

Getting Started on RTTY

Introduction

Everyday more and more Amateur Radio operators are operating on the HF digital modes, in particular, RTTY. In each RTTY contest I operate, I find about 8-10% new calls that I've not seen before. There are several reasons for wanting to be a RTTY op. No matter what that reason might be, it is the purpose of these pages to assist getting you started on RTTY.

Even though I've been active on RTTY for over 20 years, have won several RTTY contests and have achieved RTTY DXCC Honor Roll, I don't claim to have all the answers. I do have a technical background and am familiar with many of the technical aspects of operating RTTY. RTTY is the most fun I've had in over 30 years of Amateur radio. It can be both complicated and simple. So I'll try to keep things simple.

Anyone can operate RTTY. You don't have to know how to touch type to run RTTY. Hunt & peck works fine. Every program I know for RTTY includes special "buffers" which hold pre-typed messages that can be sent by pressing a function key or clicking a button on your screen with a mouse. The late Junior, previously N5JR (this call has since been re-issued to Joel Rubenstein who is an active RTTY operator too), was a paraplegic and earned RTTY DXCC before he died. He operated RTTY with a stick in his mouth. He should be an inspiration to all of us and shows that even those with disabilities can enjoy this very fun and exciting mode. There's really no excuse not to try.

Whether you desire to operate RTTY for DX'ing, contesting or ragchewing, you have to start somewhere. It's my hope that I can point you in the right direction. From there you will be able to make your own decisions on how you want to operate RTTY from your station.

RTTY is [Baudot](http://chem.ch.huji.ac.il/~eugeniik/history/ baudot.html) code (see <http://chem.ch.huji.ac.il/~eugeniik/history/ baudot.html> for excellent information on Mr. Baudot and his code). More specifically, on the Amateur HF bands, it's 5 bit Baudot meaning that every character consists of five bits, either mark or space (in actuality Baudot is 8 bits because a start bit and two stop bits are added for synchronization see http://www.aa5au.com/gettingstarted/rtty_diddles_technical.htm). In general, a baud rate of 45.45 baud is used on HF. 45.45 baud is the equivalent of 60 wpm. Even though 45.45 is standard, you will occasionally come across a RTTY signal at a different speed. Ed, P5/4L4FN, preferred to run 50 baud rate (66 wpm) when he was active on RTTY from North Korea. 75 baud (100 wpm) can also be used on the Amateur HF bands.

The standard mark and space tones are 2125 hz and 2295 hz respectively. These frequency tones are also referred to as "high" tones. Although these standard tones are used by most Amateurs, it's possible to operate RTTY using other frequency tones. This is fine as long as you maintain the standard 170 hz shift ($2295 - 2125 = 170$ hz). Some commercial TNC's such as the KAM and PK232 use a 200 hz shift when running AFSK. Although 200 hz shift will work OK, 170 hz is standard on HF. Sound card programs will sometimes change the frequency of the mark and space tones when transmitting AFSK while using the NET feature to line up your transmit signal with that

of a received station, but they maintain the 170 hz shift. Although that's important to know, I suggest not using the NET feature just yet.

For the purpose of getting you started, MMTTY will be used here as the example program to use for running RTTY. Why? For several reasons. MMTTY is a simple program to use. It's easy to set up and in all the years I've operated RTTY, MMTTY is the best decoder I've ever used. The best part of MMTTY is that it's free! The MMTTY help file has an abundance of information about RTTY in general.

AFSK vs. FSK (Audio Frequency Shift Keying vs. Frequency Shift Keying)

The biggest decision you will make when you begin to set up for RTTY, is whether you want to use AFSK or FSK to transmit RTTY. Either way is acceptable.

There is an excellent explanation of AFSK and FSK in the MMTTY help file so I won't go into a lot of technical detail here. For simplicity sake, AFSK and FSK are terms to describe how RTTY is transmitted. AFSK is when you send audio from a TNC or Sound Card to the audio input of your transmitter either via the mic input or accessory jack. FSK is when you send on/off keying from a TNC or Serial COM port (with MMTTY you can also use a parallel LPT port to transmit FSK) to the FSK input of your transmitter. Most modern transceivers today have an FSK input. By using the FSK input to your transceiver, you can then operate the radio in the RTTY or FSK position and make use of filters available for receiving RTTY, such as a narrow 250hz or 500hz IF filter. In most cases, when using AFSK, your radio will be placed in the LSB position (although some, especially in Europe, prefer using USB).

I am biased in my opinion of AFSK vs. FSK. I prefer FSK over AFSK all of the time. There are advantages and disadvantages to both. When operating AFSK, you must make sure the audio coming from your TNC or Sound Card is at the correct level and maintain this level. If the audio is too high it will overdrive your transmitter and more than likely result in a distorted RF signal or cause your radio to put out "image" signals across the band. You also must make sure you do not have the speech processor turned on when transmitting AFSK RTTY. This will also cause problems on your RF signal. The only real advantages to running AFSK are that you can get started rather quickly using this method because it's simple audio-to-a-soundcard input for receive and audio-from-a-soundcard output to your transceiver for transmit and you can also make use of the NET features of sound card programs. But personally, I think NET is a nice feature, but it can cause problems when not used correctly. Another disadvantage of using AFSK is that most transceivers will not allow you to use the narrow IF filters in your radio when operating in the LSB or USB positions. Some recently manufactured radios allow you to change the characteristics of your IF filters so you can effectively receive RTTY in the SSB position. Check your manual to see if this is the case for your radio. And if you wonder how your radio works on RTTY, go back to my [RTTY Page](#) and find your radio listed under my "RTTY Radios" section.

I prefer FSK because it's straight on/off keying into the FSK input of my radio. I don't have to worry about the audio level or whether I forgot to turn the speech processor off. I can then use the FSK mode on my radio along with the narrow 250 and 500 hz filters. When I switch from SSB to RTTY, I only have to change the mode on my radio. There is a little more work involved when using FSK. If you use a sound card, you must have a spare serial COM port (or parallel LPT port) available on your PC in order to key both

FSK and PTT, whereas if you use AFSK, you don't need this extra COM or LPT port and you can use VOX to key the radio. However, if you use MMTTY or any other sound card program to generate AFSK and use VOX to key your radio, any other sound generated by Windows could possibly key your radio and send that sound out on the air. That would not be good. There are ways to keep this from happening and I will explain that as well.

There is more detailed information covering AFSK and FSK on pages 5, 6 and 7 which will help you make your decision on whether to set up for AFSK or FSK RTTY transmission.

Let's get started. The first thing we will do is to download MMTTY from the Web.

Downloading MMTTY

We will begin by downloading the program that will get you started - MMTTY. It's available from the HH HamSoft website. When you go to the MM HamSoft website, you are going to see a lot of different programs you can download and several links to other programs that use MMTTY such as Zakanaka, HamScope, etc. But to get you started I am going to stick with the main MMTTY program. Once you learn MMTTY, you can migrate to the other programs if you wish. MMTTY is located at <http://mmhamsoft.ham-radio.ch/mmtty/index.html>.

Scroll down to the middle of the page and you will find the link to the MMTTY page. It looks like this:



Click on MMTTY and it will bring you to the MMTTY page. To download the program, scroll down to the middle of the page and you find the link to the download.

MMTTY V1.65

If you already have version 1.62 or newer install or want to download the help file separately, download the update version.

May 19, 2003

[Inno Installer Info](#)

[What's New in Ver. 1.65](#)

(Full Version - 2.09mb)

With Help file v1.62 in windows format

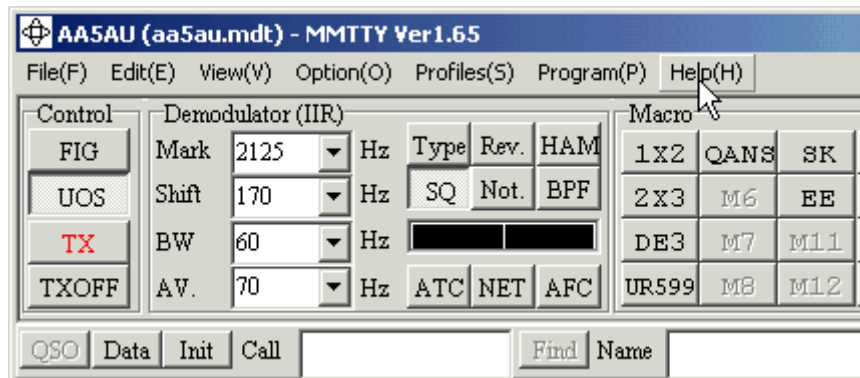
[MMTTY165.exe](#) - QSL.Net (USA)

[MMTTY165.exe](#) - Cox.Net (USA)

(Redirect to the website of W0EB)

You can download from either location. When you click on either of the download links shown above, you will see the standard download screen. If you are familiar with downloading software off the Internet, go ahead and download the file and run it. MMTTY165.exe is a self-extracting file which means it will extract all the necessary files needed and automatically start the installation process. When the installation is finished, MMTTY.EXE will be installed in the C:/PROGRAM FILES/MMTTY folder. You run the program MMTTY.EXE from that location or create a shortcut on your desktop. For detailed instructions on downloading MMTTY165.EXE from the Web and running it for the first time (including creating a shortcut on your desktop) click [here](#).

When you first start MMTTY, the screen should look like this. Immediately go to the Help pull-down menu and select MMTTY Help. Browse through the ENTIRE help file. The help file is excellent.



Once you have browsed the entire help file and hopefully read most of it, you will then

be ready for the next step. The next step will be hooking up your sound card to your radio to RECEIVE RTTY. We will concentrate on receiving RTTY first. Once you've read the help file and can receive RTTY, then you should be ready to make that most important decision - transmitting AFSK or FSK - and we will move on to transmit.

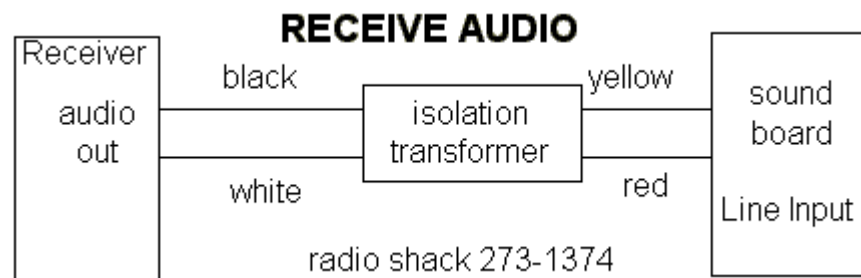
Along the way, if you have problems, the best place to ask is the MMTTY User's Group. This is an [MMTTY reflector on Yahoo](#) that you can join. You can access this User's Group by going to the Help pull-down menu within MMTTY and select "MMTTY User's Group". Choosing this option will open up your web browser to where you can join the User's Group. There are lots of users of MMTTY that will be very happy to help you. I'm not an MMTTY expert. It worked straight out of the box for me. I don't use all of the functions such as the log or contest features. But if you have questions, don't hesitate to send them to me at aa5au@bellsouth.net.

I don't use the MMTTY program for my everyday RTTY operation. I do use MMTTY as part of my WriteLog contest program. A special MMTTY plug-in was written by Jorgen, SM6SRW, for WriteLog. And I use WriteLog with the MMTTY plug-in nearly every day. If you are a WriteLog user, then by all means, continue with this tutorial and learn MMTTY. From there, you can easily use MMTTY with WriteLog. I maintain a WriteLog RTTY website at www.rttycontesting.com and have a full set of instructions on how to use the MMTTY plug-in for WriteLog there.

Receive Audio

Hooking up the Sound Card to your radio to receive RTTY is pretty easy. You'll need to buy or make a cable in order to do this. Many operators use commercially made interfaces such as a [West Mountain Radio RIGblaster](#), [MFJ Sound Card Interface](#) or [Bux Comm Rascal](#) to connect the sound card to the radio. These interfaces are covered in more detail on page [Page 9](#).

