

HF Digital Mode Primer

By Val Campbell K7HCP

INTRODUCTION

Getting started using the Amateur Radio Digital Modes of communications can be confusing and frustrating at times but it doesn't have to be that way. The purpose of this primer is to introduce you to the basics of using this fun to use mode of communication and to provide you with the understanding of the processes to setting up your hardware and software to easily and quickly start copying and later to start sending digital communications on the amateur radio HF shortwave bands.

The minimum hardware requirements to receive or copy HF digital communications are a personal computer (PC) with a standard sound card and a short wave or ham radio receiver with SSB mode. A receiver with digital tuning display is preferred but a receiver with analog tuning can work also.

You may have heard about various digital modes such as RTTY, SSTV, FACTOR, PSK31, and of course, CW. CW or Morse Code, as it is more commonly known, was the original digital mode used in communications; however few thought of it as digital until recently. Just like our old wristwatches were analog watches, we didn't think of them as such until digital watches came into existence. PSK31 has become by far the most popular digital mode used by amateur radio operators lately. PSK31 stands for Phase Shift Keying with a bandwidth of only 31 hertz. That's really all you need to know to use this mode of communications. The program does the rest for you.





The ARRL has the following to say about PSK31:

Since the spring of 1999, PSK31 has taken off like wildfire. What seems to be so attractive is that for very little investment, a simple station can achieve virtually flawless communications under very adverse conditions. This new mode also seems to have been made for the ham who might be hampered by an indoor, or less-than-optimum antenna. There are numerous reports of solid two-way communication when the signal is barely audible from the speaker. PSK31 requires a standard ham station, a computer with a SoundBlaster 16 compatible card, some free software and a very simple four component circuit if you wish the computer to control TR switching.

The software needed to get you started is freeware and can be downloaded from the Internet. One thing about Hams is that there are a lot of very talented amateur radio operators that are also talented programmers and freely share their programs in the name of promoting the hobby of Amateur Radio. **Digipan** is such a program and is available free for download. This PC application program, once installed on your PC, will support receiving, sending and logging PSK31 communications. We will discuss in detail the minimum requirements to get you started; first, to simply receive PSK31 communications, and later, to transmit PSK31 transmissions.

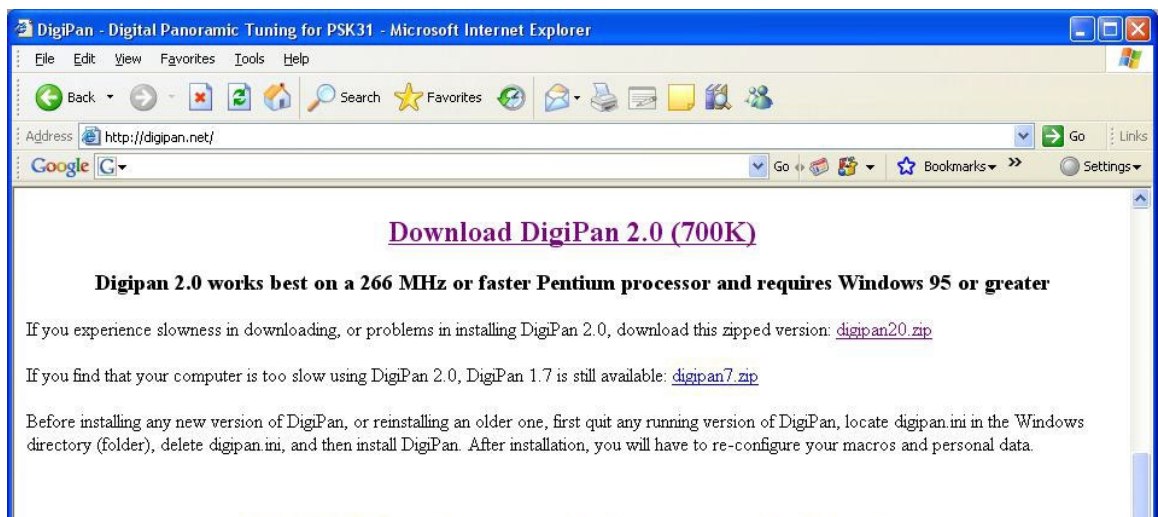
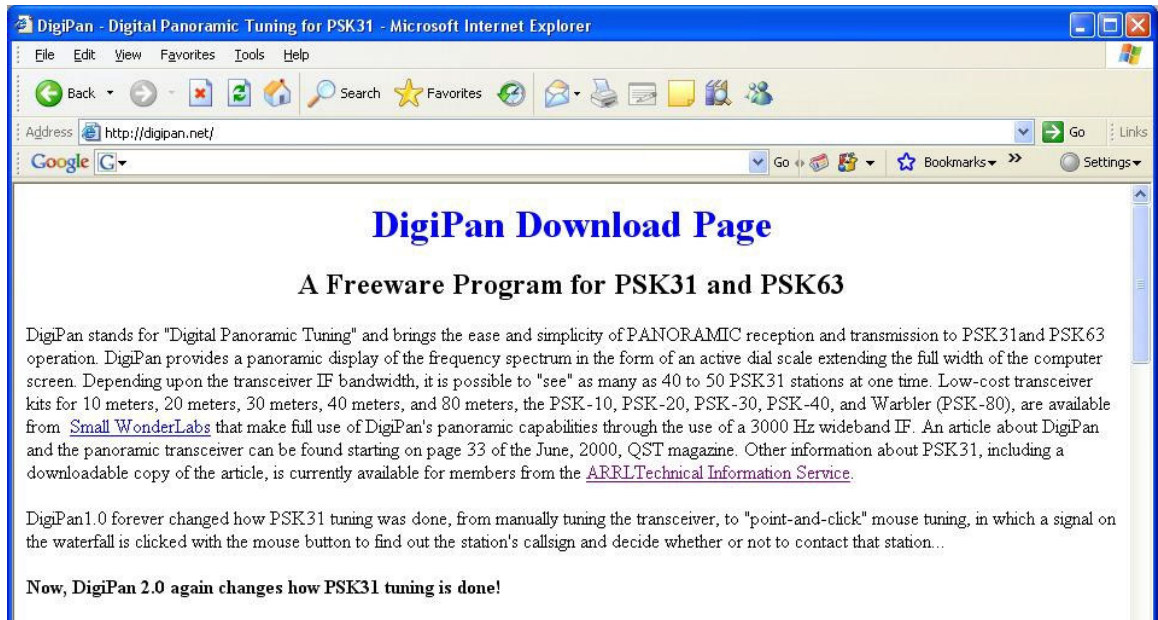
[\(Digipan authors: KH6TY, UT2UZ, UU9JDR\)](#)

