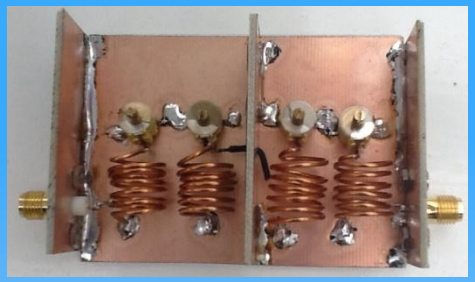
The black magic of filters and PAs

Filters



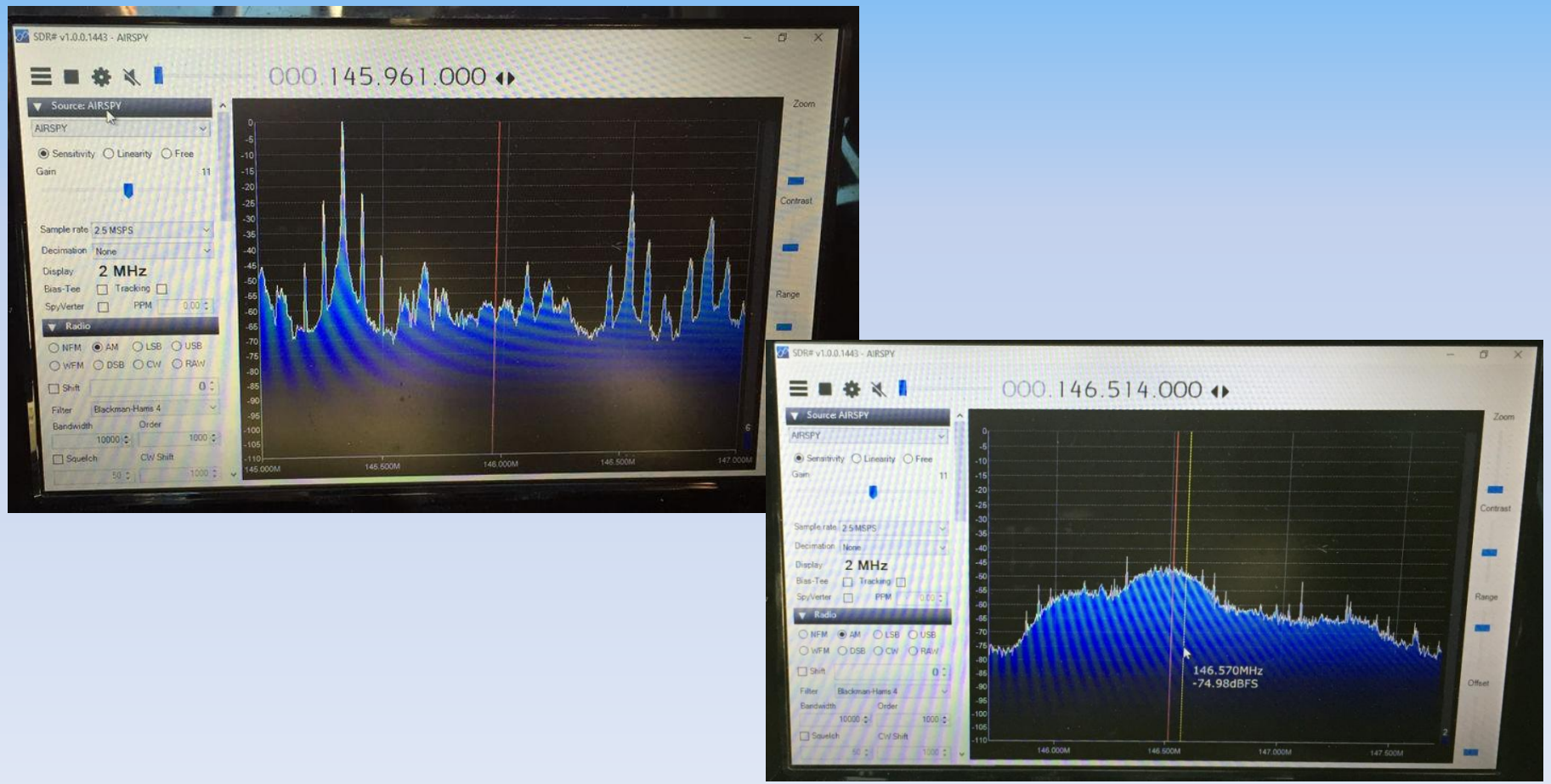
- Good filters are essential in a modern day Tx and Rx
- Yaesu and Icom fit them for us (hopefully!)
- Uniquely ATVers still construct our own Tx and Rx!
- It is essential we use filters on Tx and Rx
  - Time to the dust off the text books!
- But why – it works without them??

