Anan SDR transverter interface

Prepared for NEWSVHF April 2015

Stu ve2xx

Objectives

- One mouse click control
- Build it the KISS method that it can easily be replicated using whatever components were available.
- Use BDC output from my Anan
- Find an off the shelf device as a BDC – Unified Micro
- Interface bdc either using relays or opto couplers, relays seemed a simpler route.
- Isolate the opto / relay board for the rest of the system, using separate power supply
- Provide a custom VHF solution tailored to the modern day station.
- Provide transparent switching that needs to go on , ptt, antenna relays amplifiers, power measurements , Hv B-

Objectives continued

- Possibility of expansion without compromising what was already in place.
- Switch low voltage high current 12v to power transverters

BDC output

- Unified Micro band decoder drives a series of Omron relays , some of which power preamps , sequencers and ptt. If used in conjunction with the Aduino strips a large amount of switching per band could be done. One could also go with 4N30 opto’s, i chose the relay strips because they were easy to use cost effective.

Unified Microsystems Band decoder

Unified Microsystems

Performance for the Competitive Radio Amateur

BCD-10 & BCD-14

Band Decoder / Antenna Selectors

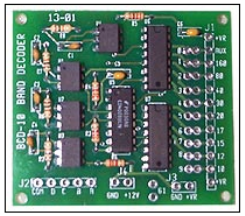
Are you building your own antenna switching system? The BCD-10 and BCD-14 Band Decoder/ Antenna Selector modules are an important component in it. Board level products, they include the switching logic and relay drivers to easily interface between your Elecraft® K3, Yaesu® radio or computer and the antenna switches.

The BCD-10/14 decode the band select signals from the radio or computer to automatically select the proper antenna or band pass filter for the current band. The inputs are optically isolated to provide maximum isolation between your radio or computer and the antenna switching system.

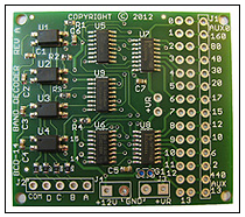
The outputs are grounding type open collector relay drivers. One output will be active, depending on the input signals. Outputs can be wired OR'd to select a single antenna for multiple bands. For example one relay may be used to select your tribander. With two jumpers on the BCD-10, the relay will be activated whenever your radio is set to 10, 15 or 20 meters.

The BCD-10 covers all bands, 160-10 meters, including the WARC bands. The BCD-14 includes all the same bands covered by the BCD-10, plus 6M, 2M, and 440MHz. Both boards are the same size and have the same mounting hole positions.

If the antenna or filter switch you wish to control requires high side drivers, add the HSD-9 module.



BCD-10



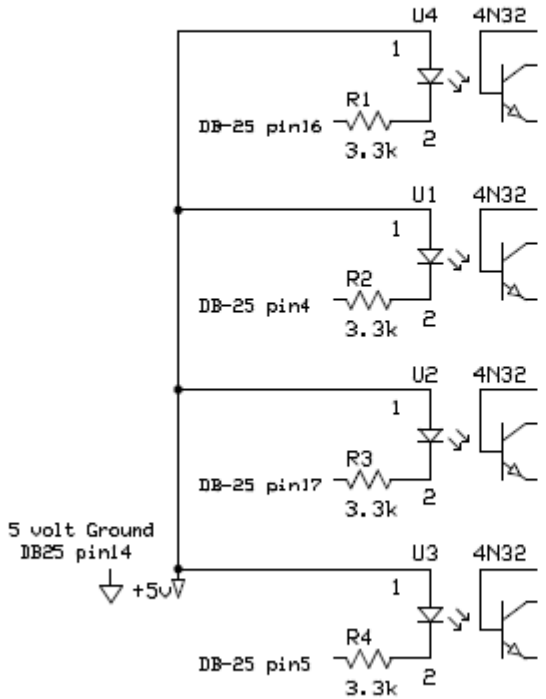
BCD-14

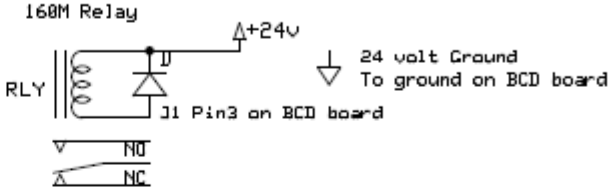
Shipped assembled and tested as shown.

Documentation:

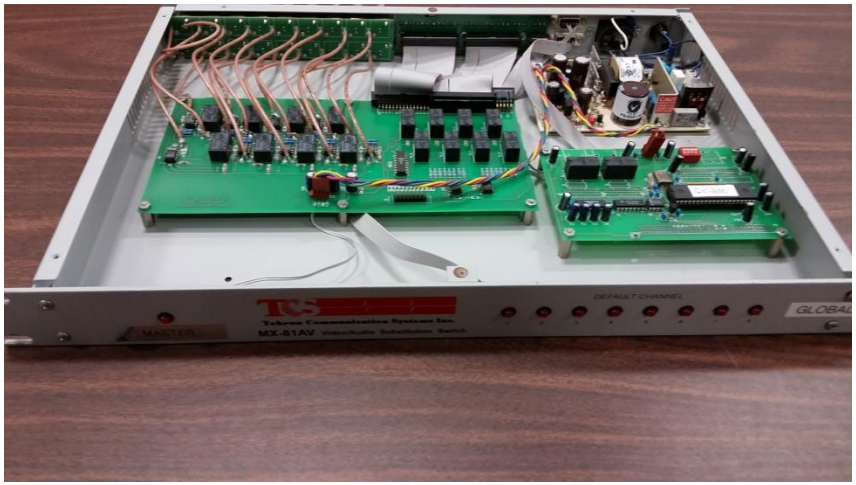
- BCD-10 Block Diagram - Typical Configuration (PDF)
- BCD-10 User's Manual (PDF)
- BCD-10 Schematic (PDF)
- BCD-14 Block Diagram - Typical Configuration (PDF)

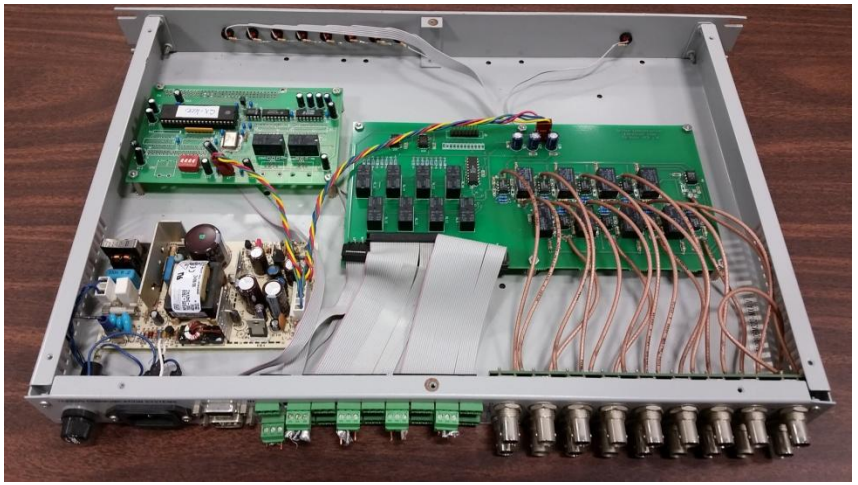
Rewiring the Unified Micro band decoder 4N32 for Anan's common collector output





