MFJ-780 DSP FILTER

Thank you for your purchase of the new MFJ-780 DSP Filter plug-in board. The MFJ-780 is designed to provide Mark and Space filtering for the MFJ-1278B and MFJ-1278BT Multi-Mode Data Controllers. The MFJ-780 will also function very nicely when installed in the MFJ-1278 or MFJ-1278T Multi-Mode Data Controllers too. The MFJ-780 uses state-of-the-art Digital Signal Processing, or DSP technology. DSP technology greatly improves signal clarity by reducing or eliminating noise, QRN and interference, QRM. This will inturn improve weak signal copy in modes such as CW and RTTY.

NOTE: If you have purchased the MFJ-1278B DSP unit, then the MFJ-780 DSP Filter board is already installed.

Modem	Mark Tone (Hz)	Space Tone (Hz)	Baud Rate (MAX)	Center Freq. (Hz)	Bandwidth (Hz)
P	1200	2200	1200	1700	2400
H	2125	2295	75	2210	280
	2125	2295	300	2210	504
V	1275	1445	75	1360	280
	1275	1445	300	1360	504
V*	2125	2975	75	2125	246
	2125	2975	75	2975	246
	2125	2975	300	2125	470
	2125	2975	300	2975	470
C	700	------	------	700	50
	700	------	------	700	100
	700	------	------	700	200
	700	------	------	700	500
M	1100, 1200, 1300, and 1500 to2250 in 50 Hz. Steps			1200	300
				1875	850

* All filters are of type FIR, Finite Impulse Response, linear phase with two different choices: (1) 24 mSec delay time with an attenuation of 50 DB @ 60 Hz outside the bandpass or (2) 12 mSec delay time with an attenuation of 30 dB @ 60 Hz outside the bandpass.

NOTE: **Modem V*** and **Modem M** are dual-bandpass filters.

INTRODUCTION TO DSP

The MFJ-780 DSP uses "*state-of-the-art*" Digital Signal Processing or DSP technology. Digital Signal Processing greatly improves signal clarity by reducing or even eliminating noise, QRN, and interference, QRM. DSP technology has existed for many years, but has always been very complicated and expensive. Recent advances in integrated circuits have greatly increased the processing power and reduced the size of DSP units. These same advances also lowered the cost of DSP filtering, making DSP technology more affordable for the average amateur or shortwave listener.

Almost any microprocessor can perform DSP, but only very fast or special function processors perform DSP in *real time*. Therefore, the heart of any DSP system is the digital signal processor. A digital signal processor is similar to the CPU in a home computer, but its commands are tailored to the type of instructions used in signal processing. The use of special DSP commands allows a DSP filter function to be completed within a few clock cycles, usually one, whereas a typical home computer CPU would require a long set of instructions and therefore many clock cycles to perform the same function. Analog Device's ADSP-2105, 16-bit processor is used in the MFJ-780 design.

The MFJ-780 DSP Filter takes the "*unprocessed*" audio signals from your receiver and converts them to digital information. This conversion is achieved through the sampling of the signal many thousands of times per second with an A-to-D converter. The result is a string of digital "numbers" that represent the amplitude and frequency of the analog input signal. The ADSP-2105 signal processor chip, then processes the resulting information with different digital filtering algorithms depending on which one the user selects via the MFJ-1278Bs **MODE** command. The end result is a digitized signal with undesired signal components either reduced or eliminated. The "*processed*" digital signal information is converted back to an audio signal by the use of an digital-to-analog converter and sent back to the MFJ-1278B demodulator circuits.

INSTALLATION

If you have purchased the MFJ-1278B DSP unit, then the MFJ-780 DSP Filter board is installed. This **INSTALLATION** section *does not apply* to customers who have purchased MFJ-1278B DSP unit.

For those customers who have purchased the MFJ-1278B, not the MFJ-1278B DSP unit, this is probably the most important section of this instruction booklet. Performing the installation procedure precisely will determine if you have a working or non-working installation when you are finished. Please follow the steps below to ensure a good working installation. In the below procedure we will refer to the MFJ-1278B, however if you have an MFJ-1278BT, MFJ-1278, or an MFJ-1278T, the procedure is still the same.

