The Alachua County “QUINTPlexor”

Gordon Gibby KX4Z

Driven by ARRL FIELD DAY….
We started with simple BandPass Filters

- Goal was simply to be able to operate multiple stations with Field Day antennas not that far apart and still be able to operate.
- Our filter experience was near zero.

ARRL Butterworth Filters

Band-Pass Filters for HF Transceivers

Do your multiple-transmitter Field Day or contest efforts suffer from intrastation interference? These handy and inexpensive filters can help!

By Lew Gordon, K4VX
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Hannibal, MO 63401

One of the more aggravating aspects of competitive Amateur Radio operation comes when you're all set up for Field Day or a DX contest in a multiple-transmitter category and you discover an intrastation interference problem. All that planning and anticipation appears to be headed down the drain! Frustrations and tempers immediately mount: Someone yells "Eighty meters is wiping me out!" or someone else screams "Every time you

band phase-noise interference is not usually a major problem unless stations are operating in close physical proximity, as is the case in Field Day or multitransmitter contest operations.

In seeking a solution to the intrastation interference problem that I could apply in my multitransmitter DX-contest station, I first entertained the idea of constructing large, high-power-handling band-pass filters for each transmitter. These filters would not only reduce the transmitted noise

tion, this scheme would provide filtering during receiving, helping to reduce front-end overload problems. The best part is that even if you use all new components, the cost of these filters should not exceed $10 each. All that's necessary for tune up is a dip meter and a general coverage receiver. These filters were first described in an article I wrote for the *National Contest Journal*.[2]

Filter Design and Construction

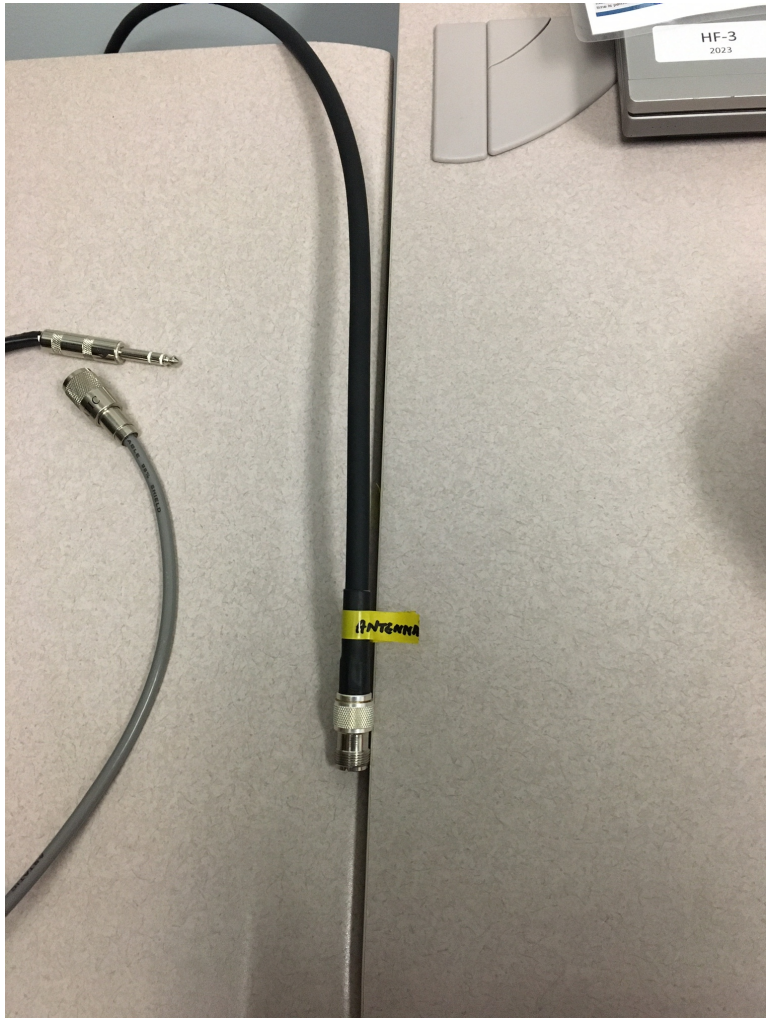
Perhaps driven by cost / availability, author recommends relatively SMALL toroids and allows For 500V capacitors…. These are a BEAR to tune….complex interactions

Tolerable Bandpass Filter Results

- Insertion losses 0.5-1 dB
- “Next-Band” separation nothing to write home about – 20 dB? Between 20meters and 15 meters not so good…..
- Tremendous help in Field Day when combined with
  - Attenuation added in receiver
  - IP+ turned on, ICOM 7300

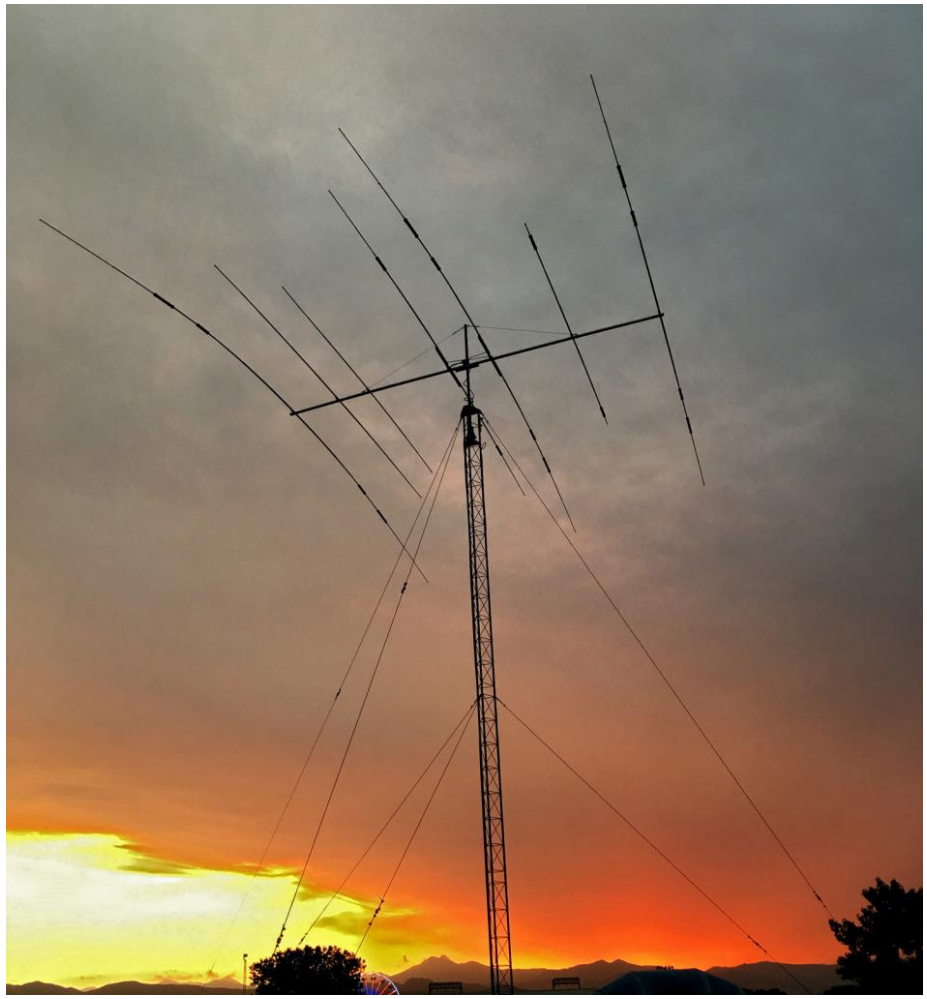
Our EOC Problem:

- Exactly ONE HF coaxial cable with which to work….
- At Summer Field Day we had SEVEN Antennas & 7 coaxes….
- At the EOC for Winter Field Day….only 1



Then we heard about “Triplexers”

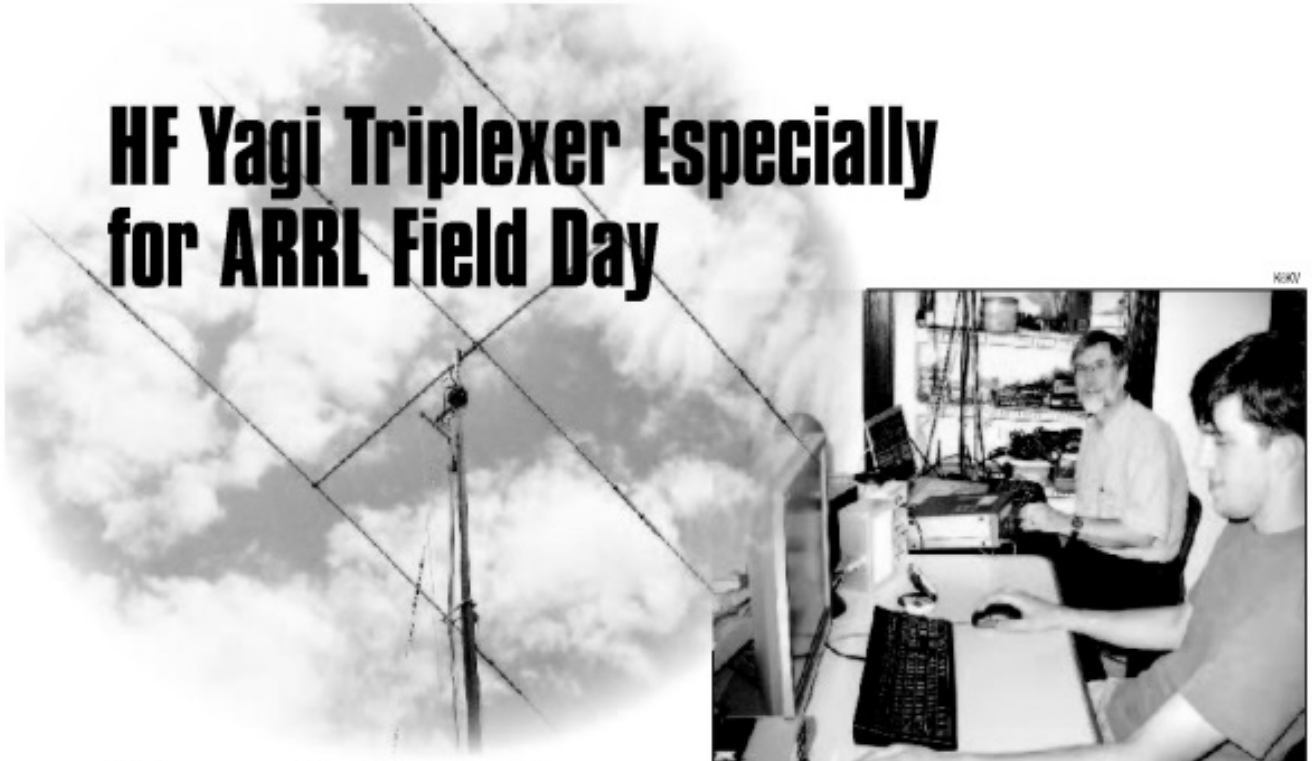
- Designed to allow 3 transmitters to use a single Yagi simultaneously