There are other freeware programs available for download to support some of the other HF digital modes, and yet other programs that support more than one mode in the same package. There are also for-purchase programs available. Having said that, PSK31 is by far the most popular mode being used today and Digipan is by far the best program available to support PSK31, and it's FREE.

[\(For other modes and programs – see Reference section below\)](#)

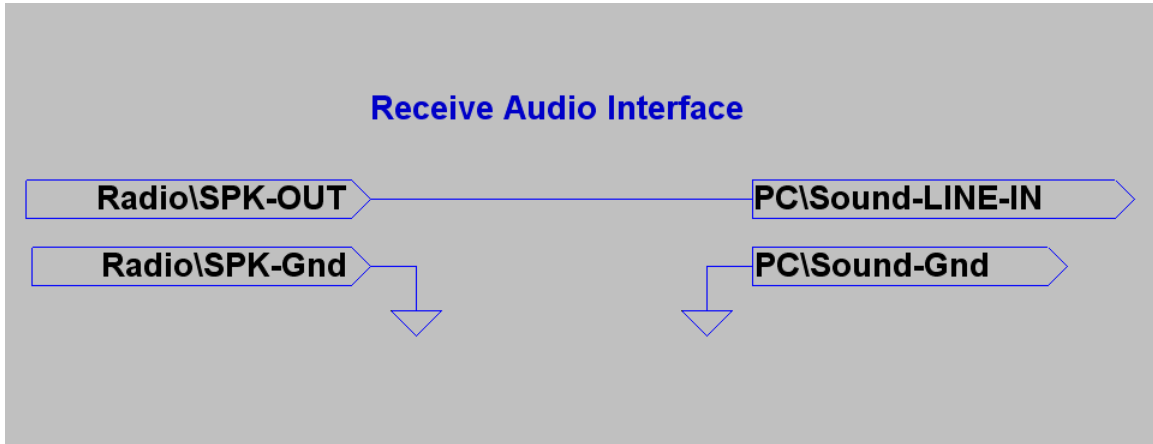
PROGRAM DOWNLOAD

So let's get started. First, point your browser to <http://digipan.net>. Scroll down the page and click on **Download DigiPan 2.0**. After downloading DigiPan, install the program as per the installation prompts. Don't start the program yet. We have a few other things we must do first.



HARDWARE CONFIGURATION – RECEIVE

Before we start the program we must interface your PC to your receiver. This can be done any number of ways. The simplest and quickest way would be to plug a microphone into your PC sound card **MIC/SOUND-IN** jack (orange) and place the microphone in front of your shortwave receiver speaker. If you do not have a Microphone or if you prefer to take this interface to the next level of sophistication, obtain a shielded audio/stereo cable and plug one end into the PC Sound Card **LINE-IN** (blue) jack and the other end into your receiver **SPEAKER-OUT/EARPHONE** jack.



DIGIPAN CONFIGURATION - RECEIVE

Now, it's time to start **Digipan**. The first time you start the program, you must personalize Digipan with user information. Follow the query to enter your call sign, name and QTH (city & state). If you do not have a call sign yet, simply enter SWL for Short Wave Listener. Of course, it will NOT be legal to transmit until you have a amateur radio call sign but you will be able to copy the other HAM radio operators as they QSO (contact/communicate) one with another.



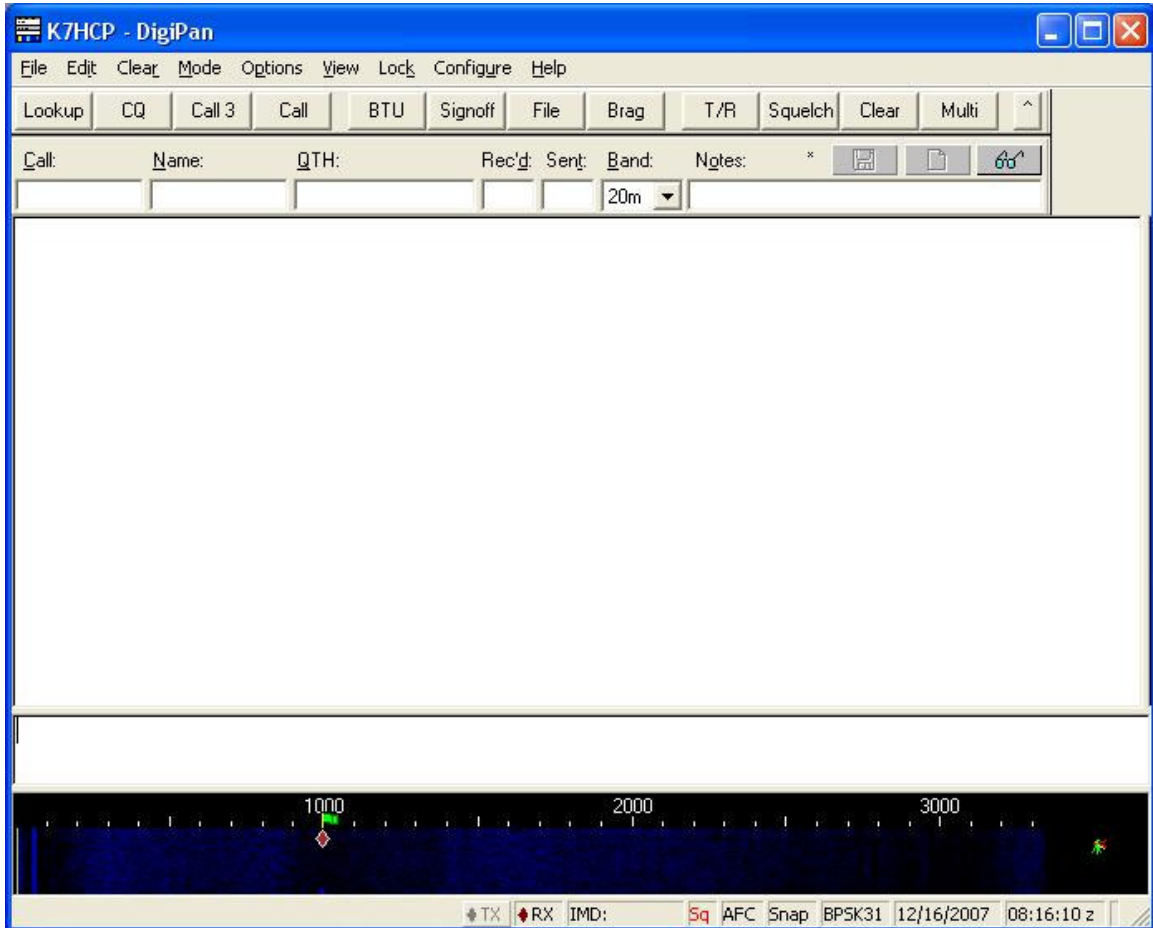
The screenshot shows a 'Personal data' dialog box with the following fields and controls:

- Call:** K7HCP
- Name:** Val
- QTH:** Ogden UT
- Use CWID
- Fast
- Slow
- CWID:** de K7HCP sk
- Buttons:** OK, Cancel

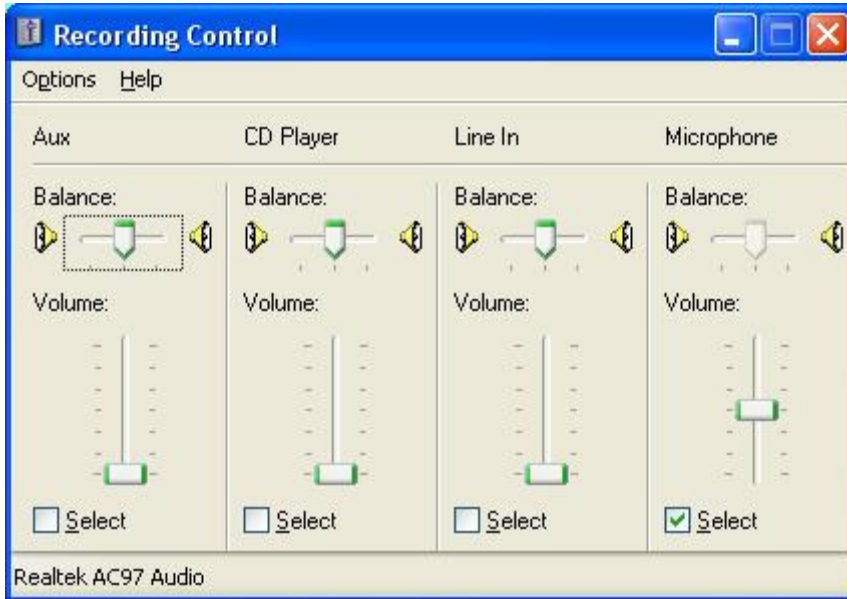
NOTE1: If you need to change the personal data at a later time, on the main Digipan screen click the **CONFIGURE** keyword on the tool bar at the top of the Digipan window and then click **PERSONAL DATA**

NOTE 2: To make things simpler for first time users, on the main Digipan screen click the **VIEW** keyword on the tool bar at the top of the Digipan window and then click to '**un-check**' the **MULTI-CHANNEL WINDOW** selection. Later you may choose to go back and check this choice for enhanced usability.

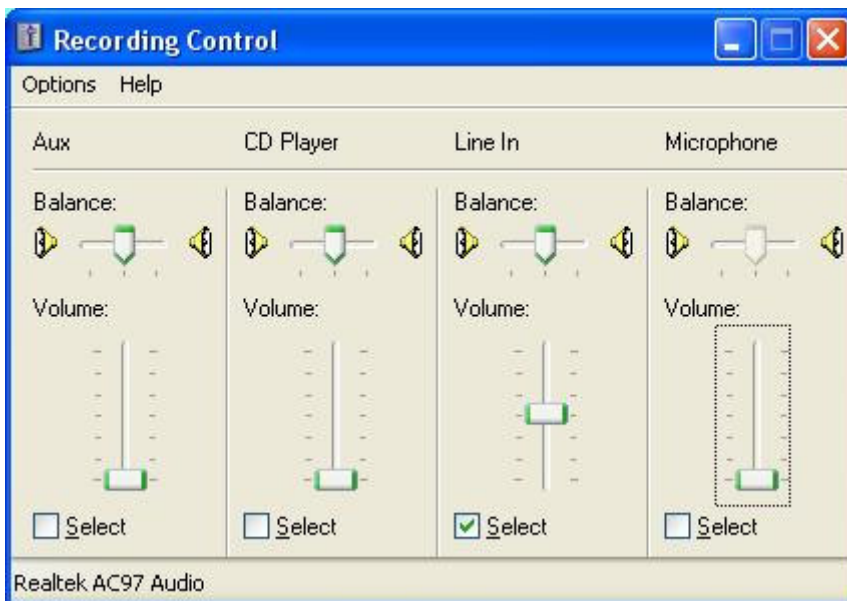
This is how the Digipan screen looks right after installing the program. With a little familiarization you will want to personalize the appearance and function ability of the operational window to suit your personal preferences. All the screens that I will show you after this one have been personalized to suit my preferences.