NOTE: If you have an MFJ-1278 or MFJ-1278T with an MFJ-56A, B, or C Memory Expansion board installed, then you will have to make a quick decision. You will either need to remove the MFJ-56A, B, or C Memory Expansion board, or not use the MFJ-780 DSP addition. The reason for this is that both the MFJ-56 and MFJ-780 mount in the same place on the MFJ-1278 or MFJ-1278T motherboard.

1.   Remove all power connections and other cables from the MFJ-1278B.

2.   Remove the top chassis cover from the MFJ-1278B by removing the (4) screws from the sides of the chassis cover.

3.   If your MFJ-1278B has an MFJ-44, Plug-in Scope Tuning Adapter installed, you will need to remove it too. To remove the MFJ-44, just remove the hold-down screw with a small Phillips screwdriver and set it aside. Holding the MFJ-44 firmly, gently pull up on the MFJ-44 PC board, until it is unplugged from header, J15, on the MFJ-1278B motherboard. Set the MFJ-44 PC board aside, you will re-install it later.

4.   Remove the MFJ-1278B PC board from it's chassis, and position the PC board it in front of you so the LEDs are facing you. This step is very important in order that the next step is done properly.

5.   Locate C68, **Point B** in Figure 1, and desolder *Capacitor Lead W1* of C68 that is closest to the front panel of the MFJ-1278B and carefully

remove the lead from the motherboard of the MFJ-1278B. Please refer **Figure 1** on page 12. **DO NOT** damage the *solder pad* that you are desoldering *Capacitor Lead W1* from; ensure that you desolder the hole completely before trying to remove the capacitor lead.

6. Once *Capacitor Lead W1* of C68 is desoldered and removed from the motherboard, lay the capacitor down and bend the removed lead straight up. This needs to be done right so that the next step can be done properly.

7. Re-install the MFJ-1278B motherboard into the bottom chassis. Position the bottom chassis so the LEDS on the MFJ-1278B are facing you.

8. Secure the MFJ-1278B motherboard to the bottom chassis, by starting the hold-down screws in the left and right-front and right rear corners of the PC board. **DO NOT** tighten these screws down yet.

9. Start the threads of the *14mm aluminum hex spacer* provided into the hole in the left rear corner of the PC board. *Be sure not to cross-thread it.*

10. Start the middle hold-down in the rear of the PC board, but **DO NOT** tighten it yet. If you have an MFJ-44 to re-install, then start the aluminum spacer that was removed earlier, but DO NOT tighten it down yet.

11. Once you either have the hold-down screws or aluminum spacers started in the proper PC board mounting holes, tighten them down securely. *DO NOT over-tighten this spacer as it is made out of aluminum, thus you could strip the threads very easily.*

12. Remove the **4052B IC** from **U32**, located in front of the mounting hole of step #4. Be careful not to bend or break any of the IC pins, as this IC will be used later.

13. Place the IC removed in step #12 into the IC socket on the MFJ-780 PC board labeled, **U1**. Be sure to align the notch of the IC with the notch on the IC socket. The notch on the U1 socket is nearest the inside edge of the MFJ-780 PC board. Please refer to Figure 3.

14. Align the pins of the extended socket, **U1** on the MFJ-780 PC board with IC socket, U32 on the MFJ-1278B motherboard. Also, be sure to align the mounting hole on the MFJ-780 PC board with the 14mm hex spacer.

15. Plug the MFJ-780 onto U32 on the MFJ-1278B motherboard, firmly seating all extended socket pins into the U32 socket. Only firm straight down pressure is needed to fully seat all extended socket pins.

16. Secure the MFJ-780 PC board with the screw that was removed from the MFJ-1278B motherboard in Step # 3. **DO NOT** over-tighten this screw, as the 14mm hex spacer that you are screwing it into is aluminum, thus you could strip the threads.

17. Locate the PC board mounting hole at **MOUNTING HOLE A**, just in front of the radio DIN connectors on the MFJ-1278B motherboard, and remove it. Please refer to Figure 1. Set this screw aside as it will be used later.

18. Locate the **5" BLUE** wire on the MFJ-780 at hole **W2** and solder it to *Capacitor Lead W2* of C68. This needs to be made as short as possible, in order to reduce any RFI from the microprocessor circuitry. Please refer to **Figure 2, C68 Exploded View** on page 12. Make a good clean solder joint by using only enough heat and solder to do the job. Always remember that a "good solder" presents a smooth, shiny appearance, where a "cold solder" joint will be dull and grayish in appearance.