REF: https://www.mosley-electronics.com/

Gary Gordon Starrted it all...2010

HF Yagi Triplexer Especially for ARRL Field Day

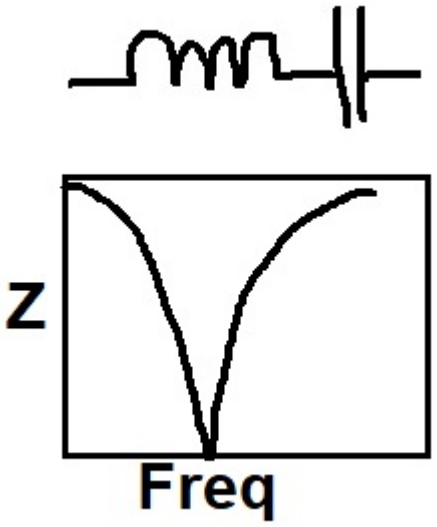


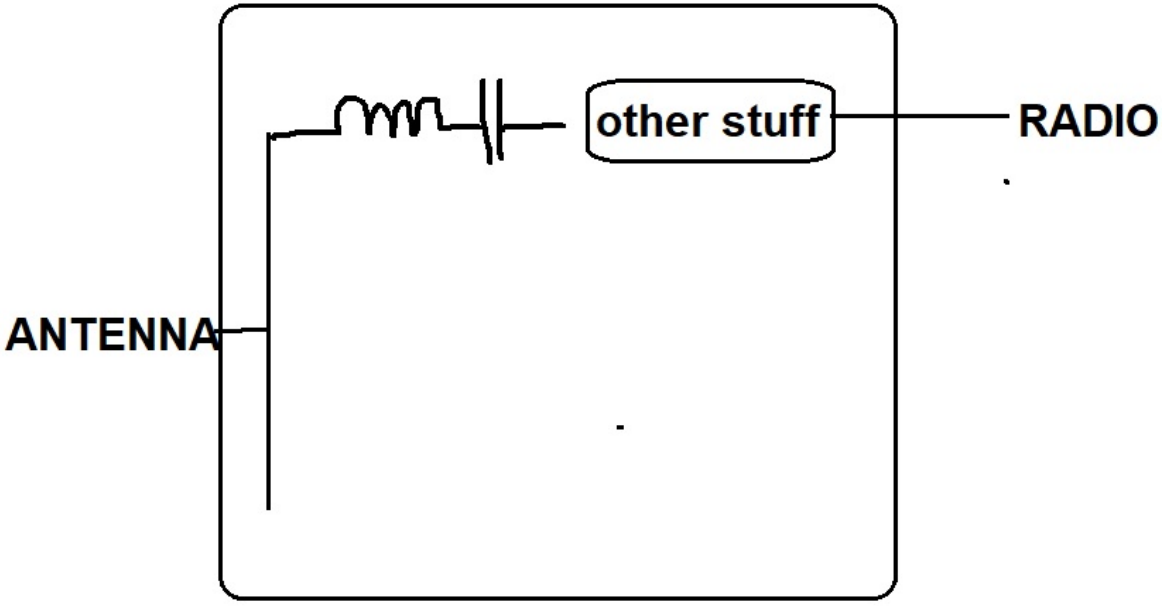
This easy-to-build project lets up to three transceivers on 10, 15, and 20 meters share the same antenna.

Gary Gordon, K6KV

Figure 1 — Kenneth Finnegan, W6KWF, in foreground and Phil Verinsky, W6TQG, at Phil's station, competing in the July 2009 NAQP contest in the multioperator two transceiver category. Using the triplexer standing on the table between them, Kenneth and Phil operate on both 20 and 15 meters sharing Phil's triband antenna.

