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The Basics

Introduction

The MFJ-414 Professional Classroom Code Tutor is the most capable and versatile Morse code training tool on the market. This unit can be used by individuals to practice receiving and sending code, by instructors to provide practice to their classes, by clubs and other groups to provide on-the-air code practice through all types of radios and repeaters, by Volunteer Examiners in preparing and administering code examinations, and as a keyer by amateur operators on all bands.

Its strong, high-quality audio, its ability to work with a computer and its printer output port make it a valuable tool for any training environment. The MFJ-414 can provide:

- Individual or group code practice with random sending of:
 - Basic, advanced or custom-configured character groups, including:
 - All characters in the FCC code tests and more
 - Preprogrammed or custom-configured sets of words
 - Exam-style sample amateur QSOs
- Printouts of practice sessions, for grading purposes, via its printer port
- Ability to tape-record practice sessions via its audio port
- Practice, demonstrations or examinations for large groups via either its built-in speaker or by feeding its audio output to a Public Address system
- Custom practice sessions downloaded from a computer, including the ability to generate a complete FCC code test for a VE session
- Over-the-air code practice via its radio interface for FM, AM or SSB transceivers
- Iambic or semi-automatic keying of CW transceivers.

In this manual, we'll start by explaining the basics of the MFJ-414, then show how you can quickly start using it for some of its major functions. In this Fast Start section, we'll concentrate on putting the unit to work for you immediately. As you'll see, you can start using it in just a few minutes. In later sections, we'll cover all its capabilities and features in full detail.

Getting Started: How to Use the Menu System

You may set up the MFJ-414 to perform any of its many functions by making the appropriate selections from its menu system. This system consists of eleven main menus, eight of which have submenus. You make your selections using the three buttons under the LCD display—Previous, Next and Select. These buttons do the following:

- Previous—Selects the previous main menu, or the previous item in a submenu.
- Next—Selects the next main menu, or the next item in a submenu.
- Select—Enters a submenu to allow changing your choices within that submenu. To do this, press and release the Select button within one second (as we'll see later, this button does other things when held down longer than one second).

The menus are arranged in a "wrap-around" structure, so that pressing the Next or Previous button will bring up another menu or submenu item in a sequence. Figure 1 shows the sequence of the main menus. Notice the availability of the Combine, the Group and the Interactive menus depends on the selection in the Set menu. When power is turned on, the menu displayed is the one that was displayed when the unit was last turned off.

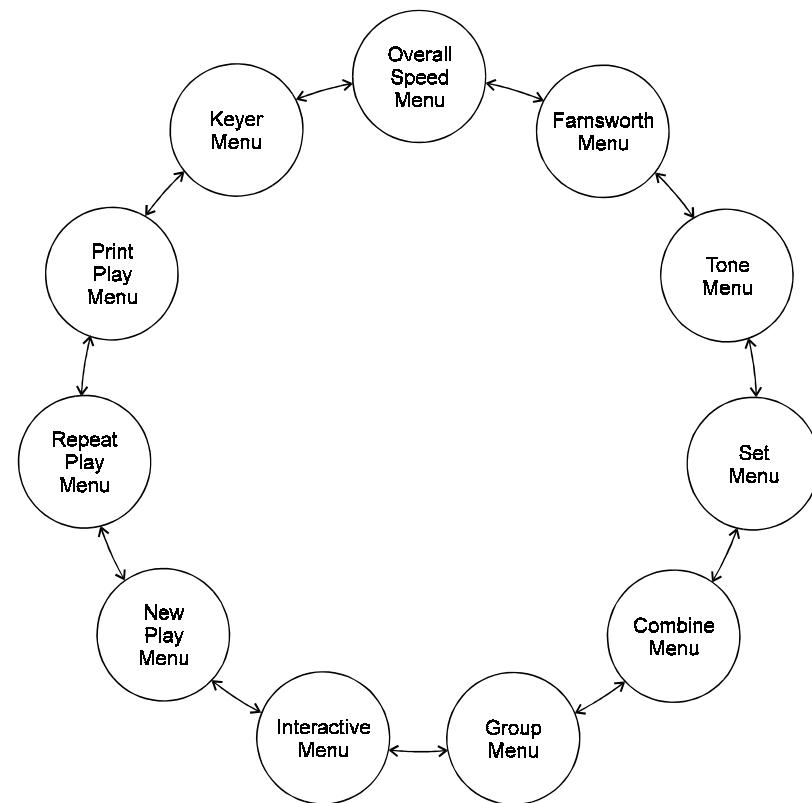


Figure 1. MFJ-414 Main Menu System.

To see how the menu system works, consider the following example.

EXAMPLE: If the display shows that you are in the Overall Speed menu, pressing the Next button would put you in the Farnsworth menu and pressing the Previous button would put you in the Keyer menu. Pressing the Select button would put you in the Overall Speed submenu. This is indicated by a blinking block at the right side of the LCD display. While this block appears, you may raise the speed by pressing the Next button or lower it by pressing the Previous button. Once you have selected the speed you desire, you may leave the submenu by pressing the Select button again.

Once you have made your choices within the unit's submenus, they will be saved in non-volatile memory for your next session.

Fast Start: Using the MFJ-414

In the following sections, we'll show how you can quickly set up the MFJ-414 to perform each of its major functions. To start, power up the unit and press the Next button until you reach the first menu mentioned, then follow the instructions.

Using the MFJ-414 As a Standalone Morse Code Trainer

- Keyer Menu—Set to "Keyer Off"
- Overall Speed Menu—Enter this submenu by pressing Select and choose your overall sending speed (using the Next and Previous buttons), then exit the submenu by pressing Select again.
- Farnsworth Menu—Farnsworth spacing means that individual characters are sent faster than the overall sending speed. For example, many 13-wpm Amateur Radio examinations consist of characters sent at 18 wpm, but spaced out to reduce the overall sending speed to 13 wpm. To choose Farnsworth spacing, press Select. The blinking block will appear. Use the Next and Previous buttons to select the Farnsworth speed you desire. Setting the Farnsworth speed the same as the overall sending speed will turn Farnsworth spacing off.
- Tone Menu—Press Select to enter this submenu and select the audio tone you desire. If you're preparing for a code examination, you should know that most exams are given using audio tones between 700 and 800 Hz, so you may want to stay within that range so it sounds familiar to you during the exam. Pressing Select again will exit the Tone menu and return you to the main menu sequence.
- Set Menu—This selects the set of characters (or words or QSOs) that will be randomly sent. The MFJ-414 offers a wide variety of practice sessions applicable to many different code-training techniques and to all stages of your code training. The character sets available are: nine beginner sets, eleven advanced sets, four custom sets you may program yourself, and sixteen memory sets you may program yourself. As you step through these options, the contents of the sets are displayed on the LCD.

When you have selected the second or higher Beginner Set or the second or higher Custom Character Set, the Combine menu allows you to combine previous Beginner or Custom Character sets into a single set for practice purposes.

When you have selected a *character* set, the Group menu lets you set the number of characters to be sent in each group.

For complete details of the Set menu, see page 12.

To decide which of these sets to choose, you must first decide how you are going to approach the task of gaining code proficiency. See the section titled "Learning Morse Code" on page 8 for information about different code-training techniques.

- Interactive Menu—With the Interactive function turned on, the unit will halt after sending one or more (your choice) words or code groups and wait for you to press the Next button before sending the next word(s) or group(s). If you want this feature activated, press Select to turn Interactive on, then Next or Previous to choose how many words or groups the unit should send before halting. When you have made this selection, press Select again to exit this menu.
- New Play Menu—Press Select to have the unit start sending code. To pause the sending, press Select again (the word "PAUSE" will appear in the display). To stop the sending, press the Select button and hold it down for more than one second (the word "STOP" will appear in the display).
- Repeat Play Menu—If you wish to hear the previous session sent again, press Select.
- Print Play Menu—Pressing Select in this menu also will cause the previous session to be replayed, and in addition will send the text to a printer. This is particularly useful if you wish to grade yourself on how accurately you copied.

Using the MFJ-414 As a Keyer

With the MFJ-414, you may send Morse code in all the major ways commonly in use. This includes both Iambic A and B automatic keyer modes with dual-lever paddles, semi-automatic key mode using a single-lever paddle, or even with a straight key or mechanical, semi-automatic "bug." The unit comes with Iambic A selected as the default keyer mode. To change this, you enter the Setup menu, which is described on page 9.

The Key Input jack accepts a 1/4-inch stereo phono plug. For dual-lever "squeeze" keys, connect the dot wire to the tip of the plug and the dash wire to the ring. Use two-conductor shielded cable, or, if two shielded cables are used, connect the shields together. The shield must be connected to the plug's ground.

To use a straight key or "bug," also use a stereo phono plug; a mono plug will not work. Connect one wire to the plug's ring and the other to the ground (the tip is not used). You then must enable the Semi-Auto mode and disable the Reverse function (both done from the Setup menu).

- **Keyer Menu**—Press Select to turn the keyer to "on." The keyer speed and the audio tone will be the same as those last selected from those menus. However, you can change both (as well as the PTT hang time for the radio interface) from within the Keyer menu when the keyer is turned on. To do this, press Select briefly. Three numbers showing, from left to right, speed, tone and PTT hang time will be displayed on the second line of the display. One of these will have a set of square brackets around it. Pressing the Select button will move the brackets to the next parameter, such as from speed to tone. You can change the value within the brackets by pressing the Next or Previous buttons. To turn the keyer off, press the Select button and hold it down for more than one second.