19. Locate the **5" RED** wire on the MFJ-780 at hole **W1** and solder it to *Solder Pad W1*. This connection needs to be made as short as possible, in order to reduce any RFI from the microprocessor circuitry. Please refer to **Figure 2, C68 Exploded View** on page 12. This is the same solder pad that you removed **Capacitor Lead W2** from earlier. Make a good clean solder joint by using only enough heat and solder to do the job. Always remember that a "good solder" presents a smooth, shiny appearance, where a "cold solder" joint will be dull and grayish in appearance.

20. Route the **BLUE** and **RED** wires neatly and out of the way, so they **DO NOT** get pinched.

21. Ensure that all jumpers are set to the factory default positions according the Jumper Settings table.

22. If you removed an MFJ-44, Plug-in Scope Tuning Adapter earlier, then re-install it onto header, J15, on the MFJ-1278B motherboard.

23. You have finished with the installation of the MFJ-780 DSP PC board. At this point it is best to go back and **DOUBLE** check all previous steps in this installation procedure.

24. Put the top chassis cover back onto the MFJ-1278B and secure it with the (4) screws you removed in step #2 of this instruction.

This will complete the installation section of the MFJ-780 PC into your MFJ-1278B. You are now ready to use your new MFJ-780 DSP Filter, but first you need to know a little about the onboard jumpers, and what they have to do with the filter operation.

JUMPER DESCRIPTION

Please refer to Tables 4-1 to 4-3 in the **MFJ-1278B/MFJ-1278BT Main Instruction Manual** for further information on the following.

Jumper JP1, Modem P/Modem M

Operational Modes: VHF Packet, 2-Level and Multi-Level FAX, & Color SSTV

Jumper JP1 is used to select the optimum filter for either Modem P or Modem M tones. The units comes with Pins 2 & 3 shorted. Shorting Pins 1 & 2 sets up a dual-bandpass filter with passbands of 1050-1350 Hz. and 1450-2300 Hz., which is for Multi-Level FAX or Color SSTV **only**, Modem M. Short Pins 2 & 3 sets up a single bandpass filter with a center frequency of 1700 Hz. and filter bandwidth of 2400 Hz. This is optimum for VHF Packet and 2-Level FAX. This filter can also be used for Multi-Level FAX and Color SSTV, even though it is not the optimum filter setting for them.

Jumper JP2, Modem H

Operational Modes: HF Packet, Baudot RTTY & ASCII @ 170 Hz. Shift, Amtor, Sitor, and Navtex

Jumper JP2 is for the Modem H tones. The units comes with Pins 2 & 3 already shorted, which is the factory setting. This sets the MAXIMUM BAUDRATE of the filter to 300 baud and the filter bandwidth to 504 Hz. If you want to set the MAXIMUM BAUDRATE lower than 300, then short Pins 1 & 2 for a MAXIMUM BAUDRATE of 75 baud and filter bandwidth of 280 Hz.

Jumpers JP3 and JP4, Modems V and V*

Operational Modes: Baudot RTTY and ASCII @ 425 or 850 Hz. Shift, European Tone Standard @ 170 Hz. Shift

Jumper JP3 is used to select either Modem V or Modem V*, European or US tone standards respectively. The unit comes with Pins 2 & 3 already shorted for the US tone standard, using MARK & SPACE frequencies pairs of 2125 and 2975 respectively, or an 850 Hz. shift. Shorting of Pins 1 & 2 set the unit up for using the European tone standards for MARK and SPACE of 1275 and 1445 respectively, or 170 Hz. shift.

Jumper JP4 is used in conjunction with jumper JP3. The unit comes with Pins 2 & 3 already shorted for a MAXIMUM BAUDRATE of 300 baud. Short Pins 1 & 2 for a MAXIMUM BAUDRATE of 75 baud.

For the European frequencies, the filters' bandwidths are 280 Hz. for 75 baud, and 504 Hz. for 300 baud. The center frequency of (1445+1275) /2 = 1360 Hz.

For the U.S. frequencies, the filter is a dual-bandpass filter which centers at the MARK and SPACE frequencies. The filters' bandwidths are 246 for 75 baud, and 470 Hz. for 300 baud.

