ADSL filter for 160M

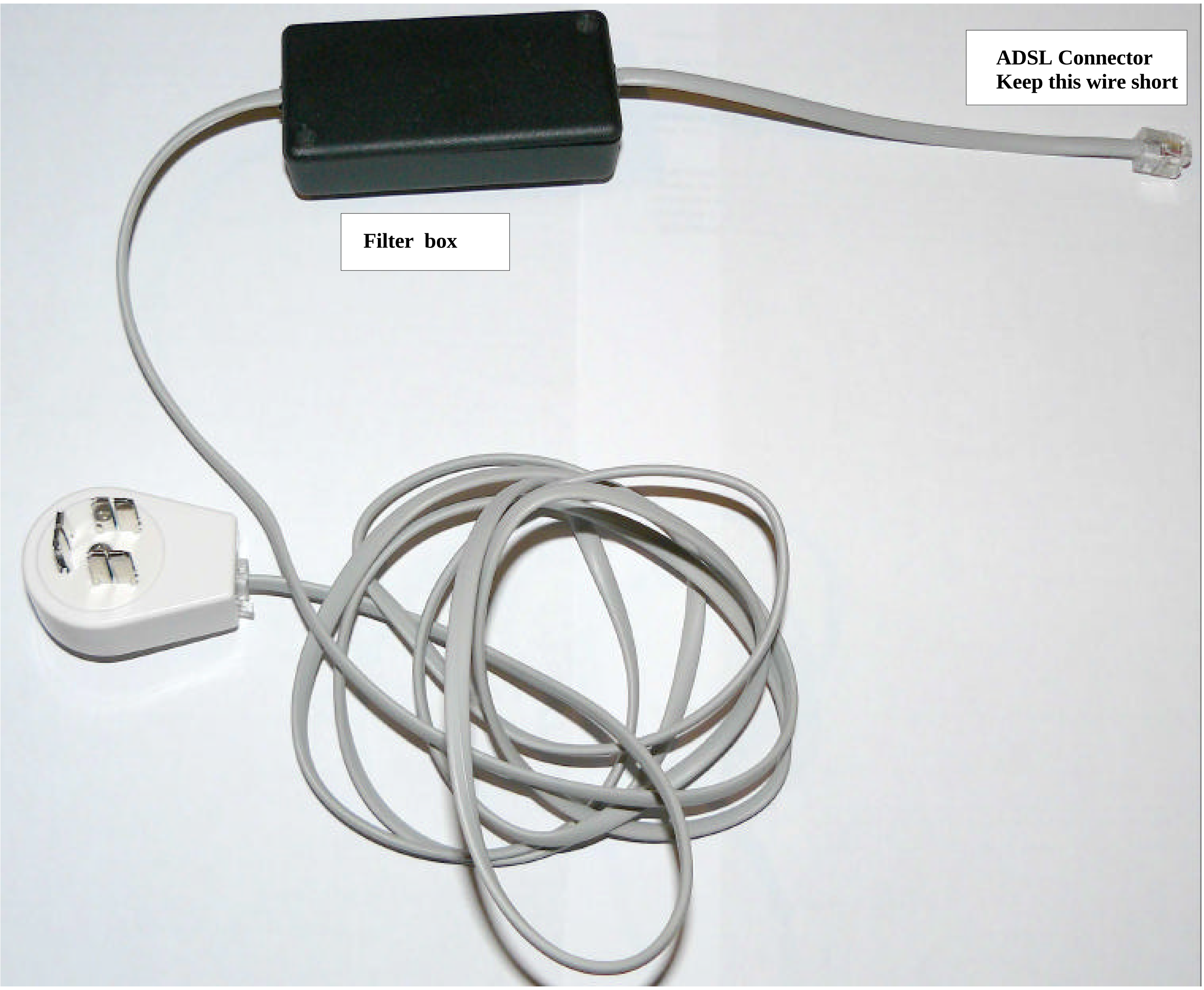
Before I was only able to use 50W, after installing ADSL filter 1Kw without problems.

