Audio CW Filter

My name is John and I hold the call signs 4F3EW (Philippines) and GM4DKO (Scotland).

The aim of this article is to bring to the attention of any radio amateur who does not have an internal cw filter installed in their transceiver and if the cost of buying the cw filter or the thought of having to open their transceiver to install the internal cw filter deters some radio amateurs from using cw, then an external audio filter for cw would be worth considering.

Icom IC-718 transceiver, the cw filter was extra and in 2016 the Icom cw filter would have cost an extra $170 to $209 plus any additional cost due to any shipping and import charges and since 2017, the Icom cw filters for the IC-718 have been discontinued.

With the Icom IC- 718, I would have had to open up the transceiver, remove screws, ribbon connectors, plugs, PCB etc before soldering the Icom cw filter in place.

A good cw filter in the IF section of the transceiver is usually more desirable and usually performs better than a audio cw filter.

Audio Filter: Audio filters can amplify (boost), pass or attenuate (cut) some frequency ranges.

A audio cw filter is a way to add narrow audio filtering to the audio output of a transceiver or receiver, the audio filter is usually placed between the audio output from the transceiver phone socket and the operators headphones or speaker, using an audio cw filter also helps to reduce qrm/qrn (fig 1)

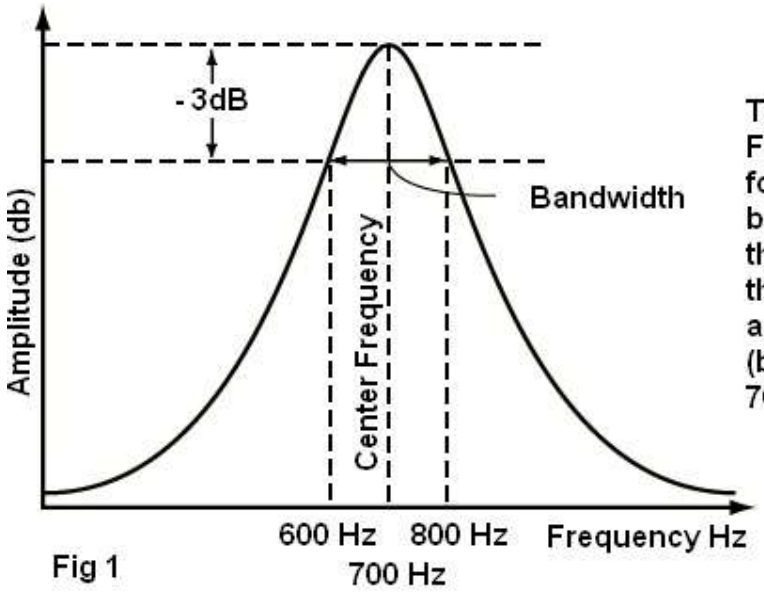


Fig 1

This diagram is use for illustration purposes. For example if the audio cw filter was designed for a center frequency of 700 Hz and with a bandwidth of 200 Hz and the audio pitch of the transceiver was 700 Hz, the result heard in the headphones or from the speaker, would be a audio bandwidth of between 600 Hz to 800 Hz (between the - 3dB points) centered on the 700 Hz cw pitch of the tranceiver.

An external audio cw filter is also transferable between transceivers, which is useful in giving the radio amateur a wider choice when it comes to buying a new or second hand transceiver without an already installed cw filter.

The difference between Passive and Active audio filters can be found on page 6

While doing the research for audio cw filters on the internet, I found a lot of information including audio cw filter reviews, video demonstrations of different audio cw filters in use, technical articles on audio filtering, published audio cw filter circuit designs and filter computer software.

My idea was an external audio cw filter which I could switch In and Out like I would do if I had a internal cw filter fitted in the transceiver and I found that I had the choice of buying a ready built audio cw filter, building from a kit, building from a published circuit design, I decided to build the audio cw filter from a kit.

Before looking at audio cw filters my preference was to find a audio cw filter kit which had a fixed bandwidth, center frequency and gain.

There are some audio cw filters which allow the varying of one or more of these parameters and some filters also have peak, notch and DSP.

My other preference is that the kit did not have SMD's or toroid's and could be powered by 6v or 9 volt power supply (batteries).

During the research I found several audio cw filter kits which could have met my criteria and I decided to buy and build the Hi-Per-Mite (HPM) Active Audio CW Filter kit from The Four State QRP Group and I did not pay any import charges in the Philippines.