Filters on rx??

- There's lot of loud signals on VHF and UHF
- And you can't see digital
  - It just raises the noise floor
- Satellite tuners are wideband
  - Designed to look at the Sky
  - No big interferers
- Essential to use bandpass and notch filters on rx

Do I really, really need to?

- SPF 1043 on 146 MHz



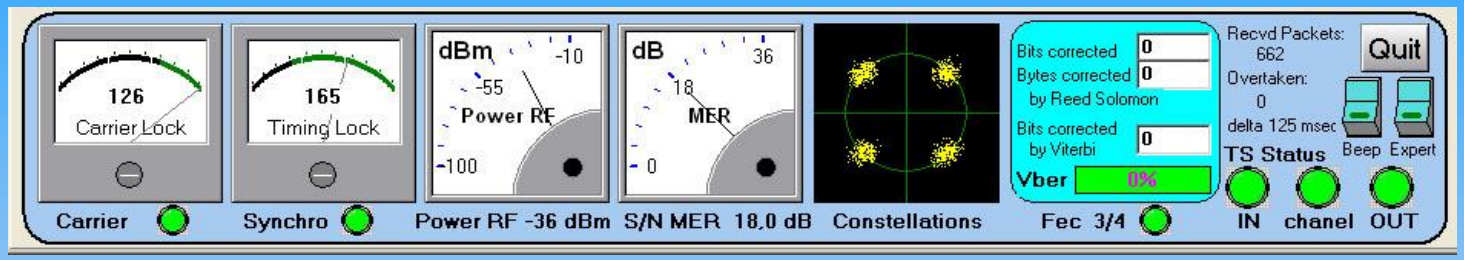
Rx filters

- Need to be band pass
  - To filter both high and low of the wanted frequency
  - Protect against mix products
  - As tight as possible (high Q)
- Maybe a notch for band 2 and TV transmitters
  - And 144.800!
- Caution re DC shorts!
- Filter Insertion loss is critical if before the pre-amp...

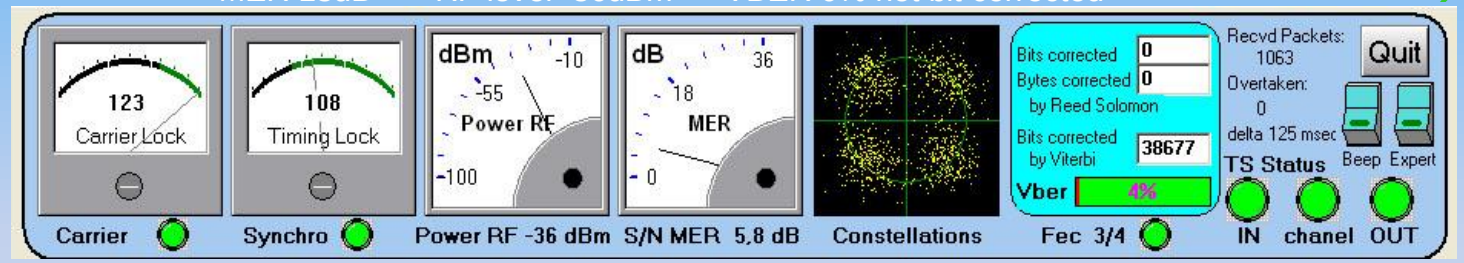
Before or after the pre-amp

- Always put your pre-amp at masthead
- 20mts of RG213 @ 70cms = 3dB!
  - Same as tx station doubling his power
- Modern devices have NF of <1dB and can handle large signals
- But terrestrial noise = ~ 2dB
- So don't take the risk – put the filter in front of the pre-amp!
- Or use a good filtered pre-amp
  - See Ian White GM3SEK excellent article on the DG8 pre-amp

