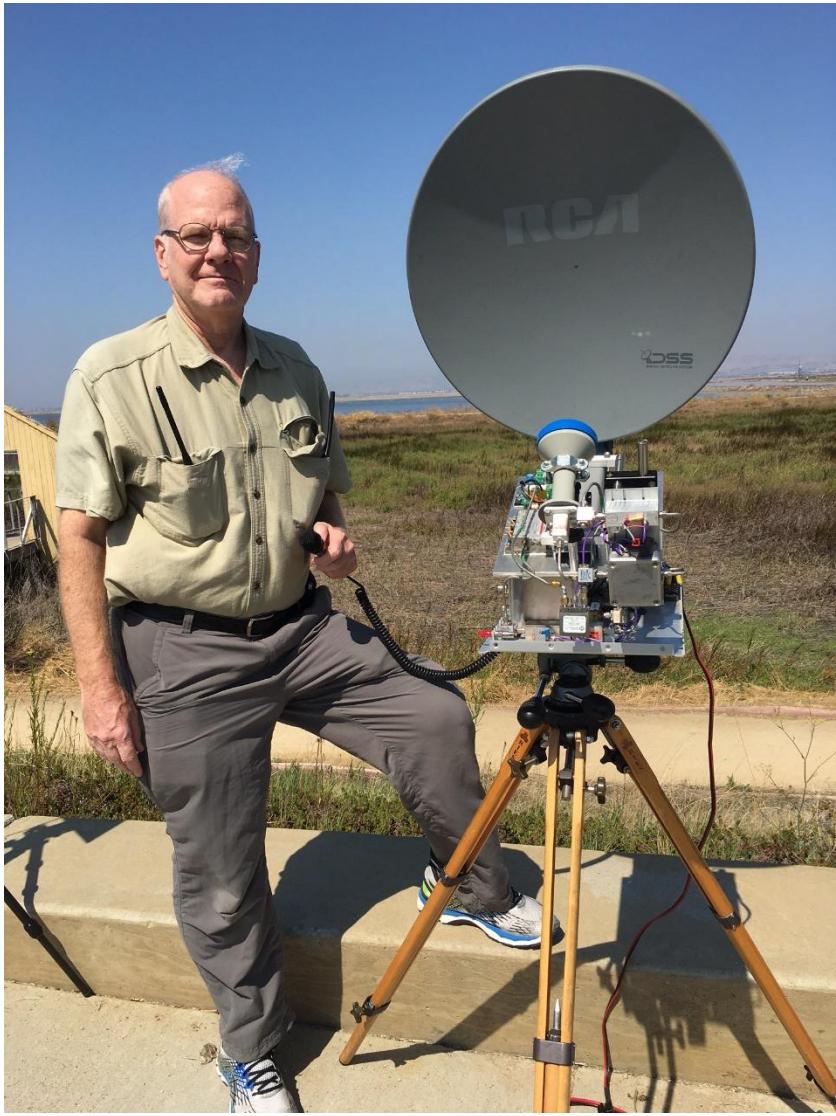
(some) Ham don't build anything anymore.

5 Steps To Homebrew Bliss

1. Have a purpose
2. Set up your workbench
3. Learn something new
4. Build a project
5. Share it with someone

1 Have a Purpose

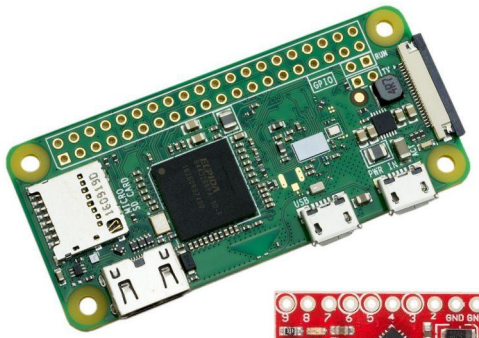
- Field operating
- Contesting
- Build HF antenna farm
- Build a repeater system
- Learn a new technology
- Improve your CW skills
- Outfit a workbench
- Build a go kit
- …

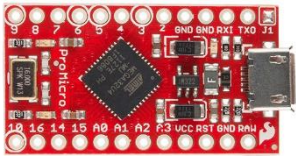


2 Set Up Your Workbench

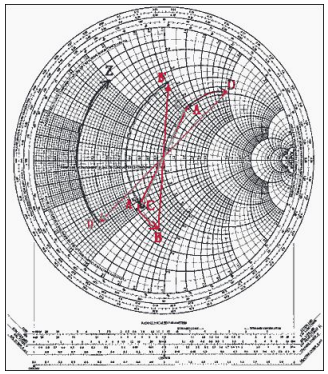
- Hand tools
- Test equipment
- Soldering iron
- Parts
- Power supply
- Lighting

