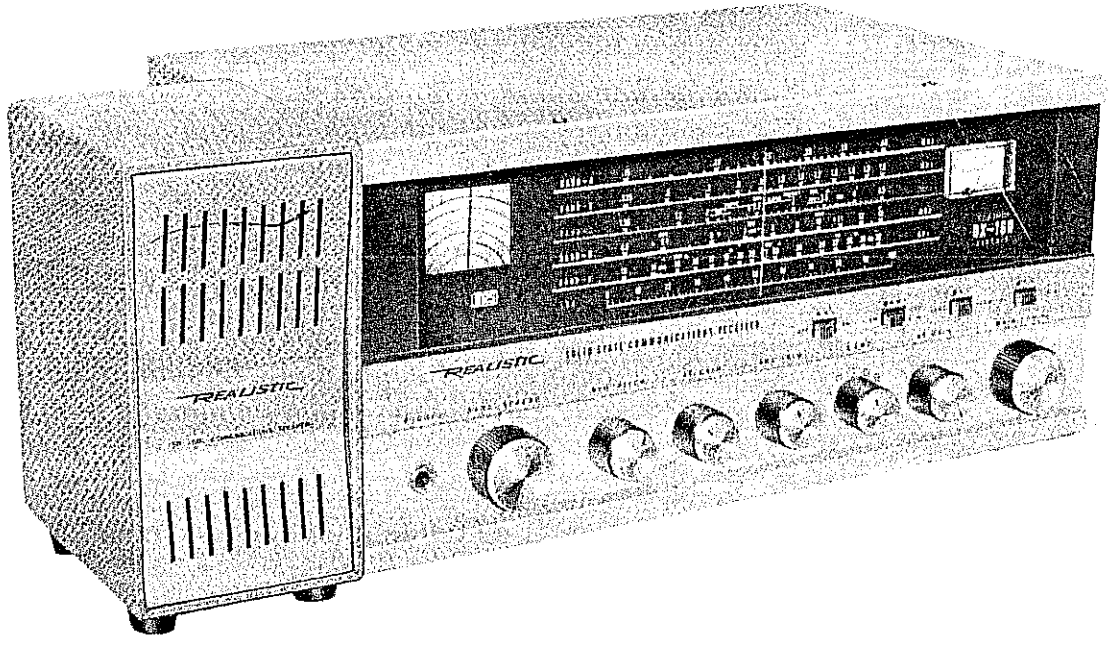
2/7/76

5-Band Solid State Communications Receiver



DX-160

OWNER'S MANUAL

PLEASE READ BEFORE USING THIS EQUIPMENT

REALISTIC®

CAT.NO. 20-152

CUSTOM MANUFACTURED FOR RADIO SHACK A TANDY CORPORATION COMPANY

- Long Wave to Short Wave Puts the World at Your Fingertips!
- Tune In On Broadcasts From Far Off Places!
- Hear Live-Action Drama as It Actually Happens!
- Be Able to Tune in all Types of Communications—SSB/AM/CW-Amateur, CB, International, Government.....

...It All Comes to Life on Your Realistic DX-160 Communications Receiver

Today's busy airwaves are literally full of programs of entertainment and educational value. A good portion of international programming is transmitted in English from such distant cities as London, Tokyo, Paris, Rome, Berlin and Moscow.

Many fascinating and important events occur every day on the long wave and short wave radio bands. You may hear the captain of a fishing vessel radioing news of his catch... or the Coast Guard instituting rescue operations to aid a ship in distress. The armed services contantly use short wave frequencies to communicate between aircraft, land bases and ships at sea. Radio Amateurs provide a wealth of technical information during their contacts with one another throughout the world.

The short wave bands encompass many, many interesting services, providing thousands of listeners with an absorbing new hobby. There is activity on these bands, day and night, every day, every week of the year.

This booklet has been prepared to help you discover for yourself what a fascinating and wonderful world short wave really is. Happy Hunting on the airwaves!