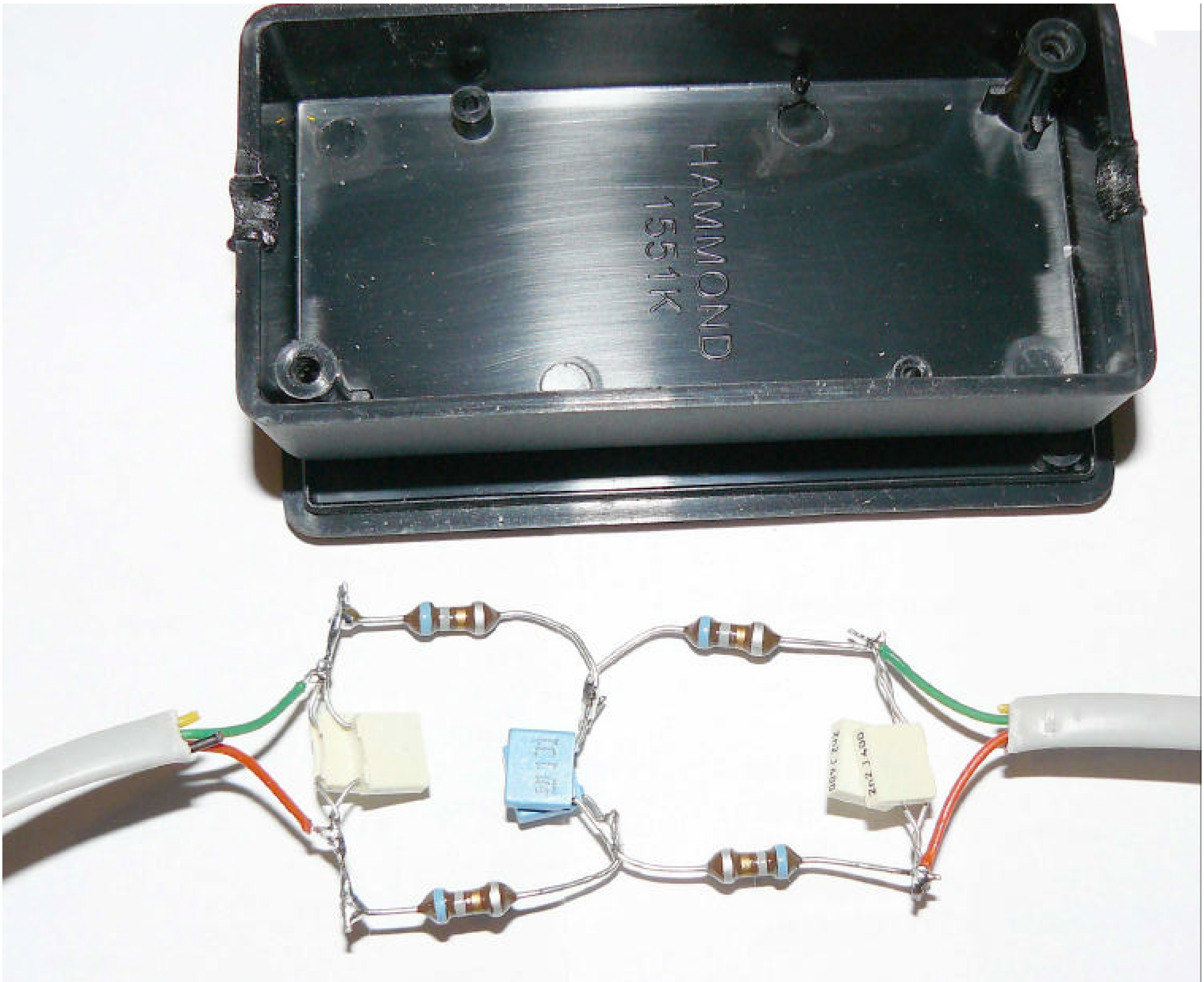
ADSL speed starting with 1Mb dwn 256Kb. Up . today I run 5Mb. dwn and 1Mb. up