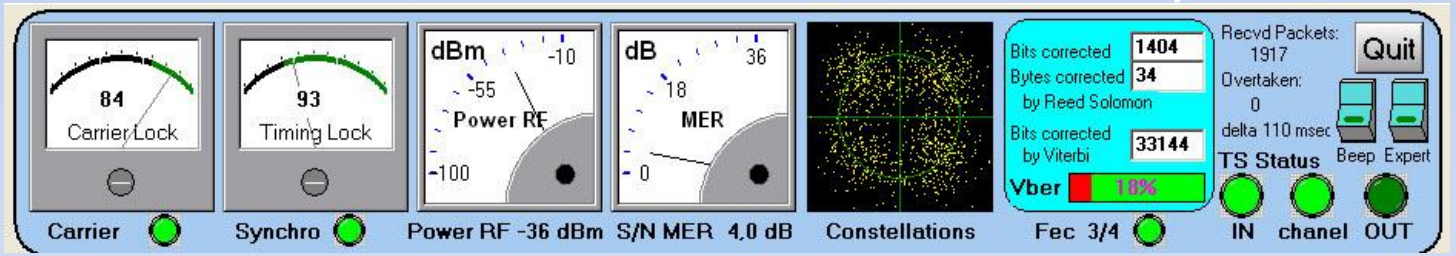
Forget the S meter!



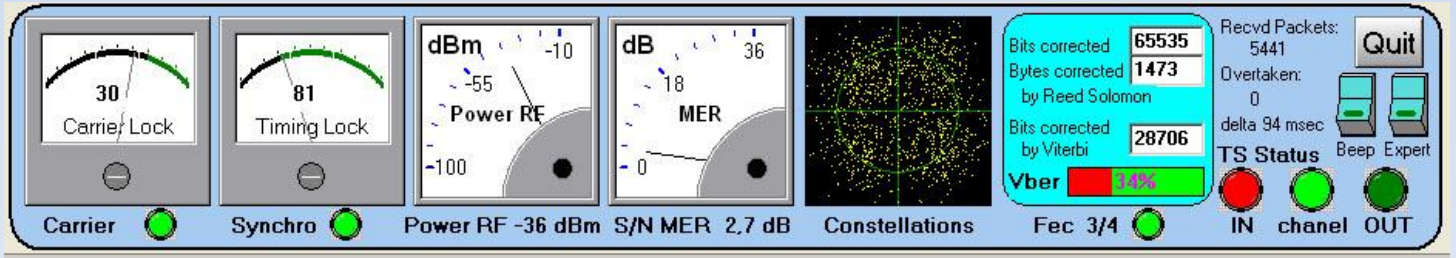
MER 18dB -----RF level -36dBm ----VBER 0% not bit corrected →TS OK



MER 5.8dB -----RF level -36dBm ----VBER 4% bits corrected by Viterbi →TS OK



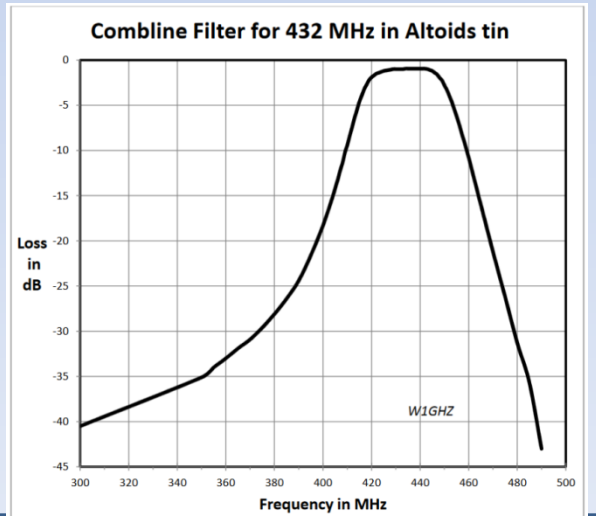
MER 4dB -----RF level -36dBm ----VBER 18% bits corrected by Viterbi and Reed Solomon →TS OK