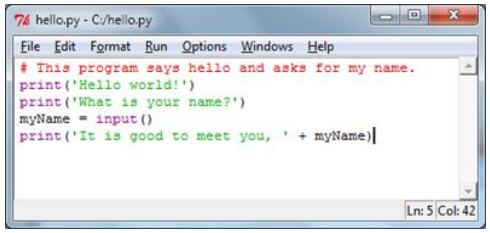
3 Learn Something New

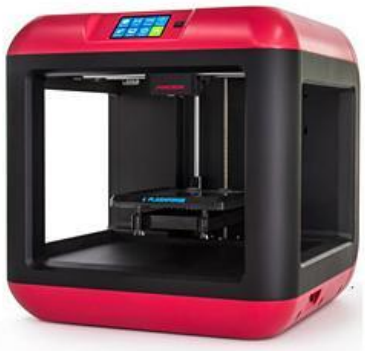


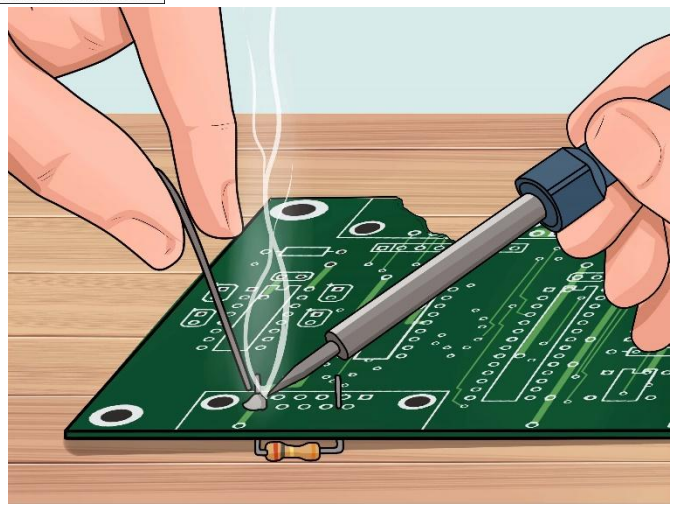


- Microcontrollers – Arduino, PIC
- Embedded linux – Raspberry Pi, BeagleBone
- Programming language
- Antenna theory
- Proper assembly technique
- PCB layout
- 3D printing
- Digital modes
- Repeater building
- D-STAR, DMR







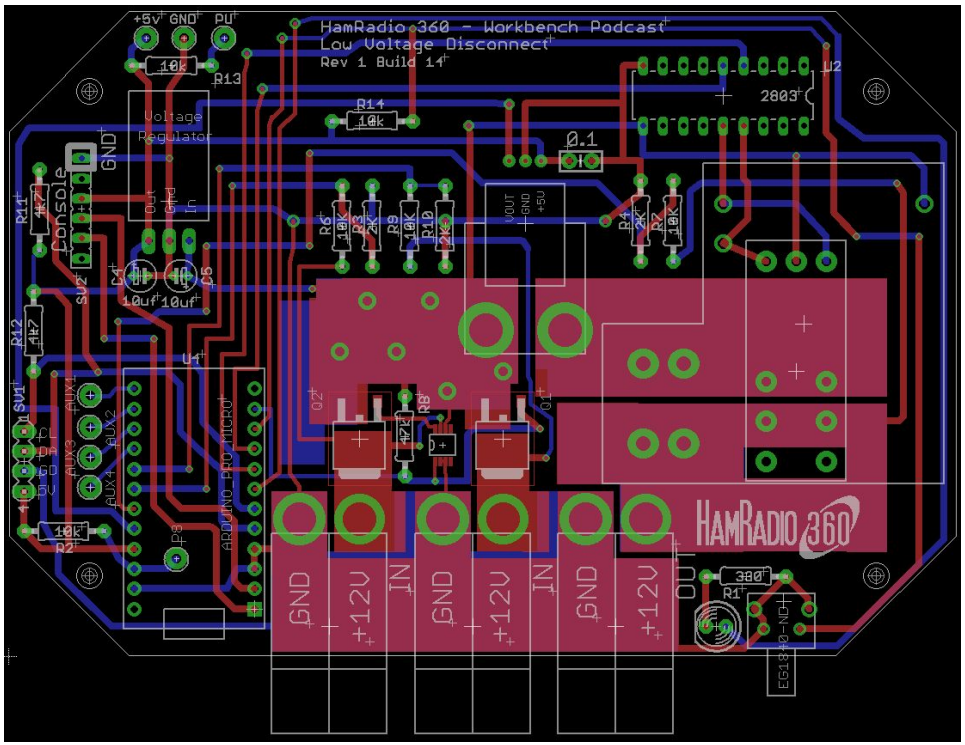


4 Build A Project

- Antenna Analyzer
- Power Gate & LVD
- QRP Dummy Load
- Smart QRP Dummy Load
- PowerPole DC Power Strip

Workbench Build Project Tools and Tips

- Autodesk Eagle Schematic & PCB layout software
- PCB Fab
  - Seeedstudio
  - PCBWay
- Parts source
  - Digikey
  - Allied Electronics
  - Banggood
- Reuse of favorite parts
- Reuse of Arduino code