The basic idea is to come from the audio output of your radio and go to the audio input of your sound card. You can go directly from radio to sound card, but it's always a good idea to put an audio transformer in line between your radio and sound card for isolation. Although this is not absolutely necessary, it is good practice. When we get to the transmit part of RTTY, and if you decide to use AFSK transmission, you will also want to put the same type audio transformer between the audio output of the Sound Card and the audio input of your radio. The most popular transformer used for this application is the [Radio Shack audio isolation transformer part number 273-1374](#). Here is a diagram showing the connection.



Courtesy of W5BBR website www.w5bbr.com

The computer end of the cable is pretty simple. Your sound card will be either stereo or mono. More than likely, it will be a stereo sound card. It doesn't matter. In most cases, the plug required is a 1/8" (3.5mm) phone plug ([Radio Shack p/n 274-284](#)). This is a stereo plug with tip, ring and sleeve. Use the tip pin for your audio and the sleeve for your ground and shield. You can use the ring if you like, but if your Sound Card is mono, it won't work. Normally, tip is left channel, ring is right channel and sleeve is common or ground. You don't have to use a stereo plug. You could use a mono plug regardless of whether your Sound Card is stereo or mono. In any case, it's best to use shielded cable in an attempt to keep RF off the audio line. In MMTTY you can use left channel, right channel or mono. This is selected in MMTTY under Options, Setup MMTTY on the Misc tab.

The radio end of the cable requires a little thought. There are several ways to derive audio from your transceiver. You could get the audio from an accessory jack or come straight from the PHONES plug or from an external audio filter that you may already be using. Some discussion is required here.

Getting the audio from an accessory jack usual works well, especially if you can vary the level of that audio with a menu command on your radio. If the audio coming from the accessory jack is at a constant level, you can still adjust the level to the input of the sound card through the Windows Recording control in most cases. Getting the audio from an accessory jack may be advantageous since you will be able to adjust the audio gain on the front on your transceiver to a comfortable listening level while maintaining a constant level to the Sound Card. This is important.

I've always used audio coming from the PHONES jack (via an external audio filter). If you decide to get your audio from the PHONES jack, you need to consider how you are going to listen to the RTTY tones coming from your receiver as well. It's necessary to listen to the tones coming from your radio when operating RTTY to assist in identifying and tuning the signal (in the case of deaf operators, tuning could be done by using the tuning indicators alone but it's difficult and takes practice). You could simply split the audio coming from your PHONES jack with a Y cable or adapter. Or better yet, as I do, you could use an external audio filter to further filter the signal before sending it to your Sound Card and headphones. I use a JPS NIR-12 on my radios. A JPS NIR-10 or Timewave DSP-599 will also work. If you already have some sort of external filter, it's recommended that you take the audio output from that filter and send it to your sound card. In many cases, doing it this way, will not disrupt the audio going to your headphones. There is a big difference in the quality of audio coming from a commercial or home-brew audio filter and the audio coming straight out of your PHONES jack. Cleaning up the audio before sending it the Sound Card will prove wonders when copying RTTY, especially weak signals. The nice thing about getting audio from your PHONES jack directly or via an external audio filter is that you can vary the level with the audio gain control of the radio to obtain a proper input level to your sound card and still maintain a comfortable listening level to your headphones or speaker.

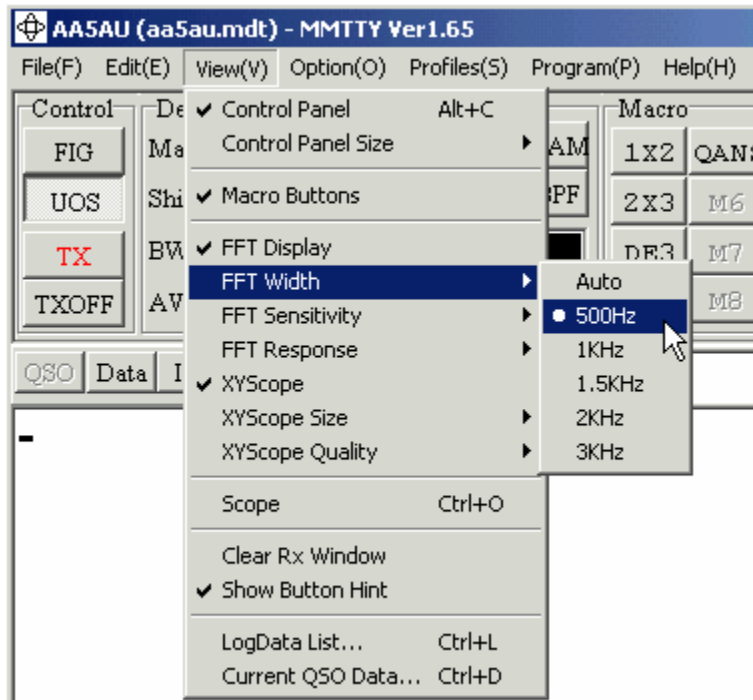
The NIR-12 audio filter allows me have a constant level coming out of the filter and still be able to adjust the volume control on the front of the unit for easy listening in my headphones much like using audio from the radio's accessory jack except I have an added advantage of adjusting the audio input to the filter with the audio gain control of my transceiver. The NIR-12 is no longer available on the market, but I'm willing to guess most of the other commercial external audio filters have this same feature.

You can also obtain your audio from a SPEAKERS jack, but if you do this, you definitely should have an isolation transformer in line to get rid of any hum or voltage that might be present and you may need to attenuate the audio using a resistive "pad". To start out, it's not important where the receive audio comes from as long as you can still listen to the RTTY tones and get the correct level of audio to the input of your Sound Card.

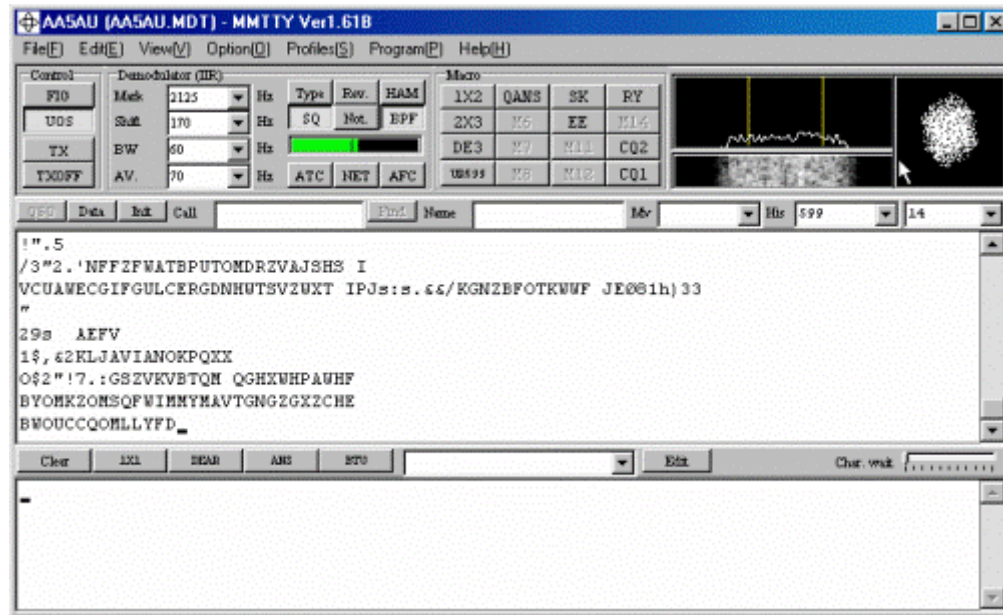
The best source I know of for excellent information on interfacing to a Sound Card is on W5BBR's web site at www.w5bbr.com/soundbd.html. Go there and study the different ways of interfacing to your Sound Card. Make the necessary connection between your radio's receiver and your PC's Sound Card input then come back here and we'll see if we can print some RTTY.


Receiving RTTY with MMTTY

It is assumed you have a cable connected from an audio output of your radio to the audio input of your PC's Sound Card. Bring up MMTTY on your PC. Go to the View menu. Ensure the Control Panel, Macro Buttons, FFT Display and the XY Scope options are selected. It's also advisable to set the FFT Width to 500 Hz to start out. You can change some of these settings later when you become more comfortable with the program.



Turn on your radio, set it to either LSB or FSK (or RTTY mode) with an antenna connected. You should see some activity in MMTTY's tuning indicators and depending on the squelch setting, you may even see some characters scrolling across the receive window and it may look like this.



If your screen looks like this, you may be off to a good start. What you are seeing in the tuning displays is noise. If the noise is high enough for the signal indicator (green horizontal bar ) to go above the vertical mark showing the squelch threshold, then characters, looking like gibberish, will appear in the receive window. To set the squelch threshold, click inside the signal indicator where you want to move the vertical threshold marker. Seeing the "alphabet soup", as it is sometimes called, is a good thing. Don't be bothered by these random characters. Instead, be glad you are seeing them because it means that MMTTY is seeing some sort of audio and it's enough to decode these noise characters.

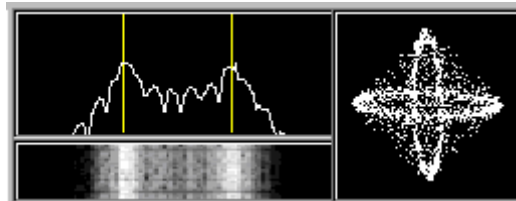
If your signal level or tuning indicators are not active at all, then something is wrong. It may be something as simple as not having the correct sound card channel (left, right or mono) selected within MMTTY (Options, Setup MMTTY) or the audio level not being high enough for MMTTY to recognize it. Another thing to try is turning the BPF on or off using the BPF button just above the signal indicator. If you still have problems, click [here](#) to go to Receive Audio Troubleshooting on Page 10.

If it looks like you are getting audio to your PC and the MMTTY indicators are active, then you are ready to copy RTTY. With your radio in either FSK (or RTTY) or LSB mode, tune across one of the RTTY sub-bands. Depending on what time of day or night it is, you can first check from around 14080 to 14090 kHz or 21080-21090 kHz to try to find a RTTY signal to tune. 20 meters is the most popular RTTY band and you will most likely find a RTTY signal there. For a complete list of HF RTTY sub-bands check [here](#).

Tuning RTTY signals is not difficult but you do need to know what to look and listen for. If your radio has a FINE option for slower tuning you should use it. If you tune too fast across a RTTY signal you might miss it completely. Tune slowly until you hear a

signal.

Once you find a signal, start watching the MMTTY tuning indicators in the upper right hand corner. MMTTY comes with a spectrum display (called FFT Display) , XY scope and waterfall display. I find the spectrum display (FFT) to be the most helpful to first get the tuning close. I then use the XY Scope for fine tuning. The two yellow vertical bars represent Mark and Space frequencies. You will line up the signal with these vertical bars. As you do this, the signal indicator on the MMTTY screen should go above the squelch threshold and intelligible print should begin to scroll across the screen. You may need to adjust the squelch threshold level as described earlier. If the green signal level meter goes all the way to the right hand side, don't worry. As long as you are not getting a message flashing in the tuning indicators displays saying the level is too high, you should be OK. Below is an example of what the tuning indicators look like when a RTTY signal is properly tuned in.



Tuning takes practice and if you are unfamiliar with what a RTTY signal sounds like, then it can be a challenge to learn. Click [here](#) to listen to what RTTY sounds like.

Once you are comfortable with receiving RTTY, it's time to learn how to transmit.

Transmitting RTTY

Maybe by now, you have read something or experienced something when receiving RTTY to give you an idea of how you want to transmit RTTY. Again, your choices are AFSK or FSK. When receiving RTTY perhaps you noticed that you copied better with your radio in the FSK or RTTY position than in the LSB position. Or it's possible your transceiver does not have the capability of using narrow filters in the SSB position. If this is the case, you may want to use FSK transmission. Or maybe your radio does allow use of narrow filtering in the SSB mode, thus permitting satisfactory AFSK operation using LSB. Before making your decision, read the next two topics covering both AFSK and FSK transmission.

