Filter-Preamp Rev 6

Front-end shelf and anti-alias low-pass filter, with preamp

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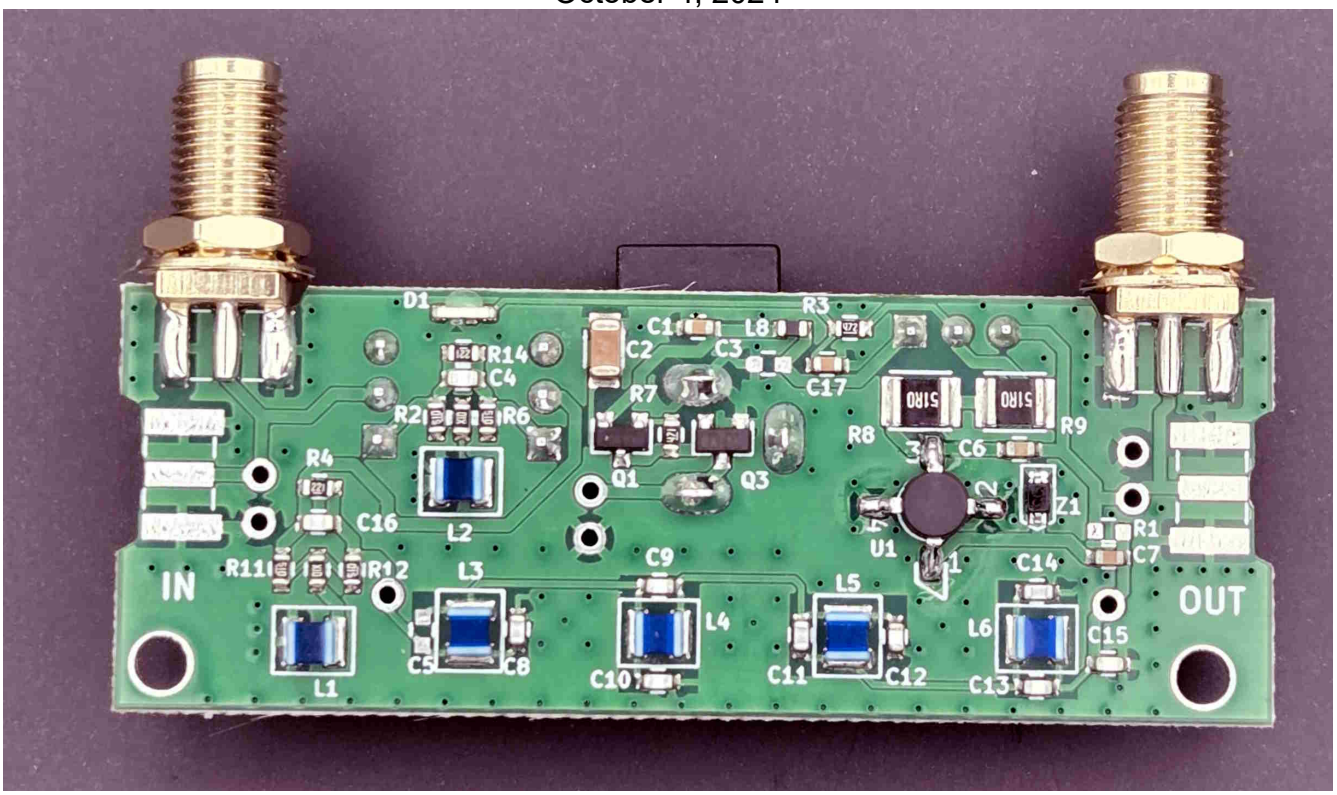

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About the Filter-Preamp

This is a 30 MHz four section elliptic low-pass filter, combined with a two-section shelf filter, and followed by a medium-gain preamplifier. The low-pass filter serves as an anti-aliasing filter for a SDR, especially one that is clocked at 66 MHz or so. The shelf filters will provide moderate attenuation at the lower frequencies, where powerful signals can cause overload.