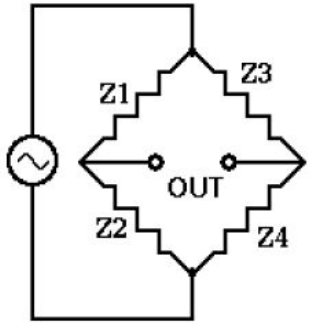


EAGLE
PCB DESIGN

Project 1 – K6BEZ Antenna Analyzer

+

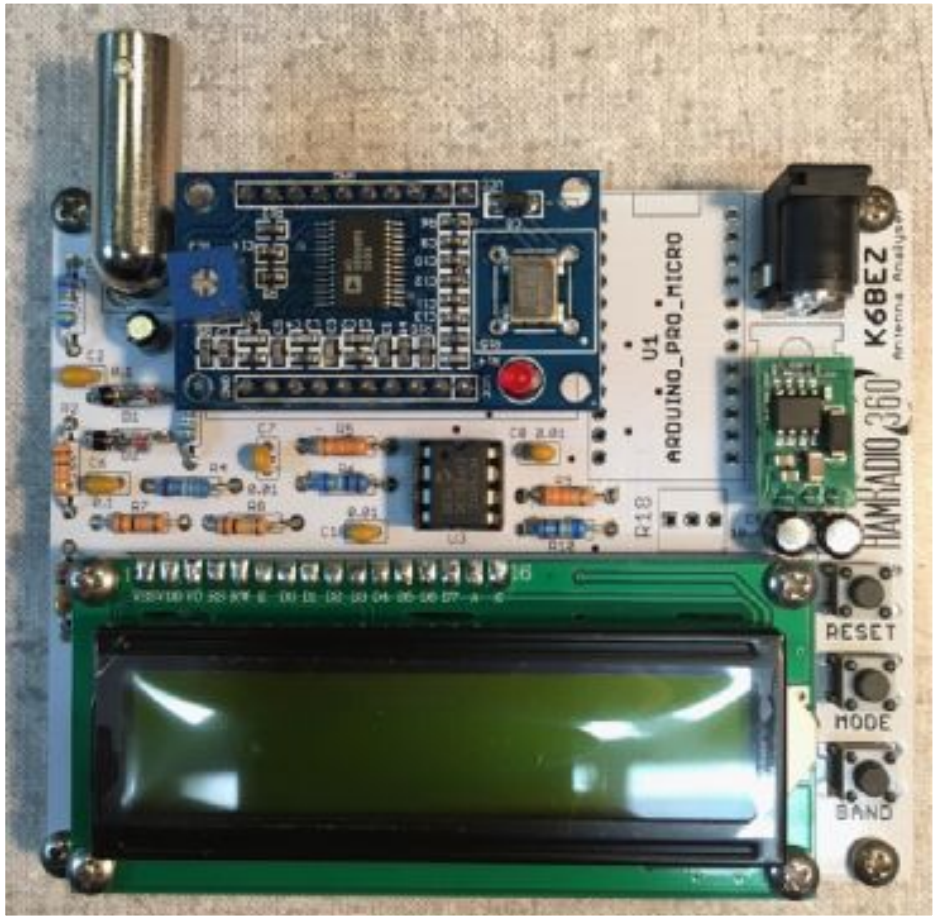
+



- DDS Chip
- Microcontroller
- Bridge

Shipped over 450 boards !
150 more boards here at Hamvention