SPECIFICATIONS

FREQUENCY COVERAGE:	Band A = 150 to 400 kHz (.15—.4 MHz) Band B = 535 to 1600 kHz (.535—1.6 MHz) Band C = 1.55 to 4.5 MHz Band D = 4.5 to 13 MHz Band E = 13 to 30 MHz
SENSITIVITY (10 dB S+N/N at approx. center of band):	Band A = 50 μv Band B = 100 μv Band C = 3 μv Band D = 4 μv Band E = 4 μv
SELECTIVITY:	4 kHz at -6 dB 18 kHz at -40 dB
IMAGE RESPONSE (at approx. center of band):	Band A = -48 dB Band B = -65 dB Band C = -45 dB Band D = -35 dB Band E = -20 dB
FREQUENCY RESPONSE:	300 to 3000 Hz, -6 dB
AUDIO OUTPUT:	700 milliwatts at less than 10% distortion
SPEAKER/HEADPHONE IMPEDANCE:	8 ohms
SEMICONDUCTOR COMPLEMENT:	1 Integrated Circuit 5 Field Effect Transistors (FET's) 6 Transistors 15 Diodes
POWER REQUIREMENTS:	AC: 115/220-240V.50Hz 3-6 watts DC: 12 volts, negative ground, 30-180 ma

HISTORY OF SHORT WAVE RADIO

The development of short wave radio involved such famous personalities as Hertz, Maxwell, Marconi, DeForest, Armstrong and many others. Each made significant contributions to the growth of radio and short wave... Maxwell developed new mathematical formulae; Hertz transmitted the first radio signals; DeForest invented the vacuum tube; Armstrong conceived and developed such radio circuitry as the superheterodyne and the FM receivers. Marconi, of course, transmitted the first transatlantic radio signal from England to Canada.

Marconi's feat was the more amazing because it was generally assumed the radio signals, like light rays, travelled in straight lines. It was thought that radio waves would shoot off into space—that they were incapable of curving around the earth.

Further transatlantic tests indicated an increase in distance from day to night operation. Two theorists—Kennely and Heaviside—working independently of one another, conceived the idea of an electrical region high in the earth's atmosphere that acted like a mirror on radio waves. Instead of heading into space, radio-wave energy was reflected back to earth where it could be received by a distant station. In tribute to the accuracy of the concept, the region was designated the Kennely-Heaviside Layer. Today it is more commonly called the ionosphere. The special behavior of this electrified region is largely responsible for international reception activity in the short wave radio bands.

"Ham" Operators also have contributed greatly to the development of short wave listening. Radio amateurs have been communicating across the "Pond" (the ocean) since the early 1920's on all the short wave bands available to them.

HOW SHORT WAVE WORKS

A short wave radio signal is an invisible field of energy which travels at the speed of light (186,000 miles per second) as it carries a signal from the antenna of a station to the short wave set.

The electrical forces which produce a radio wave originate in the transmitter portion of the sending station. Electrical currents are made to surge back and forth at extremely high speeds. As these currents progress through the various stages in the transmitter, they are amplified and boosted in power. This radio frequency power is then applied to the transmitting antenna thus generating the actual radio wave... the field of electrical energy which travels outward from the antenna. As described earlier, this wave travels upward toward outer space with some of the wave's energy reflected off the ionosphere and back to earth to a distant receiving station. See Figure 1.

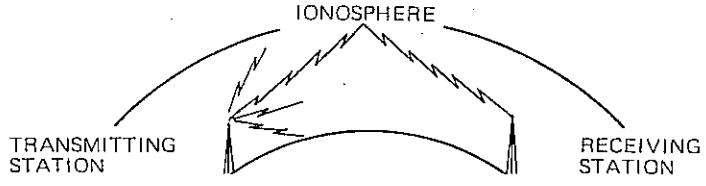


Figure 1

At different periods of the year, short-wave reception improves above the usual value between the receiving site and various areas in the world. As an example—the spring months bring the strongest signals from Australia and the South Pacific. In the fall months, signals from Europe and the Far East dominate the bands. Also, as daylight changes into darkness each day between your receiving location and the transmitting station, so does the nature of the reception. Day-to-day variations are also present. Further, the sunspot cycle greatly affects the overall reception quality. Sunspot activity varies in an 11-year cycle. The last peak activity was about 1968; minimum activity will be about 1976. Maximum activity = best DX reception; minimum activity = inconsistent and/or poor DX reception. Thus, reception will vary from year to year.

WHAT TO LISTEN FOR

The Short Wave frequencies are your passport to a world of exciting adventure—*G.I.*

AMATEUR RADIO Amateur (Ham) radio stations are operated by private citizens in more than 250 countries around the world. See **Band Spread and Dial Calibration**, also **Notes on Operating on Each Band.**

Hams talk to other amateur operators for personal pleasure or experimentation. No business or commercial transactions are permitted over stations operating in this service. Hams are allowed to operate on any frequency within assigned bands. The amateur bands are the 160-80-40-20-15 and 10 meter bands. The section on **Frequency Conversion** will give an explanation of the relationship between megahertz and meters.