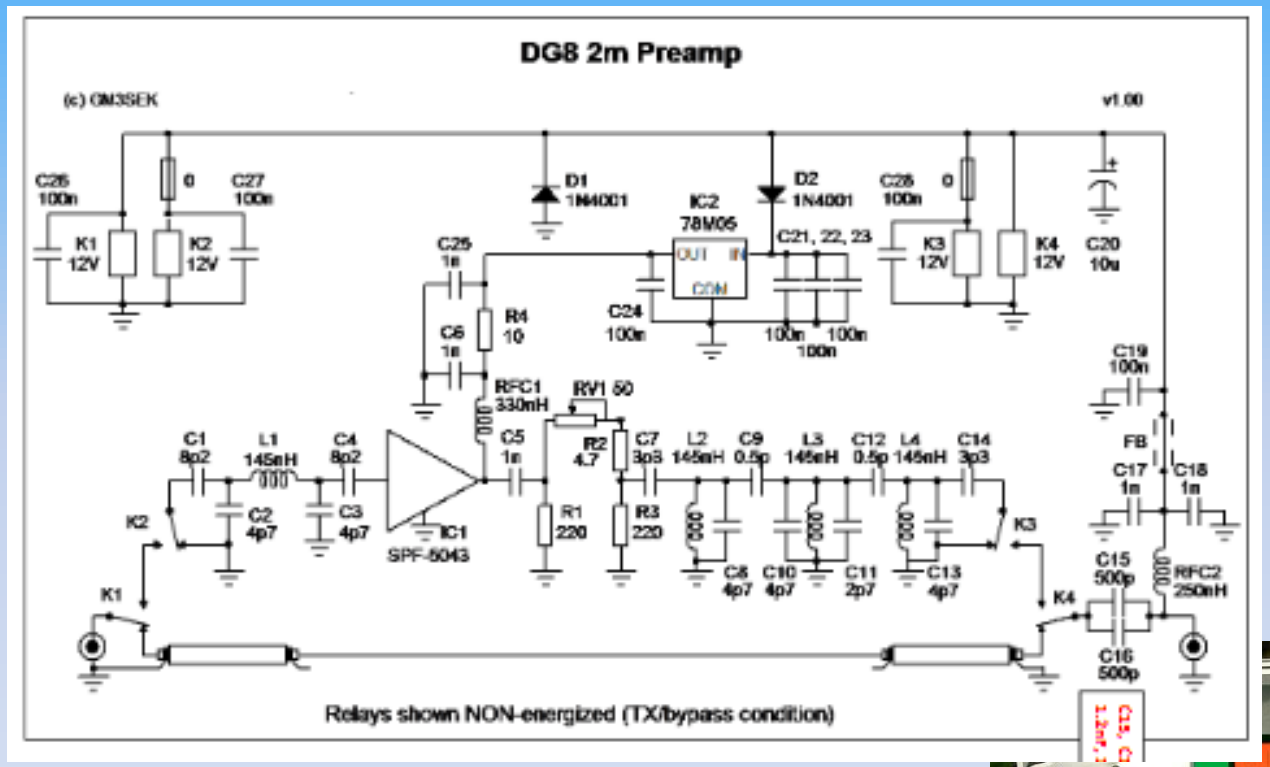
MER 2.7dB -----RF level -36dBm ----34% bits corrected by Viterbi and Reed Solomon →TS NOT OK