Chassis from surplus equipment

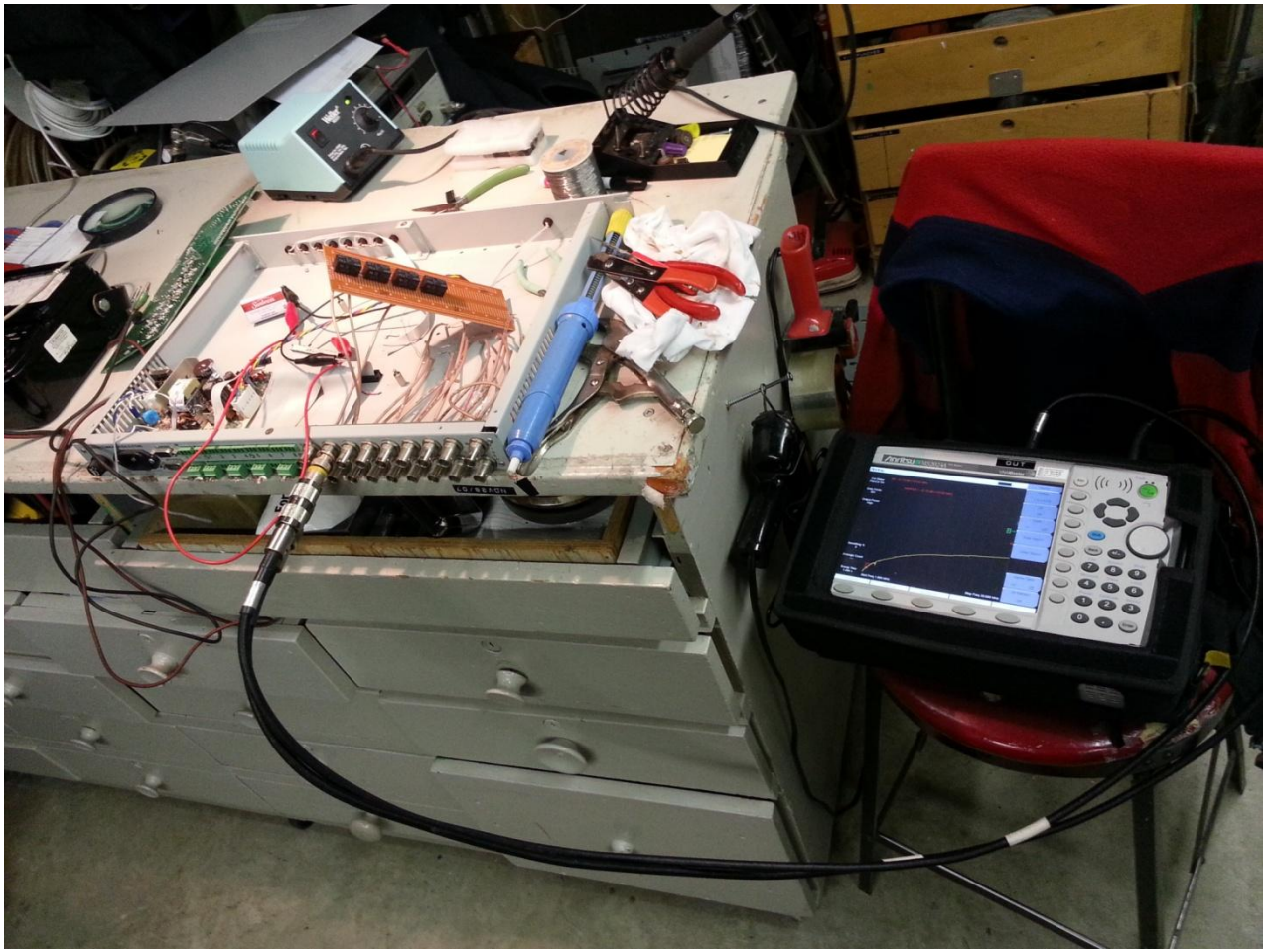




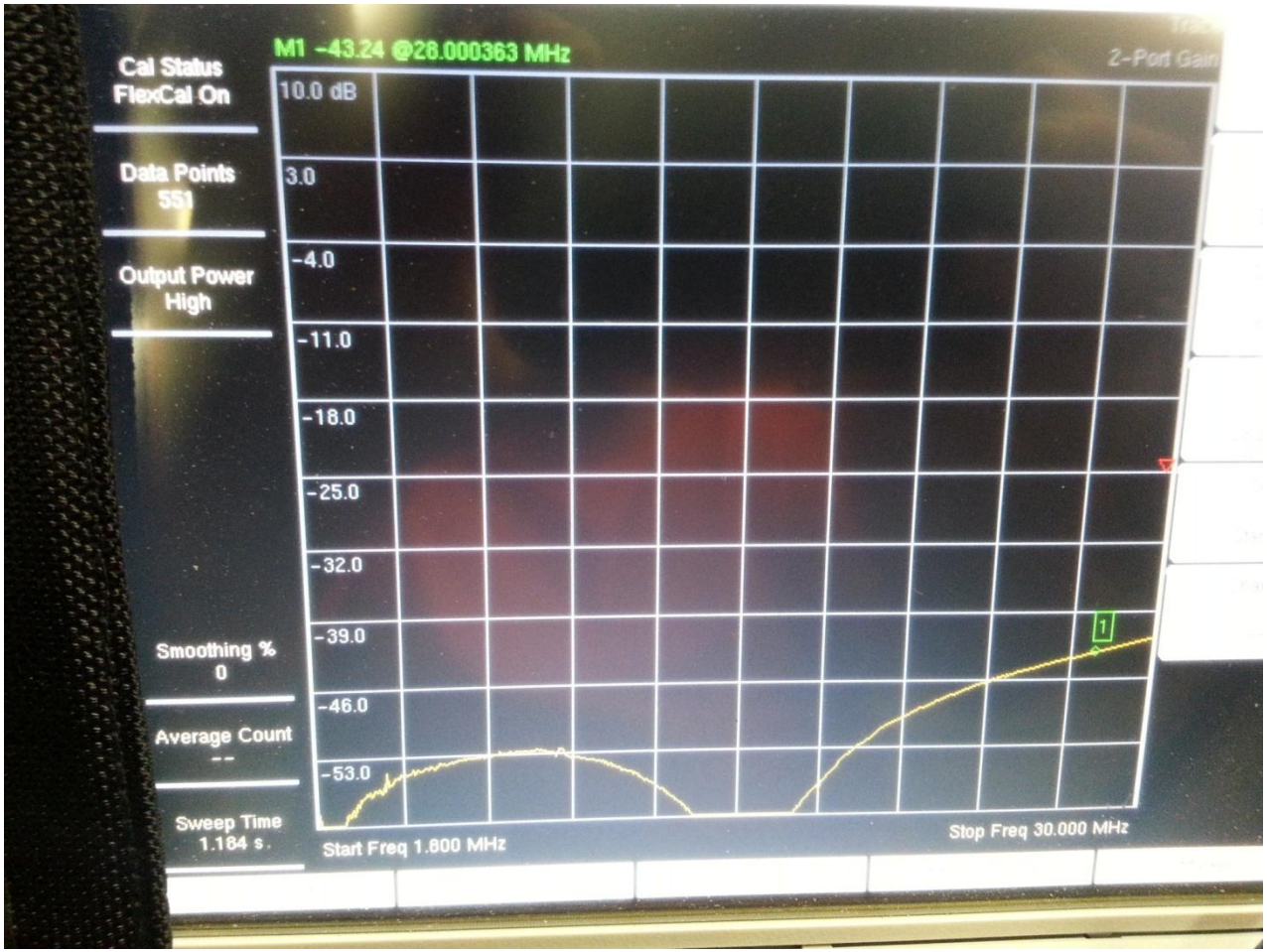
Video **S**ubstitution **S**witch it is..
(VSS)

- The format seemed quite suitable for project
- Plenty of bnc connectors with teflon coax to switch the IF in /out
- Led's on front panel for switch position and power
- Pheonix connection strip , offered 54 contacts for Ptt power in out ect
- Pheonix Plugs are easily sourced out and do not require a soldering iron
- Fuse and ac plug, db 9 for additional connections

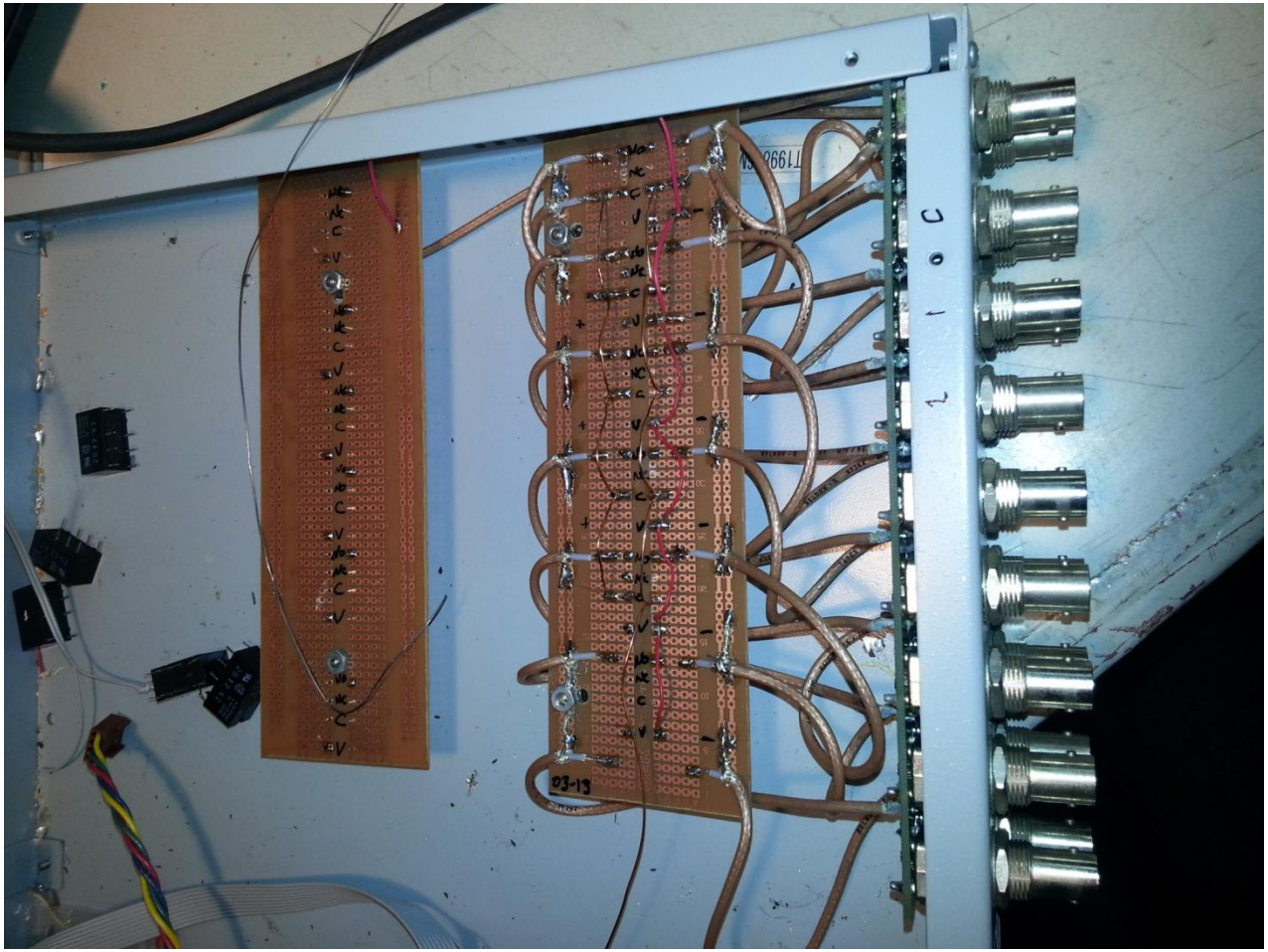
Measuring isolation directly on relay contacts w Vna ~-35db



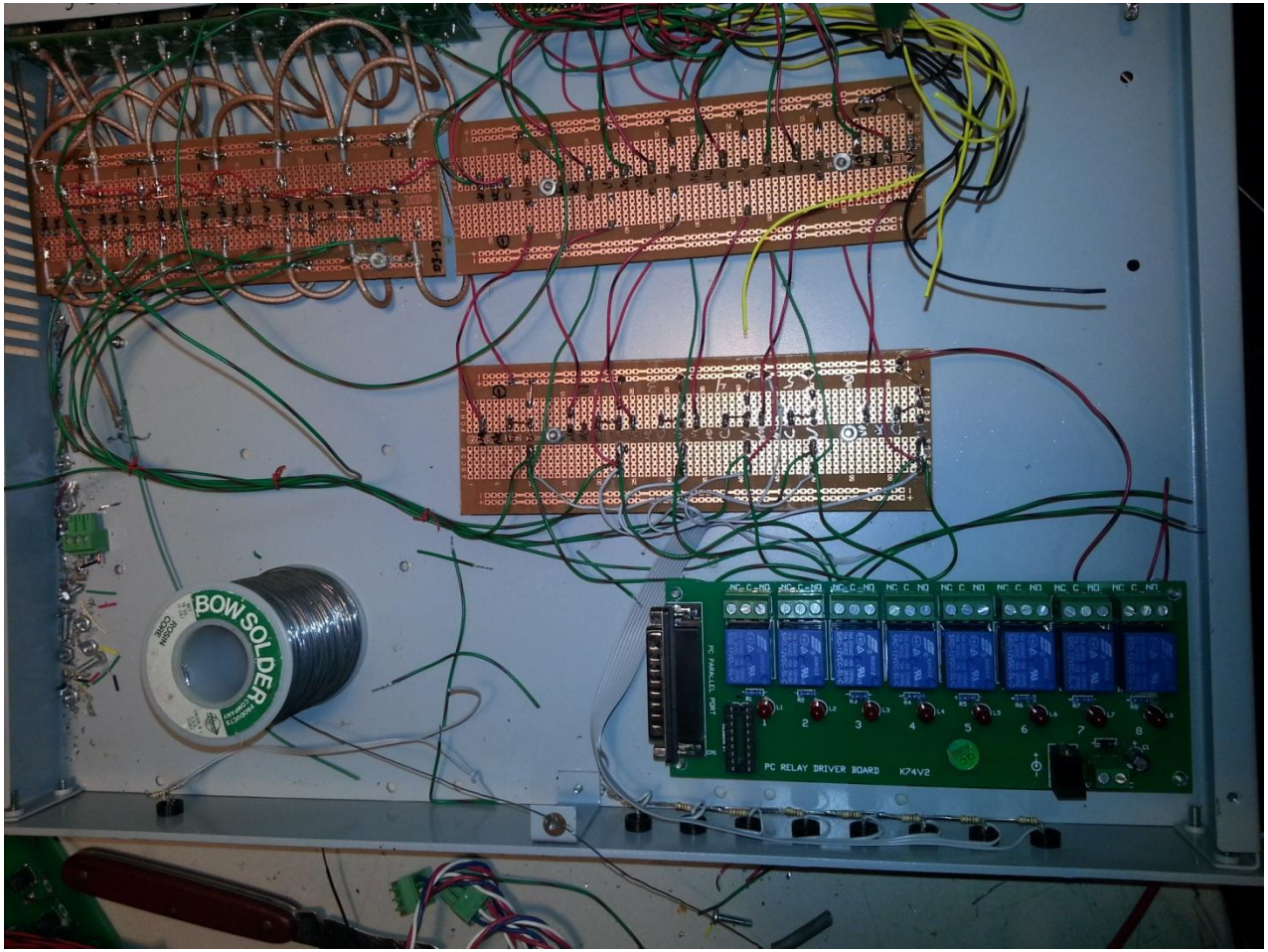
Isolation between bnc ports -43db , Hot setup ...really??