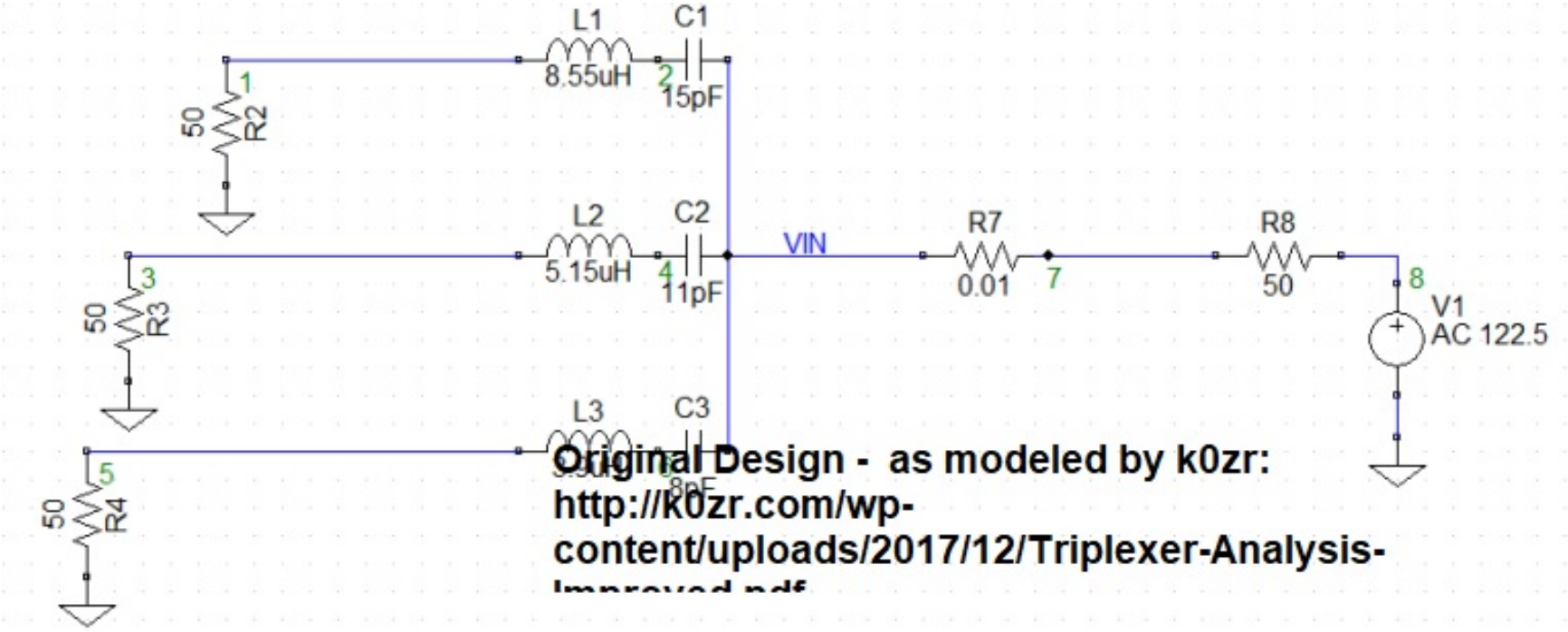
Series Tuned Filters Separate Sections





Original Simple Design

Series tuned separators



Requires: 2 sets of filters

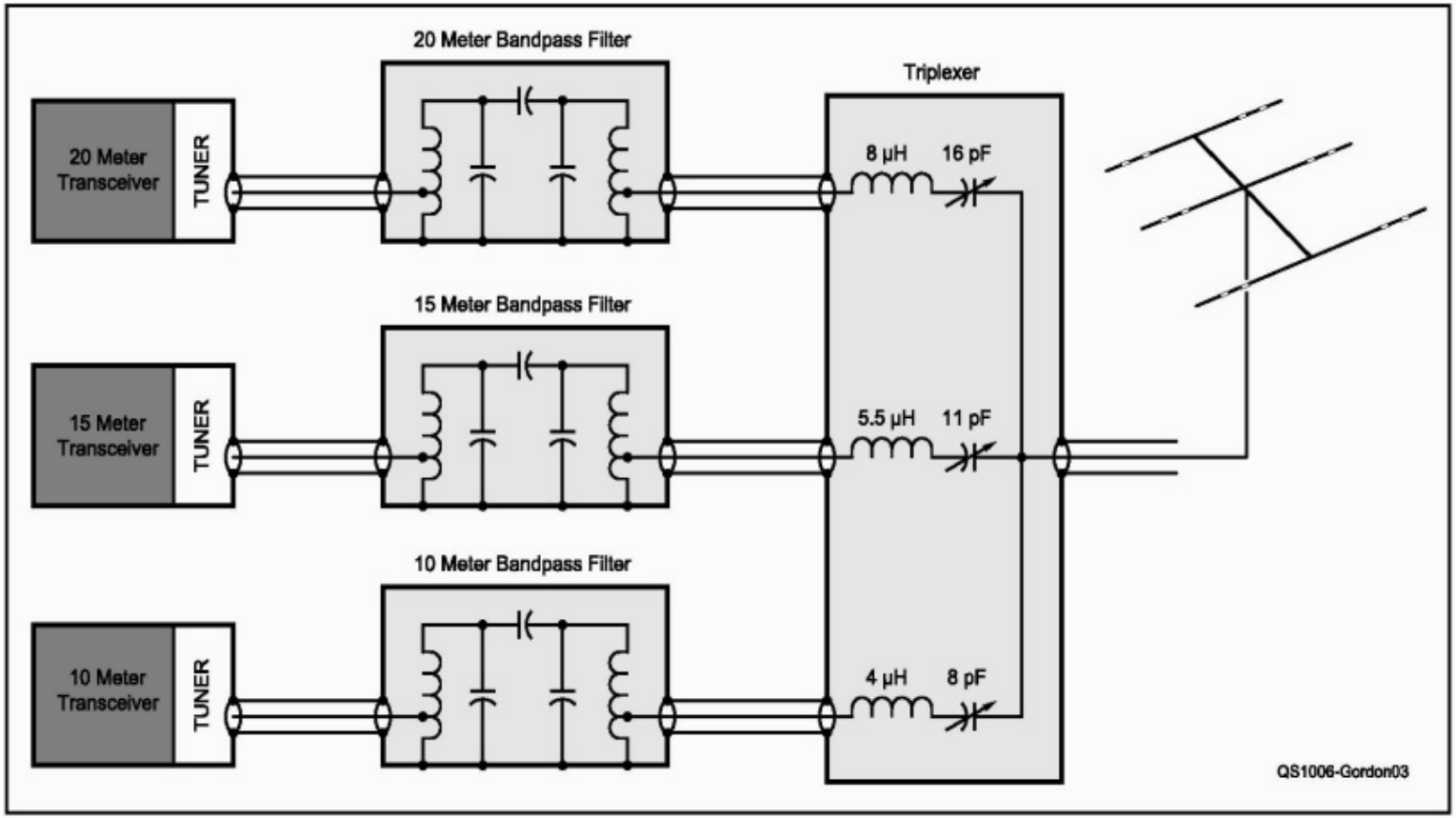


Figure 2 — Triplexer schematic. See the article regarding choosing the capacitors and winding the inductors.

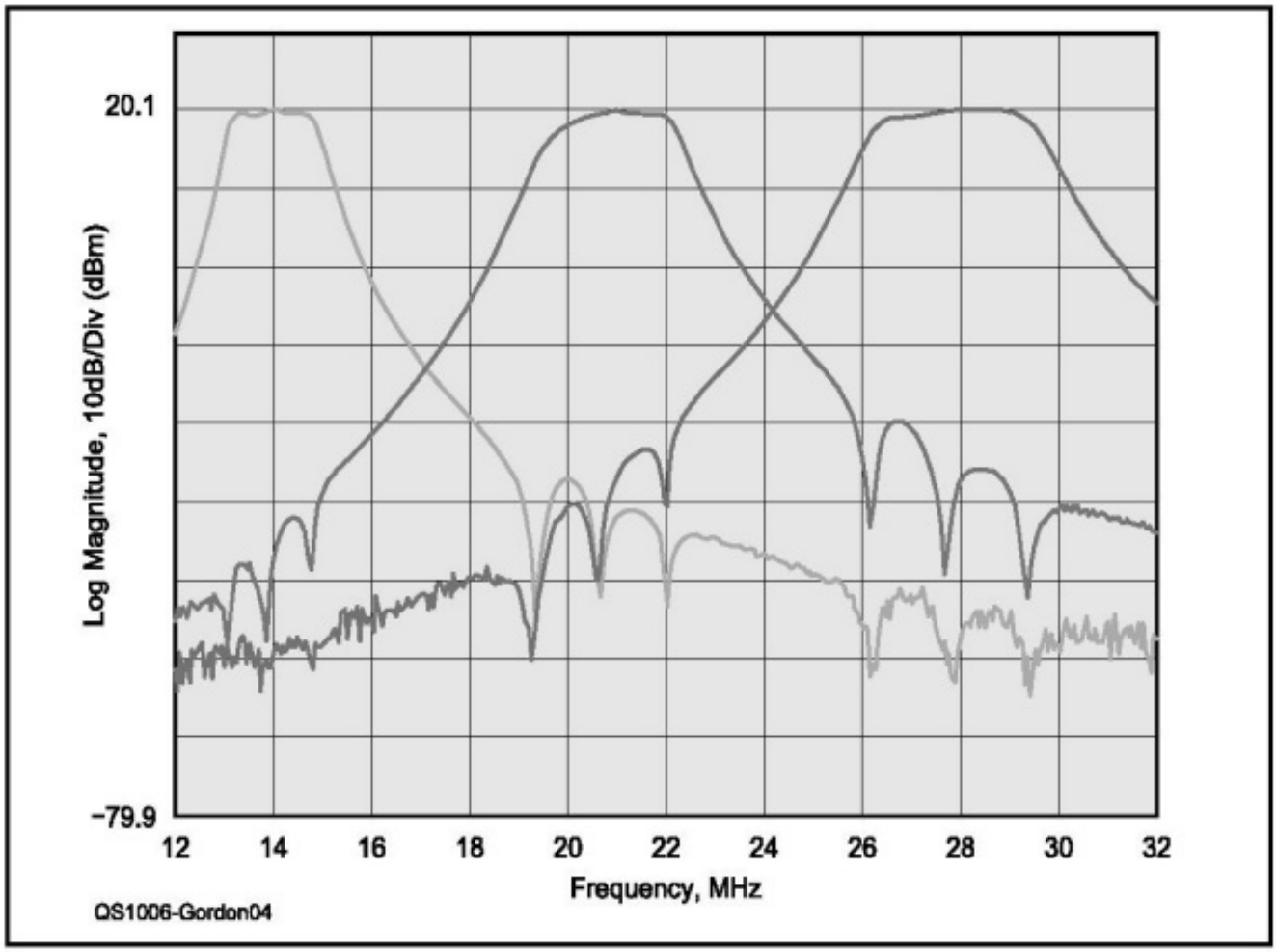


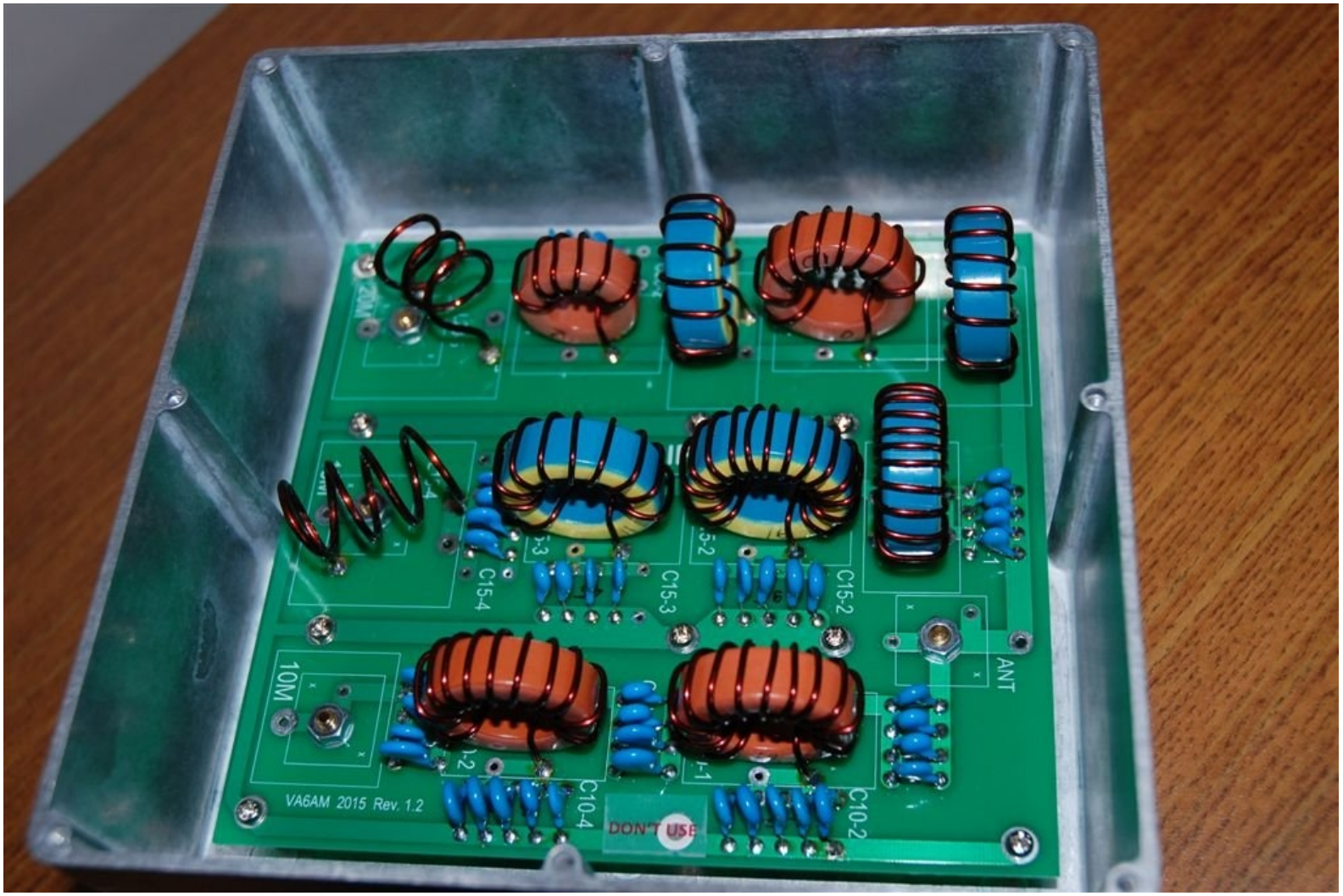
Figure 3 — Frequency response of the triplexer decoupling network and band-pass filters. Next-band signals are attenuated by approximately 50 dB.

