

MultiMode

MultiMode Version 3.9.6 October 22, 2001

Introduction

MultiMode allows you to decode (and transmit!) many digital and other specialized radio communications modes on your Mac. Best of all, MultiMode is distributed as shareware! This means that you're free to test and evaluate MultiMode prior to registering (paying for) it. Please read the chapter on Registering to discover how you can register your copy, and help support software for the Macintosh.

This documentation describes both MultiMode and MultiMode Lite. The lite version is identical, except that it is receive only, and only supports CW, RTTY, ASCII, SITOR A/B, FAX, and FFT modes.

If you're an existing MultiMode user, please be sure to check the Release History at the end of this documentation, to see what changes have been made since your last version.

Information on transmitting is scattered throughout this document, in the relevant mode sections.

Please note that effective with version 3.0.0, MultiMode only runs on PPC Macintosh systems. 68K Macs don't have the processing power necessary.

I've done all testing on a G4, iBook, and an iMac DV. I'm anxious to hear how MultiMode performs on other machines.

Why did I write it? I've always been frustrated with the lack of decent ham/radio software for the Mac. Why should the wintel boys have all the fun? I've written several other Mac radio related programs in the past (check my web page for details), and have often had requests for a CW/RTTY/FAX/SSTV/etc. decoder for the Mac.

Please read through the chapter on registration, to learn how you can register your copy of MultiMode, and help support ham radio software for the Macintosh.

73's
Chris Smolinski, N3JLY
Black Cat Systems
multimode@blackcatsystems.com

Requirements

Computer

Macintosh computer with G3 or G4 processor. Some 604 and 603 systems may be able to run some modes of operation. Ancient 68K systems are not supported.

Sound input is required. If you have a Macintosh model without sound input, such as an iBook or Cube, a USB sound input device (such as the Griffin iMic) may be used.

If you wish to control the PTT (Push To Talk) line of a transmitter, a serial port and appropriate interface hardware (such as the RigBlaster) is required.

Operating System

MacOS 8.6 to 9.1. Some earlier versions of MacOS 8 may be able to run MultiMode. Classic mode under Max OSX does **not** work, because Apple has disabled sound input.

Radio

For receive only, a shortwave radio or scanner may be used, depending on which modes of operation you wish to listen to. Weather fax requires an HF (shortwave) radio with single sideband capability, while ACARS mode requires a VHF radio (scanner) with AM aircraft band (118-136 MHz) capability.

For transmitting, an appropriate amateur transmitter is required.

Connecting Your Radio

Connecting your radio to your Mac

Note: While connecting your Mac to your radio is generally quite simple, some tips: We find that it is best to get receive mode working before diving into transmit mode, and trying to control the Push To Talk (PTT) line of your rig.

If you only want to receive transmissions, you simply need to connect the audio output of your radio to your Mac's audio input (this is the jack on the back, usually with a little microphone icon). A standard 1/8" phono plug will work fine. Monophonic is fine. You can pick up a patch cable from stores like Radio Shack, or indeed most general purpose stores like WalMart or KMart. Get a cable with the correct plug to fit into your radio.

You may wish to place an isolation transformer in the cable, to reduce hum caused by ground loops.

Some Macintosh models require you to select your sound input source, usually from the Sound control panel.

If you have a Mac without sound input, such as an iBook, you can use a USB microphone. We've successfully used the units manufactured by Telex and Griffin.

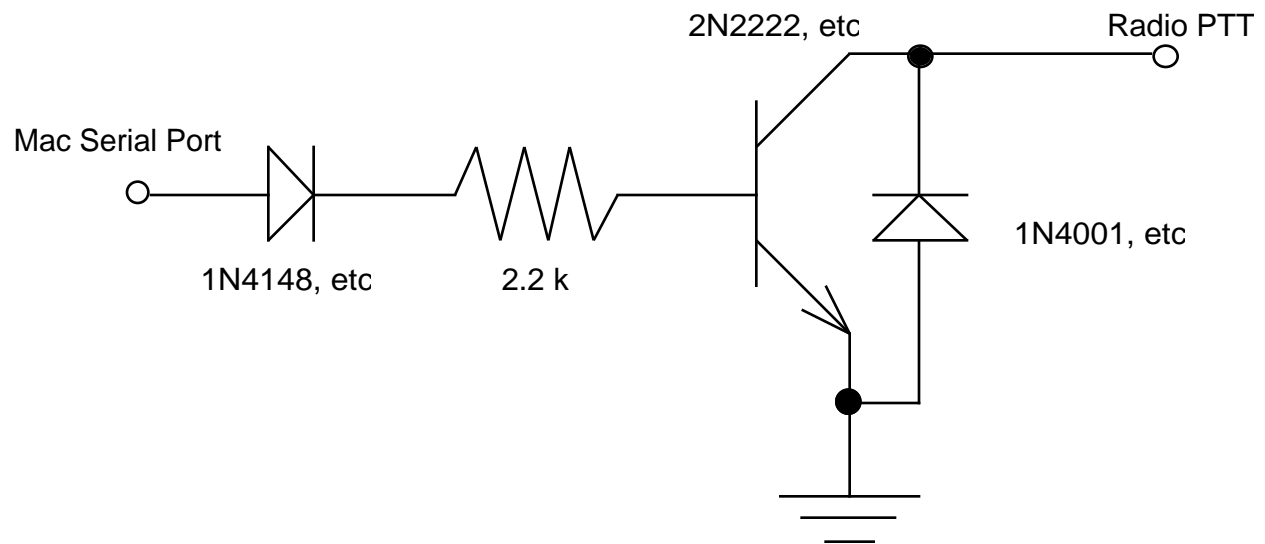
Also, you probably want to tap the audio from your radio's headphone or external speaker jack, rather than a line level or "Record" output, which may be too low in amplitude. You'll need to experiment. There are too many possible combinations and Mac models for me to give you a definitive answer for your particular setup.

If you also want to transmit, you'll need to connect the audio output (speaker) jack of your Mac to your radio's microphone input jack. You may need to reduce the audio amplitude using a potentiometer, or attenuating audio cable. Many have successfully used the RigBlaster, made by West Mountain Radio (<http://www.westmountainradio.com/>).

For transmitting, you may want to be able to control your radio's PTT (Push To Talk) line. A PTT output is generated from the DTR output of the Mac's serial port. A CW key output is generated from the Transmit Data output. You need to select which port to use (if any) from the Preferences. After selecting the port, re-start MultiMode to make the change effective.

If you have a newer Mac without a serial port (such as an iMac or iBook), you can use a USB to serial converter. We have tested MultiMode with the Keyspan Twin Serial Adapter, and found it to work. Other adapters may also work.

The following schematic shows one way to connect a radio. Please note that dangerous voltages may be present in your radio. It is up to you, the user, to determine how to safely connect to your radio, and prevent any damage to your computer (or yourself!) This type of circuit could also be used in CW mode to key a transmitter.



How the circuit works:

When the serial port output goes positive, it biases the transistor, so the collector can sink current. The 1N4148 diode protects the transistor when the serial port output is negative. The 1N4001 protects the transistor against flyback from a relay that might be lurking in the radio. A faster diode would probably offer additional protection.

The connection on the Mac end would go to the DTR output line. If you'd like to use a similar circuit for CW key control, then it would go to the TxD+ line (or TxD- if you need to invert the logic of the output).

Another (perhaps better) way would be to use an opto-isolator.

As a test, select the serial port connected to your external modem. In CW mode, if you type keys, the morse code characters are transmitted out the serial port, causing the TD (or equivalent) light on your modem to flash. Likewise, if you go into transmit mode in RTTY, SSTV, etc modes, the DTR light on the modem will turn on.

Mac serial port pinout

- 1 HSKo Handshake (DTR) output.
- 2 HSKi Handshake (CTS) input or external clock.
- 3 TxD- Transmit data (inverted).
- 4 GND Signal ground.
- 5 RxD- Receive data (inverted).

6 TxD+ Transmit data.

7 GPi General-purpose (DCD) input.

8 RxD+ Receive data.

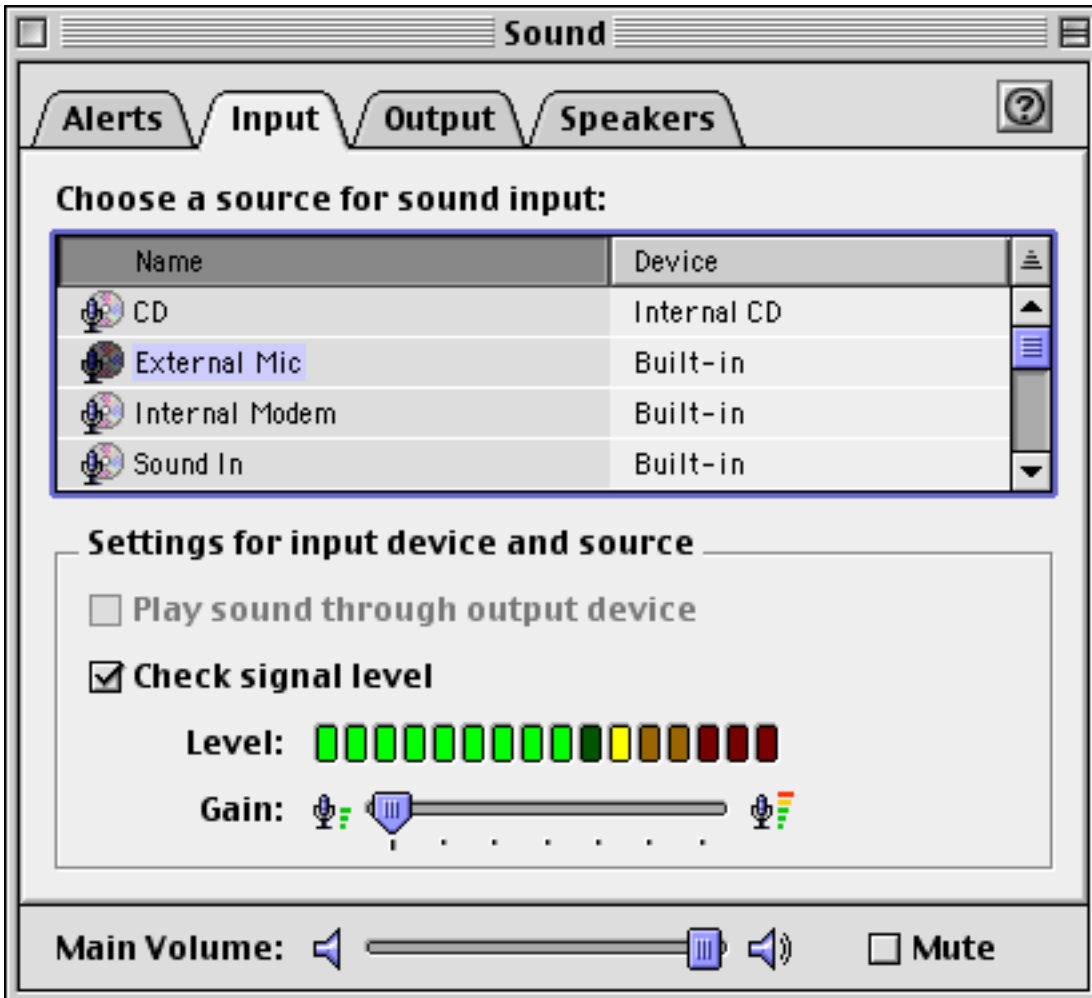
Serial Port Mini-DIN Connector View:

8 7 6
5 4 3
2 1

Basic Information and Getting Started

Before Starting Up MultiMode

First, make sure that the Sound control panel input settings are properly configured. The exact layout varies with each version of MacOS, here it is for MacOS 9.1:



As you can see, we have selected the external microphone jack for the input. As a test, we enabled Check Signal Level. With the radio connected and tuned into a station, we can verify that the audio is getting into the Mac. If it isn't, stop right here, and figure out why.