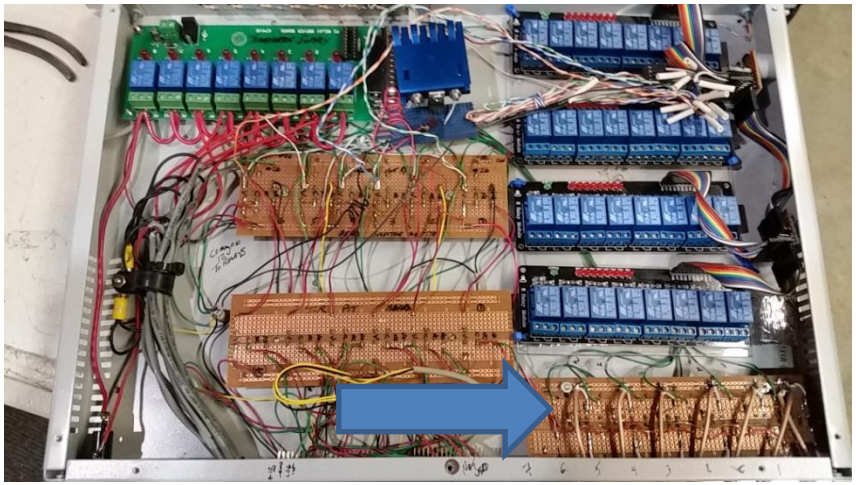
If switching relays being built up

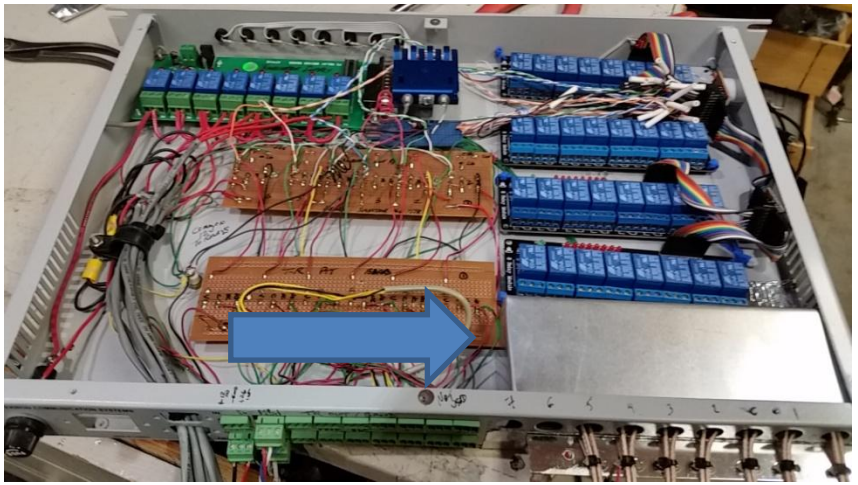


Adding more DPDT relays for PTT ect



Ready for testing showing 28mhz IF shield and additional relay strips





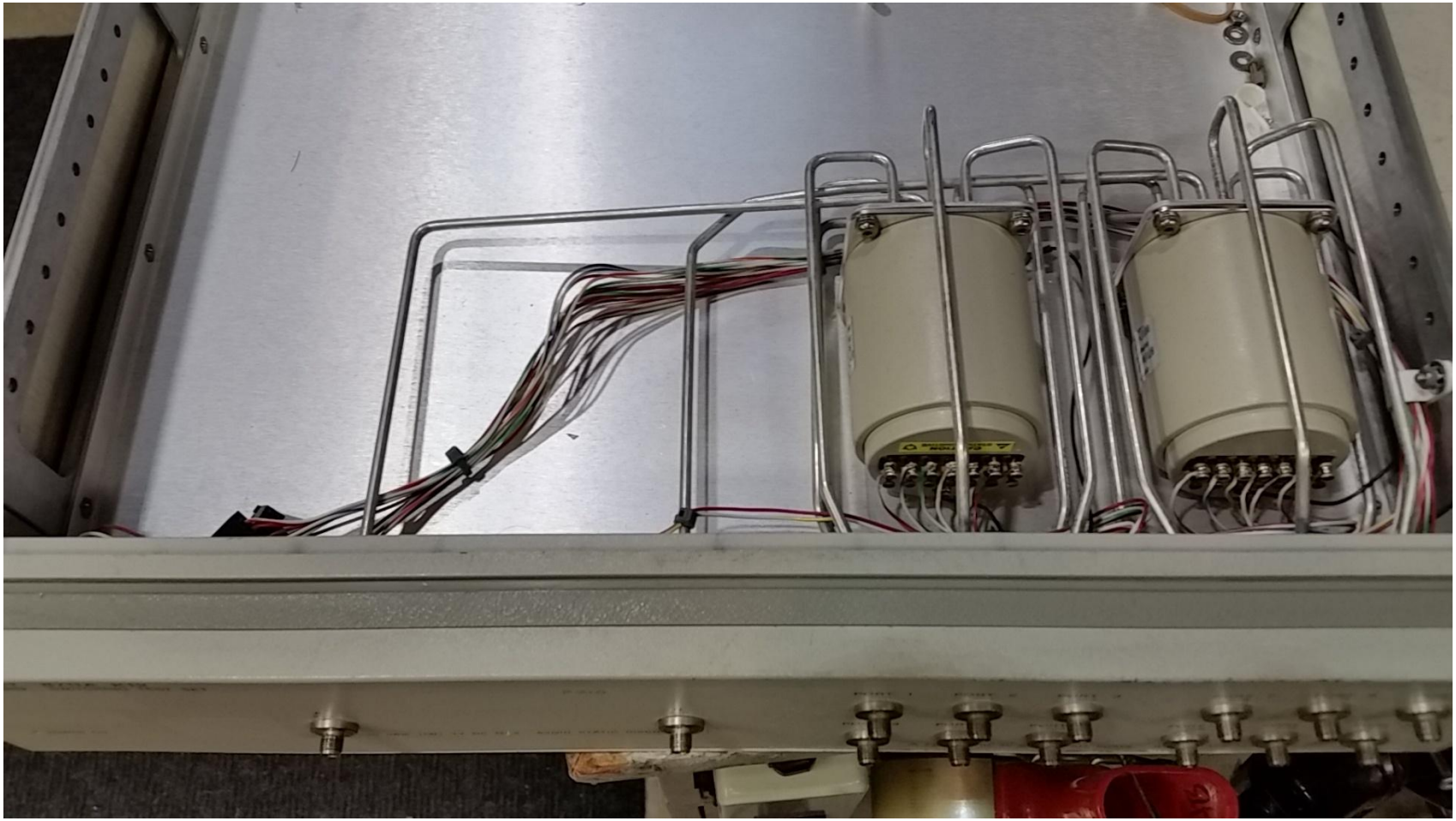
Initial testing

- BNC terminal strip turned out to have many faulty corroded solder joints, causing the Teflon cable initially not detected on first pass measurements w vna . Replaced IF BNC strip completely w a new one.
- BIG time IF leakage , was copying 10M beacons all over the place..

Back to the drawing board..

- Forget the project , put it away for about a year! Many hours went into this and i was very disappointed with the results. I will think of something...
- 8 months later.....
- Mike N1jez to the rescue! An email pointing out a super HP lab type switching setup for $100 on ebay.. HP 8711A K12

HP switch top view



HP switch specs

Agilent 87104/87106A, B, C
Multiport Coaxial Switches
dc to 4 GHz, dc to 20 GHz, dc to 26.5 GHz

Technical Overview

High performance multiport switches for microwave and RF instrumentation and systems

- SP4T and SP6T configuration
- Magnetic latching
- Operating life of 10 million cycles, typical
- Guaranteed repeatability of 0.03 dB up to 5 million cycles ensures accurate system measurements and reduces calibration intervals
- Excellent isolation, typically >90 dB at 26.5 GHz
- Opto-electronic indicators and interrupts
- Terminated ports
- TTL/5 V CMOS compatible (optional)

Modern automated test systems demand higher accuracy and performance than ever before. The Agilent Technologies 87104A/B/C and 87106A/B/C multiport switches offer improvements in insertion loss repeatability and isolation necessary to achieve higher test system performance. Long life, repeatability, and reliability lowers the cost of ownership by reducing calibration cycles and increasing test system uptime and are vital to ATS measurement system integrity over time.

Description

The 87104A/B/C SP4T and 87106A/B/C SP6T terminated multiport switches provide the life and reliability required for automated test and measurement, signal monitoring, and routing applications. Innovative design and careful process control creates switches that meet the requirements for highly repeatable switching elements in test instruments and switching interfaces. The switches are designed to operate for more than 10,000,000 cycles. The exceptional 0.03-dB insertion loss repeatability is warranted for 5 million cycles at 25 °C.

This reduces sources of random errors in the measurement path and improves measurement uncertainty. Switch life is a critical consideration in production test systems, satellite and antenna monitoring systems, and test instrumentation. The longevity of these switches increases system uptime, and lowers the cost of ownership by reducing calibration cycles and switch maintenance.