OVERALL RESPONSE INCLUDING BANDPASS FILTERS

Power Levels

- 100 Watts = +50 dBm
- 0.6V pk forward biases a diode, might cause damage.
  P= $(0.42Vrms)^2/50$ = 3.5 mW = 5.5 dBm
- **DAMAGE Threshold = -45 dB separation**
- S9+20 = 0.5mV = -73 dBm…..unlikely we can get -120dB separation….
- 60 dB separation yields -10 dBm = 100uwatt = 70 mV → not damaging, possibly tolerable on a separate band?

VA6AM Triplexer – KIT Available!

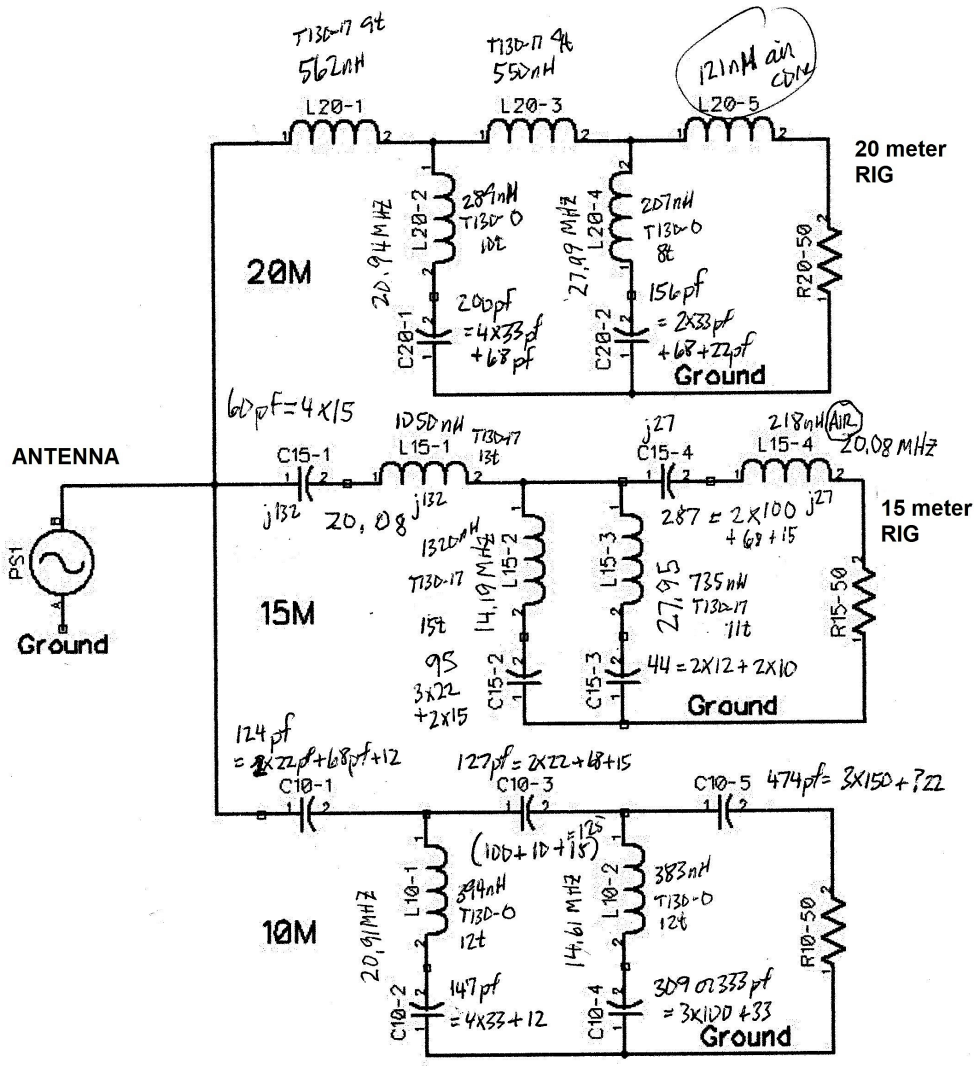


https://va6am.com/2017/01/20/low-power-triplexer-assembly/

Our First Efforts

NanoVNA extremely helpful. Amazing how much you can do by poushing and pulling the Turns on a toroid! Introduced to BIG toroids and BIG wire – much lower losses.

Triplexer Building Schematic



Caps, inductors marked

Original Build

	BAND		
Measurement (beginning)-> end values	20 meters	15 meters	10 meters
SWR into 50 ohms on antenna terminal	(1.067)-> 1.03	(1.33)-> 1.19	(1.26)-> 1.1
Passband loss	(0.49)-> 0.2 dB	(0.28)-> 0.18 dB	(0.49)-> 0.29dB
Isolation from lower interfereing frequency transmitter	(37)-> 38 dB	(37.5)-> 31 dB	(55)-> 42 dB

Need additional filtering!

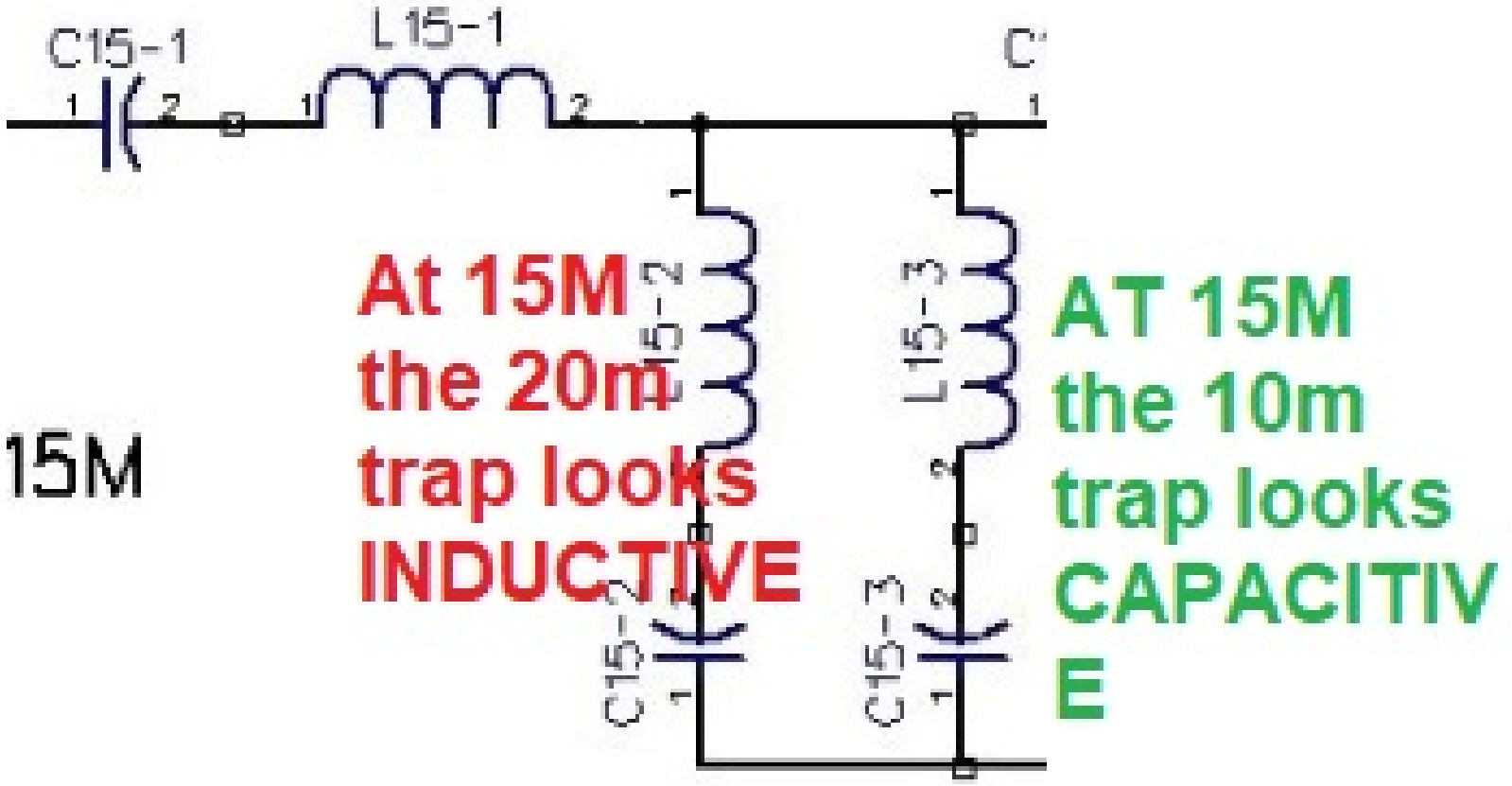
- 38dB is way short of 60 dB requested
- Add 20+ additional BandPass Filtering (a stretch for our simple Butterworths)

Need to add another band

- 20/15/10 is not going to cut it as the sun lowers…
- Need 40 meters for certain,
- Want 80 meters also….

