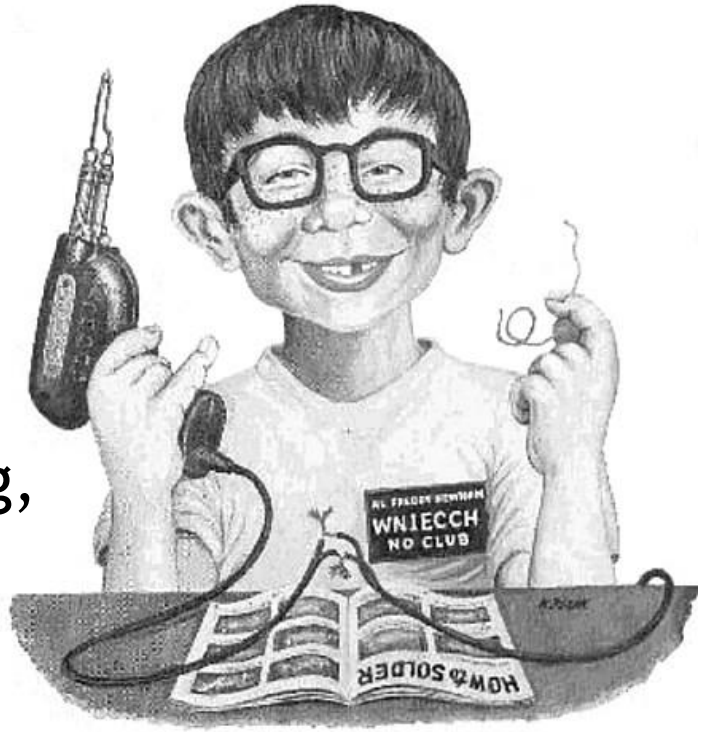
The Ham Radio

Workbench Podcast

Set up your workbench and build something

George Zafiropoulos KJ6VU



- Licensed in 1972
- Repeater building, QRP, microcontrollers, antenna building, portable operating
- Sierra Radio repeater controllers
- PackTenna portable antennas
- Ham Radio Workbench podcast
- My station: K3, Flex-6400, KX2

The Ham Radio Workbench Podcast

- Jeremy KF7IJZ & George KJ6VU
- Technically oriented topics
- Build projects
- Product reviews and advice
- Guest interviews
- General BS about radio & tech

The Ham Radio

Workbench Podcast

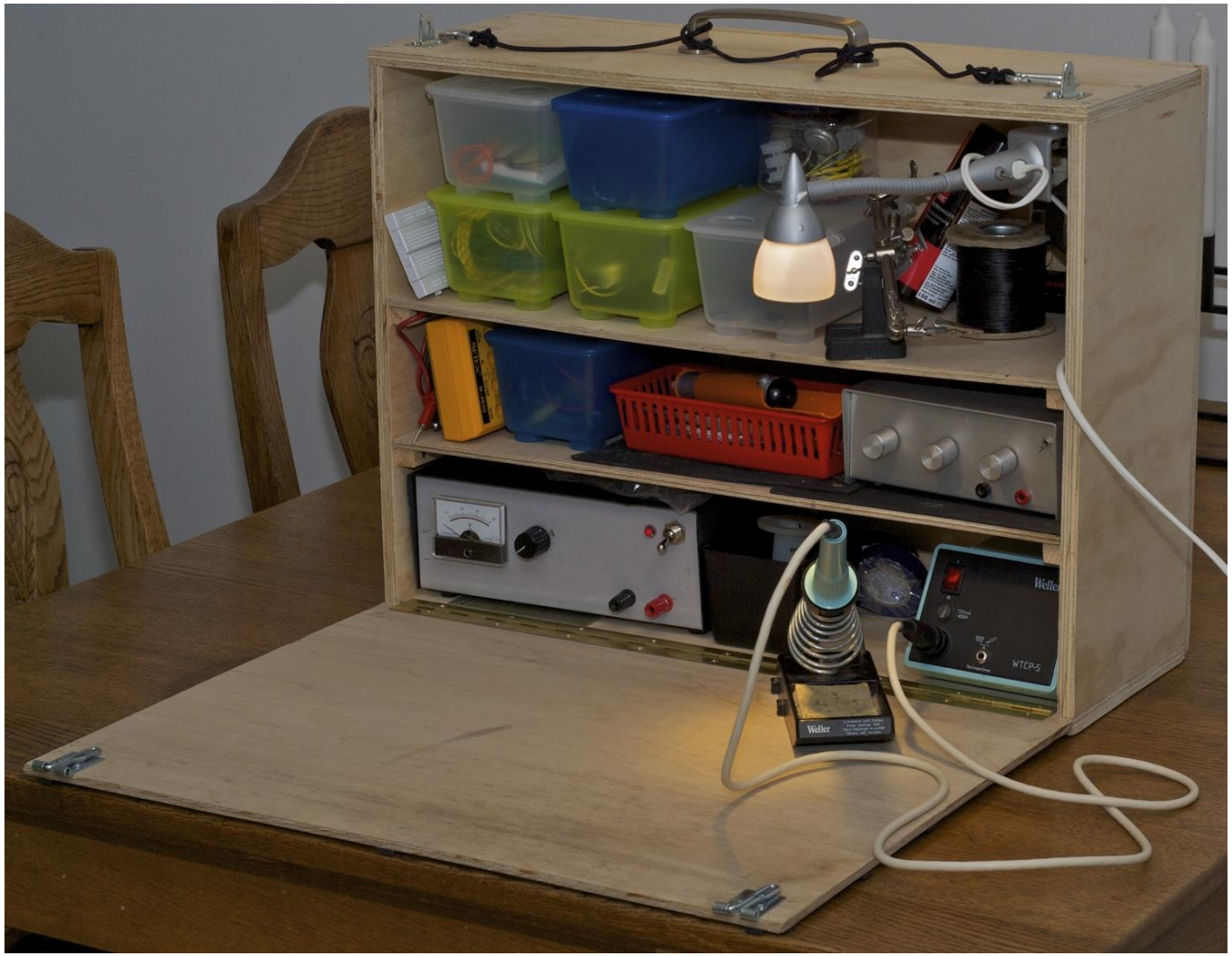
- Over 100 hours of content
- Web site www.hamradioworkbench.com
- DMR Talk Group 31075
- Facebook page HamRadioWorkbench
- Twitter @hamworkbench

Your Bench

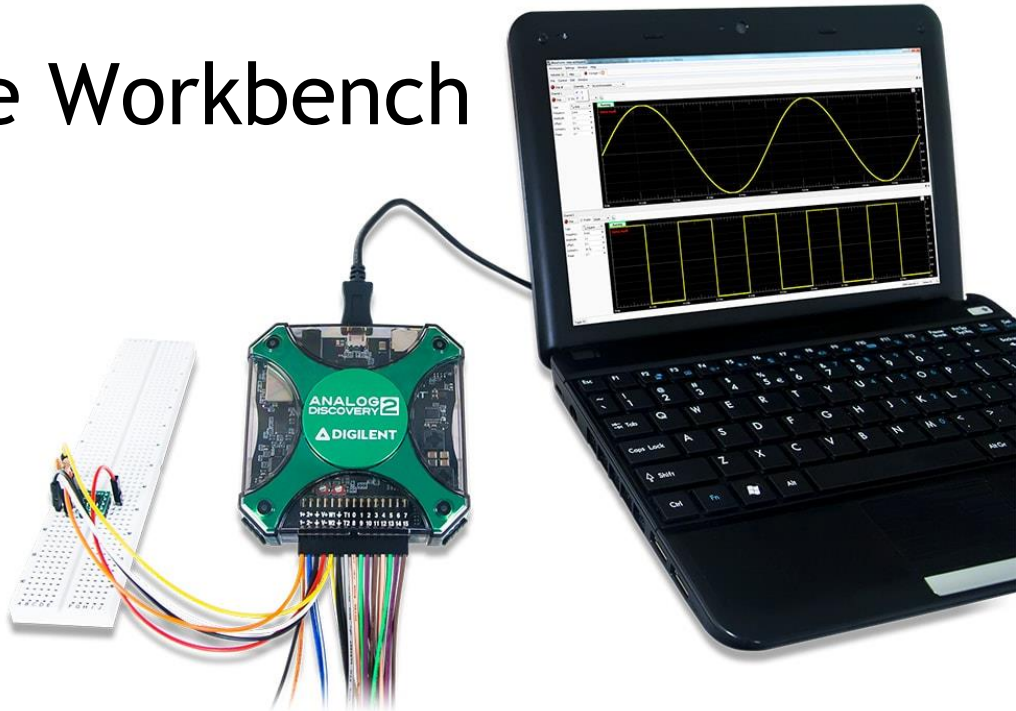
What is a workbench?

- A workbench is a happy place
- A place where you can make things with your own hands
- It’s a place where you can learn something new
- It’s a place to make something useful

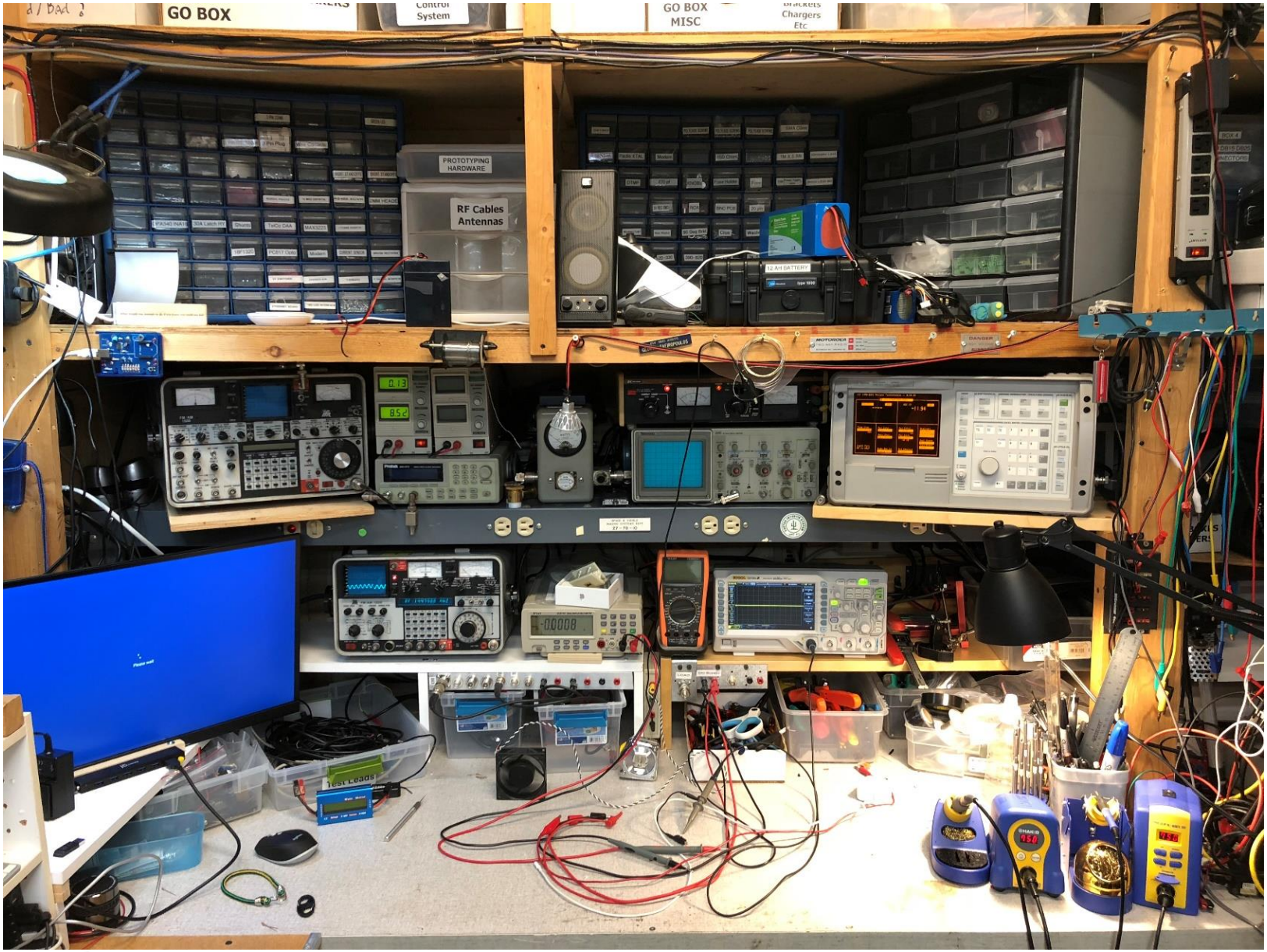
Or… A Portable Workbench !