PTT hang time indicates the amount of time the PTT line will be active after you have sent your last character. You may adjust this to your liking for on-the-air sending.

- **Overall Speed Menu**—When the keyer is turned "on," it is automatically set to the last speed selected. Speed can be selected from within the Keyer menu as described above. This menu has no effect when using a straight key or bug.
- **Farnsworth Menu**—Not used in this function.
- **Tone Menu**—When the keyer is turned "on," the tone is automatically set to the last tone selected. The tone can be selected from within the Keyer menu as described above.
- **Set Menu**—Not used in this function.
- **Combine Menu**—Not used in this function.
- **Group Menu**—Not used in this function.
- **Interactive Menu**—Not used in this function.
- **New Play Menu**—Not used in this function.
- **Repeat Play Menu**—Not used in this function.
- **Print Play Menu**—Not used in this function.

Display During Keyer Operation: When using the unit in Keyer mode, except when the Semi-Auto function is enabled, the code sent is displayed on the front-panel LCD and sent to the Serial Port. If the Keyer Memory is enabled, the code sent with the paddles also is stored in the non-volatile Keyer Memory. The keyer memory bank has a maximum capacity of 1022 characters. If more than that are sent, the newest characters will replace the oldest ones—a "circular" memory arrangement. Invalid code is displayed as a lowercase "x" and is not stored in memory.

Using the MFJ-414 For Over-the-Air Code Practice

The MFJ-414 allows you to send code practice sessions over the air, using all types of transceivers. The Key Output jack on the rear panel provides keying for solid-state CW transmitters. The Radio

Output jack, also on the rear panel, provides PTT switching and audio for sending Morse code as audio tones through an FM, SSB or AM transmitter. With this function, you may, for example, send Morse code using FM transceivers on VHF simplex frequencies or over repeaters.

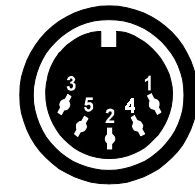
Important Note: With the MFJ-414, you may send Morse code using several different emission types as defined by the FCC. The FCC regulations regarding emission types apply whether you're sending Morse code or voice signals with that type of emission. Thus, for example, when you connect this unit to an FM transmitter, you are sending Morse code by FM, not by CW. That means you must remain within the band limits designated for FM transmissions. In the amateur six- and two-meter bands, the subbands 50.0 - 50.1 MHz and 144.0 - 144.1 MHz are reserved exclusively for CW transmissions. If you're sending Morse code as audio tones with an SSB transmitter on the HF bands, you must remain within the band segments designated for SSB; you cannot transmit this type of emission in the CW bands.

Also remember to identify your station at least once every 10 minutes during your code practice transmission.

Hooking Up to the Radio

Connect your radio to the unit, using a cable run from the Radio Output jack on the MFJ-414 to your radio. MFJ sells cables for most major brands of radios. See the list on page 30 for the appropriate stock number. If you wish to make your own cable, below is a diagram of the standard 5-pin DIN jack on the MFJ-414 and a table showing its connections.

Pin	Radio Output Function
1	Transmit Audio
2	Ground
3	PTT
4	No Connection
5	No Connection



- **Keyer Menu**—If your over-the-air code practice is to be sent using the unit's character sets or text loaded into its memory, turn the keyer function off. If you're going to send the practice session yourself with a key or paddle, select the type of keying you want to use, as described above in the section on using the 414 as a keyer.
- **Overall Speed Menu**—Select the overall speed at which you wish the practice session to be sent. If you're sending the session yourself using the keyer function, select the speed just as you would any other keyer.

- Farnsworth Menu—If you're sending from the MFJ-414's character sets or from text you entered into the unit's memory banks, you may choose a Farnsworth speed for the over-the-air practice session. If you're sending the code practice yourself using the keyer function, the Farnsworth mode is temporarily disabled.
- Tone Menu—If you're using the MFJ-414 to key a CW transceiver, the Tone menu is not applicable. If, however, you're using the MFJ-414 to send Morse code as audio tones over an FM, AM or SSB transceiver, the Tone menu allows you to choose the audio tone sent.
- Set Menu—Choose a set for transmission unless you're sending the code practice yourself with the keyer.
- Combine Menu—Not used if you're sending the practice yourself. Otherwise configure accordingly just as you would if using the unit as a standalone tutor.
- Group Menu—Not used if you're sending the practice yourself. Otherwise choose the number of characters per group just as you would if using the unit as a standalone tutor.
- Interactive Menu—Not used in this function.
- New Play Menu—Not used if you're sending the practice yourself. Otherwise start a new session just as you would if using the unit as a standalone tutor.
- Repeat Play Menu—Not used if you're sending the practice yourself. If sending a Tutor session over the air, you can repeat the session if desired.
- Print Play Menu—Not used in this function.

When you begin sending, make sure your radio goes into transmit mode. If it does not, or if it transmits continuously whether or not the MFJ-414 is sending, you will need to adjust the PTT Keying Adjust trimpot, accessible from the back panel. Use a small, flathead screwdriver to adjust this pot so that your radio transmits when the MFJ-414 is sending and does not transmit when the unit is not sending. You may adjust the level of the transmitted audio with the Line Audio Adjust trimpot, also on the back panel. Monitor the signal transmitted by your radio or have someone else do this and adjust for a comfortable audio level.

Connecting to a Computer

You may connect the MFJ-414 to a computer using the unit's serial port, on the back panel. A 9-pin-to-9-pin serial cable is provided with the unit. If your computer has a 25-pin serial port, you can use a 9-pin-to-25-pin adapter.

To use a computer with the MFJ-414, run a terminal program that will upload and download ASCII files, and configure the terminal program to do so. Set the terminal program for 1200 baud, 8 data bits, no parity and one stop bit. If you see extraneous linefeeds on the computer screen

when receiving data from the MFJ-414, you may configure your software to strip out these extra linefeeds.

During New Play, Repeat Play or Print Play, the characters sent by the MFJ-414 are sent through the serial port, so you may use your computer to monitor the transmitted copy. You may find this particularly convenient.

You also may upload and download text files between the MFJ-414 and your computer. For details on this, see the discussion of the Set Menu starting on page 12.

Connecting to a Printer

The printer port will send your practice session to any Epson compatible printer. This function is only active during Print Play, which repeats the previous session. The printer must be connected and turned on before starting Print Play; otherwise you will get an error message saying "PRINTER FAULT." This message includes Abort and Retry options. If you selected Print Play by mistake, press Previous to abort the operation; if you wish a printout, make sure the printer is properly connected and powered up, then press Select to retry.

Learning Morse Code

Learning Morse code is a matter of practice, practice and more practice. Whether you're just starting to learn the characters or working on high-speed "head copying," you'll succeed through regular, frequent practice. That is why the MFJ Classroom Morse Code Tutor is the ideal tool for learning the code. It provides an extremely wide variety of practice sessions, all sent in truly random fashion and with high-quality audio like that used in examination sessions.

Unlike tapes, which you quickly can memorize and thus defeat the purpose of the practice, the Classroom Code Tutor sends a new practice session every time to hone your skills. The keyer functions allow you to practice sending. With speeds from 3 to 60 wpm and sets from a few characters to the entire character set, then words and QSOs, this unit can take you from no code skills at all up to the ranks of high-speed CW contesters.

Over the years, many different programs for building code proficiency have been developed, but the common element to all these programs is regular practice. With the MFJ-414, you may follow any training program you desire. This unit is extremely versatile and allows you to tailor its functions to provide the type of code practice you desire. It also allows you to customize your practice sessions to focus on any particular trouble spots that may arise during your training.

A traditional method of gaining code proficiency has been to learn all the characters, then slowly build speed. While this succeeds for many people, it proves frustrating for others. A common complaint is that, at about 10 wpm, students hit a "plateau," where they see no increase in their

copying speed for some time. An alternative method, devised by a psychologist in the 1930's, starts students at full speed, say 15 or 20 wpm, but with only a limited set of characters at the beginning. This Koch Method, named after its inventor, showed the fastest training progress of any method ever published in the psychological journals.

The MFJ-414's Custom Character sets allow you to use the Koch Method in an easy, straightforward manner. For full details on the Koch Method, as well as on CW operating and the history of Morse code, see the book, "Morse Code: Breaking the Barrier" (MFJ-3400), available from MFJ Enterprises, Inc.

The Details

The Menus—Detailed Descriptions

Setup Mode

Entering the Setup mode allows you to change some basic functions of the Tutor and the Keyer. To enter the Setup mode, first turn off power to the unit, then press and hold both the Previous and Select buttons while turning power on. When "ON-THE-FLY SPEED" appears, release the buttons. In the Setup mode, press Previous or Next button to select the previous or next submenu, respectively, and press the Select button to toggle the options within that submenu.

To exit the Setup mode, press and hold the Select button for one second. If the Keyer Memory option has been changed, "CHG KEYER MEMORY" will appear. Press the Previous button to confirm the change (and *erase* the content of the last memory bank), or press the Select button to cancel the change. Release the button after "EXIT" appears to resume with normal operation.