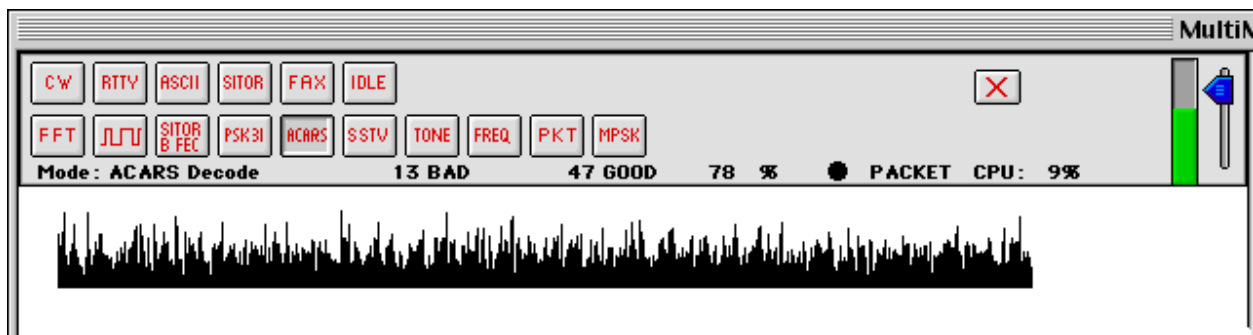
Starting Up MultiMode

Double click on the MultiMode icon. MultiMode will start up, and display the main window. Each of the small buttons with red lettering represent one mode. Clicking on a button will put MultiMode into that mode of operation.

Assuming you still have your radio connected, you should see activity in the volume indicator, the bar at the upper right of the control section of the main window. This verifies that MultiMode is getting the audio input, and can be used to help set the audio volume level from your radio. You want it to stay in the green (red would mean that the audio level is too high), about one half to three quarters of the way up.

The blue slider to the right of the volume indicator allows you to vary the audio input gain into your computer. This lets you adjust the volume of the incoming audio, if it is too weak or too loud. It only has a limited dynamic range, so it is best to make sure that the volume level coming from your receiver is correct.

Most of the skill in using MultiMode does not come from learning how to use the software, but instead from learning how to use your radio.



The smaller buttons on the right hand side select various options for each mode, things like the baud rate, inversion, etc. As they are mode specific, the number of buttons and their use changes as you change decoding mode.

In the lower left portion of the top of the window, you see the demodulated signal. The lower right part shows a real-time spectrum display, to help you properly tune in the signal. The bar graph at the upper right shows the average audio level. When it is green the audio level is acceptable, red means that it is too high, and is being clipped. This results in distortion, which will cause improper reception.

Morse Code (CW) is one of the easier modes to start with. I would advise beginning with that mode, then perhaps RTTY and WEFAX, before moving to some of the more advanced modes. We have found the many users have great difficulty using MultiMode if they just dive right in, and don't learn how to properly tune their radios, set audio levels, etc.

The following sections describe operation for each mode. Please take the time to read the sections for the modes you're interested in decoding.

MultiMode Menus

File menu

New Log File...

This allows you to start up a log file. All subsequent text decoded will be saved in this file. Ideal for unattended monitoring.

Append To Log File...

Similar to the above, except that it appends new information on to the end of an existing text file.

Close Log File...

Stops writing decoded text to a log file, and flushes any unwritten text to the file. You must select this option when you are done storing interceptions to a file, or some information may be lost.

Save PICT...

This allows you to save a FAX or SSTV picture to disk. It is stored as a PICT file. The creator/type IDs are set for opening with JPEG Viewer, although any of the popular image applications may be used.

Save Text As...

This allows you to save the decoded text to disk. It is stored as a plain text file. The creator/type IDs are set for opening with TeachText or SimpleText, although any of the popular word processors or text editors may be used.

Page Setup...

The usual Page Setup dialog is displayed.

Print. PICT..

This allows you to print a FAX or SSTV image. Text printing is not yet available.

Decode From WAVE File...

This allows you to select a WAVE format sound file, and decode using the recorded sound in that file. This is very handy if you've previously recorded some audio, or someone sends you a digitized sound file. Please note that the file must be in the WAVE format, sampled as 8 bit audio at 22050 kHz. Some other formats, such as AIFF that use 8 bits and 22050 kHz sampling may also work. As the sound is read in and decoded, it will be played out the Mac's sound output (speaker). The playback of the sound may not be entirely synchronized with the decoding.

Edit menu

Copy

This allows you to copy the decoded text or picture to the clipboard, depending on which mode you are in. As of now now, in a text mode, it only selects all of the decoded text, I hope to add support for selecting a portion of the text.

If you want to be able to copy a FAX image, you need to make sure you give MultiMode enough memory, as faxes tend to be quite large. I would suggest 10000K or so, some experimentation may be necessary. You can also copy SSTV pictures to the clipboard.

Clear

This allows you to clear the text window. To clear the Fax window, hit the spacebar.

Preferences...

The Preferences are fully explained under their own section, which is next.

Register...

Select this to register your copy of MultiMode. You'll be asked to enter your name and registration number. Optionally, you can enter your email address. The information you enter is stored in your License file.

Control Menu

Fax Calibration

Used to calibrate Fax mode for the actual sound input rate of your Mac.

Transmit Mode

Places MultiMode in the transmit mode, allowing you to send information, via your Mac's audio output (or serial port for CW).

Receive Mode

Places MultiMode in the receive mode, allowing you to decode audio fed into your Mac's sound input port.

Build Fax File

Creates a transmit file which can later be sent in FAX mode.

Build SSTV File

Creates a transmit file which can later be sent in SSTV mode.

Preferences

Several different sets of preferences may be set, one for each mode of operation, plus a few general settings. They are described below.

General Settings

Timing Delta - Used to correct the slight variance in timing between different computers. This value is automatically set by the Calibration mode. See the section on that mode for more information.

Tuning Indicator- Displays a spectrum tuning indicator on the right side of the Signal Window, which can help in tuning in RTTY and CW stations. As this does take extra processor power, users with slower systems may want to disable it.

Call- You can enter your callsign into this field. In SSTV mode, your callsign will be placed into the header of any pictures transmitted.

TCP Port- Entering a value into this field will allow MultiMode to accept TCP/IP connections to the port assigned. This allows MultiMode to pass decoded data on to other applications for further decoding/processing.

CW Settings

Center Freq - Sets the frequency that MultiMode uses for morse code mode, both for transmission and reception. You can set this frequency to the center of the bandpass filter in your rig, or to your personal taste.

RTTY Settings

Center Freq - Sets the center frequency that MultiMode uses for RTTY/ASCII/SITOR modes, both for transmission and reception. The mark and space tones are centered around this frequency. You can set this frequency to the center of the bandpass filter in your rig, or to your personal taste.

FAX Mode Settings

Auto-save Faxes - When a fax is received while in Auto mode, it will be saved to disk automatically. The file name will be in the format "ddMonYear hhmmZ". For example: 10Jan1999 2330 for a file saved on January 10, 1999 at 2330 hours local time. Faxes are saved as PICT files.

Select Fax Image Folder- Clicking this button allows you to select where MultiMode should auto-save faxes. If you select this mode by checking the above box, make sure that you select a folder for storing the received faxes. The full pathname of the folder is displayed on the following line, for your reference.

ACARS Mode Settings

Use ACARS.LST Plane Listing File - Instructs MultiMode to check the plane's registration number against the plane listing in the ACARS.LST file, to print additional information. See the ACARS documentation section for more details.

Replace chars with parity error with ~ - Characters which are received with parity errors will not be printed, instead a tilde (~) character will be printed.

Suppress packets with parity errors - Packets with parity errors will not be displayed. Useful to suppress garbled packets.

Use DACARS Format - Alters the format of displayed packets, to more closely match the format required by the DACARS program, a shareware program for the PC which

Sound Input Settings

Enable Sound Play-Thru - Checking this box enables the audio from your radio (through the microphone input) to be played out your Mac's sound output, to any external speakers you may have. This option will not work on all Macintosh models, depending on your particular configuration.

Enable AGC - Enables the Automatic Gain Control (AGC) of your Mac's sound input port, if it has this ability. This option will not work on all Macintosh models, depending on your particular configuration.

Transmit

Loopback Audio- Causes transmitted audio to be looped back (internally inside MultiMode) to the sound input, so that you can monitor what you're transmitting. Very useful for SSTV mode, to receive the image as you send it.

Serial Port- Indicates which serial port (if any) should be used to provide the Morse code output. The data transmit line of the selected port is used. If you're not interested in transmitting Morse code, then select None. Selecting a port will result in MultiMode using that serial port, which could cause problems if you're actively using that port for printing or a modem. Only one application can use a port at a time on the Mac.

USB serial adapters are supported effective with MultiMode version 3.7.0. MultiMode has been tested with the Keyspan Twin Serial Adapter on both desktops and the iBook. NuBus or PCI serial port cards may also work.

Up to four serial devices are displayed as options. If your Mac has fewer than four serial ports, then some of the options will be blank and dimmed out.

Note: If you change the selected serial port, you must quit and restart MultiMode for the change to take place.

Macros

Macro keys are available to store commonly used phrases. There are 36 of them, and they are selected by holding down control and option while typing a letter or number, that is, A-Z and 0-9.

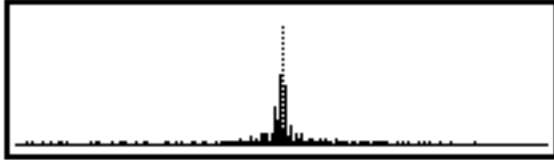
There is a file that came with MultiMode called MACROS. This is a text file that you can edit with SimpleText. Here are the first three lines of the file:

```
0|This is Macro 0  
1|This is Macro 1  
2|This is Macro 2
```

The first two characters in each line are special - the first one identifies which macro is being defined, and is a digit from 0 to 9, or a letter from A to Z. This is followed by a | symbol. After that, you may type the text to be sent when that macro key is selected, up to 255 characters long.

Morse Code

This mode translates standard International Morse Code into text. Speeds up to 40 wpm are supported.



The tuning display shows a real-time spectrum of the received signal. Tune your receiver so that the received signal is displayed in the center of the display, centered on the vertical dotted line. Adjust the audio level so that the volume bar graph shows a reasonable signal, without going into the red.



The demodulated audio from your radio is displayed in the Signal Window (shown above) in an amplitude vs. time basis. The audio is sampled in one half second chunks, which is evident in the update of this window. Four lines are also displayed - two horizontal and two vertical.

The two horizontal lines are the thresholds for detecting a signal. The ambient noise level should be below the bottom line, the code signal should be above the upper line. The more separation between the two, the better. Adjust your radio's volume and tuning accordingly. The program's audio filter is centered for 750 Hz. When receiving CW, your radio's AGC should of course be turned off.

The two vertical lines move to show where new data is being placed, and where data is being read. There is a buffer in the area between the two lines. If the speed of the received code is too slow, so that dashes (or even dots) exceed the width of this buffer, you may have decoding problems.

Buttons



These buttons allow you to select the receive speed in wpm. The program defaults to 13 wpm.



The button with the question mark '?' allows you to have the program automatically select the correct speed, based on previous audio captured.

The button with the red X clears the speed buffer. This should be used when you've tuned in a new station, or the station has changed speed, or a lot of noise/static was received. Use this button if the program seems to select erroneous speeds.

The last button (Auto) sets the auto-speed mode, where MultiMode will try to compute the received speed, based on the last few seconds of audio. Please note that you need to still have the station properly tuned in, and the audio volume correctly set, or the Auto mode will not work. Also, it is always more reliable setting the speed by hand than using the Auto mode, as pulses of noise can easily confuse it.