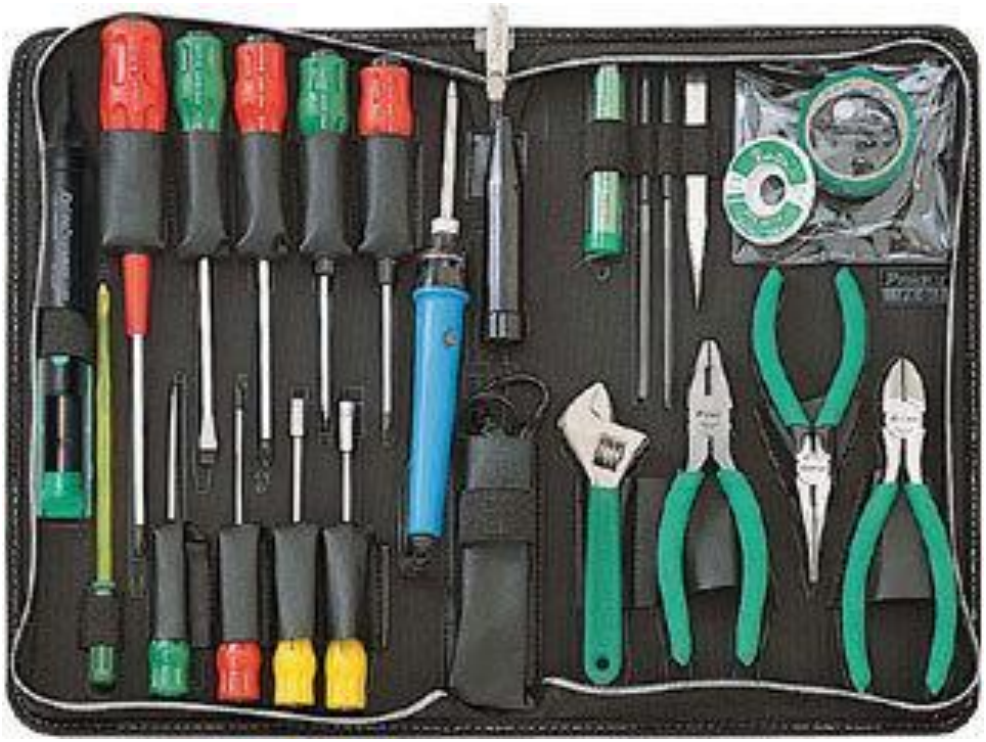
Or… a VERY Portable Workbench



My Workbench



Hand Tools



- Screwdrivers
- Nut Drivers
- Needle nose
- Wire cutters
- Pliers
- Wrench
- Tape
- Xacto knife

Soldering Irons

Hakko FX888D $100

Hakko FX951 $250

Weller Soldering Station

- Soldering station
- Not a pencil
- Temperature adjustment

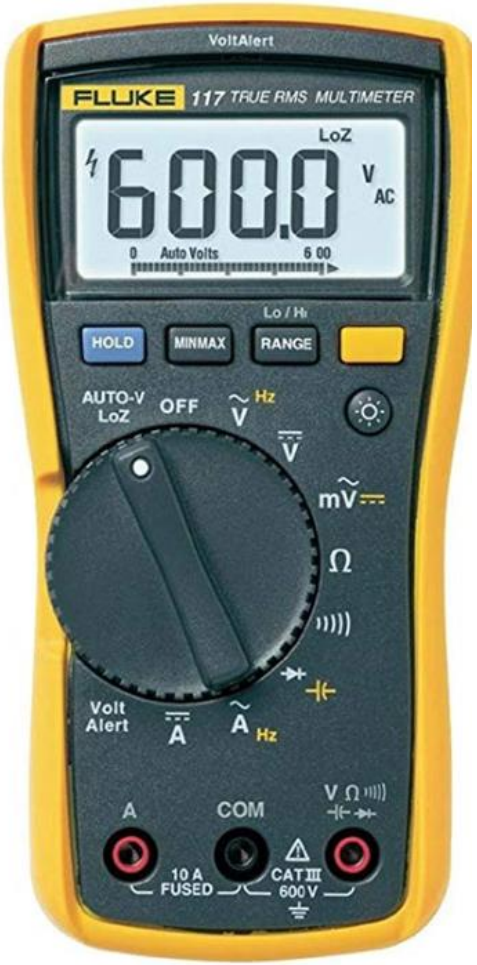
Your Next Christmas Present

Hakko FR301 Desoldering tool

Digital Multi Meter

- Good enough $20

- Fluke DMM $160



Bench DMM – Siglent SDM3045 $380

- Real 4½ digit (60000 count) readings resolution
- Up to 150 rdgs/s measurement speed
- True-RMS AC Voltage and AC Current measuring
- 1 Gb NAND flash size, Mass storage configuration files and data files
- Built-in cold terminal compensation for thermocouple
- With easy, convenient and flexible PC software: EasyDDM

Low Current Bench Power Supply

B+K 1601 $60 on Ebay

- 0-30 VDC
- 0-2 A
- Over current protection

Low Current Bench Power Supply

Workbench Podcast 3

No Name on Ebay

- 0-30 VDC
- 0-5 A
- $80

Siglent SPD-3303C DC
Dual output
0-30V 3 Amp
$240

High Current 12v Bench Supply

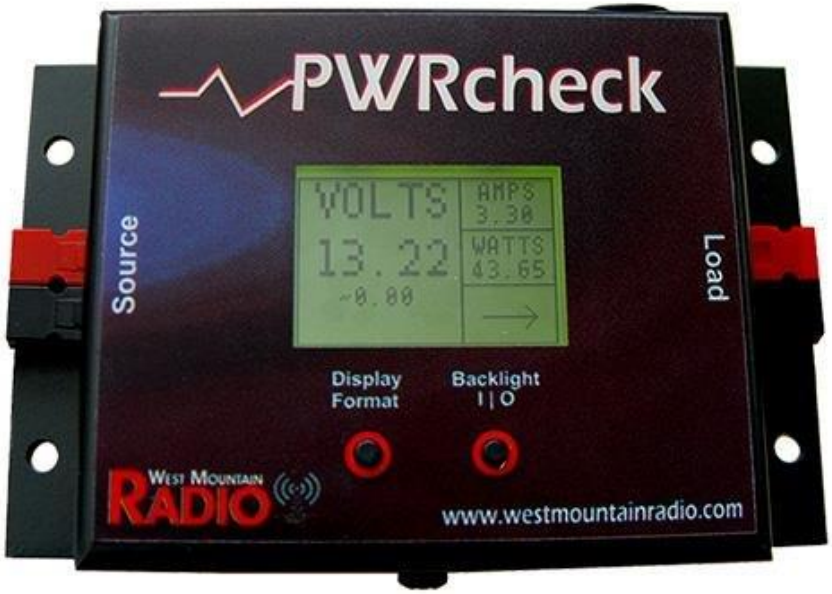
Tekpower $99

- 13.8v
- 30 Amps
- Frequency shift
- PowerPole connectors

Powerwerx $160

- 13.8v
- 30 Amps
- Digital voltage & current meters

Handy DC Power Meters



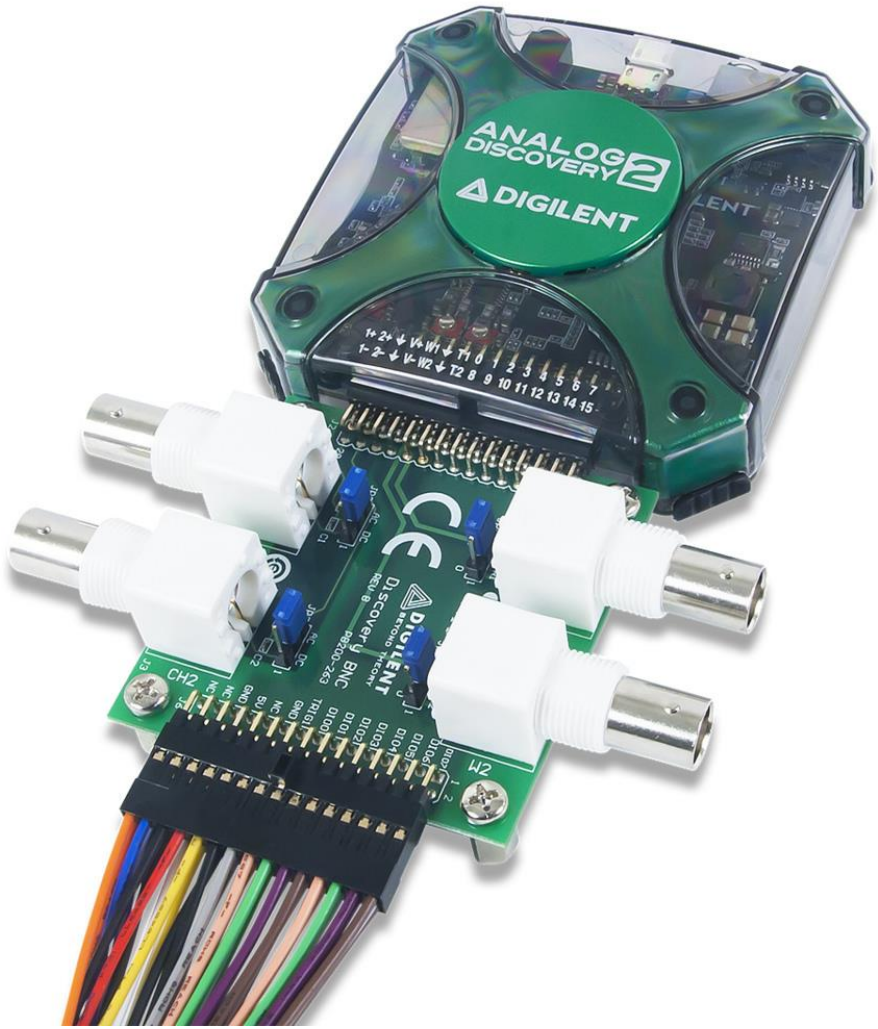
West Mountain Radio
PwrCheck
$200

No Name brand on Ebay
0-60 Volts 0-100 Amps
Must add PowerPoles
$10

Oscilloscopes
Rigol Z1054 $350

- 4 Channels
- 50 MHz Bandwidth – hackable to 100 MHz
- UltraVision: Deeper memory 12 Mpts
- 7" screen WVGA(800X480) TFT
- USB HOST, USB DEVICE, LAN, Aux

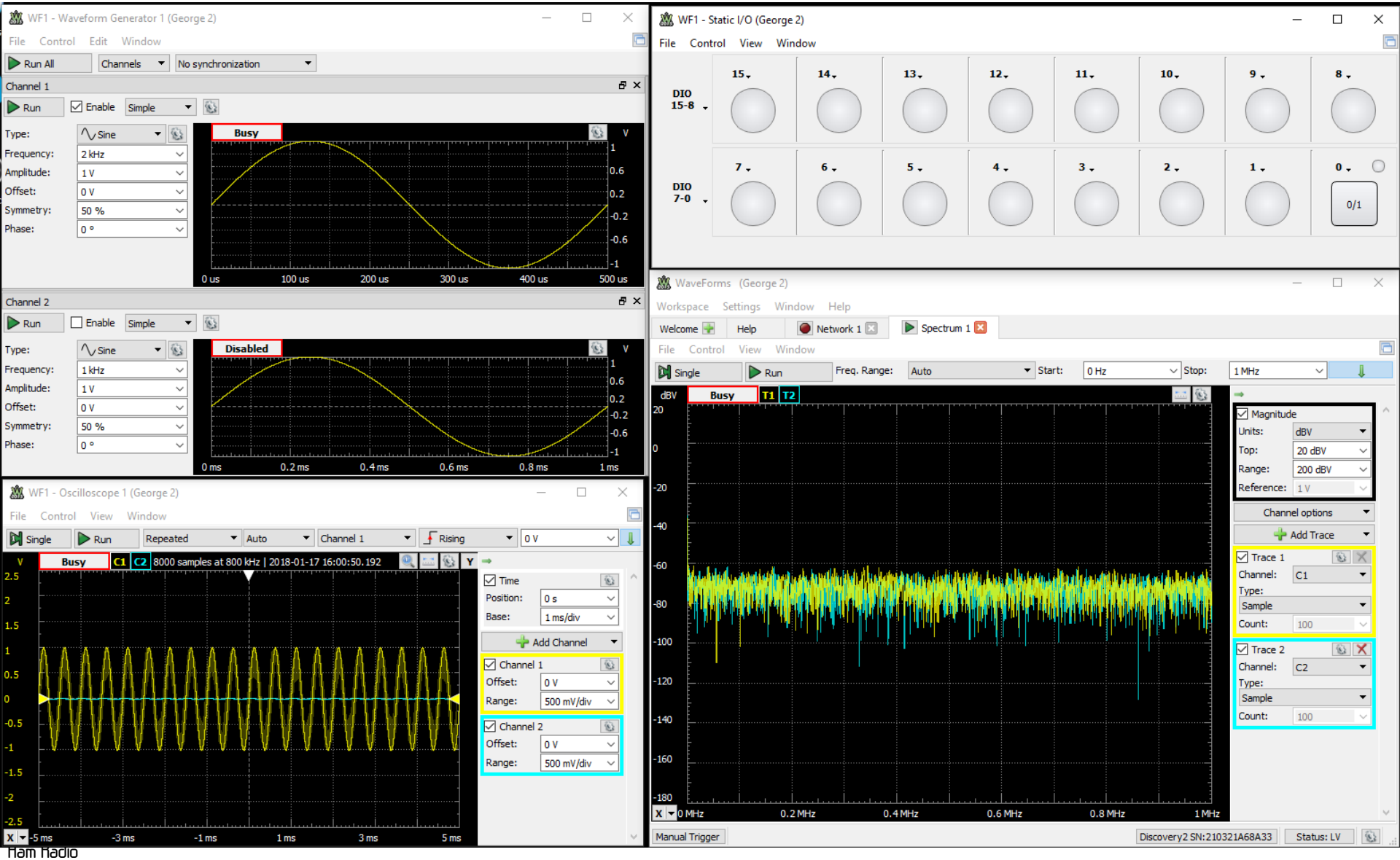
Oscilloscopes
Digilent Analog Discovery



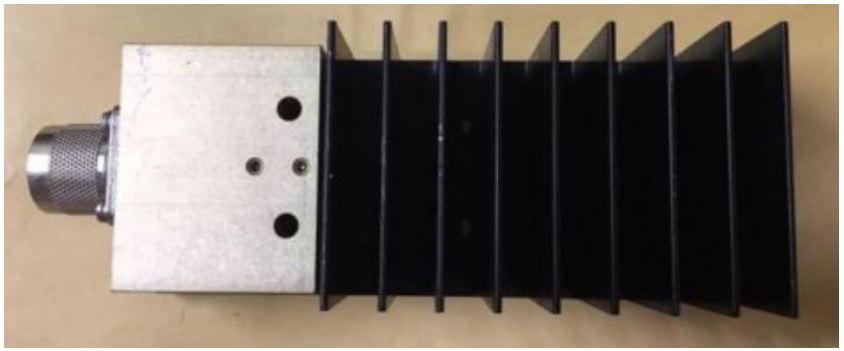
~~$339~~ **$239 !**

- USB Connected Instrument
- 2 Channel oscilloscope
- 2 Waveform generators
- Power supply
- Data logger
- Logic analyzer
- Pattern analyzer
- Switch I/O control panel
- Network analyzer
- Spectrum analyzer