You choose Setup options from seven submenus. These are:

- **On-the-Fly Speed:** With this option ON, you may change the sending speed while the Tutor is sending, as described below in the section on the Play menus. In Setup mode, you may turn this feature OFF to avoid accidentally changing the speed during a session.
- **Play Format:** This selects the order in which the character is sent to the display and the speaker. You may choose to have the character sent to the display first, then the speaker, or vice-versa.
- **Semi-Auto:** With the Semi-Auto option OFF, the keyer functions as an iambic keyer, for use with a dual-lever paddle. As an iambic keyer, the MFJ-414 has dot and dash memories, for "squeeze keying," and functions just like other iambic keyers, both standalone keyers and

those built into radios. With Semi-Auto turned ON, the keyer can be used with a single-lever key, with dots generated automatically and dashes formed manually by the user. This emulates the function of a mechanical, semi-automatic "bug." You also may use this unit with a straight key or a bug—connect the key or bug to the ground and the dash line. With semi-auto turned ON, the MFJ-414 will not display the code sent or record to the keyer memory.

- **Iambic:** There are two different types of iambic keying, and both are available. The difference in behavior of these two modes occurs when both paddles are squeezed, then released. In iambic mode A, the keyer will simply complete the element (dot or dash) in progress, then stop sending. In iambic mode B, the keyer will complete the element in progress, then send an additional opposite element. You may choose either mode.
- **Reverse:** When using paddles, the MFJ-414 normally expects the dot paddle to be connected to the tip of the plug and the dash paddle to be connected to the plug's ring. If your paddles are wired in the opposite manner, or you wish to change between right- and left-handed operators, you may turn Reverse ON to switch the paddle functions. You can also set this mode by simply pressing the paddle you desire to designate as the dot paddle.
- **Keyer Memory:** With Keyer Memory turned ON, you change the last memory bank (Bank P) into a keyer memory. If you change the state of this memory, you erase its contents. When Keyer Memory is turned on, the text you send with the paddles is saved into memory and can later be played back. This memory has a total capacity of 1022 characters. If more than that are sent, the newest characters will replace the oldest characters, in a "circular" memory arrangement. During sending, invalid code is displayed as a lowercase "x" but not stored in the memory.

Hint: To store an extra word space, send an invalid code and pause for a word space.

When switching from the Keyer mode to Tutor mode (by pressing Select for one second), a 5-digit number will appear indicating the number of characters sent (plus two for "[" and "]") and stored into the keyer memory. If more than 1022 characters were sent, "FULL" will be displayed. In that case, only the last 1022 characters will have been stored.

- **Write Protection:** Turning this function ON prevents the non-volatile memories, the random words and memory banks, from being accidentally overwritten. In order to download files into the MFJ-414 memory, this option must be OFF.

Keyer Menu

When "KEYER OFF" is displayed, press Select to turn the keyer on. The keyer speed and the audio tone will be the same as those last selected from those menus. However, you can change both (as well as the PTT hang time for the radio interface) from within the keyer menu when the keyer is turned on. To do this, press Select briefly. Three numbers showing, from left to right, speed, tone and PTT hang time, will be displayed on the second line of the display. One of these will have a set of square brackets around it. Pressing the Select button will move the brackets to the next parameter, such as from speed to tone. You can change the value within the brackets by pressing the Next or Previous buttons. To turn the keyer off, press the Select button and hold it down for one second.

Overall Speed Menu

This menu allows you to select a keying speed from 3 to 60 words per minute (wpm). By "overall" speed, we mean the speed at which the words or groups are sent. A "word" is defined as 50 units of time, and the word "PARIS" is exactly 50 units in length. Therefore, if "PARIS" is sent 13 times in one minute, the sending speed is 13 wpm.

Standard Morse code timing defines a dit as one unit of time and a dah as three units of time. Within each character, there is one unit between elements (dits and dahs). Three units separate characters and seven units separate words. Farnsworth spacing (see below) will increase the amount of time between characters and words.

When "OVERALL SPEED" is displayed, press Select to enter the menu, then Next will increase the overall sending speed and Previous will lower it, both in 1-wpm increments. Once you have selected your speed, press Select again to exit the menu. Note that setting the overall speed greater than or equal to the Farnsworth speed will disable Farnsworth spacing.

Speed requirements for U.S. amateur licenses are: 5 wpm for Novice and Technician-Plus; 13 wpm for General and Advanced; and 20 wpm for Amateur Extra Class. Many amateur exams are administered using Farnsworth spacing. For example, many 5- and 13-wpm exams are administered by sending 18-wpm characters spaced out to provide the slower overall speed. In order to provide themselves a "buffer" to overcome possible test-day jitters, many amateurs practice at a slightly higher speed than that at which they will be tested. Someone trying for the 13-wpm test, then, might practice with 18 or 20 wpm characters spaced out to an overall sending speed of 15-16 wpm. That way, when test day comes, the exam may sound slow and easy, boosting your chances of success.

Farnsworth Menu

As explained previously, Farnsworth spacing adds more time between characters to slow down the overall sending speed. The advantage of this is that, by hearing the characters sent at a faster speed, you learn to recognize each character by its distinctive rhythm, rather than by trying to "count dits." This greatly assists you in copying Morse code at higher speeds.

To activate Farnsworth spacing, press Select when "FARNSWORTH OFF" is displayed. A black box will blink on the right-hand side of the display. Press Next to increase the Farnsworth speed, or Previous to reduce it. The Farnsworth speed, however, must be higher than the overall speed. To turn Farnsworth off, reduce the Farnsworth speed to the same speed as the overall speed.

Tone Menu

The Tone menu allows you to select the audio frequency sent by the unit. You may select frequencies from 305 to 1006 Hz. While you can choose an audio frequency that pleases you, you should be aware that most amateur code exams are given using audio frequencies between 700 and 800 Hz. Also, most CW transceivers use sidetone frequencies in the 700 to 800 Hz range.

To select your audio frequency, press Select when "TONE" is displayed. Then, you can use Next to raise the frequency or Previous to lower it. Press Select again to exit the Tone menu.

The MFJ-414 features smooth, clean audio, with sine wave output, instead of the harsh square wave audio used by many other code-training machines. Also, the MFJ-414 produces each dit and dah with a rise and decay time of approximately 5 milliseconds, avoiding the "spikes" that cause distracting key clicks. The MFJ-414's audio sounds like that of the high-quality tapes frequently used for exams or that of a good CW transceiver.

Set Menu

The Set menu allows you to select the set of characters (or words or QSOs) from which the MFJ-414 will send random practice when playback is started. These are classified as Beginner Sets, Advanced Sets, Custom Sets and Memory Sets. There are nine Beginner Sets, 11 Advanced Sets, four Custom Sets, and 16 banks of non-volatile memory for Memory Sets that you may download into the Tutor from a computer. The Combine feature (detailed below) allows you to combine Beginner and Custom Character sets for your practice sessions.

Beginner Sets

The nine Beginner sets include letters, numerals, punctuation marks and prosigns (procedural signs used on the air). When a single Beginner set is selected, each playback will begin with the characters in that set sent in the sequence listed below three times, separated by a word space. Then the characters will be sent randomly. The three repetitions at the beginning are designed to familiarize you with the sound of the characters before random sending begins. This

familiarization sequence is not sent when the Combine function is turned on, indicated by a "+" character on the right-hand side of the display.

The Beginner Sets are:

- | | |
|-------------------|----------|
| • EISHTMO | letter1 |
| • AWJNDB | letter2 |
| • UVGZKRPX | letter3 |
| • FCLQY | letter4 |
| • 12345 | number1 |
| • 67890 | number2 |
| • . , ? / + * = | prosign1 |
| • ; : ' " - _ \$ | prosign2 |
| • () & ! % @ # ^ | prosign3 |

Note: In the above listings, punctuation marks are included in the prosign sets. In addition, prosigns are represented here by symbols that also appear on the unit's display when the prosigns are sent. The prosign1 set includes all prosigns included in the characters required for the FCC Amateur Radio tests. To see which symbols represent the prosigns, refer to the chart on page 30.

The Combine Menu:

When you have selected any Beginner or Custom Character set other than the corresponding first sets (EISHTMO and CST CHR1), the Combine menu will be available to you. This feature allows you to combine Beginner or Custom Character sets into a larger pool of characters from which the unit will send. By combining sets, previously learned sets are combined with new sets to reinforce all that you have learned.

When the second or higher Beginner or Custom Character set is selected, Combine will appear in the main menu sequence. To make your choice, press Select to activate the Combine menu, then press either Previous or Next to toggle the Combine function on or off. Then press Select again to leave the Combine menu.

When the Combine function is on, the current character set is combined with all previous Beginner or Custom Character sets (a "+" character will appear on the right-hand side of the display in the Set menu). When off, *only* the current character set is used (no "+" character displayed).

The Group Menu:

When sending from character sets, rather than words, callsigns or QSOs, the unit sends the characters in groups, with word spacing between groups. You may select either random-length groups or fixed-length groups with lengths up to 8 characters per group. When you have selected a character set, the Group menu is activated. To change the group type, press Select, then, using the Next or Previous button, choose either random-length groups or the number of characters for fixed-length groups.