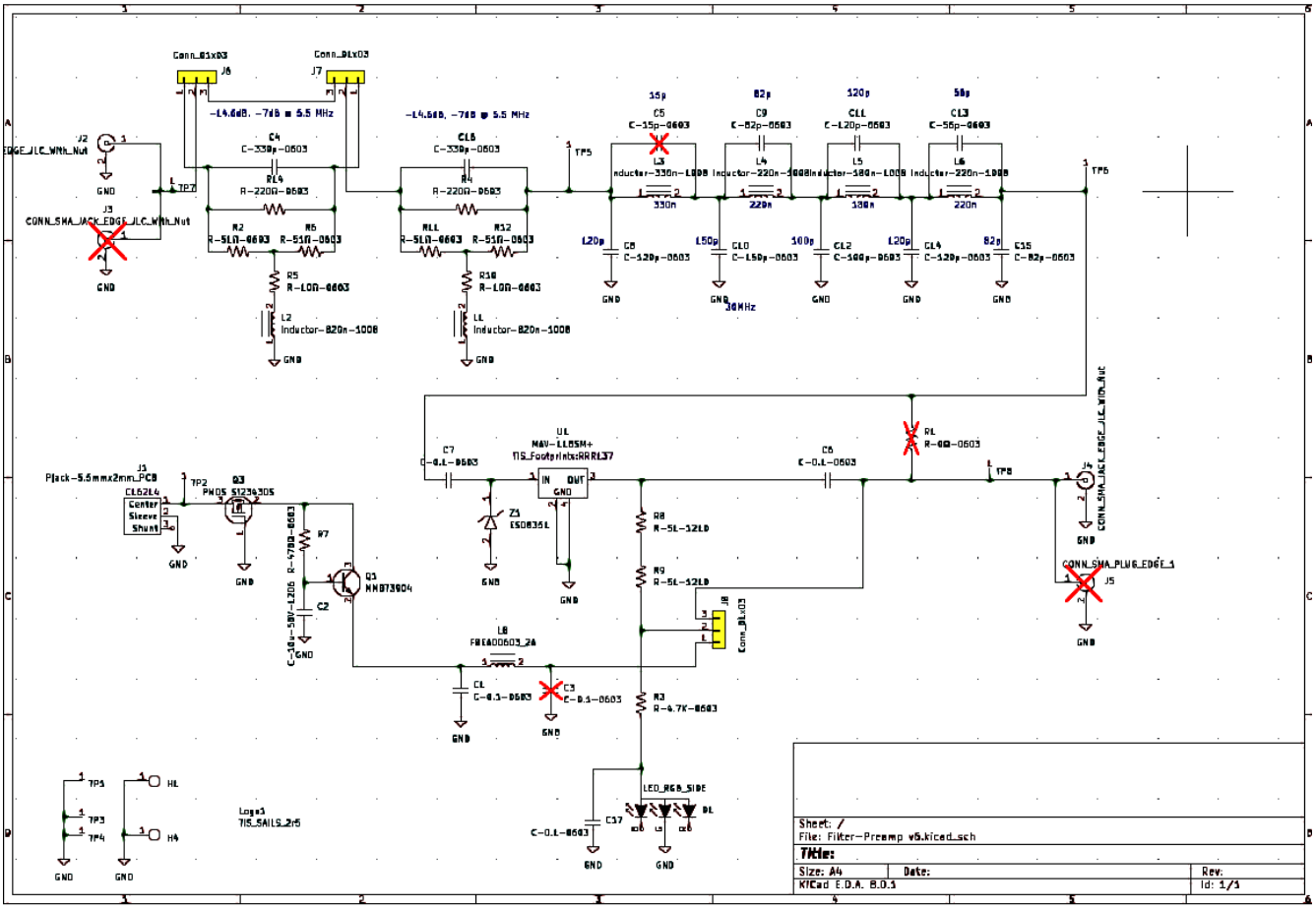
The amplifier provides enough gain to compensate for the filter loss, and boost the signal presented to the receiver. Depending on the antenna system, some SDRs may require additional gain for optimal performance.

The filter is available in the in-line plug/jack configuration, or in a two-jack arrangement (which fits nicely in a small aluminum box for extra shielding.)

Connections

- Input, output: SMA jack, 50 Ohms.
- Power: 12VDC, 60 mA typical current drain. 5.5 x 2.1mm barrel jack, pin positive, sleeve negative.