Text is displayed in the lower portion of the MultiMode window. You will notice a slight delay between when each character is received, and when it is actually displayed. This is normal. Presently, a character isn't displayed until the next one is received, which means that the last character of a message may never get printed; this will be fixed.

Transmitting Morse Code

It is also possible to use MultiMode to transmit Morse code. When you are in CW mode, any keys you type will be converted to Morse code and sent. But how are they sent? You have two options, one keys your transmitter, the other plays audio you feed into your transmitter.

Keying Transmitter

It is obviously necessary to interface your Mac to your transmitter. You need connect your Mac to where the key would normally go. In Preferences, you select a serial port to use for this purpose. The data transmit line of that port is turned on and off to simulate a key being pressed. In addition a small green LED is displayed in the MultiMode Window. (Due to timing constraints, the LED may not exactly blink correctly. Rest assured, the serial port output is correct)

Now, you need to condition this signal, of course. An opto-isolator should work fine. You would use the serial port output to turn the LED in the opto-isolator on and off (through an appropriate current limiting resistor, of course!). The opto output could then be connected to the key input of your transmitter. There are other possibilities as well. See the section on Connecting your Radio for more details.

Note, as this does involve connecting your Mac to your transmitter, you must be careful in what you are doing. We can in no way be held responsible for any damage that you cause to your radio or your Mac. Nor can we provide specific assistance in doing this. If you don't know what you're doing, seek assistance from a responsible person.

MCW

If you place MultiMode into transmit mode while in morse code mode, then any time you type a key, that character is transmitted as audio. This is sometimes referred to as MCW for Modulated CW. This audio can be fed into your transmitter's microphone jack, possibly through isolation/matching transformers. You'll have to experiment with your particular brand of

radio.

The audio is transmitted at 750 Hz, the same frequency that MultiMode decodes morse code, so that you could feed your Mac's audio output into the microphone jack, and monitor what you're sending, for example.

In this mode, MultiMode will continue to use the transmit line of the selected serial port as well. Please note that the two outputs are not necessarily in sync with each other.

Hints

Often, it is best to leave the AGC disabled on your receiver, and use your rig's RF gain control to adjust the received volume. You need to set the volume such that the CW audio is loud enough, but noise pulses are not decoded. If you see strings of letters E and T, chances are the audio level is too loud.

FAX

Fax mode is commonly used to decode weather maps, this is also referred to as HFFAX or WEFAX mode. It is also possible to decode pictures directly from weather satellites. Since these two modes use different modulation methods, it is necessary to select which mode should be decoded.

You may also want to visit the following web site for more information about FAX mode, including station schedules:

<http://www.blackcatsystems.com/radio/fax.html>

Buttons



Two buttons, called HF and SAT, select the mode. Satellite mode has recently been added, so I would be interested in reports of how well this mode works.



Next, the correct speed must be selected. The speed is measured in lines per minute (LPM), and possible selections are 60, 90, 120, 240 LPM. For HFFAX, 120 LPM is almost always used. For POES satellites, 120 LPM is generally used, for GEOS, 240 LPM.



The IOC (Index of Cooperation) must be selected. For HF FAX, this is almost always 576, as is also used for POES satellites. GEOS satellites use 288.



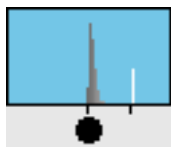
You may select whether to display gray scale, or line mode (black and white). Gray scale should be used for satellite images (which are also sent via HFFAX stations) and other images where shades of gray are sent. Line mode is useful when weather maps are sent that have no shading information. It is possible to display these in gray mode, but improper tuning and noise may affect the picture quality. In these cases, line mode may provide a better image quality.



Finally, there is also an AUTO mode, this attempts to use the phasing and start/stop tones sent by

HFFAX stations to properly synchronize to the fax signal. When a start tone is detected, a blue circle is displayed under the tuning display (described below), on the left side. MultiMode will now clear the display, lock onto the fax signal, and properly align the image. When a stop tone is detected, a red circle will light up under the tuning display. If auto-save is enabled in the Preferences, the fax image will automatically be saved to disk with a unique filename based on the date and time of day. This mode can be useful for unattended reception of weather fax.

When you start decoding in fax mode, the decoded fax document is displayed in real time in the MultiMode Window. Proper tuning of your receiver is necessary to correctly decode and view the fax. If the image appears negative (white on black) you may want to change from LSB to USB mode, or vice-versa. You need to very carefully tune the radio to achieve proper reception. Note that proper tuning for FAX decoding may NOT mean tuning your radio to the actual frequency of the station, an offset may be necessary. For most fax stations, you must tune 1.9 kHz below the carrier frequency. For example, the USCG in Boston uses a carrier frequency of 6340.5 kHz. Tune your radio to 6338.6 kHz (in USB mode) for proper reception.



To aid this process a tuning display is available (shown above) located in the information window near the buttons. This displays a spectrum of the received signal. Two small tick marks appear on the bottom of this display, the one on the left represents the audio tone for black, the one on the right for white. A typical fax consists mostly of white. So, you can quickly tune in the station by aligning the peak tone (representing white) to the right mark. If the fax also contains a lot of black, you'll see a second (usually shorter) peak over the left mark.

If you find that the picture is slanted, then the Timing Delta will have to be adjusted. See the section on FAX Calibration at the end of this chapter.



Chances are, when you start to decode a fax, you won't be correctly aligned in the horizontal direction. Pressing the << or >> button will slightly shift the decoding to the left or the right.

When you reach the bottom of the window, no new image information is displayed. You can click the clear button to clear the display, and start decoding new information at top of the display..

The + and - buttons zoom the display out and in. This can be helpful if you're trying to fit a large fax onto a small monitor.

The + and - keys on the keyboard adjust the timing. As you press them, the Timing Delta is changed by 0.1 units. This is displayed in the main window, under the mode buttons, as the number after the Delta (triangle). If you find that decoded fax images are slanted, you can use these keys to adjust the received timing. We find that on most modern Macs, the timing is excellent, and this can be left at or close to 0.0.

It is possible to scroll around the fax window using the scroll bars. The MultiMode Window size may also be changed to suit your display. It may be possible to screw up alignment on a slower computer by moving around too much, this was a problem with the 680x0 version. (presumably because too much time is spent sloshing pixels around).

Please note that if insufficient memory is available, the maximum number of shades displayed will be decreased, with only black and white possible as the worst case. Less memory than that will probably cause a crash!

FAX Calibration

This mode is used to calibrate MultiMode to the particular timing of your computer. The timing oscillators in each computer run at a slightly different speed, which means that the audio sampling may not be exactly correct. Any error in sampling will cause FAX images to be skewed and distorted. You only need to calibrate MultiMode once for your machine, the calibration is saved in your MultiMode preferences file.

MultiMode is calibrated for your particular machine by adjusting the Timing Delta value. This is a number, displayed in FAX mode in the status area, where information on the FAX lines per minute, etc is displayed, following the Δ (delta) symbol. It can be either positive or negative.

The easiest way to calibrate is to tune into a FAX transmission that included a black sync strip running down the edge of the picture. Adjust the Timing Delta by using the + and - keys to increase or decrease it in steps of 0.1 units, until the line begins to draw straight vertically.

If you find that vertical lines slant to the left as they go down, then the Timing Delta must be made more negative. If vertical lines slant to the right as they go down, then the Timing Delta must be made more positive. Once you set this, you should not need to change it, unless you get a new computer, which may have slightly different timing in the audio input circuitry.

Note that when you change the Timing Delta, only NEW parts of the line will be drawn differently, the old part will remain as it was received.

You may want to record the Delta for your machine, so that in case you should lose your Preferences file, you can simply re-enter it, rather than going through the calibration procedure again.

Hints

WEFAX is one of the easiest modes to tune in, partially because it is "analog" not digital, so slight tuning errors only slightly degrade the picture quality. Almost all WEFAX transmissions use 120 LPM, and an IOC of 576, so use these settings as default.

The Auto mode does require careful tuning - an error of a few hundred Hz will cause it to not work properly, or not at all.

Baudot RTTY

Baudot is the standard mode for transmitting teletype over shortwave radio. It uses a 5 bit code, which only allows for 32 symbol total, obviously not enough for all the letters, digits, and punctuation. Therefore, two special characters may be transmitted - letters shift (LTRS) and figures shift (FIGS). These two modes determine which character will actually be printed when a 5 bit symbol is received.

Buttons

The various buttons in the Signal Window perform the following operations:



These buttons select the baud rate.

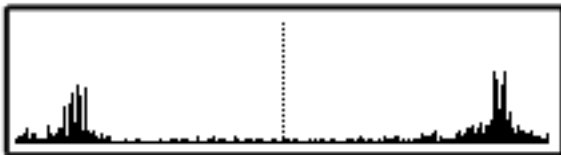


These buttons select the shift frequency.



The N button selects Normal shift, the I button selects Inverted shift. The ABC button acts as an LTRS shift, and will return the program to letters mode, from figures mode. Very useful if a burst of noise shifts the program into numbers mode.

Tuning Indicator:



As shown above, tune your radio so that two spikes are visible, representing the mark and space tones. You want to center between these tones to be centered as close as possible. Select the appropriate shift frequency using one of the five shift buttons, described above.



When properly tuned, the mark/space tones are represented by black and white pulses. Gray means the audio tone is neither a mark or space. If you see gray mixed in (or all gray), then either the station isn't properly tuned in, or the shift isn't correct.

Select the combination of speed and polarity (*Normal* or *Inverted*) for proper display of decoded text.

Transmit Mode

Selecting Transmit Mode (from the Control menu, or -T) will place MultiMode in the transmitting mode. RTTY audio will be played out the Mac's sound and/or speaker ports. Characters that you type will be converted into baudot code at the selected baud rate and shift. During transmission, the DTR line of the selected serial port will be active, this may be used as a PTT signal to a transmitter.

Macro keys are available to store commonly used phrases. There are 36 of them, and they are selected by holding down control and option while typing a letter or number.

There is a file that came with MultiMode called MACROS. This is a text file that you can edit with SimpleText. Here are the first three lines of the file:

```
0|This is Macro 0  
1|This is Macro 1  
2|This is Macro 2
```

The first two characters in each line are special - the first one identifies which macro is being defined, and is a digit from 0 to 9, or a letter from A to Z. This is followed by a | symbol. After that, you may type the text to be sent when that macro key is selected, up to 255 characters long.

Hints

Other than ham radio transmissions and weather forecasts, most RTTY on the air today is encrypted, and can not be decoded. So if you try to tune in a station and can't get proper decode under any settings, it may be an encrypted transmission. Unfortunately most of the news agencies have abandoned HF as well.

ASCII RTTY

This mode behaves very much like Baudot mode. Different speeds are available, representing the baud rates commonly found for ASCII transmissions.

Please refer to the Baudot RTTY section for details.

SITOR-A

SITOR-A mode sounds very distinctive, with a chirping sound. In this mode, three characters are transmitted at a time. The receiving station then sends one character back, indicating whether or not the three characters were correctly received. If not, they are re-transmitted. Each cycle takes 450 milliseconds, so you hear two "chirps" per second.

You will notice two types of chirps are heard, one longer than the other. The longer chirp is the data, the shorter chirp is the acknowledgement from the receiving station. Often, you may only be able to hear one of the stations from your location. You must be able to hear the longer chirp to decode data.

Properly tune in the station, using the tuning indicator, as described in the Baudot RTTY section.



You'll notice that three colors are displayed in the signal window - black, white, and gray. The black and white colors represent valid mark/space tones being received, the gray means neither tone is present. Normally you'll see a burst of white/black bits, surrounded by gray. When you first tune in a SITOR-A station, it may take MultiMode a few seconds to properly synchronize on the signal.



The N button selects Normal shift, the I button selects Inverted shift. The ABC button acts as an LTRS shift, and will return the program to letters mode, from figures mode. Very useful if a burst of noise shifts the program into numbers mode.