AFSK Transmission

For AFSK transmission, you have two things to consider. You have to get audio (the RTTY tones) from your sound card to either the mic input or audio input on an accessory jack to your radio. And you must be able to key PTT on the radio to turn the transmitter on. With AFSK, there are several ways of getting both of these criteria done. AFSK is easier to cable-up but it also has some pitfalls.

You could run a single cable from the output of the sound card to the microphone input of your radio (with an audio transformer in line, of course) and use VOX to key the transmitter. This is the easiest of all scenarios. With MMTTY, no audio is sent out of the sound card until you key the TX button or hit F9 (F9 toggles TX on and off). When TX is enabled within MMTTY, audio is sent out of the sound card and your radio is keyed by VOX. The main problem with using VOX, and especially if you use the speaker out jack on the sound card for RTTY, is that other sounds from your computer, such as sounds generated by Windows, will also key your radio and these other sounds will be transmitted out over the air. Not only is this very poor operating, it's illegal.

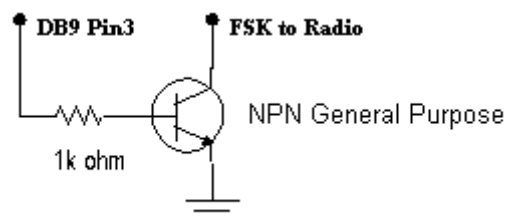
One way to keep Windows sounds from keying your radio is to turn Windows Sound off. You do this by going to the Windows Control Panel and then to Sounds. Under Schemes, choose "No Sounds". However, this does not totally eliminate sounds generated by your computer. For instance, the beep sound used in many programs will still be generated.

Better alternatives to using VOX are to either use a separate PTT circuit from a spare serial COM port or to use computer control of your radio (Icom radios do not support PTT via computer control). You will need to key your transmitter by one of these two methods if you have wired into the audio input of your radio via an accessory plug instead of the microphone jack since the VOX circuit is normally part of the mic input circuitry. And you also need to use one of these methods if you decide to use FSK instead of AFSK. VOX will not key PTT when using FSK because audio is needed to key VOX and audio is not sent to the radio when using FSK. More on keying the radio when using AFSK on the next page.

Getting back to the audio feed from the output of the sound card to the input of your transmitter, great care must be taken to ensure this audio is not too high in level to overdrive your transmitter. This also will be discussed further on the next page (*Running AFSK with MMTTY*).

FSK Transmission

FSK transmission with MMTTY requires an interface circuit coming from a serial COM port. This interface circuit takes high and low RS-232 signals, commanded by MMTTY, on pin 3 (TXD) of a 9 pin serial port or pin 2 of a 25 pin serial port and converts them to on/off (short/open) keying to the FSK input of your transmitter. The simplest interface circuit is shown here.



Your radio does the frequency shift keying inside so all you have to worry about is providing on/off keying. To show how simple this concept is, plug an open ended cable (2 conductor) into the FSK input of your transmitter. With your transmitter connected to a dummy load, key the radio manually and listening to the side tone. It will be a steady

tone, either 2125 hz or 2295 hz. Now take the open ended cable plugged into your FSK input and short the two wires together. The tone frequency will change. If an open produced 2125 hz (mark tone), a short should produce 2295 hz and vice versa. You will not hurt your radio by shorting the FSK input. That is how FSK is keyed anyway! This simple procedure is used to test the FSK circuit in your transmitter in case you suspect you have problems with your interface or with the FSK circuitry of your transmitter. A few years ago my station was struck by lightning. It damaged the FSK circuit in my Kenwood TS870. This is how I tested it. When I shorted the two wires going into the FSK input, the tone stayed the same frequency.

It's always a good idea to listen to your transmit tones while sending RTTY, to make sure the tones are shifting correctly high and low. You can monitor your transmit RTTY tones whether you are using AFSK or FSK by using the Monitor function of your transceiver. However, I do know that the Kenwood TS570 transceiver does not allow you to monitor your RTTY tones when using FSK. I'm not sure why Kenwood missed this, but don't be alarmed if you don't hear tones going out while transmitting RTTY in FSK with a TS570.

In FSK, you also must key the transmitter PTT circuit. Again, you have two choices, use an external interface to key PTT or use computer control of your radio (Radio Command). I'll cover this on [Page 7](#) for FSK transmission. And by the way, you should use the exact same circuit shown above for PTT as well as FSK and better yet, you can put them on the same COM port! More on that later.

Page 6 will discuss setting up MMTTY to run AFSK. Page 7 will be for running MMTTY in FSK. If you still haven't made up your mind, read both pages and maybe you can then make your decision.

Setting Up MMTTY to run AFSK

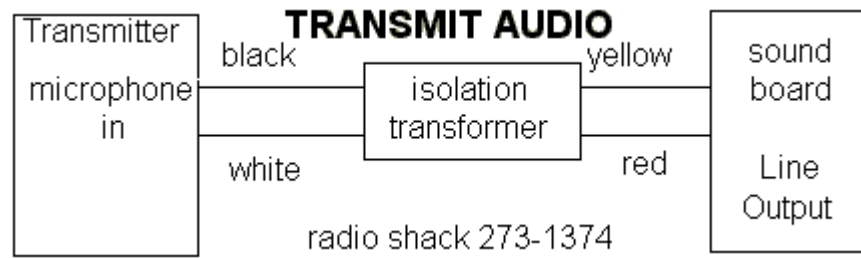
First off, if you are currently cabled up to run PSK31 and can run PSK31 successfully, then you are already cabled up to run AFSK. If not, you will need to run a cable from your sound card to your radio. The easiest way I know of to route audio from your sound card to your radio is by using a Heil AD-1 or CC-1 microphone adapter. Heil makes these adapters for their headsets. They come with a jack for both audio in and PTT. And for \$17 (current price for an AD-1), it sure beats having to find another mic plug or soldering into an accessory plug. They make these adapters for most kinds of radios. If you already own one of these adapters, you're in business. Check the [Heil Website](#) for more information.

If you use the Heil adapter, you only need to connect the sound card to the adapter with a male-to-male 1/8" mono phone plug cable for audio.

Much like receive audio from radio to sound card, the circuit is the same going back the other way for transmit. Even though I use FSK, I do use this circuit when running AFSK for PSK31 operation. I placed a 47k ohm mini-potentiometer across the microphone input to further reduce the audio going into the transmitter. Remember, if you hit the mic input with too much audio you run the risk of overdriving and distorting of your transmit signal.

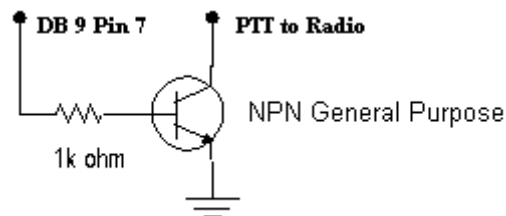
Again, if you own a RIGblaster, MFJ or Bux Comm interface, this "type" of circuit is

already included in the unit.



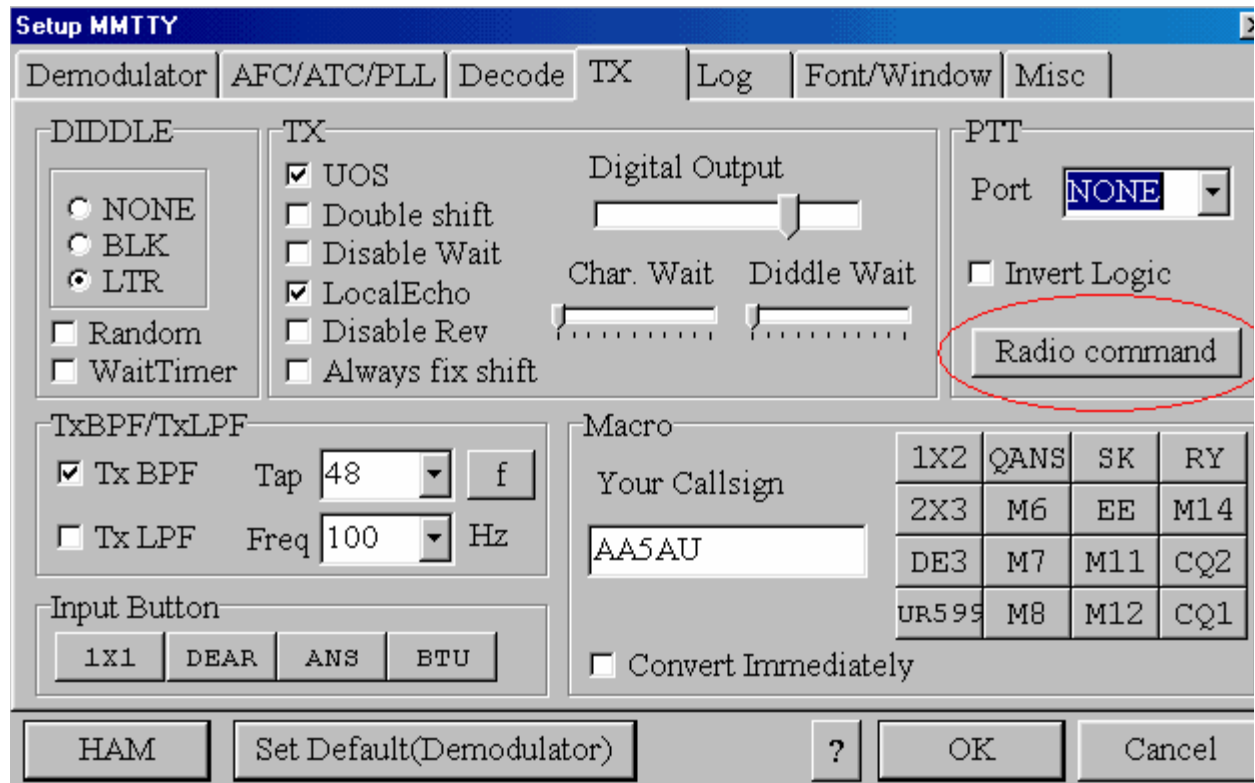
Courtesy of W5BBR www.w5bbr.com

Once you have this cable in place and if you are going to use VOX, you are ready to transmit. If you decide to key PTT from a serial COM port instead of using VOX, you can build a simple circuit as shown below and connect it to your COM port. Notice that this is the exact same circuit as shown on the previous page to key FSK.



Before attempting to transmit. Bring up MMTTY and go to MMTTY setup (Options, Setup MMTTY). Go to the TX tab. In the upper right hand corner you will see PTT Port. If you are going to use VOX or Radio command to key PTT, the Port should be set to NONE. If you are going to use an interface circuit (homebrew or commercial) from a serial COM port to key PTT, you need to set the Port to the COM port number this interface is connected to.

If you are going to use Radio command to key PTT (remember Icom radios do not support PTT via radio command), click on the Radio command button.



When the Radio command screen appears, select the Port your radio is connected to and set the Baud rate, Data length, Stop bit & Parity for what is needed to communicate with your radio. Then go to the bottom of the screen and select which type of radio you are using. If you are not sure what parameters you need to set, refer to the operator's manual for your radio. (Note: Most radios will probably communicate using 9600 baud, 8 bits, 1 stop pit, and parity none.) Below are settings I use to control my Kenwood TS-870 transceiver which is connected to serial COM port 4 on my PC. (Note: The TS-870 will work with 8 bits, 1 stop bit & no parity with MMTTY, but I prefer to set it to 4800 baud with 2 stop bits because that is what I must use when interfacing my radio to another program. This way, I don't have to change the setting in the radio when I switch between programs). Click OK which brings you back to Setup.

Radio command

Port definition

Port Baud Char. wait ms

Data length 7bits 8bits

Stop 1bit 2bits

Parity None Even Odd

flow control XON/XOFF CTS

DTR/RTS PTT

Commands

Init

Rx

Tx

VFO polling

Frequency offset OFF LSB USB

Polling interval s

KENWOOD

When you get back to the Setup MMTTY screen, click on the Misc tab. If you clicked NONE as the COM port in the TX window, then you will only have one option in the TX Port section - Sound. If you set up to key PTT from a serial COM port in the TX tab, the other options will be available, but for AFSK, you must select Sound. Select Sound, then click OK to get back to the main MMTTY screen.