The HPM bandwidth 200 Hz, center frequency 700 Hz which can be shifted between 7 fixed center frequencies (480 to 850 Hz) by changing resistors, the signal gain is selectable by resistor selection from 0db in steps to 50dB and a volume control can be added. DC Power: 5 to 13 VDC at less than 15 mA

The HPM comes with a 2.2" x 1.5" PCB and has 34 components (including 2 x IC's), does not use SMD's or toroid's and requires a suitable enclosure.

To solder the kit components to the PCB, I assembled my soldering set up.


Fig 2


Fig 2A

With patience and concentration the HPM kit is fairly straight forward to assemble, for information about soldering see page 6.

3

Using a suitable enclosure, measure where to place the filter inside, the top switches and the In and Out sockets.

Thinking twice before soldering the component in place, I use IC sockets and being careful when it comes to the actual soldering due to the proximity of the components, hence my using the light source and the magnifying glass (Fig 2 and 2a)

Where it was more convenient, I mounted some resistors vertically and I was unable to distinguish the color coding on some of the resistors so I used the ohmmeter to confirm the resistor values.

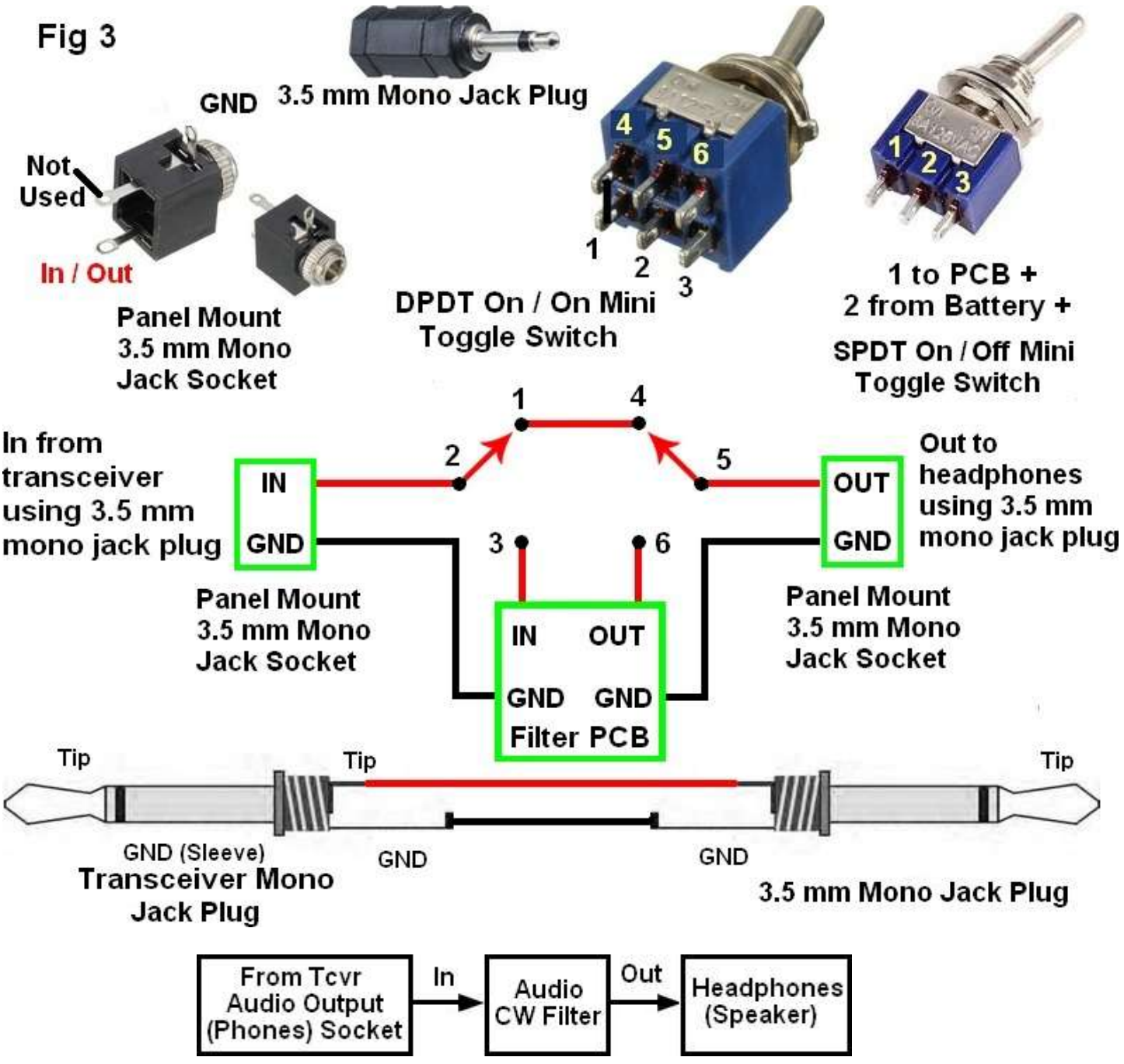


Fig 3 : The DPDT 6 terminal On / On mini toggle switch is used to switch the filter In /Out to allow listening to the wide audio (ssb) from the transceiver or narrow audio (cw) via the audio cw filter.