Waveforms – PC / Mac / Linux Software



RF Dummy Load

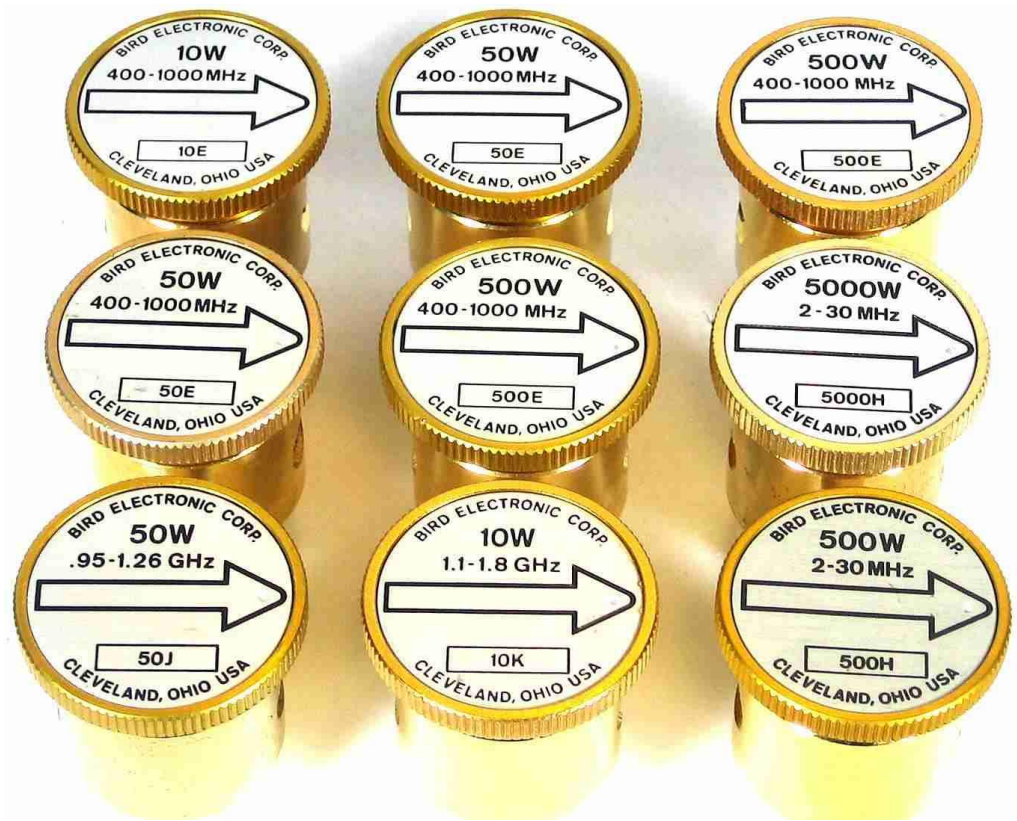


- 1,500 watts
- Air cooled
- 0-650 MHz
- $79 (DX Engineering)

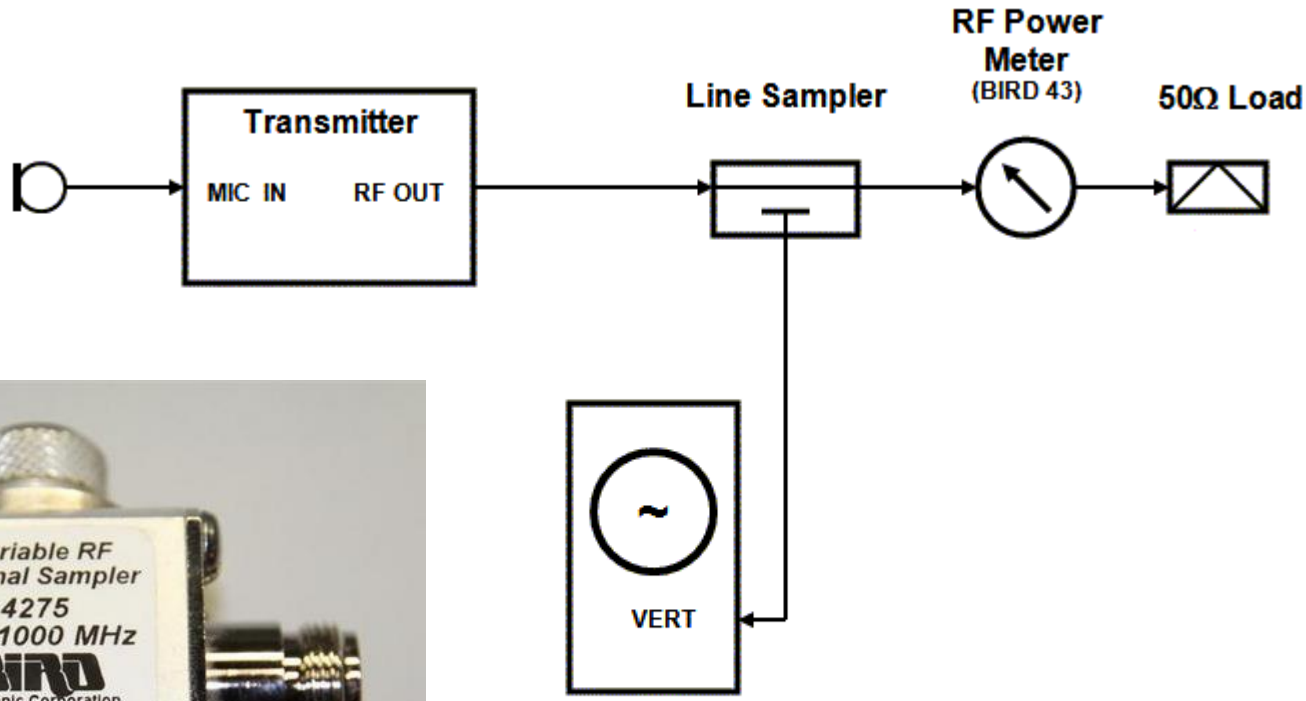
- 25 watts
- Air cooled
- VHF/UHF
- $15 (Ebay)

RF Watt Meter – Bird 43

- > $400 new !!!
- Used: $100-$250
- Slugs $30-$100
- Slugs 10 mW to 5 kW
- VLF – 2 GHZ



Sampler



- Scopes
- Spectrum analyzer
- Frequency counters

RF Watt Meter – Comet / Diamond / etc.

- 1.8 – 160 MHz
- 140 - 525 MHz
- PEP / Average SWR
- 200 Watts
- $180

Parts

The Usual Suspects

Digi-Key Corporation

Mouser Electronics

Allied Electronics

Other Important Sources

ebay

Banggood.com

AliExpress

Build Projects

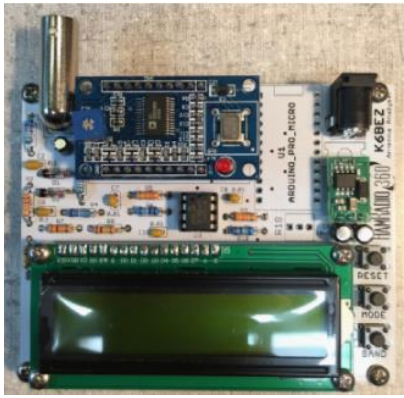
Build Projects

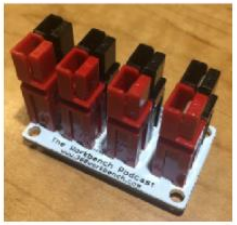
- K6BEZ Antenna analyzer
- PowerPole power strip
- QRP dummy load
- QRP “smarty load”
- **Remote coax switch**
- 12 VDC Power monitor & Low Voltage Disconnect