Setup MMTTY

Demodulator | AFC/ATC/PLL | Decode | TX | Log | Font/Window | Misc

Sound Card

Buff

Priority Normal Highest Higher Critical

Device ID

Source Mono Right Left

Clock Hz

Tx Port

Sound Save window loc.

Sound + COM-TxD (FSK)

COM-TxD(FSK)

System Font

Window

Fixed pitch

You are now ready to transmit RTTY using AFSK. Connect your radio to a dummy load. Turn your Power output control all the way up and your Mic Gain all the way down. Put your radio in the LSB position and make sure your speech processor is turned off. Key your radio by either clicking on the TX button in the main MMTTY window with your mouse or press the F9 key (F9 toggles TX on and off). With Monitor turned on in your radio, you should hear diddles in your headphones or coming out of your radio's speaker. Diddles are a term used for RTTY being transmitted in an idle state. If you don't hear diddles or to find out what diddles are, what they do and what they sound like, check out [Page 11](#). (*Diddles & Transmit Troubleshooting*).

If you hear diddles, you are off to a great start. You are transmitting RTTY. Now slowly increase your mic gain while watching the ALC meter on your radio. Increase the mic gain until you see the ALC meter start to move above zero then stop. Now turn the mic gain down slightly until your ALC reading is just back to zero. Now look at your output power. If you are near full output power, you are set up correctly.

If you are not near full output power of your transmitter, then the level of audio coming from your sound card is too high. If you don't get any ALC, then the audio going into the radio is too low. Too low is better than too high. The idea is to decrease the audio going into your radio until full output power can be obtained and still have little or no ALC on the meter. This why a potentiometer across the audio input to the radio is a good idea. If you are not using a potentiometer or some kind of resistive pad, you can attempt to turn the audio output of the sound card down in the Windows Volume Control panel. If your audio is too low, you can attempt to increase the level in the Windows Volume Control. However, experience has shown that this adjustment is very coarse and hard to control. You may find that you will have to have this control set nearly to zero to get the audio level low enough to be acceptable in most cases without using a potentiometer or pad. Normally the problem is audio too high.

Once you have achieved nearly full output power with no ALC, then you are ready to go on the air!

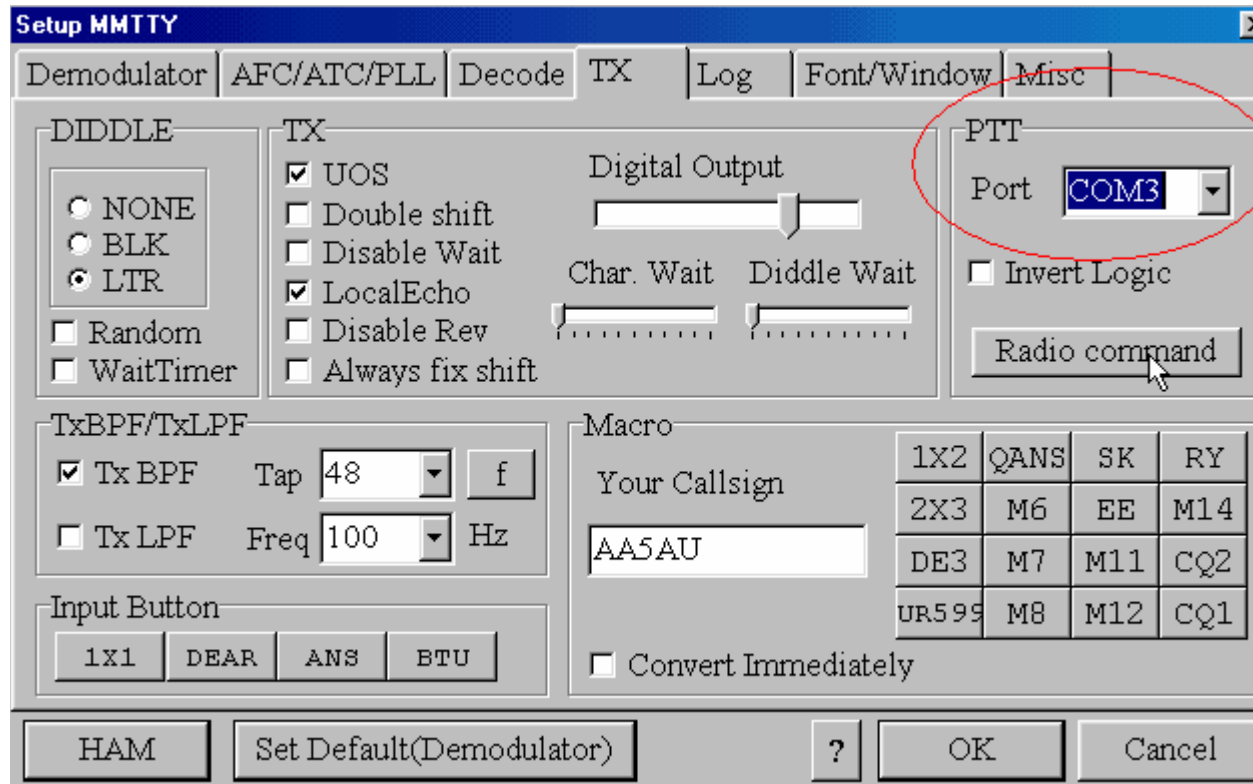
If you wish, set up some transmit buffers following the MMTTY help files. Listen around for someone calling CQ or generate a CQ yourself. This completes setting up for AFSK transmission. FSK transmission is detailed on the next page.

Setting Up MMTTY to run FSK

With FSK, you are not concerned about audio coming out of the sound card. You must key the FSK input to your transmitter with an interface circuit connected to a serial COM port using either the simple transistor circuit shown below or some other type of circuit. Many operators use opto-isolator transistors or IC circuits to key FSK and PTT from a COM port. Some commercially sold interfaces also include an FSK keying circuit (see Page 9). The choice of interface circuit is up to you. I've had great success with the simple transistor circuit. The advantage of opto-isolators is electrical isolation between COM port and radio. This may be helpful if you experience RFI or to protect the PC or radio in the unlikely event of a lightning strike. To eliminate RFI on my cables between computer and radio, I use ferrite or iron powder rods or toroids on nearly all my cables. Click [here](#) for my RTTY RFI page.

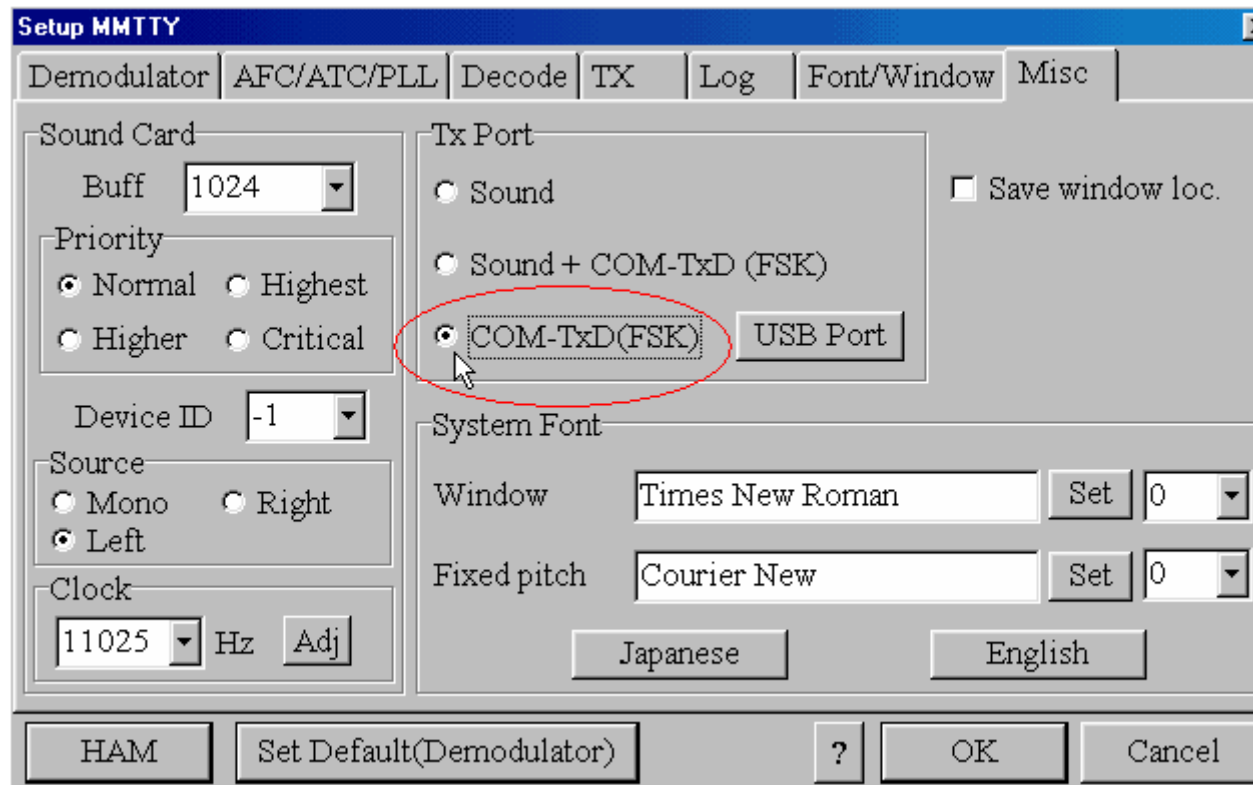
With FSK you have two necessities - FSK & PTT. With PTT, you have three choices.

You can either build another circuit identical to your FSK circuit (for a nice packaged interface, check out the one built by Ron, ND5S, [here](#)), use a commercial interface, or use Radio Command within MMTTY. With MMTTY, if you are going to key PTT with an interface, you must use the same serial COM port for both FSK and PTT. And you set this COM port on the TX Tab of MMTTY Setup as shown here.



The "PTT port" setting on the TX tab is actually for both PTT and FSK. If you use Radio command for PTT, you still must set the "PTT port" setting to the serial port where your FSK interface is connected. In the example above, the FSK interface is connected to COM3 regardless of how PTT is activated.

Once the "PTT port" is set to the serial port connected to the FSK interface, go to the Misc tab of MMTTY Setup. Here you must set the "Tx Port" to "COM-TxD (FSK)". Click OK and go back to the main MMTTY screen. Once the physical FSK connection is made to your transceiver, you are now ready to transmit FSK.



Specifics - Serial port pinouts, USB-to-Serial Adapters & EXTFSK

There are a few things I didn't cover on the other pages which are good to know, but not necessary to understand in order to get started on RTTY. These things are specifics which might help you grasp certain concepts better or help in troubleshooting RTTY problems. There is also information on USB adapters and using EXTFSK on this page. EXTFSK is required to key PTT and/or FSK from a parallel port, along with other nice features.

Serial Interface Pinouts

While covering PTT and FSK interfaces, I showed a diagram of a simple transistor circuit connected to pin 7 of a 9 pin serial port for PTT. However, I didn't mention that this pin is specified as RTS (Request To Send). It just happens that pin 4 (DTR - Data Terminal Ready) on a 9 pin serial port does the exact same thing and could be used in place of pin 7 (RTS). It doesn't really matter if you use RTS or DTR, but you might want to know this if you are trying to install jumpers in a RIGblaster Plus or trying to understand why some PTT interfaces use Pin 7 while others use Pin 4 on a DB 9 connector.

Likewise, I failed to mention pin 3 of a 9 pin serial port, the one used for FSK, is called TxD (Transmit Data). You really don't need to know this either, but don't you feel better now that you do?

And because most computers today use 9 pin serial ports, I failed to tell you what pins

would be used for a 25 pin serial port. RTS is pin 4, DTR is pin 20 and TxD is pin 2 on a 25 pin serial port.