There is a webpage with a version made with SMD components made by WD8DSB here

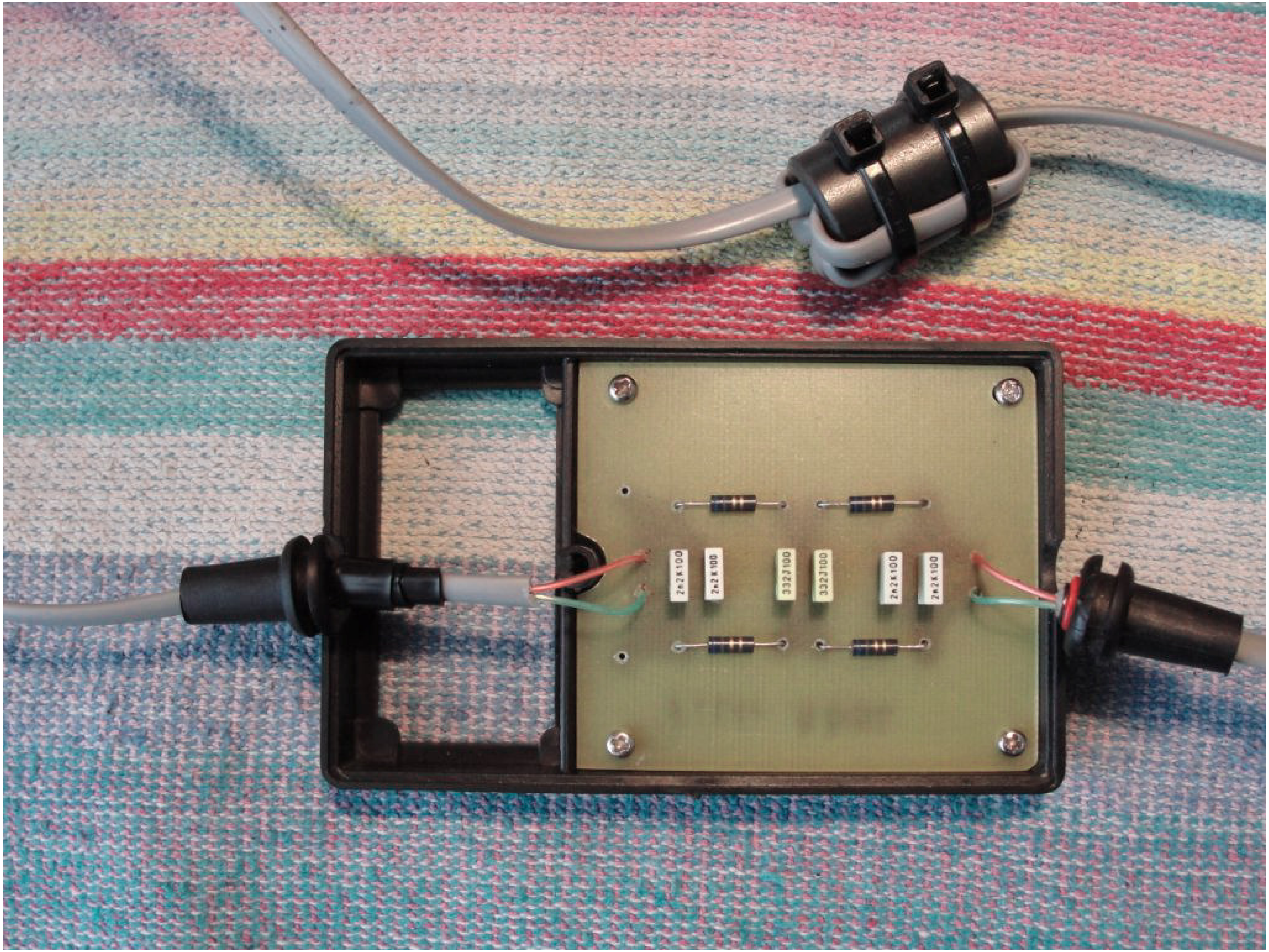
https://sites.google.com/site/adsl160filter/

73 Boye


ADSL Connector
Keep this wire short
Filter box


HAMMOND
1551K

Made by SP6AEG




VEL MEAS. SET
MHz
PSM-139
el & Goltermann
RX
LEVEL
-1.2 dB
100 000 Hz
-100
0
1 000 Hz FSTEP
LEVEL ABS-REF
REF : 0.00 dB
OFF AFC
TX 0.0 dB
100 Hz BANDW
NOISE
INTERR
AUTOSTEP
SWEEP
SETUP
DOCUM
TEST & CONF
VOICE
NPR
HOT
TX/RX IMPED
DISPL/ UNITS
HELP
RECEIVER (RX)
BLANK
GENERATOR (TX)
Z/Ω


