TEN-TEC

USER'S MANUAL

PC RADIO
MODEL RX-320

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INTRODUCTION

Thank you for purchasing the TEN-TEC PC RADIO, Model RX-320. Worldwide shortwave listening is now only a mouse click away on your Windows based PC.

The PC RADIO is different from conventional portable and tabletop shortwave radios in two ways. First, there are no front panel controls, as it operates entirely by mouse and keyboard commands. Second, the receiver itself is designed with Digital Signal Processing or "DSP" technology. Model RX-320 represents a new breed of receivers that are more software than hardware. This software-based approach provides features only dreamed of in previous radios in this price class. The software package you are about to install is your link to shortwave listening. We strongly recommend beginning listeners read the "Introduction to Shortwave Listening" on Page 11. It contains a wealth of information to help you get started.

If you need help for any reason, there are four convenient ways to get in touch with us. You can phone the service department directly or through the main switchboard. If you prefer, send a FAX or drop us an e-mail. The numbers are all listed in the unpacking section that follows.

UNPACKING

Carefully unpack your PC RADIO and inspect for signs of shipping damage. Should any damage be apparent, please notify the delivering carrier immediately, stating the full extent of the damage. Retain all damaged cartons. Liability for shipping damage lies with the carrier. It is recommended you keep the shipping carton and fillers in the event that storage, moving or reshipment becomes necessary.

The following hardware and accessories are packed with your PC RADIO. Please make certain that you have received everything.

1 #98586 CD Program Disk
1 #74360 User's Manual
1 #74020 Warranty Card
1 #46172 9-pin female to 9-pin male DB-9 cable, to serial port
1 #46171 Line-Out to Audio-In cable, to sound card
1 #21195 Wall Transformer, 120VAC Input, 15VDC, 800 mA Output
1 #38264 Telescoping Whip Antenna
1 #35003 Male phono connector, for an external antenna
1 #46206 USB to Serial Adapter

If any of these items are missing, please call the service department at TEN-TEC and we will send the missing item promptly.

Service Department.....	428-0364	Area Code
Company Switchboard.....	453-7172	(865)
FAX.....	428-4483	

LOCATING AND CONNECTING THE HARDWARE

Where you place the PC RADIO is mostly a matter of personal choice. If you plan to use the telescoping whip antenna, there are a few pointers to keep in mind. Set the radio as far away from your PC and monitor as is practical given the cables provided. PCs generate lots of noise that can cover up the very stations you wish to hear. You will have better reception with the receiver sitting on a table, high on a bookshelf or near a window as opposed to sitting on the floor. The PC RADIO can be hidden away almost anywhere if you plan to use an external antenna.

At least for the initial installation, we suggest you get things up and running using the telescopic whip antenna. It is adequate to hear the stronger stations on the shortwave bands. The use of an external antenna is highly recommended for all types of shortwave listening and will significantly improve receiver performance. Helpful information on external antennas can be found in "Introduction to Shortwave Listening", Page 18. Connection of an external antenna automatically disconnects the whip antenna. A standard "phono" type connector is provided in the packing kit if you decide to use an external antenna.

The whip antenna is attached by inserting the threaded end through the access hole located on the top of the receiver. Rotate the antenna clockwise to tighten. The antenna should attach easily. Excessive stress on the antenna may damage the antenna or receiver. If needed, the antenna can be removed by holding firmly and twisting the antenna counterclockwise to unscrew the threaded portion from the receiver.

There are three additional connections to be made:

POWER

Provided by the AC wall adapter. Insert the DC barrel connector into the +15 VDC socket on the rear panel of the RX-320. Now plug the wall adapter into any convenient 120 VAC outlet. The ON/OFF switch is also located on the rear of the PC RADIO. If desired, this can be left in the ON position indefinitely.

SERIAL PORT

Connect the RX-320 to your computer's serial port using the standard 9-pin female to 9-pin male cable provided. If the communications port(s) on your PC are 25 pin, you will need to obtain a 25-pin to 9-pin adapter. These are readily available from most local computer and office supply stores.

SOUND CARD or YOUR OWN EXTERNAL SPEAKER

We anticipate that most customers will wish to use their sound card for audio. A shielded audio cable is provided with 1/8" stereo plugs on each end. Connect this between the LINE OUT on the RX-320 and the AUDIO IN of your sound card.

NOTE: The PC RADIO does not have a built-in speaker. You may connect an external speaker to the receiver using the EXTERNAL SPEAKER output. This jack accepts an 1/8" monaural plug (the tip is audio) and may be connected to an 8 ohm speaker. Audio is available at both "LINE OUT" and "EXTERNAL SPEAKER" connectors at the same time depending on the software setups you select.

All of the hardware preparation is now complete.

INSTALLING THE SOFTWARE

Windows based software is provided to run the PC RADIO. It operates on any PC running Windows 3.1 or Windows 95. Follow the installation steps for your particular operating system.

WINDOWS 95

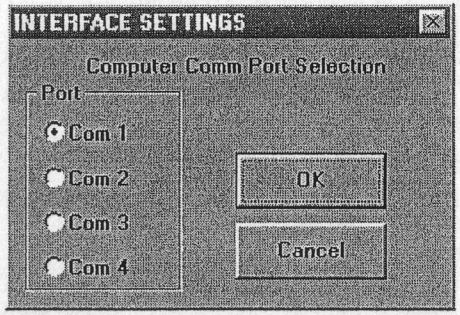
Insert the disk into your PC's floppy drive. Choose RUN from the START menu. At the prompt, type A:setup (or B:setup if using your B drive). Begin the installation by selecting OK. Follow the instructions provided by the installation program to complete the software installation. In addition to the main program files, a file containing release notes may be installed on your system at the same time. The installation program will automatically ask if you wish to read the notes.

WINDOWS 3.1

Insert the disk into your PC's floppy drive. Choose FILE from the Program Manager's Menu and then select RUN. At the prompt, type A:setup (or B:setup if using your B drive) Begin the installation by selecting OK. Follow the instructions provided by the installation program to complete the software installation. In addition to the main program files, a file containing release notes may be installed on your system at the same time. The installation program will automatically ask if you wish to read the notes.