Project 1 – K6BEZ Antenna Analyzer

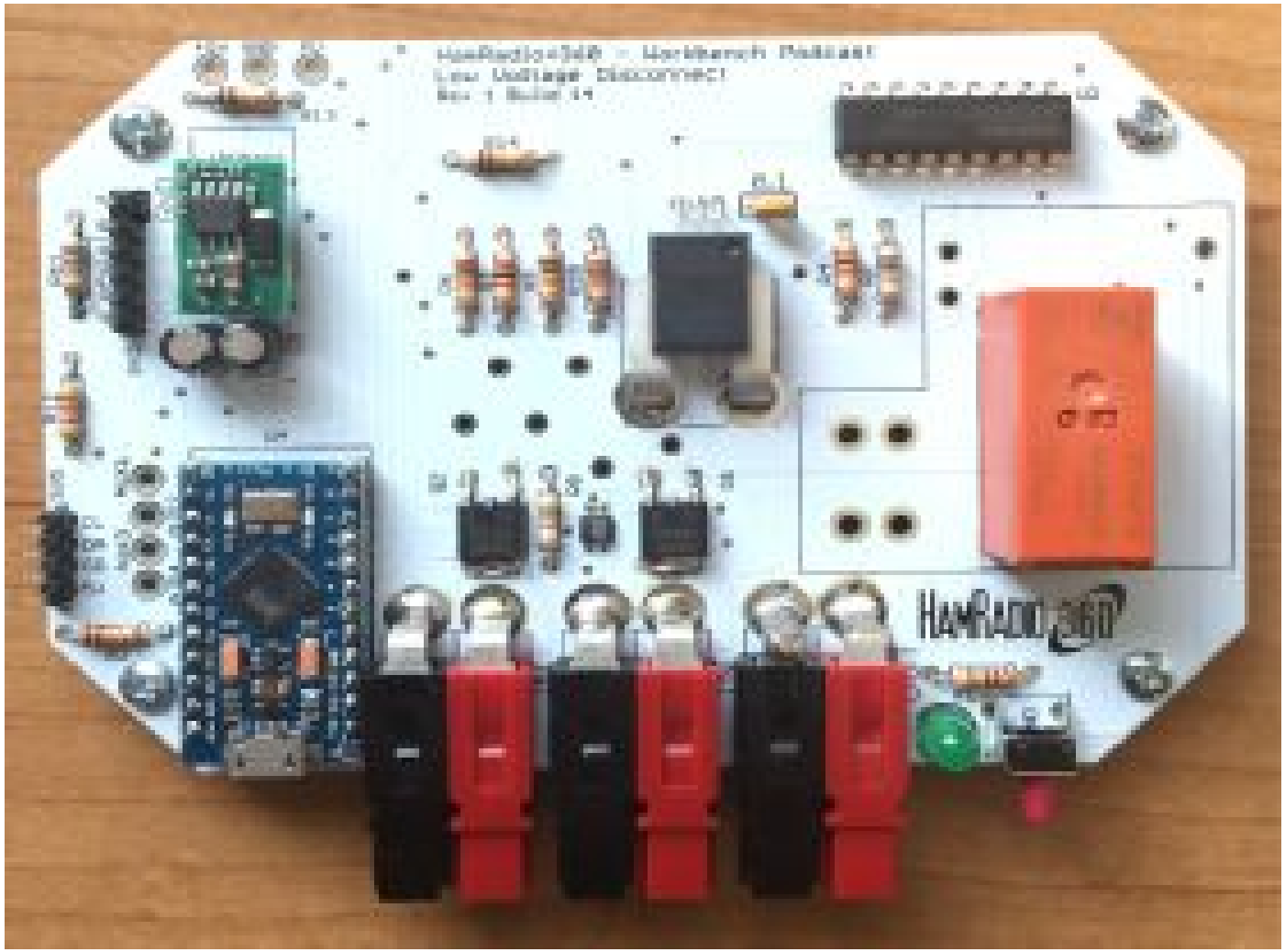


Final Version

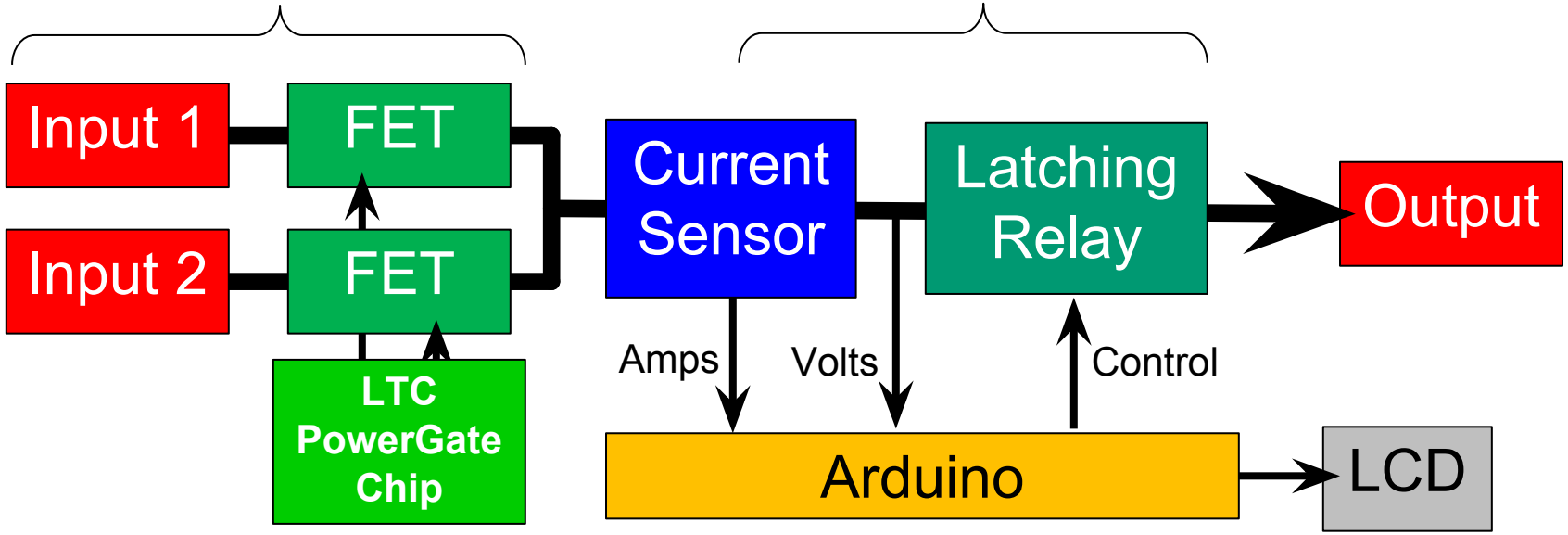
PIC-based Prototype 1

Arduino based Prototype 2

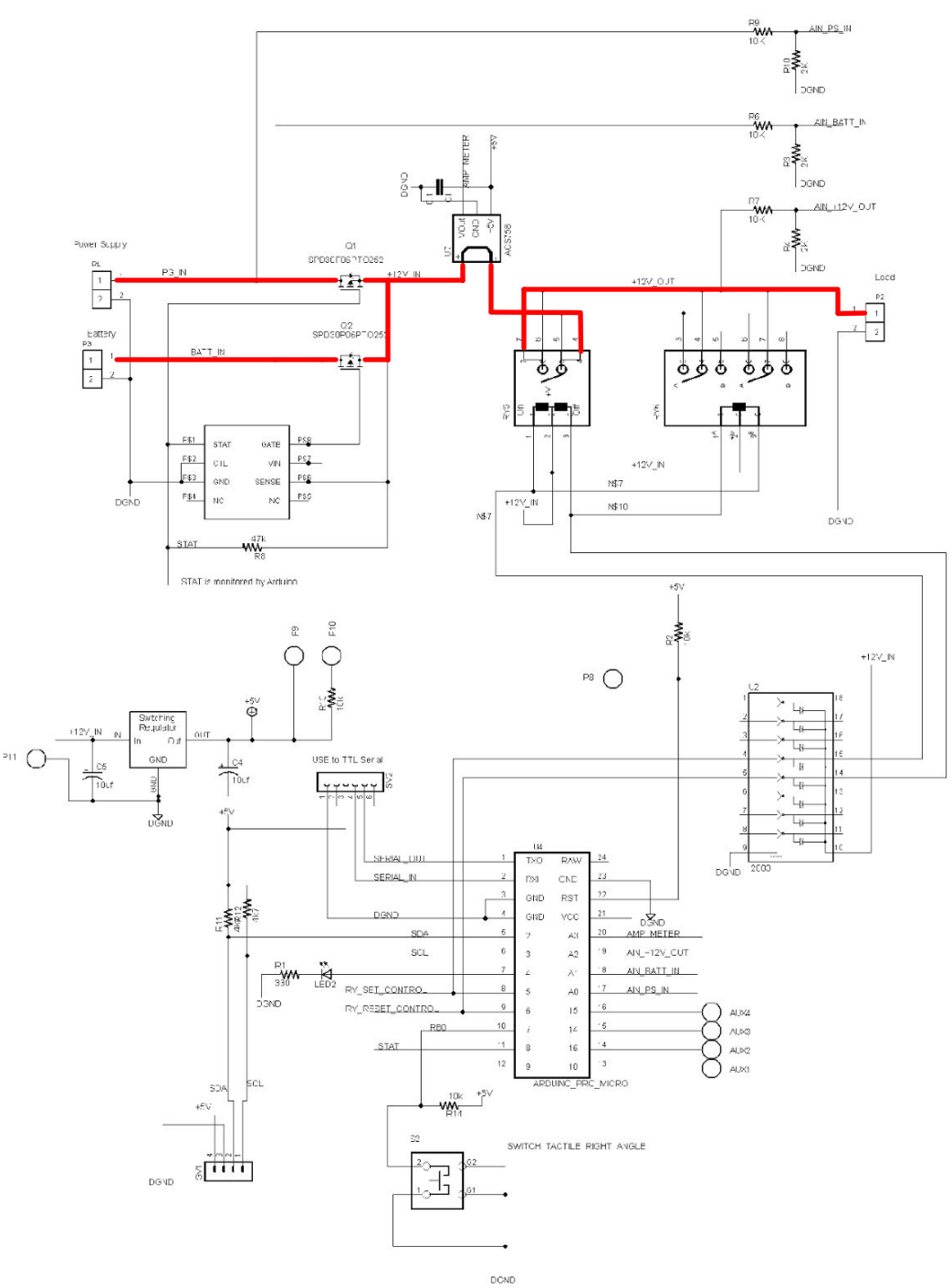
Project 2
Power Gate & Low Voltage Disconnect