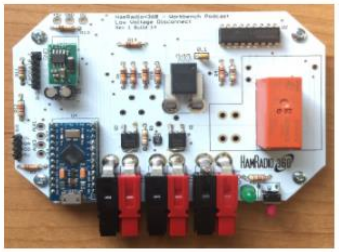
PAST

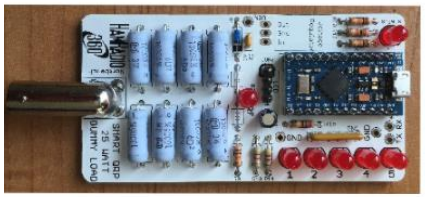
CURRENT

NEW



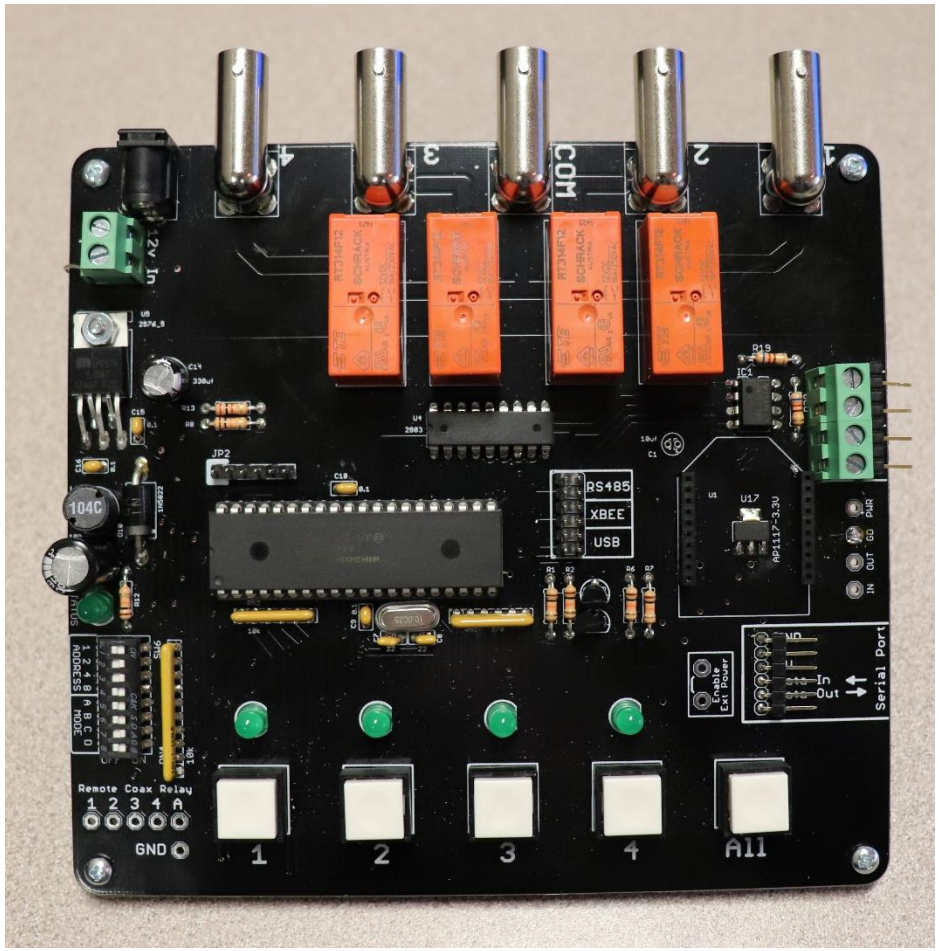




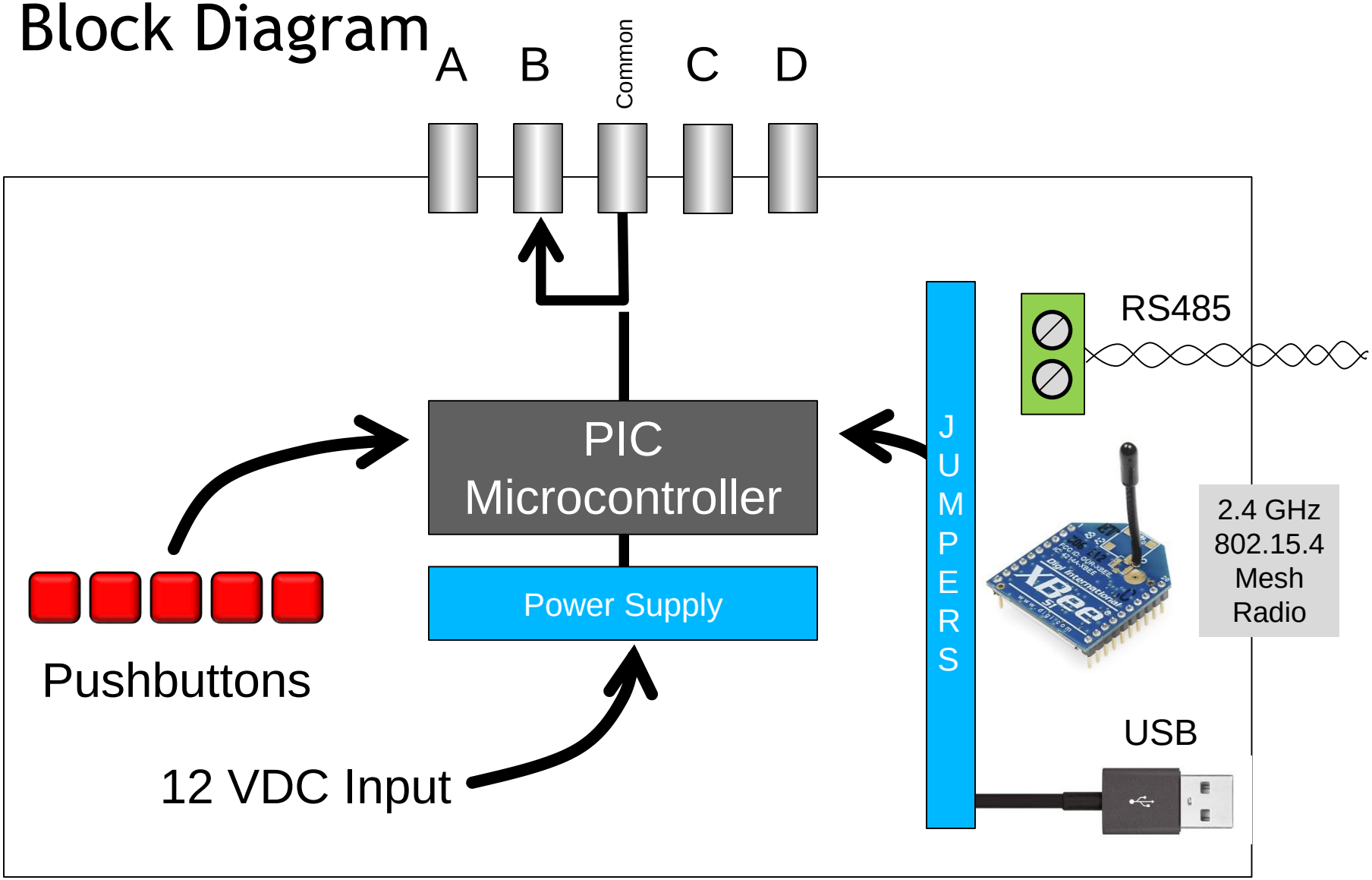


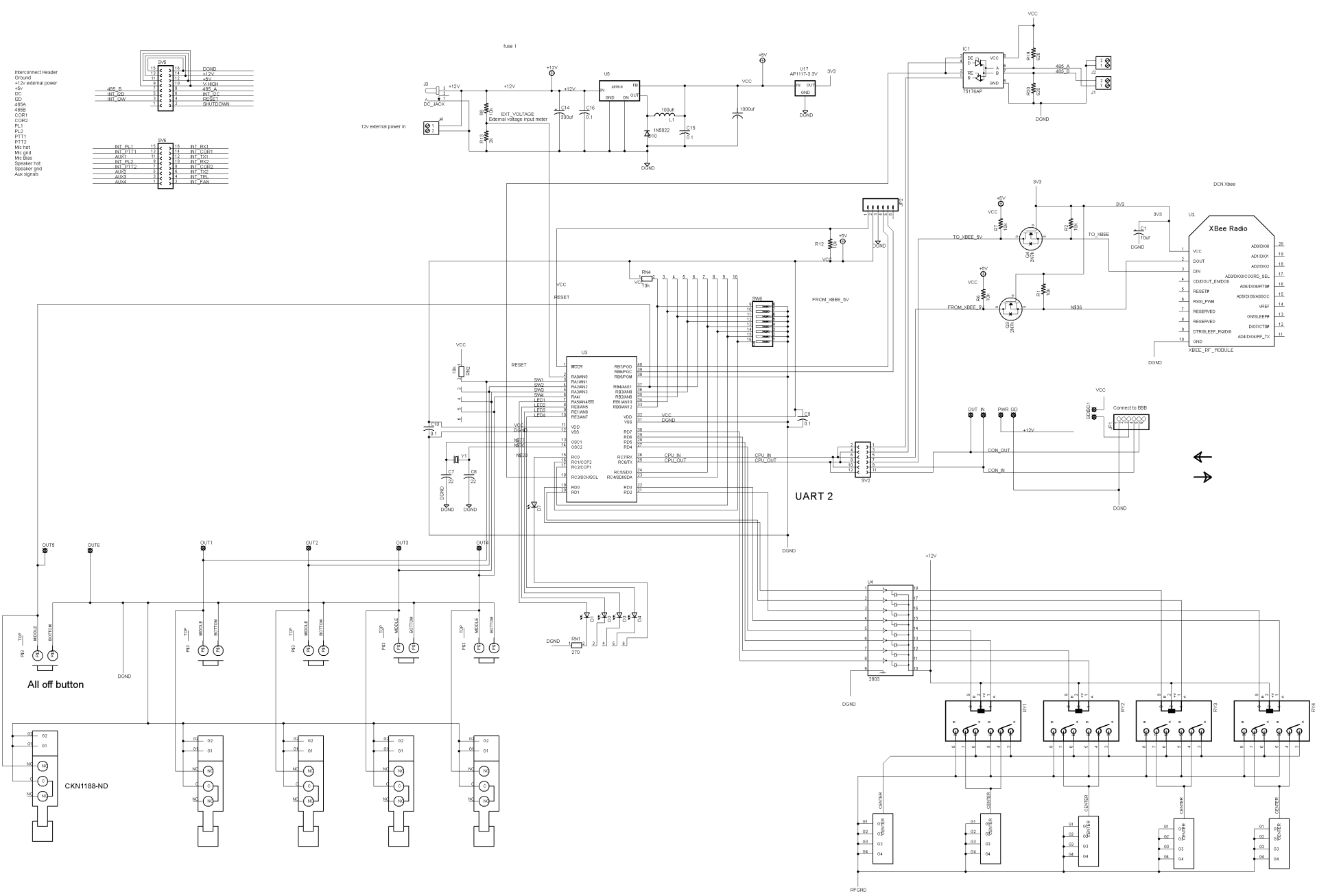
Remote Coax Switch

- 1 pole / 4 position switch
- Latching relays
- Control ports
  - Pushbuttons
  - USB
  - RS485
  - Wireless
- Runs on 12 VDC
- All through hole parts



Block Diagram



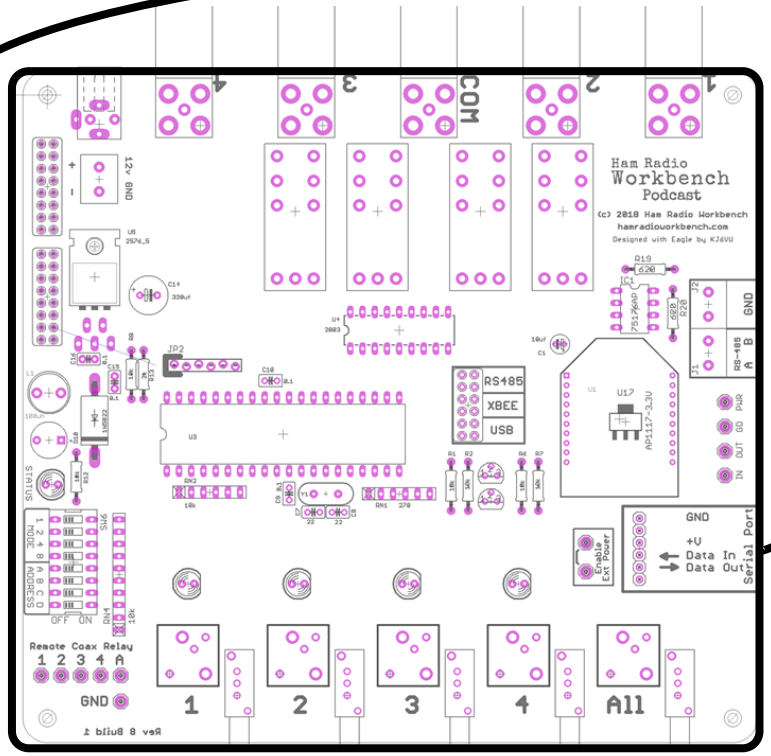


Ham Radio Workbench Podcast

Simple Computer Control

Dumb terminal
putty

FTDI
Cable



//RY1 Selects port 1

//RY2 Selects port 2

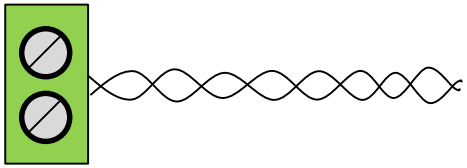
Etc…

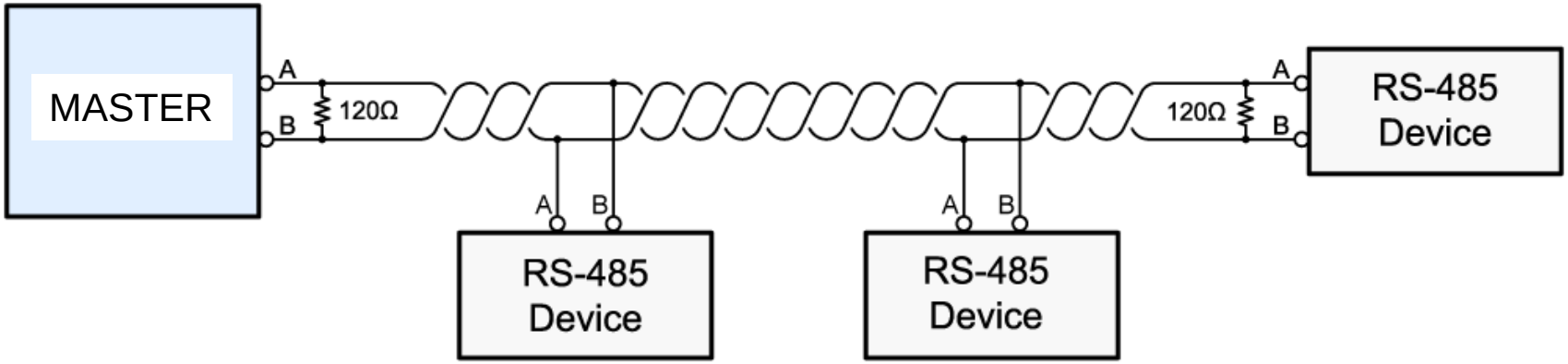
//ALL Forces all on or off

User selectable

//STATE Responds with RY state

RS485

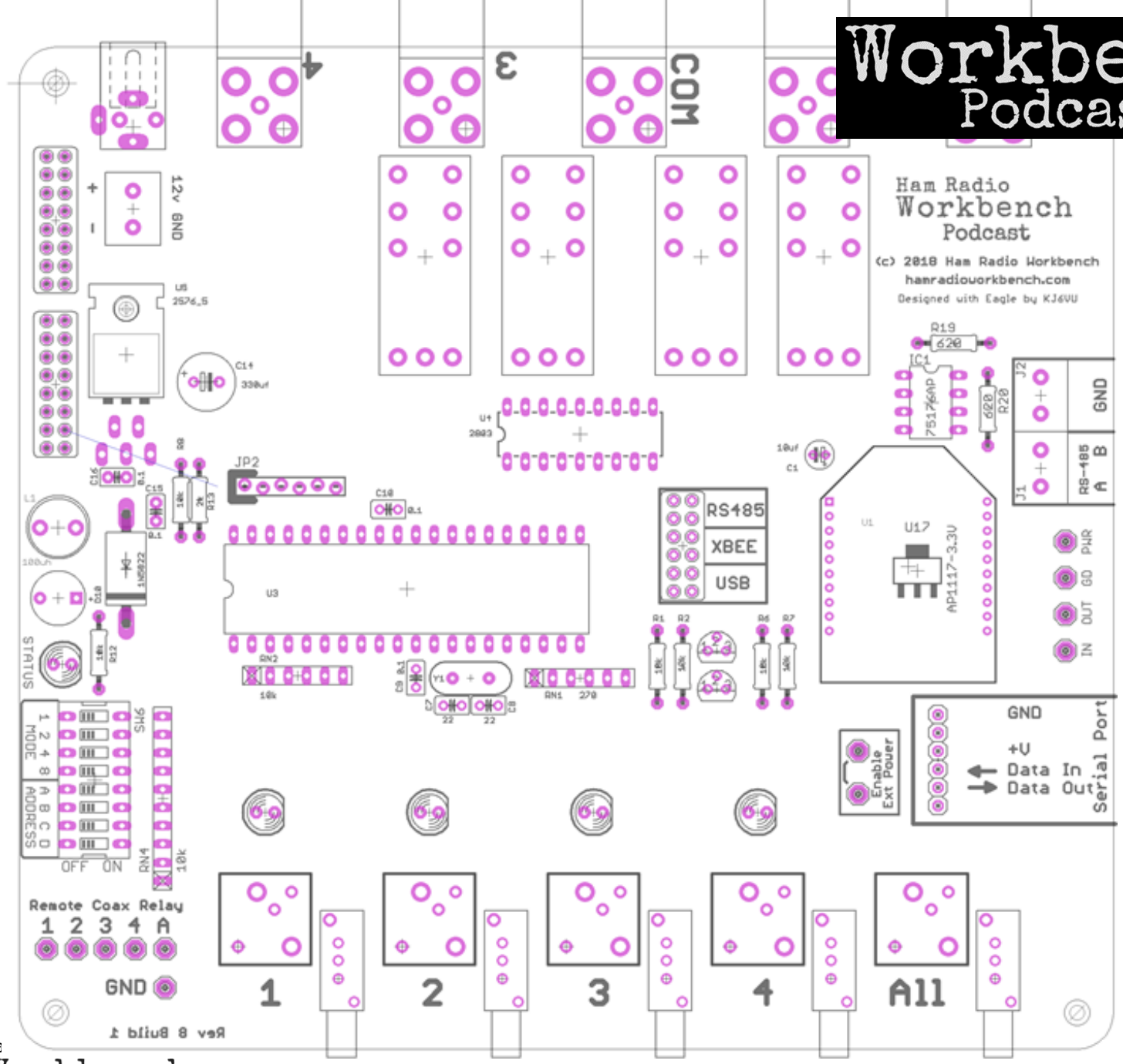




- Defines the physical signaling layer
- Half duplex
- Multi-drop network
- 1000’s of feet