Running the Program for the First Time

Be certain that the rear panel power switch is ON. Now launch the program by double-clicking the TTRCX icon. From the Setup Menu, select Interface and choose the COM port (COM1, COM2, COM3 or COM4) to which the RX-320 is attached.



This completes the installation and setup of the software.

Visit our web site at www.tentec.com for software updates, programming information and other documentation.

USING THE PC RADIO

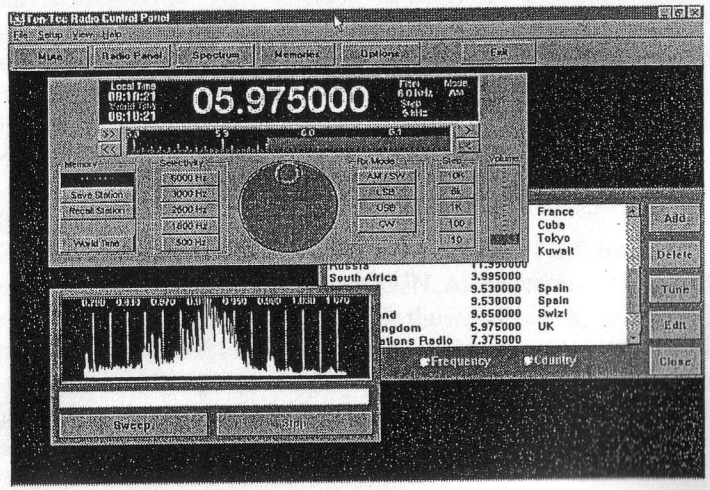
The software running on your PC provides the "virtual" front panel. The shortwave receiver is easily controlled by mouse clicks and/or keystrokes. Some features duplicate those found on conventional receivers with front panel controls. Other features are unique to a PC controlled, mouse driven radio. Some basic information on using the PC RADIO is included on the next few pages, just enough to help you get started. The HELP file should be used as your detailed reference.

KEY FEATURES

There are three main screens or windows:

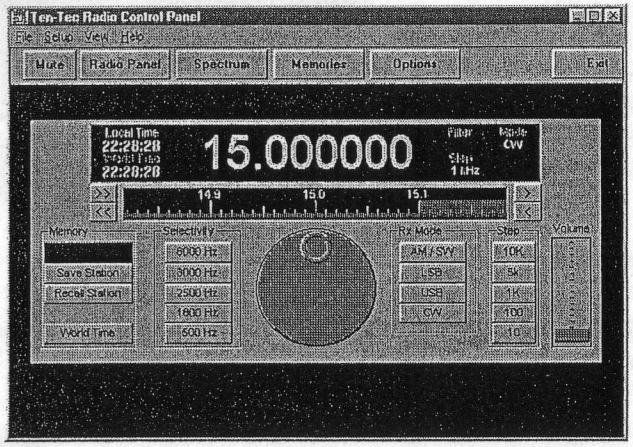
- Radio Panel
- Memories
- Spectrum

Each window may be displayed or hidden as desired. This may be done through the VIEW option from the program's MAIN MENU or by using the quick select buttons on the CONTROL BAR. The RADIO PANEL should be used first to familiarize yourself with the PC RADIO and will likely be the screen used most often. It has all of the main "receiver" features familiar to users of conventional shortwave radios. Functions for memory storage and recall are combined in the MEMORIES window. Activity over a range of frequencies, called a band, can be seen in the SPECTRUM window.



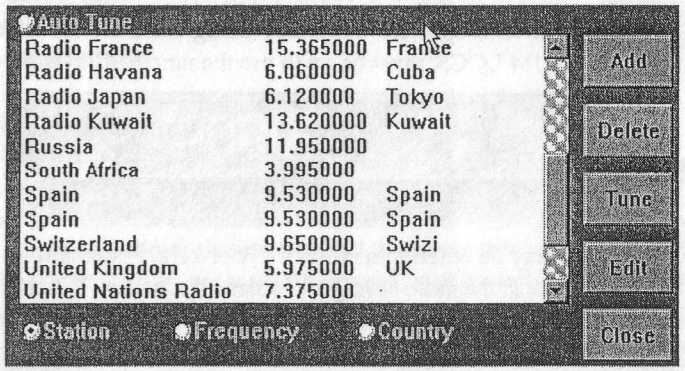
RADIO PANEL

This is the heart of the RX-320. Complete control over the receiver is accomplished from this window. Convenient controls are provided for TUNING, TUNING STEP SIZE, VOLUME, RX MODE and SELECTIVITY.



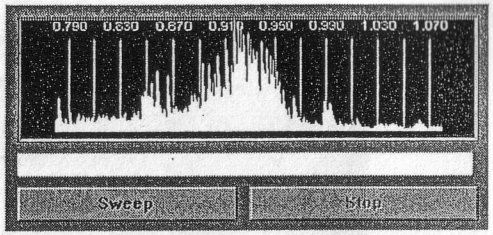
MEMORIES

This window allows you to store and recall station information. Use this screen to store your favorite stations and frequencies. At a later time, they can be recalled quickly without having to tune the band to locate them.



SPECTRUM

This window provides a way of viewing active frequencies in a visual format. It can help locate activity on otherwise quiet bands. Hit the SWEEP command and the receiver tunes below and above the frequency on which it is presently located.



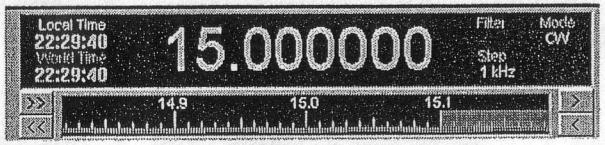
Any stations present are displayed as a line on the screen. You can tune instantly to any station by clicking on the frequency of interest.

TUNING THE RADIO

The most fundamental operation of any radio is tuning to a desired signal or station. Several methods of tuning are provided.

1. Using the mouse, locate the cursor inside the large tuning knob at the center of the radio panel. Note the cursor changes to an "upturned" or "downturned " arrow. Press the left mouse button. The tuning direction is determined by the location of the mouse. Clicking on the upper half of the knob causes the radio to tune up in frequency while clicking on the lower half causes the radio to tune down in frequency. The tuning speed is determined by the STEP SIZE currently selected.