The left and right arrows may be used to manually shift the sampling period of the signal, to help synchronize reception.



The BAD or OK lamp will flash as each packet is received. This can help in properly tuning in the station. When you can only hear the receiving station transmitting the ACK/NAK symbols (a shorter chirp sound), the OK lamp will flash BLUE, to indicate that something is being received, although it cannot be decoded.

SITOR-B (FEC)

This mode can be used to monitor FEC and NAVTEX (518 kHz) transmissions at 100 baud.



There are three indicators, marked PHASE, BAD, and OK.

The PHASE indicator will light up blue when phasing signals are being received. These are typically sent at the beginning and end of transmissions, and during transmissions as filler.

The BAD OK indicator will light up red when garbled or invalid characters are being received.

The OK indicator will light up green when valid characters are being received.

When first tuning in a station, the BAD indicator will light up, until the reception is synchronized with the transmission. It may also light up during reception, if the lock on the signal is lost due to interference.

NAVTEX transmissions may be found on 518 KHz.

Spectrum / QRSS Display

This mode is selected by clicking on the FFT button.

General

This mode analyzes the frequencies in a received signal, and displays them graphically. There are two variations of this mode, the normal display, and a graphical display, also called QRSS mode. (QRSS is the Q code for very slow morse code)

Buttons

There are four buttons in this mode:

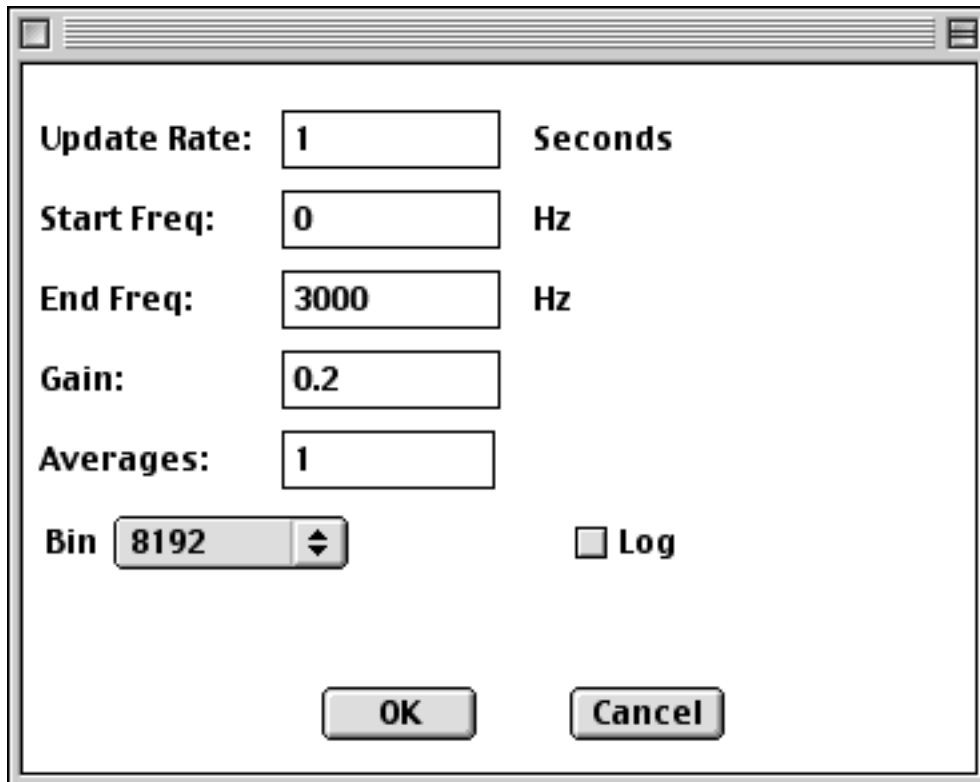


The NRM button selects the normal spectrum display, while the QRSS button selects the waterfall display used for detecting very slow speed CW signals.

The button with the red X clears the waterfall display in the QRSS mode (not visible in the normal mode).

Settings

The CFG button brings up the following settings window:

A settings dialog box with a title bar and standard window controls. It contains the following fields and controls:

- Update Rate:** A text box containing '1' followed by the label 'Seconds'.
- Start Freq:** A text box containing '0' followed by the label 'Hz'.
- End Freq:** A text box containing '3000' followed by the label 'Hz'.
- Gain:** A text box containing '0.2'.
- Averages:** A text box containing '1'.
- Bin:** A spin box showing '8192' with up and down arrow buttons.
- Log:** A checkbox that is currently unchecked, labeled 'Log'.
- OK** and **Cancel** buttons at the bottom.

Using this window, you may change the following settings:

Update Rate: This controls how often MultiMode computes a new spectrum. Setting this to 1 will tell MultiMode to compute a new spectrum every second. Setting it to 0.2 will tell it to compute a new spectrum every 0.2 seconds, or 5 times a second. You are limited to a range of 0.01 to 1 second update rates. Please note that as the update rate gets faster (smaller) more computer processor time is required. You may not be able to run at the fastest rates unless you have a very fast G4 Macintosh.

Start Freq: This determines the minimum frequency displayed on the graph, at the left side.

End Freq: This determines the maximum frequency displayed on the graph, at the right side.

Gain: In the Spectrum mode, this determines how tall the peaks are. In the QRSS mode, this amplifies (darkens) the pixels. As you adjust the update rate and bin size, you may need to change this value, by experimentation.

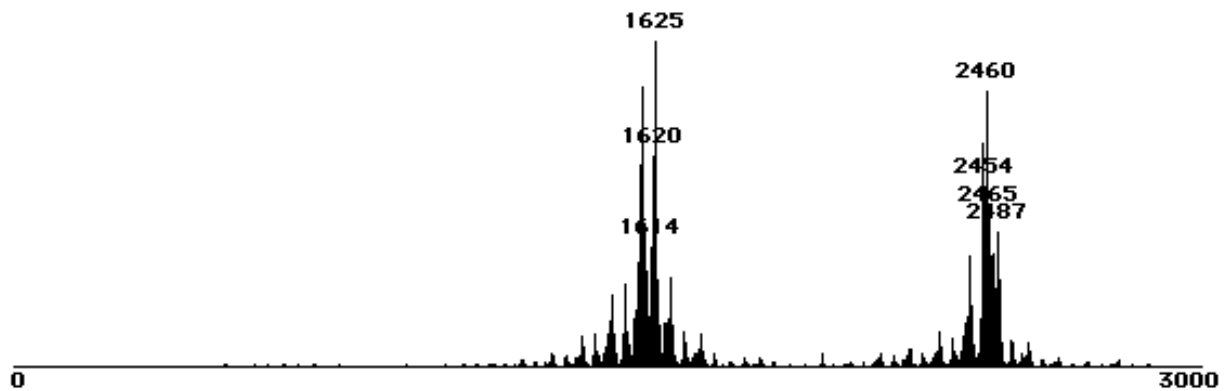
Averages: If set to a number higher than one, this tells MultiMode to average several spectrums. This has the effect of reducing noise. It will also reduce the effective update rate.

Bins: This selects the bin size, or how many different frequencies the incoming audio is broken up into. Smaller bins give poorer resolution, but run faster. You need to select the update rate, gain, number of averages, and number of bins on a case by case basis. There is no substitute for experimentation, and learning the relationships between the various settings.

Log: When checked, causes the QRSS display to take the logarithm of amplitude of each frequency before converting to a pixel darkness. This has the effect of expanding the dynamic range, and can be useful in some situations.

Spectrum Display

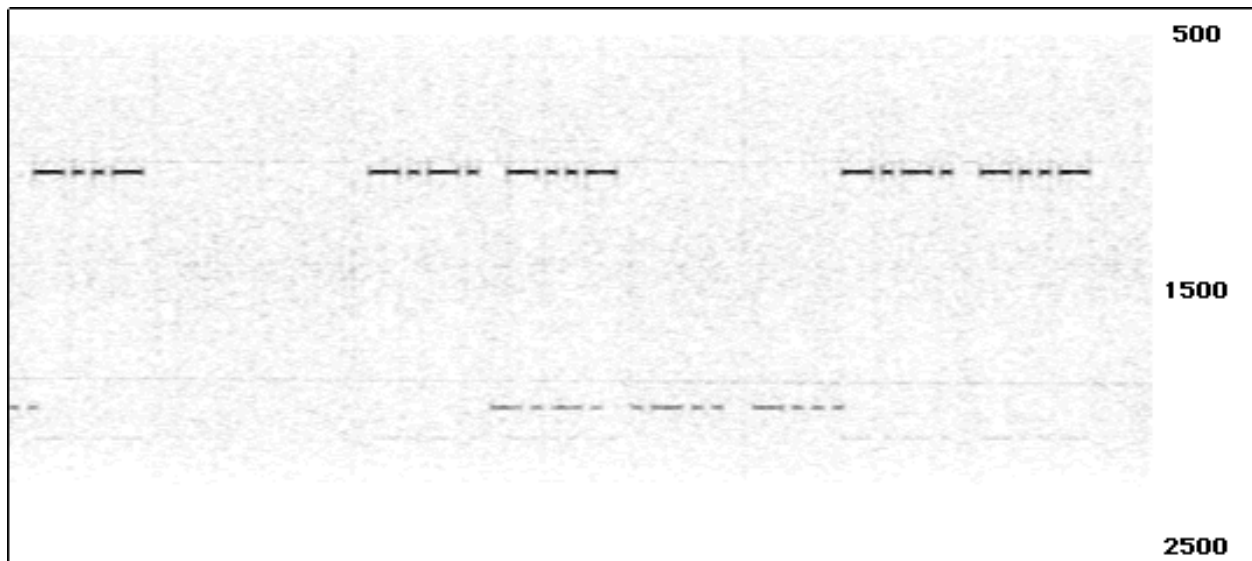
This mode displays the spectrum of the received signal. It is very useful for properly tuning in a station, and finding the shift rate of an RTTY station.



The above sample shows an RTTY station properly tuned in. Also, as you can see, the frequencies of the highest peaks are also displayed, making it easy to determine what frequencies are dominant in a signal. In this case, they are 1625 and 2460 Hz, a difference of 835 Hz. This tells us that the signal is probably 850 Hz shift, and the center frequency is about 2040 Hz.

QRSS (Waterfall) Display

This mode is extremely useful for pulling weak CW signals up and out of the noise. It is often used to copy QRSS (very slow speed CW) stations. It can also be used for monitoring standard CW signals. In the example shown below, the receiver was tuned to 218 kHz, monitoring aeronautical beacon CX, which is AM modulated on 219 kHz and transmits the CW ID at an audio frequency of 1000 Hz. It is clearly visible. Also visible is beacon CLB as a 2000 Hz audio signal. In this case, the mode was set to an update rate of 0.03 seconds, with 4096 bins, and a gain of 10.



Tone Decode

This mode decodes several types of tones which are commonly heard on the shortwave and VHF/UHF bands.



These buttons select which type of tone to decode:

DTMF

EIA

CCIR

XPH tones

PICCOLO - Not yet implemented

ICAO - SELCAL tones used in civil aviation

ALE - Automatic Link Establishment

The decoded information is displayed in the text window.

A brief description of the tone modes:

DTMF

Also known as “Touch Tone” which is probably a trademark of the telephone company.

This is the common set of tone pairs used to dial telephones. It is also sometimes used for paging and remote control applications.

EIA

Electronic Industry Association. Another set of tones, used for paging.

CCIR

Yet another set of paging tones.

XPH

XPH is a spy numbers station that sends messages via tones, rather than voice or morse code. It is believed to be operated by a Russian intelligence organization.

ICAO

International Civil Aviation Organization. This tone mode is also referred to as SELCAL, for SElective CALLing. It is used to alert the pilots of aircraft that they are about to receive a transmission. When their radio receives the correct pair of dual tones, the squelch is broken. This means that they don't have to listen to hours of static between messages. Each aircraft in the world is assigned its own dual tone pair.

