Review by Ken Reitz, KS4ZR

The MFJ-784B Tunable DSP Filter

There's a world of noise and confusion out there and I'm not talking about the election this year: I'm talking about the HF spectrum. Somewhere, amidst the din of clashing electromagnetic waves, is the signal you're trying to tune in.

Most of us have radios with, at best, built-in ineffective noise blankers which do little to combat the layers of reception degradation. What can we do to get some relief? Isn't there some sort of caped radio crusader to come to our aid?

Well, you can put away those tights, because help has already arrived in the form of MFJ's Model 784B Tunable DSP Filter. This compact digital signal processor (DSP) filter can sort through everything but your laundry to help tune in what you're trying to hear. It will help take some of the frustration out of shortwave listening and HF amateur radio operating.

Many new, sophisticated shortwave radios and amateur radio transceivers have DSP filtering built in, but, for the tens of thousands of us whose gear doesn't include such amenities, our hobby is a little more arduous. The idea of expanding into more exotic modes may seem futile. But, before you surrender and take up collecting Beanie Babies® consider investing in the MFJ-784B.

How the 784B Works

Any time you shell out $250 for a radio add-on you ought to get something to play with. MFJ understands this and the 784B has no fewer than five knobs (including a 10 position filter switch), nine pushbuttons and two multi-purpose LEDs. And that's just the front panel! But, there's more: MFJ has also made it possible to get inside the product and fiddle with jumpers to make even more variations possible. In fact, there are so many things you can do with this unit, I'll bet few have actually done them all. Anyway, here's how it works.

The heart of the 784B is a 16 bit 12 MHz processor built by Analog Devices which converts the analog signal from your receiver to digital information. It does so by sampling the audio from your receiver thousands of times per second with an analog-to-digital converter. This audio signal is then fed into the processor chip along with the various filter settings from the front panel (or internal jumpers) and sent to a digital-to-analog converter which is fed to the audio amplifier stage of the filter and sent (finally!) to a speaker or line-out connection.

That's enough about the internal workings of this thing. Does it actually work? And how!

Pushed to the limits

On the weekend I tested this model, the bands were wide open. There were amateur HF contest enthusiasts jamming the ham bands, international broadcasters coming in like AM locals, and digital modes on nearly all frequencies in between. I went first to the ham bands to check out the perennial problem of CW operators on top of each other; tuner-uppers on net frequencies, and well-financed operators running full power less than 2 kHz from small-time operators.

Separating CW signals was easy once I got the hang of tuning the filters; tuner-uppers simply disappeared from net frequencies at the touch of a button, and, from my location on the East Coast I heard stations on 80 meter phone from as far away as Mexico and British Columbia!

Tuning in digital modes without the aid of a DSP is tedious. The MFJ-784B makes it much easier to tune in weather charts and weather satellite photos by simply setting the filter switch to the appropriate mode and tweaking the tunable filter knobs and noise reduction control.

The factory pre-set HF Packet filters are set for 170 Hz shift, 300 baud HF Packet signals. The RTTY and AMTOR filter is similarly set, but can be reset to other parameters. The SSTV/FAX/WEFAX filter is set so that it allows two separate frequency groups to pass through the filter for sync tone and vertical interval signal tones, but it cannot be reset. The front panel noise reduction filter can attenuate random noises from zero up to 20 dB when it's fully engaged.

Setting Up for Action

Setting up the unit for shortwave listening (SWL) or casual ham operating is easy. The extensive, well-illustrated, 56-page manual has a two-page "Fast Start" section up front for those who just can't wait to use the product.

The 784B does not come with a power supply but does have a power cable designed for use with a 12 volt power supply. Its power requirements are minimal and you should be able to use it with the power supply you're using for your transceiver. If your receiver has a built-in power supply, avoid using poorly filtered "wall cubes" for the 784B which may introduce extra unwanted noise.

The other connections you'll need are from the speaker jack on the back of your receiver or transceiver to the "receiver audio in" on the 784B, and a speaker cord from the "speaker out" on the 784B to your own external speaker. This is a good opportunity to add a decent external speaker to your listening post. Most signals will sound better on an external speaker than on the tiny built-in speaker that came with your receiver. In addition there is an RCA "Filtered Audio Out" jack for line-out use, such as with a small amplifier/speaker system, the volume for which is not controlled by the MFJ-784B.

If you're using the unit in connection with a TNC (terminal node controller) for HF packet work you'll need the optional DSP Cable Pac ($8.00) to connect the DSP filter to your TNC and your transceiver to the DSP via the Aux, Mic, or Acc relay output. This also allows the passage of the transceiver's side tone for CW and digital modes. All connections are thoroughly explained in the manual, but you'll have to make up the connector ends going into your radio and TNC yourself. This will involve some close-up work with a soldering iron.

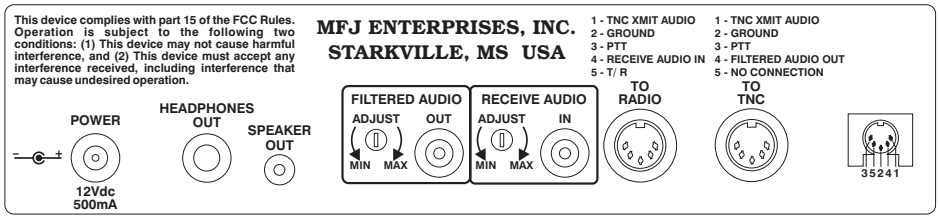
When you have it all set up, expect to spend a few hours touring the HF spectrum and playing with the variety of settings possible with all the modes available. When turning the tunable filter knobs, it helps to make small adjustments and not just sweep quickly from low to high on these knobs. The setting you may need may be very narrow and you could sweep right past it. It takes a while to review the steps necessary to

set up for various modes, but with a little practice you'll soon know what you're doing.