2. You may enter a specific frequency using the numeric keys on the keyboard (NUM LOCK must be on to use the numeric keypad).



Frequencies may be entered in either MHz or kHz. For example: 850 and 0.850 will result in the radio tuning to the same frequency. The program will attempt to determine the format of the entry based on the numbers entered. The kHz format can be forced by following the entered numbers with the letter K. This tell the program that the entry is in kHz. Otherwise the program would assume incorrectly that the entry was in MHz. The [ENTER] key will always complete the entry. You may also enter a specific frequency by clicking the mouse on the main frequency display which will activate a numeric entry box.

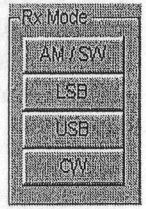
3. The PC RADIO can also be tuned by using the log scale located directly under the main frequency display.

A red marker located at the center of the log scale display indicates where the radio is presently tuned. Press and hold the left mouse button while over the log scale to allow the scale to be dragged right or left to raise or lower the frequency. Double clicking the left mouse button while over the log scale will cause the radio to jump to the frequency indicated by the mouse position.

4. Tune the radio by using the quick-tune buttons located at each end of the log scale. The buttons located to the right of the log scale (single arrows) will tune the radio up or down at a rate determined by the currently selected STEP SIZE. The buttons located to the left of log scale (double arrows) are for fast tuning at a rate 10 times the currently selected STEP SIZE.

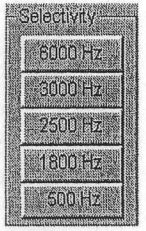
RX MODE

The RX-320 provides four signal detection modes. AM, LSB and USB will be used most frequently. These are selected using the buttons located immediately to the right of the main tuning knob. When a new mode is selected, the optimum SELECTIVITY and STEP size are automatically selected at the same time.



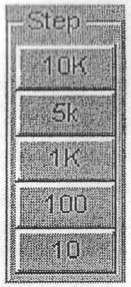
SELECTIVITY

Five user selectable filters are provided to improve reception under certain band conditions. The optimum filter for a given mode is selected automatically when the mode is selected. Under most conditions, there is no need to change this selection. However, on a frequency with several signals nearby or a large noise level, it is helpful to increase selectivity by selecting a narrower filter. The buttons located to the left of the main tuning knob provide single mouse click access to the available filters. Please note that some filters are too narrow for some modes. For example: the 500 Hz filter is too narrow to hear voice signals in AM, LSB or USB modes.



STEP SIZE

Five selectable tuning steps are provided. These were chosen as the most useful for shortwave listening. Small steps such as 10 Hz are good for fine-tuning a station in CW mode. A larger step size such as 5 kHz is perfect for listening to AM international broadcasts. 100 Hz is just right for LSB or USB modes. Like the filter selection mentioned above, the optimum tuning step is selected automatically when the MODE is selected. There are also keyboard shortcuts for selecting a tuning step. By using the left and right arrow keys on the keyboard the tuning step can be adjusted up or down.



ADJUSTING THE VOLUME

A sliding control is provided on the RADIO PANEL to adjust the volume. This adjusts the speaker level and the line output level if the option is selected in the OPTIONS menu. The line output level can also be set to a fixed level in the OPTIONS menu. This is most useful when connecting the radio to a computer's sound card and the mixer panel is used to control the audio level. There is also a shortcut to controlling volume; hold the CTRL key while pressing the left or right arrow keys.

Introduction to Shortwave Listening

Joseph J. Carr, K4IPV

1.0 Introduction

Now that you own the TEN-TEC Model RX-320 Digital Signal Processing shortwave receiver, what do you do with it? The receiver covers the low frequency, medium wave and high frequency ("shortwave") bands. In this section we will take a look at some things you need to know about shortwave listening, including the types of stations that will be found on the various frequencies that are within the range of the RX-320 receiver.

2.0 The Shortwave Listening Hobby

There are many reasons why people use shortwave receivers. A significant number of them make a hobby of trying to receive distant stations. This hobby is called "Shortwave listening" (SWL) or "DXing". The term "DX" comes from the old telegraph abbreviation for "distance." The shortwave listener is able to hear world and local news from many countries. And these broadcasts will come from many different perspectives, most of which are different from what you get in your local newspaper or network TV. Even smaller countries operate shortwave stations to get their story out to the world. In addition to world and local news from different perspectives you will also hear ethnic and folk music, and cultural programs. There are many different programs designed to show the country in the best light possible.

You will also hear transmissions from military sources, ocean going shipping, ham radio operators, commercial transoceanic airlines, and many, many different forms of commercial "utility" stations.

Some stations are utterly mysterious. There are a few "numbers stations" that do nothing but transmit groups of numbers. These are believed to be spy stations transmitting instructions to spies in various parts of the world. Each spy knows his numbers and what they mean, according to experts. Also part of the "mysterious" category are a number of illegal "pirate" stations. These stations are usually operated by hobbyists who want to set up their own stations, and don't mind operating illegally. But others are part of underground resistance groups in various countries. They will transmit either from a friendly foreign country, or clandestinely in their

own country. The latter tend to change frequency a lot to keep from being arrested.

Many DXers collect "QSL" cards from the radio stations. The term "QSL" comes from the telegraphic standard message for "acknowledgement", and confirms that the station was actually received. You can build an interesting and colorful collection of QSL cards by sending reception reports to the stations that you hear. Most of the broadcasters actively encourage signal reports, and will give their address between programs.

There is a list of bands in a later section. You will need to know some "technical jargon," but never fear; it's really quite simple. In the next few sections we will give you some of this "technical lore" that's needed to understand the information given in the list of bands.

You can select the information that you feel the need to read from the list below:

Section 3: Frequency and Wavelength. Tells you how to read the frequency dials of the radio, and understand the use of wavelength to describe radio channels (as many foreign stations do).

Section 4: Band Descriptions. This section describes the differences between the medium wave and high frequency portions of the shortwave bands.

Section 5: Modes. You will hear different types of transmission on the shortwave bands. In addition to the familiar AM form of transmission, you will also hear CW (Morse code), radioteletype (RTTY) and a special type of voice transmission called single-sideband (used by amateurs, commercial stations, and airliners).