Some SELCAL frequencies:

3016 5598 8906 13306 17946
2899 5616 8864 13291
2962 6628 8825 11309 13354
2872 5649 8879 11336 13306
2971 4675 8891 11279 13279
3476 6622 8831 13291

ALE

Automatic Link Establishment. This system was developed by the US government, and is now in use by many organizations and countries world-wide. It is a modem system using eight tones. It exists to allow stations to contact each other, not to transmit data. This is handled by other methods after the stations are in contact. But, it is still possible to monitor the ALE transmissions to see what stations are on the air.

ALE mode uses tones ranging from 750 to 2500 Hz, so you may want to use the wide filter setting on your radio, to not clip any of the tones. MultiMode displays a set of eight indicators in ALE mode, one for each tone. The intensity of each indicator indicates the amplitude of tone(s) at that frequency. It is normal for them all to not light up at the same intensity:



For each received transmission, MultiMode displays one line of text, as follows:

[Date Time] [Type] [Message]

The message types are as follows:

DATA		Data
THRU		Thru
TO	To	
TWAS	This was	
FROM	From	
TIS	This is	
CMD	Command	
REP	Repeat	

Example Transmissions:

```
[12 Apr 2000 19:26:11] [ TO ] [ BOB ]  
[12 Apr 2000 19:26:34] [ TIS ] [ TOM ]
```

In North America, 11250 kHz is a very popular ALE frequency.

Hellschreiber

Introduction

Hellschreiber is a method of sending text by radio. Each character is sent as an image, pixel by pixel. It was invented in 1929 by Dr. Rudolf Hell, of Bavaria, Germany.

Each character is encoded as a 7 by 7 matrix of pixels. 150 characters are transmitted per minute. A character takes 400 milliseconds to send. As there are 49 pixels per character, each pixel is 8.163ms long. The effective baud rate is 122.5 baud, and 2.5 characters are sent each second, for an average speed of about 25 WPM.

The following is an example of a received Hellschreiber transmission:

```
CQ CQ CQ DE N3JLY N3JLY N3JLY PSE KKK  
CQ CQ CQ DE N3JLY N3JLY N3JLY PSE KKK
```

Since the transmitting and receiving system may not be precisely in sync, nor transmitting at exactly the same speed, each received line is displayed twice. This way, the text can always be read, even if it slants up or down.

There is an excellent web site devoted to Hellschreiber, the URL is <http://www.qsl.net/zl1bpu/>

This is one of the Tone modes.

Common Hell Frequencies

80m	3.575	(Region 1) 3.559 (Region 3)
40m	7.030 - 7.040	
30m	10.135 - 10.145	
20m	14.063 - 14.070	(many operators watch 14.063 MHz)
17m	18.101 - 18.107	
15m	21.063 - 21.070	
10m	28.063 - 28.070	
	28.100 - 28.110	(novice)

PSK31

Introduction

This mode handles the PSK31 mode, which has recently started to gain interest in the amateur community. This mode is ideal for conversations, as it supports effective rates of around 50 wpm.

PSK31 is sort of a cross between CW and RTTY. Data is transmitted at 31.25 baud (hence the name). A tone (typically 1000 Hz) is continuously transmitted, and the phase is inverted if the next bit is a zero. This produces a distinctive trilling sound, somewhat like a treefrog.

However, unlike RTTY, and much like CW, the length of each character varies, from a minimum of one bit (for a space) to a maximum of ten bits (for seldom used characters). Two zero bits are sent between characters. When no data is being sent (idle), continuous zero bits are transmitted, so there are phase reversals 31 times per second, meaning there is always a signal to lock onto.

Correct receiver tuning is extremely critical for successful PSK31 reception. A tuning error of 20 Hz can cause poor or no reception! The following shows a correctly tuned PSK31 mode signal:



This is the demodulated signal. Any portion below the red line is a zero bit, above the red line is a one bit. During idle transmission mode, all of the demodulated data will be below the red line.

Frequencies

Suggested frequencies for PSK31 operation are:

1838.150
3580.150
7035.150
10140.150
14070.150
18100.150
21080.150
24920.150
28120.150

The "Official PSK31 Homepage" is located at: <http://www.kender.es/~edu/psk31.html>

ACARS

ACARS is the acronym for Aircraft Communications Addressing and Reporting System. It is a data transmission between airplanes and ground stations. The purpose is to handle many types of traffic that would normally be done by voice in the past. ACARS transmissions are on VHF.

Frequencies

The following frequencies are commonly used:

131.550	Primary Channel worldwide
130.025	Secondary channel for USA and Canada
129.125	Additional channel for USA & Canada
130.450	Additional channel for USA & Canada
131.125	Additional channel for USA
136.700	Additional channel for USA
136.800	Additional channel for USA
131.725	Primary channel in Europe
131.525	European secondary
131.475	Air Canada company channel
131.450	Primary channel for Japan
136.900	European secondary
136.925	ARINC European Channel
136.850	SITA Canadian Frequency

As with all other VHF-Aeronautical transmissions, AM mode is used. Most scanners automatically change to AM mode when tuning the 108-136 MHz aircraft band, but you may want to verify your scanner does this. Make sure to have the squelch turned off!

The transmissions sound like data bursts ranging from about 0.2 second to 1 second in length. Due to the high altitude of aircraft, transmissions from aircraft may be monitored for several hundred miles. Those living close to airports may also hear the ground transmissions sent to aircraft.

Tuning in ACARS transmissions is fairly easy - just select ACARS mode and adjust the radio's volume for proper decoding. Please note - it is very important to have the squelch of your radio completely off, that is, so you always hear the background static. The squelch action of any radio is too slow, and you'll miss the packet!

I find that for my setup, it works best if the background static is three - fifths of the volume indicator.

Status



There is an LED type indicator under called PACKET in the Signal Window which lights up green

when a good ACARS packet is received, and red if a packet is received but it is bad. In addition, statistics are displayed for the number of good and bad packets received, along with the percentage of good packets. This is useful for adjusting your radio setup, obviously you want to maximize the percentage of packets which are good.

There are two demodulations methods available, called OLD and NEW. The "NEW" method is far more reliable and handles poor signals better. The "OLD" is available for those who find it works better for their setup. Users are suggested to only use the "NEW" demodulation method, as the "OLD" one is no longer supported.



Clicking the X button will reset the BAD/GOOD packet counters back to zero.

You will find that many transmissions are garbled or not decoded. This is a very difficult mode to demodulate without external hardware, so good reception quality and strong signals are required. You'll see many packets are repeated, this is because the ground station didn't get the message, so the aircraft had to re-send it. Since the nicely equipped ground stations don't copy 100%, don't be surprised if your setup doesn't either! I find that under good conditions, slightly less than half of the packets decode properly.

Packet Display

MultiMode displays the transmitted packet, and parses out some of the information, such as the plane's wing number, flight number, etc. It does not attempt to parse out other specific information in the text portion of the packet, which is displayed on the second line. A timestamp is also displayed on the first line.

Here is an example of a received ACARS transmission:

```
.N227AA 5Z 2 [13 Sep 97 20:57:06]  
5651 AA0742 OS LGA /ALT00000122
```

N227AA is the aircraft registration, note the leading period(s), to force it to 7 characters.

5Z is the message type

2 is the downlink block identifier

[13 Sep 97 20:56:51] is the date and time, added by MultiMode

5651 is the message sequence, minutes and seconds past the hour

AA0742 is the carrier and flight number (American Airlines flight 742)

OS LGA /ALT00000122 is the text message sent, for those modes which include a message

You may create a file called ACARS.LST, which is a listing of plane registration numbers, along with text that you may enter. This file is read in when MultiMode first starts up, and must be located in the same folder as the MultiMode application. When a packet is decoded, the plane registration number is compared to the registration numbers of the planes in the ACARS.LST

file. If a match is found, the text from that line of the file is displayed after the timestamp. You may use this file to display text or comments about each aircraft.

An example of the file format follows below:

```
.N814US This is plane number 1  
.N320US This is plane number 2  
.NIM5AA This is plane number 3  
.N781NC This is plane number 4  
.N609AA This is plane number 5
```

Note that the first 7 characters of each line are the plane registration number, followed by a space. The rest of the line contains the text to be displayed. Leading periods are required to force the registration number to be seven characters long.

If you are not interested in using the ACARS.LST file, you may simply remove it from the MultiMode folder.

MultiMode can now import the AIRCRAFT.CSV aircraft database file, which is available from <http://www.ziplink.net/~acars/alaceqip.htm>

Please be sure to obtain the correct file, which is comma delimited.

You'll need to enable the use of the Plane Listing file in the ACARS part of the MultiMode preferences.

Here are some Web Pages devoted to ACARS which you may find of interest:

http://patriot.net/~acars/	ACARS-Link
http://patriot.net/~jetset/acars.html	Northern Virginia ACARS Page
http://www.euronet.nl/users/bart_b/	Bart 'Beaver' Hoekstra ACARS Page
http://web.inter.NL.net/hcc/Hans.Wildschut/	ACARSWeb

There is also the ACARS mailing list, which is handled by (but not run by) Grove. Requests to join should be sent to majordomo@grove.net with the text "subscribe acars" in the BODY of the e-mail.

There is a book out on ACARS, called "UNDERSTANDING ACARS, 3rd Ed." written by Ed Flynn, with Robert E. Evans, ISBN 1-882123-36-0. This book should be available at your local shortwave store. I bought my copy from Universal Radio. It does a good job of explaining the formats of the various messages.

Robert E. Evans also wrote the column "ACARS Downlink", which appeared bimonthly in Popular Communications magazine.

Two Digit Airline Codes

AS	Alaska Airlines
AQ	Aloha Airlines
AA	American Airlines
MQ	American Eagle
HP	America West
TZ	American Trans Air
DH	Atlantic Coast Airlines
5Y	Atlas Air
BO	Boeing
C8	Chicago Express
CO	Continental Airlines
DL	Delta Airlines
W9	Eastwind
EB	Emery Air Freight
9E	Express 1/NW Airlink
FX	Fedex
GR	Gemini Air Cargo
B6	Jet Blue
LC	Legend
XJ	Mesaba/Northwest Airlink
NW	Northwest Airlines
PO	Polar Air Cargo
00	Skywest Airlines
NK	Spirit Airlines
SY	Sun Country
SM	Sunworld
TW	T.W.A.
UP	U.P.S.
UA	United Airlines
MC	U.S.A.F.
US	US Airways
AC	Air Canada
TS	Air Transat
2T	Canada 3000
CP	Canadian Airlines

SSTV

SSTV stands for Slow Scan TeleVision. It is a mode used by amateur radio operators to send images, both color and black and white. An SSTV image takes from 8 seconds to several minutes to receive, depending on the mode used. In North America, Scottie S1 is the most commonly used mode. In Europe, Martin M1 is the most commonly used mode.

Buttons

Scottie DX VIS code 76

In the top button, the current SSTV mode is displayed. Clicking on the mode will display a popup menu, from which a new mode will be selected.

If Auto Select Mode is checked, MultiMode will automatically select the mode based on the VIS code sent. However, it is possible for the VIS code to get garbled, or you may manually start reception. Under these conditions, you need to select the correct SSTV mode. You may do so even while receiving an image, the old data is preserved, and the image display will be automatically adjusted and updated.

Clear Picture

This button will clear the SSTV display, and reset the mode. MultiMode will now wait for the start signal and VIS code of the next SSTV image.

<< Move Left

>> Move Right

These two buttons are used to shift the image to the left and right. This is useful when reception was manually started. Holding down the option key while clicking will move the picture further each time. Holding down shift will cause it to jump even further, and is useful for making gross adjustments. The left and right arrow keys may also be used to scroll the image, and the option and shift keys may also be used.