Next we must set up the sound card input (receive) audio levels. Click on the **CONFIGURE** keyword on the tool bar at the top of the Digipan window and then click on **WATER FALL DRIVE**. This opens the **RECORDING CONTROL** panel. If you are using a microphone connected to PC sound card Mic-In jack, click 'select' for the MICROPHONE panel and slide that slider to about the mid range position.



If you are using a direct connect audio/stereo cable between your radio Speaker-Out and the PC sound card Line-In, click 'select' for the LINE-IN panel and slide that slider to about the mid range position.

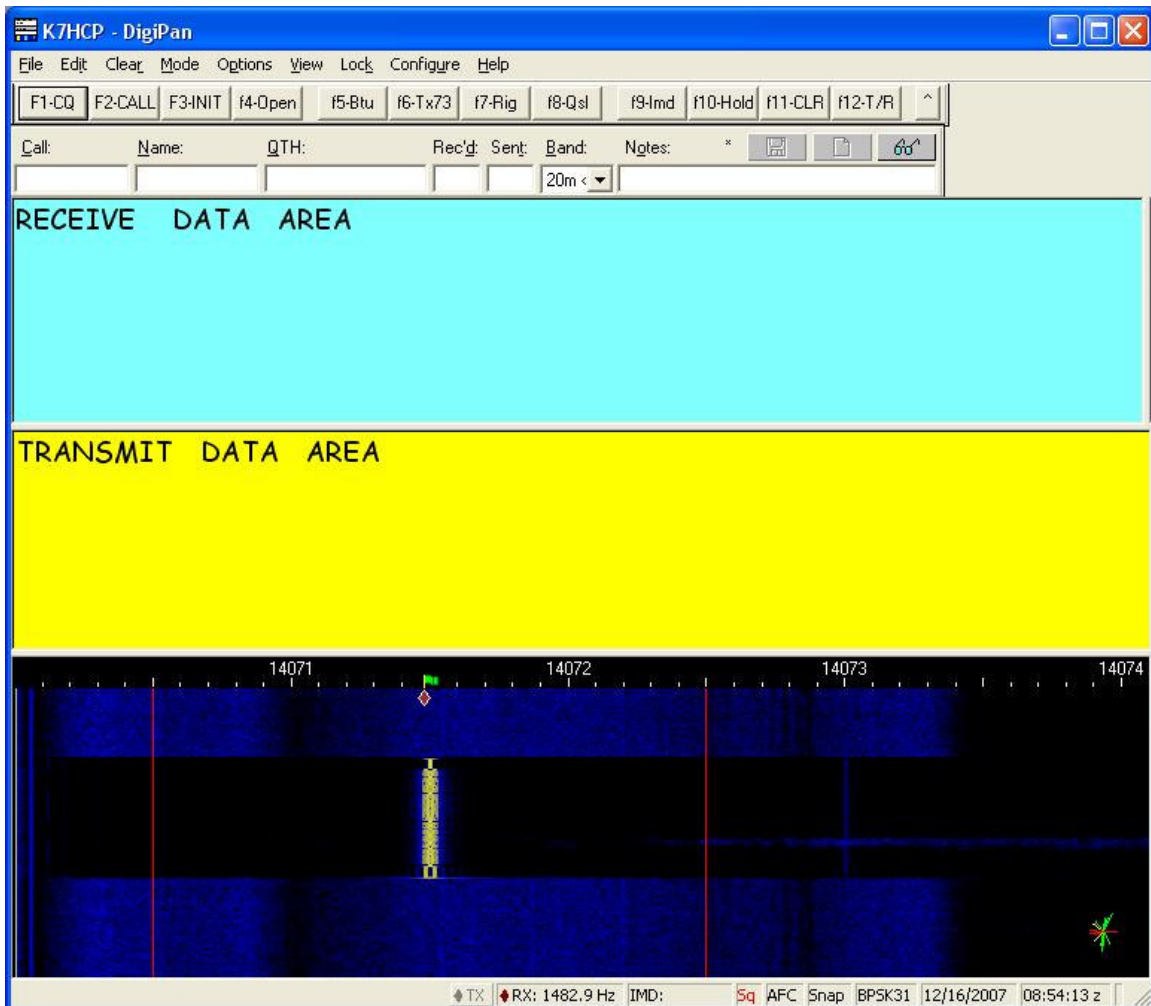


Finally, if your recording control window has a panel for the main RECORDING volume, depends on the PC sound card being used, slide that slider to about the mid range position. If not, we will do it later. Now you can close the recording control window.

DISPLAY SCREENS

On the main DigiPan screen, there are 3 data display areas. The area at the bottom of the screen is the **receive signal WATER FALL display** area. The area just above the water fall signal display area is the **transmit data entry** area. We won't be using this area until we setup your configuration for sending PSK31 signals. Of course, that would require that you are already a licensed Amateur Radio operator. The display area just above the transmit data entry area is the **received data display** area. This is where the received text messages are displayed as they are decoded by DigiPan. Think of this as your Amateur Radio wireless Instant Message (IM) screen. Hi Hi

You can resize any of the data areas by clicking on the heavy horizontal borderline immediately above each data area and dragging the borderline upward or downward. I recommend that we should enlarge the bottom water fall display area because this is where you do all your **tuning** while operating PSK31. More about tuning later. First, let's make room for the larger water fall display area by resizing the middle, transmit data area. Do this by clicking on the heavy horizontal borderline immediately above the middle display area and drag it upwards. Now, do the same thing with the heavy horizontal borderline immediately above the bottom water fall display area. I would suggest making the top receive data area about one-half of the total screen area and then split the remaining area between the middle transmit data area and the bottom water fall display area.