Section 6: World Time. Shortwave time is world time, i.e. what we used to call Greenwich Mean Time. You will need to understand the time system used in radio schedules, and how it is converted to your local time. In addition, radio programs use the 24-hour or "military" system of notation.

Section 7: Radio Propagation. One of the things that profoundly affects what you hear at different times of day, or different times of the year, is radio propagation. In this section you will find information on what types of propagation are found on the shortwave bands.

Section 8: External Antennas. Your receiver has a built-in antenna that will work for most situations. You will discover in this section there are good reasons to consider an external indoor or outdoor antenna.

Section 9: What's on the Bands? This section describes in much more detail what you will find on the medium wave and high frequency shortwave bands. It is broken down by frequency and wavelength, so that you can locate the stations on your dial.

Section 10: For Further Reading. If you want to find out more about the hobby of shortwave listening, then look for the publications on this list.

3.0 Frequency and Wavelength

Radio stations operate on specific frequencies, i.e. spots on the radio dial. You are familiar with radio frequencies from your AM and FM radio dials. The *frequency* of a radio wave is the number of times per second that it oscillates (which is similar to sound vibrations in air). The unit of frequency is the *Hertz* (Hz), which is *one cycle-per-second.* In the radio bands the convenient units of frequency are the *kilohertz* (kHz), which is 1000's of Hertz (i.e. 1 kHz = 1,000 Hz), and the *megahertz* (MHz), which is 1,000,000's of Hertz (i.e. 1 MHz = 1,000,000 Hz). Converting back and forth between kilohertz and megahertz uses the factor 1 MHz = 1,000 kHz.

The AM broadcast band (AM BCB) is found on frequencies from 540 kHz to 1,700 kHz on the radio dial. The FM broadcast band (FM BCB) is found between 88 MHz and 108 MHz.

World band radio broadcasters often use the *wavelength* to specify the channel, rather than frequency. Wavelength is the distance that the radio wave travels over one complete cycle. The wavelength (L) is specified in meters (m). Thus, we find that $L = 300/F_{MHz}$ if megahertz is used for frequency, or $300{,}000/F_{kHz}$ if kilohertz is used for frequency. Thus, a signal at 10 MHz has a wavelength of L = 300/10-MHz = 30-meters.

4. 0 Shortwave Band Descriptions

Medium Wave Bands

The medium wave bands are found from approximately 300 kHz to 3,000 kHz (e.g. 0.3 to 3 MHz). The AM broadcast band (AM BCB) is 540 kHz to 1,700 kHz, and is considered a medium wave band.

High Frequency (HF) Bands

The shortwave bands occupy the "high frequency" (HF) section of the radio spectrum from 3,000 to 30,000 kHz (3 to 30 MHz). These bands are capable of very long distance communications and broadcasting. It is not unusual, for example, to find stations from Japan, Australia, Korea and other areas of the Far East.

5.0 Modes

There are different types of radio signals heard on the shortwave bands. One way of classifying these signals is by the *mode*, i.e. the method by which information is imparted to the radio signal. You are already familiar with the AM ("amplitude modulation") mode. This type of signal imparts audio information to the radio signal by varying its strength ("amplitude"). International broadcasters use AM mode.

You will also hear Morse code or "CW" signals and radioteletype ("RTTY") signals. RTTY signals are machine sent coded text signals. If you are skilled in reading the International Morse code then you will be able to understand what CW stations are saying. However, for those who do not "copy" code, special electronic decoders are available from shortwave equipment dealers. RTTY decoders are also available.

A special form of voice mode is *single-sideband* (SSB). When you tune in an SSB signal using a receiver set for AM mode, the output will sound like someone talking with a mouth full of marbles and dry oatmeal. It is unintelligible. But if you switch to one of the SSB modes, then you will understand what is being said. Keep in mind, however, that SSB signals are more critical to tune, so use 100 Hz or 10 Hz frequency steps to fine tune the signal once you locate it. Two forms of SSB are *upper sideband* (USB or USB SSB) and *lower sideband* (LSB or LSB SSB). If you want to know more about SSB signals, then consult one of the books in the *For Further Reading* section.

6.0 World Time

Shortwave stations operate all over the world. They usually schedule for listeners in completely different parts of the world, so time-of-day and date become important. As a result, international radio broadcasters use *World Time* for their schedules. This form of time notation is also called *Greenwich Mean Time* (GMT), *Zulu time*, Universal Coordinated Time (UCT) or *Universal Time* (UT). World Time is based on the time at the prime meridian, which passes through the Royal Observatory at Greenwich, England.

World Time also uses the 24-hour "military" time notation scheme. The time of day starts at 0000 at midnight. The designation for Noon is 1200, for 1 PM it is 1300 and so forth. When the clock gets around to the next Midnight, the time is 2400. It is also 0000 hours in the following day. Common times of day are:

0000	Midnight (also 2400)
0600	6 AM
1000	10 AM
1200	12:00 (Noon)
1500	3 PM
1800	6 PM
2200	10 PM
2400	Midnight (also 0000 next day)

Times given in World Time may be listed in several different ways. For example, 1800 hours world time may be listed as: 1800 WT, 1800 GMT, 1800Z, 1800 UCT, 1800 UT.

You must adjust the radio broadcasters schedule by comparing with local time. World Time is related to times in the U.S.A. by the following factors:

U.S. Time Zone	World Time
Eastern Standard Time	WT - 5 hours
Central Standard Time	WT - 6 hours
Mountain Standard Time	WT - 7 hours
Pacific Standard Time	WT - 8 hours

In other words, 1800 WT is the same as 1300 hours EST. During the summer time, areas that go under Daylight Savings Time should subtract one hour from the differences shown above. In other words, where EST is WT - 5 hours, EDST is WT-4hours.

An example of how this time notation is used is where the shortwave broadcaster's schedule lists a program at "2200-2300 hours" in World Time, it will be heard at 1700 to 1800 hours Eastern Standard Time (5 to 6 PM).