Advanced Sets

The Advanced sets are designed for the later stages of code training, after the student has learned all the characters. These include letters, numbers, prosigns, and combinations of these, as well as callsigns, words and sample QSOs—the format of the FCC Amateur Radio tests. Anyone preparing for an Amateur code exam should practice copying sample QSOs such as those sent by the MFJ-414. Be sure you copy such details as the stations' callsigns, the operators' names, their QTHs, rigs, and any other details that could be asked in a multiple-choice or fill-in-the-blanks test question.

In addition to preparing for tests, Amateurs who already have passed the tests and wish to improve their code proficiency will find these advanced sets very useful. The sets of callsigns and words and the sample QSOs are an excellent way to help build the ability to copy at higher speeds and to copy "in your head." The callsign practice can be useful for contesters who wish to improve their ability to work CW contests where the speeds can be quite high.

The Advanced Sets are:

- | | |
|--------------------|---|
| • LETTERS | All letters |
| • NUMBERS | All numbers |
| • PROSIGNS | All prosigns |
| • LETTERS+NUMBERS | All letters and all numbers |
| • LETTERS+PROSIGNS | All letters and all prosigns |
| • NUMBERS+PROSIGNS | All numbers and all prosigns |
| • FCC CHAR | The 43 characters required on FCC code tests [†] |
| • ALL CHAR | All characters |
| • CALLSIGNS | Randomly-generated USA callsigns |
| • WORDS | Random words (500 programmable words, 10 char. max. each) |
| • QSOs | Randomly-generated sample QSOs |

[†] FCC testing requirement consists the 26 letters, the 10 numerals, and *prosign*1 set.

The Random Words Database:

The random words database is a set of 500 words. When this database is selected for code practice, the unit will choose randomly from these words for its code transmission. You may change this set of words by loading a new set from your computer into the Tutor. You may substitute a completely new set of words or replace only some of the words by editing the existing database. To edit the database, you may transfer it from the Tutor to your computer, perform the editing, then transfer the edited database back to the Tutor. The database is stored in non-volatile memory, so it is preserved even when the power is turned off.

To transfer files to and from the Tutor, use a terminal program that will transfer data in ASCII format. Configure the program for 1200 baud, 8 data bits, no parity and one stop bit.

To prepare a random words database, use an ASCII text editor on your computer. Valid characters for the database include all those listed in the chart of page 30, the space and the angle brackets "<>". The angle brackets are used to build custom prosigns—a custom prosign must begin with "<", end with ">", and contain at least one non-space character. Examples are <IMI>, <AAA> and <AS>.

The words in this database may have a maximum of ten characters each. Compound words, such as "ham radio" and "code tutor" are allowed. Each word or compound word in the database file must be on a separate line. Leading spaces, blank lines and invalid characters are ignored by the unit when the file is downloaded. All characters following the first ten valid characters on any line are also ignored. You may add trailing spaces to insert extra spacing between words.

Transferring a Random Words Database From the Computer

- Go to the Set menu and enter its submenus by pressing Select.
- Go to the Words submenu.
- Press Select and hold it for one second. "TRANSFER" will appear on the display.
- Press Previous to begin receiving. "RECEIVING" will appear on the display.
- Begin sending the ASCII file from your terminal program. You may stop the transfer at any time by pressing Select.
- At the end of the transmission, press Select. If you ended your ASCII file of words with a close square bracket "]", the unit will stop the transfer automatically when the bracket is received. The unit also will stop the transfer automatically when 500 words have been received. If your file contains less than 500 words, the unit will replace in its existing database only the number of words in your file, starting at the beginning of its database. This will leave the words at the end of the existing database.
- When the transfer is complete, the unit will check the database for errors. If an error is found, it will display the word number and the word containing the error on the first line and the error number on the second line. See the list of error messages on page 29.
- Press Select to return to normal operation.

Transferring the Random Words Database to the Computer

- Go to the Set menu and enter its submenus by pressing Select.
- Go to the Words submenu.

- Press Select and hold it for one second. "TRANSFER" will appear on the display.
- Configure your computer's terminal program to receive ASCII data.
- Press Next to begin sending. "SENDING" will appear on the display.
- A progress indicator will appear on line two of the display to indicate the number of words sent. Each block represents 32 words.
- You may stop the transfer at any time by pressing Select.
- After the transfer is complete, the unit returns to normal operation.

Custom Sets

There are three custom character sets (CST CHR1, CST CHR2 and CST CHR3) and one custom word set (CST WORD). The custom character sets can contain up to 16 characters each and the custom word set may contain up to 10 words. These may be configured with the characters or words you wish. In addition, the custom character sets may be combined with the Combine function, described above, to make a single custom set of up to 48 characters.

The custom character sets allow you to use the MFJ-414 to learn Morse code using the *Koch Method*. To do this, configure the first custom character set with your first two characters for Koch practice, and practice using that set. When your copying accuracy reaches 90 percent, add another character to this custom set. As you again reach 90 percent accuracy with the next character, add another. By combining the three custom character sets, you can add characters to your Koch practice sessions until you have learned all the characters required for the FCC exam, at which point you can switch to copying words and QSOs. For full details on the Koch Method of code training, see the book "Morse Code: Breaking the Barrier" (MFJ-3400), available from MFJ Enterprises, Inc.

At any time in your training, you can configure a custom character set to provide extra practice on characters that prove troublesome.

Custom Characters:

Here is how to configure a custom character set:

- Go to the Set menu and press Select. A blinking cursor will appear.
- Go to any of the three Custom Character submenus by using the Previous or Next button.
- Press and hold the Select button for one second. The blinking cursor will then move to the second line of the display.
- You may then change the character under the cursor by pressing Previous or Next. The order of the characters is the 26 letters in alphabetical order, the blank character, the 10 numerals, then the prosigns in the order they appear in the chart on page 30.
- Press Select to set the character under the cursor and move the cursor to the next character.
- Press both Previous and Next to erase all remaining characters, including the one under the cursor.

- A character may be erased by changing it to the blank character. You cannot erase the first character in any set; a set must contain at least one character.
- A character may be repeated to have it sent more often.
- To stop programming and save the custom character set, press Select for one second. The blinking cursor will disappear. You may now start a practice session using the custom set you have built.

Custom Words:

To configure the Custom Words set, first read the section above on Custom Characters.

- Go to the Set menu and press Select. A blinking cursor will appear.
- Go to the Custom Words submenu using the Previous or Next button.
- Press and hold the Select button for one second until [CST WORD] is replaced by [WORD XX].
- You may select any word in the set by using the Previous or Next button.
- Press Select to modify the word displayed. You then may modify it character by character just as you would change Custom Characters as described above. To set the word and return to the word-selection submenu, press Select for one second.
- The first letter in any word cannot be erased. Compound words, such as "ham radio" and "code tutor," may be used.
- You may include prosigns in the Custom Word set by using "<" and ">" to build the prosigns. See the chart on page 30 for the character sequence for prosigns. A custom prosign must begin with "<", end with ">", and contain at least one non-space character. Examples are <IMI>, <AAA> and <AS>.
- To stop programming and save the current word set, press Select button for one second. The blinking cursor will disappear and [WORD XX] will be replaced by [CST WORD].

Memory Sets

You may compose messages on a computer and load them into the MFJ-414's memory banks. The unit's memory system is quite flexible and allows up to sixteen messages to be saved. One message can call another for additional flexibility. Using the memories, you may prepare the text for a classroom or over-the-air code practice session in advance. Also, a complete set of code tests for a VE session can be prepared and loaded into the MFJ-414. The memory is non-volatile, so it is saved even when the unit is turned off and it does not require battery backup to preserve the recorded messages.

The unit's memory is composed of sixteen individual banks, arranged in a stack structure, illustrated in the diagram shown below. These memory banks are labeled A through P. The total memory available is 16K characters (where 1K = 1024). Each memory bank is nominally 1K. However, an individual message may fill more than one bank. When this happens, banks are filled sequentially, moving upward in the diagram. If a message begins in Bank B or higher banks, 1K is reserved for each of the previous banks.

For example, a message begun in Bank C will, if longer than 1K characters, flow into Bank D, then Bank E, and so on. However, it cannot flow downward into Bank B or Bank A. Because each of these lower banks has 1K reserved, the message starting in Bank C can be a maximum of 14K characters.

The first character displayed on line two in the Memory Set submenu indicates the status of that memory bank. If this character is an open square bracket "[" (the "beginning-of-message" indicator), the displayed bank is the beginning of the message; otherwise, it is a portion of the previous memory bank. Message playback will always start at the beginning of a message no matter which bank of the message you have selected in the Set menu.

Bank P can be configured either as a regular memory bank or as a Keyer Memory in which text you send with the paddles is stored. If Bank P is configured as Keyer Memory, it is not available for messages; thus, the total message memory then available is 15K.