Hp switch is 50 ohm terminated! eliminates ALL leakage and crosstalk

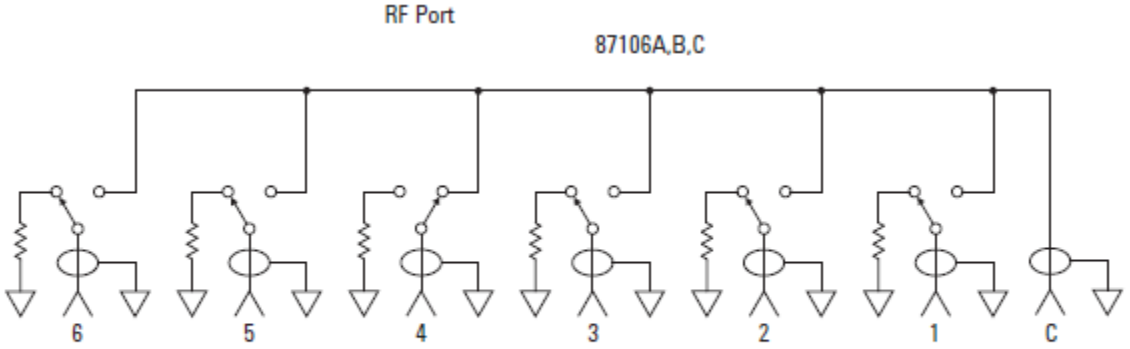


Figure 1. Agilent 87104A/B/C and 87106A/B/C simplified schematics

Hp switch isolation and insertion loss

	87104A 87106A	87104B 87106B	87104C 87106C
Frequency range	dc to 4 GHz	dc to 20 GHz	dc to 26.5 GHz
Insertion loss (see Figure 7)	0.3 dB + 0.015 x frequency (GHz)	0.3 dB + 0.015 x frequency (GHz)	0.3 dB + 0.015 x frequency (GHz)
Isolation (see Figure 8)	100 dB minimum	100 dB minimum to 12 GHz 80 dB minimum to 12 to 15 GHz 70 dB minimum to 15 to 20 GHz	100 dB minimum to 12 GHz 80 dB minimum to 12 to 15 GHz 70 dB minimum to 15 to 20 GHz 65 dB minimum to 20 to 26.5 GHz
SWR	1.2 maximum	1.2 maximum dc to 4 GHz 1.35 maximum 4 to 12.4 GHz 1.45 maximum 12.4 to 18 GHz 1.7 maximum 18 to 20 GHz	1.2 maximum dc to 4 GHz 1.35 maximum 4 to 12.4 GHz 1.45 maximum 12.4 to 18 GHz 1.7 maximum 18 to 26.5 GHz
Repeatability (Up to 5 million cycles measured at 25 degrees C)	0.03 dB maximum	0.03 dB maximum	0.03 dB maximum
Connectors	SMA (f)	SMA (f)	SMA (f)

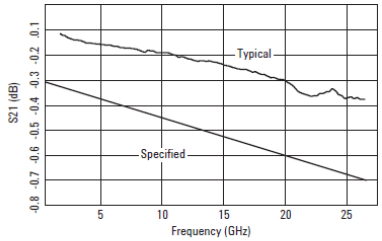


Figure 7. Insertion loss

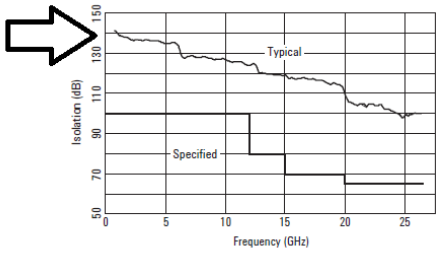
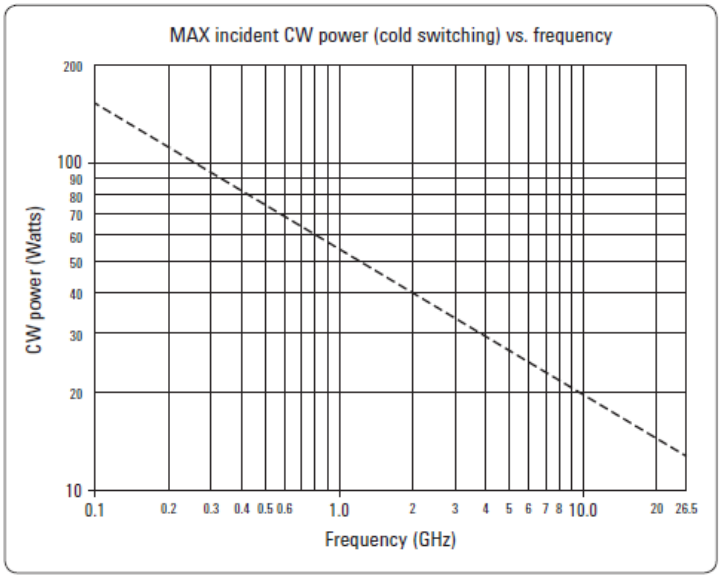


Figure 8. Isolation

Hp switch power handling

Supplemental specifications (cold switching)



Reference conditions:

- Cold switching only (NO Hot switching)
- Ambient temperature of 75 °C or less
- Sea level (0.88 derating @ 15,000 ft.)
- Load VSWR < 1.2 (see graph for derating above 1.2 VSWR)

Specifications (continued)

Maximum power rating	
Into internal termination	1W CW 50 W peak, 10 µs max pulse width, not to exceed 1 W average
Into thru path	2 W CW
Hot switching	100 W peak, 10 µs max pulse width, not to exceed 2 W average
Cold switching	150 W CW at 3 GHz, 25 °C 120 W CW at 4.2 GHz, 25 °C

Environmental specifications

Operating temperature	–25 to 75 °C
Storage temperature	–55 to 85 °C
Temperature cycling	–55 to 85 °C, 10 cycles per MIL-STD-202F, Method 107D, Condition A (modified)
Vibration	
Operating	7 g: 5 to 2000 Hz at 0.25 in p-p
Survival	20 g: 20 to 2000 Hz at 0.06 in p-p, 4 min/cycle, 4 cycles/axis
Random	2.41 g (rms) 10 min/axis

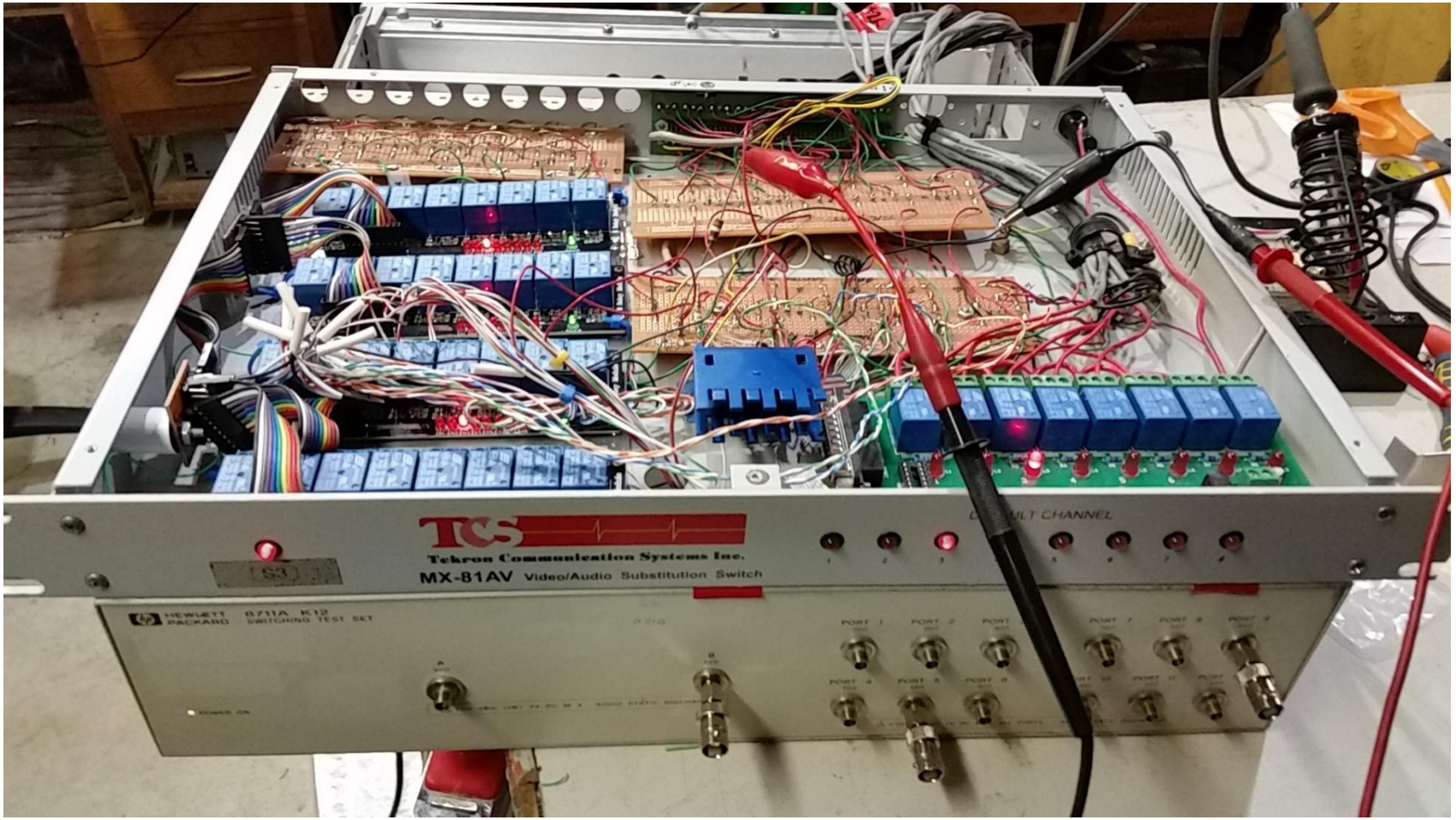
Features of HP switch

- Requires 20-32Vdc to switch , the contacts are latching so once port is selected and contact is made no further power is required .
- Extremely high isolation in the order of 135bd at 28 mhz.
- Easily handle a few watts if required to be used as 144 IF for microwave bands.
- Plenty of space inside cabinet to actually put all the relays i have in the VSS band selector chassis if it was well planned out.

Decisions , decision..

- I now have a kind of bulky HP switch in a rack mount 4” high chassis with nothing in it, beautifully wired with Ut 141 w sma connectors , there is no way I'm taking this apart, and there is no way that I'm taking my VSS band switcher apart either.
- Solution , keep them both as is.