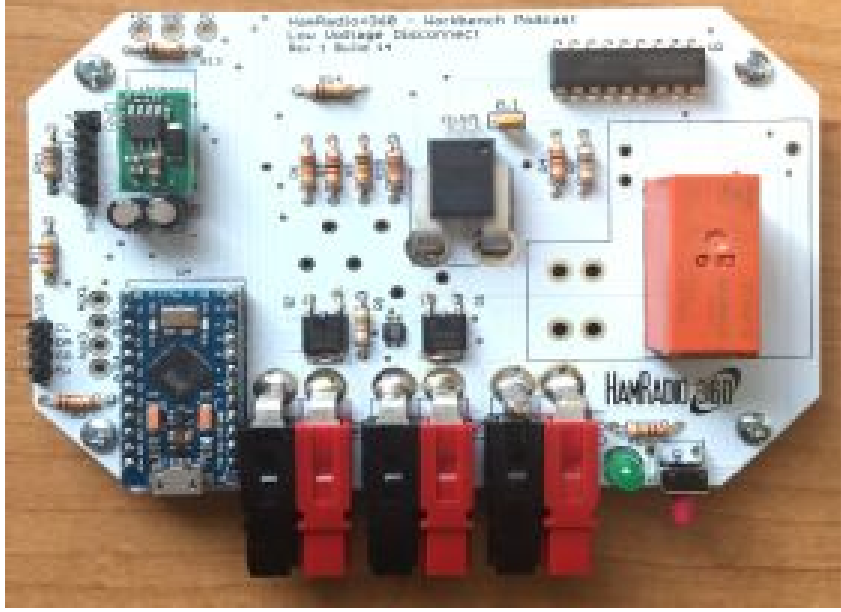


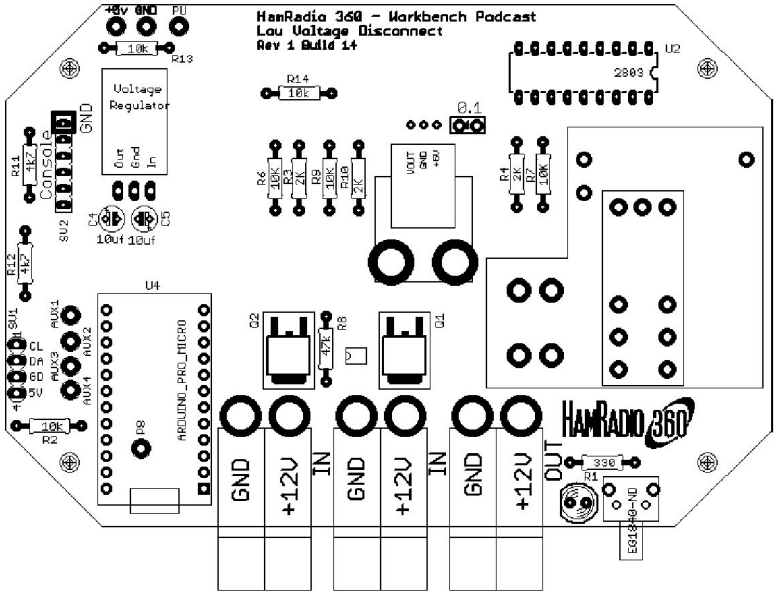
Project 2
Power Gate & Low Voltage Disconnect



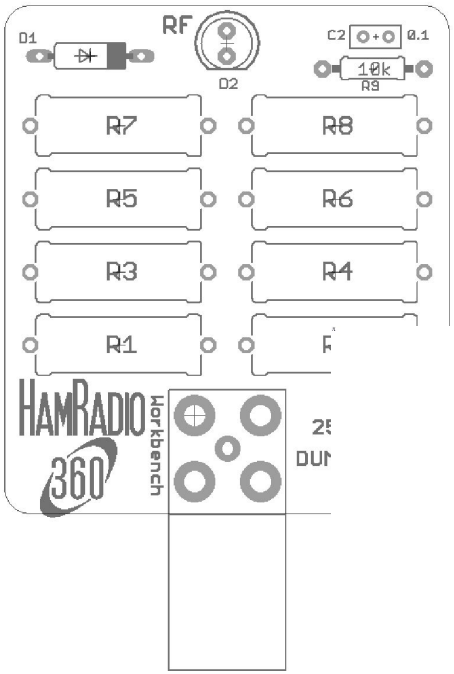
- 2x 12v DC power inputs
- Auto switching based on highest voltage
- Arduino controlled latching relay (15 Amps & 30 Amps)
- Measure voltage and current
- PCB made with 3oz copper