How Pavel's Traps Combine…

(15 meter filter example)

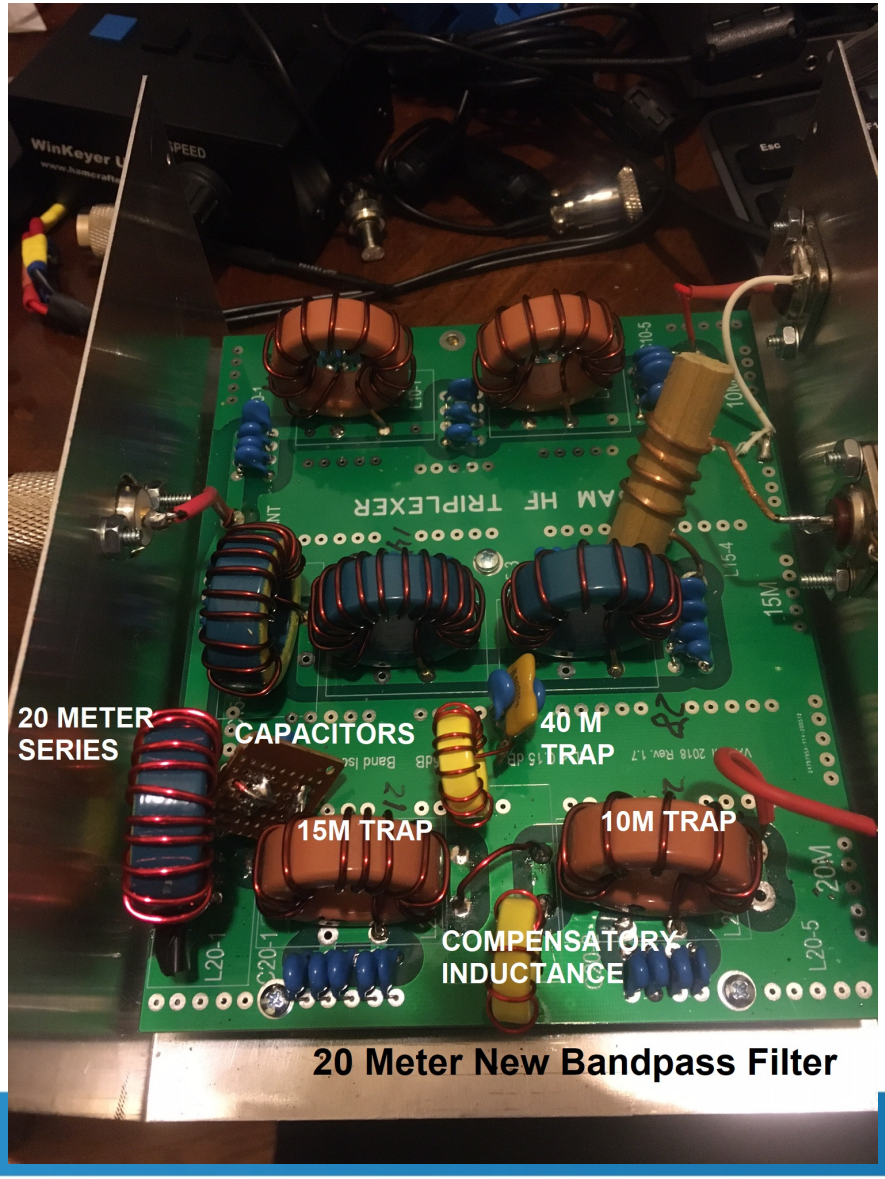


Must rework Pavel's 20m

- 10m = High Pass
- 15m = Bandpass (tricky combination of traps)
- 20m = Low Pass

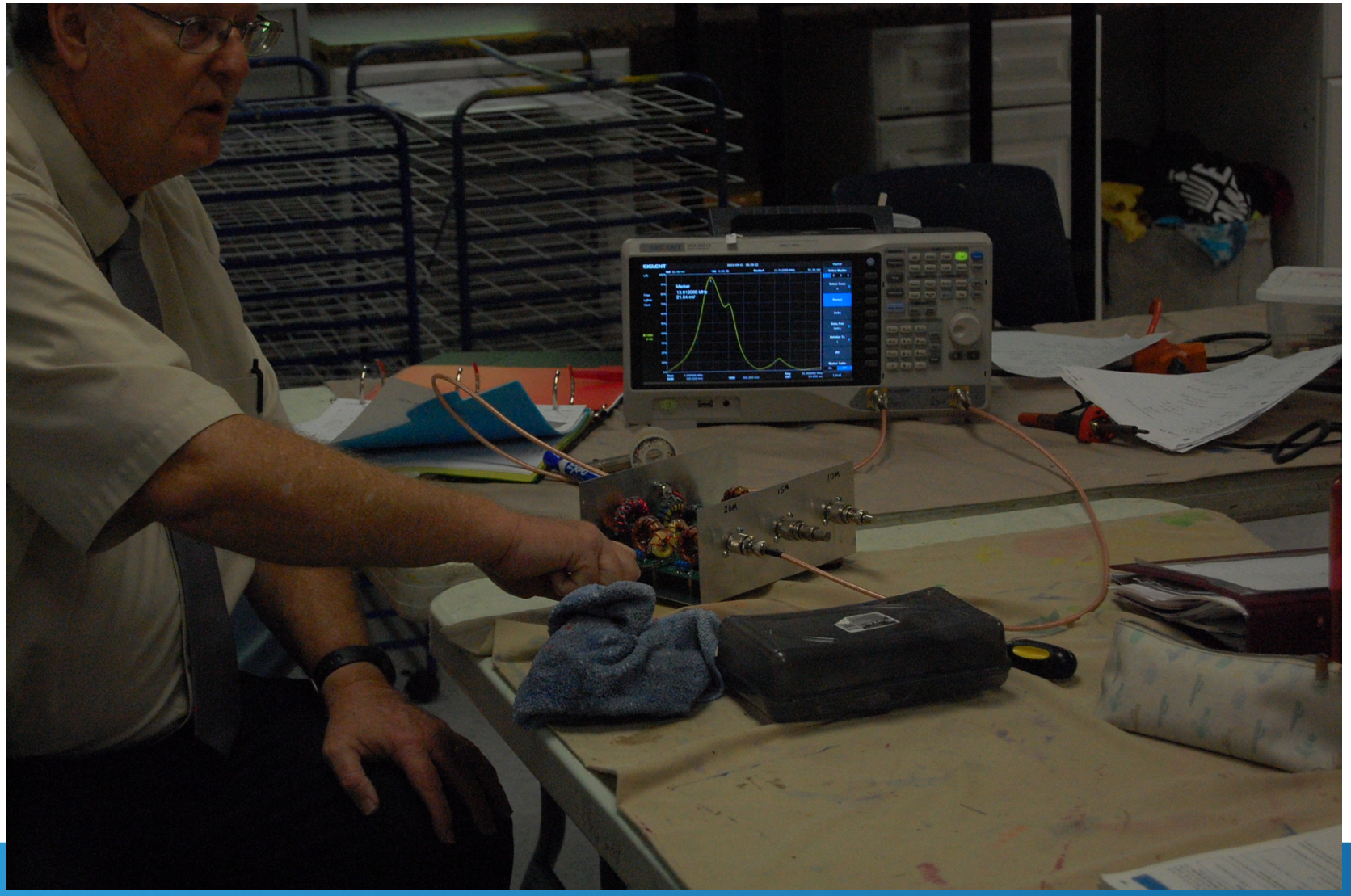
- To achieve additional bands, 20m must become bandpass….