Why can't you just connect your radio straight to these pins on your serial port? Because some of the pins will vary in voltage from +12v to -12v (RS-232 voltage levels) and your radio may not be able handle that. Your radio's PTT circuit is looking for a ground to key the circuit and turn on the transmitter. Your FSK circuit is looking for either an open or a ground to shift the frequency of the radio. Although some operators have had success directly connecting the TxD line straight to the FSK input of their transceivers, I do not recommend this. Thus you need an interface circuit.

```
**9 pin and 25 pin serial port assignments**  
  
DB 9  
Pin 3 - TXD (Transmit Data)  
Pin 4 - DTR (Data Terminal Ready)  
Pin 5 - GND (Signal ground)  
Pin 7 - RTS (Ready to Send)  
  
DB 25  
Pin 2 - TXD (Transmit Data)  
Pin 4 - RTS (Data Terminal Ready)  
Pin 7 - GND (Signal Ground)  
Pin 20 - DTR (Data Terminal Ready)
```

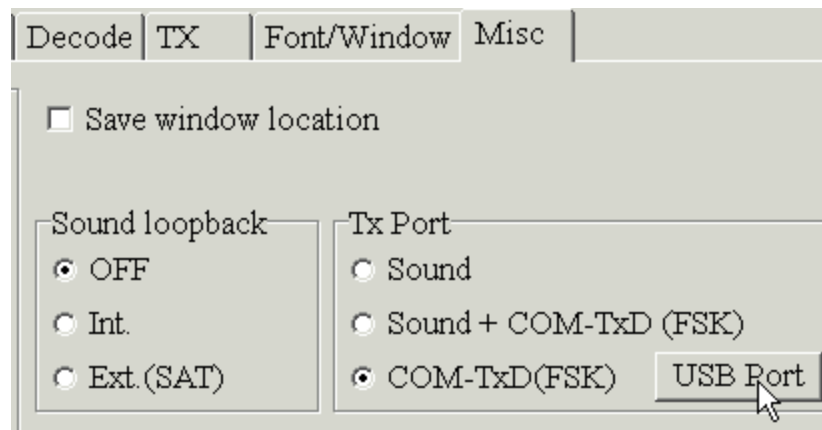
USB-to-Serial Adapters

MMTTY has provisions for altering the polling rate and speed on a USB port for use with a USB-to-Serial adapter when using such a device to run FSK. However, only one USB adapter, the Belkin F5U103, will run 5-bit Baudot code. There may be another option to getting USB adapters to work. An extension to MMTTY is available called EXTFSK that can be used to control serial, parallel and USB ports. See the EXTFSK discussion in the next section on this page. The problem with USB adapters is the UART used in nearly all adapters today do not support 5-bit data and will not work for FSK transmission. I have used the Belkin F5U103 to run FSK and it worked with no problems under Windows 98. However, I could never get my F5U103 to run under Windows XP. Some operators claim to have installed their F5U103 adapter under Windows XP, but I've not had their success.

The [Microham](#) USB micro KEYER successfully keys FSK via the USB port when used with MMTTY. I have tested the USB micro KEYER and reported my results on my rttycontesting.com web site. For the Microham pages, click [here](#).

If you own a USB adapter, I encourage you to test it to see if it works for FSK. Please report your findings back to me so I can update my [USB web page](#).

To get to the USB Port Options within MMTTY, go to Options, Setup MMTTY and to the MISC tab. Next to the COM-TxD FSK) option, there is a button that, when pressed, brings up the USB Port Option window.



When the USB Port Option window appears, there are four options to choose from. I used option C: to get my F5U103 to work. Try each of the options to determine if any of them will work.

Using EXTFSK

EXTFSK.DLL is an additional driver that can be added to MMTTY which allows software control of FSK and PTT keying on serial, parallel and USB-to-serial port adapters. Normally, these functions have been controlled by the hardware UART for the serial port or USB adapter. This extension has been tested successfully under Windows 2000 and Windows XP. What this means is that it's now possible to key FSK and PTT on a parallel port as well as changing which pins control FSK and PTT on a serial port. By using EXTFSK, it may also be possible to allow USB-to-Serial adapters work for FSK and PTT which would not work under the normal MMTTY setup described earlier. EXTFSK is available from the [MMTTY web page](#) just under the download for MMTTY. EXTFSK is contained in the comfsk105.zip file along with the source code and readme.txt file. To use EXTFSK, download comfsk105.zip, unzip it and place EXTFSK.DLL in the same directory as MMTTY.EXE. The readme.txt file contains the information needed to use EXTFSK.DLL. Oba, JA7UDE, has an excellent web page (in English) on EXTFSK [here](#).

COM-FSK V1.05 (186kb)*January 13, 2003*

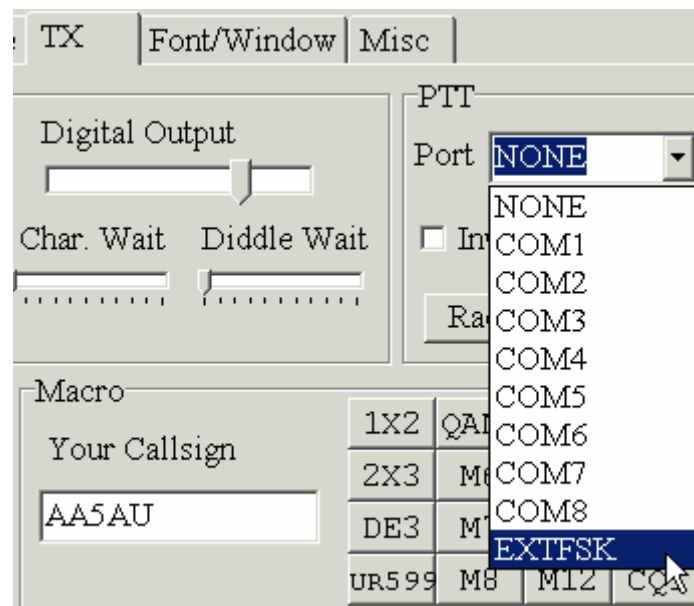
COM-FSK works as an extension to MMTTY, allowing interface to user-made hardware devices. With it you can do the FSK keying and PTT control by one of the following:

- (1) The legacy parallel port
(USB-Parallel converter not supported).
- (2) The legacy serial port
- (3) USB serial adapter

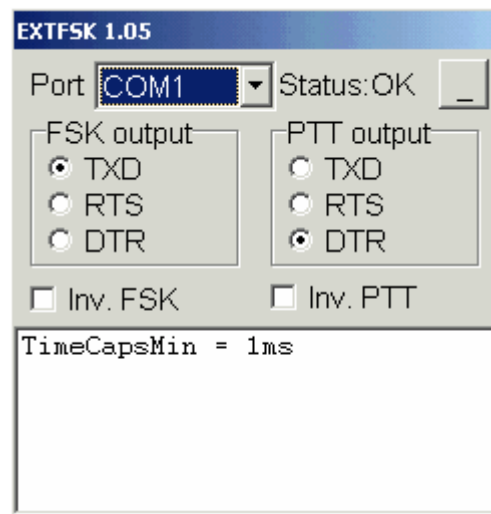
(See the readme for more information)

[comfsk105.zip](#) - QSL Net

To activate EXTFSK once EXTFSK.DLL has been placed in the MMTTY directory, first go to the TX tab in MMTTY Setup and select EXTFSK in the PTT Port pull-down window (remember this Port selection is for both PTT and FSK).



If EXTFSK is not showing in the Port pull-down menu, then EXTFSK was not properly placed in the same directory as MMTTY.EXE. After EXTFSK has been selected, go to the MISC tab and select either FSK Tx port option and press the USB button. Select A: Normal and hit OK. Back at the TX tab, hit OK again and the EXTFSK window will appear separately from the MMTTY window. In this window, you can select which COM or LPT port you wish to configure. In order to use an LPT port, you must first install DLPORIO. DLPORIO installation is covered in the readme.txt file.



EXTFSK can also be used with a USB-to-Serial adapter. I have not tested any of the EXTFSK functions. But I do know that others have had success in keying FSK & PTT from a parallel port under Windows 2000 and XP. This is important for those laptop computers that do not have a serial port. You can also change which which pins control FSK & PTT on a serial or parallel port. Some sort of interface to convert the control voltages to on/off keying is still needed.

Commercial Sound Card Interfaces

If you choose not to build your own audio interface cables or FSK/PTT interfaces, you can buy a commercially built sound card interface.

There are several commercial sound card interfaces available. All of them should work with MMTTY and nearly all of them come with cables to interface to your transceiver (you must specify which cable you need). However, not all of them are capable of keying FSK. If you are using AFSK, they all should work. Four manufacturers and their products are included on this page. They are the RIGblaster models by [West Mountain Radio](#), [MFJ Sound Card interfaces](#), the RASCAL GLX interface by [Bux Comm](#) and the Signalink Model SL-1+ by [Tigertronics](#). Only basic information on each model will be included here. For more specific information, refer to each manufacturer's website.

The RIGblaster

The RIGblaster may be the most popular brand of sound card interface. There are four models to choose from - Nomic, M8, Plus and Pro. All work with MMTTY.

The most basic unit is the Nomic. The next model in line is the M8. Both the Nomic and M8 do not support FSK keying or a separate stand-alone PTT output. These units are for AFSK operation only by offering an audio interface between the sound card and transceiver for both transmit and receive. PTT is connected to the radio's mic input. Gert, K5WW, did build an FSK keying circuit inside his Nomic. See <http://www.qsl.net/k5ww/HTML/FSK.htm>.

The Plus and Pro models fully support FSK (and CW) operation and have a separate output for PTT in addition to PTT on the MIC connection. The Plus model outputs CW

and FSK on the same jack though. In order to change from CW to FSK, jumpers are changed inside in the unit. The Pro model has separate FSK and CW outputs as well as a full compliment of connections for two radios.

MFJ Sound Card Interfaces

MFJ offers two interfaces - the [MFJ-1275](#) and [MFJ-1279](#). Both work with MMTTY. The MFJ-1275 does not support FSK, but the MFJ-1279 does. However, like the RIGblaster Plus, FSK and CW share the same output on the MFJ-1279.

RASCAL GLX by Bux Comm

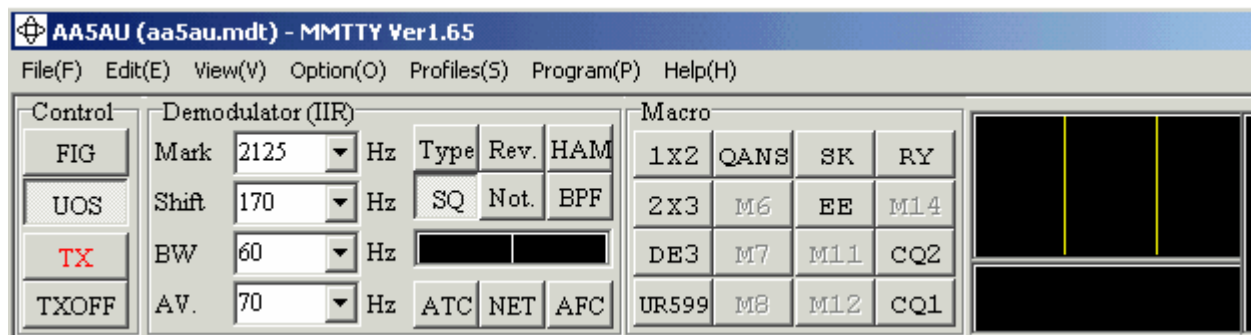
Bux Comm offers one basic unit. It comes in three flavors - Black, Beige and kit form. All three are the same interface and will work with MMTTY. The GLX supports FSK keying. Bux Comm offers a very large assortment of cables to interface to just about any transceiver made.

Signalink SL-1+ by Tigertronics

The [Signalink SL-1+](#) offers a unique circuit that senses audio from the sound card to activate PTT. Therefore no connection to a serial port is required. This is great for use with newer laptop computers that do not have serial ports. However, it does not run FSK and must be used for AFSK operation only.