802.15.4 Mesh Radio

- 802.15.4 Physical layer and MAC
- 2.4 GHz
- 1mW to 63mW
- UART in/out
- Easily covers a typical home / lot
- One end in the shack one at the antennas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Workbench
Podcast
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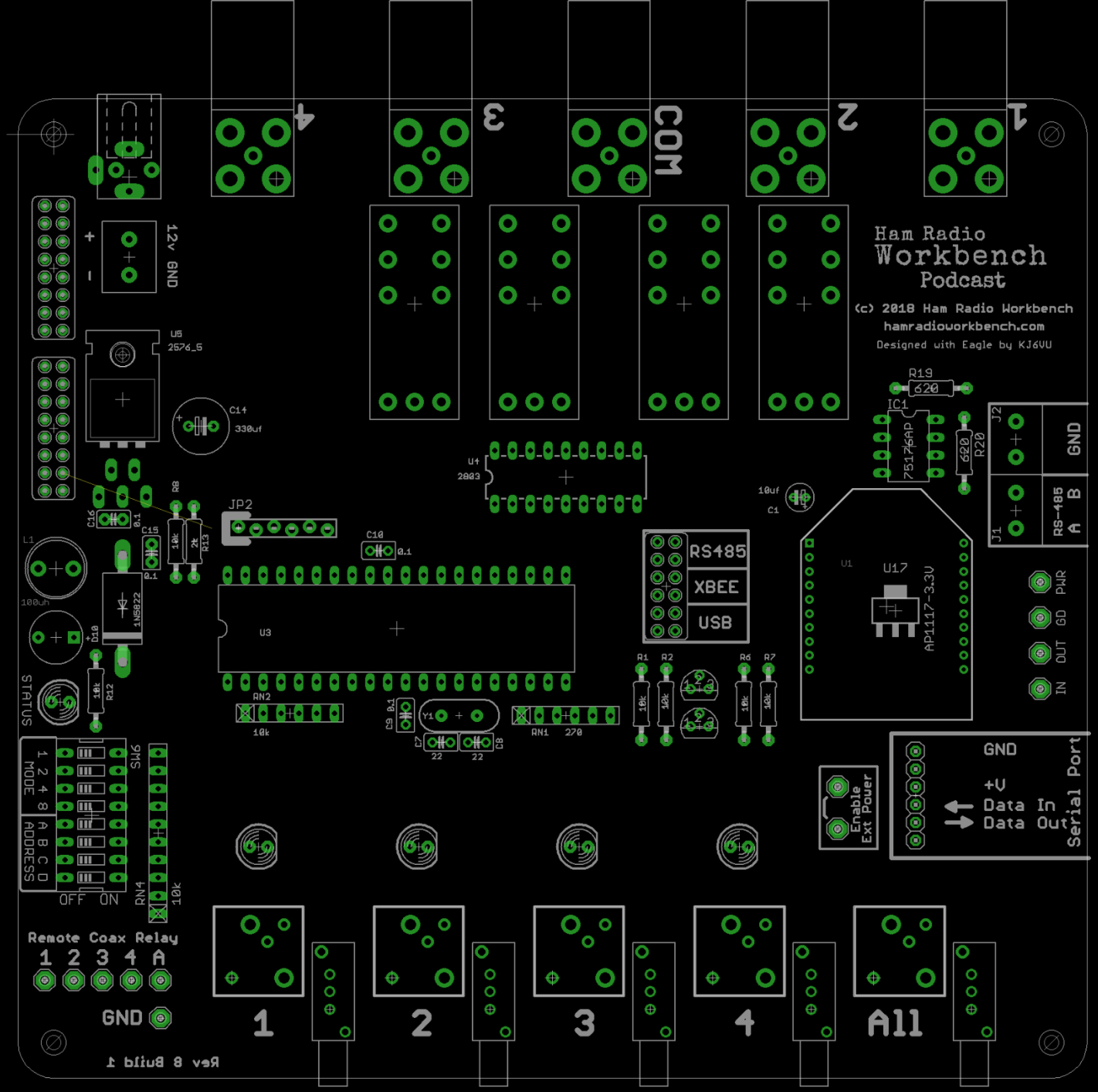
Designed with Eagle by KJ6VU
12v GND
COM
RS485
XBEE
USB
U17
AP1117-3.3V
GND
RS-485
A B
PWR
GD
OUT
IN
Enable Ext Power
GND
+V
Data In
Data Out
Serial Port
MODE
ADDRESS
OFF ON
STATUS
Remote Coax Relay
1 2 3 4 A
GND
1
2
3
4
All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Workbench
Podcast
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Designed with Eagle by KJ6VU
Rev 8 Build 1
12v GND
U5
2576_5
C14
330uf
L1
100uh
D10
1N5822
STATUS
R12
10k
C16
0.1
C15
0.1
R8
10k
R13
2k
JP2
C10
0.1
U3
U4
2003
RS485
XBEE
USB
RN2
10k
C9
0.1
Y1
C7
22
C8
22
RN1
270
R1
10k
R2
10k
R5
10k
R7
10k
R19
620
IC1
75176AP
R20
620
10uf
C1
U1
U17
AP1117-3.3V
J2
GND
J1
RS-485
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GD
OUT
IN
Enable
Ext Power
GND
+V
Data In
Data Out
Serial Port
MODE
1 2 4 8
ADDRESS
A B C D
SW6
OFF ON
RN4
10k
Remote Coax Relay
1 2 3 4 A
GND
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All
COM
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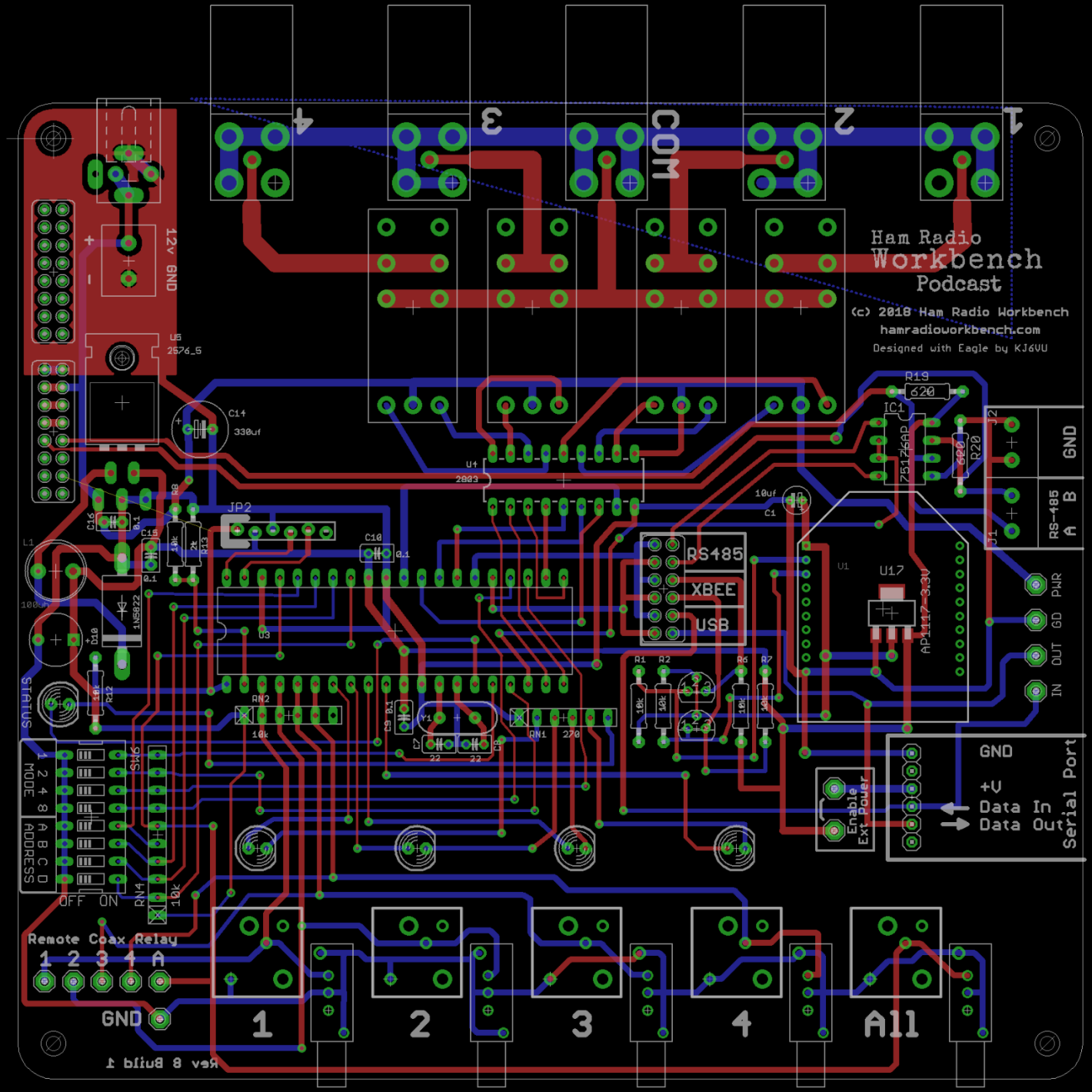
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COM
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2803
JP2
C10
0.1
RS485
XBEE
USB
U3
RN2
10k
RN1
270
Y1
22
22
C7
C8
C9
R1
R2
R5
R7
10k
IC1
7512560P
R19
620
R20
620
J2
GND
RS-485
A B
J1
C1
10uf
U1
U17
AP1117-3.3V
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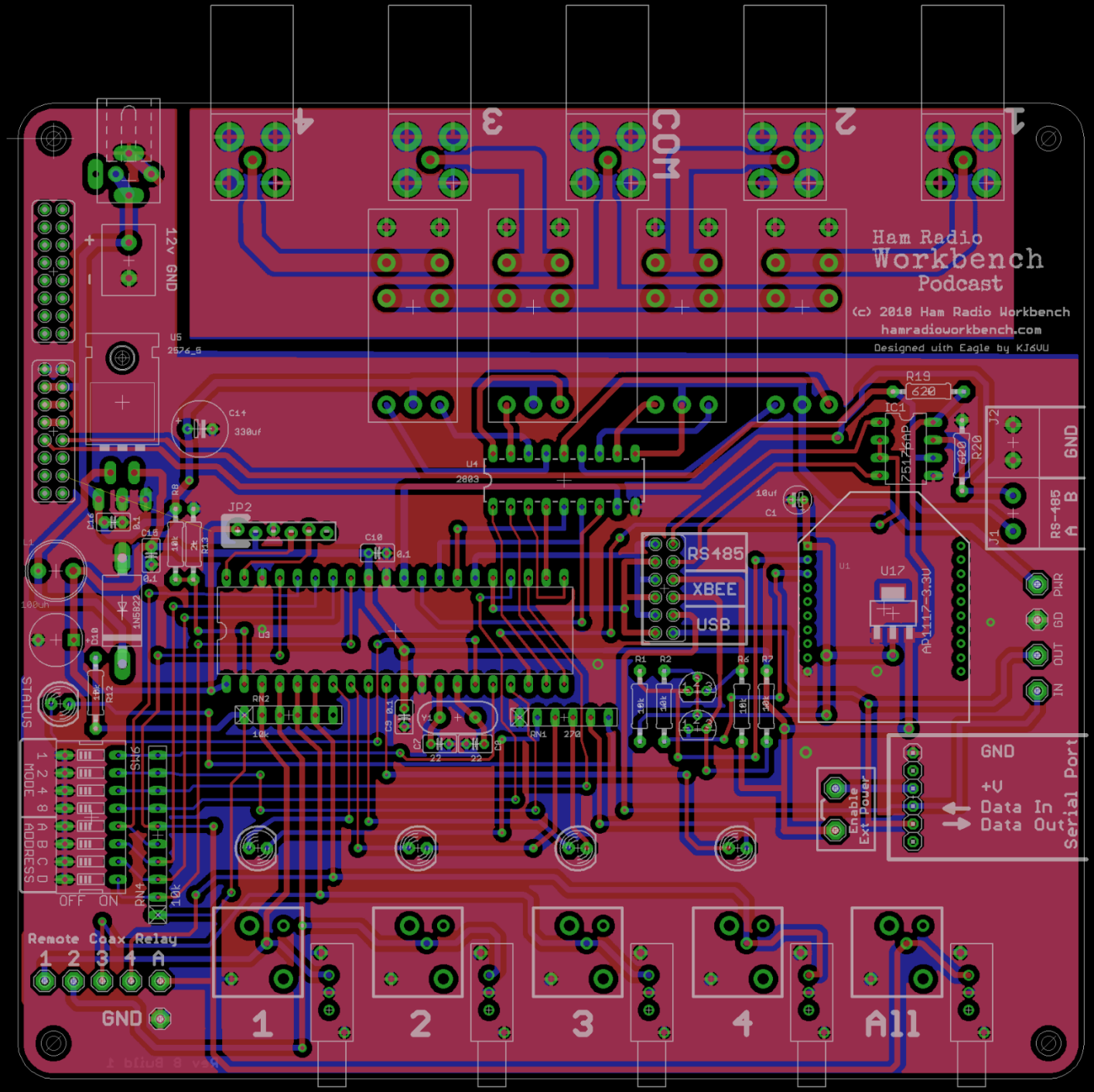
R13
2k
D10
1N5822
R12
10k
Rev 8 Build 1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COM
1
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3
4
12V GND
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2576_5
C14
330uf
U4
2803
JP2
C10
0.1
R19
620
IC1
7512CAP
R20
620
J2
GND
RS-485
A B
J1
10uf
C1
U1
U17
AP1117-3.3V
RS485
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USB
PWR
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OUT
IN
R1
R2
R6
R7
10k
RN2
10k
RN1
270
Y1
22
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C16
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R8
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R13
2k
D16
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R12
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STATUS
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1 2 4 8
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A B C D
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10k
Enable
Ext Power
GND
+V
Data In
Data Out
Serial Port
Remote Coax Relay
1 2 3 4 A
GND
1
2
3
4
All

Ordering Boards – www.seeedstudio.com

Upload files

Enter size

Quantity

Thickness

Color

Inbox (3,503) - george.z | Fusion PCB Manufacturi

Secure | https://www.seeedstudio.com/fusion_pcb.html

seeed | Bazaar | Fusion | Propagate | Support | What are you looking for?