Testing


TCS
Tekron Communication Systems Inc.
MX-81AV Video/Audio Substitution Switch
HEWLETT PACKARD 8711A K12 SWITCHING TEST SET

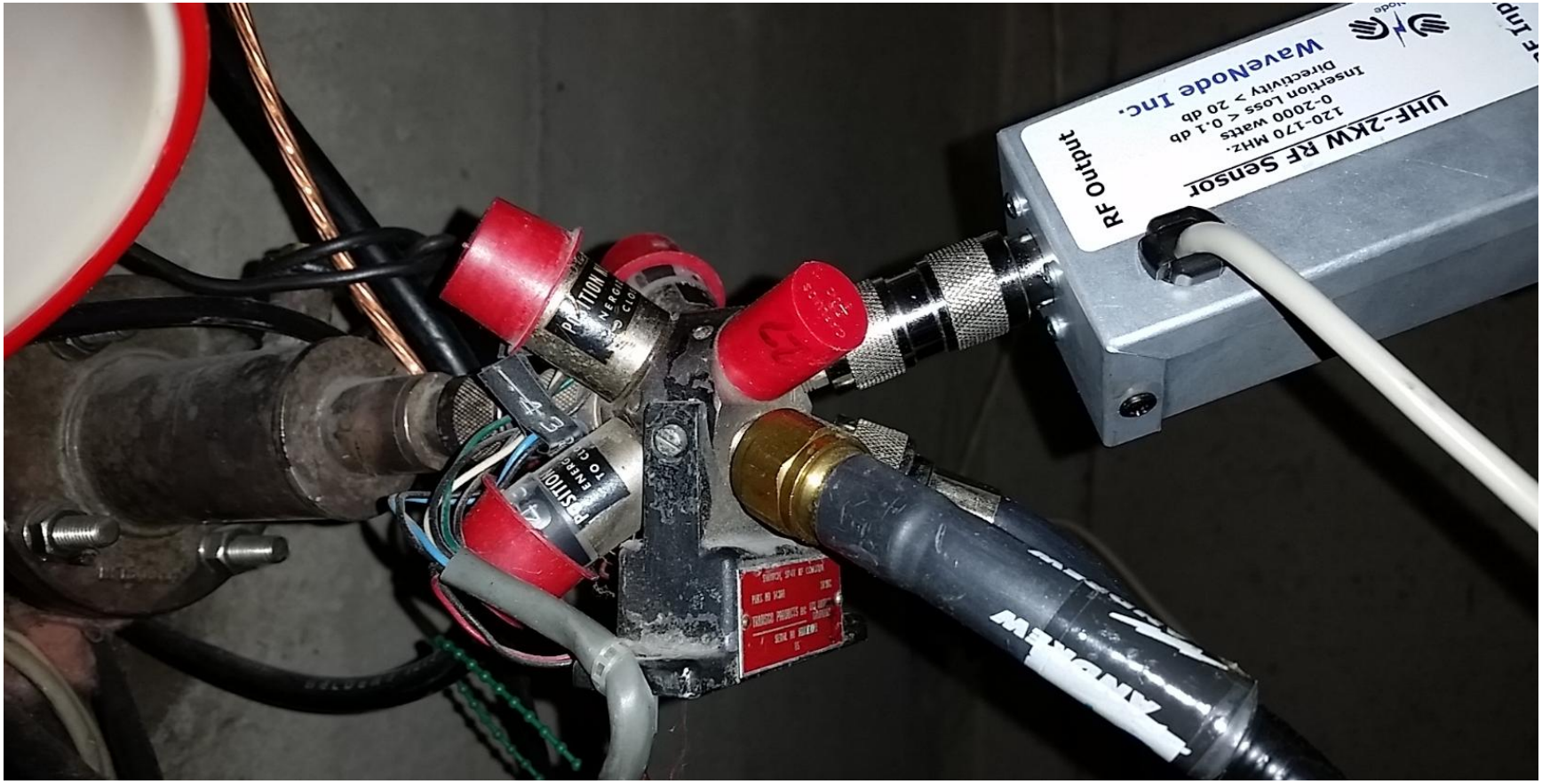
HP switch with VSS

Band selector

A look at what I am switching

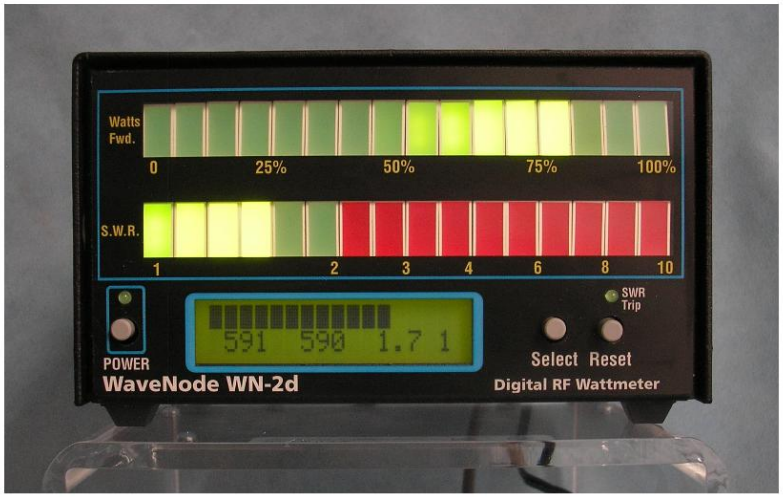
- Transco 4 way antenna relays
- PTT on all radios and amplifiers
- B- resistor “matrix”
- IF in/out relays
- Various Voltages to supply each of the equipment requirements.
- Wavenode power meter individual sensors
- Using a Gal 5 MMIC to amplify 0dbm signal from Anan transverter output and feeding abt 15mw into switch system, device proved to be very linear and clean.

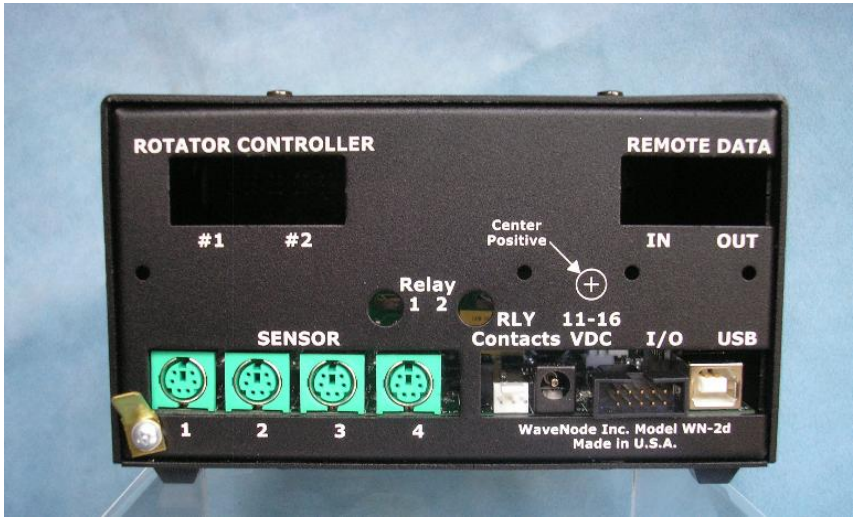
Transco 4way w/ Wavenode Sensor



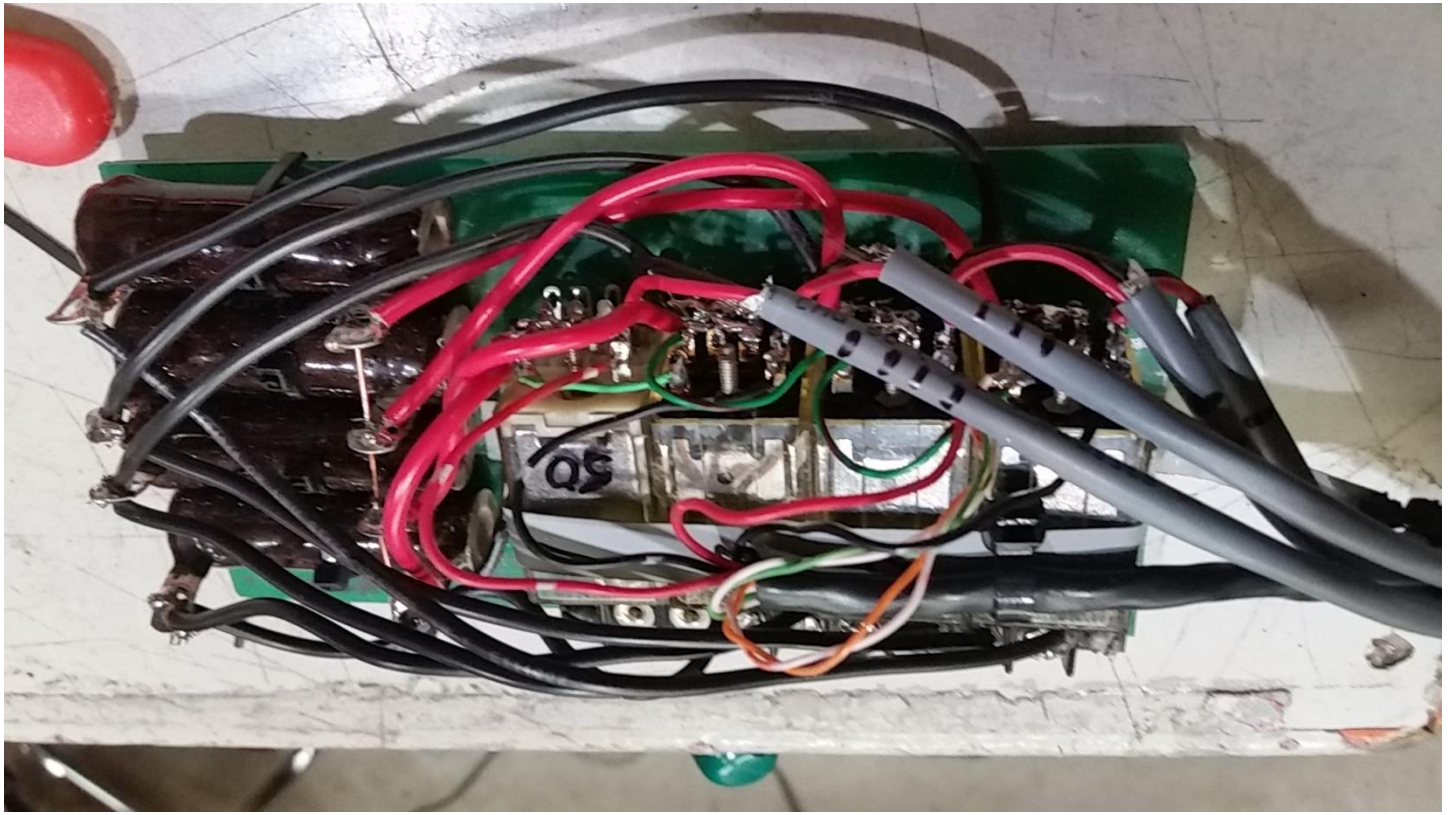
Wavenode Power Meter
Wide range of sensors cover 100 milliwatt to 8 KW, 1.6 MHz to 1.3 GHz.