Making 20M bandpass work…

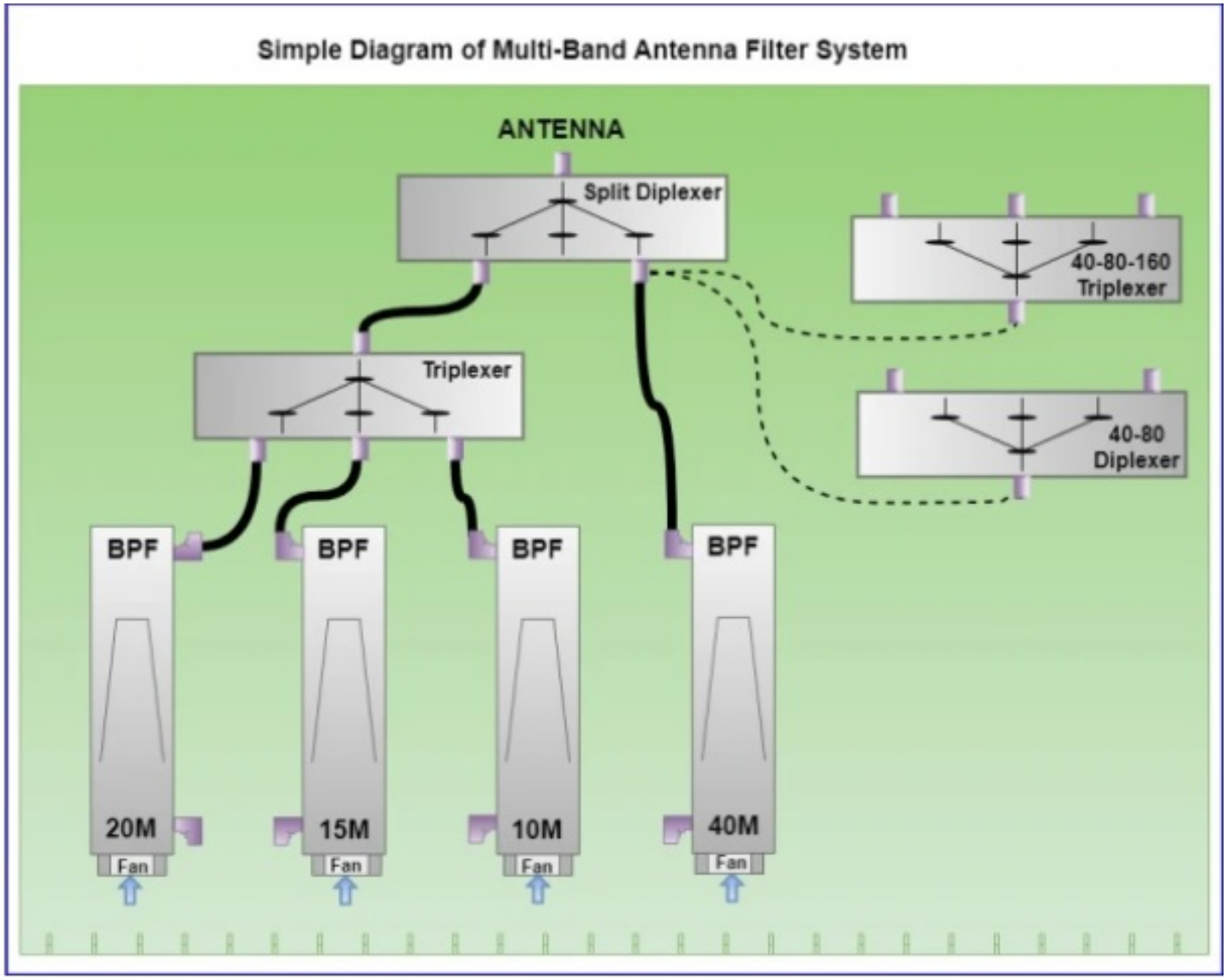


Our 20M reworked filter

Showing PreCalc Students



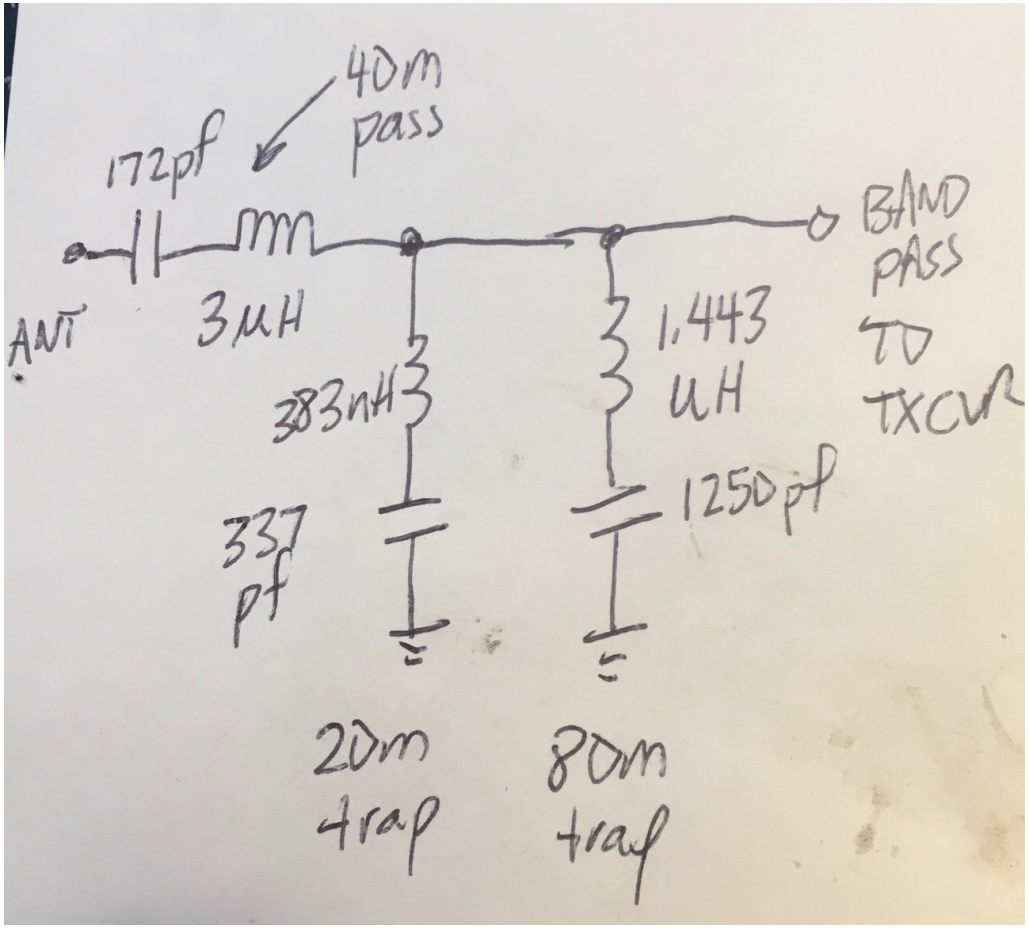
How Pavel Does Diplexer



VERY EXPENSIVE!!!

We wanted merely to expand the Triplexer and avoid having to add a diplexer in front….

40M Triplexer Plan

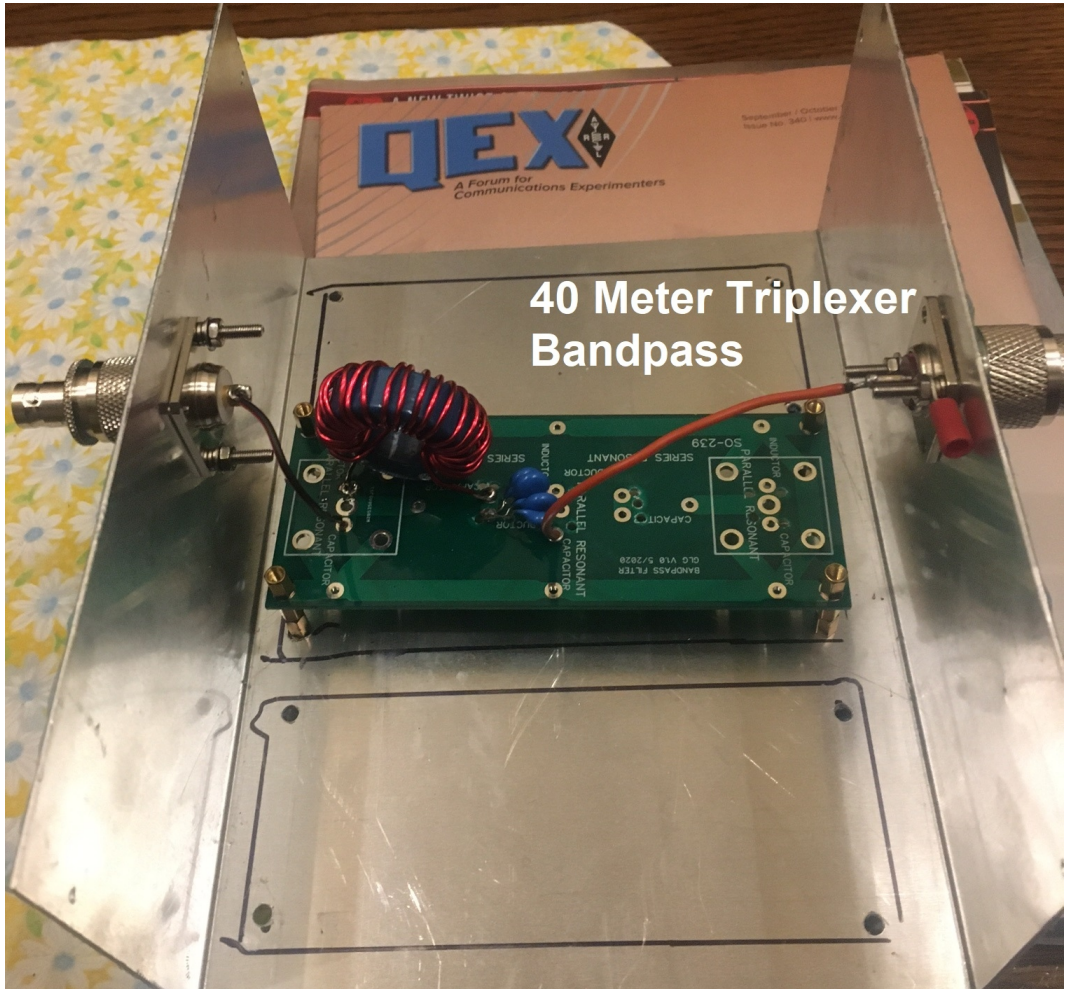


40 Meter BandPass Development

40-meter: must be a BANDPASS design. Pavel tends to put in 130-ish ohms of reactance at the passband frequency for each of his series reactances. 40-meter series tuned filter should be about 172 pf and 3µH. For 100watts, it should be on a T130-17 toroid, #16 wire, approximately 27turns (46"). Two series traps to ground are chosen to approximately quash the 20meter energy and the 3.75 MHz energy, but combined to a parallel resonance on 40 meters.