Fusion | PCB / PCBA | PCB Assembly | Advanced PCB | Stencil | 3D Printing | PCB Layout | Gallery | More | English

Add Gerber Files

Only ZIP or RAR files accepted. Maximum size 4MB.

684678_bnc4portremotecoaxrelayrev7build1.zip Gerber Viewer

Base Material	FR-4 TG130 / Aluminum / Flexible Boards
No. of Layers	1 layer / 2 layers / 4 layers / 6 layers
PCB Dimensions	150 * 150 * Units in mm 100 mm * 100mm
PCB Quantity	10
No. of Different Designs	1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 Example
PCB Thickness	0.6 / 0.8 / 1 / 1.2 / 1.6 / 2 / 2.5 / 3 * Units in mm
PCB Color	Green / Red / Yellow / Blue / White / Black
Surface Finish	HASL / HASL Lead Free / ENIG / Hard Gold
Minimum Solder Mask Dam	0.1mm↑ / 0.4mm↑
Copper Weight	1oz. / 2oz. / 3oz.
Minimum Drill Hole Size	0.2mm / 0.25mm / 0.3mm
Trace Width / Spacing	4/4 mil / 5/5 mil / 6/6 mil
Blind or Buried Vias	Yes / No
Plated Half-holes / Castellated Holes	Yes / No

Base Material	FR-4 TG130
No. of Layers	2 layers
PCB Dimensions	150mm * 150mm
PCB Quantity	10
No. of Different Designs	1
PCB Thickness	1.6mm
PCB Color	Green
Surface Finish	HASL
Minimum Solder Mask Dam	0.4mm↑
Copper Weight	1oz.
Minimum Drill Hole Size	0.3mm
Trace Width / Spacing	6/6 mil
Blind or Buried Vias	No
Plated Half-holes / Castellated Holes	No
Sub-Total	USD$50.70
Production Time	5 ~ 6 Working Days
Weight	0.72kg

Add to Cart

Buy !

Contact Support

Firmware Development – C or Basic

Swordfish IDE - Coax Switch Rev 1 Build 9.bas

File Edit View Project Plugin Help

New Open Save Cut Copy Paste Undo Redo Print Build

Front Panel rev 11 build 2 | DIN Front Panel rev 6 build 3 | DIN PR1 rev 11 Build 4 | Coax Switch Rev 1 Build 9

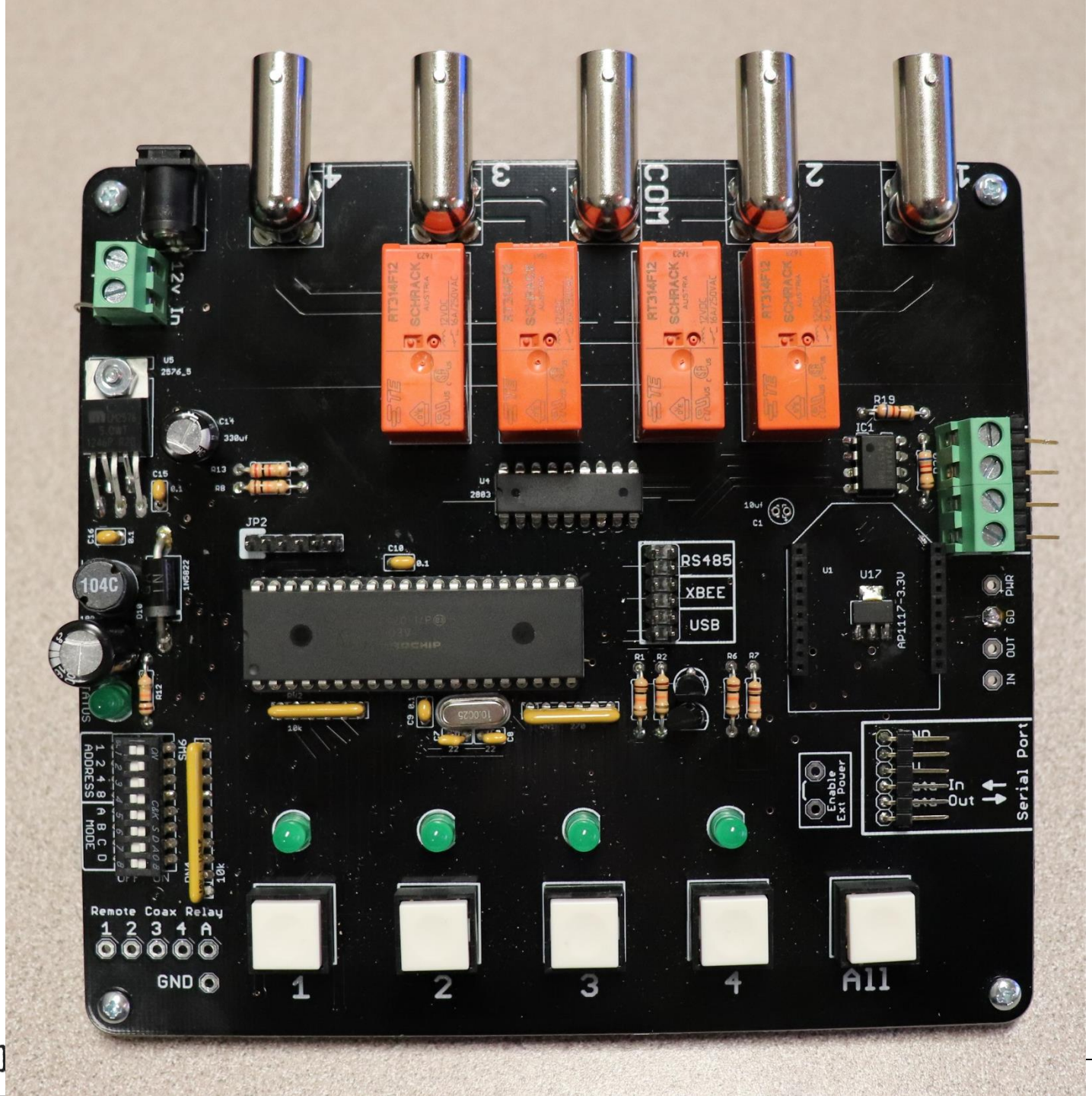
Code Explorer

- Includes
  - 18f4620
  - USART
  - suart
  - hs_DS18B20
  - ow
  - hs_LCD
  - ISRRX
  - STRING
  - ADC
  - hs_convert
  - hs_shift
  - eeprom
  - hs_utils
- Constants
- Types
- Structures
- Variables
- Subs and Functions
  - led_on ()
  - led_off ()
  - send_msg (msg As S
  - relay_1_on ()
  - relay_2_on ()
  - relay_3_on ()
  - relay_4_on ()
  - relay_1_off ()
  - relay_2_off ()
  - relay_3_off ()
  - relay_4_off ()
  - send_packet (msg A
  - get_analog_inputs (
  - set_all_off ()
  - get_dip_sw ()
  - help_screen ()
  - process_payload (cm
- Macros
- Interrupts and Events

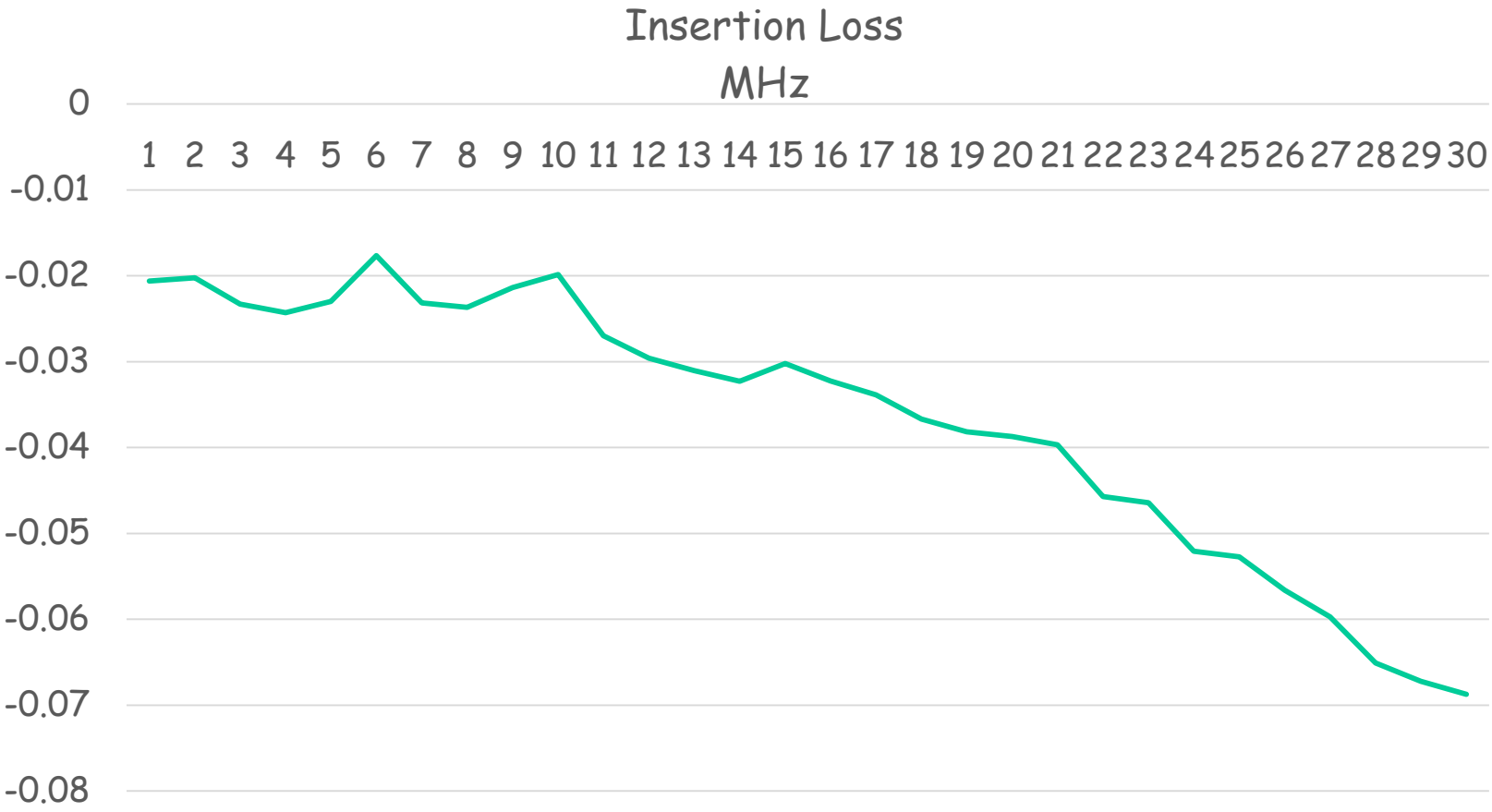
Coax Switch Rev 1 Build 9

```
While (true)

'==========================================================================================
'------------------------------------------------------------------------
'   Process serial buffer - DO NOT CHANGE THIS CODE
'------------------------------------------------------------------------
    '----- Drain the hardware ring buffer into the working inbuf buffer ------
    While (ISRRX.DataAvailable() And (bufindex<inbufsize) And (Not inbuflineready))   ' New byte present in
      inbuf(bufindex) = ISRRX.ReadByte()    ' Transfer the byte in the UART to the input buffer
       If inbuf(bufindex) = #13 Or inbuf(bufindex) = #10 Then     ' Command terminator present
         inbuflineready = true      ' Set flag to process payload
       EndIf
       bufindex = bufindex + 1      ' No terminator, increment the index pointer
       inbuf(bufindex) = 0          ' Set next character in the input buffer to null
    Wend

    If bufindex >= inbufsize - 1 Then
        inbuflineready = false      ' Reset data ready flag
        bufindex = 0                ' Reset buffer index pointer
        inbuf = ""                  ' Clear input buffer
    EndIf

    '----- Pluck the data from the input buffer inubf and flush the buffer
    If bufindex<>oldbufindex Then
        oldbufindex = bufindex
    EndIf
   '----- Process incomming serial payload, if any
    If inbuflineready Then          ' Data is in the input buffer, ready to be processed
        x = Length(inbuf)           ' Determine the size of the data in the input buffer
        inbuf = Left(inbuf,x-1)     ' Grab all characters in the input buffer except the last character
        process_payload (inbuf,device_address)     ' Check to see if payload (inbuf) contains a valid seria
        inbuflineready = false      ' Reset data ready flag
        bufindex = 0                ' Reset buffer index pointer
        inbuf = ""                  ' Clear input buffer
    EndIf

'==========================================================================================
'------------------------------------------------------------------------
'   Check for reboot flag
'------------------------------------------------------------------------
    If reboot_flag = 1 Then
        reboot_flag = 0
        Break
    EndIf

'==========================================================================================
```