SINGLE SIDE BAND When tuning your Receiver across the amateur bands, you will hear many single side band signals. This type of signal will sound distorted and unintelligible in an ordinary AM (Amplitude Modulated) receiver. The reason for this is the absence of a carrier in the transmission of a single side band signal. Your DX-160 receiver allows you to clarify a single side band signal through the use of a "product detector." The SSB-CW position on the **MODE** switch enables you to "re-insert" a carrier to a received SSB signal. The adjustment of the **BFO PITCH** and **BAND SPREAD** tuning will further clarify the received signal.

SHIP-TO-SHORE MOBILE RADIO TELEPHONE Essentially a telephone without wires. Operated by telephone companies and businesses who lease transmitters and receivers to individuals. Listen between 2 and 3 Megahertz.

AIRCRAFT Weather information, flight conditions, rerouting of planes in time of bad weather. Federal Aviation Administration communications between planes and stations on the ground. Signals in this service are found at approximately 2.6, 2.9 to 3.0, at 4.1 and at approximately 7.6 MHz.

MILITARY Air Force, Army, Navy, Marine and Coast Guard communications may be heard between ground stations and planes or vehicles 24 hours a day. These signals may be heard throughout the short wave frequency range.

MARITIME MOBILE Commercial vessels, fishing fleets, and pleasure craft regularly communicate routine and emergency messages on short wave. These may be heard in the ranges from 2 to 3 MHz, 4 to 4.4 MHz, 6.2 to 6.5 MHz and 7.9 to 8.8 MHz.

INTERNATIONAL SHORT WAVE BROADCASTING International broadcasting offers the most varied entertainment of all the services you will listen to on short wave. Many governments operate powerful short wave transmitters (e.g. the U.S. Government's Voice of America) to keep the world informed of activities within their countries. Many countries also license commercial short wave stations and, in fact, many regions of the world conduct most of their daily brodcasting on short wave instead of on the standard broadcast band. For specific stations and frequencies consult your Country Log. Also, see **Band Spread and Dial Calibration** and **Notes on Operating on Each Band.**

STANDARD TIME SIGNALS—WWV/H and CHU The United States Bureau of Standards broadcasts the correct time with voice as well as code identification. Other checks such as radio frequency, audio frequency and forecast of conditions which will affect radio reception are broadcast. WWV will be found at 2.5, 5.0, 10.0, 15.0, 20.0 and 25 MHz. The Canadian Government provides a similar service at 3.3, 7.33 and 14.67 MHz. Voice announcements are made every minute in both English and French over station "CHU".

INSTALLING YOUR RECEIVER

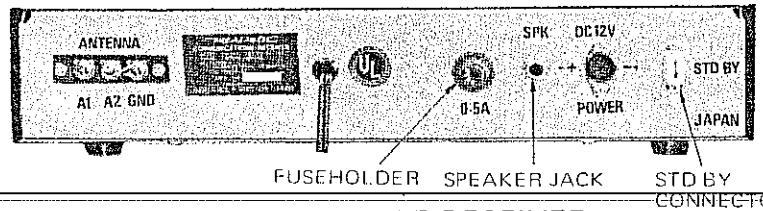
Your Realistic DX-160 is a communications Receiver designed and manufactured to the most rigid quality standards. It has been packed to ensure safe arrival. Carefully lift the unit out of the shipping carton and inspect for any visible damage.

Decide where you want to set up the receiver. In making your decision you should consider:

A. YOUR COMFORT. You will spend many hours with your receiver; be sure it is placed where you can enjoy it at any time.

B. YOUR ANTENNA. In the beginning, you will doubtless use a long wire antenna. As you gain more experience and begin reaching out for more distant stations, you may want to set up an outside antenna. With this in mind, choose a location near a window or outside wall. A short wave antenna kit is available at your nearest Radio Shack store (Catalog Number 278-758).

C. YOUR GROUND. If you set up on outside antenna, **it is good practice to ground your set for safety.** This will require running a ground wire from the ground connection on the back of the receiver to a cold water pipe or metal pipe driven into the earth.



BACK VIEW OF RECEIVER

Figure 2

Connect a lead-in wire to the antenna terminal marked **A1** and the ground lead to terminal marked **GND.** Route the lead-in wire out through the window and up to your antenna.

For more information, see the **ANTENNAS** section.