Troubleshooting Receive Audio Problems

If there are no indications of activity in either the signal level display or the tuning indicator displays, then MMTTY is not seeing any receive audio from your radio.



Either audio is not getting to your sound card or the audio is not a high enough level for MMTTY to recognize. If you are getting your audio from the PHONES jack of your radio, try turning up the audio gain of your radio. If you still don't see any indication, check to make sure your connections are good going from the radio to the sound card input. It could be possible that you have a loose or broken connection or that you are not plugged into the correct jack on your sound card. If you are unsure which jack to use, plug into every jack to see if you get any indication of audio. You won't hurt anything by doing this.

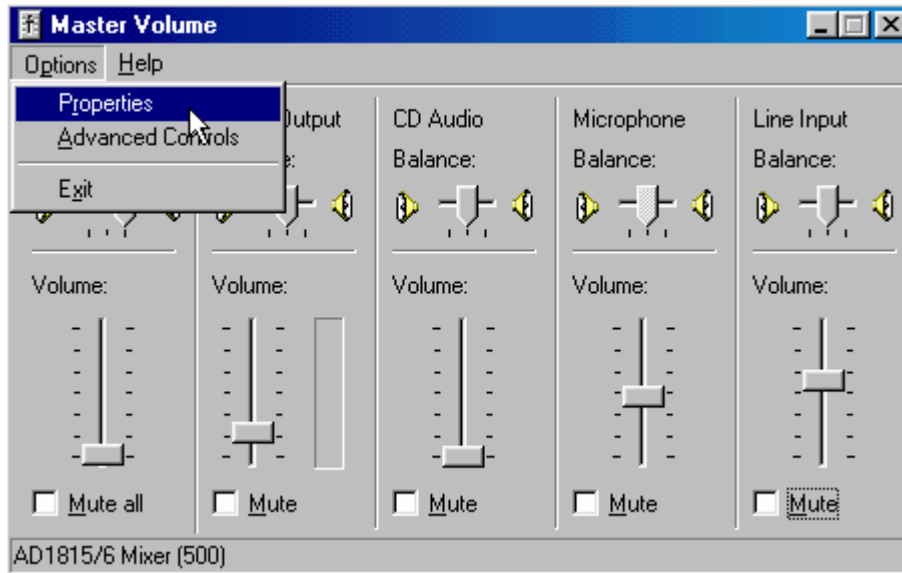
If you try every jack and still nothing, put the plug back into the jack you believe is the

line input.

Go to the Windows Sound Control by double clicking on the sound icon in the lower right hand corner of your computer screen. It's the speaker icon near the time display

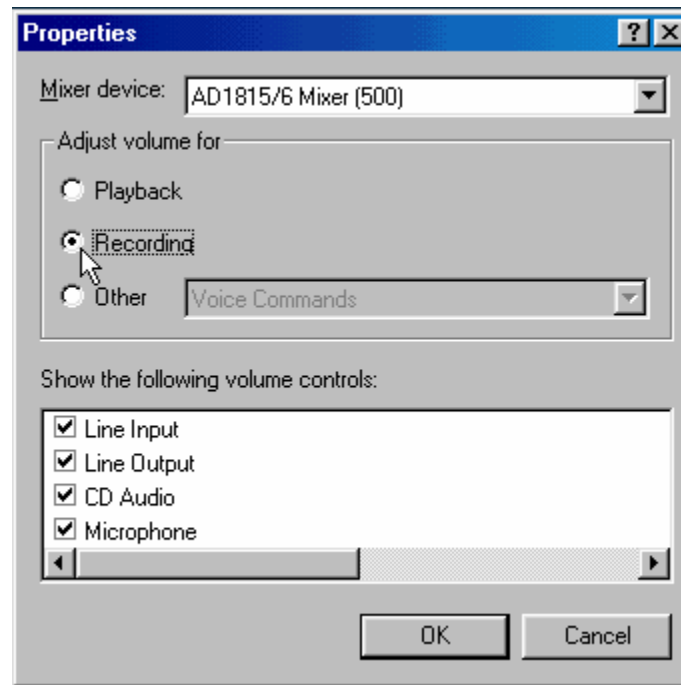


. This will bring up the Master Volume screen.

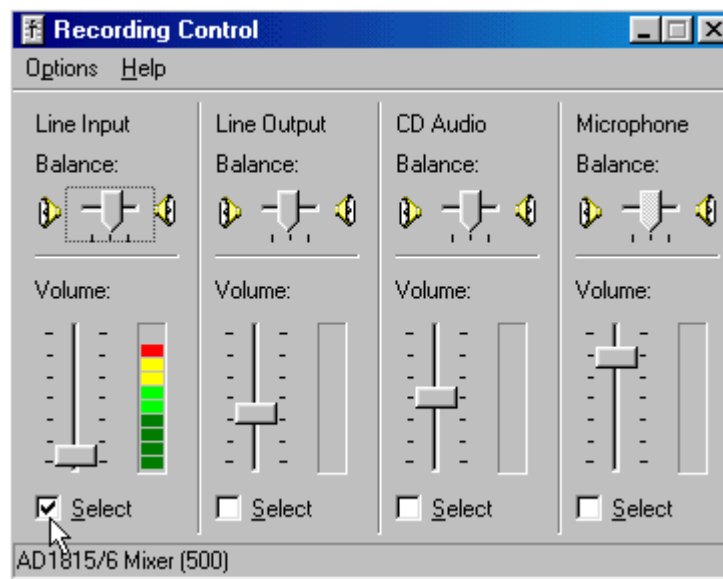


When troubleshooting receive audio problems you normally wouldn't think the Volume control has anything to do with audio input to the sound card. There is a separate Recording Control that controls the input to the sound card. The Master Volume controls are for audio being outputted from the sound card, such as audio going to your PC's speakers. But if you have a Line Input control in your Master Volume control panel, this controls the level of audio coming from the Line Input jack, but being routed back out of the sound card as an output, like to the speakers. So this is really a Line Input "output" control. If you have this control not Muted, then audio to the input of your sound card is routed back out to the speakers and you should hear what is plugged into your Line Input jack. If you Mute this control, you will still have audio going into your sound card but you won't hear it in your speakers. If you hear noise from your radio coming out of your PC speakers with this control not Muted, then you positively know audio is getting to the Line Input of your PC. In normal operation, this Line Input "output" or volume control is muted unless you desire to hear the audio from your radio in your PC's speakers.

If this control is present and not muted and you don't hear audio coming from your speakers, you need to check your input or Recording controls. To get to the input controls of the sound card, click on Options, then Properties and the Properties window will appear.



Click in the 'Recording' circle, then click OK to display the Recording Control panel. Depending on what kind of sound card you have in your computer, you may or may not see a colored bar graph indicator as shown here. The bar graph is very helpful in determining if audio is getting to the Line Input of your sound card. Check to make sure your Line Input is selected (Note: Your computer may or may not show the colored bar graph indicator. Most PC's don't.)

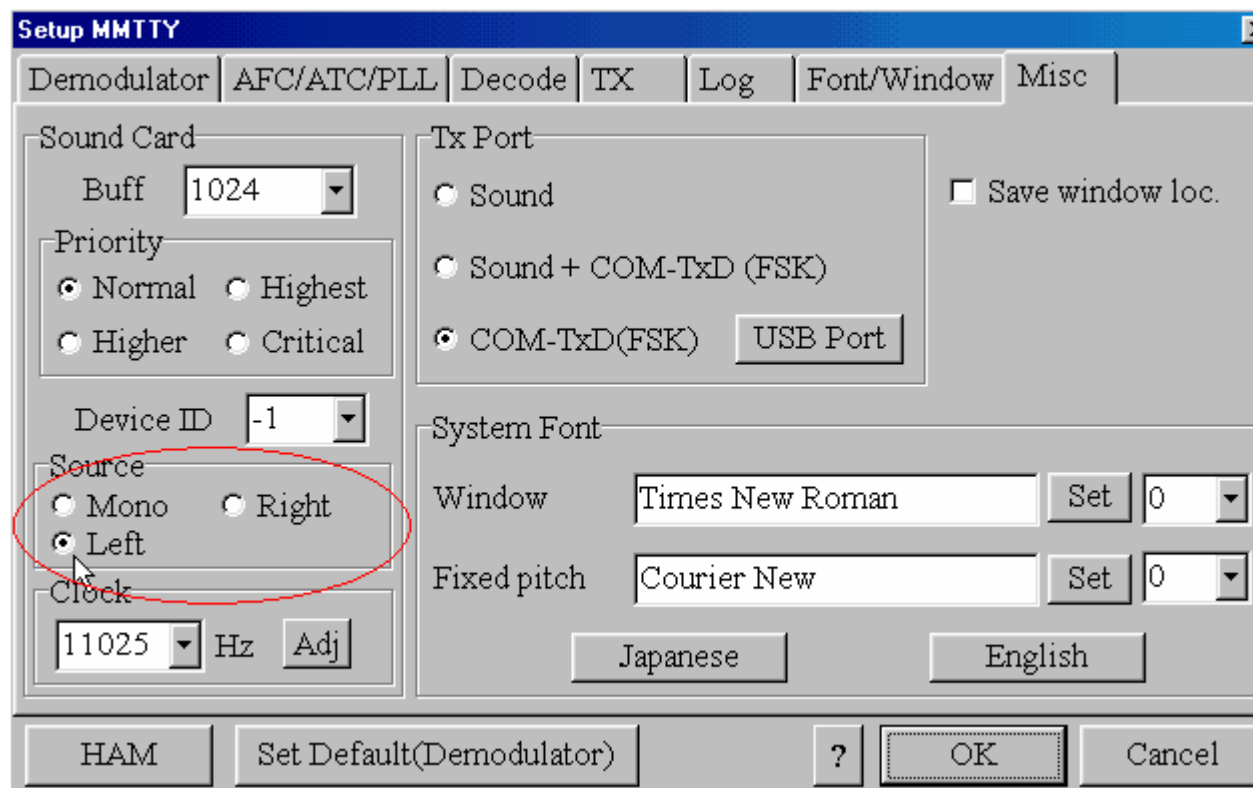


In the screen shot above, I purposely increased the audio gain of my radio so that the red would show at the top of the scale (I use audio from the PHONES jack via an external audio filter). In normal operations, regular noise will kick up 3-4 of the dark green bars. When a signal is present, the bar may go up into the yellow bars. If the level stays up in the red section, then the audio is too high hitting your sound card. You can try to lower it with the slide bar or lower the input level coming from your radio. Or you may

need to put a resistive pad in line (again see the [W5BBR web site](#)).

Look at the Line Input Balance and make sure it's in the center. If you see audio indication in the bar graph, turn your radio off and watch it go down. If it does, then you know you have audio going to your sound card. If you still don't have any activity in the MMTTY tuning indicators, we will next check some parameters within MMTTY itself.

If you are confident that audio is getting to your sound card, but there is still no activity in the tuning indicators, check to make sure the correct channel is selected within MMTTY. Go to MMTTY Setup (under the Options menu). Select the Misc tab and check to make sure the Source is set to the correct channel. If you used the tip part of a 3 conductor 1/8" (3.5mm) phones plug to go into your sound card, then you should select the Left channel. However, it should work by selecting Mono as well. To change which source is used, click inside the circle you wish to select and hit the OK button.



If you try all three options, Mono, Left and Right, and you still do not have any activity in the tuning indicators, try selecting one at a time again except this time, increase the audio going into the sound card either by increasing the audio gain on your transceiver or by increasing the slide control in the Windows Recording Control for each selection.

If you still don't have any activity, then you could have a bad sound card but that would be very rare. It's time to join that MMTTY User's Group and start asking questions. Something else could be wrong that I haven't thought of.