WaveNode WN-2d

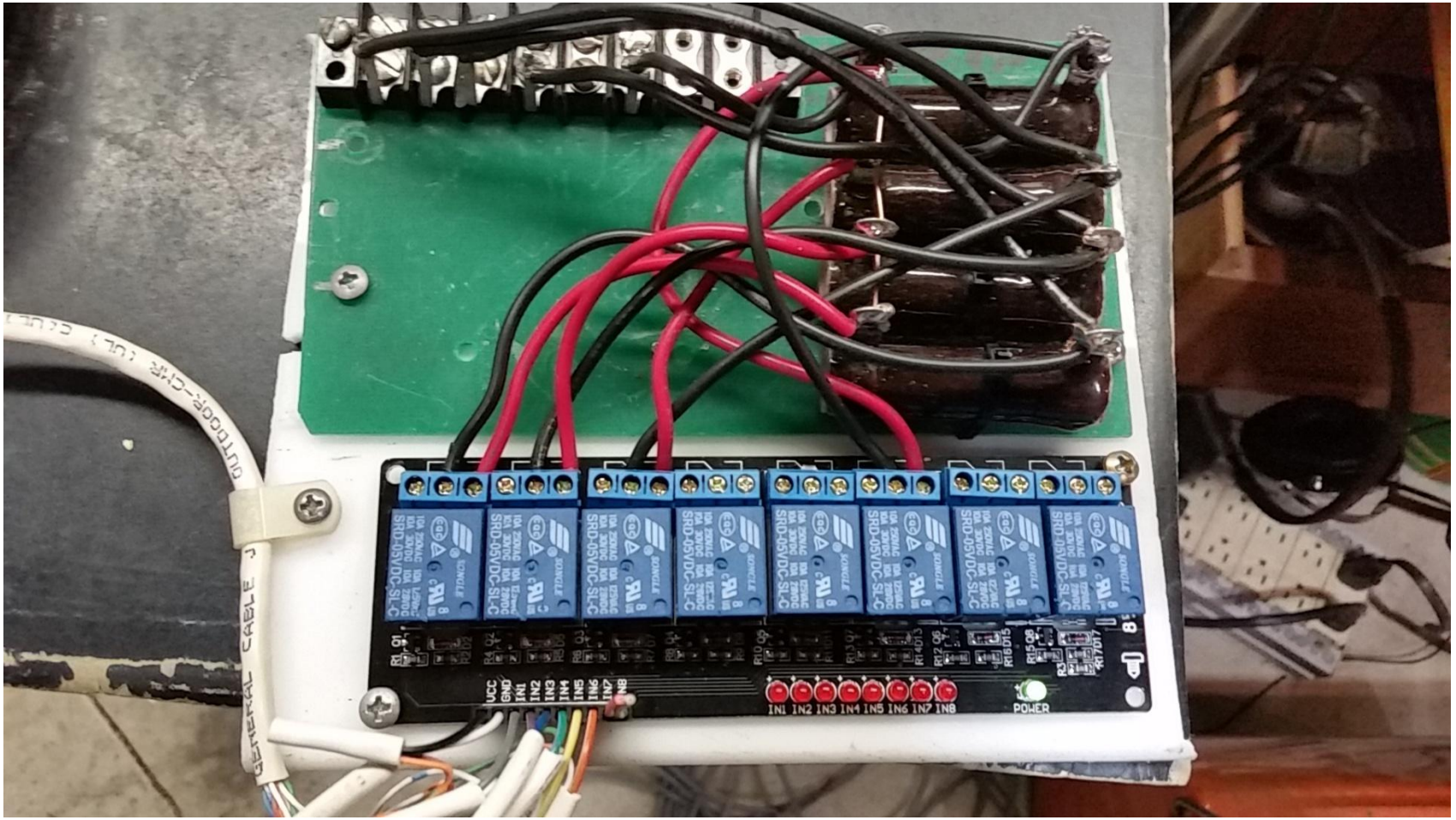




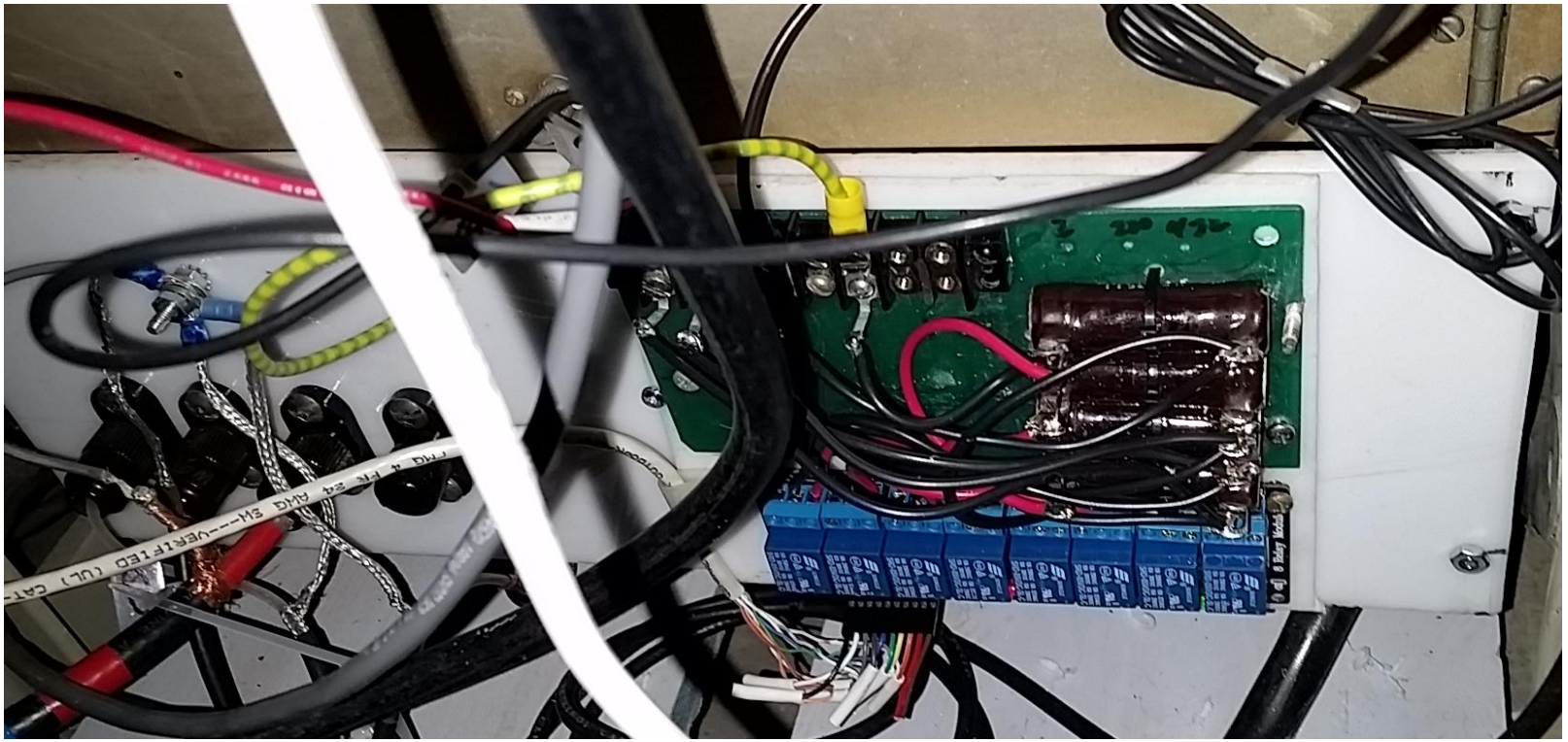
HV B- switching , first attempt using separate control lines



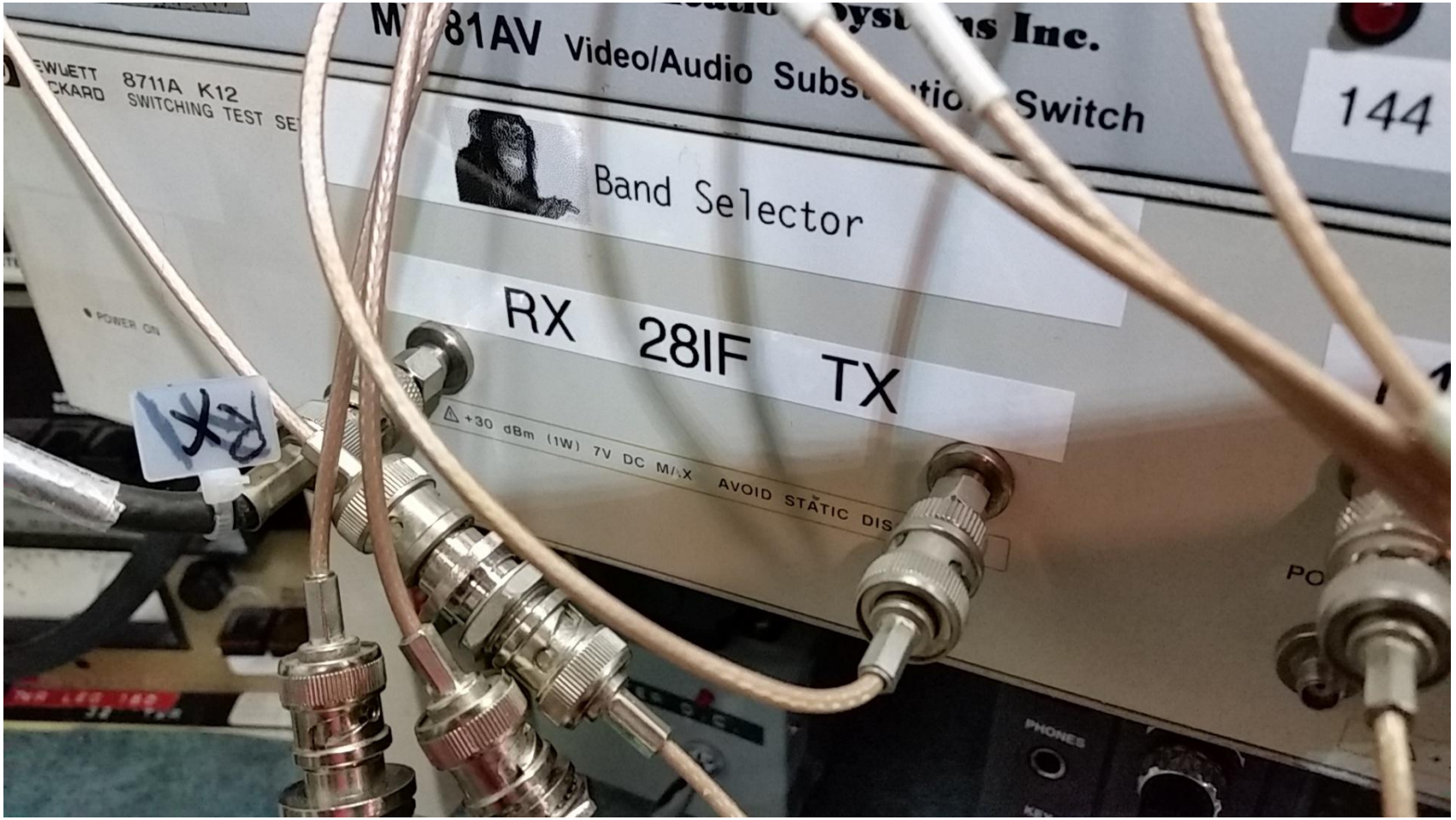
HV B- switching Arduino type relay boards