Plug the Speaker into rear panel jack marked **SPK.**

AC OPERATION

To complete the initial AC installation, plug the line cord into a source of **115/220-240V.50Hz** AC power. Power consumption is about 10 watts.

12 VOLT DC OPERATION

You can also operate your DX-160 from a 12 volt DC supply. **It must be a negative ground electrical system.** 12 volts negative ground is standard for most U.S. cars. Or, you can use any other 12 volt DC source, such as eight 1-1/2-volt type D batteries (Catalog Numbers: 23-466, 23-451, 23-550 from your Radio Shack store).

A useful accessory is Radio Shack's Catalog Number 20-1501, which includes a cigarette lighter socket adapter, plus an 8-cell Battery pack (with 8 D cells).

NOTE: The dial lights do not function with 12 volt power. This conserves battery power when operating from 12 volt battery sources.

WIRING THE DC PLUG

Unscrew the back of the plug provided (comes plugged into the rear socket). Insert wires through the back of the plug, remove insulation from the ends of the wires and insert and solder into the pins as shown in Detail A. Replace the back and then plug into the socket.

NOTE: Be sure you connect wires with the correct polarity.

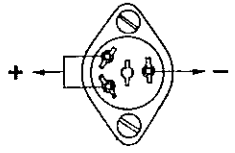
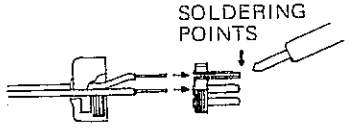


Figure 3



Detail A

OPERATION

Before you start to use your Receiver, turn to pages 10 and 11 for a brief description of each control and its basic function.

Then, you might find it helpful to operate the Receiver for a while on Band B—the standard AM Broadcast band. You are most familiar with this band and will soon become confident to use the other bands too. You'll notice all the standard stations on the AM band—but you'll also discover other stations you have never heard before.

Preparing for Operation

Be sure you have the Speaker plugged in, the Antenna and Ground connected and the line cord plugged into a source of **115/220-240V.50Hz** Hz AC power. Or, if you are using 12 volt DC power, be sure you have made the proper connections as indicated above. For all tuning procedures, start with the following control settings.

1. Turn "on" by rotating **AF GAIN** clockwise.
2. Set **MODE** to AM.
3. Set **OPR** (operate) to REC (receive).
4. Set **BAND SPREAD** maximum clockwise—the high end of the Band Spread Dial.
5. Set **BAND** to the desired band of operation.

6. Set **RF GAIN** maximum clockwise. For normal operation, leave **RF GAIN** set to maximum and adjust volume with **AF GAIN**. If you are near a very strong signal, you can use **RF GAIN** to reduce the volume; if you don't, the strong incoming signal can "swamp" the first stages in the Receiver and cause various types of distortion. Also, you should realize that the S-Meter is accurate only when **RF GAIN** is set to maximum.

7. Set **ANL** to OFF and **AVC** to SLOW.

Tuning Band A

1. Set **BAND** to A.

2. Adjust **MAIN TUNING** for the desired frequency as shown on the Main Tuning Dial.

3. Adjust **AF GAIN** for the desired sound level.

4. If signals are code, set **MODE** to SSB/CW, and **AVC** to FAST. Then adjust **BFO PITCH** for the best code tone or pitch.

5. Adjust **ANT TRIM** for maximum reading on the Meter.

6. If noise is excessive, you may want to set **ANL** ON.

In most cases you will not need to fine-tune with **BAND SPREAD**, although it does function on all bands. Use it if you desire. However, remember that the frequency indicated on the Main Tuning Dial will not be accurate if the **BAND SPREAD** is not set to the high end of the range (see **Band Spread and Dial Calibration** later on).

Tuning Band B

1. Set **BAND** to B.

2. Adjust **MAIN TUNING** for the desired frequency as shown on the Main Tuning Dial. Adjust for maximum Meter reading.

3. Adjust **AF GAIN** for the desired level of sound. If signals are very strong, you may want to adjust **RF GAIN** also. On Band B, you may prefer to set **RF GAIN** to about midpoint, leave it there and then use **AF GAIN** for control of volume.

4. Adjust **ANT TRIM** for maximum reading on the Meter.

Once again, if you want, you can use **BAND SPREAD** for fine-tuning, but remember the accuracy of the Main Tuning Dial will not be precise if **BAND SPREAD** is not set maximum clockwise.