T-0013
Goltermann
RX
LEVEL
-7.9 dB
1 100 000 Hz
-100
0
1 000 Hz FSTEP
LEVEL ABS-REF
REF = 0.00 dB
OFF AFC
TX 0.0 dB
100 Hz BANDW
INTERR
AUTOSTEP
SWEEP
SETUP
DOCUM
TEST & CONF
VOICE
NPR
HOT
TX/RX IMPED
DISPL/ UNITS
HELP
RECEIVER (RX)
GENERATOR (TX)
10kHz...14MHz
50Hz...620kHz
BLANK
50Hz...32MHz
10kHz...14MHz
Z/Ω
124
∞
150
150
∞
600
50
75
Z/Ω
124
150

SP6AEG 1.8Mhz

Staying Connected to Your Broadband - An Improved ADSL Filter

By Stephen Wilson, G3VMW

Many of us in the UK have our houses connected to the telephone network by long, overhead lines. This is especially true in rural areas and in older properties where these overhead telephone lines can be up to about 150 feet (46m) in length. I live in a rural Yorkshire village in a house that was built in 1969 and consequently, the overhead telephone line that connects me to the telephone network is about 130ft (40m) long; an ideal length for an HF antenna in some respects. For years, I have been plagued with constant ADSL router disconnects when trying to use the Internet and my radio equipment at the same time. Power levels as low as 10W on 160m and 80m were enough to totally kill my Netgear DG834GT router and cause the ADSL to renegotiate down to the lowest connect speed of 125kbps. It would then take two to three days of no interruptions before the ADSL synchronisation speed came back to the normal 4Mbps or so. My crude solution was simply to cut the power to my ADSL router before I used the radio.

However, more recently, things got a lot more complicated when some of my near neighbours all got broadband ADSL. They, like me, are all connected to the telephone network by long overhead BT lines. Even if I powered down my own router, every time I went on the bands with QRP, I disconnected all the neighbouring broadband routers around me. If you think TVI makes you unpopular, this adds a whole new dimension.

British Telecom (BT), is our UK private telecommunications monopoly and the only provider of the *last mile*[1] copper connection to the house (excluding cable networks). They were most definitely not interested in the QRM. Not their problem you see:

> *"Radio interference from a Radio HAM?"*
> *"He thinks OUR overhead lines are the problem?"*
> *"Ho Ho Ho! You are having a laugh, we're the professionals."*
> *"Go and tell him it must be his radio equipment that is faulty."*

OK, so we know where BT thinks the problem lies. Sadly, none of us here can rent a telephone line from anyone else but BT and we don't have cable network providers out here in the backwoods. The only practical solution then was to find a way of keeping my RF out of all the local ADSL routers.

A Short ADSL Primer

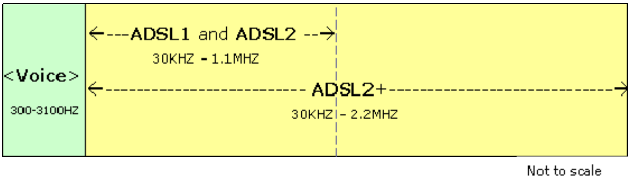
So that we understand the nature of the beast and because it is important to identify what sort of broadband you have to select the correct filter, I've included here a very short description of UK ADSL systems and the baseband frequencies that are used.

*ADSL (**A**symmetric **D**igital **S**ubscriber **L**ine)* works by transmitting signals through traditional PSTN phone lines at higher frequencies than normal analogue voice signals. Voice signals fall within the 300 to 3400 Hz frequency range, whilst ADSL1 and ADSL2 both work in the 30 kHz to 1.1 MHz frequency range. However, ADSL2+ works in the 30 kHz to 2.2 MHz range. By doubling the available downstream frequencies, you roughly double the amount of bandwidth available.

---

[1] *The "last mile" conundrum of how to deliver broadband connectivity from a communications provider to a customer's home is famously known in UK telecommunications circles.*

Although there are two basic flavours of ADSL: ADSL1 and ADSL2, there are a number of additional variations, the most significant of which are ADSL Max, an enhanced 8Mbps ADSL1 and ADSL2+, an enhanced ADSL2 that can provide download speeds of up to 24Mbps.



Above: a frequency chart showing different ADSL signals

Although voice calls do not use frequencies above 3400 Hz, the telephone equipment itself can generate spurious noise at higher frequencies, which can lead to data corruption within the ADSL frequency band. To prevent this, telephone equipment must be filtered to suppress this spurious noise and this can be achieved by fitting a micro-filter to each phone or by fitting a filtered faceplate on the incoming NTE5 master socket.