After your initial session with the 784B from the "Fast Start" set-up, go back and thoroughly read the manual. It's packed with useful tips on using the advanced features and getting the most out of the DSP filter.

Extra Goodies

Most SWLers and hams will be happy to use this product straight out of the box. Those willing to get out a screw driver have many hours of tinkering satisfaction yet to enjoy. MFJ gives detailed instructions in chapter 4 of the manual called "Advanced Features," which shows how to save filter settings to built-in memory; how to use a CW "spotting tone" to find the center frequency for the CW filter and to measure the frequency of any audio tone between 300 Hz and 1000 Hz; how to change the aggressiveness of the Auto Notch feature; how to set the CW side tone filter and change the pre-set filters for RTTY, HF Packet, AMTOR, and PacTOR filters.



Back panel layout of the MFJ-784B. Normal SWL and ham operations need only use the speaker out and receive audio in jacks. 5 pin DIN jacks are for use with a TNC for HF Packet work. Courtesy: MFJ Enterprises

The 784B also has a "Talk" feature which "...tells you filter settings by sending them over the audio outputs and by flashing them on the LEDs in Morse code." Heck, you don't even have to connect this filter to a radio to have hours of fun just chatting with the unit itself! You can even use the internal jumpers to change the pitch and speed of the Morse code talk feature.

Last Word

For a comparison, I set aside the Kenwood transceiver and dug out my Uniden 2021 shortwave receiver and hooked it into the 784B. With just the telescopic whip for an antenna, I was able to tune in some pretty good DX, and, adjusting the BFO, catch a lot of CW action as well as tuning into clear digital modes. It didn't make the 2021 perform like the Kenwood but it certainly enhanced its capabilities.

As great as it is, the MFJ-784B can't compensate for a poor antenna, unfavorable propagation, fading, or static crashes. In short, it can't do the impossible. Between the effects of Nature and the actions of Man, the state of the HF spectrum tends to chaos.

There are a number of things which you can do to make any listening experience better and maximizing the DSP results:

- use a low noise antenna;
- go through the house and turn off any appliance guilty of adding hash to your reception (dimmer switches, TV sets, computers, VCRs, hair dryers, vacuum cleaners and sewing machines); and,
- locate your antenna, if possible, away from leaky power line transformers.

I thoroughly enjoyed operating in the ham bands with the MFJ-784B. It was a treat to make tuner-uppers disappear with the flick of a switch: "poof" they're gone. Most satisfactory!

It was exciting to turn the filter switch to SSTV/FAX/WeFAX and get rid of adjacent channel interference often responsible for weird artifacts in this type of reception. About the only thing I couldn't do was cut the jamming on Radio Marti, but, maybe with a little more tweaking I could do that, too!

[The MFJ-784B is available through most amateur radio supply houses or directly through MFJ Enterprises, Inc. 300 Industrial Park Road, Starkville, MS 39759 Phone: 601-323-5869 FAX: 601-323-6551 or visit their web site at **www.mfjenterprises.com**]

Filter specifications from the MFJ-784B Instruction Manual (Courtesy MFJ Enterprises)

Filter	Left Control	Right Control	Attenuation[7]	Type
LR/HR[1]	LR: 200-2200 Hz	HR: 1400-3400 Hz	57 dB @ 75 Hz	FIR
BP	fc: 300-3400 Hz	BW: 30-2100 Hz	47 dB @ 60 Hz	FIR
2BP[2]	f1: 300-3400 Hz	f2: 300-3400 Hz	47 dB @ 60 Hz	FIR
CW[3]	fc: 300-1000 Hz	BW: 30- 700 Hz	47 dB @ 60 Hz	FIR
SSB[4]	fc: 600-1700 Hz	BW:1000-2500 Hz	57 dB @ 75 Hz	FIR
RTTY	Jumper Programmable		47 dB @ 60 Hz	FIR
HF PACKET	Jumper Programmable		47 dB @ 60 Hz	FIR
AMTOR	Jumper Programmable		47 dB @ 60 Hz	FIR
PACTOR	Jumper Programmable		47 dB @ 60 Hz	FIR
SSTV/FAX/WeFAX	Fixed @1050-1350 Hz and 1450-2350 Hz		45 dB @ 60 Hz	FIR
Manual Notch	f1: 150-3400 Hz	f2: 150-3400 Hz	40 dB @ 95 Hz	IIR
Manual Notch (CW mode)	f1: 300-1000 Hz	f2: 300-1000 Hz	40 dB @ 105 Hz	IIR
Multiple Automatic Notch[5]	Entire freq. range of the received audio		Up to 50 dB	LMS
Random Noise Reduction[6]	Entire freq. range of selected band-pass filter		Up to 20 dB	LMS

Notes

1 The **LR/HR** filter becomes a band-stop filter when **LR** is adjusted higher than **HR**.
2 The **2BP** filter uses the bandwidth setting last used in **BP** filter but allows independent variation of the two center frequencies.
3 The **CW** filter has an optional jumper-programmable sidetone filter.
4 The **SSB** filter has its lower cutoff frequency limited to 175 Hz.
5 The multiple automatic notch has four levels of aggressiveness.
6 The random noise reduction has a variable level of noise reduction.
7 All FIR and IIR filter attenuation is indicated in dB @ a distance in Hz outside the passband. All LMS filter attenuation is dependent on the characteristics of the noise.

- All FIR filters are linear phase with a 23 mS time delay and have the upper cutoff frequency limited to 3900 Hz.

FIR - Finite Impulse Response IIR - Infinite Impulse Response LMS - Least Mean Square