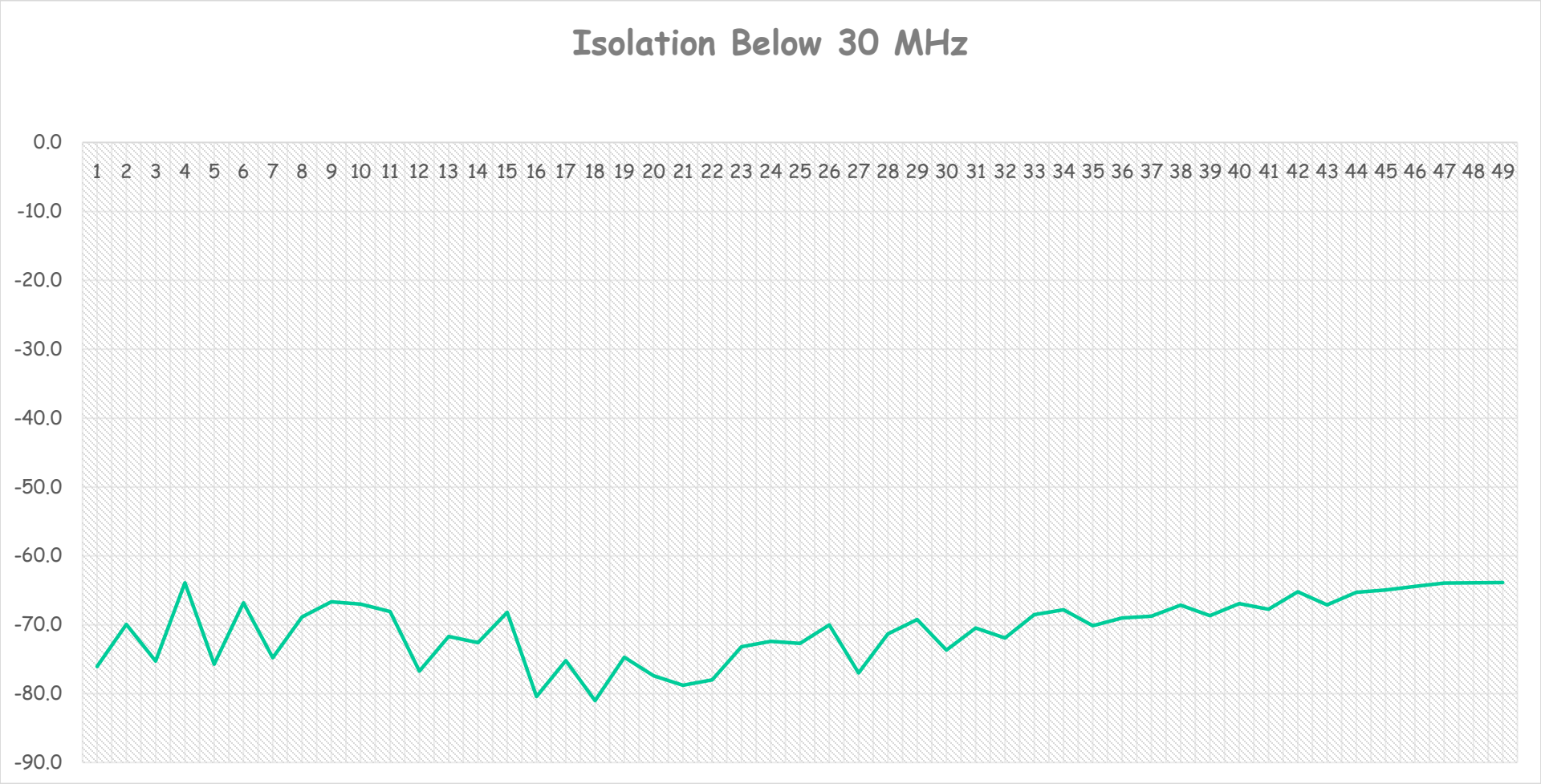
Success : 18341 program bytes used, 2677 variable bytes used | Ln 914 : Col 87 | CAP | OVR


12v In
COM
4
3
2
1
RT314F12
SCHRACK
U5
2576_5
C14
330uf
C15
0.1
R13
R8
C16
0.1
JP2
104C
1N5822
D10
R12
STUS
U4
2803
C10
0.1
RS485
XBEE
USB
U1
U17
AP1117-3.3V
R19
IC1
10uf
C1
PWR
GD
OUT
IN
R1
R2
R6
R7
C9
0.1
10.0025
C8
22
22
10k
ADDRESS
1 2 4 8
MODE
A B C D
SW16
10k
Remote Coax Relay
1 2 3 4 A
GND
1
2
3
4
All
Enable
Ext Power
In
Out
Serial Port

Testing – Insertion loss < 0.1db at 30 MHz



Testing – Isolation >64db Below 30 MHz

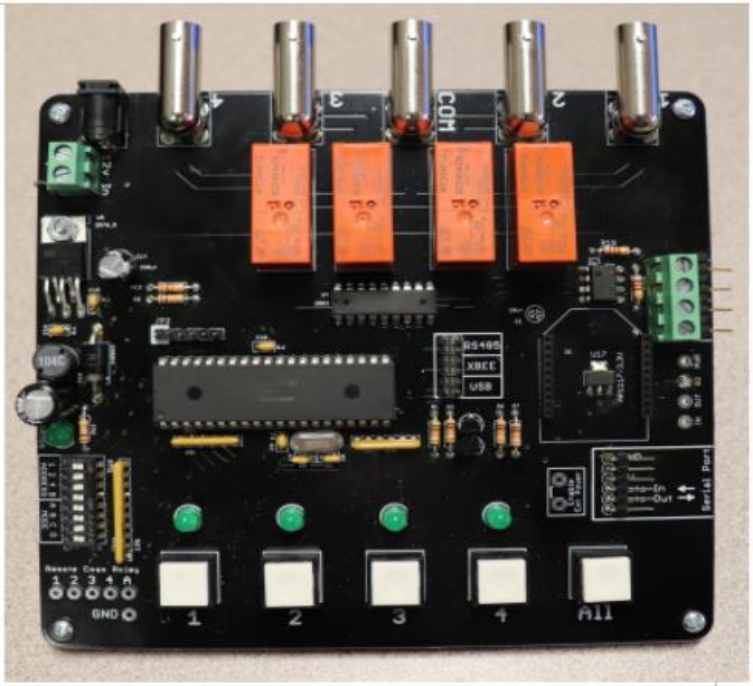


Project Web Page

Remote Coax Relay

Documents

- Bill of Materials (BOM) in Excel format
- Coax relay manual



Parts Suppliers

You must order the Basic Kit

- Basic Kit (PCB, programmed CPU chip)

You can order the rest of the basic parts from Digikey or source from your junk box

- Digikey shopping cart for the required parts

If you want every possible option, you will need to order the rest of the parts. Please note that there are multiple options for Xbee radios. Pick ONE for the board and another one for your host PC side of the connection.

- Digikey shopping card for the optional parts

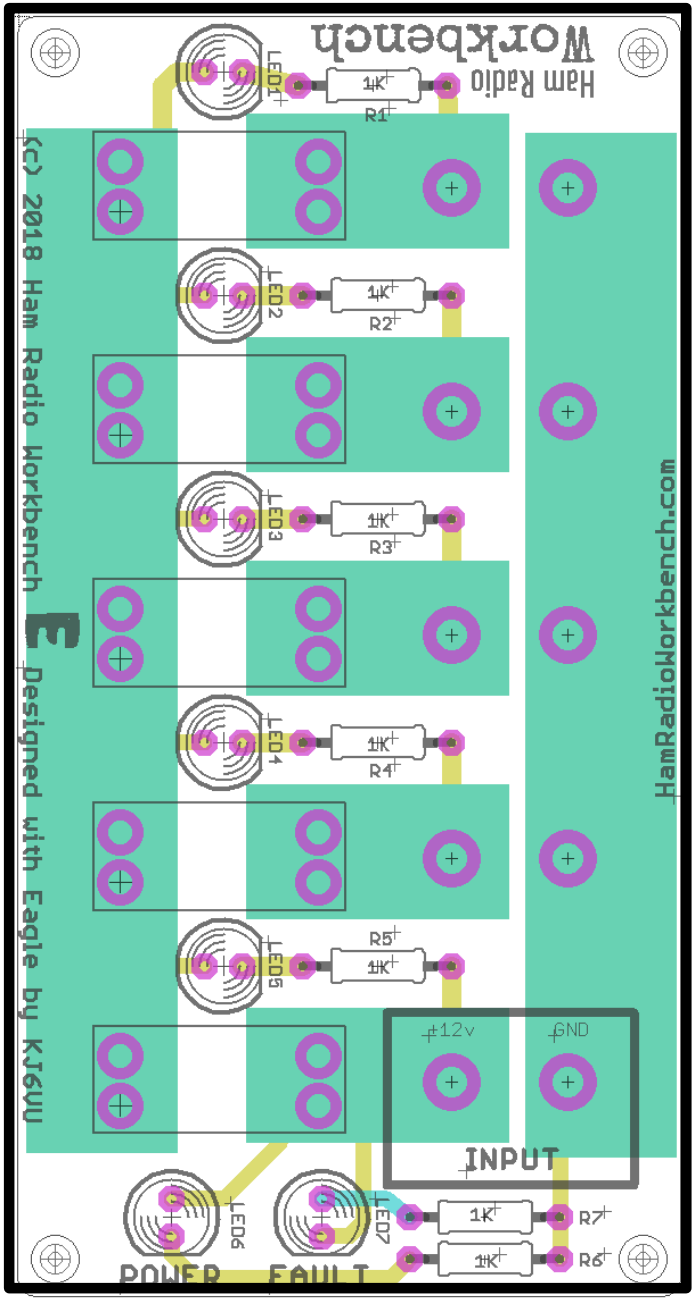
The PC side of the optional Xbee wireless data radio link can be found at many sources including Amazon, Ebay, Aliexpress and others. Search for "Xbee USB adapter"

Firmware

```
'  Ham Radio Workbench Podcast 4 Port Coax Relay Board
'  Open source firmware Rev 1.0
'-----[ Set configuration parameters ]---------------------------------
Device = 18f4620
Clock = 40
Config osc = hspll              ' Set clock mode to 4x PLL

#option WDTEN = on
#option usart_brgh = TRUE
#option usart_brg16 = TRUE
#option RX_BUFFER_SIZE = 11     ' Set serial port rx buffer size  (multiple of 2)
'-----[ Include subroutine libraries ]---------------------------------
Include "USART.bas"              ' UART subroutines
Include "ISRRX.bas"              ' Interrupt driven serial subroutines
Include "STRING.bas"             ' String manipulation subroutines
Include "ADC.bas"                ' A/D converter subroutines
Include "hs_convert.bas"         ' Number conversion subroutines
Include "eeprom.bas"             ' Include EE PROM subroutines
Include "hs_utils.bas"

'==========================================================================
'=====[  Physical IO pin assignments  ]=====================================
'==========================================================================
       Public Dim status_led  As PORTC.0
       Public Dim sys_voltage As PORTA.0
       Public Dim button1     As PORTA.1
       Public Dim button2     As PORTA.2
       Public Dim button3     As PORTA.3
```