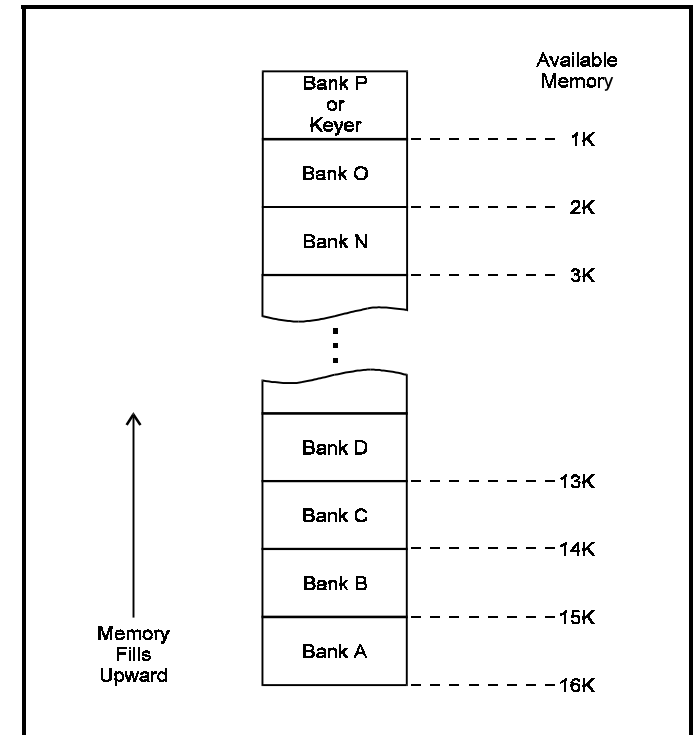


Figure 2. MFJ-414 Memory Bank Structure.

Preparing Messages:

To prepare messages, use an ASCII text editor on your computer. Valid characters for messages include all those listed in the chart on page 30, the space, tab and carriage return. In addition, there are special characters, shown in the table below. Braces "{}" are used to enclose comments, preferably at the beginning of a message, that will appear when viewing the Set menu but will be ignored during playback. Any invalid characters in a message will be ignored by the unit when the file is downloaded.

Special Characters

Character	Represents
Square Brackets ([])	Delimiters for messages in memory bank.
Angle Brackets (< >)	Delimiters for custom prosigns.

Braces ({ })	Delimiters for comments.
Backslash Character (\)	Embedded command.
Pipe Character ()	Embedded Call command.

You may control the unit's features during message playback by using embedded commands. These embedded commands can set sending speed, audio tone, and Farnsworth values, as well as provide great flexibility by allowing functions such as message looping and one message calling another. Embedded commands begin with a backslash "\" and must not contain spaces. Upper or lowercase letters may be used; embedded commands are not case-sensitive.

When a parameter such as Overall Speed or Tone is specified by an embedded command, the parameter will remain set during playback of that message. When playback of that message is completed or stopped, the value of the parameter will revert to the value set prior to the message playback.

The embedded commands are:

- \C# Call—call the message in memory bank #, where # is a single letter in the range of A to P. This allows one message to be called from another. When playback of the called message is finished, playback continues with the rest of the calling message. This command has a 15 level deep stack; that is, a message can call another message, this message then calls another message which in turn calls another message and so on up to 15 times. One message must not call itself or any of its calling messages; otherwise, the stack will overflow. An equivalent short-hand command is to precede # by the pipe character "|" such as "|#".
- \D Disable—disables on-the-fly speed changing during playback of the file. This is used to prevent inadvertent speed changes if, for example, the unit is being used to play exam text during a VE session.
- \F## Farnsworth—sets the current Farnsworth speed to ## WPM, where ## represents two digits in the range of 10 to 60. Setting ## to 00 disables the Farnsworth mode (two zeros must be used here).
- \F+# Farnsworth Up—increases the Farnsworth speed by # WPM, where # is a single digit in the range of 0 to 9. Increasing (wraparound) to 00 or less than or equal to the overall speed will disable the Farnsworth mode.
- \F-# Farnsworth Down—decreases the Farnsworth speed by # WPM, where # is a single digit in the range of 0 to 9. Decreasing to 00 or less than or equal to the overall speed will disable the Farnsworth mode.

- \G#** Goto—go to the message in memory bank #, where # is a single letter in the range of A to P. This allows you to continue your message into another memory bank. This command can be used to create loop of multiple messages. Note that any character after "\G#" will not be sent.
- \L** Loop—creates a loop of the *current* message. Note that any character after "\L" will not be sent. For example: BEACON AA5CS 5 W \L.
- \P##** Pause—inserts a timed pause of ## seconds into the message, where ## represents two digits in the range of 00 to 99. When setting pauses under 10 seconds, leading zero must be used. Pauses greater than 99 seconds are obtained by using consecutive commands that total the desired value. For example: TIMEOUT 1 SEC \P01 TIMEOUT 1 MIN \P60 TIMEOUT 1 MIN 39 SEC \P99 TIMEOUT 2 MIN \P60\P60.
- \R** Repeat—repeats playback from the beginning. Note that any character after "\R" will not be sent.
- \S##** Speed—sets the current overall speed to ## WPM, where ## represents two digits in the range of 03 to 60. When setting speeds under 10 WPM, leading zero must be used.
- \S+#** Speed Up—increases the overall speed by # WPM, where # is a single digit in the range of 0 to 9.
- \S-#** Speed Down—decreases the overall speed by # WPM, where # is a single digit in the range of 0 to 9.
- \T##** Tone—sets the current sidetone frequency to approximately ##0 Hz, where ## represents two digits in the range of 30 to 99. Note that this command sets the sidetone to one of the 24 available frequencies (see table below).

Embedded Tone Command "\T##"

##	Tone Freq.	##	Tone Freq.	##	Tone Freq.
30, 31, 32	305 Hz	54, 55, 56	549 Hz	78, 79, 80	793 Hz
33, 34, 35	335 Hz	57, 58, 59	579 Hz	81, 82, 83	823 Hz
36, 37, 38	366 Hz	60, 61, 62	610 Hz	84, 85, 86	854 Hz
39, 40, 41	396 Hz	63, 64, 65	640 Hz	87, 88, 89	884 Hz
42, 43, 44	427 Hz	66, 67, 68	671 Hz	90, 91, 92	915 Hz
45, 46, 47	457 Hz	69, 70, 71	701 Hz	93, 94, 95	945 Hz
48, 49, 50	488 Hz	72, 73, 74	732 Hz	96, 97, 98	976 Hz
51, 52, 53	518 Hz	75, 76, 77	762 Hz	99	1006 Hz

- \T+#** Tone Up—increases the sidetone frequency by # available frequency, where # is a single digit in the range of 0 to 9.

\T-# Tone Down—decreases the sidetone frequency by # available frequency, where # is a single digit in the range of 0 to 9.

Uploading and Downloading messages:

To send messages either from your computer to the MFJ-414 or from the unit to your computer, you use a terminal program on the computer that is capable of transferring ASCII data. Configure the terminal software for 1200 baud, 8 data bits, no parity and one stop bit. To perform the transfer, you prepare either the computer or the Tutor to receive the file, then send from the other.

Loading a Memory Bank From the Computer

- Go to the Set menu and enter its submenus by pressing Select.
- Choose the memory bank you wish to load.
- Press the Select button and hold it for one second. The word "TRANSFER" will appear on the display.
- Press the Previous button. The word "RECEIVING" will appear. The unit now is ready to receive data from your computer. To stop the process, press Select.
- Begin sending the data from the computer. To stop loading data at any time, press Select.
- When the message transfer is completed, press Select. If the unit runs out of memory, the transfer will be stopped automatically.
- The MFJ-414 automatically inserts an open square bracket "[" at the beginning of every message. This is its "beginning-of-message" indicator. When you press Select to end a transfer, the unit inserts a close square bracket "]" as its "end-of-message" indicator. If you insert a "]" at the end of your message file, the MFJ-414 will stop the transfer automatically when the bracket is received.
- Once the transfer is complete, the unit will check the message for errors. These errors include illegal commands, invalid custom prosigns or a completely empty message. An empty message can consist of only spaces, tabs and carriage returns, but no other characters. If the message is empty, the word "EMPTY" will appear on the display. If there is another error, the second line of the display will indicate the type of error by showing "ERROR #". The last character displayed on first line will be the cause of the error. See the listing on page 29 for an explanation of the error.
- If there is no error, the unit will display a five-digit number indicating the number of characters received. This number includes the opening and ending message delimiters "[" and "]", plus tabs and carriage returns.
- Press Select to return to normal operation.

One way of speeding data transfer is to configure your terminal program to strip out linefeeds that follow carriage returns. While computers store a carriage return as two characters—the carriage return followed by a linefeed—the MFJ-414 stores only the carriage return, then generates the

linefeed following it during playback. The additional linefeed thus does not need to be transferred to the Tutor.

Sending Contents of a Memory Bank to the Computer

- Go to the Set menu and enter its submenus by pressing Select.
- Choose the memory bank you wish to send to the computer.
- Configure your terminal program to receive ASCII data.
- Press Select and hold it for one second. "TRANSFER" will appear on the display.
- Press Next to begin sending. "SENDING" will appear on the display.
- A progress indicator will appear on the second line of the display to indicate the percentage of the message that has been sent.
- To stop the transfer at any time, press Select.
- Return to normal operation when the transfer is completed.

Interactive Menu

The Interactive function allows you to have the unit send one or more words, groups of characters or QSOs, then pause. With the Interactive function turned on, the unit will halt ("HALT" appears) after sending one or more (your choice) words, code groups or QSOs; and wait for you to press the Next or Select button before sending the next word(s), group(s) or QSO(s). To repeat the previous word(s), group(s) or QSO(s), press the Previous button.

If you want this feature activated, press Select to turn Interactive on, then Next or Previous to choose how many words, groups or QSOs the unit should send before halting. When you have made your selection, press Select again to exit this menu. To turn the Interactive function off, press Previous to reduce (or Next to increase) the number of words, groups or QSOs. When you reduce the number below 1 (or increase above 100), Interactive is turned off.