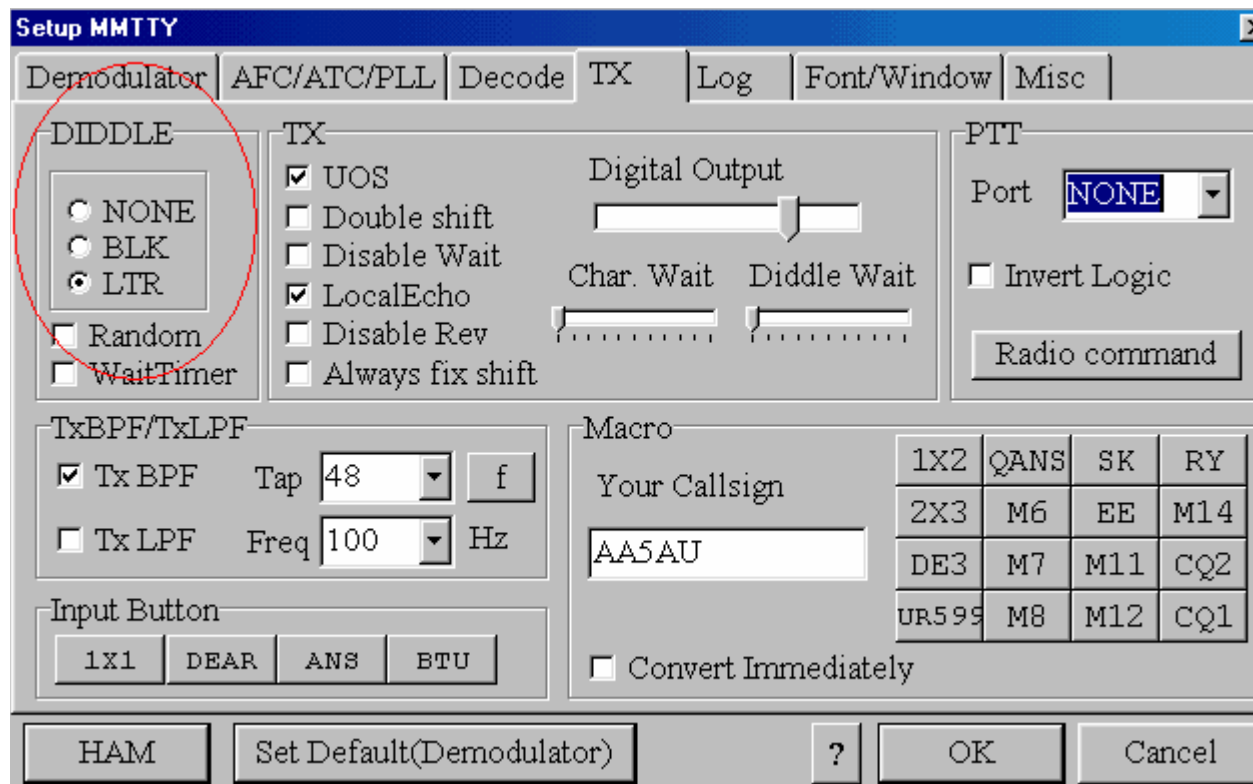
Diddles & Transmit Troubleshooting

Diddles are transmitted in RTTY when idling. When no text characters are being sent,

the RTTY modulator should send out a steady stream of diddles. This normally happens when you key your transmitter and don't type anything from the keyboard. Or if you are typing live in a QSO and you pause. While you are paused, diddles are being sent in an attempt to keep the receiving station's demodulator in sync. It's a timing device that assists when receiving RTTY. It does nothing for your transmit. It's a receive-only issue. Diddles are very important in RTTY. It is highly recommended that you always transmit diddles. You could send out a steady Mark or Space tone when idle, but this could alter the timing sequence of the receiving station's demodulator in the event of a hit. If the signal should fade or a burst of noise occur, it would take the receiving station's demodulator a longer amount of time get get back in sync and more print will be lost than if diddles were being used. To hear what diddles sound like, click [here](#). For a more technical & excellent explanation of diddles, courtesy of Chen W7AY, click [here](#).

Diddles are turned on by default in MMTTY. So when you first key your transmitter, you should hear diddles in your side tone. If not, there is a problem. Either diddles got turned off somehow in MMTTY or your signal is not shifting between Mark and Space as it should be.

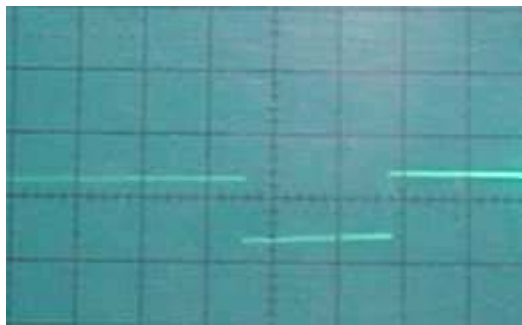
The first thing to check is to make sure diddles is turned on in MMTTY. Go to Options, Setup MMTTY and to the TX tab. Under DIDDLE in the upper left hand corner, LTR should be checked. If not, click on LTR, then click OK.



If diddles were turned on and you still don't hear diddles when you key your transmitter, then there is most likely a hardware problem somewhere. If you are running AFSK, I can think of no reason why diddles would not be sent if your radio is transmitting. With AFSK, you either have audio or you don't. If your radio is in the LSB position, the radio keys up when F9 is pressed and you hear a steady tone instead of diddles, then something is happening I cannot explain. The only thing that comes to mind is RFI on

the audio line coming from the sound card. If you suspect RFI, go to the RFI page [here](#). You should visit this page anyway as there is a lot of information here on protecting yourself against RFI when operating RTTY.

If you are running FSK, then there are a couple of things to look at. If you are running FSK and you hear a steady Mark or Space tone when you key your radio, chances are that your interface circuit is not working correctly. With your interface connected into the FSK input of your transmitter, check the DC voltage on the FSK output of the interface. It should be around +5VDC. If you don't see 5 volts, then your interface is not working. When you key your radio you should see this the voltage fluctuate as diddles are being sent. The best way to test your interface circuit is by using an oscilloscope. Place an oscilloscope across the FSK output of your interface. Set your scope for 5 volts/division and a sweep of about 10 ms per division. You should see a waveform something like this:



If you don't see a waveform or any change in state on your DC voltmeter, then your interface is not working. There is a very remote chance that your serial COM port is not working, but that is rare. You could change COM ports to see if the problem still exists, but odds are your interface is not correct.

If you do see this waveform but you still don't hear diddles while monitoring your radio's transmit, it could be possible that the FSK circuit in your radio is not working. This is also very rare. You can test the FSK circuit in your radio by manual shorting and opening the FSK input while monitoring your transmit. You won't hurt anything by doing this. If the tone changes in frequency from 2125 to 2295 or vice versa, then the FSK circuit is working. If you do not hear a change in frequency between an open and a short on the FSK input of the transmitter, then the FSK circuit in the radio is indeed inoperative.

Other Transmit Problems

I mentioned RFI. RFI is a common problem in RTTY. If you are having any sort of "strange" occurrences while operating RTTY, it could be RFI getting into audio cables, your monitor, your keyboard or FSK line. Be sure to check the [RFI page](#).

Something I haven't covered yet, and it pertains to FSK transmission only, is making sure your radio's FSK circuit is set for 170 hz shift. Most radios that operate FSK have at least two shift selections - 170 hz or 850 hz. 850 hz is called "wide shift" just as 170 hz shift is referred to as "narrow" shift. My Kenwood TS870 has four choices - 170, 200, 425 & 850 hz. If you start transmitting and your RTTY tones do not sound right, it could be possible that your radio's FSK circuit is not set to the correct shift. Check your

owner's manual to determine how to set the correct shift in your radio. Modern radios have menu selections that set the shift, while some older models, such as the Icom IC-751A has a switch under the top cover inside the radio.

One of the most common transmit problems is transmitting inversely or up-side-down. RTTY is polarity sensitive. Transmitting inverted means you are sending a Mark when you should be sending a Space and vice versa. This can happen if you are using AFSK or FSK. With AFSK, it could mean you are using the wrong sideband. LSB is standard but USB can be used if you have the polarity correct. Yet, most stations who send inverted are using the wrong sideband. If you are set up to transmit in LSB, sending RTTY while in USB will result in your transmit being inverted.

When operating FSK, you could transmit inverted if your radio is not set correctly. Most modern transceivers today will have a menu option for setting the polarity of your Mark tone. If you find yourself receiving RTTY OK but transmitting inverted, change the setting in your radio. Some older radios will have a switch setting to change the polarity of your FSK signal. Refer to your owner's manual on how to change the polarity of FSK.

Unless you know what an inverted RTTY signal sounds like, it can be difficult to tell if you are transmitting inverted or not. The best way to test your RTTY operation is to get on the air with someone you know who can tell you if you have it right or not. If you are on the air and someone tells you that your transmit is inverted, 9 times out of 10, you are. Eventually you will be able to recognize an inverted RTTY signal quickly. Occasionally, I'll have someone tell me I am inverted. But after 20 years on RTTY, I can guarantee you I know what an inverted signal sounds like. Soon you will be able to tell the difference as well.

If after all this, you are still having transmit problems, you need to direct your questions to the MMTTY reflector. Another excellent forum for RTTY operations is the [RTTY Reflector](#). I have been a subscriber to the RTTY reflector for many years, first with WF1B and now with contesting.com and I can tell you there is no finer group of people willing to help you with RTTY.

RTTY Subbands

The HF RTTY sub-band boundaries are not written in stone. This is particularly true during RTTY contests. Below are approximations of "normal" operating RTTY subbands.

10 meters - 28080 to 28100 kHz, during contests 28060-28150 kHz. (note PSK operation around 28120).

12 meters - 24910 to 24930 kHz with most activity around 21920 kHz.

15 meters - 21080 to 21100 kHz, during contests 21060-21150 kHz (note 200 watt output power limit for USA stations above 21100 kHz, PSK31 operations around 21070-21072 kHz).

17 meters - 18100 to 18110 kHz with occasionally operations below 18100 but above 18090 kHz. Note: It is illegal for USA stations to operate RTTY above 18110 kHz.

20 meters - 14080 to 14100 kHz, during contests 14060-14120 kHz (note MFSK16 operations around 14080-14082, PSK31 around 14070-14072 kHz).

30 meters - 10120 to 10150 kHz, with most operation around 10140 kHz.

40 meters - 7025 to 7050 kHz and 7080 to 7100 kHz, during contests 7025-7100 kHz.

80 meters - 3580 to 3600 kHz (JA 3520-3525 kHz), during contests 3570-3630 kHz.

160 meters - 1800 to 1820 kHz (RTTY is very rare on 160 meters).

Technical Discussion of Diddles

Most people think diddles only assist when tuning RTTY signals. However, diddles help to keep the demodulator synchronized when receiving RTTY. Kok Chen, W7AY, explains why.

Says Chen:

"Even though Baudot is a 5 bit character code, 3 extra bits are added to provide character synchronization. A start bit (space tone) is pre-pended to the Baudot code, and two stop bits (mark tone) are added after the Baudot code. Thus the actual character is 8 bits.

In "rest" or idle condition, RTTY sends a continuous Mark tone. After an idle (Mark) period, the Baudot stream decoder is going to wait for the first space tone to be demodulated. The Baudot decoder then assumes this is a Start bit. It then assumes that the tone 1/45.45 seconds later represents the first bit of the Baudot character, the one 2/45.45 seconds later represents the second bit of the Baudot character, and so on.

After sending the 5 bits of the character, you send a stop sequence (two bit times, in the case of Amateur RTTY) to place the system back into the idle state, so the Baudot decoder can now look for the Start bit of the next character.

Now take the case of not sending diddles.

Let's say you miss that first start bit of the first character after a long idle mark. Not only do you miss decoding the first character properly, you will be out of sync for quite a while, mistaking a lot of future data bits as start bits, and advancing the character timing only when the place where a start bit should have fallen happens to have a mark tone.