+ Slant Left

- Slant Right

No Slant

Slant Ratio : 1.00000

The + and - buttons are used to adjust for timing differences between your Mac and the computer sending the SSTV image. Small offsets in timing can cause large skewing of the image. If the vertical edges of the image are diagonal, then these buttons should be used to correct the

timing. The timing variation is shown to the right of the three buttons. 1.00000 means the timing is at the default value.

Clicking the + or - button will change the timing by 0.00001. Holding down the control key while clicking will cause the timing to change by 0.00010. Holding down the option key will cause the timing to change by 0.00100. The No Slant button will reset the timing to the default value. You can change the timing while receiving an image, and the display will be automatically updated in real-time.

A rectangular button with a grey gradient and a black border, containing the text "Start Reception" in bold black font.A rectangular button with a grey gradient and a black border, containing the text "Stop Reception" in bold black font.

The Start Reception button allows you to manually start receiving an SSTV image. This is useful if the start signal and/or VIS code are not correctly received. It is also useful if you tune into a transmission that is already in progress. You can also hit the spacebar to start reception.

The Stop Reception button will stop reception of an image. Normally this occurs after the receive buffer fills up, after about four minutes.

A rectangular button with a grey gradient and a black border, containing the text "Save Picture" in bold black font.

The Save Picture button allows you to quickly save a received SSTV picture. The picture is saved to the folder selected in the SSTV section of the preferences, with a filename consisting of the date and time the image was stored.

SSTV Transmission

There may be some slight timing offsets in some of the modes, please bear with them for now.

To transmit an SSTV image, perform the following steps:

1. Select SSTV Mode.
2. Select the SSTV mode you wish to use.
3. Push the **Picture From File...** button located on the right side of the SSTV image display area.
4. A file open dialog will appear. Select the picture file. Note: at present, it must be a PICT file. The should be the same size as the transmission mode uses, or some distortion may occur as the image is scaled.
5. A preview of the image to send is shown. Click on OK to proceed, or Cancel to abort.
6. After the sound output file is built (when the watch cursor reverts to a normal cursor) you may select **Transmit** mode from the **Control** menu, and the picture

will be sent. During transmission, the DTR line of the selected serial port will be active (if a port was selected), this may be used as a PTT signal to a transmitter.

It is best to not try to do too much else with your Mac while transmitting an SSTV image, or the audio may start to skip, especially on slower machines.

At present, a 16 line grayscale title is included in all modes. You can enter your callsign into this title by going to the General Preferences, and entering it into the Call field. If your copy of MultiMode is unregistered, then UNREG will be sent as your callsign.

If you have a QuickTime compatible camera connected to your system, you can push the **Capture Image** button to capture an image to send. When you push the button, you'll get a small window with real-time video from your camera. Click the **Capture** button, and the image will be captured and made ready to send. The **Capture Settings...** button can be used to configure your camera.

SSTV Modes

MultiMode supports the following SSTV modes. Is your favorite mode not listed? Email me with the specifications for the mode, and I'll add support for it!

Robot Modes

8 Second B&W
12 Second B&W
24 Second B&W
36 Second B&W
36 Second Color
72 Second Color

Martin Modes

Martin M1
Martin M2
Martin M3
Martin M4

Scottie Modes

Scottie S1
Scottie S2
Scottie S3
Scottie S4
Scottie DX

SSTV Frequencies

The following SSTV frequencies are commonly used. 14230 MHz is by far the most popular frequency. SSTV nets may be heard throughout the weekend.

3720 kHz LSB
3730 kHz LSB
7033 kHz LSB
14230 kHz USB
18160 kHz USB
21340 kHz USB
28680 kHz USB
28700 kHz USB
50300 kHz USB

144.500 MHz FM
144.525 MHz FM
145.985 MHz FM (MIR space station on weekends)
433.700 MHz FM
433.925 MHz FM

Hints

The Auto Select Mode requires very good receiving conditions. Most SSTV operations take place using S1 or M1 modes, so it is usually best to manually set the mode, and sometimes even manually start receiving. Just tap the spacebar when you hear the transmission begin. You may have to adjust the picture alignment slightly, but this is very easy to do, and can be done while you're still receiving the image.

Packet

Introduction

First a note - MultiMode does **not** operate like a full TNC!

At present, MultiMode decodes 300 and 1200 baud packet. It can also transmit Unnumbered Information (UI) packets. It is designed to show all packets that are received, and does not attempt to organize them, as a TNC would, into the correct stream of data. All packets, including supervisory, are shown.

By selecting the DEBUG mode, even packets with bad checksums are displayed.

By selecting the INFO mode, only information packets are displayed. Supervisory packets are not displayed.

Packet Display

Below is an example of some packet transmissions copied off of HF (300 baud) on 14099 kHz:

```
[ RR ] [ AJ00 7 ] [ W6OAV ? ]
[ I ] [ W6OAV ? ] [ AJ00 7 ] DX de lu6hdf: 14260.0 AY0N/X
[ UI ] [ BEACON0 ] [ AJ00 0 ] [ W0TX 0 ]
[ RR ] [ EA8DW 2 ] [ EA3RKD2 ]
[ I ] [ W0TX 7 ] [ W9UW 0 ] SP W6OAV
[ I ] [ W6OAV ? ] [ AJ00 7 ] DX de wa6yfd: 14217.3 RN6BY
[ I ] [ W0TX 7 ] [ W9UW 0 ] Hello Bill...hope that all is we
[ I ] [ W0TX 7 ] [ W9UW 0 ] ll with you. We had a very nice
[ I ] [ W0TX 7 ] [ W9UW 0 ] day here today.Sun and the high
```

The format is as follows:

```
[ type] [ dest ] [ source ] [ digipeaters] Message
```

Packet Types

DISC	Disconnect Request
DM	Disconnected Mode
I	Information
FRMR	Frame Reject
REJ	Reject
RNR	Receive Not Ready
RR	Receive Ready
SABM	Connect Request
UA	Unnumbered Acknowledge
UI	Unnumbered Information

Transmitting

To transmit, enter transmit mode (from the menu, or command-T). Type a string, and then press enter, the string is sent. The destination callsign is "CQ", and your callsign (from preferences) is used. If you have enabled one of the serial ports to serve as the PTT line, that

handshake line will be used. Right now, the delays between turning on PTT and transmitting, and after transmitting and before turning off PTT are around 400 milliseconds, fixed.

MultiMode uses the following standard tone pairs:

HF (300 baud): 2110 / 2310 Hz

VHF (1200 baud): 1200 / 2200 Hz

For VHF this isn't a problem. For HF, you need to make sure your receiver is properly tuned. The FFT mode is handy for checking the tuning.

Bit Rate



(The funny little digital waveform button)

This mode will help you determine the bit (baud) rate and shift of an RTTY station. The length of each bit received is converted into an effective baud rate. The bit lengths are sorted into bins, with the resulting histogram displayed, with a bit of averaging, to get more accurate results and offset the effects of noise. Therefore it takes several seconds to get a good reading.



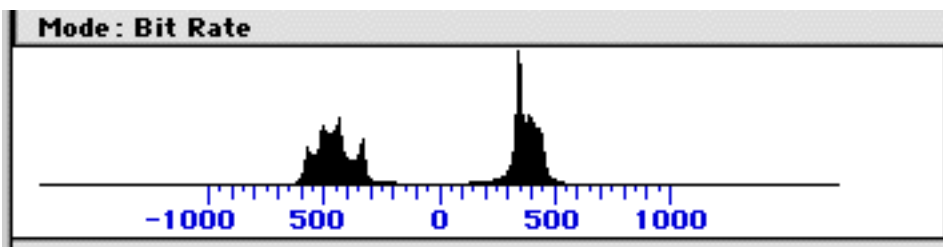
These buttons select the shift, as in the RTTY modes.



This button clears the display.

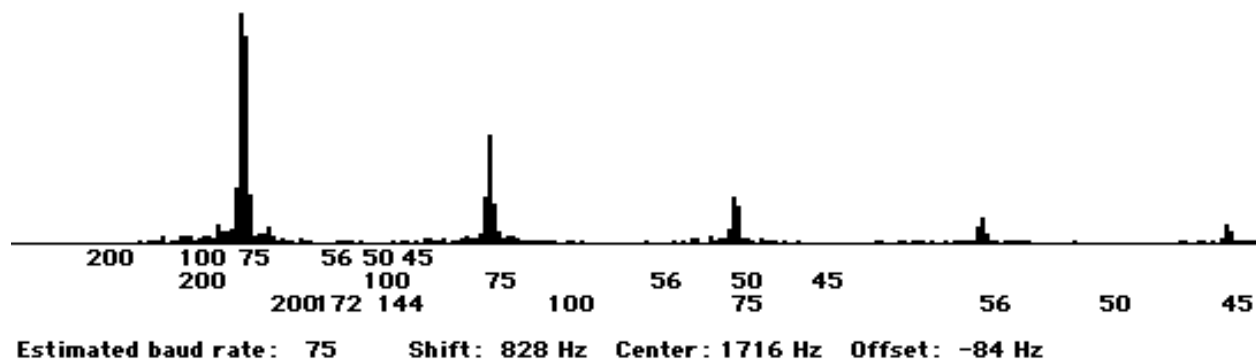
As an example, let's tune in and analyze an RTTY signal...

In the upper left part of the MultiMode window, we see the following display:



It shows the demodulated data. Just by looking at it, we can see that the shift is most probably 850 Hz or so. This is found by estimating the frequency difference between the two peaks. So let's select 850 Hz by clicking on the 850 button.

Now let's look at the display below this one, occupying the center of the window:



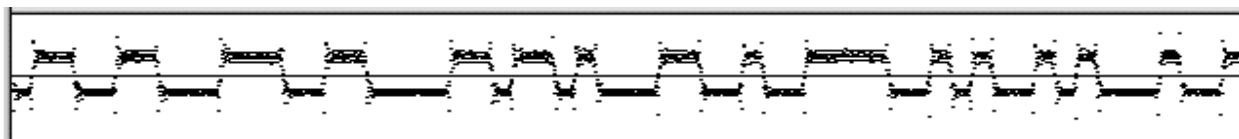
There are three scales on the x-axis to indicate the baud rate of the signal. Why three? Well, imagine how two adjacent bits of the same value (0 or 1) are read by the computer - they appear as one bit which is twice as long. The same thing with three adjacent bits of the same value. So some bits of a 100 baud transmission would appear as 50 baud bits, or even 33.3 baud bits.

In this example, the main peak is at 75 baud, which is what we would expect. Then there are smaller peaks at what would be 37.5 baud ($75/2$) and 25 baud ($75/3$). Hence the second and third scales, where these smaller peaks also read as 75 baud.

There could also be peak around 50 baud. Why? It would be due to stop bits in an asynchronous mode, which are typically $1\frac{1}{2}$ bits long. A stop bit at 75 baud appears like a 50 baud data bit. This also explains the other small peak between the second and third 75 baud peaks - it is the result of a stop bit, with the data bit preceding it having the same value as a stop bit.

We can see that the estimated baud rate is 75. The shift is estimated at 828 Hz, so it probably is 850 Hz, a common shift value. The center frequency is listed as 1716 Hz, with a -84 Hz offset. The center frequency for MultiMode for RTTY stations is 1800 Hz. This means that the station is tuned 84 Hz too low. Ideally, the receiver should therefore be tuned up 84 Hz.

The final display looks like this:



This display shows the demodulated data.

MPSK

MPSK is the 400 bps transmission mode used by the OSCAR 40 satellite for telemetry beacon transmissions. This mode demodulates the signal. No decoding or analysis of the information is performed, just demodulation.

TCP/IP Port Connections

If you select a TCP/IP port in the general preferences, MultiMode will accept a connection at that port. Any decoded information (text modes) will be sent through that connection, allowing another application to receive the data and perform additional processing.