The World Day is reckoned according to the day at Greenwich, England. Listeners in North America may see a program listed as occurring at "0200 to 0300 on May 3rd." It will actually be heard in North America during the evening of the previous day, May 2nd. To hear that program the listener in the Eastern time zone would tune in at 2100 to 2200 (9 PM to 10 PM) on May 2nd.

Standard Time and Frequency Stations

The United States *National Institutes of Standards and Technology* (NIST) operates two standard time and frequency stations in the shortwave bands. Radio station WWV is located at Fort Collins, CO, while WWVH is located at Maui, Hawaii. These stations appear on frequencies of 2.5 MHz, 5 MHz, 10 MHz, 15 MHz and 20 MHz. You can identify WWV by the male announcer, and WWVH by the female announcer. In some locations, or on some occasions, both WWV and WWVH are audible at the same location.

In most parts of North America at least one of these stations will be audible. They give one-second ticks, followed by a voice announcement every minute that gives the exact time in Universal Coordinated Time.

The operating frequencies of WWV and WWVH are controlled by atomic clocks, so are extremely accurate. You can calibrate your receiver by comparing the indicating frequency with the frequency of WWV or WWVH.

7.0 Radio Propagation

Radio signals are electromagnetic waves. They are the same as light waves, except have extremely long wavelengths compared with light waves, and obey similar rules. Two mechanisms are routinely seen in radio reception: *ground wave* and *sky wave*.

Ground Wave. As the name implies, the ground wave travels along the surface of the Earth. Because of absorption by the ground, and certain other phenomenon, the ground wave is usually heard at a limited distance. In the AM BCB, for example, ground waves are the normal daytime means of propagation. It is common to find stations only thirty or forty miles away too weak to be heard. In the shortwave bands the ground wave may be heard up to a couple hundred miles, depending on the operating frequency.

Sky Wave. The sky wave travels by way of the portion of the Earth's atmosphere called the *ionosphere*. The signal leaves the radio station's antenna, and then travels into the ionosphere. At some frequencies, the signal is refracted back to the Earth's surface. The result from the point of view of the receiver is that there is a giant "radio mirror" in the ionosphere. Sky wave propagation is also called "skip" in radio jargon.

Sky wave propagation is very frequency dependent. It also varies by the time of day and season of the year. During the day, for example, the AM BCB does not support skip. But at night, when the Sun goes down (removing the ionizing energy source), skip begins to roll in. A good radio receiver, such as your RX-320, will not pick up much AM BCB skip during the day, but as evening progresses more and more distant stations are heard. The distant stations may be so strong that local stations on the same frequency are drowned out. As dawn breaks, however, the skip begins to disappear and reception again becomes local.

The AM BCB is in the medium wave band. Similar behavior is seen in MW band up to frequencies of several megahertz. But as frequency gets higher into the shortwave bands, the skip becomes more and more pronounced. It is not difficult to observe skip from the other side of the Earth. During the day, for example, North American and European listeners may hear shortwave stations in Australia and New Zealand on frequencies between 15 MHz and 25 MHz. After local sunset, however, the frequencies at which skip occurs become lower and lower. In the evening, intercontinental skip is seen in the bands below 15 MHz.

During evening hours, listeners in North America will find European and South American stations operating in the bands between 5 MHz and about 12 MHz. Time of day differences in these bands are seen in the 40-meter amateur band (7,000 to 7,300 kHz). "Ham radio" communications out to several hundred miles are seen during the day, but after dark the distances get much longer because of skip. It is not uncommon to hear ham stations

with "ZL" (New Zealand) and "VK" (Australia) in the 40-meter band just before dawn each day.

8.0 External Antennas

The antenna that is built into your receiver will work for most situations. However, an external antenna can significantly improve reception. All shortwave receivers can benefit from a properly installed external antenna. A computer driven receiver, such as the RX-320 unit, must operate in close proximity to an extremely noisy computer and monitor. Some video monitors are especially bad sources of noise. If you have a lot of interference from the monitor or computer, then first try placing the receiver six or more feet from the monitor. This will help in many cases. If the interference is still at an objectionable level, then consider an external antenna.

There are a number of antennas that can be used. Details about many different types of antenna can be found in the books given in the *Section 10: For Further Reading*. I will limit my discussion here to the simplest form of external antenna. It provides significant performance, but is very easy to install.

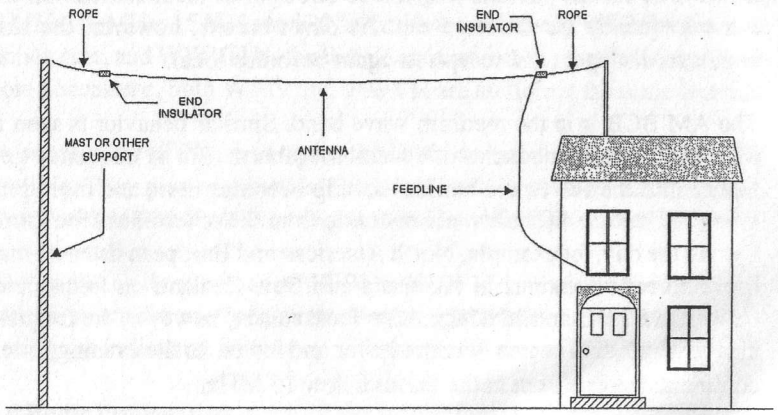


Fig. 1

The basic configuration is shown in Fig. 1. The antenna consists of a piece of wire stretched between two supports. This antenna is called a "random length Marconi" antenna. In the installation pictured, the house is one support, while a wooden mast is the other support. You can also use any combination of wooden, metal or fiberglass masts, trees, and buildings, provided that the installation is both safe and legal.

The antenna wire can be anything from 20 to 100-feet long. Shorter antennas might not provide the improvement that you seek, while longer antennas do not increase performance in proportion to their cost and the difficulty of installation.

The wire used for the antenna should be special antenna wire (e.g. #14 AWG stranded copper clad steel or hard drawn copper wire). You can buy suitable wire from most shortwave equipment dealers, or from sources that advertise in the radio magazines. If you bought your receiver from a retail dealer, then you might consult that dealer for antenna supplies. Even if there are no shortwave or amateur radio equipment dealers in your area, Radio Shack stores usually stock or can order shortwave antenna wire and kits.