HV B- switching installed on back of HV supply



Final approval logo



January 2015 contest modification

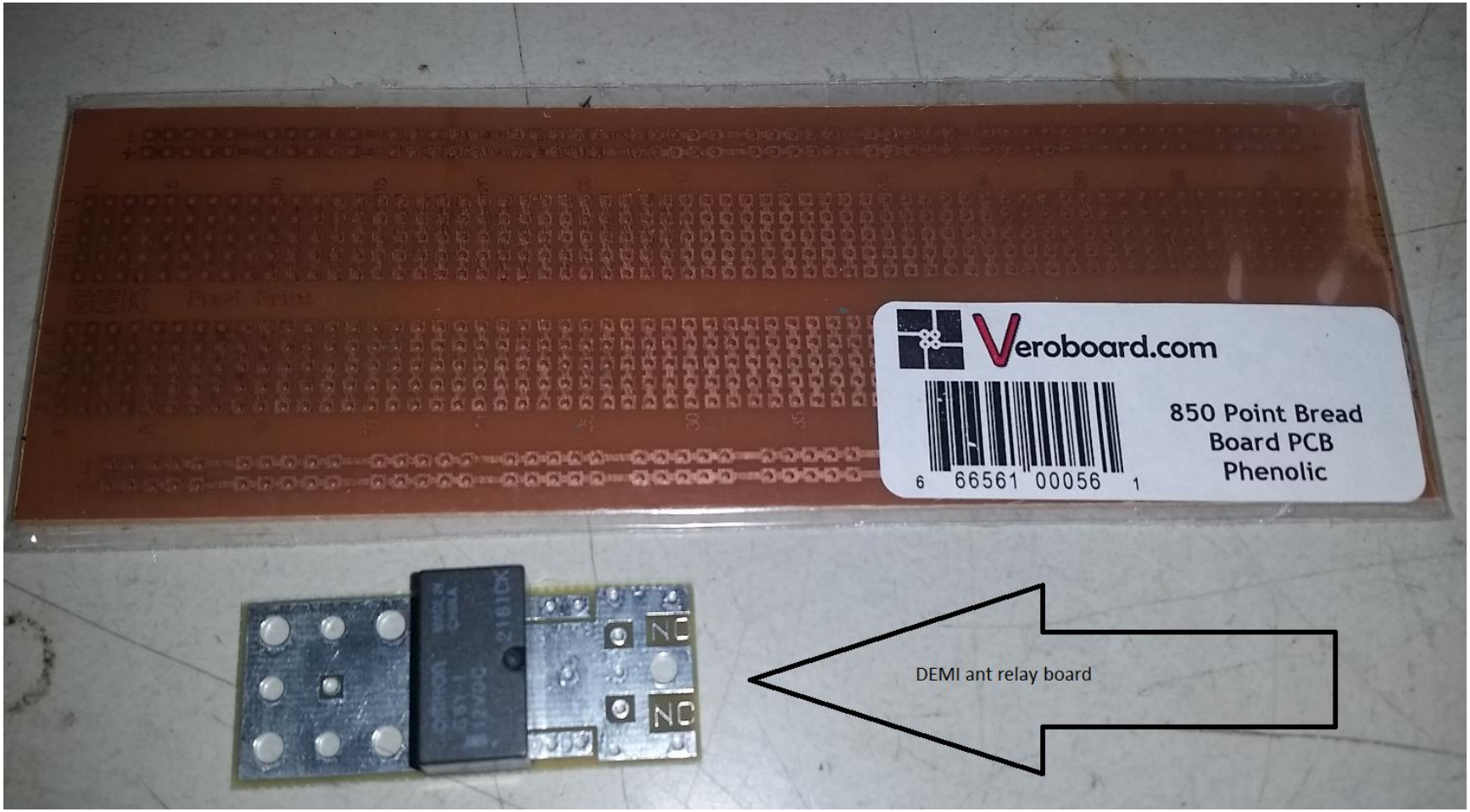
- Installed a switch to control 12vdc leaving transverters powered on for duration of contest and terminating IF's into the Hp switch.

Comments on interfacing of Anan

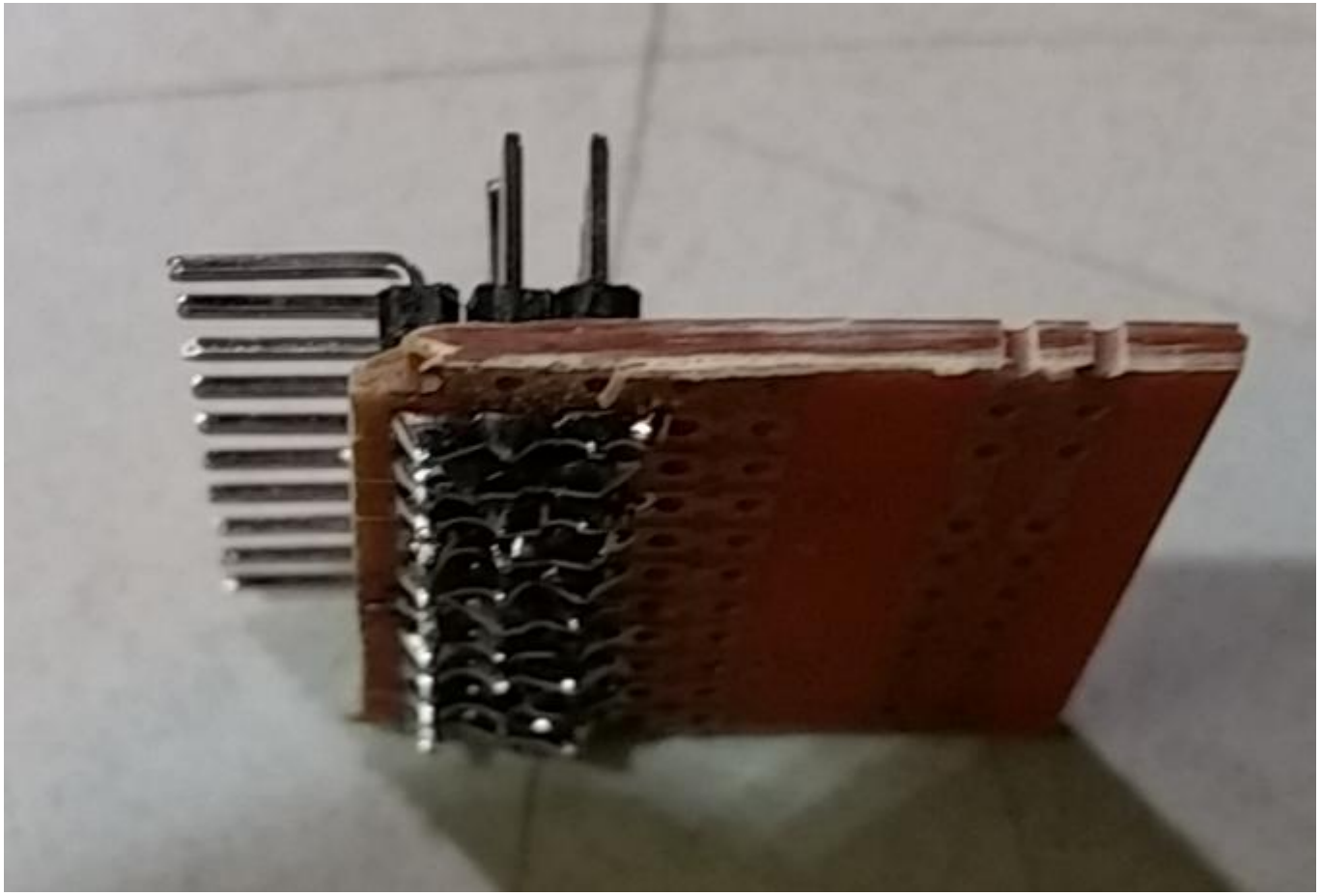
- I said good! “Common collector (u22) ULN2003AD can switch .5a at 50 V “
- Comment from Mike N1jez

  “Personally, I don't want to connect anything directly to my ANAN-100 without some sort of buffering. It's a small price to pay in complexity to avoid blowing something up in the ANAN and it also serves to eliminate ground loops as there is opto isolation.”

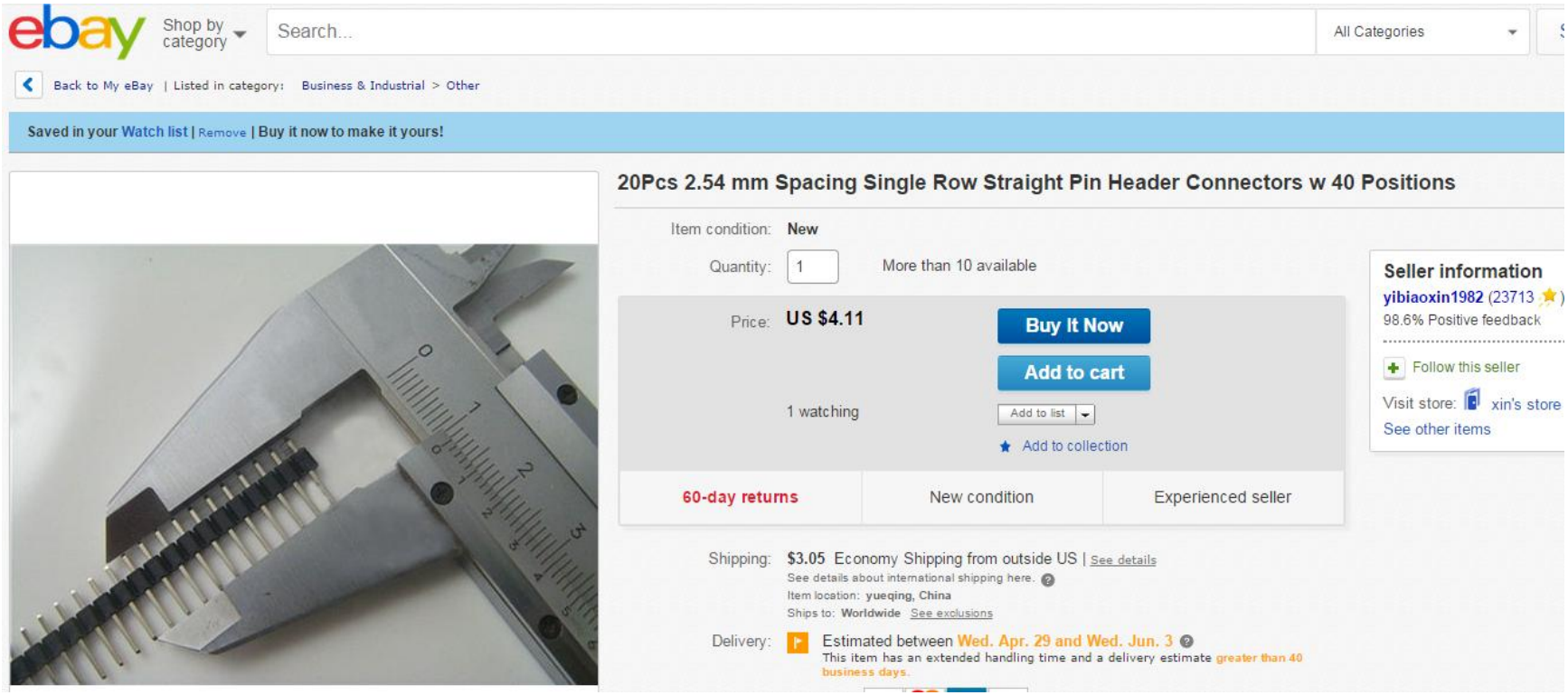
Phenolic board for relays and 10pin cable headers