Note: The Interactive menu is not available when you have selected a Memory set.

Important: The word "HALT" must appear on the display *before* pressing either the Previous or Next button *once-and-only-once* to send another set of word(s), group(s) or QSO(s); otherwise, the overall speed will unintentionally be changed on-the-fly (if it's enabled).

New Play Menu

Pressing the Select button when "NEW PLAY" is displayed will begin a new practice session. From the set you have selected, the unit will send random practice. All current settings, such as speed, tone, etc., will be in effect for your practice session. To pause sending, press Select and "PAUSE" will appear. To resume sending, press any button. To stop the session, press and hold Select for one second ("STOP" will appear).

Repeat Play Menu

Pressing the Select button when "REPEAT PLAY" is displayed will repeat the previous practice session. To pause the session, press Select. To stop the session, press and hold Select for one second. During playback, the text sent is displayed on the LCD and sent to the serial port in addition to the audio. The length of a session that can be repeated is unlimited. Repeating a session allows you to recopy the same code to check your accuracy, perhaps at a slower speed and/or with interactive mode enabled.

Print Play Menu

Pressing the Select button when "PRINT PLAY" is displayed will, like "REPEAT PLAY," repeat the previous session, but also send it to the printer port. The printer must be on-line before starting this function; otherwise you will see an error message and be prompted to retry (after placing the printer on-line) or abort the session. The printing function is useful for checking the accuracy of your copying or for grading examinations in a VE session.

Note: During New, Repeat or Print Play, while the unit is sending, the speed may be changed during the sending by pressing Next to increase or Previous to decrease the speed. This feature is called on-the-fly speed changing. By pressing Next or Previous once quickly, you change the speed by 1 wpm. If you hold the button down, the speed continues to change. After the fifth change, the rate of the speed change will increase. During on-the-fly speed changes, two numbers will appear on the second line of the display. The first is the overall speed and the second is the Farnsworth speed (00 if Farnsworth is disabled). If you bring the overall speed up to the Farnsworth speed, that will turn the Farnsworth function off. Speed changes take effect after the button is released and the element in progress is completed. If you do not want the on-the-fly feature in effect during your sessions, you may turn it off from within the Setup menu.

If "EMPTY" appears during playback of a memory bank, it means the memory bank is empty or consists of only spaces, tabs, and/or carriage returns. If "ERROR12" appears, the stack is overflow. In either case, press the Select button to resume with normal operation.

Hint: A short-cut to the *last-used* Play menu is by pressing and holding the Select button for one second from any *main menu* (no blinking block character).

The Front and Back Panels

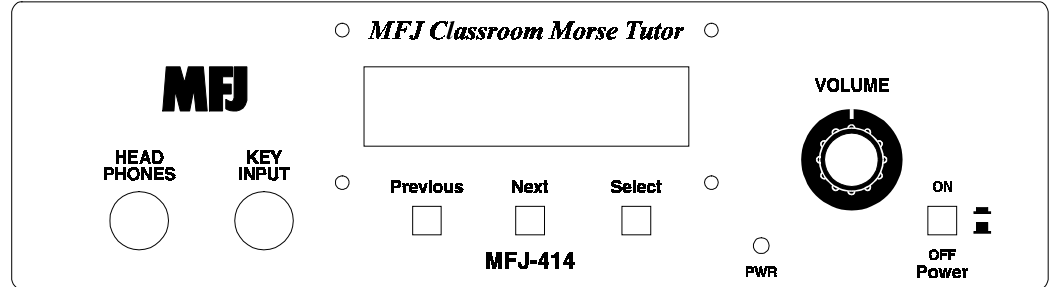


Figure 3. MFJ-414 Front Panel.

- **LCD display:** A 2-line by 16-character alphanumeric display.
- **Head Phones jack:** A 1/4-inch stereo phono jack. This jack accepts both stereo and mono plugs. When headphones are used, both the internal and external speakers are disabled.

WARNING: To prevent suffering hearing damage when using headphones, turn the Volume control to minimum before putting on the headphones, then slowly adjust for a comfortable volume.

The audio level to this jack is attenuated to provide a comfortable volume. If you cannot obtain sufficient audio through this jack, you may increase the level by using jumpers JMP2 and JMP3, which are located next to the jack inside the unit. To raise the audio level for mono headphones, put a 470 ohms or smaller resistor on JMP2. For stereo headphones, put another 470 ohms or smaller resistor on JMP3.

WARNING: Do not short jumper JMP3 when using a mono phono plug, or damage to the unit will result.

- **Key Input jack:** A 1/4-inch stereo phono jack. When used with paddles, the dot lever should be connected to the tip of the plug, the dash wire to the ring, and the ground wire to the shield.
- **Previous button:** Press to display the previous menu or setting.
- **Next button:** Press to display the next menu or setting.
- **Select button:** Press to select the current menu or setting.
- **PWR LED:** Indicates power to the unit is on.
- **Volume control:** Controls the audio volume to the speakers and headphones.
- **Power button:** Press to turn power on; press again to turn power off.

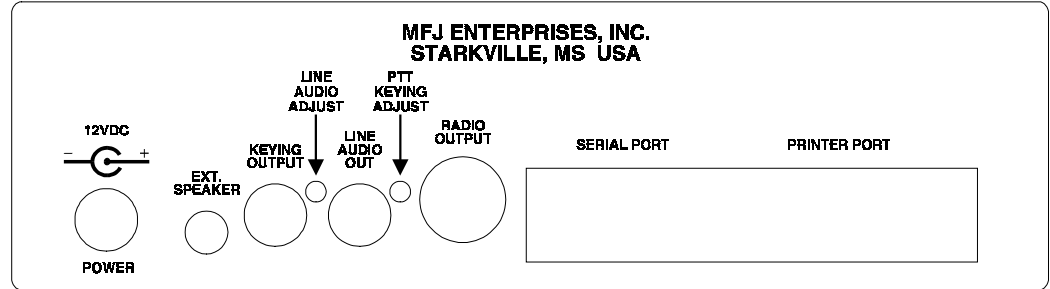


Figure 4. MFJ-414 Back Panel.

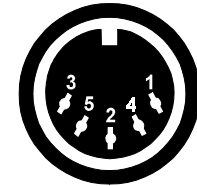
- **Power:** A 2.1 mm coaxial jack. A 2.1 mm coaxial plug with positive center and negative sleeve should be used. This unit requires 12 volts DC. An optional power supply, the MFJ-1315, is available from MFJ Enterprises, Inc. This unit requires a minimum of 50 mA and a maximum of 300 mA at maximum volume into an 8-ohm audio load.

WARNING: Do not apply voltages greater than 18 volts to this unit, or permanent damage to the unit may result.

- **Ext. Speaker:** A 3.5 mm jack that accepts both stereo and mono plugs. This jack is volume controlled and can deliver a maximum of approximately 1.2 watts into an 8-ohm load using the MFJ-1315 power supply. Use of external speaker will disable the internal speaker. An optional external speaker, the MFJ-281, is available from MFJ Enterprises, Inc.
- **Keying Output:** An RCA phono jack for keying of solid-state transmitters only (direct keying). Use a quality shielded cable for connection to this jack. Consult your transmitter's manual to determine if it uses direct (positive) keying. If it does not, the transmitter will either not key at all or key continuously.
- **Line Audio Adjust:** This is a trimpot that adjusts the level of audio supplied to the Line Audio Out jack and to the audio line of the Radio Output jack. At midrange, the level provided is about 2 volts peak-to-peak into a 600-ohm impedance or higher load. The pot is adjusted with a small, flathead screwdriver.
- **Line Audio Out:** An RCA phono jack supplying audio for audio amplifiers or tape recorders. Use a quality shielded cable for connecting to this jack. The line audio level is independent of the front-panel Volume control.
- **PTT Keying Adjust:** This is a small trimpot that adjusts the Push-to-Talk (PTT) line to the Radio Output jack. Use a small, flathead screwdriver to adjust this pot. This pot should be adjusted so that the radio goes into transmit mode when the MFJ-414 is sending and returns to receive mode when it is not.

- **Radio Output:** A standard 5-pin DIN jack providing connections for a PTT line and audio for sending Morse code through FM, AM or SSB radios. Use a quality shielded cable for connecting to this jack. MFJ offers optional pre-wired cables for most major brands of radios. See the chart on page 30 for model numbers. If you wish to make your own cable, consult the chart and diagram below.

Pin	Radio Output Function
1	Transmit Audio
2	Ground
3	PTT
4	No Connection
5	No Connection



- **Serial Port:** A standard 9-pin serial port for connecting the MFJ-414 to a computer for ASCII file transfers or monitoring your code practice sessions on the computer screen. A 9-pin-to-9-pin serial cable is provided with the unit. If your computer has a 25-pin serial port, use a 9-pin-to-25-pin adapter.

To communicate with the MFJ-414, use a terminal program on your computer that is capable of transferring information in ASCII format. Configure the software for 1200 baud, 8 data bits, no parity and one stop bit.

- **Printer Port:** A 25-pin printer port for use with any Epson-compatible printer. When using this feature, turn the printer on and have paper in the printer before starting the Print Play session.