The SPDT 2 terminal On / Off mini toggle switch is to switch the battery supply On/Off to the filter PCB.

Depending on the DPDT switch position, the audio at terminal 5 will be either….
The wide audio from the transceiver via the switch terminals 1 and 4 or the narrower audio from the audio filter PCB via the switch terminals 3 and 6.

Fig 3 shows the DPDT switch selected to listen to the transceiver audio (SSB).
Note : The permanent link between terminals 1 and 4.

DPDT Toggle Switch….Instead of using a Mini-Toggle switch to switch between cw and ssb and a mini on/off toggle switch for the battery. I now use a 9 terminal 2 position - On/On - 250V 15A heavy duty toggle switch….See page 5

Fig 6A. Enclosure (4.0” x 2.75” x 1.25”) housing the HPM filter and the internal 9v battery, now I use 4 x 1.5V D2 batteries soldered in series and connected to the filter PCB using 3.5 mm jack plug (battery) and 3.5 mm jack socket fitted to the enclosure.

Fig 7. Shows the phones output of the 718 connected to the in(put) of the audio cw filter.

To test the HPM plug the 3.5mm mono jack plugs into their respective filter enclosure sockets with In from the transceiver audio (phones) output socket and Out to the headphones.

Switched the transceiver On and filter battery On and when switching the 6 pin toggle switch back and forth I could hear in my headphones the wide audio output from the transceiver in the one position and the narrow audio output from the filter in the other position, showing the filter was working and marked the enclosure switch SSB (wide) and CW (narrow)

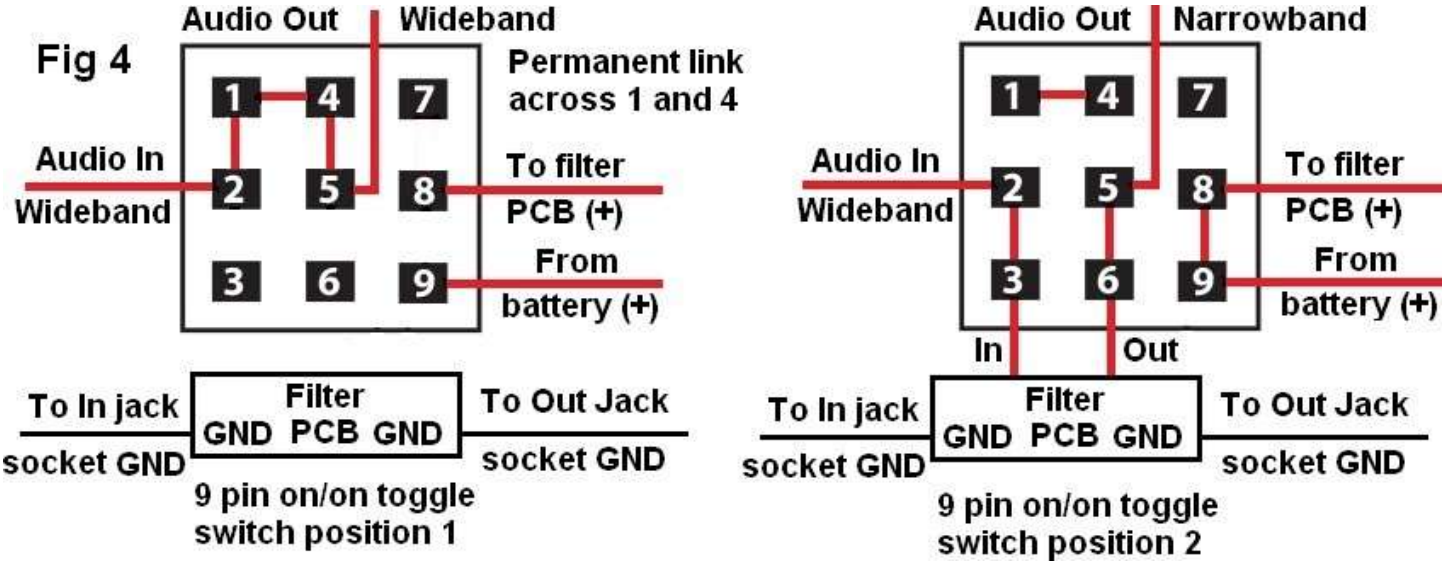
DPDT switch selected to listen to the transceiver audio (SSB), tuned the transceiver for the strongest signal from the target cw signal, switched the audio filter to CW and battery On, was roughly more or less zero beat (maybe have to fine tune) the cw signal, now ready to give the station a call.