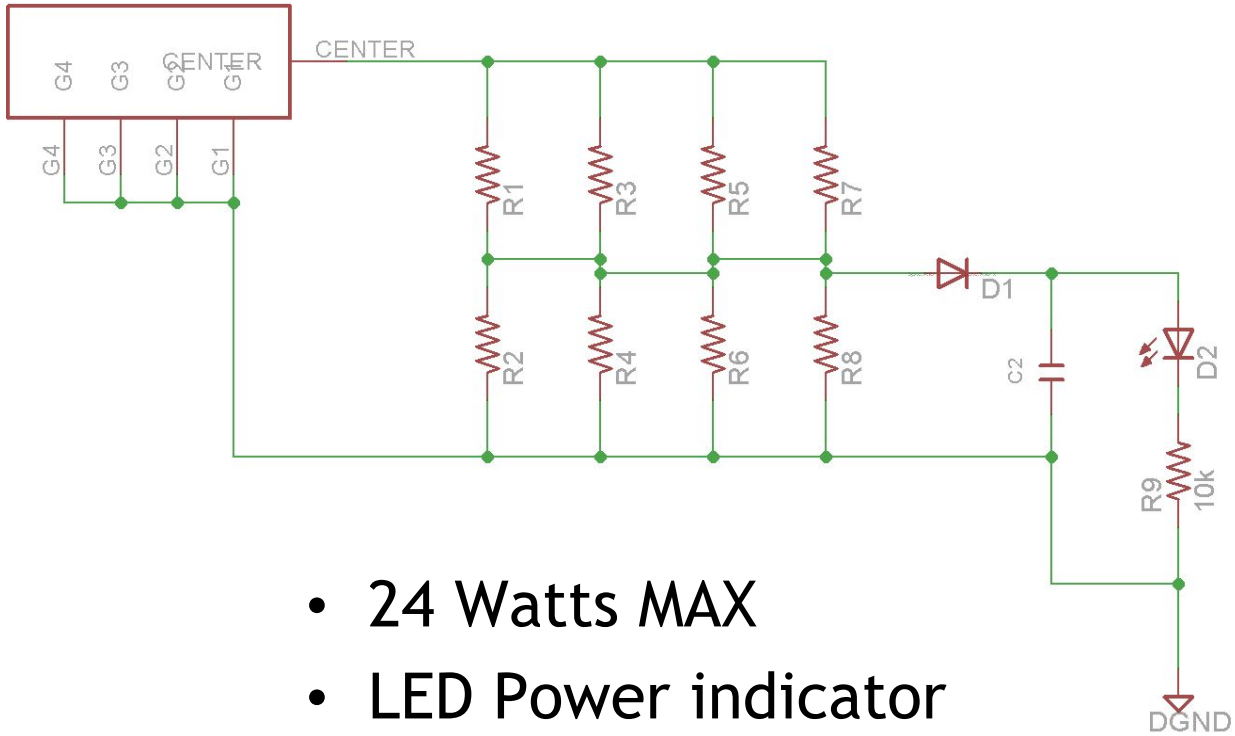

Power Supply
P3_IN
+12V_IN
+12V_OUT
Load
Battery
BATT_IN
STAT
STAT is monitored by Arduino
DGND
AIN_PS_IN
AIN_BATT_IN
AIN_12V_OUT
AMP METER
SERIAL_OUT
SERIAL_IN
SDA
SCL
RY_SET_CONTRO
RY_RESET_CONTRO
AIN_-12V_CUT
AIN_BATT_IN
AIN_PS_IN
AUX4
AUX3
AUX2
AUX1
ARDUINO_PRO_MICRO
SWITCH TACTILE RIGHT ANGLE
USE to TTL Serial
Switching Regulator
+5V
+12V_IN
DGND


HamRadio360 - Workbench Podcast
Low Voltage Disconnect
Rev 1 Build 14
HamRadio 360


HamRadio 360 - Workbench Podcast
Low Voltage Disconnect
Rev 1 Build 14
Voltage Regulator
Console
ARDUINO_PRO_MICRO
GND
+12V
IN
OUT
HamRadio 360