40 Meter MultiPLEXOR	Series Tuned Input	20 meter trap	3.75 MHz trap
Inductor	~ 3µH*	383 nH*	1443 nH
ACTUAL TURNS in our instance	23 turns T130-17	8 turns T130-17	15 turns T130-17
Capacitor	~160 pf >= 1kV	~337 pf >=1kV	~1250 pf, >= 1kV

Our 40 Meter Added Filter

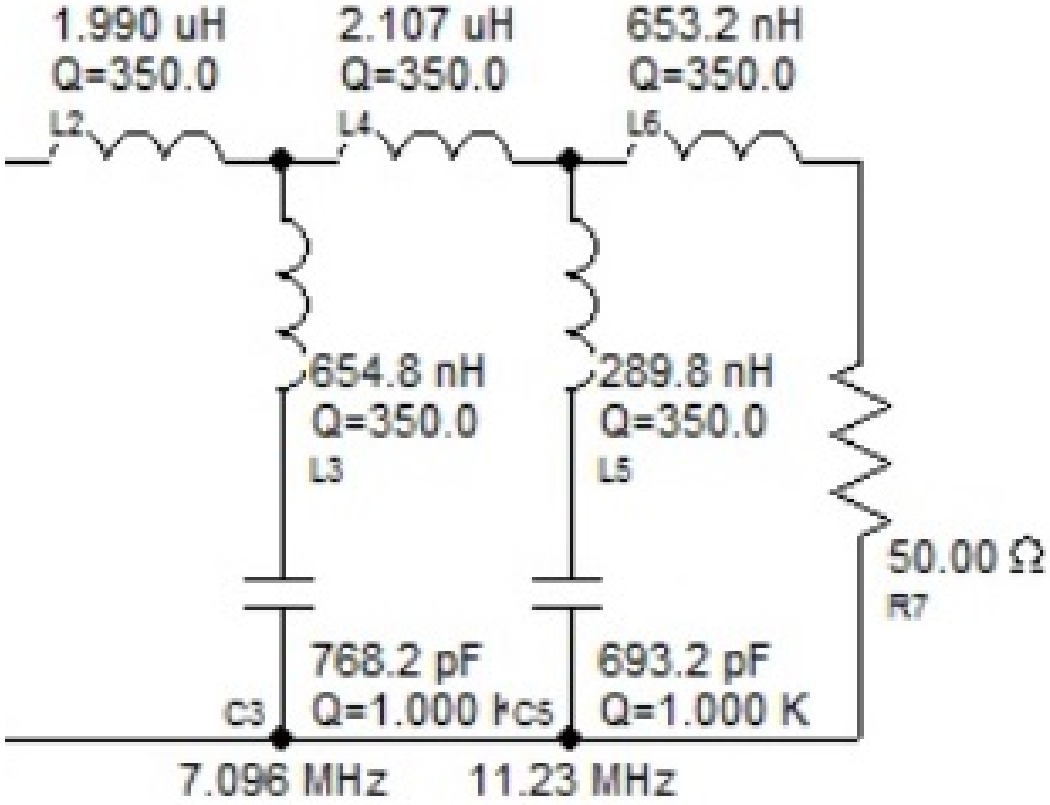


40 Meter Response

QuadPlexer Outcome

PASSBAND	40 meters	20 meters	15 meters	10 meters
Loss Measurements	Estimates of "additional required" are based on a minimum of 50dB separation required for possible reception and good safety.			
80 meters	~ -28 dB (need 22+ addnl dB)			
40 meters	0.36 dB	-51 dB (need 0+ dB addnl)	-21 dB (need 29+ dB addnl)	-29 dB (need 21+ addnl)
20 meters	-57 dB (adequate)	-0.23 dB	-32 dB (need 18 dB addnl)	-44 dB (need 6+ addnl)
15 meters	-24 dB (need 26 dB addnl)	-34 dB (need 16+ dB addnl)	-0.49 dB	-31 dB (need 19+ addnl)
10 meters	-24 db (need 26 db addnl)	-48 dB (need 2+ dB addnl	-37 dB (need 13 dB addnl)	-0.43 dB

Add 80? 80/160 LPF - Pavel



VA6AM LPF for 80 & below
see: https://va6am.com/2017/01/01/4080-band-diplexer/

Our wimpy 80/160 LPF result

LPF instead of BPF.

Built external LPF as well...not a bandpass…

Could not operate 160 at same time as 80…

During WFD, 160 was taken over by an international CW contest...so didn't matter that much...

Two Boxes (connect w/coax)

Bare QuintPlexor Response

Signal at common Antenna connector / Operating BAND PORT	80/160	40 meters	20 meters	15 meters	10 meters
80/160m	-0.35 dB	-42 dB	-22 dB	-24 dB	
40 meters	-27 dB	~ -0.35dB	-47	est -20 dB	
20 meters		-57 dB	-0.23 dB	-32 dB	-44 dB
15 meters		-24 dB	-34 dB	-0.49 dB	-31 dB
10 meters		-24 dB	-48 dB	-37 dB	-0.43 dB

HV Capacitor Sourcing

Possible Sources of RF / HV Capacitors		
Capacitance	Rated Voltage	Link to potential source
100 pf and higher values	1kv	https://www.amazon.com/gp/product/B08BFWG5T7
220 pf silver mica	500V	https://www.amazon.com/gp/product/B00L5YM4X6
Assorted	supposedly 500V	https://www.amazon.com/gp/product/B01INRL2WQ Be careful -- not all of these are 500v
TDK 47pf	6kV	https://www.digikey.com/en/products/detail/tdk-corporation/CC45SL3JD470JYVNA/7383672
TDK 22pf	6kV	https://www.digikey.com/en/products/detail/tdk-corporation/CC45SL3JD220JYGNA/7383661
TDK 10pf	6kV	https://www.digikey.com/en/products/detail/tdk-corporation/CC45SL3JD100JYNNA/4457596

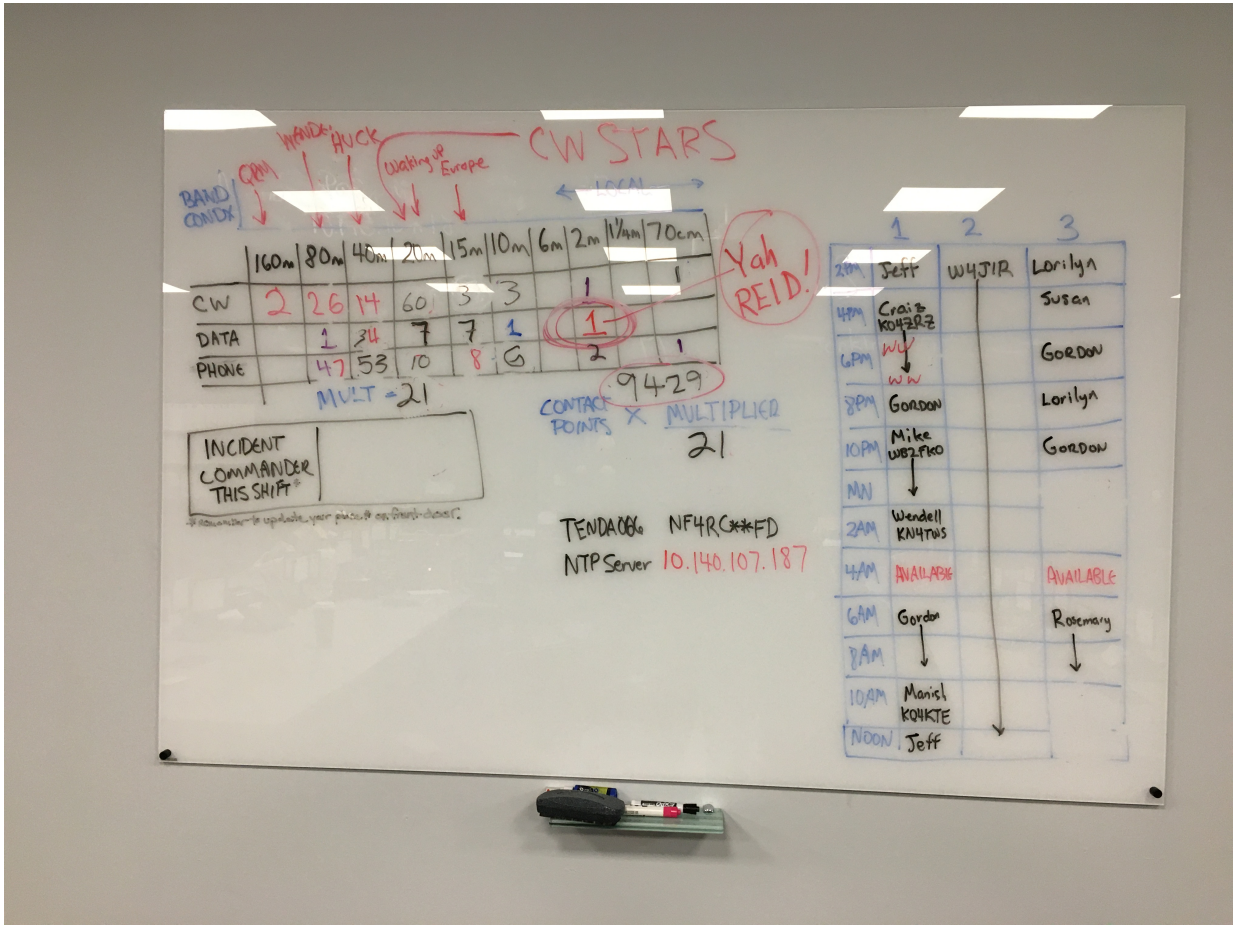
“Filter Room”


Primary Backup Volunteer Radio Station
Nation- and World-wide Communications

300W visible!