The feedline, also called the "downlead," is used to carry signal from the antenna to the radio receiver. This wire must be insulated. You should use #22 to #14 AWG stranded wire for this purpose, although solid wire will also work (it is less reliable). In many cases, you can run the wire underneath the window sash, but in most cases you will want to use special window straps or other methods for this purpose.

It is also possible to bring the wire through the wall of the house. This should be done only if you have the skill necessary to waterproof the hole. Some of the references in the For Further Reading section give information on passing a wire through the wall.

Grounding the Antenna System

There are two reasons for grounding a shortwave antenna. One reason is that the antenna-receiver combination often works better when the receiver is grounded. The other is that a proper grounding system provides some, but not absolute, protection from lightning damage.

Your antenna will not attract lightning from afar, but it may channel lightning that comes into the immediate vicinity of the house. The lightning

most probably would have struck anyway, but the antenna will serve as a kind of lightning rod. Some localities require that outdoor antennas either be grounded or fitted with a lightning arrester for this reason. The proper method is to ground the chassis of the radio receiver for signal purposes, and provide a lightning arrester in the feedline for lightning protection (see Fig. 2).

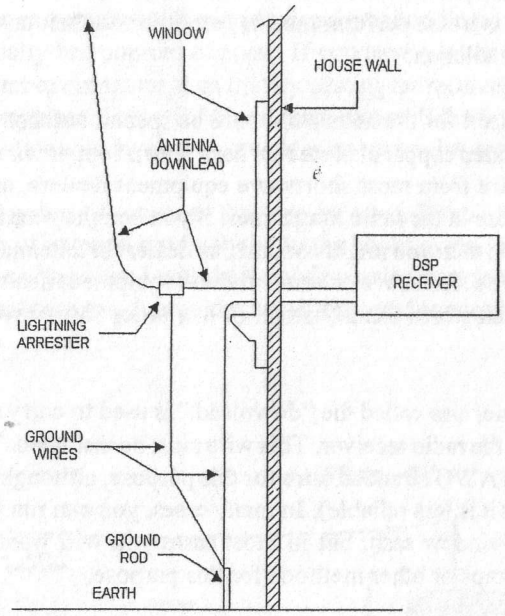


Fig. 2

The ground wire is usually quite a bit larger than the antenna downlead. It is often the case that #8 AWG wire or the braided shield stripped from coaxial cable is used for this purpose. The ground wire is connected to a ground rod.

The ground rod should be at least four feet long,but even that short length is considered marginal. Lightning protection requires at least an eight-foot ground rod (check local regulations!), and they are harder to drive into the earth. The ground rod should be inserted into the Earth with only four to six inches showing above the surface. Most of these rods do

not require soldering. Connection is made with a special fitting and machine screw fastener.

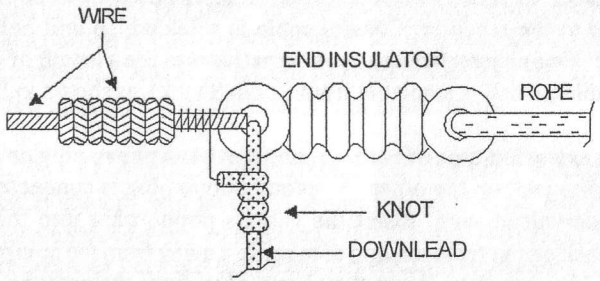


Fig. 3

Connections to the Antenna. The Marconi antenna is held aloft (see detail in Fig. 3) by ropes and end insulators. The end insulator is made of either ceramic, glass or synthetic materials such as nylon. Some of them are ridged (as shown) in order to increase the electrical length of the insulator. There will be two eye holes, one in either end. The rope is passed through one eye, and from there to the support. Use nylon rope, or some other type that will weather well. Make sure that the knot used to tie the rope to the insulator is very well made. The forces on even a short wire will surprise you, especially when winds blow.

The antenna wire is made of #14 AWG stranded copper wire. Pass one end of the antenna wire through the remaining hole, and then wrap it around itself at least seven times. Solder the connection with 50/50 or 60/40 lead/tin rosin core solder (DO NOT USE ACID CORE SOLDER!).

The downlead is made from insulated stranded wire. It can be almost any size from #14 AWG to #24 AWG, although keep in mind that the larger sizes (i.e. smaller gauge numbers) are stronger. Strip about two inches of insulation off the end of the wire, and then pass it through the same hole in the insulator that holds the antenna wire. Wrap the downlead wire around the antenna wire, and solder with the same type of solder used for the antenna wire.

An Alternative Connection Method

Because of possible pick-up from the monitor or receiver, try using a 10 to 24-foot piece of RG-58 coaxial cable or shielded cable to connect the downlead to the receiver. Coaxial cable is shielded, so will help guard against picking up interference. An alternative is to use a length of shielded phono cable (which is available from Radio Shack), as shown in Fig. 4.

Select an extension type of cord, i.e. one that has a phono plug on one end and a phono jack on the other. A second phono plug is connected to the antenna downlead wire. Insert the cable's phono plug into the phono antenna jack on the receiver, and then route it away from the computer and monitor. You can then insert the phono plug from the antenna into the phono jack on the cable.

In either case, connect the downlead of the antenna to the center conductor of the coaxial cable or shielded wire.

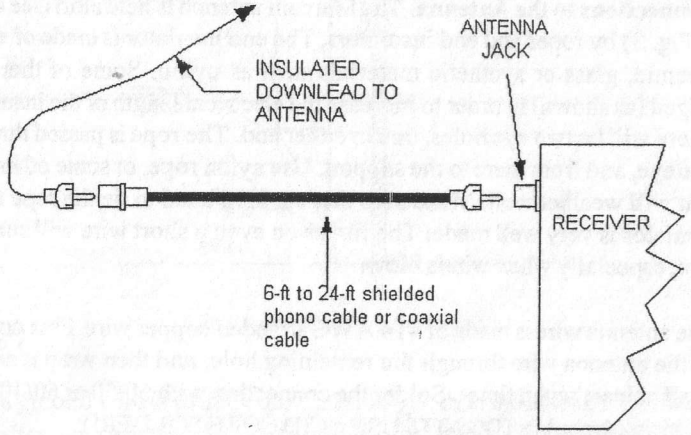


Fig. 4

Antenna Supplies. Most shortwave and scanner equipment dealers carry complete antenna kits that include detailed instructions for installation. Consult the dealer where you bought the receiver, or a Radio Shack store, for suitable wire, other supplies or complete kits.