Schematic



This design has a two-stage high-pass shelf filter (one stage bypassable), followed by a four-section elliptic low-pass filter. The shelf filters provides attenuation at the lower frequencies, reducing the potential overload from AM broadcast-band stations in the USA. This filter will have little effect on European HF broadcast-band signals. The low-pass filter has a sharp cutoff above 30 MHz, greatly reducing SDR sampling aliasing of signals above this frequency.

Note that the “notch” capacitor (C5) in the first section of the LPF has been removed. While this does allow the response above 50 MHz to rise slightly, when this capacitor is installed there is a significant filter response peak near 425 MHz, probably due to inductor parasitics. Removal of this capacitor greatly attenuates the parasitic response.

Following the filters is a relatively low-noise, high dynamic-range preamp: the Mini-Circuits MAV-11BSM+.

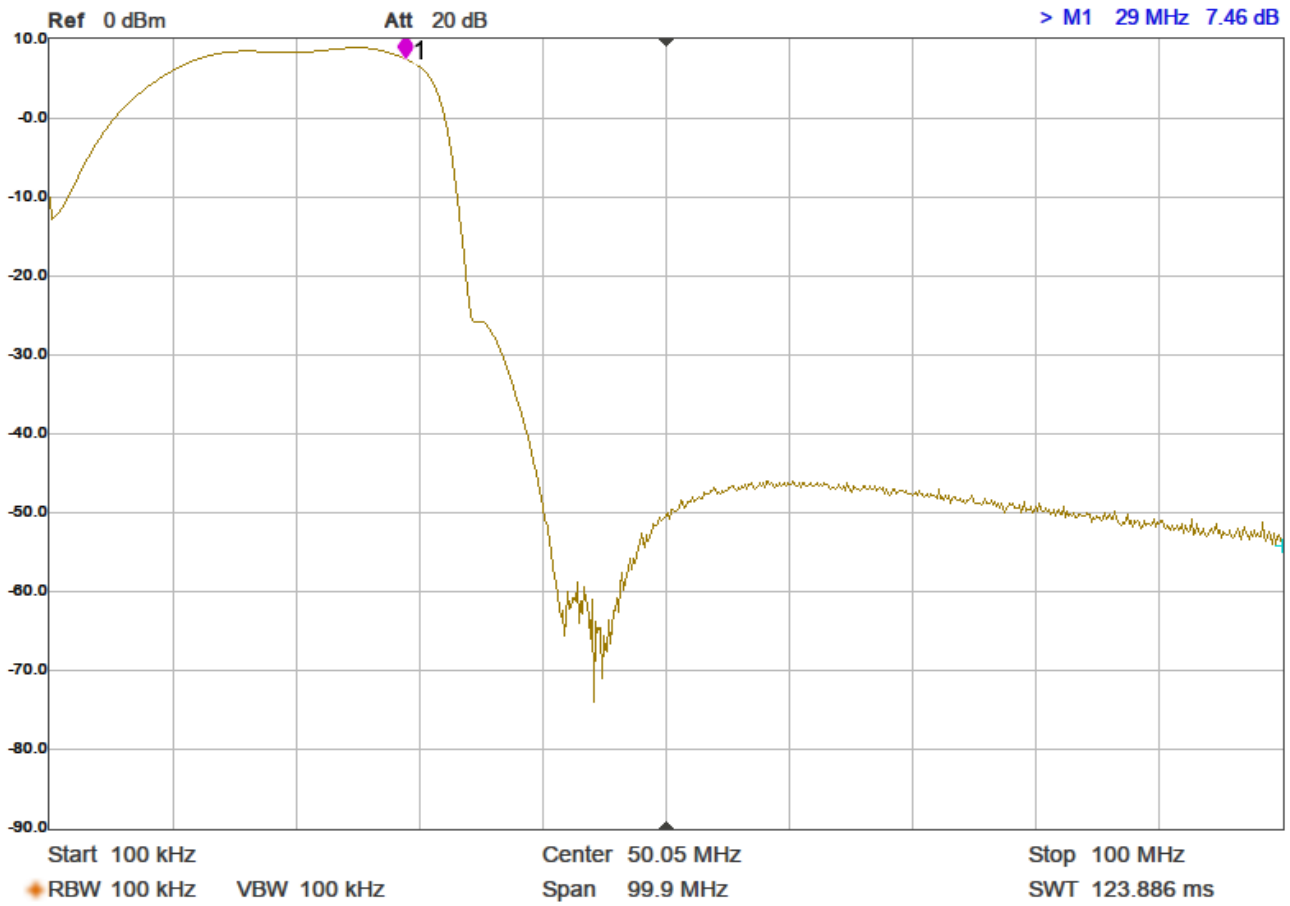
The preamp requires a 12V DC power supply, capable of providing at least 60 mA. A PFET transistor protects the amplifier from reverse-polarity voltage., and a simple NPN transistor active filter circuit provides over 30 dB of supply-noise attenuation. A small LED lights up when power is present.