Improved ADSL Filters

After some investigation on the web with Google and after reading older messages archived on some of the amateur radio mail reflectors, I became aware of two possible methods of improving RF immunity for ADSL broadband routers. These were:

a) The RF-1 KY Filter made by the KY Filter Company, Davis, California:

http://www.ky-filters.com/

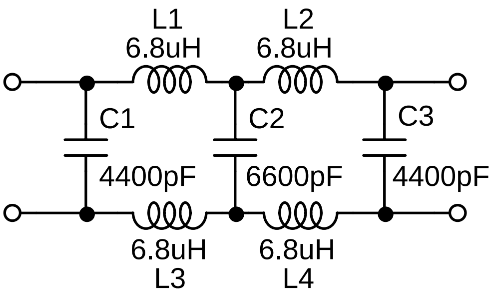
b) A design for a home-made ADSL filter by OZ7C:

http://www.ddxg.dk/oz7c/adsl/adsl_160m_filter.pdf

I decided to try the KY Filter and ordered one from the company. The current cost is $27.95 USD plus postage. However, when the filter arrived, I was disappointed with the performance and although it did provide a slight improvement, it didn't stop the constant disconnects. However, the OZ7C ADSL filter looked promising and several people had reported success with this filter.

Looking at the design of the OZ7C low pass filter, it is clear from the frequency plots that it was designed to start attenuating signals from just below 1 MHz. Since we know that in the UK ADSL1 and ADSL2 (but not ADSL2+) work up to 1.1 MHz, I decided to alter the filter characteristics slightly so that my filter began to attenuate unwanted signals from 1.1 MHz, to allow the entire wanted ADSL signal to pass through to my router. Whether this has made any significant improvement in practice, I'm not absolutely sure.

The original OZ7C article (shown below) used simple 6.8µH axial chokes, but for my filter, I decided to use Amidon T50-2 toroids to give some degree of accuracy in inductance values and to take advantage of the somewhat better Q of the toroidal inductors.

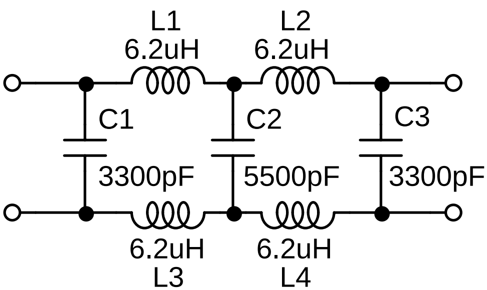


Above: Circuit of the original OZ7C Filter using axial chokes

Coming back to the design of the improved ADSL filter, I decided to use the circuit modelling facilities in the highly-rated LTSpice computer simulation program, which you may be interested to know is a free download from here:

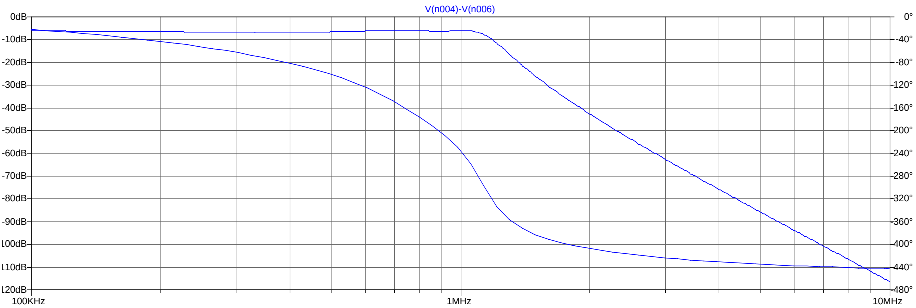
http://www.linear.com/designtools/software/ltspice.jsp

After trying a few different component options, the circuit below produced the best filter response and insertion loss. The filter is designed to be flat up to 1.1MHz and then to start attenuating rapidly after that. There is over 30dB of attenuation on 160m and over 55dB on 80m with very little insertion loss to the wanted ADSL signals.