Appendices

Factory Defaults

The unit is shipped with the following default settings:

- OVERALL SPEED = 13 WPM
- FARNSWORTH OFF
- TONE = 701 Hz
- SET [ADVANCED] FCC CHAR
- COMBINE OFF
- GROUP = 5-CHAR
- INTERACTIVE OFF
- NEW PLAY
- ON-THE-FLY SPEED ON
- PLAY FORMAT DISPLAY → AUDIO
- SEMI-AUTO OFF
- IAMBIC A
- REVERSE OFF
- KEYSER MEMORY OFF
- WRITE PROTECTION OFF
- PTT HANG TIME = 1.00 SECOND

To reset the MFJ-414 to these defaults, first turn off power to the unit, then press and hold *both* the Next and Select buttons while turning power on. When "DEFAULTS RESET" appears on the display, release the buttons to resume operation.

Self Test

A self-test routine will check the functions of the MFJ-414. This routine checks the display, the ports, the front-panel buttons, the paddles, the internal memory and the audio circuitry. During the self-test, you may stop the test by turning off the unit; however, this should NOT be done during the memory test or the memory could be corrupted. The self-test can be completed in approximately 30 seconds.

Connections of the serial and printer ports are not necessary for this test. If testing of the printer port is desired, make sure the printer is connected, on-line and has paper.

Note: *Performing the self-test will reset the unit to its factory default settings.*

Here is the self-test procedure:

1. Turn off the power to the Tutor.
2. Press and hold *only* the Select button while turning the power on.
3. The test begins by displaying a copyright message. This is the test of the display. This message is also sent to the serial and printer ports. Release the Select button before the message completes.
4. You will be prompted to press each of the front-panel buttons.
5. You will be prompted to press the dot and dash paddles. This assumes the dot paddle is connected to the tip of the plug and the dash paddle to the ring of the plug.
6. The unit then tests its non-volatile memory. Notice this step will reset the unit to its factory default settings.
7. If the unit is okay, a repetitive message "PASS" will be displayed and sent as audio. If there is a problem, a failure message will be displayed and sent.
8. Once you have confirmed that the audio is okay, turn the unit off.

Failure Message Meanings:

- DASH FAIL Dash paddle (ring of the plug) is shorted or improperly connected.
- DOT FAIL Dot paddle (tip of the plug) is shorted or improperly connected.
- EEPROM# FAIL Non-volatile memory circuitry is improperly connected.
- MEMORY FAIL Non-volatile memory is bad.
- NEXT FAIL Next button is shorted or improperly connected.
- PREVIOUS FAIL Previous button is shorted or improperly connected.
- SELECT FAIL Select button is shorted or improperly connected.

Troubleshooting

Q. Why does the overall speed change after playing a session?

- A. When playing with the Interactive mode enabled, the overall speed might have accidentally changed on-the-fly when either the Previous or the Next button is pressed before "HALT" appears. If so, the on-the-fly speed feature can be disabled in the Setup mode.

Q. Why can't I change the speed on-the-fly?

- A. This feature is disabled, go to the Setup mode and enable it. If playing a memory bank, this feature is probably disabled by the embedded Disable command.

Q. Why can't I enable the Farnsworth mode?

- A. The overall speed is at its maximum of 60 WPM.

Q. Why do I get extra linefeeds when uploading to the computer?

- A. Configure your terminal program to strip the linefeeds from the carriage returns.

Q. "PRINTER FAULT" appears on the display when I start Print Play.

- A. It indicates the printer is not switched on, the printer is not in the on-line status, the printer is out of paper, or the printer cable is not properly connected.

Q. "EMPTY" appears on the display when I start playback.

- A. It means the memory bank you selected for practice is empty or consists of only spaces, tab, and/or carriage returns.

Error Messages

The following error messages are produced immediately after loading a memory bank if there is any error, except the last one which appears during playback.

- ERROR1 Double "<"**
 Prosign did not terminate with a matching close angle bracket. For example, "<PROSIGN<".
- ERROR2 Leading ">"**
 Prosign began with a close angle bracket. For example, ">PROSIGN>".
- ERROR3 Invalid character within "<" and ">"**
 Invalid character (space, tab, carriage return, backslash character, or pipe character) or no character encountered within custom prosign. For examples, "<PRO|SIGN>", "<PRO\SIGN>", "<PRO SIGN>", and "<>".
- ERROR4 Unmatched "<"**
 An open angle bracket did not have a matching close angle bracket. For example, "<PROSIGN".
- ERROR5 Unmatched "{"**
 An open brace did not have a matching close brace. For example, "{COMMENT".
- ERROR6 Illegal memory bank designator**
 An illegal character in a memory bank designator. For examples, "\CW" and "|Z". Valid characters for memory bank designators are "A..P, a..p".
- ERROR7 Illegal embedded Speed command**
 An illegal value for the Speed setting. For examples, "\S99", "\S+A", and "\S-B". Valid range for speed is 03 to 60; valid range for relative setting is 0 to 9.
- ERROR8 Illegal embedded Farnsworth command**
 An illegal value for the Farnsworth setting. For examples, "\F90" and "\F+A". Valid range for Farnsworth is 10 to 60 and 00 to disable Farnsworth mode; valid range for relative setting is 0 to 9.
- ERROR9 Illegal embedded Tone command**
 An illegal value for the Tone setting. For examples, "\T20", "\T+A", and "\T-B". Valid range for tone is 30 to 99; valid range for relative setting is 0 to 9.
- ERROR10 Illegal embedded Pause command**
 An illegal value for the Pause setting. For example, "\P+4". Valid range for pause is 00 to 99.
- ERROR11 Illegal embedded command**
 An illegal character in an embedded command. For example, "\Z". Valid characters for embedded commands are "C", "D", "F", "G", "L", "P", "R", "S", "T", "c", "d", "f", "g", "l", "p", "r", "s" and "t".
- ERROR12 Stack overflow**
 The 15 level deep stack used by the embedded Call command is overflow during playback. For example, memory bank A has "|B" and memory bank B has "|A".

MFJ Pre-wired Cables and Open End Cables

The following MFJ radio-to-TNC cables are pre-wired for most 8-pin rigs and HTs. The open end cables allow you to make your own cables. For your nearest dealer or to order call toll free 800-647-1800.

Pre-wired Radio-to-Tutor Cables

Radio	MFJ Part #	Price*
Alinco ¹ /Standard HTs	MFJ-5022	\$14.95
Icom ² /Yaesu/Radio Shack HTs	MFJ-5024	\$14.95
Kenwood ³ HTs	MFJ-5026	\$14.95
Yaesu 8-pin	MFJ-5080	\$14.95
Yaesu ⁴ 8-pin modular	MFJ-5080M	\$14.95
Icom ⁵ 8-pin	MFJ-5084	\$14.95
Icom ⁶ 8-pin modular	MFJ-5084M	\$14.95
Kenwood/Alinco 8-pin	MFJ-5086	\$14.95
Kenwood 8-pin modular	MFJ-5086M	\$14.95
Radio Shack 8-pin modular	MFJ-5088M	\$14.95
MFJ-8621 Data Radio 5-pin DIN	MFJ-5100	\$14.95

Note 1: Does not include DJ-100, 120T, 200, 500.

Note 2: Does not include IC-W2A.

Note 3: Does not include 2500.

Note 4: Does not include FT-50, FT-8000.

Note 5: Does not include 25A, 255A.

Note 6: Does not include IC-100H, IC-2700H.

Open End Cables With Radio Connectors

Open End Cable ...	MFJ Part #	Price*
... with 8-pin mic connector	MFJ-5082	\$9.95
... with 5-pin DIN connector (general purpose)	MFJ-5205	\$4.95
... with split connectors for Alinco & other hand-helds	MFJ-5222	\$9.95
... for Icom/Yaesu/Alinco/Radio Shack hand-helds	MFJ-5224	\$9.95
... for Kenwood hand-helds	MFJ-5226	\$9.95
... with 8-pin modular mic plug for Yaesu, Kenwood, Icom, and Radio Shack	MFJ-5268	\$9.95

* Prices and specifications subject to change without notice.