A new feature on the Version 6 board is the jumper-header selected option to power the

amplifier through the coaxial output jack connection via a remote “bias-tee”. In this mode there is no supply filtering or reverse-polarity protection. The remote supply should be +12V nominal, coax shield negative ground, center conductor positive. The current drain will be approximately 60 mA.

The schematic shows two options for the input and output connector orientation.

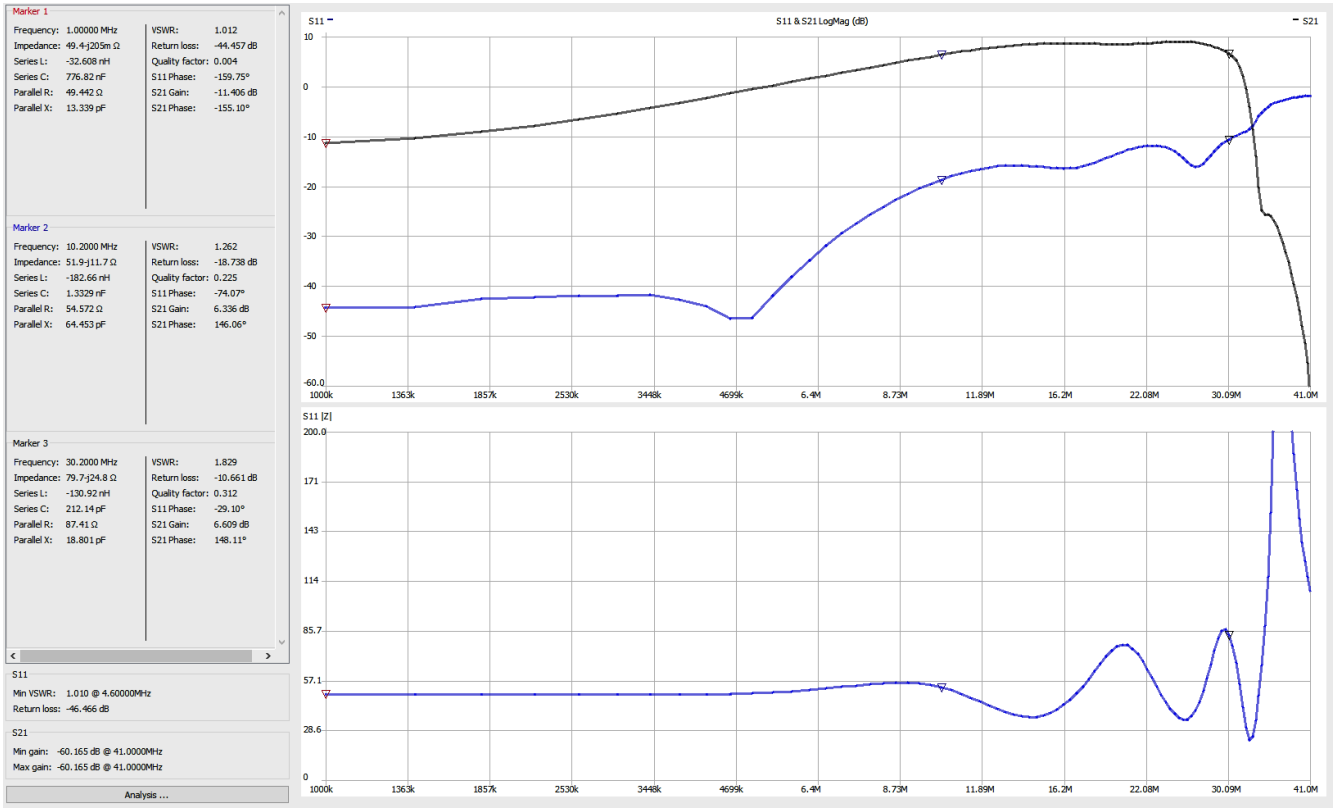
Gain, Frequency Response