Above: Circuit of G3VMW's improved ADSL1 and ADSL2 Filter

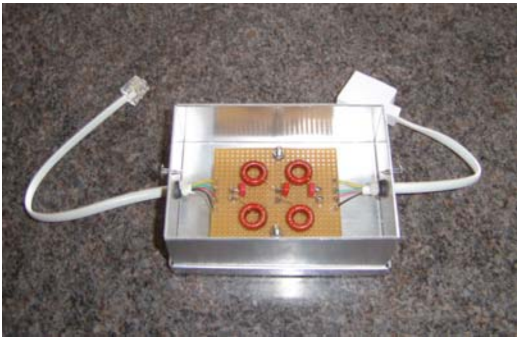
The filter shown above is suitable for ADSL, ADSL Max and ADSL2 but ***not*** for ADSL2+ systems, which use a baseband up to 2.2 MHz. The 6.2µH inductors are made by winding 35 turns of 32swg wire on T50-2 toroids. It is a bit tedious, but not difficult. The capacitors can be paralleled up to achieve the capacitance. For C2, I used two capacitors marked 4700pF and 1000pF, which when paralleled up and measured on an AADE LC Meter, actually came out at 5500pF. Because there is a nominal 50v on a BT telephone line, the capacitors should be at least 63v or better still 100v working. I've used 63v capacitors because they were at hand, but 100v (or higher) working is probably a better choice.



Above: LTSpice plot (top) of the response of the improved ADSL filter. Please note that 6dB of the insertion loss shown is because the plot is taken across a 75 ohm terminating resistor and the actual insertion loss is less than 0.3 dB.

The filters were constructed on blank *"Perfboard"* with 1mm *"Veropins"*, which were used as anchors to connect all the parts together. The flying leads for connection to the BT line was made from a 2m RJ11 modem extension lead obtained from eBay. These look like the picture at the left and come in all sorts of differing lengths. The filter connecting wires to the RJ11 plug and socket are just cut down in length to about 6" (15cms) per end and soldered to the "*Veropins*" on the "*Perfboard*" filter assemblies. The two centre conductors, usually red and green, carry the ADSL signal.

The picture below shows the simple construction technique used to build the filters with the circuit boards housed in small aluminium boxes 4" x 2¾" x 1½" (10cms x 7cms x 3.5cms) and the RJ11 flying leads brought into the boxes via small rubber grommets with cable ties to stop the wires being pulled off the filter circuit board. The circuit board was fixed inside the box with two 15mm M3 nuts and bolts with a suitable spacer. This has proved very effective in practice and the filters are physically robust. It might be safer to hot glue the T50-2 toroids down to the circuit board, but I've not found this to be strictly necessary in practice.



Above: A completed ADSL filter

In terms of performance, the difference has been remarkable. I can now operate at 400W RF out on any band 160m through to 10m without disconnecting my ADSL1 broadband. The performance throughput of my broadband connection has also improved with higher router synchronisation speeds, which I think is due to the filter preventing Short Wave broadcast stations and other electrical noise being fed back to the router and reducing signal-to-noise ratio.

I have now provided several similar ADSL filters to my neighbours and they now enjoy their Internet without interruption from my transmitter. The goodwill has been worth the small outlay in parts and the time taken to build the filters.

G4RCG's troublesome ADSL2 installation

Fellow CW enthusiast, John Muzyka, G4RCG contacted me for some help with his particular ADSL installation and the fact that he couldn't operate on any band without disconnecting his and also, more worryingly, his next door neighbour's broadband connection.

G4RCG lives in a rural location with a significant run of overhead cable approximately 2 miles long, but he is served by the newer ADSL2 service, which supposedly provides better performance on long lines. ADSL2 can increase the data rate by as much as 50 kbps and extend the reach by about 600 feet. The line attenuation on John's ADSL service is 65dB compared to the 50dB line loss I have here. The best synchronisation speed he can manage on his Netgear router is just 2Mbps with a signal-to-noise ratio of 4.5dB. This looked like a bit of a challenge and would certainly give the G3VMW ADSL filter a tough test.

ADSL2 extends to up 1.1 MHz, just like normal ADSL and, in this case, BT had been very helpful by providing John with the ADSL2 since it was originally thought that his line loss would be just too great for any broadband service at all. BT Openreach engineers literally hand-picked their lowest loss copper cables for the long route, avoiding aluminium cored cables where they could.

There are a couple of tricks that BT used and might be worth mentioning here to maximise your ADSL connection and broadband speed. BT went the extra mile at John's QTH by fitting the NTE-2000 filtered faceplate. The NTE-2000 faceplates isolate the now largely defunct (third) bell wire from your broadband telephone line and help to give the best connection speed possible by