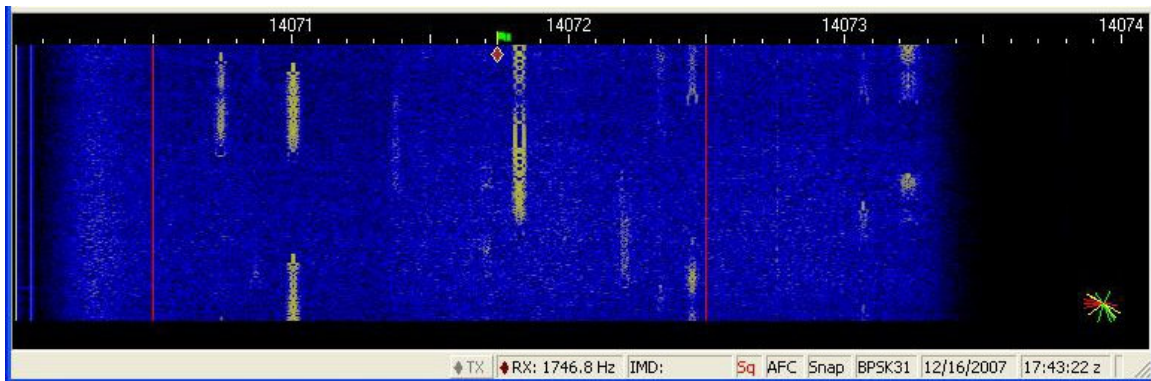
RECEIVING PSK31

Okay, it's time to turn on the radio. Set your receiver to Upper Sideband (**USB**) mode and tune to **14.070 Mhz** [20 meter band] daytime, **7.070 Mhz** [40 meter band] late afternoon/evening or **3.580 Mhz** [80 meter band] night time. Adjust the volume until you can hear a respectable level of audio. PSK31 signals sound like a lot of various TONES whistling in the background. What you are hearing (hopefully) are many stations all simultaneously transmitting PSK31 digital signals across the band. Worry not. Even though your human ear cannot sort out all the signals the PC sound card with the help of Digipan can.

The **water fall** display area is your main point of control for most of the digital operations. This is where you do your tuning, not at the radio. The water fall background is black initially. As you turn up the receiver volume the background will start to turn blue. As you advance the volume further, yellow noise will be displayed on the blue background. If you turn the volume up too far the blue will be completely covered with yellow noise. Back off the volume until you have a balance between blue background and yellow noise.

Note that you can also control the audio receive sensitivity by using the 'Recording Control' mentioned earlier. Click 'Configure' on the tool bar and then click 'water fall drive'. Adjust the **slider controls** to affect the water fall display area background as described above. You will be amazed how low a speaker volume is needed to get perfect copy. More about this later.

The water fall display area is where we see displayed the various stations transmitting in the PSK31 ham band. Every station that is transmitting at any one time shows up as a vertical trace on the water fall. Another station may show up either to the left or to the right (up frequency or down frequency) of the other stations. Many stations may show up here at the same time, especially when the band is open, spread out horizontally across the water fall display. With a receive signal present, fine tune the volume controls until the vertical signal trace stands out as a deep yellow **train track** (two parallel lines). If you get the volume too high, the deep yellow train tracks will turn to red. This indicates that you have the audio input level too high. Back off the volume until you have the perfect trace.