As an example, you can telnet into that port (using your Mac's IP address as the destination address) and receive all text decoded by MultiMode.

Processor Utilization

In the upper right hand corner of the Signal Window, you will see the amount of processor time required for the current mode, in ticks (1/60 of a second), and as a percent of available time. The smaller the number, the better.

Sound Information

There's a pseudo-secret window you can bring up, which prints out all sorts of gory information about sound input on your Mac. This may be of help to me in debugging MultiMode on systems where it doesn't properly run. Here's how to get to this window:

1. Open the "About MultiMode..." window from the Apple Menu.
2. In the About Window, you'll see a bunch of colored blinking dots on the right hand side. Click on them. (clicking anywhere else clears the About Window)
3. You can write down what you see, or press Shift-Command-3 to take a snapshot (this of course saves the image of your screen as Picture 1, Picture 2, etc... on your startup volume). You can email this snapshot to me.

Localized Language Support

The menus, dialogs, buttons, and miscellaneous text in MultiMode can be displayed in several different languages. English is the default language. To choose another language, look inside the Languages folder, where you will see several files, one for each language supported. Move (or copy by dragging while holding down option) the language file of choice to the same folder as the MultiMode application. From now on, MultiMode will use that language. To change languages, return that file to the Languages folder, and move another. To change back to English, return that file to the Languages folder.

At present, MultiMode supports the following languages:

- English
- Dutch
- French
- German
- Italian
- Spanish

If you'd like to help translate the MultiMode text and/or documentation to another language, please contact me at multimode@blackcatsystems.com.

Known Bugs, Hints, Suggestions

To assist with debugging, MultiMode now creates a text file called `STARTUP_STATUS_DEBUG` as it starts up. This text file contains status information showing the progress of MultiMode through the startup process. If you report crashing or other difficulties to me, please attach a copy of this file to your email.

Some users have been reporting conflicts with RamDoublor. If you have RamDoublor, and are experiencing problems you may want to try disabling it to see if that helps. MultiMode, unlike many other applications, really does need all the memory it asks for. The same goes with other extensions - you may want to try disabling them if you're having problems, to see if that helps. You may also have problems if you're using Virtual Memory, as the disk activity can slow it down.

I've also heard of some problems with some third party printer drivers, particularly Epson. This causes crashing problems, even if you're not trying to print. The solution was to get the latest version of the driver.

Don't try to do too much multitasking when decoding. If your Mac is busy and can't get a sound sample in time, it will be lost, causing garbled display. Holding down the mouse button for an extended time can cause this also. (It's not a bug, it's a feature!) Quit all other applications, if possible.

In Fax mode, all drawing is done to an offscreen port with an 8 bit pixel depth. If CPU utilization is too high in fax mode, you may want to set your monitor pixel depth to 256 colors, this will speed things up. (For example, on my PowerCenterPro 180 system, the CPU time is around 10% in Fax mode, when I am in millions of colors. If I switch to 256 colors, it drops to 3%. On this system, it isn't much, but on slower systems, it can be critical.) You also may wish to try not running other applications in the background.

Take time to make sure your signal is properly tuned in, with minimal interference. That's the best way to get clean copy. Don't overdrive the audio input into the Mac either, that will only distort the signal. If the audio volume is too high, the audio can be clipped, which will cause lots of errors (garbage) to be displayed while decoding. So, if the decoding doesn't seem to be working very well, try turning the volume on your radio down before you try turning it up!

Closing Comments

I hope you enjoy using the program. Please forward your comments and suggestions, along with any bugs to me. I'll try my best to help you out. Email is preferred, and I cannot provide any support over the telephone. Please always mention which version you are using, and what type of Mac system you have (model, System version, Etc.). As always, try starting up with extensions disabled if you have problems.

The documentation will be improved over time, suggestions for areas that need additional clarification are always welcome.

I would appreciate it very much if everyone who tries this program emails me to let me know whether or not it works (including the version number, and your system configuration as described above). This will let me build a matrix of functional system configurations. Please also include the CPU utilization times for each mode you use, so I can see how different systems behave. This will help me tune the software so that all users may benefit.

What other types of digital signals are you interested in decoding? Tell me, and I'll do my best to add support for those modes. Even better, send me a cassette tape with a clean recording of that mode, so I have some audio to use for testing purposes. (And if you could include a printed copy of the text sent, that would really be appreciated!)

I am presently working on adding support for the following modes:

RDS (The format for transmitting data over an FM subcarrier)
PACTOR

These modes may appear as buttons available in the Signal Window, but are for my testing purposes only. Don't expect them to be very functional at this point!

Also, if you'd like, you can request to be automatically informed, via email when, when a new version of MultiMode is available from my web site. Just send me email requesting this, along with your return email address. It's that easy.

The most recent version is available at the following URL:
<http://www.blackcatsystems.com/software/multimode.html>

Registering

MultiMode is shareware. The registration fee is only \$89. The registration fee for MultiMode Lite is only \$39. Take a moment to compare this to the prices charged for commercial decoding programs, which, in addition to being many times more expensive (often by around a factor of ten), are also only available for the PC.

When you register, you'll get a year's worth of upgrades to MultiMode.

By registering your copy of MultiMode, you'll help support my efforts to develop newer versions, which will further increase the number of modes which can be monitored, and the features available. I'd like to be able to continue developing new versions of MultiMode, so that we Mac users won't be forced to abandon the Macintosh for the wintel platform.

When you register and receive your registration code, select **Enter Registration Code** from the **Edit** menu, and enter the code. If you register and don't get your registration code within a week, please send me an email at multimode@blackcatsystems.com.

The following sections explain how to register MultiMode, by check/money order, or by credit card.

Thanks again for giving MultiMode a try.

73's !

Chris Smolinski
Black Cat Systems
P.O. Box 2293
Westminster, MD 21158

email: multimode@blackcatsystems.com

Web: <http://www.blackcatsystems.com/software/multimode.html>

Registering by Check or Money Order

To order by check, please fill out and mail the following form, along with your payment. You can pay with a wide variety of cash from different countries but at present if you pay via check, it must be a check drawn in US Dollars on a US Bank. While there is the risk of loss in the mail, currency is also OK, including foreign currency (I collect foreign banknotes).

I would like to register ____ copies of MultiMode, at \$89 US per copy.

I would like to register ____ copies of MultiMode Lite, at \$39 US per copy.

Please make sure you include your email address with your payment. That way I can send the registration code to you, so you **must** include your email address. If you do not send me a valid email address, I have no way to send you the code.

If you must have your registration code mailed to you, please include an addition \$5 processing and postage fee.

Name: _____

Address: _____

City: _____ State/Province: _____

ZIP/Postal Code: _____ Country: _____

Email Address: _____

Macintosh Model: _____ System Version: _____

Enclosed, please find my check / money order / cash in the amount of \$_____

Mail this form, along with payment, to:

Black Cat Systems
P.O. Box 2293
Westminster, MD 21158
USA

Registering Online by Credit Card

To register online with a credit card, go to the following URL:

<http://www.blackcatsystems.com/register/multimode.html>

Please make sure you include your email address when you register online. That is the only way we can send the registration code to you, so you **must** include your email address. If you do not send me a valid email address, we have no way to send you the code.

Registering by Credit Card using the Register Program

Open the Register program that accompanies MultiMode. Enter your name, your email address, and the number of single user licenses you desire for each program you wish to purchase. Save or Copy or Print the data from the Register program and send the data and payment to Kagi at sales@kagi.com. More specifics on the Register program to follow. Kagi handles my payment processing.

If paying with Credit Card or First Virtual, you can email or fax the data to Kagi. Their email address is sales@kagi.com and their fax number is **+1 510 652-6589**. You can either Copy the data from Register and paste into the body of an email message or you can Save the data to a file and you can attach that file to an email message. There is no need to compress the data file, it's already pretty small. If you have a fax modem, just Print the data to the Kagi fax number.

Payments sent via email are processed within 3 to 4 days. You will receive an email acknowledgement when it is processed. Payments sent via fax take up to 10 days and if you provide a correct internet email address you will receive an email acknowledgement.

If you are mailing your credit card payment to Kagi, send it to:

Kagi
1442-A Walnut Street #392-SZ
Berkeley, California 94709-1405
USA

Please make sure you include your email address with your payment. That way we can send the registration code to you. You **must** include your email address. If you do not send us a valid email address, we have no way to send you the code.

Release History

3.9.6 10/22/2001

1. Improved grayscale display for satellite fax mode
2. Fixed another bug that would cause a crash in FAX mode in MultiMode Lite.

3.9.5 9/23/2001

1. Fixed some bugs in FAX display.
2. Added selection of old or new ACARS demodulation methods
3. ACARS can import the AIRCRAFT.CSV aircraft ID file.

3.9.4 5/30/2001

1. Fixed a bug that would cause a crash in FAX mode in MultiMode Lite.

3.9.3 5/13/2001

1. Improved ACARS mode decoding.
2. Added adjustable input volume gain.

3.9.2 4/24/2001

1. Improved detection of start and stop tones in FAX mode.
2. Modes continue to update while in preferences.
3. FAX auto-mode stored in preferences and restored next time program run.

3.9.1 4/21/2001

1. Improved detection of start and stop tones in FAX mode.
2. Spacebar starts capture in SSTV mode, arrow keys shift picture.

3.9.0 1/28/2001

1. Added QRSS mode.
2. Modified spectrum display mode to update faster, display peak frequencies.
3. Improved font in Hellschreiber mode.
4. Improved ACARS mode demodulation.

3.8.1 12/17/2000

1. Misc bug fixes.

3.8.0 12/16/2000

1. Ability to accept TCP/IP connections to pass decoded data onto other applications for additional processing.
2. Added demodulation of MPSK transmissions of OSCAR 40 telemetry.

3.7.2 10/5/2000

1. Misc bug fixes.

3.7.1 9/12/2000

1. Fixed a bug which could cause a crash when viewing the Transmit Preferences.

3.7.0 8/31/2000

1. USB serial adapters now supported.
2. Runs better in the background.
3. Preview of image to be transmitted in SSTV mode.

3.6.0 8/11/2000

1. Added IOC selection to Fax mode (288 or 576)
2. Fixed some bugs dealing with sound file playback.
3. Fixed tuning display in SAT Fax mode.

3.5.1 7/26/2000

1. Fixed a bug that could cause problems after exiting MultiMode on some systems.

3.5.0 7/24/2000

1. Improved (hopefully!) morse code and RTTY demodulation routines.
2. Adjusted locations of buttons in SSTV mode so they fit better in smaller windows.

3.4.0 6/11/2000

1. Bug fix - SSTV receive images could be too dark or light if the RTTY center frequency was changed.
2. Bug fix - small white rectangle superimposed over received image in fax mode on some systems.

3.3.5 4/28/2000

1. Added packet transmit mode.

3.3.1 4/24/2000

1. Added ability to only display information packets in Packet mode.

3.3.0 4/22/2000

1. Added 300 and 1200 baud packet decoding.
2. PageUp, PageDown, Home, and End keys now scroll the text window.

3.2.1 4/17/2000

1. Fixed a bug that would cause the system to pause on some mouse clicks.

3.2.0 4/12/2000

1. Added ALE mode.

3.0.3 3/12/2000

1. Released lite version.

3.0.2 2/24/2000

1. Added 24 wpm for CW mode, changed 26 to 28 wpm.

3.0.1 1/1/2000

1. Fixed a bug where the center frequency was not always properly stored.
2. When decoding from a WAVE file, the sound is played out the Mac's speakers.

3.0.0 1/1/2000

1. Added ability to change the center frequency for CW and RTTY/ASCII/SITOR modes

2.7.0 11/21/99

1. Added support for transmitting MCW (morse code using a tone).
2. Fixed a bug in morse code mode where the last character received would not be displayed until another character was received.
3. Added ICAO SELCAL decode mode.