9.0 What's on the Bands?

100-540 kHz. Longwave bands. Some CW (Morse code) activity. Also some beacon stations using CW to identify their callsigns. Some beacons transmit using AM and provide weather forecasts. Europeans broadcasters use a portion of the longwave bands for a second AM broadcast band. The European LF AM BCB is from 145 kHz to 280 kHz. Signals in this band are often difficult to receive due to high noise levels.

540-1,700 kHz. AM BCB (formerly ended at 1600 kHz). A large number of AM BCB stations will be heard, especially after dark. North American stations are spaced every 10 KHz (e.g. 780 kHz and 790 kHz). Other nations use frequencies between the North American frequencies (e.g. 785 kHz and 795 kHz).

1,800-2,000 kHz. Amateur radio (160-meter band). CW and SSB. Active from evening to sunrise, especially during late Fall and Winter months.

2,000-2,850 kHz. Maritime SSB, CW and RTTY. International voice emergency and distress channel is 2,182 kHz. Also check out 2,082, 2,638 and 2,782 kHz. Coast Guard marine weather broadcast at 2,670 kHz. At times you may hear South American, African and Pacific rim domestic AM broadcast services, especially between 2,300 and 2,500 kHz (2,500 kHz is used by WWV/WWVH).

2,850-3,150 kHz. Some CW and USB SSB voice communications and weather broadcasts. Primarily airlines.

3,150-3,400 kHz. Fixed station and mobile stations. Some Federal Emergency Management Agency stations. Time and frequency station CHU (Canada) on 3,330 kHz. Portion of the band used for tropical broadcasting.

3,400-3,500 kHz. Similar in use to 2,850-3,105 kHz.

3,500-4,000 kHz. 75/80-meter amateur radio band. CW and RTTY is found from 3,500 to 3,750 kHz. LSB SSB is used 3,750-4,000 kHz. Occasionally you will hear European and African broadcasters, and a South American standard time and frequency station on this band.

4,000-4,065 kHz. Fixed station and Military Affiliate Radio System (MARS) stations.

4,065-4,438 kHz. Maritime CW, RTTY and USB SSB signals. Check 4,125 kHz (international calling channel).

4,440-4,650 kHz. Fixed and mobile allocations. Check out 4,449 kHz for USAF USB voice activity.

4,750-4,995 kHz. 60-meter tropical broadcast band. African stations will begin to appear right after local sunset, and continue until late evening. Also look for South and Central American stations, and Pacific rim (e.g. Indonesia) stations.

5,730-5,950 kHz. Numerous stations using CW, RTTY and SSB. U.S. Weather Bureau operates a network on 5,923 using USB SSB voice. Also found are Department of Energy, NASA and USAF. The NASA frequency (5,810 kHz) is used in support of space shuttle launches.

5,950-6,200 kHz. 49-meter international broadcast band. AM signals from Europe, South America, Asia, Eurasia, and Pacific areas.

6,200-6,525 kHz. Maritime communications. CW, RTTY, and USB SSB voice. Often used for inland waterway communications.

7,000-7,300 kHz. Amateur radio operations. CW and RTTY is used from 7,000 to 7,150 kHz, while LSB SSB voice and slow-scan TV is found in 7,150-7,300 kHz range. At night international broadcasters share this band. This band is active at all hours. During the day communications from strictly local to about 800-1,000 miles occurs. After sunset, distances increase. All continents can be heard at various times of the day.

7,300-8,195 kHz. CHU (Canada) time and frequency station on 7,335 kHz in French and English. U.S. Customs Service and Interpol (international police agency) use this band on occasion. Also, some international broadcasters are found.

8,195-9,040 kHz. Aeronautical communications, especially trans-Atlantic. Long Island, NY and Gander, Newfoundland stations handle in-bound aircraft from Europe. SSB commonly used.

9,500-9,900 kHz. 31-meter international broadcast band. One of the most popular listening bands because of the variety of signals heard. AM mode is used in the international broadcast bands.

10,005-10,100 kHz. Airline corporate communications. USB SSB.

10,100-10,150 kHz. 30-meter amateur band. CW and RTTY.

10,150-11,175 kHz. Feeder signals for international broadcasters to overseas relay stations. Carry the same content as the AM signals in the regulator international broadcast bands, but use SSB instead.

11,650-11,975 kHz. 25-meter international broadcast band. Active during day and at night, but evening is by far the most active. Broadcasters from around the world are heard in this band.

13,600-13,800 kHz. 22-meter international broadcast band. Active during the day, especially in the early afternoon.

14,000-14,350 kHz. 20-meter amateur radio band. CW and RTTY is used from 14,000 to 14,100 kHz. USB SSB is used from 14,100 to 14,350 kHz. Open during the daylight hours and well into the evening.

15,010-15,100 kHz. Aeronautical band using USB SSB. Military airborne stations are found in this band.

15,100-15,600 kHz. 19-meter international broadcast band. Band is quite active during daylight and evening hours. Especially during the day signals from Australia, Japan and other Far East countries are heard.

17,550-17,900 kHz. 16-meter international broadcasting band. Active during most of the day, into the early evening.

17,900-18,030 kHz. Aeronautical signals using USB SSB.

18,068-18,168 kHz. 17-meter amateur radio band. CW, RTTY and USB SSB.

20,010-21,000 kHz. Aeronautical and fixed stations. USAF and NASA use this band on occasion. The USAF uses USB SSB, while NASA uses LSB SSB.

21,000-21,450 kHz. Amateur radio 15-meter band. CW and RTTY are found from 21,00-21,200 kHz, and USB SSB is found from 21,200-21,450 kHz. This band is very active during the day, with signals being heard from all over the world. Only the 20-meter band is more active over so wide an area.