Pounding on Filters with 3x100W


EMERGENCY OPERATIONS CENTER
HIGH FREQUENCY (HF) STATION #1


CW STARS
BAND CONDX
GRN
HANDX
HUCK
Waiting up Europe
LOCAL
160m 80m 40m 20m 15m 10m 6m 2m 1¼m 70cm
CW 2 26 14 60 3 3 1 1
DATA 1 34 7 7 1 1 1
PHONE 47 53 10 8 6 2 1
MULT = 21
Yah REID!
9429
CONTACT POINTS X MULTIPLIER
21
INCIDENT COMMANDER THIS SHIFT
TENDA086 NF4RC**FD
NTP Server 10.140.107.187
1 2 3
2PM Jeff W4JIR Lorilyn
4PM Craig KO4ZRZ Susan
6PM WX Gordon
8PM Gordon Lorilyn
10PM Mike WB2FKO Gordon
MN
2AM Wendell KN4TWS
4AM AVAILABLE AVAILABLE
6AM Gordon Rosemary
8AM
10AM Manisl KQ4KTE
NOON Jeff

First ever CW contact…
can't copy CW….
why let that stop you?

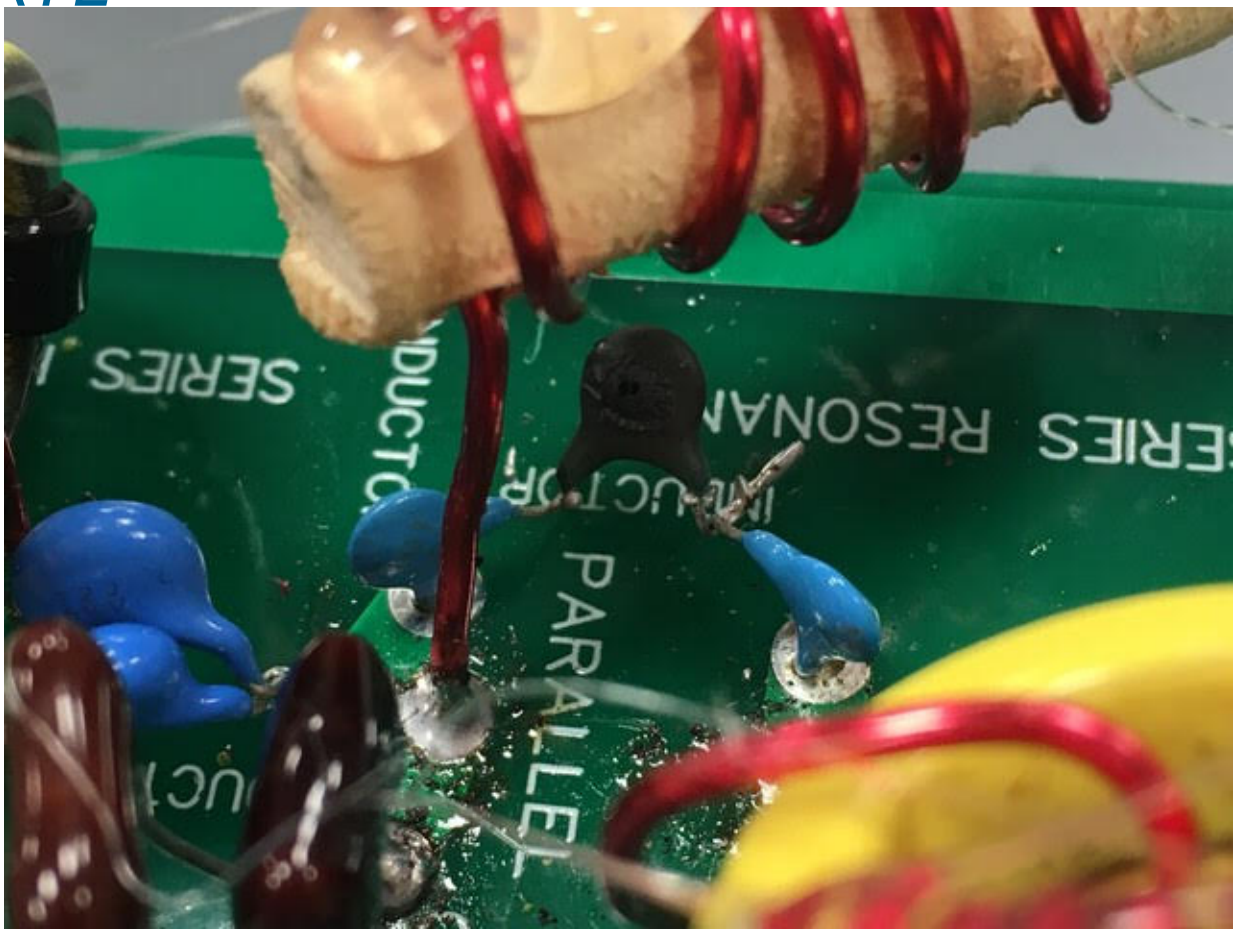
OOPS! “I smell SMOKE!”

Manish Sahni KQ4KTE

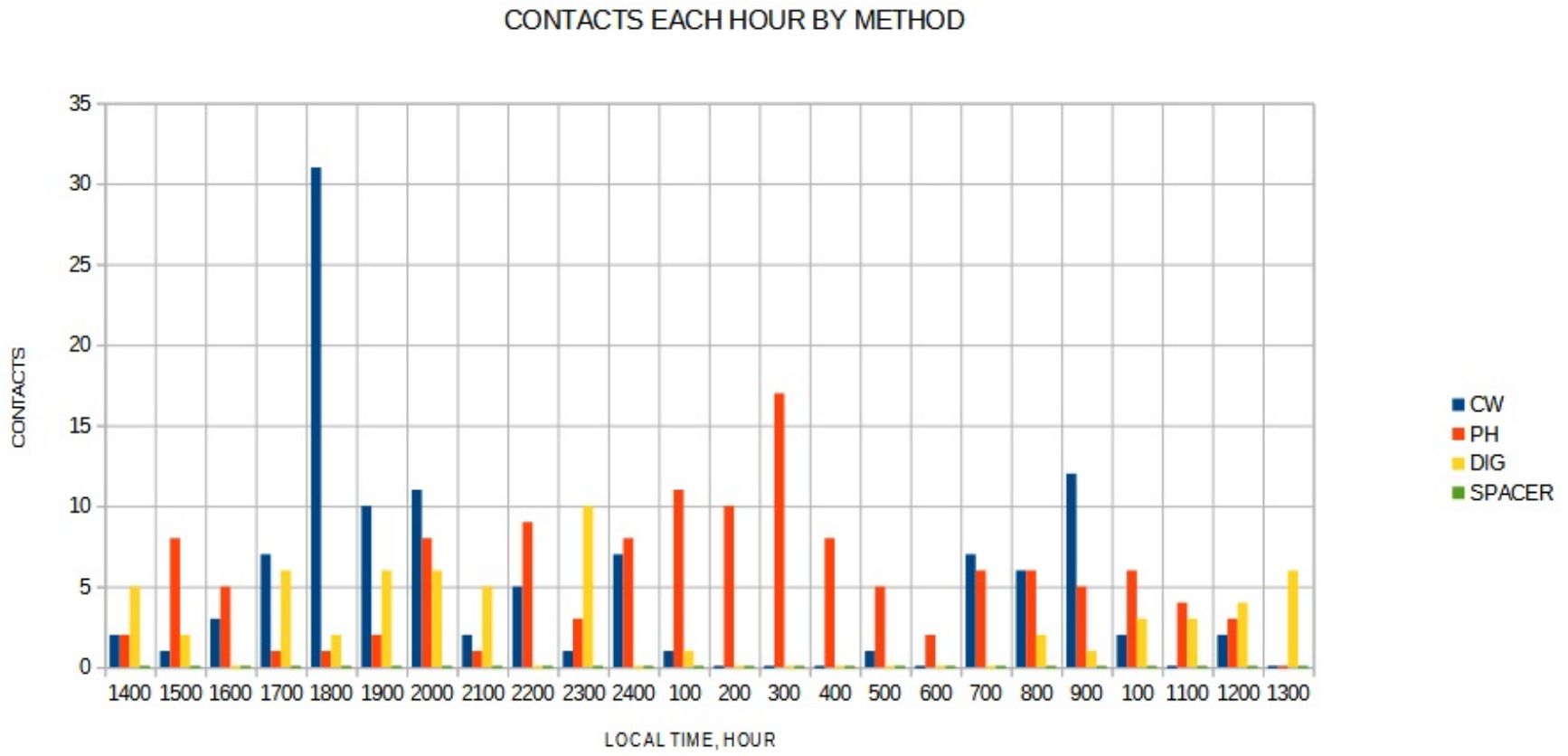
15 meter bandpass filter had long been “suspect”….rapidly changing SWR….

2/3 of the way into winter field day….it gave up the ghost.

Believe it or not, we had it repaired and back on the air with better outcome in about 30 min



Total CW Contacts	111
Total Phone Contacts	129
Total DIG Contacts	64
Total Multiplier	21
Total Score	10,059
Total on-site operators	13
Primary off-site contacts	1 (K9RFT)


CONTACTS EACH HOUR BY METHOD
CONTACTS
35
30
25
20
15
10
5
0
1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 100 200 300 400 500 600 700 800 900 100 1100 1200 1300
LOCAL TIME, HOUR
CW
PH
DIG
SPACER

Conclusions

- Replace the 15m bandpass with a Pavel Kit
- T130 sized toroids much better than T80!
- Bigger wire much better than #18!
- 3kv/6kv caps much better than mica 500V
- You really want 60dB separation
- We want a YAGI!
- Add separate 160m tap?