Jumpers JP5 and JP6, Modem C

Operational Modes: CW, Memory Keyer, and Modulated CW

Jumpers JP5 and JP6 are used to select the different CW filter bandwidths for Modem C. You can select any 1 of (4) filter bandwidths of 50, 100, 200, or 500 Hz. The unit comes with Pins 1 & 2 of both jumpers shorted for a filter bandwidth of 50 Hz. Short Pins 1 & 2 of JP5 and Pins 2 & 3 of JP6for a bandwidth of 100 Hz. Short Pins 2 & 3 of JP5 and Pins 1 & 2 of JP6 for a bandwidth of 200 Hz. Short Pins 2 & 3 of both jumpers to select a bandwidth of 500 Hz. For **slow speed CW** work, the **100 Hz.** factory setting for the bandwidth will be sufficient. You may even want to try the **50 Hz.** bandwidth setting. If the 50 Hz. bandwidth setting is used, signal tuning will be a little critical, along with the **THRESHOLD** setting. For **high speed CW** work, you may need to widen the bandwidth to the **100 or 200 Hz.** setting. The **THRESHOLD** setting also becomes more critical at higher CW speeds, than at slower speeds.

Jumper JP7, AGC

Function: AGC ON/OFF

Jumper JP7 is used for setting the **A**utomatic **G**ain **C**ontrol, AGC ON or OFF. The unit comes with Pins 1 & 2 already shorted to disable the AGC. Shorting Pins 2 & 3 will enable the AGC function. The AGC function is designed to maintain the same audio output level during signal fading. If the audio input level from the receiver is too high, the output audio will distort when the AGC is being used. If you find that the signal you are trying to copy is fading or very weak, then try setting the AGC feature to ON. Please refer the Table 2, Jumper Settings as to how to set the AGC feature ON and OFF.

Jumper JP8, Time Delay
Function: Time Delay, 24 mSec and 12 mSec Time Delay FIR Filters
Jumper JP8 is for selection of filters with different time delay. The unit comes with Pins 2 & 3 already shorted, which selects an FIR linear phase filter of 24 mSec time delay. The attenuation of the 24 mSec FIR filter is 50 dB @ 60 Hz. outside the filter passband. Short Pins 1 & 2 to select an FIR linear phase filter of 12 mSec with an attenuation of 30dB @ 60 Hz. outside the filter passband.

NOTE: If the 24 mSec time delay filters cause problems, set the jumper for the 12 mSec filters at the expense of less attenuation outside the filters passband.

Jumper JP9, Filter-In/Bypass
Function: Filter-In and Bypass Digital Signal Processing
Jumper JP9 is for selecting either to process the audio, Filter-In or to bypass all signal processing, Bypass. If your *MFJ-780 is a Revision 0 or 1*, then the unit comes set-up for Signal Processing, with Pins 2 & 3 shorted. If DSP bypassing is required, then short Pins 1 & 2 of JP9.

If your *MFJ-780 is a Revision 2*, then the unit still comes set-up for **Signal Processing**, with **Pins 1 & 2 and Pins 3 & 4 shorted**. If DSP **bypassing is required**, then remove both jumpers and short **Pins 2 & 3 only**.

All jumpers are listed along with a short explanation, in Table 2, Jumper Settings, on the following page. The default settings for each jumper is denoted by a **?**.

Jumper Settings	Pin Position	Function	Comments
JP1	1/2	Modem M	Optimum Filter Modem M
	?2/3	Modem P	Optimum Filter Modem P
JP2	1/2	Modem H	75 Baud Setting Modem H
	?2/3	Modem H	300 Baud for Modem H
JP3	1/2	Modem V	European Tone Standard
	?2/3	Modem V*	U.S. Tone Standard
JP4	1/2	Modem V, V*	75 Baud Filter
	?2/3	Modem V,V*	300 Baud Filter
JP5	?1/2	Modem C	50 or 100 Hz CW Bandwidth
	2/3	Modem C	200 or 500 Hz CW Bandwidth
JP6	1/2	Modem C	50 or 200 Hz CW Bandwidth
	?2/3	Modem C	100 or 500 Hz CW Bandwidth
JP7	?1/2	AGC	Sets AGC function to OFF
	2/3	AGC	Sets AGC function to ON
JP8	1/2	Time Delay	Selects 12 mS FIR Filter
	?2/3	Time Delay	Selects 24 mS FIR Filter
JP9†	1/2	Filter-In/Bypass	Selects DSP Bypass
	?2/3	Filter-In/Bypass	Selects Signal Processing
JP9††	?1/2, 3/4	Filter-In/Bypass	Selects Signal Processing
	2/3	Filter-In/Bypass	Selects DSP Bypass