Before giving a CQ call on cw, select the audio filter to cw and battery On, check if the frequency is clear before calling CQ and maybe have to use the RIT to check if anyone is replying to the CQ call.

I originally used a 6 pin mini toggle On/On switch and mini toggle battery On/Off switch wired as Fig 3…For convenience I wanted to be able to switch the filter In and battery supply to the filter PCB On at the same time with the one toggle switch.

I tried using a 9 pin mini on/on toggle switch but between having to solder wiring to its small terminals and the switch sensitivity I decided to use a 3PDT - 2 position - On/On - 9 terminals - AC 250V 15A - 380V 10A heavy duty toggle due to its more solid switching and easier soldering.

Fig 4. When switched to position (1) filter is Out, the battery is Off to the filter PCB and in position (2) filter is In and battery + supplied to the filter PCB…The 9 pin switch is wired the same as the 6 pin mini toggle switch (Fig 3) with the terminals 8 and 9 on the 9 pin heavy duty toggle switch being used to switch the battery + supply On/Off to the filter PCB. Terminal 7 not used.



Position 1: The audio wide band input from the transceiver at terminal 2 goes via terminals 1 and 4 to the audio wideband out (headphones or speaker) at terminal 5 with no battery supply to the PCB.

Position 2 : The audio wideband input at terminal 2 goes via terminal 3 to Filter PCB In and PCB Out (narrow band) goes via terminal 6 to the audio out at terminal 5 with the battery (+) being supplied to the PCB using terminals 8 and 9…Switching the 9 terminal switch is slightly noisy and is a trade-off for the convenience and having solid switching…This switching arrangement may not be suitable for everyone but I find it well worth the effort.

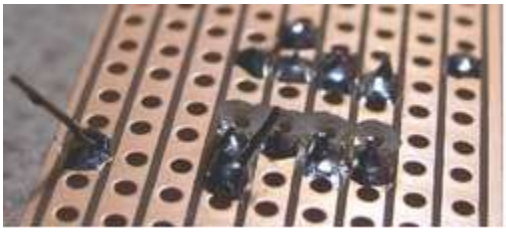
Because the 9 terminal heavy duty switch is bigger than the 6 terminal mini toggle switch, I used a larger plastic enclosure and mounted the switch on the side of the enclosure. I still use 4 x 1.5V D2 external batteries soldered in series to give the 6 volts.

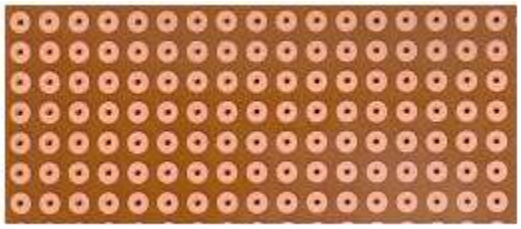
Soldering : On the internet there are a few instructional websites including…
Soldering Is Easy Comic Book.
http://mightyohm.com/files/soldercomic/FullSolderComic_EN.pdf

There are also videos available including...
How to Solder Electronics.
https://www.youtube.com/watch?v=IpkkfK937mU

Before soldering components onto a PCB, try and practice soldering bits of wire and even practice soldering a IC socket onto say a piece of Veroboard.

If necessary resistors can be soldered vertically, paying attention to the polarity of electrolytic capacitors, diodes, IC orientation and using an IC socket.





Passive Filters….Use passive components, such as resistors, capacitors and inductors, they have no amplifying elements (ie transistors, op-amps etc).
They have no signal gain ie, the gain is never greater than unity and are not depend on a external power supply.

Active Filters….Use active components like transistors and op amps as well as resistors and capacitors for filtering electronic signals.
They have signal gain and require a external power source and use the power supply to boost or amplify the output signal.

Lots of enjoyment with the hobby de John (age78) November 2020