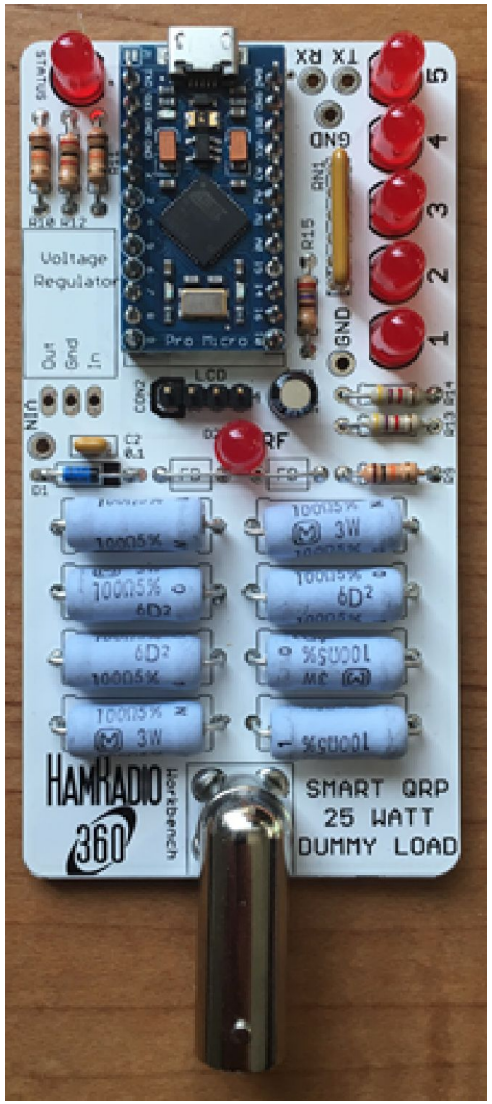
Project 3 - QRP Dummy Load

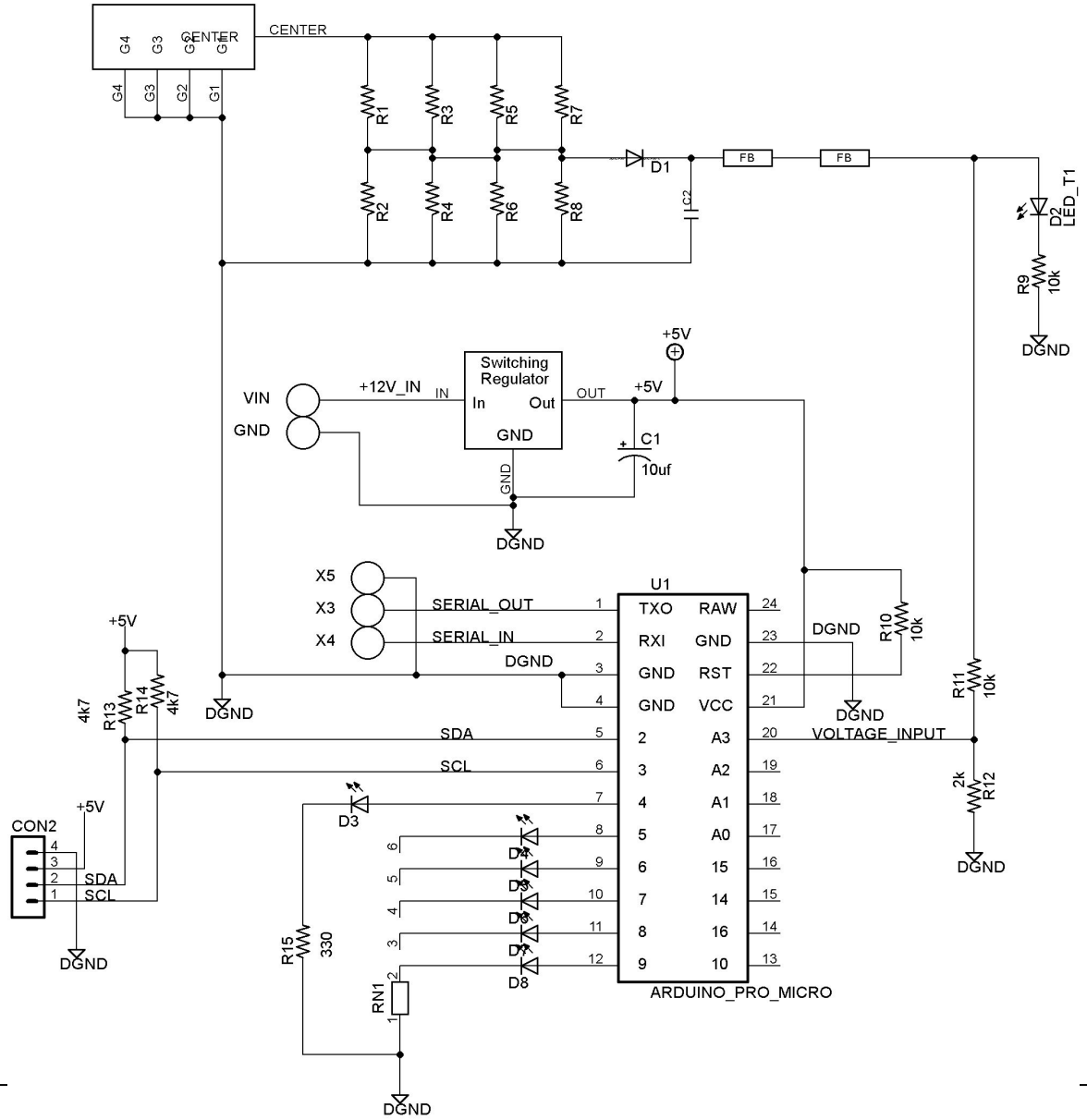




- 24 Watts MAX
- LED Power indicator

Project 4 - “Smart” QRP Dummy Load





Setup

- Import libraries
- Declare constants
- Declare LCD pins
- Declare variables
- Set I/O pins
- Set UART speed
- LCD splash screen

```
//-----( Import Libraries )-----------------------------------------
#include <Wire.h>                  // Comes with Arduino IDE
#include <LCD.h>
#include <LiquidCrystal_I2C.h>     // Must be installed
/*-----( Declare Constants )-----*/
  int analogPin = 3;
  int status_led = 4;
  int led1 = 9;
  int led2 = 8;
  int led3 = 7;
  int led4 = 6;
  int led5 = 5;
//-----( Declare Objects )------------------------------------------
  LiquidCrystal_I2C lcd(0x27, 2, 1, 0, 4, 5, 6, 7, 3, POSITIVE);
//-----( Declare Variables )----------------------------------------
  int val = 0;           // variable to store the value read
//-----( Program Initialization )-----------------------------------
void setup()
{
  pinMode(status_led, OUTPUT);
  pinMode(led1, OUTPUT);
  pinMode(led2, OUTPUT);
  pinMode(led3, OUTPUT);
  pinMode(led4, OUTPUT);
  pinMode(led5, OUTPUT);
  Serial.begin(9600);                //  setup serial
  lcd.begin(16,2);                   // initialize the lcd for 16 chars 2 lines
  lcd.backlight();                   // LCD backlight on
  //--- Splash screen 1 ------------
  lcd.setCursor(0,0); //Start at character 4 on line 0
  lcd.print("HR360 Workbench");
  delay(2000);
  lcd.setCursor(0,1);
  lcd.print("Dmyload Pwr Mtr");
  delay(2000);
  //--- Splash screen 2 ------------
  lcd.clear();
  lcd.setCursor(0,0); //Start at character 0 on line 0
  lcd.print("PWR");
  lcd.setCursor(0,1);
  lcd.print("PWR       Watts");
  //--- End of Initialization -----------
}
```

Control Loop

- Blink status LED
- Read ADC input
- Send value to serial
- Turn on LEDs
- Update LCD display