Table 2 Jumper Settings

? Indicates factory or default Jumper position.
†   JP9 Configuration for Revision 0 and 1 PC boards only.
†† JP9 Configuration for Revision 2 PC boards only.

MFJ-780 DSP OPERATION

The selection of the various filters is done automatically when the user switches the operational modes by using the **MODE** command. The two (2) modem select lines, **MODEM-A** and **MODEM-B**, pins 10 and 9 of U1, 4052, respectively, are what tells the MFJ-780 DSP to switch it's filters. These lines are switched via the **MODE** command as shown below:

Modem-A	Modem-B	Selected Modem
Low	Low	P or M
High	Low	H
Low	High	V or V*
High	High	C

Operation of the MFJ-1278B with the MFJ-780 DSP installed is no different than without the MFJ-780 DSP, accept for the jumper settings. The various jumpers on the MFJ-780 DSP are there to optimize the DSP operation in the various operational modes that the MFJ-1278B is capable of performing.

The jumper settings are factory set to certain positions to optimize the MFJ-780 DSP operation These settings should allow good performance from the MFJ-780, however, the customer should feel free to experiment with these settings depending on the Operational Mode, **MAXIMUM BAUDRATE** being used or even band conditions. The term **MAXIMUM BAUDRATE**, refers to the baudrate or speed which is used during **VHF** or **HF RTTY** or **ASCII** operations, **MODE HB or MODE HA or MODE VB or VA**. Take for instance, you would not want to activate the AGC function if band conditions were very noisy, this would even more hamper the ability to copy the signal well.

AGC Operation
You will notice that jumper **JP7** is set so that the **AGC** function is **OFF**. The **AGC** can be used during poor band and weak signal conditions. If there is a lot of "band noise", the **AGC** should remain **OFF**, due to the fact that the **AGC** will bring the **signal and "band noise" up to the same level**. This could make signal tuning very difficult in order to get good copy.
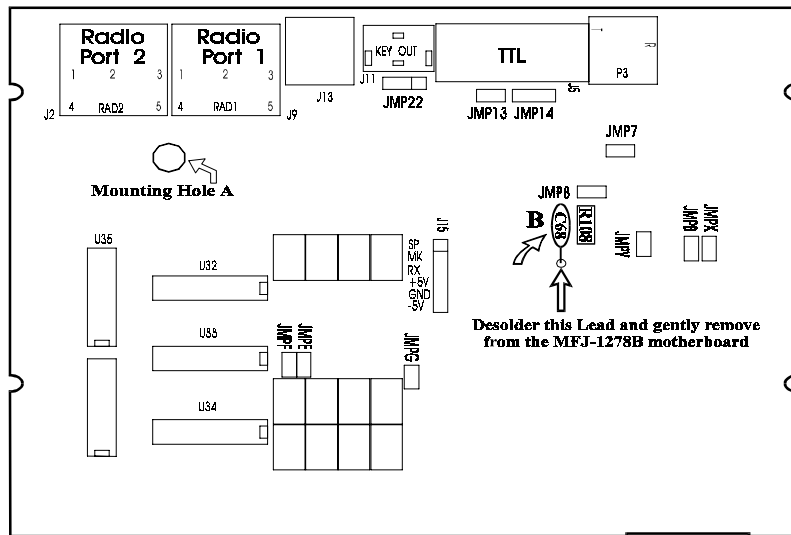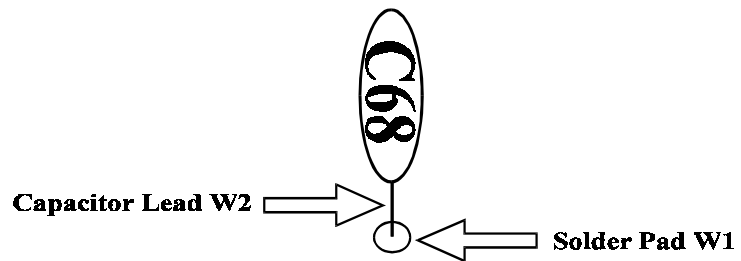
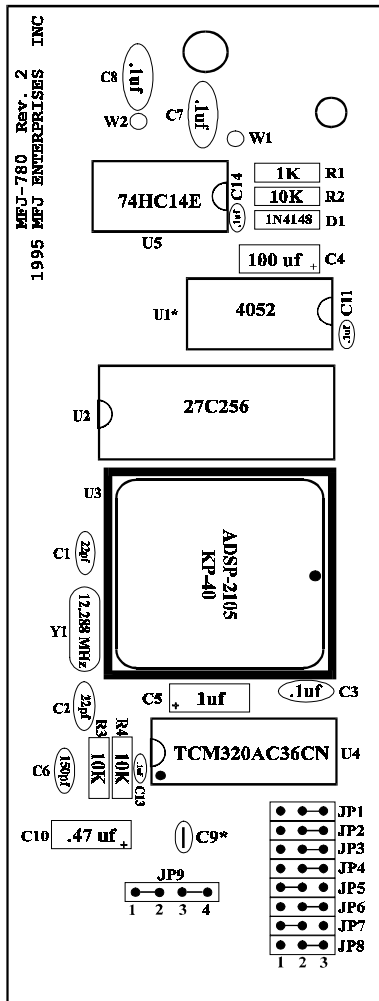**Figure 1**