21,450-21,850 kHz. 13-meter international broadcast band. Not used very much during periods of low solar activity, but now that the solar cycle is on the way up more activity is expected.

21,870-22,000 kHz. Aeronautical and fixed stations.

22,000-22,855 kHz. Maritime stations using USB SSB.

24,890-24,990 kHz. 12-meter amateur radio band. Popular during high end of the solar cycle.

25,670-26,100 kHz. 11-meter international broadcasting band. Not used very much except during periods of peak solar activity.

26,100-28,000 kHz. Fixed and mobile communications. This frequency range includes the Citizens Band (26,965-27,405 kHz). A number of illegal CB operators can be found in the space above the Citizen's Band, 27,500-28,000 kHz.

28,000-29,700 kHz. 10-meter amateur band. Mostly USB SSB and some AM. Mostly used locally during low sunspot periods, but you can expect to see spectacular performance during the high portion of the sunspot cycle.

10.0 For Further Reading

Books

Carr, Joseph J. (1998). *Practical Antenna Handbook Third Edition.* New York: McGraw-Hill

Carr, Joseph J. (1993). *Joe Carr's Receiving Antenna Handbook.* San Diego: HighText Publications.

Helms, Harry (1993). *Shortwave Listening Guidebook.* San Diego: HighText Publications.

Helms, Harry (1992). *All About Ham Radio.* San Diego: HighText Publications

Passport to World Band Radio (annual editions). A must have! International Broadcasting Services.

Yoder, Andrew (1996). *Pirate Radio: The Incredible Saga of America's Underground, Illegal Broadcasters.* San Diego: HighText Publications

For amateur radio information and books, contact American Radio Relay League (ARRL), 225 Main Street, Newington, CT 06111. E-mail: info@arrl.org. World Wide Web site at http://www.arrl.org.

Magazines

Popular Communications. 76 North Broadway, Hicksville, NY 11801

Monitoring Times. P.O. Box 98, 7540 Highway 64 West, Brasstown, NC 28902

Shortwave. PW Publications, Arrowsmith Court, Station Approach, Arrowsmith Court, Station Approach, Broadstone, Dorset BH18 8PW, England.

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MODEL RX-320 SPECIFICATIONS

MODES: AM, LSB, USB, CW

FREQUENCY RANGE: 100 kHz - 30 MHz

FREQUENCY ACCURACY: +/- 100 Hz at 25 degrees C.

MEMORIES: Limited only by available RAM in PC, virtually any PC will store 1000's of stations.

SENSITIVITY:

MODE	B/W	
AM (80% mod @ 1 kHz)	6 kHz	.64uV for 12 d S+N/N
CW/SSB	2.5 kHz	.3 uV for 10 dB S+N/N

SELECTIVITY: Selectable 6 kHz, 3 kHz, 2.5 kHz, 1.8 kHz or 500 Hz; all 1.5:1 shape factor or better

THIRD ORDER INTERCEPT: + 10 dBm

DYNAMIC RANGE: 90 dB @ 2.4 kHz bandwidth at 50 kHz spacing

I-F FREQUENCIES: 1st I-F 45 MHz, 2nd I-F 455 kHz, 3rd I-F 12 kHz

I-F REJECTION: > 60 dB

IMAGE REJECTION: > 60 dB

ANTENNA: 50 ohm unbalanced for external antenna. High impedance at telescoping whip connection, automatically switched out of line when external antenna connected.

PC INTERFACE: Industry standard serial interface on DB9 connector

CONNECTIONS: + DC input, DB9 for serial port, external antenna, line output to sound card, external speaker.

POWER REQUIRED: < 500 mA at 13.5 - 15 VDC, wall transformer supplied

AUDIO: 1 watt at 4 ohms. > 1 v p-p output into 600 ohms (typical to drive a sound card).

CONSTRUCTION: 2 epoxy glass PC boards, aluminum chassis, steel top and bottom

SIZE: HWD 3"x 6.25"x 6.5"

WEIGHT: 2.5 lbs (1.14 kg)

All specifications are typical, degraded performance below 1 MHz, subject to change without notice.

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TEN-TEC, Inc.
1185 Dolly Parton Parkway
Sevierville, TN 37862

LIMITED WARRANTY AND SERVICE POLICY, U.S.A.

TEN-TEC, Inc. warrants this product to be free from defects in material and workmanship for a period of one year from the date of purchase, under these conditions:

1. THIS WARRANTY APPLIES ONLY TO THE ORIGINAL OWNER. It is important that the warranty registration card be sent to us promptly to establish you as the owner of record. This will also insure that any bulletins pertaining to this equipment will be sent to you.

2. READ THE MANUAL THOROUGHLY. This warranty does not cover damage resulting from improper operation. Developing a thorough understanding of this equipment is your responsibility.

3. IF TROUBLE DEVELOPS we recommend that you contact our service department direct. The selling dealer is not obligated by us to perform service in or out of warranty. It has been our experience that factory direct service is expeditious and usually results in less down-time on the equipment. Some dealers may offer warranty service and of course, have our complete support.

4. WE ENCOURAGE SELF HELP. Taking the covers off does not void the warranty. In many cases our service technicians, with your help, can identify the fault.

5. EQUIPMENT RETURNED TO THE FACTORY must be properly packaged, preferably in the original shipping carton. You pay the freight to us and we prepay surface freight back to you.

6. EXCLUSIONS. This warranty does not cover damage resulting from misuse, lightning, excess voltages, polarity errors or damage resulting from modifications not recommended or approved by TEN-TEC. In the event of transportation damage a claim must be filed with the carrier. Under no circumstances is TEN-TEC liable for consequential damages to persons or property caused by the use of this equipment.

7. TEN-TEC RESERVES the right to make design changes without any obligation to modify equipment previously manufactured.

8. THIS WARRANTY is given in lieu of any other warranty, expressed or implied.

SERVICE OUTSIDE OF THE U.S.A.

Many of our dealers provide warranty service on the equipment they sell. Many of them also provide out of warranty service on all equipment whether they sold it or not. If your dealer does not provide service or is not conveniently located, follow the procedure outlined above. Equipment returned to us will be given the same attention as domestic customers but all freight expense, customs and broker fees will be paid by you.

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