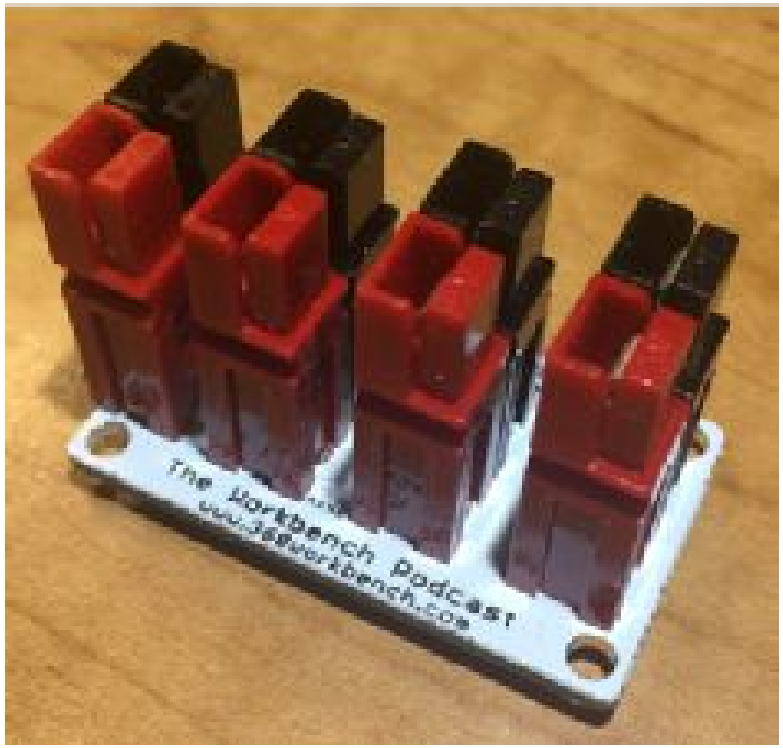
```
//---( Main Program Loop )-----------------------------------------
void loop()
{
  // digitalWrite(status_led, HIGH);    // Turn on status LED
  val = analogRead(analogPin);          // Read ADC voltage input from load
  Serial.println(val);                  // Send ADC value (0-1023) to UART
  //--- Update 5 measurement LEDs ----------------------------------
  if (val >160) digitalWrite(led1,HIGH);
  if (val >270) digitalWrite(led2,HIGH);
  if (val >350) digitalWrite(led3,HIGH);
  if (val >405) digitalWrite(led4,HIGH);
  if (val >460) digitalWrite(led5,HIGH);

  if (val <160) digitalWrite(led1,LOW);
  if (val <270) digitalWrite(led2,LOW);
  if (val <350) digitalWrite(led3,LOW);
  if (val <405) digitalWrite(led4,LOW);
  if (val <460) digitalWrite(led5,LOW);

  //--- Update LCD -------------------------------------------------
  lcd.setCursor(4,0); //Start at character 0 on line 0
  lcd.print("************");
  lcd.setCursor(4,1); //Start at character 0 on line 0
  lcd.print("100.0");

  // delay(100);
  // digitalWrite(status_led, LOW);    // Turn off status LED
}
```

Project 5 - PowerPole DC Power Strip



- 4 Ports
- Anderson PowerPoles
- Use solid conductor wire
- 14 AWG works great
- Crimp or solder

- PowerPole the world !

- Do not use holes to mount the board !

www.360workbench.com

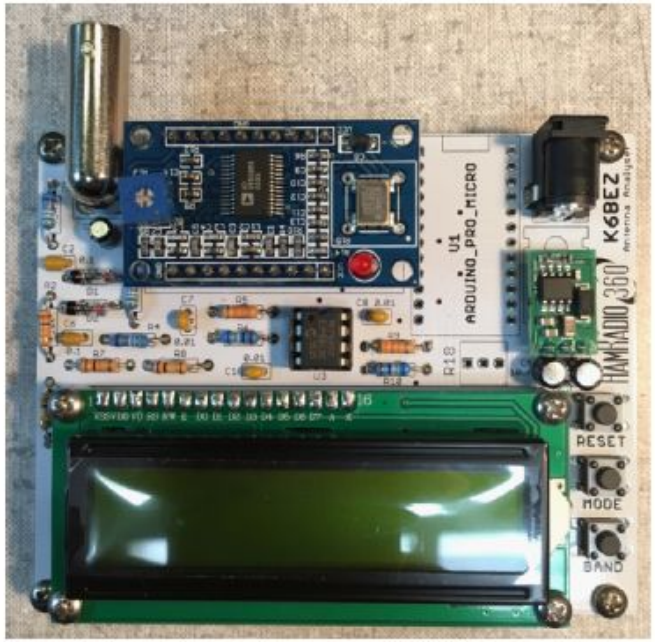
www.360workbench.com

HAMRADIO 360

the Workbench Podcast

Build Project Info

K6BEZ Antenna Analyzer Project



Check out the HamRadio360 Forum

Many of these documents and multiple firmware versions of firmware and software are located in our GitHub site

Documents

- Bill of Materials (BOM) in Excel format
- Assembly Instructions

5 Share It With Someone

- Publish a web site
- Start a blog
- Shoot a video
- Present at a club meeting
- Build it at a club meeting
- Do a podcast interview


OSEPP-LCD-01
OSEPP
HamRadio 360
Workbench Podcst
Q&A
LCD DISPLAY 16X2
LCD-01
(Rev 1.0)
SELECT
LEFT
UP
DOWN
RIGHT
RST
PWR
R1
5V
VIN
A0 A1 A2 A3 A4 A5
The
Workbench
Podcast

About HamRadio 360

Cale Nelson - (K4CDN) launched the Fo Time Amateur Radio Podcast in the summer of 2014 as an inside joke for some online ham radio friends. Fo Time focused on introducing the many aspects of amateur radio to operators young and old alike. The show quickly grew to something more than just an inside joke. Fo Time was re-branded as Ham Radio 360 in the Spring of 2016 and it continues to explore the hobby in every direction today.

After Dayton Hamvention in 2016, Cale brought long-time contributors George - KJ6VU and Jeremy - KF7IJZ under the HamRadio360 banner with the launch of their own bi-weekly podcast, The Workbench. Every other week, George and Jeremy explore the intersection of Ham Radio and the Making aspect of the hobby.