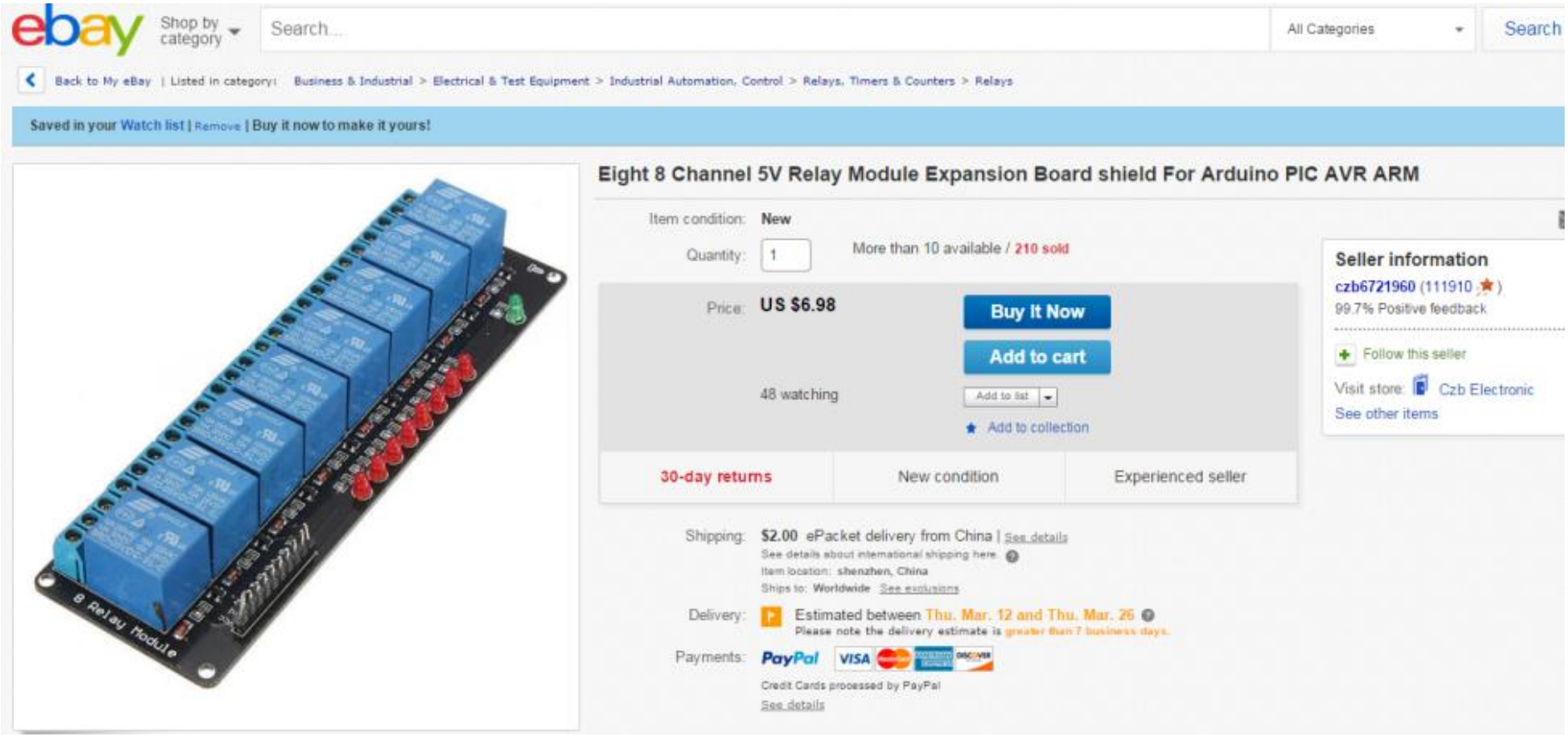
Home made 10 pin header extender using pc board



2.54 mm header material

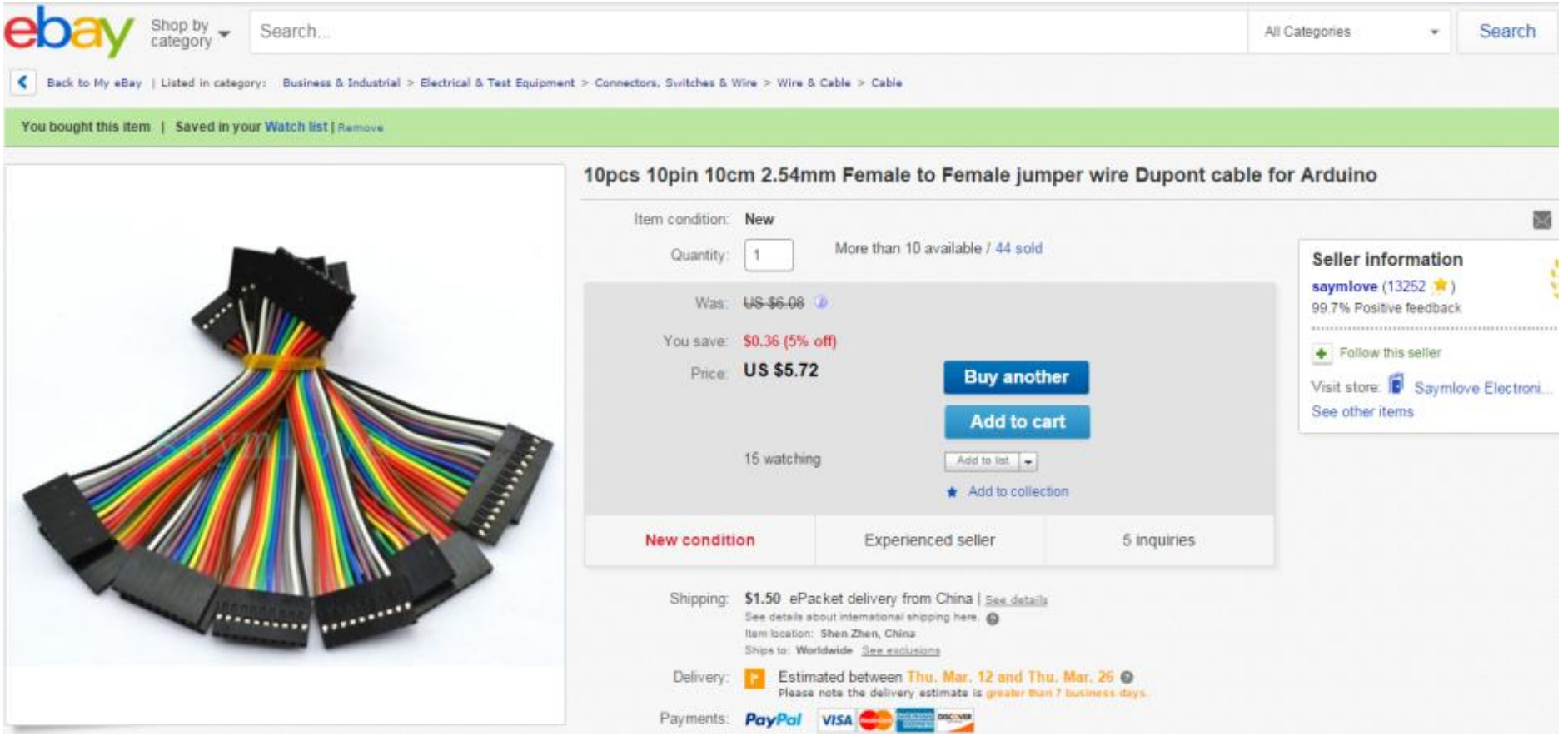


Arduino relay boards



5v Arduino relays $7.00/strip

Arduino cables

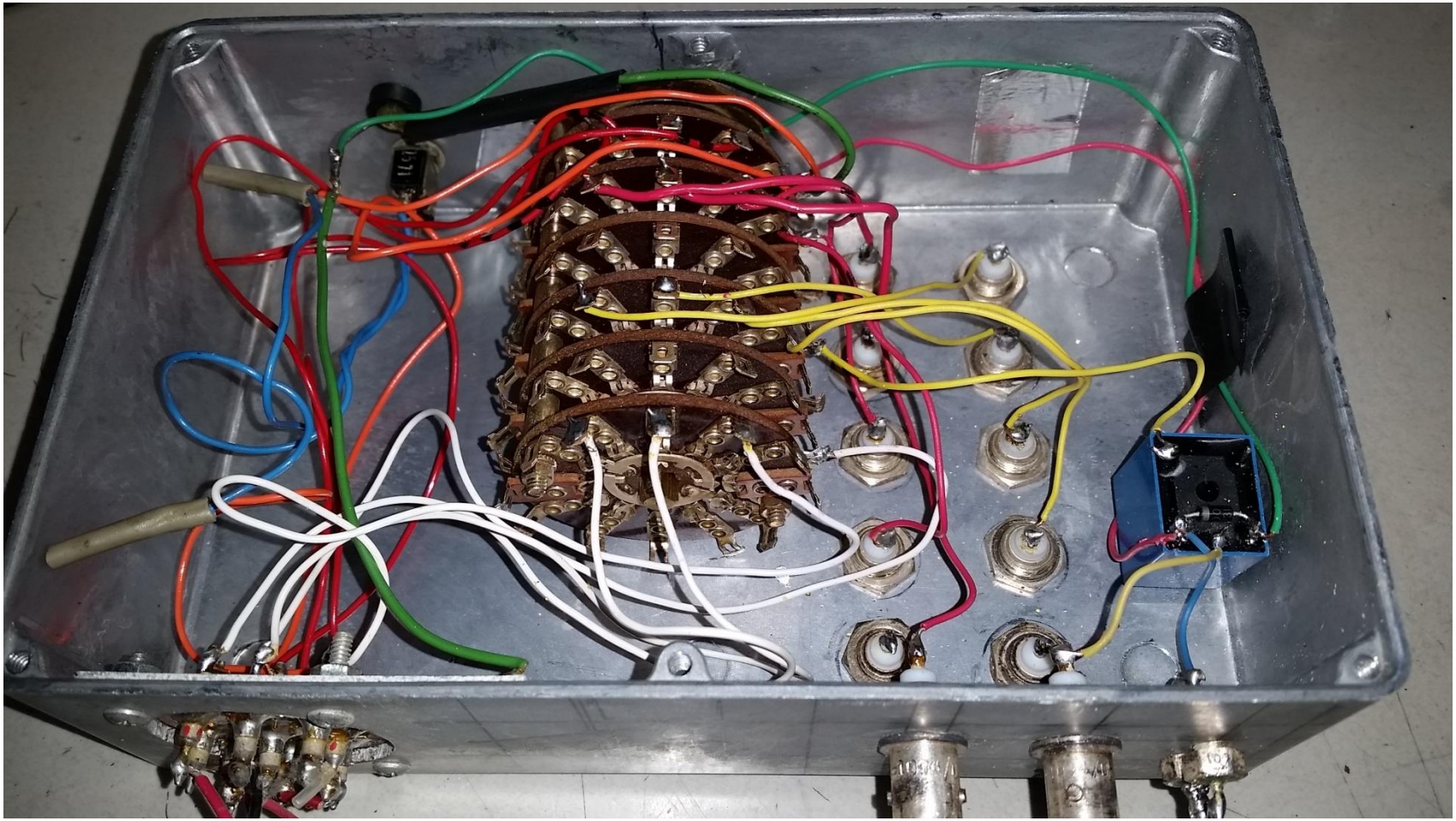


Closing comments

- Have a clear picture of just how far you want to go with this type project
- Keep it simple enough to be able to find off the shelf reliable components
- design and plan it with expansion in mind
- Use high isolation relays to illiminate cross talk and leakage
- Make it universal so that any rig can use this system

My 1982 transverter switch

Simple and effective



Questions ???