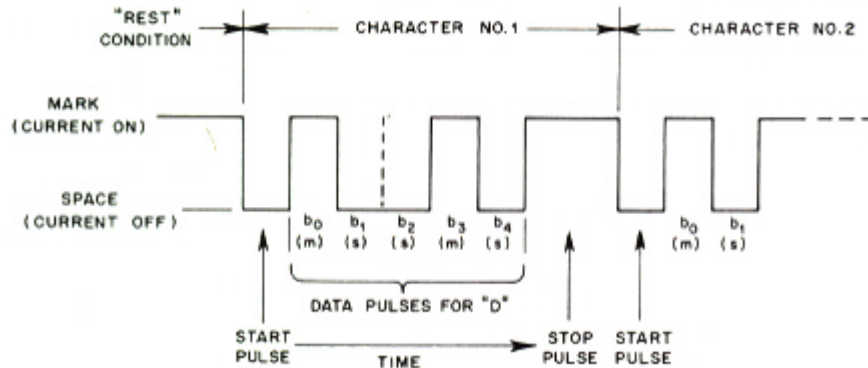
There is a 50% chance that you will advance after an error, and 50% chance you continue to be out of sync. Even when you advance, you may hit yet another space character that is not a start bit. On average, it takes 3 to 4 character times before you are in sync again.

So, after making a character synchronization error, not only do you screw up decoding that character, you will be printing gibberish for the next couple of characters too. Until character sync is accomplished.

Diddles are just a non-printing character, usually the Baudot LTRS character. When you transmit diddles, you replace the idle Mark tone by a repeating sequence of LTRS. What really helps is that the Baudot LTRS character is 11111 (all Mark tones). So if you miss a character synchronization of one LTRS character, the Baudot decoder will immediately advance to the next true start bit (Space) since there are no bits in LTRS which looks like a start bit."

After reading all that, you still may not understand diddles. I didn't understand it right away either. Chen explains it perfectly though. After looking up other sources explaining Baudot, and remembering the digital picture I took of what LTRS diddles looked like on my oscilloscope, it all came together for me. Let me try to explain it to you.

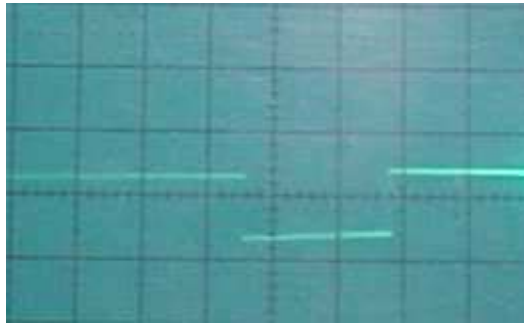
First, let's look at a typical Baudot character. Below is the character "D".



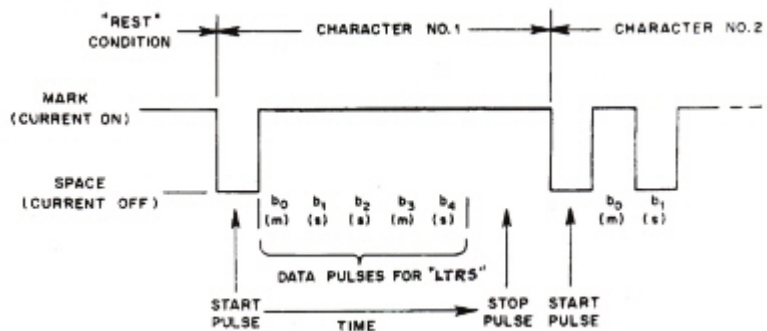
It shows the first bit or "pulse" as a Space. This is the start bit. Then the actual code for the letter "D" is sent with the first bit as Mark, followed by two Space, then another Mark and the last data bit is a Space - thus 10010 in binary so to speak. Then two Mark tones ends the sequence as stop bits. Or in other words, the last two Mark tones are really one long Mark tone at twice the time it normally takes for one bit. In theory, it looks like 8 bits as described earlier by Chen. For the letter D, in theory is 01001011 after we put a Space (0) as a start bit in front and two Mark (1's) at the end. Every character in the Baudot code starts with a Space start bit and ends with two Mark stop bits. Your decoder, in our case MMTTY, knows this sequence and uses it for timing.

Since diddles was set to the LTRS character in the MMTTY setup, when we pause sending text, we send the LTRS character over and over until we send the next text character. The LTRS character is used to tell the decoder that the next character sent will be a LETTER and not a FIGURE (unless the next character is also a LTRS or a FIGS character). So you will see nothing happen on your screen. LTRS and FIGS characters are non-printing characters.

Let's look at the picture I took on my oscilloscope when I was sending diddles from MMTTY.



When you look at it, it just looks like a steady signal with one drop in level. If you look at it closer, it looks like a steady Mark tone with one single Space tone thrown in. And that is exactly what it is. The LTRS character is 11111 in Baudot code. If you put the mandatory single Space start bit in front and the two Mark stop bits at the end it's 01111111. At that is what you see in the oscilloscope. It was difficult for me set the scope so it could be shown exactly this way, but the diagram below shows it more clearly.



As you can see, the LTRS character is one Space stop bit followed by timing for 5 Mark data bits and 2 Mark stop bits. Now go back and read Chen's dissertation again on the advantages of using diddles and it should make much more sense now. Always use diddles when transmitting RTTY. Click [here](#) to hear what LTRS diddles sound like.

RFI

Radio frequency interference (RFI) can be a problem when running RTTY. You may never have an RFI problem when running SSB or CW or not notice it anyway, but all of a sudden you find RFI creeping into your system when running RTTY. Why? Because RTTY is full keyed down power out at 100% duty cycle. This does not happen during SSB or CW.

When talking about RFI, there are two scenarios. Either your transmitter is causing the RFI to your computer and/or associated cabling or your computer is causing RFI to your radio. The discussion on this page is concerned with the first circumstance of your transmitter causing RFI to your RTTY setup. Common symptoms of your transmit signal causing RFI to your RTTY setup are erratic keyboard & mouse operation and distorted or erratic RTTY transmissions either AFSK or FSK.

You will normally only get RFI with RTTY when your antennas are very close to your shack and you run a linear amplifier. But as most of us know, RFI can happen anywhere. The most common devices affected by RFI are the computer keyboard, mouse, audio cables, FSK cables and network cables (CAT 5).

RFI can be eliminated rather easily in most cases. Ferrite toroids and rods work wonders in keeping RF out of cables going into your radio and computer. Before installing toroids or rods, check all your antenna cable connectors to make sure you don't have a bad connection. Check your antenna cables to make sure they are in good condition and not leaking RF. Also, use shielded cable on all your cabling for audio or FSK. And make sure all equipment is properly grounded. It's best to ground each piece of equipment separately and to bring the ground wires back to a central bus bar which is connected directly to a ground rod or other suitable ground. Ground wires should be kept to the shortest length possible. If shielding and grounding doesn't get rid of the RFI, the next step is to install either ferrite or iron powder rods or toroids.

In order for these toroids or rods to eliminate RFI caused by Amateur HF transmissions, they must be made of the correct material. The best source to learn about ferrite & iron ferrite devices is [CWS ByteMark](#). CWS ByteMark is one of the largest distributors of ferrite & iron core toroids, beads, rods and just about anything you can think of made of these materials. Their website is full of all kinds of information concerning which ones work best for RFI and EMI suppression.

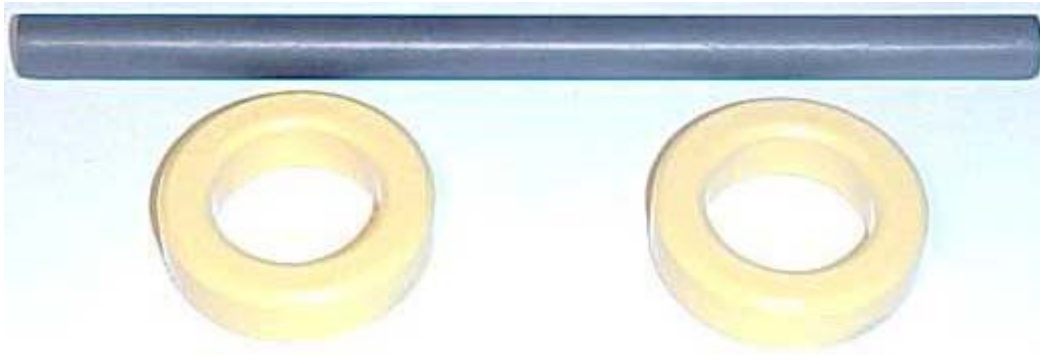
The CWS ByteMark site contains so much information, I found it difficult to navigate. And even though they have a link to a page specifically for hams, I found section 2 of their [Specifications and Downloads page](#) the most beneficial. In particular the PDF files on [EMI/RFI Suppression](#) (which shows a chart showing each material and which frequencies they suppress), [Ferrite for RFI](#), and [Ferrite Cores for RFI Suppression](#) should be read.

Ferrite material is recommended for better RFI suppression than iron core material although I have had success with both. And for simplicity sake, ferrite material 73 is probably the best for suppression in the 1 to 40 MHz range. Having said this, I also want to add that I have had success with material not actually known for suppression in the HF range. For example, ferrite rods are normally made of material 33 or 61. Material 33 is used for low frequency antennas and material 61 is known for RF suppression above 200 MHz. I've used rods with great success in eliminating RFI. I don't know the reason for this, they just worked. I like rods better than toroids because it's easier to wind cable around.

Despite being popular items, I have not had much success with round cable suppression cores as shown below.



Instead, I have better success with toroids and rods as shown here.



I'm not sure why this is. The major difference between the three are that with rods and toroids, the cable is wrapped around the ferrite material whereas with cores, the ferrite is around the cable.

I have also found that the bigger the rod or toroid, the better the suppression. When choosing a toroid, be sure you get one that is big enough for your cable, especially if you have some sort of connector already installed on the end.

Cable is wrapped around toroids and rods as shown below.



The cable shown above may be a little "over kill" but it might be necessary to put a ferrite device at each end of a cable to completely eliminate RFI. In most cases, I have found that one toroid or rod will work. Placement of the toroid or rod may be important as well, but not always. For instance, on keyboard cables, I like to put use a rod instead of a toroid and I place it near the input to the computer.

How do you know if you have RFI into your keyboard? You can tell when you are

keyed up and typing away but the characters you type are not the characters going out on the air. Wrap the keyboard cable around a ferrite rod and it will eliminate the RFI. The same goes for your mouse. Although I can't recall ever having RFI problems with my mouse, I suppose it could happen. Try a short rod.

If you run AFSK, I highly suggest using a toroid on the cable used for transmit audio from the sound card to the audio input of your radio. RF on the transmit audio cable will cause all kinds of problems. Even though I operate FSK on RTTY, I have to use an audio transmit cable when running PSK31. When I first started PSK31, I had bad RFI problems on this cable, even running low power (less than 50 watts). A ferrite rod took care of that problem and now I can run 100 watts on any band.

One symptom of RFI on a transmit audio cable can be seen by the RF power output jumping around erratically. When transmitting RTTY, your RF power output should be constant or fluctuate only slightly. If you have large fluctuations in your transmit carrier, you may be experiencing RFI.

When transmitting AFSK, you should have the monitor turned on your radio so you can hear what the transmit audio sounds like. If the tones sound distorted, then RFI is probably the culprit.

You could have RFI on the transmit audio cable and not know it. If you have a second radio, it's always a good idea to listen to what your signal sounds like. Or meet someone on the air who can tell you if your signal is clean or not.

It is possible to get RF into your computer. Many times, this is caused by RF getting onto the AC cable and into the power supply. An RF suppression AC power strip can cure the problem or use a toroid on the AC power cord. RF might be getting straight into the computer or into the sound card. Not being an expert on RFI, I can only suggest you check other resources for information on RFI suppression. There is an RFI reflector on contesting.com that may assist in getting answers to your RFI questions.

It's important to recognize and fix RFI problems in order to ensure smooth RTTY operation.

See you on the RTTY bands!

73, Don AA5AU