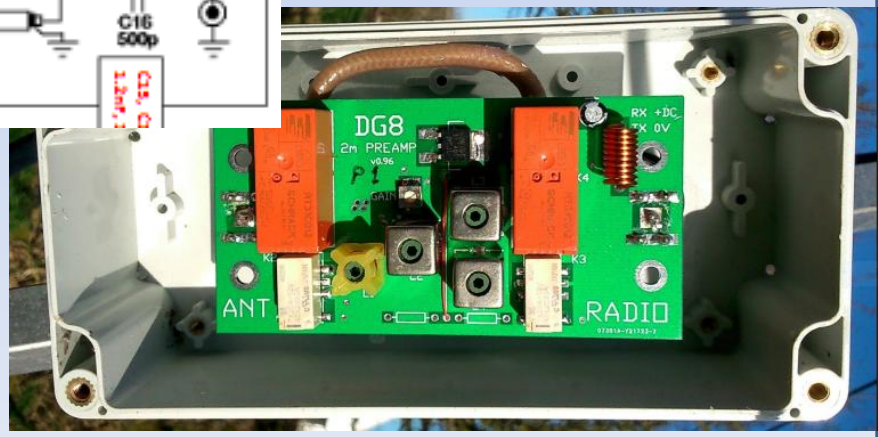
Rx filters in practice

- Interdigital designs are the best
  - Tight filter, low loss
- Plenty of designs on-line
  - Can be made from PCB
- W1GHZ combline filters are easy to make and perform well

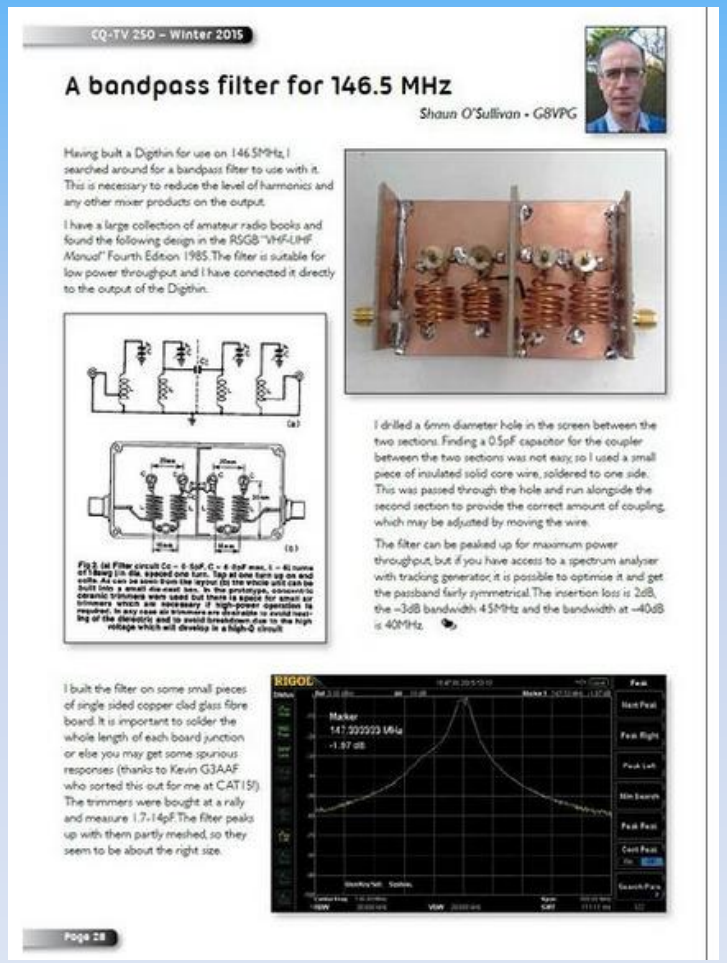


146 MHz DG8 by GM3SEK





More designs



CQ-TV 250 – Winter 2015

A bandpass filter for 146.5 MHz

Shaun O'Sullivan - G8VPG

Having built a Digithin for use on 146.5MHz, I searched around for a bandpass filter to use with it. This is necessary to reduce the level of harmonics and any other mixer products on the output.