2.6.1 9/17/99

1. Fixed a bug which allowed the window to be displayed too far up the screen, under the menu bar.

2.6.0 9/12/99

1. Numerous user-interface tweaks.
2. Added auto-saving of window size and location.

2.5.1 7/24/99

1. Changed/added some text translations.

2.5.0b2 7/6/99

1. Added support for Dutch and German.

2.5.0b1 6/25/99

1. Added support for multiple languages.

2.2.0 6/5/99

1. Added waterfall display in Spectrum mode.
2. Improved? Vertical Sync and VIS detection in SSTV mode.
3. Added button in SSTV mode to save a received picture with a date/time stamp.

2.1.2 5/22/99

1. Fixed a bug where only upper case text could be transmitted.
2. Fixed a bug where in PSK31 mode characters weren't sent at the maximum rate.
3. Fixed a bug where after playing a sound, the menu item didn't revert back to "Play From WAVE File"

2.1.1 5/7/99

1. Fixed a bug in text transmit mode where characters previously typed would be re-transmitted.

2.1.0 5/1/99

1. Added transmit support for Hellsreiber mode.
2. Added transmit support for PSK31 mode.
3. Improved reception for PSK31 mode.

2.0.0 4/25/99

1. Added receive support for PSK31 mode.
2. 2.0.0 final!

2.0.0a10 4/24/99

1. User interface tweaks.

2.0.0a9 4/16/99

1. Re-introduced support for 68K Macs, some modes not supported.
2. Last SSTV mode and slant now saved.
3. Checkbox to enable/disable auto-SSTV mode from VIS added.
4. Version number displayed in About Window.
5. Added audio loopback for transmit mode so you can see what you're sending.

2.0.0a8 4/10/99

1. Added text printing.

2. Added Registration dialog.
3. Documentation clean-up.
4. A few minor user-interface tweaks, hopefully nothing broke.

2.0.0a7 4/8/99

1. Added support for Hellscreiber Mode (receive only at present).

2.0.0a6 4/4/99

1. Fixed bug that caused crashing when MultiMode is first started.
2. Fixed bug that caused text to not be saved to disk properly.

2.0.0a5 4/4/99

1. Fixed bug that caused SSTV pictures to not be saved to disk properly.
2. Removed click sound from most buttons in SSTV mode.

2.0.0a4 3/26/99

1. PPC-Only release.
2. Fixed Epson printer driver conflict ???.
3. Improvements to the Bit Rate mode.
4. Fax and SSTV Printing now supported.
5. Can go to MultiMode web page from the Apple menu.

2.0.0a3 3/19/99

1. Added display of transmitted text for CW and RTTY modes.
2. Changed the program's Finder icon.

1.6.4 2/27/99

1. Added Robot 36C and Robot 72C SSTV modes.
2. Added callsign field to Preferences. Your call is sent when you send an SSTV picture.
3. User interface tweaks.

1.6.3 2/21/99

1. Allow 44 kHz audio sampling for iMac and G3 systems.

1.6.2 2/4/99

1. Added SSTV transmit support (some modes).

1.6.1 2/3/99

1. Program now starts up in Idle mode.

1.6.0 1/31/99

1. Fixed problem with transmit mode where gaps in audio would occur.
2. Fixed bug that caused serial port to not be fully released when exiting.
3. Changed style of pop-up menu in preferences.
4. Added SSTV support (receive only).
5. AGC mode is now always off.

1.5.4 1/22/99

1. Attempted again to fix a bug where MultiMode would crash when Virtual Memory was running.

1.5.3 1/16/99

1. Attempted to fix a crashing problem at startup, that only seems to occur on OS 8.5 or greater.
2. Re-wrote documentation as a stand-alone application.

1.5.2 1/15/99

1. Now creates STARTUP_STATUS_DEBUG file to assist in debugging.

1.5.1 1/14/99

1. Added EIA, CCIR, and XPH Tone modes.
2. Added transmit mode for Tone, SITOR and FEC modes.

1.5.0 1/10/99

1. Added transmit mode for FAX, RTTY and ASCII modes.
2. Improved FAX Auto-Mode.
3. Added auto-save for FAX mode.
4. Changed maximum picture display for FAX mode to 1810 by 3000 pixels, enough for a 25 minute fax in 120 lines-per-minute mode.

1.2.1 11/29/98

1. Added tuning display for fax mode.

1.2.0 10/25/98

1. Added support for transmitting CW.
2. Added support for zooming the display in Fax mode.

1.1.1 10/24/98

1. Fixed a memory allocation bug.

1.1.0 10/17/98

1. Added auto-sync, satellite, and variable speed modes to FAX mode.
2. Reduced memory requirements, they now range from 4000K to 8000K. The more memory you give MultiMode, the more shades of gray it can display in Fax mode. If you never use Fax mode, then 4000K should be sufficient.
3. Lengthened audio input buffer, this should reduce decoding glitches caused when your system gets busy with other tasks.
4. Started to add SSTV support.
5. Registration name / code is now displayed in the About Box.

1.0.1 9/18/98

1. Improved filtering routines for CW and RTTY modes.
2. Hopefully better performance on 68K machines.
3. Adjustments to the Bit Rate mode.

1.0.0 9/7/98

1. Added scrolling and other "Mac" features to the fax window.
2. Tweaked filtering routines.
3. Changed registration code system.
4. Added on-line help.
5. Added auto-speed detect for morse code mode.
6. Changed demodulation routines.
7. Changed signal Window format, added audio volume bar.

0.9.2 5/3/98

1. MultiMode now released as a single FAT application, rather than separate 68K and PPC versions.
2. Reduced the amount of digital filtering for some modes when running on a 68K machine. While this may increase susceptibility to noise, it will also improve performance, and may allow the use of some older machines that couldn't be used before.

0.9.1 2/15/98

1. Implemented SITOR-B / FEC / NAVTEX mode. Hopefully this will be the foundation for support of additional synchronous modes.

0.9.0 1/2/98

1. Completely re-wrote FAX receive routine. It seems to decode much better now, and decodes in gray scale.
2. Added additional morse code speed options (7, 10, 16, 26, 34 wpm added)
3. Changed RTTY center frequency to 1900 Hz (from 2100 Hz)
4. Changed 110 baud button to 150 baud for RTTY mode
5. Added statistics display to ACARS mode showing percent and number of good/bad packets.
6. Tweaked morse code receiving routine.

7. Fixed bug in morse code mode - the letter P was displayed as an H.
8. Improved memory management, reducing memory required by around half.
9. Sound input is interrupt driven, so data shouldn't be lost if performing other background tasks (to a point of course).
10. Printing faxes should work, the text window can't [yet] be printed.

0.4.7 9/19/97

1. Removed Speech (temporarily?) as this was causing problems for some users, especially those with OS8.

0.4.6 9/14/97

1. Overhauled Preferences substantially, it is recommended that this section of the documentation be reviewed to see what has been added
2. Added ability to save all subsequent text output to a log file, ideal for unattended ACARS monitoring.
3. Continued to improve Bit Rate mode.
4. Added ability to have MultiMode speak decoded text, enabled in the Preferences->General window.

0.4.5 9/10/97

1. Fixed a problem where you often had to repeatedly click on buttons to actually activate them.
2. Added tighter audio filtering to CW mode, this should help reject more interfering signals. It may make tuning a little different than before.
3. Added display of the percent CPU time being used, to help gauge processor loading
4. Major internal software changes, which aren't visible to the user, but should make it easier to add some additional modes in the future.

0.4.4 8/31/97

Fixed (again!) a major bug that would cause crashing when clicking on or moving/resizing the text display window. Hopefully this bug will stay fixed this time!
Added time display to ACARS mode.
Added support for ACARS.LST file for plane information display.
Added display of date/time stamp with ACARS loggings.

0.4.3 8/29/97

Added Preferences.
Added DTMF decoding support.
Added Calibration mode to calibrate FAX and SSTV timing.
Added support for saving text files and FAX pictures to disk.
Modified 680x0 filter routines to speed them up.

0.4.2 8/23/97

Fixed a major bug that would cause crashing when clicking on or moving/resizing the text

display window.

Added display of Processor CPU Time, to help gauge how busy a given system is.

Changed format of ACARS display.

Changed sampling period of ACARS mode, and data is buffered between reads, so packets aren't lost if they occur inbetween updates.

RTTY mode now displays gray in the signal window if a mark or space tone isn't present.

0.4.1 8/15/97

Added support for ACARS mode.

Added support for WWVB Time Code decoding.

0.4.0 8/3/97

Now compiled for PowerPC, PowerMac now required.

Started major changes to the operator interface.

Improved audio filter routines for better noise immunity.

Added support for SITOR-A

Added FFT for spectrum display

Added 600 Hz shift for RTTY

Started to add automatic bit-rate detection for RTTY

0.3.2 4/2/97

Added support for gray scale faxes

Added ability to adjust sampling rate for faxes, to correct skewing of vertical lines

0.3.1 3/19/97

Turned sound play-through back on, so you can hear the radio's audio through your Mac's speakers.

0.3.0 3/18/97

Added support for Baudot RTTY.

0.2.1 3/16/97

Added scrolling for fax reception.

0.2.0 2/23/97

Added support for Weather Fax reception.

0.1.1 12/31/96

Increased sampling frequency to 22 KHz.

[Hopefully] fixed bug that caused crash if no signal present for too long.

[Maybe] fixed a bug that caused a crash on some systems at launch.

0.1.0 12/29/96

Initial release

Software License Agreement

This is a legal agreement between you and Black Cat Systems, covering your use of MultiMode (the "Software"). Be sure to read the following agreement before using the Software. **BY USING THE SOFTWARE (REGARDLESS IF YOU HAVE REGISTERED THE SOFTWARE OR NOT), YOU ARE AGREEING TO BE BOUND BY THE TERMS OF THIS AGREEMENT. IF YOU DO NOT AGREE TO THE TERMS OF THIS AGREEMENT, DO NOT USE THE SOFTWARE AND DESTROY ALL COPIES IN YOUR POSSESSION.**

The Software is owned by Black Cat Systems and is protected by United States copyright laws and international treaty provisions. Therefore, you must treat the Software like any other copyrighted material (e.g., a book or musical recording). Paying the license fee allows you the right to use one copy of the Software on a single computer. You may not network the Software or otherwise use it or make it available for use on more than one computer at the same time. You may not rent or lease the Software, nor may you modify, adapt, translate, reverse engineer, decompile, or disassemble the Software. If you violate any part of this agreement, your right to use this Software terminates automatically and you must then destroy all copies of the Software in your possession.

The Software and its related documentation are provided "AS IS" and without warranty of any kind and Black Cat Systems expressly disclaims all other warranties, expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. Under no circumstances shall Black Cat Systems be liable for any incidental, special, or consequential damages that result from the use or inability to use the Software or related documentation, even if Black Cat Systems has been advised of the possibility of such damages. In no event shall Black Cat Systems's liability exceed the license fee paid, if any.

This Agreement shall be governed by the laws of the State of Maryland. If for any reason a court of competent jurisdiction finds any provision of the Agreement, or portion thereof, to be unenforceable, that provision of the Agreement shall be enforced to the maximum extent permissible so as to effect the intent of the parties, and the remainder of this Agreement shall continue in full force and effect.

The Software and documentation is provided with RESTRICTED RIGHTS. Use, duplication, or disclosure by the Government is subject to restrictions as set forth in subdivision (b)(3)(ii) of the Rights in Technical Data and Computer Software clause as 252.227-7013. Manufacturer is Black Cat Systems., 4708 Trail Court, Westminster, MD 21158, United States of America.

The name "Black Cat Systems", and "MultiMode" are trademarks of Black Cat Systems.

MultiMode is ©2001 by Black Cat Systems. All rights reserved worldwide.