Morse Code Character Set¹

A	di-dah	•—	N	dah-dit	—•
B	dah-di-di-dit	—•••	O	dah-dah-dah	——
C	dah-di-dah-dit	—•—•	P	di-dah-dah-dit	•—••
D	dah-di-dit	—••	Q	dah-dah-di-dah	—•—•
E	dit	•	R	di-dah-dit	•—•
F	di-di-dah-dit	••—•	S	di-di-dit	•••
G	dah-dah-dit	——•	T	dah	—
H	di-di-di-dit	••••	U	di-di-dah	••—
I	di-dit	••	V	di-di-di-dah	•••—
J	di-dah-dah-dah	•——	W	di-dah-dah	•—
K	dah-di-dah	—•—	X	dah-di-di-dah	—••—
L	di-dah-di-dit	•—••	Y	dah-di-dah-dah	—•——
M	dah-dah	——	Z	dah-dah-di-dit	——••
1	di-dah-dah-dah-dah	•———	6	dah-di-di-di-dit	—••••
2	di-di-dah-dah-dah	••——	7	dah-dah-di-di-dit	——•••
3	di-di-di-dah-dah	•••—	8	dah-dah-dah-di-dit	——•••
4	di-di-di-di-dah	••••—	9	dah-dah-dah-dah-dit	——••••
5	di-di-di-di-dit	•••••	0	dah-dah-dah-dah-dah	———•••
Period	[.]	di-dah-di-dah-di-dah	••—•—	AAA	
Comma	[,]	dah-dah-di-di-dah-dah	——••—	MIM	
Question Mark or Request for Repetition	[?]	di-di-dah-dah-di-dit	••——••	IMI	
Fraction Bar	[/]	dah-di-di-dah-dit	—•••	DN	
End of Message or Cross	[+]	di-dah-di-dah-dit	•—••	AR	
End of Work	[*]	di-di-di-dah-di-dah	•••—•	SK	
Double Dash, Pause or Break	[=]	dah-di-di-di-dah	—•••—	BT	
Semicolon	[;]	dah-di-dah-di-dah-dit	—•—••	KR	
Colon	[:]	dah-dah-dah-di-di-dit	——•••	OS	
Apostrophe	[']	di-dah-dah-dah-dah-dit	•———•	WG	
Quotation Mark	["]	di-dah-di-di-dah-dit	•—•••	AF	
Hyphen or Dash	[-]	dah-di-di-di-di-dah	—••••	DU	
Underline	[_]	di-di-dah-dah-di-dah	••—•—	IQ	
Dollar Sign	[\$]	di-di-di-dah-di-di-dah	•••—••	SX	
Left Parenthesis	[(]	dah-di-dah-dah-dit	—•—•	KN	
Right Parenthesis	[)]	dah-di-dah-dah-di-dah	—•—•—	KK	
Wait	[&]	di-dah-di-di-dit	•—•••	AS	
Understood	[!]	di-di-di-dah-dit	•••—•	SN	
Starting Signal	[%]	dah-di-dah-di-dah	—•—•—	KA	
Error	[@]	di-di-di-di-di-di-di-dit	•••••••	HH	
Paragraph	[#]	di-dah-di-dah-di-dit	•—•••	AL	
Invitation to Transmit	[^]	dah-di-dah	—•—	K	

1. FCC test requirement consists the 26 letters, the 10 numerals, the period, the comma, the question mark, $\overline{AR}$, $\overline{SK}$, $\overline{BT}$ and $\overline{DN}$.

Some CW Abbreviations

73	Best regards	NR	Number; near
88	Love and kisses	NW	Now
ABT	About	OM	Old man
AGN	Again	OP	Operator
ANT	Antenna	R	Are; received; roger
BK	Back; break	RCVR	Receiver
CPY	Copy	RIG	Station equipment
CQ	Calling any station	RITE	Right
CUL	See you later	RST	Readability, strength, tone report
CU	See you	SIGS	Signals
DE	From	SKED	Schedule
DEG	Degree	STN	Station
DX	Distance; rare station	TEMP	Temperature
ES	And; "&"	TKS	Thanks
FB	Fine business; excellent	TNK	Thank
FER	For	TNX	Thanks
FREQ	Frequency	UR	Your; you're; you are
GA	Good afternoon	U	You
GE	Good evening	WL	Well; will
GM	Good morning	WTS	Watts
GN	Good night	WX	Weather
HR	Hear; here	XCVR	Transceiver
HW	How	XMTR	Transmitter
K	Go ahead	XYL	Wife (ex-young-lady)
MSG	Message	YL	Young lady

Meaning of Q Signals

QRA	The name of my station is
QRL	Do not interfere, Frequency busy
QRM	Being interfered with
QRN	Static
QRO	Increase power, High power
QRP	Decrease power, Low power
QRQ	Send faster
QRR	I am ready for automatic operation
QRS	Send more slowly
QRT	Stop sending
QRU	I have nothing for you
QRX	I will call again at ..., wait
QRZ	Who is calling me, I am
QSB	Your signal is fading
QSD	Your keying is defective
QSK	I can hear you between my signals
QSL	I am acknowledging receipt
QSU	Reply on this frequency or mode
QSX	I am listening to ... on ... kHz
QSY	Change frequency, change to xmit on ... kHz
QTH	My location (home) is
QTR	The correct time is
QTS	I will send so my frequency can be measured
QUB	Here is the info you requested
QUM	The distress traffic has ended

Send a "?" after a Q signal to ask for information or an action.

Example: QRZ: station (call) is QRZ?: what is your station (call)?

Menus System Chart

Main Menus:	OVERALL SPEED	FARNSWORTH	TONE	SET	COMBINE
Sub Menus:	OVERALL SPEED = 3 WPM	FARNSWORTH OFF	TONE = 305 Hz	SET [BEGINNER] EISHTMO	COMBINE OFF
	OVERALL SPEED = 4 WPM	FARNSWORTH ON SPEED = 10 WPM	TONE = 335 Hz	SET [BEGINNER] AWJNDB	COMBINE ON
	OVERALL SPEED = 5 WPM	FARNSWORTH ON SPEED = 11 WPM	TONE = 366 Hz	SET [BEGINNER] UVGZKRPX	
	OVERALL SPEED = 6 WPM	FARNSWORTH ON SPEED = 12 WPM	TONE = 396 Hz	SET [BEGINNER] FCLQY	
	OVERALL SPEED = 7 WPM	FARNSWORTH ON SPEED = 13 WPM	TONE = 427 Hz	SET [BEGINNER] 12345	
	...	FARNSWORTH ON SPEED = 14 WPM	TONE = 457 Hz	SET [BEGINNER] 67890	
	OVERALL SPEED = 60 WPM	...	TONE = 488 Hz	SET [BEGINNER] . . ? / + * =	
		FARNSWORTH ON SPEED = 60 WPM	...	SET [BEGINNER] : : ' " - \$	
			TONE = 1006 Hz	SET [BEGINNER] () & ! % @ # ^	
				SET [ADVANCED] LETTERS	
				SET [ADVANCED] NUMBERS	
				SET [ADVANCED] PROSIGNS	
				SET [ADVANCED] LETTERS+NUMBERS	
				SET [ADVANCED] LETTERS+PROSIGNS	
				SET [ADVANCED] NUMBERS+PROSIGNS	
				SET [ADVANCED] FCC CHAR	
				SET [ADVANCED] ALL CHAR	
				SET [ADVANCED] CALLSIGNS	
				SET [ADVANCED] WORDS	
				SET [ADVANCED] QSOS	
				SET [CST CHR1] MORSE-CODE-TUTOR	
				SET [CST CHR2] CUSTOM	
				SET [CST CHR3] CHARACTERS	
				SET [CST WORD] MFJ	
				SET [BANK A] []	
				...	
				SET [BANK P] []	SET [KEYER] []
Word Menu:	SET [WORD 1] MFJ				
	SET [WORD 2] MORSE				
	SET [WORD 3] CODE				
	SET [WORD 4] TUTOR				
	SET [WORD 5] COPYRIGHT				
	SET [WORD 6] (C)				
	SET [WORD 7] MFJ				
	SET [WORD 8] ENTERPRISES				
	SET [WORD 9] INC.				
	SET [WORD 10] 1997				
Setup Options:	ON-THE-FLY SPEED	PLAY FORMAT	SEMI-AUTO	IAMBIC	REVERSE
	ON-THE-FLY SPEED ON	PLAY FORMAT DISPLAY → AUDIO	SEMI-AUTO OFF	IAMBIC A	REVERSE OFF Press dit paddle

ON-THE-FLY SPEED OFF	PLAY FORMAT AUDIO → DISPLAY	SEMI-AUTO ON	IAMBIC B	REVERSE ON Press dit paddle
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GROUP	INTERACTIVE	NEW PLAY	REPEAT PLAY	PRINT PLAY	KEYER
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GROUP = RANDOM	INTERACTIVE OFF
GROUP = 1-CHAR	INTERACTIVE ON EVERY 1 WORD
GROUP = 2-CHAR	INTERACTIVE ON EVERY 2 WORDS
GROUP = 3-CHAR	INTERACTIVE ON EVERY 3 WORDS
GROUP = 4-CHAR	INTERACTIVE ON EVERY 4 WORDS
GROUP = 5-CHAR	INTERACTIVE ON EVERY 5 WORDS
GROUP = 6-CHAR	...
GROUP = 7-CHAR	INTERACTIVE ON EVERY 100 WORDS
GROUP = 8-CHAR	

KEYER OFF
KEYER ON



AUTO	A	STD
[03]	0305	0.10
SEMI	B	REV
[60]	1006	5.00

or

INTERACTIVE OFF
INTERACTIVE ON EVERY 1 QSO
INTERACTIVE ON EVERY 2 QSOS
INTERACTIVE ON EVERY 3 QSOS
INTERACTIVE ON EVERY 4 QSOS
INTERACTIVE ON EVERY 5 QSOS
...
INTERACTIVE ON EVERY 100 QSOS

KEYER MEMORY	WRITE PROTECTION
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KEYER MEMORY OFF	WRITE PROTECTION OFF
KEYER MEMORY ON	WRITE PROTECTION ON

Schematic

Memory Banks Chart

Bank	Content	Comment
A		
B		
C		
D		
E		
F		
G		
H		
I		
J		
K		
L		
M		
N		
O		
P		

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; or by email to techinfo@mfjenterprises.com. Please include a complete description of the problem, an explanation of exactly how you are using the unit when the problem arises, and a complete description of any equipment you are using with this unit, such as a computer (including applicable software), printer, or radio.