The filter/preamp provides about +9 dB gain between 14 and 28 MHz, with the gain dropping to -10 dB at 1 MHz when both shelf filters are enabled. The attenuation above 40 MHz is around -50 dB or better.

Frequency (MHz)	Typical Gain (dB)
0.1	-12.9
1	-11.5
2	-8.7
5	-0.9
10	5.8
15	8.5
20	8.4
25	8.9
29	7.5
30	6.8
35	-27.1

The chart below shows the filter-preamp gain, input return loss, and input impedance plotted on a logarithmic frequency scale. This better-shows the performance of the cascaded shelf-filters.

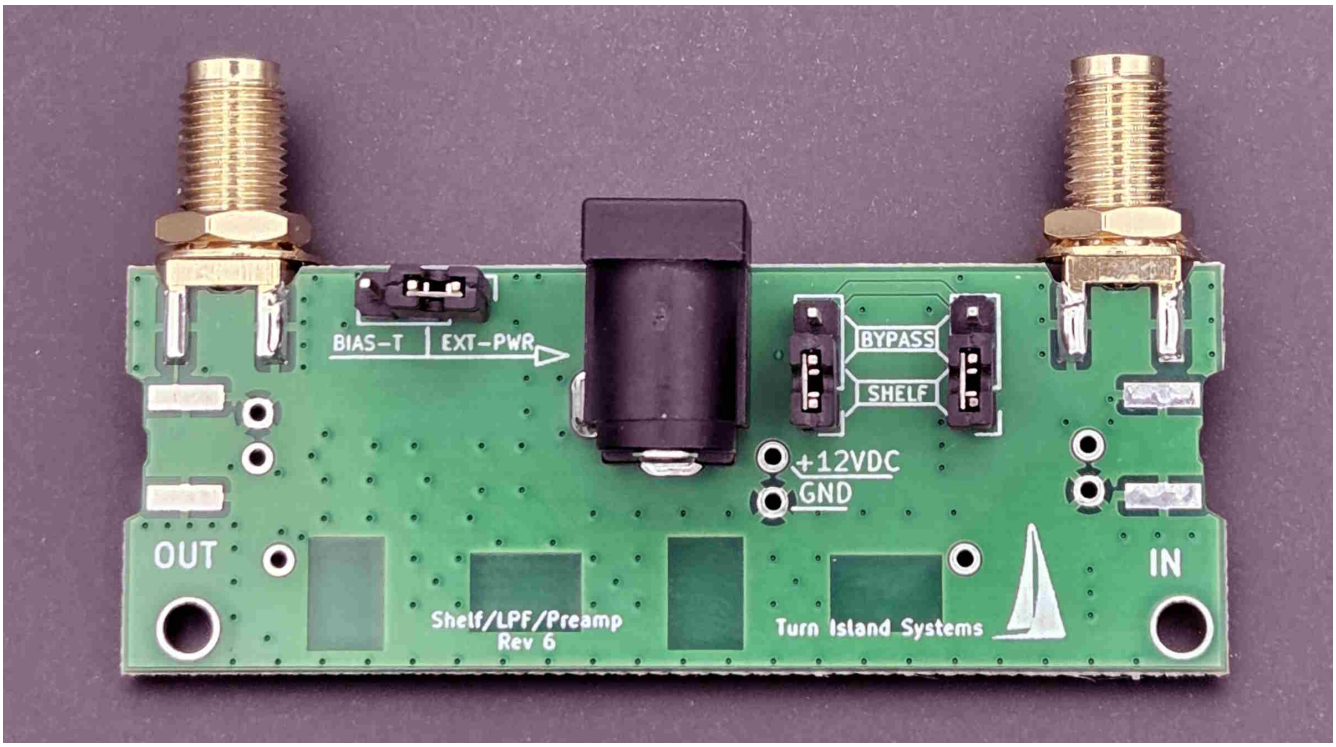


Note that when powering the unit with the remote bias-tee, the amplifier gain will increase about 1dB.