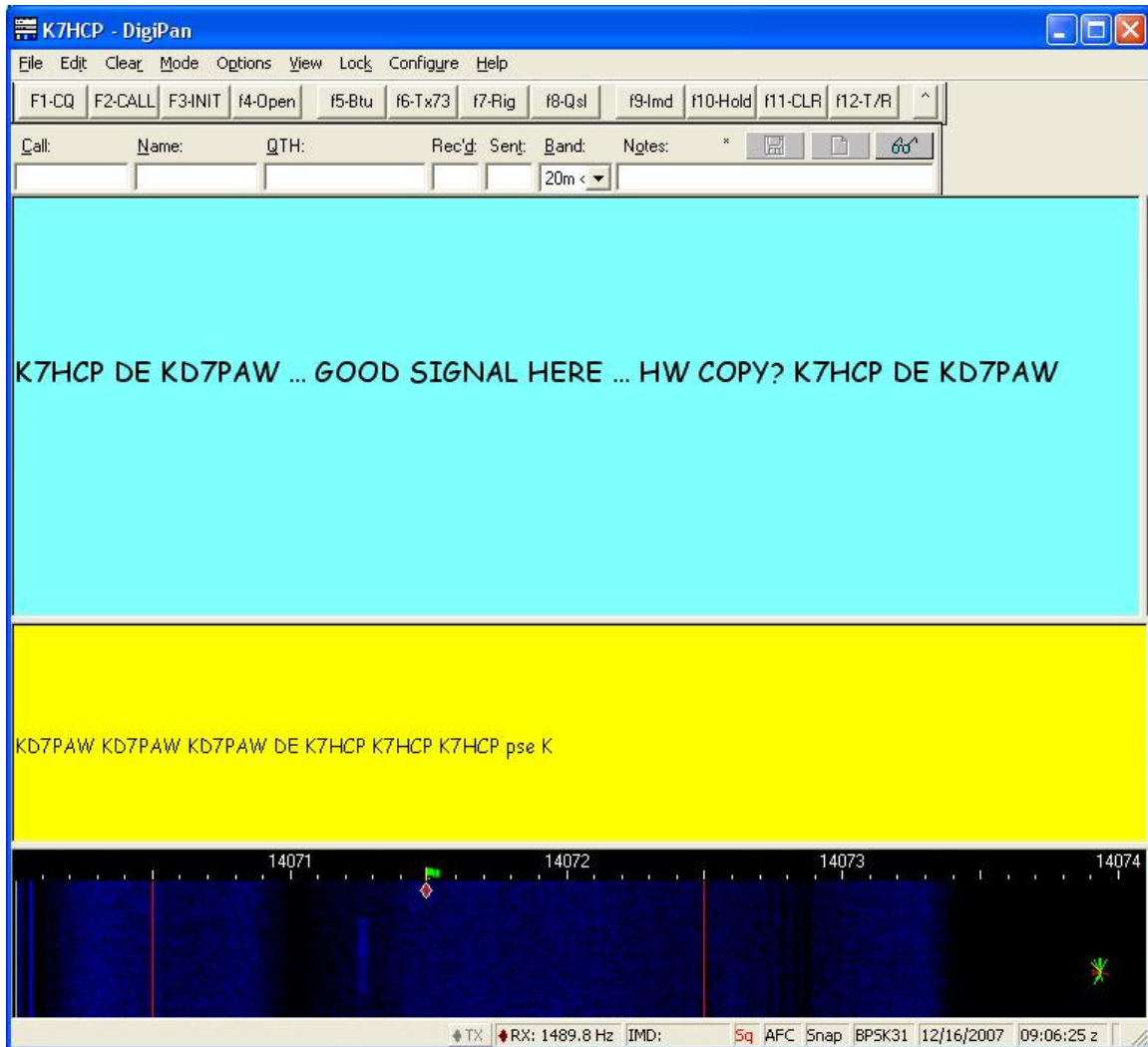


To tune in a station and start decoding any one of the stations, simply put your **Mouse Pointer** over the desired vertical trace train tracks on the water fall display and then click. Digipan will start to decode that signal and display the received data in the top display window area. To copy another station simply put the mouse pointer over another train track trace on the water fall display and click again.

NOTE 3: There is NO need to tune your receiver. You do your tuning with your mouse as described above. Set your receiver on one of the frequencies outlined above and leave it set. If your receiver does NOT have a digital tuning display an analog tuning dial will still work but will require more trial and error to find the desired frequency. Just tune very slowly and listen for the various TONES whistling in the background. Then look at your waterfall display for train tracks to appear as the waterfall cascades downward in time.

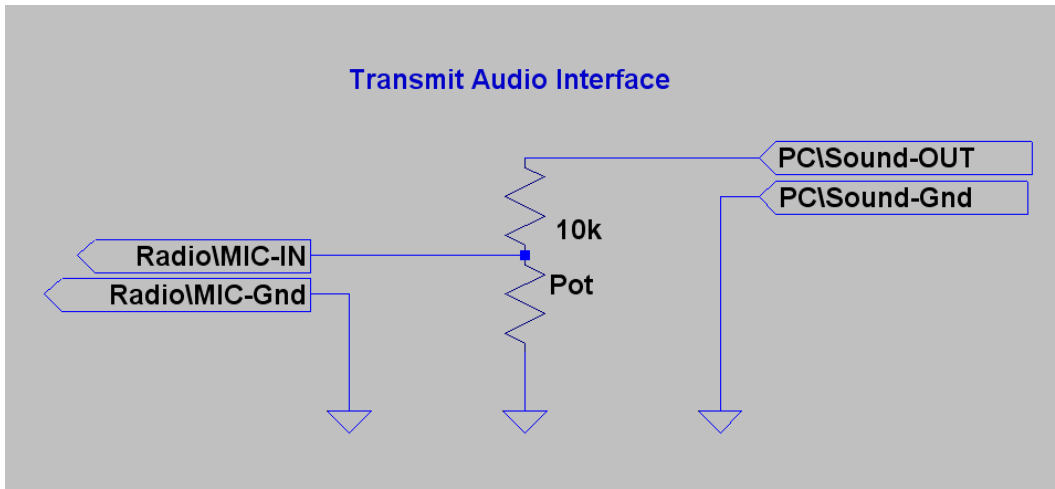
NOTE 4: Remember that for PSK31, always set your receiver to SSB mode, Upper side band (USB).

The top data area is where the PSK31 signal is displayed as it is received and decoded by Digipan.



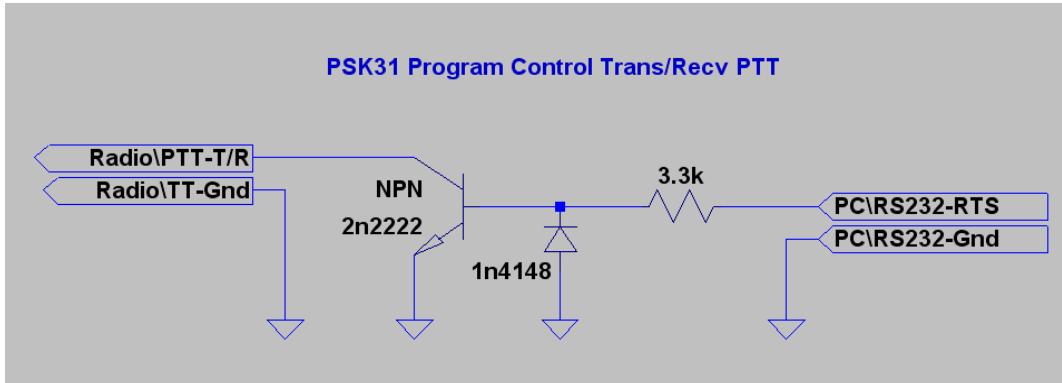
HARDWARE CONFIGURATION – TRANSMIT

Before we can transmit we must interface your PC to your transmitter (transceiver). This can be done either of two ways. The simplest and quickest way would be to obtain a shielded audio/stereo cable and plug one end into the PC Sound Card **SOUND-OUT** jack (green) and the other end into your transmitter **MIC-IN** jack. Depending on the brand/model of your transmitter you will probably need to attenuate this signal with a series resistor or the sound card may over modulate your transmitter. Different transmitters have various mic input level requirements so the value of the series resistor will vary. You will have to experiment with this or use an adjustable variable pot.