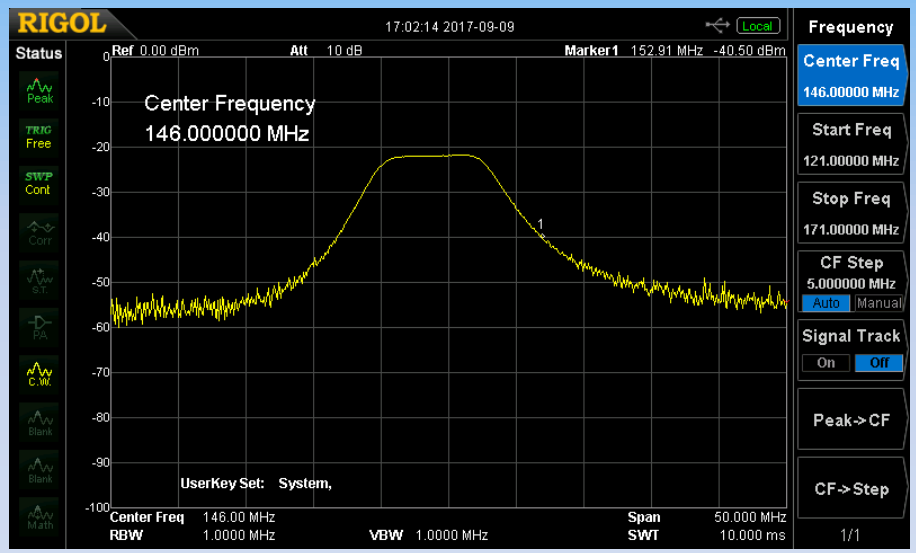
I have a large collection of amateur radio books and found the following design in the RSGB "VHF-UHF Manual" Fourth Edition 1985. The filter is suitable for low power throughput and I have connected it directly to the output of the Digithin.

I drilled a 6mm diameter hole in the screen between the two sections. Finding a 0.5pF capacitor for the coupler between the two sections was not easy so I used a small piece of insulated solid core wire, soldered to one side. This was passed through the hole and run alongside the second section to provide the correct amount of coupling, which may be adjusted by moving the wire.

The filter can be peaked up for maximum power throughput, but if you have access to a spectrum analyser with tracking generator, it is possible to optimise it and get the passband fairly symmetrical. The insertion loss is 2dB, the –3dB bandwidth 4.5MHz and the bandwidth at –40dB is 40MHz.

I built the filter on some small pieces of single sided copper clad glass fibre board. It is important to solder the whole length of each board junction or else you may get some spurious responses (thanks to Kevin G3AAF who sorted this out for me at CAT15!). The trimmers were bought at a rally and measure 1.7-14pF. The filter peaks up with them partly meshed, so they seem to be about the right size.

Page 28

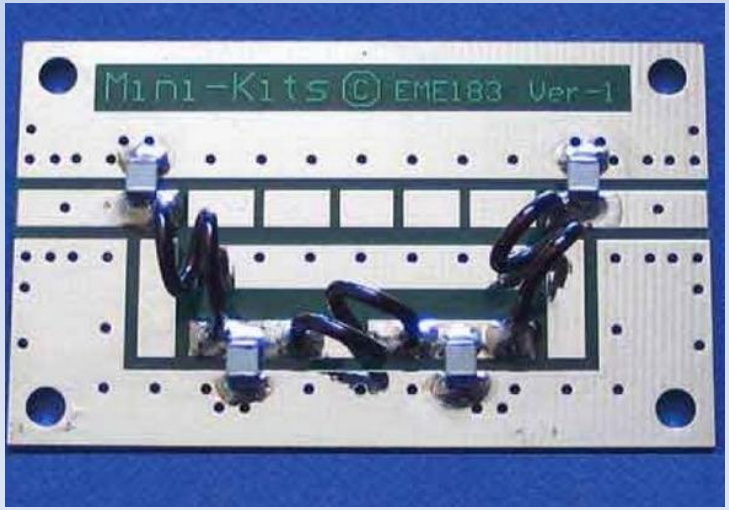


Transmit filters

- Essential to put a low pass filter on the output of your wideband DATV transmitter!
- Just try tuning your receiver to 439.5 when transmitting on 146.5 MHz!
- A simple low pass filter is adequate but it must handle the power!