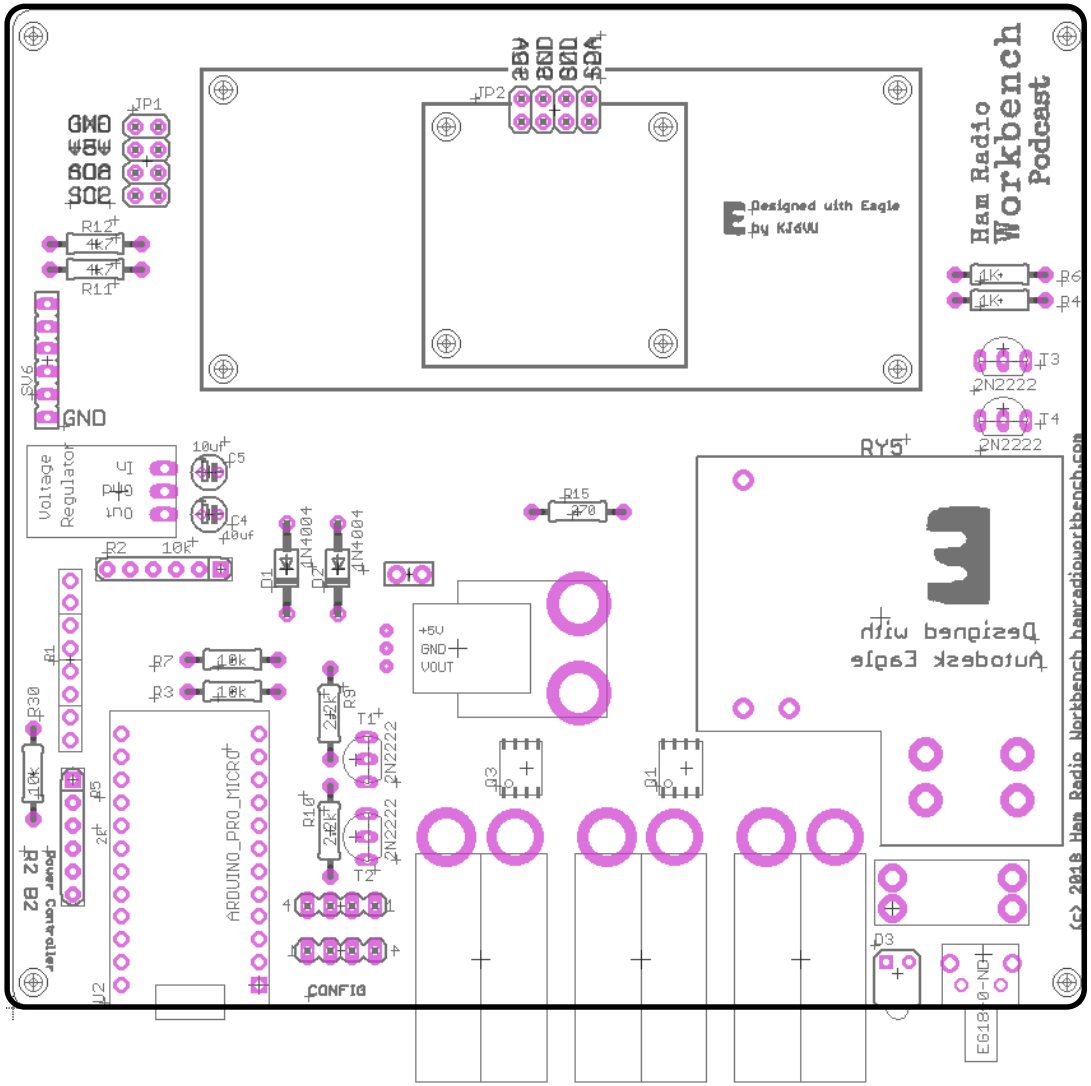
PowerPole Power Strip

- 1 Input
- 4 Fused outputs
- Blown fuse LED indicators
- Good / bad input polarity indicators



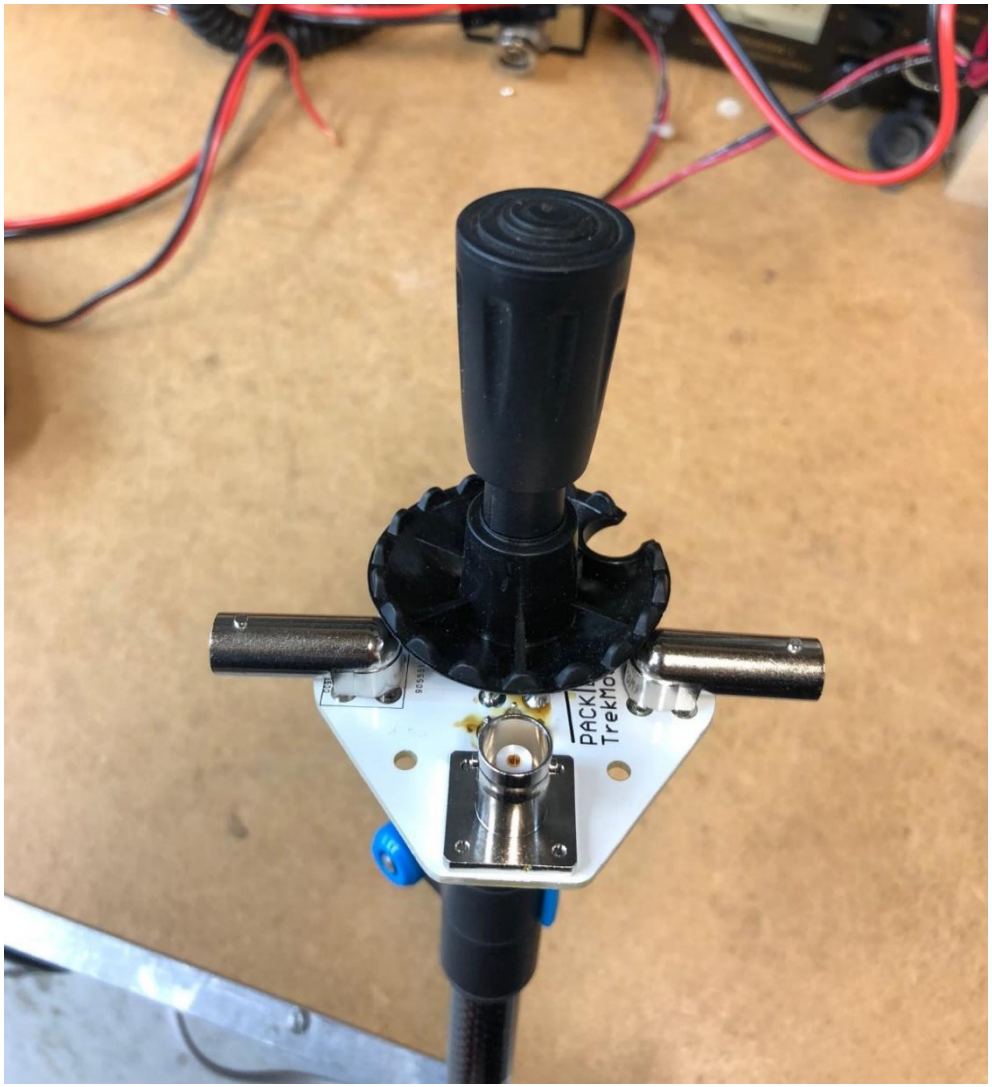
12 VDC Power Monitor & Low Voltage Disconnect

- 2 DC Inputs
- 1 DC Output
- OLED or LCD display
- 25A Current capacity
- Latching power relay
- Current Sensor
- 2oz Copper Traces
- Arduino Pro Micro
- Hackable platform

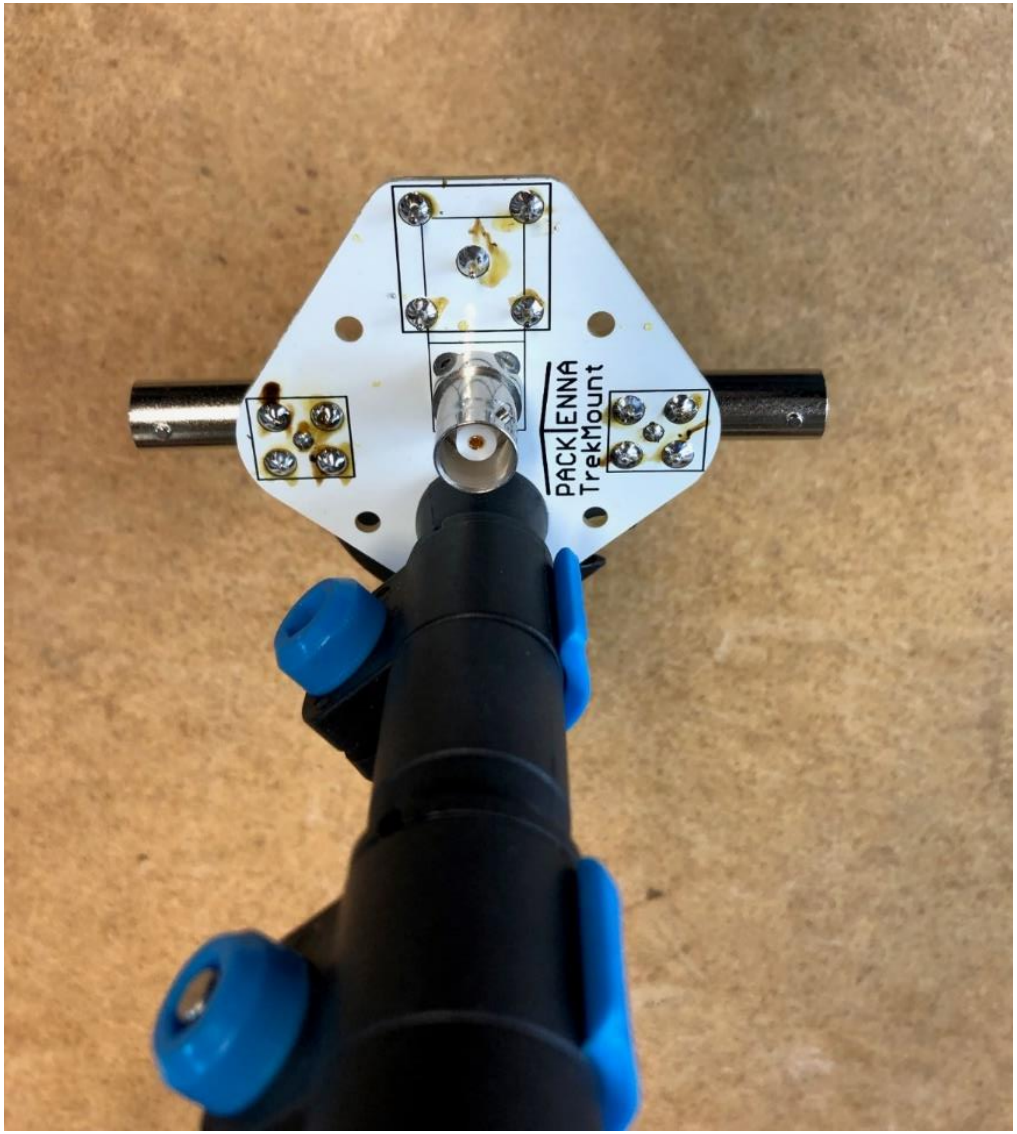


PackTenna HF Portable Antennas

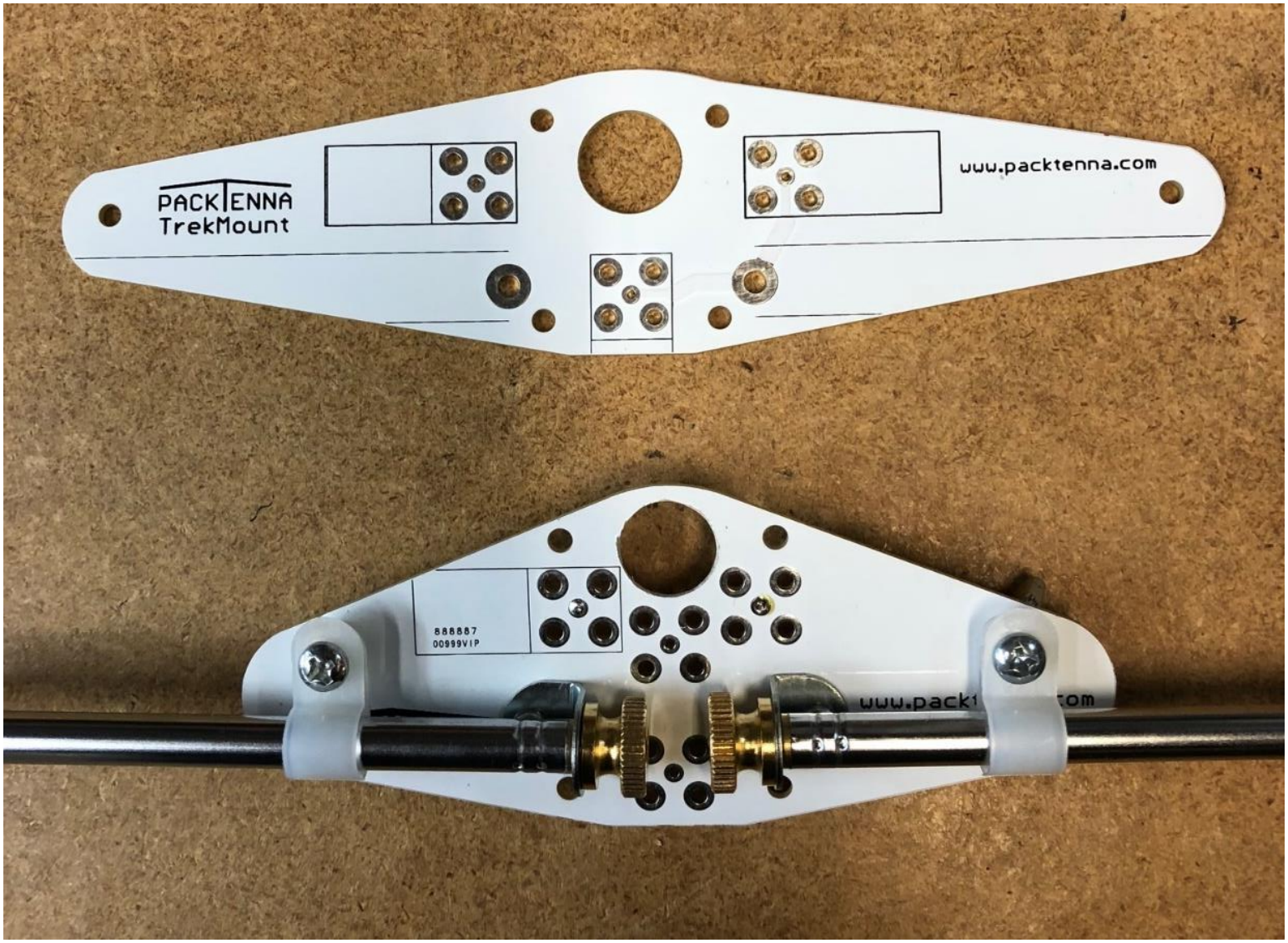
PackTenna VHF Portable Antennas



PackTenna VHF Portable Antennas



PackTenna VHF Portable Antennas



The Ham Radio

Workbench Podcast

Q&A