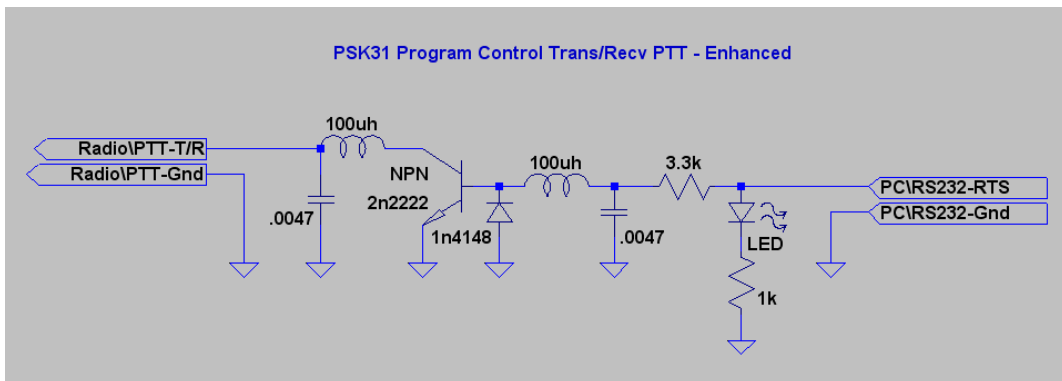
PROGRAM CONTROL – SIMPLE TRANSMIT / RECEIVE PTT

To take this interface to the next level of sophistication, you can optionally choose to interface your PC **RS232 serial port** to your transceiver Transmit/Receive (T/R) Push-to-Talk (**PTT**) which allows the PC program to switch your transceiver between receive mode and transmit mode automatically. This can be real cool. This way your **mouse pointer** becomes the point of control for all transmit/receive operations.



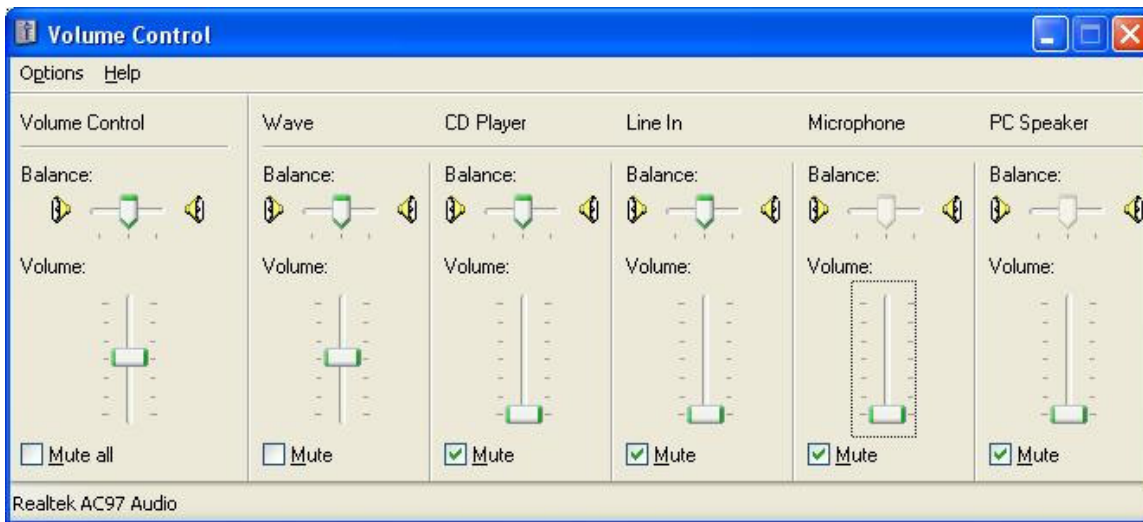
PROGRAM CONTROL – ENHANCED TRANSMIT / RECEIVE PTT

In addition please note that you may prefer to use an enhanced T/R interface option. This interface contains additional components that will help protect your T/R interface from stray RF. You will want to use this circuit if you find that when the program keys the transmitter it does NOT successfully return to receive mode. Additionally this circuit contains an LED to indicate when the program has keyed your transmitter. This can be very helpful.



DIGIPAN CONFIGURATION – TRANSMIT

Next we must set up the sound card output (transmit) audio levels. Click on the **CONFIGURE** keyword on the tool bar at the top of the Digipan window and then click on **TRANSMITTER DRIVE**. This opens windows **VOLUME CONTROL** panel. Since we are using a direct connect audio/stereo cable between your radio Mic-In and the PC sound card Audio-out, make sure that the WAVE panel is NOT muted (un-click 'mute' for the WAVE panel) and slide that slider to about the mid range position. Finally slide the VOLUME CONTROL slider to about the mid range position. Now you can close the volume control window.



TRANSMITTING PSK31

To transmit on the ham bands requires that you are a licensed Amateur Radio operator.

To transmit a CQ (general call) simply put your **Mouse Pointer** at a point on the water fall display that is **not** in use, absent of any vertical trace train tracks, and then click. This will choose that spot on the band (frequency) that you want to transmit. Be sure you do not click to near another station's tracks. Next place your mouse pointer over the **transmit data area** and click. The area just above the water fall signal display area is the **transmit data entry** area. Now you can use your keyboard to enter a CQ message to be transmitted. Mixed case characters are allowed in PSK31. When you have finished entering the outbound message click the **T/R button** on the tool bar at the top of the Digipan screen to enter transmit mode. If you are using the program controlled T/R interface circuit described above the program will control the transceiver automatically for you. Otherwise you will have to switch your transceiver to transmit manually.

After the message has been transmitted click on the T/R button again to switch back to receive mode. Again if you are using the program controlled T/R interface circuit the program will control the transceiver automatically for you. Otherwise you will have to switch your transceiver back to receive manually.

To answer another station that is calling CQ, simply put your **Mouse Pointer** over the desired vertical trace train tracks on the water fall display and click to set your transmit frequency. Digipan will start to decode that signal and display the data received in the top display window area. To reply, place your mouse pointer over the **transmit data area** and click. Now you can use your keyboard to enter a response message to be transmitted to the station calling. As described above, when you have finished entering the outbound message, click the **T/R button** on the tool bar at the top of the Digipan screen to send your message. You can continue to key in your message as you transmit. You do not need to finish entering your outbound message before you start to transmit.