Figure 2 C68 Exploded View

Figure 3a   MFJ-780, Rev. 2
Parts Layout

U1, 4052 is taken from the MFJ-1278B
motherboard and installed in this socket.

All jumpers are shown in their
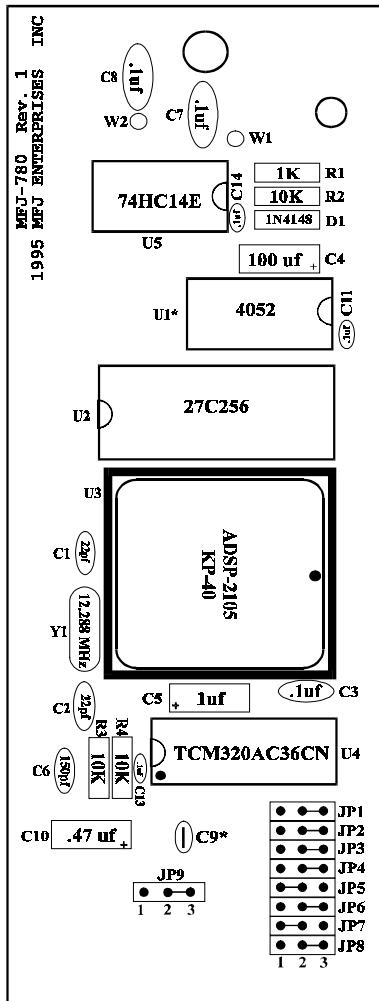FACTORY DEFAULT positions

Capacitor, C9 has a jumper installed

Figure 3b   MFJ-780, Rev. 0 & 1
Parts Layout

U1, 4052 is taken from the MFJ-1278B
motherboard and installed in this socket.

All jumpers are shown in their
FACTORY DEFAULT positions

Capacitor, C9 has a jumper installed

SCHEMATIC FOR REVISIONS 0 & 1

SCHEMATIC FOR REVISION 2

Technical Assistance

If you have any problem with this unit first check the appropriate section of this manual. If the manual does not reference your problem or your problem is not solved by reading the manual you may call *MFJ Technical Service* at **601-323-0549** or the *MFJ Factory* at **601-323-5869**. You will be best helped if you have your unit, manual and all information on your station handy so you can answer any questions the technicians may ask.

You can also send questions by mail to MFJ Enterprises, Inc., 300 Industrial Park Road, Starkville, MS 39759; by FAX to 601-323-6551; through Compuserve at 76206,1763; or by email to mfj@mfjenterprises.com. Send a complete description of your problem, an explanation of exactly how you are using your unit, and a complete description of your station.