Tx filters in practice

- Need to handle 5+ watts so must use high voltage capacitors
- Maybe wiser to buy rather than build
  - Minikits do an excellent range

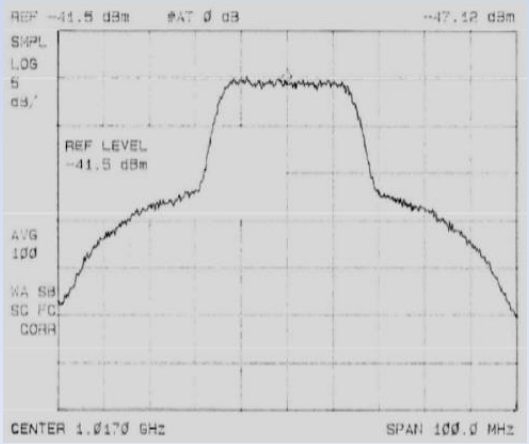


Filters

- Don’t learn the hard way
  - Like I did!
- No rx filters are a show stopper!
  - Your tuner will crunch and you won’t know!
- Transmit filters are just good practice
- Just like not over driving your PA!

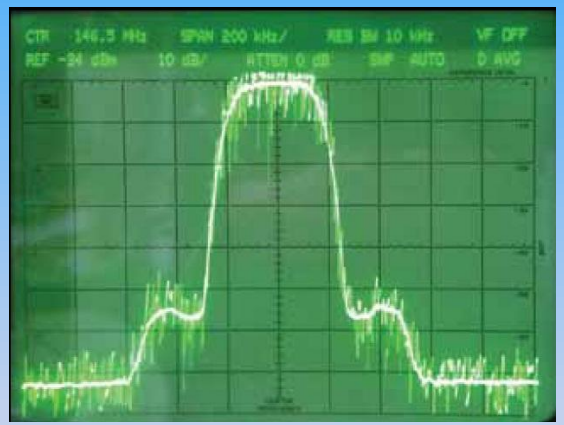
DATV Power amplifiers

- Spectral re-growth is a major issue when operating ANY digital modes
- Minimal spectral re-growth is very hard to achieve
  - Professional satellite uplinks = -30 dB!!
  - 146MHz target is -60 dB!
- Requires very linear PAs
- Average home constructor has to “back off” the PA
  - Typically 6 – 10 dB
- Pre-correction would help



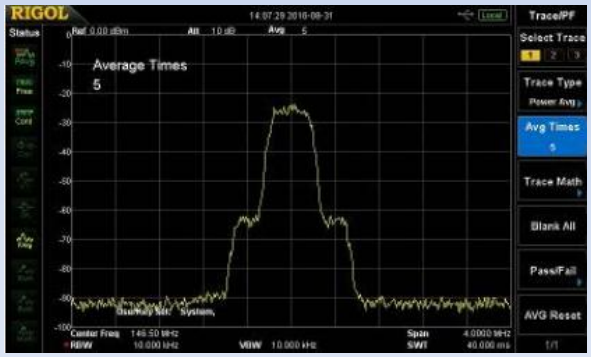
PAs for digital modes

- RD70 rated at 70watts
  - 5 watts with -55dB IMD3



- RA60H1317M
  - 5 amps @ 12v = 7 watts out!

- Need good heat sinks and fans!
  - And BIG batteries when out /p!



Back off!!!

- The extra one watt is not worth it
  - 5 watts plus 1 watt = < 1dB!
  - It will not make any difference
  - But may increase shoulders by 5 dB
- Try to get your gear on an analyser
  - Note down the numbers and don't touch it!
- A lot of work goes in to designing DATV systems – don't screw it up!