NOTE 5: Remember, there is **NO** need to tune your transmitter. You do your tuning with your mouse as described above. Set your transmitter on one of the frequency bands as outline in the receive section above and leave it set. Also note that your transmit data is displayed in your received data area as it is being transmitted.



CONCLUSION

Amateur radio digital communications can be very exciting. The purpose of this primer was to introduce you to the basics of using this fun to use mode of communication and to provide you with the understanding of the processes to setting up your hardware and software to easily and quickly get you started.

With very little investment in equipment and minimal interfacing you can be “on-the-air” using many of the digital mode communication programs that are available for download from the internet. Many of the programs are free of charge, written by amateur radio operators throughout the world. Other very exceptional programs are available at quite reasonable prices.

Operating PSK31 requires minimal transmitter power to communicate effectively. Most hams operate with only 25 to 50 watts output. Be careful to not over modulate your signal. Using too much transmitter ALC will make your signal difficult, if not impossible, to copy. Check the waterfall display for received signals that have distorted or wide ‘train tracks’. This is a visual indication that the station is over modulating their PSK31 signal. Be careful that you are not one of the stations that do that.

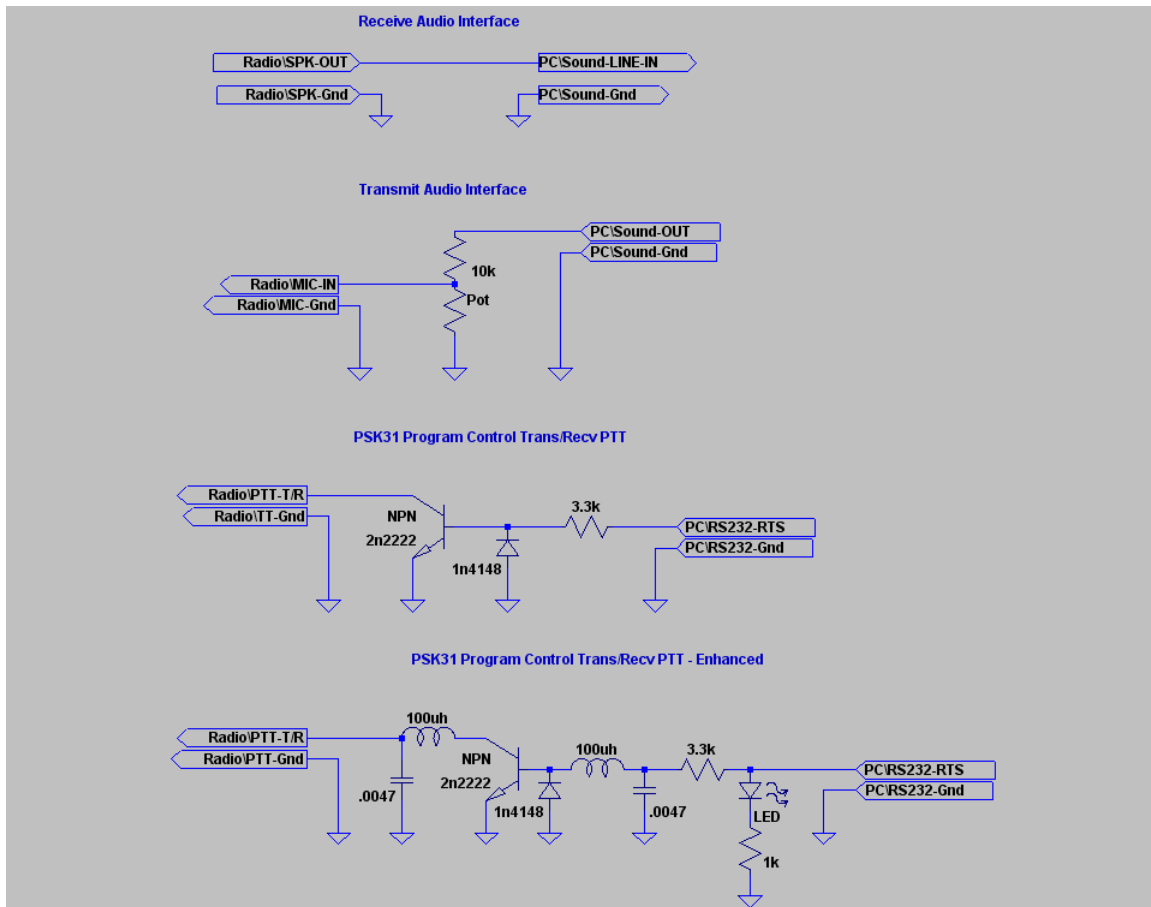
Good Luck going digital and if you have any questions or comments please feel free to contact me via email: k7hcp@arrl.net

REFERENCES

Other digital mode decoder programs

- PSK31 – Phase Shift Keying (very good program)
 - DigiPan <http://digipan.net/>
- RTTY - Radio TeleType (the best for RTTY)
 - MmRTTY <http://amateur-radio.ca/>
 - TrueTTY <http://dxsoft.com/>
- SSTV – Slow Scan TV (the best for SSTV)
 - MmSSTV <http://amateur-radio.ca/>
- CW – Morse Code (makes copying CW easy)
 - GetCW <http://dxsoft.com/>
- Multi Mode programs (*)
 - HamScope <http://www.qsl.net/hamscope/>
 - MixW <http://mixw.net> (highly recommended)
- Contact Log Programs (highly recommended)
 - AALog <http://dxsoft.com/>
 - ALog <http://n3fjp.com/>
- (*) Multi Mode programs support many of the following digital modes as well:
 - PACTOR
 - WinLink 2000
 - Clover
 - Hellschreiber
 - MFSK
 - G-TOR
 - MT-63
 - Throb
 - Olivia
 - DominoEX

Reference Diagrams



Hope to hear you on the bands soon.

73,

Val K7HCP