Enclosure

Changing the Shelf Filter and Power configurations

The filter-preamp contains two identical high-pass shelf filters, and as shipped both of these filters are enabled. This is appropriate for typical situations. Two jumpers are used to enable / bypass one shelf filter section. To access these jumpers, remove the four screws that secure the front panel (these are metric “M2.3” phillips-head). As shipped, the jumpers are in this configuration:



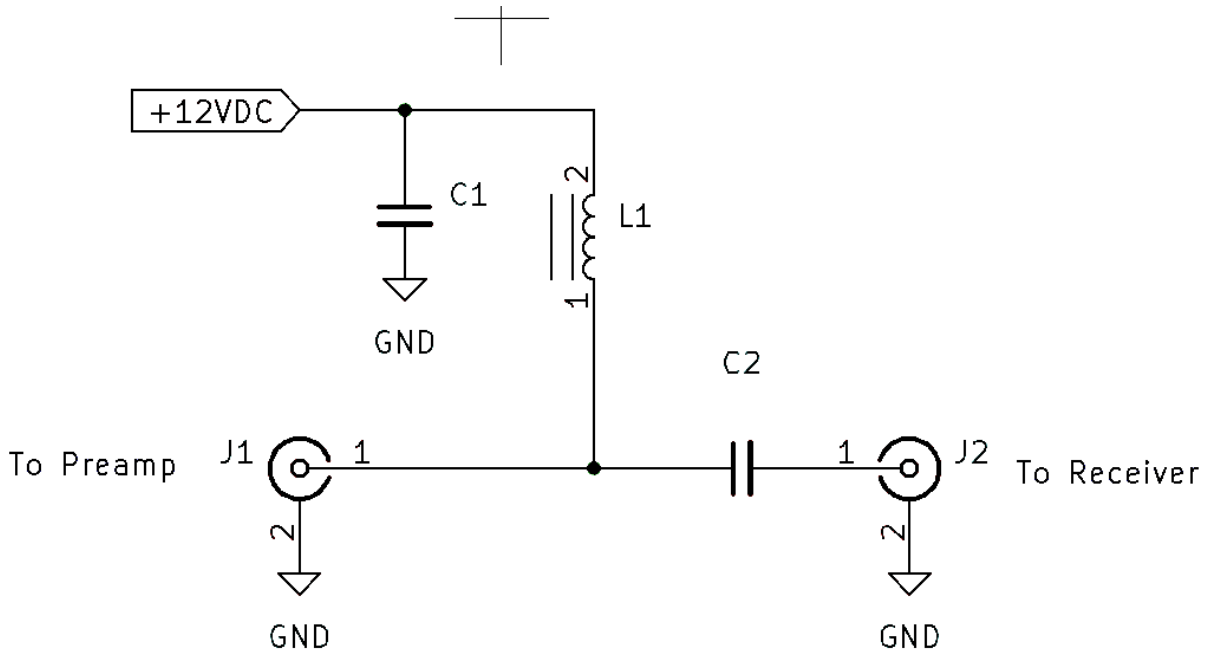
The shelf filter selection jumpers are on the right side of the board. To bypass the shelf filter, move ***both*** jumpers to the “BYPASS” position.

The power-option jumper (on the left side of the board) is shown in the locally-powered mode. To select the remote Bias-Tee mode, shift the jumper to the left.

Each of these jumpers must be installed in one or the other positions for proper operation.

Bias-Tee

For purposes of illustration, this schematic shows possibly the simplest practical Bias-Tee:



For operation from 1 to 50 MHz, C1 and C2 can be 0.1uF ceramic capacitors, and L1 might be about 22uH.

It may be desirable to include transient protection, current overload, and reverse-polarity protection. Be aware that many Bias-Tee designs are optimized for VHF operation, and will not perform well (it at all) on the lower ham bands.