Tuning Bands C, D and E

These are the Short Wave Bands. Tuning these bands requires greater skill and precision. Here is where you'll have an opportunity to use each of the controls to the greatest advantage. We should caution you that it may take a few hours of tuning and even weeks or months of "short wave listening" before you gain sufficient experience to fully utilize all the features and functions of your Receiver. Short wave listening is a lot of fun, but you will find it even more fascinating and fun after you have gained more experience. Get used to your Receiver. Use it at different hours of the day. Read magazines and books on the subject; your Radio Shack store has some helpful books and literature.

1. Set **BAND** to the desired position.

2. Adjust **MAIN TUNING** for the desired frequency on the Main Tuning Dial. You probably will need to use **BAND SPREAD** to fine-tune the signals—see **Band Spread and Dial Calibration** later on for additional pointers.

3. Adjust **AF GAIN** for the desired sound level.

4. Adjust **ANT TRIM** for maximum reading on the Meter. Adjust **BAND SPREAD** for maximum Meter reading and/or most precise signal sound.

5. If signals are code or Single Side Band, set **MODE** to SSB/CW and **AVC** to FAST. Then, adjust **BFO PITCH** for the best code tone or proper voice sounds on Single Side Band.

6. If noise is excessive, set **ANL** to ON.

It might be a good thing to remind you again of some of the differences in Short Wave reception. Many things are beyond your control and yet they effect reception to a great extent. Some of these variables are:

Atmospheric conditions—conditions of weather, solar disturbances, etc. These may make a signal come through loud and clear, or make it fade in and out, or may even block out signals completely.

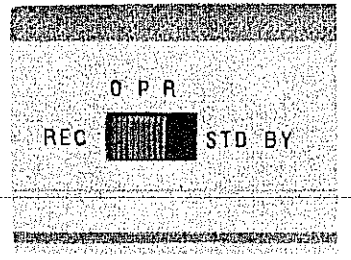
Time of the day, month and year—these greatly effect transmission of radio signals over great distances.

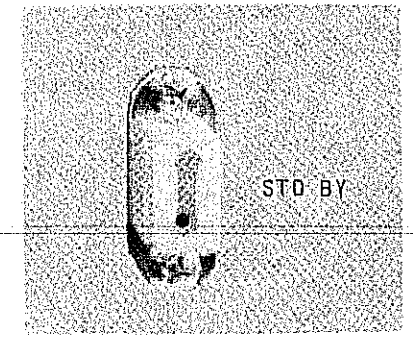
Your own skill will help to determine your success in receiving DX signals (DX stands for "distant transmissions"—meaning long-distance reception). Of course, there are a number of things **you** can do to improve your success—this instruction manual gives you a number of suggestions. Experience will help, other books and magazines can help, a good antenna will help, a DX or SWL club may help too.

OPERATING NOTES

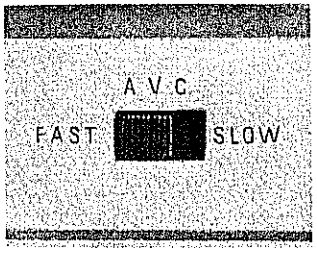
Your Receiver is a fine example of technical achievements in the field of communications equipment. It is simple to operate, and yet has all the most-wanted features and controls. Short Wave Listening is a great hobby—your skill will grow with experience and of course experience only comes with practice. This section has a number of hints relating to the proper use of your Receiver. We can't possibly turn you into an expert SWLer just by giving you thorough instructions—but these hints will help.

The OPR (operate) switch is a feature found only on high quality communications and Ham receivers. Its purpose is two-fold: one is to leave critical circuits on all the time, which provides maximum stability, and yet not be annoyed by the audio signal. The other purpose is for station set-ups which have a transmitter (as Hams do); when the transmitter is on, the Receiver must be non-operating (or radio frequency energy from the transmitter gets into the Receiver and causes all kinds of problems). For normal reception, set to REC position; for standby operation, use STD BY.





There are contacts on the back for remote control of the Receiver. If you have a station set up where you want to be able to control the Receiver from a remote position, use these contacts; a switch should close for Receive and open for Stand By. These contacts are vital for Hams who want to be able to turn their Receiver on and off together with their transmitters.

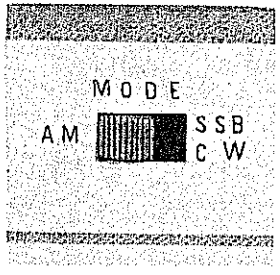


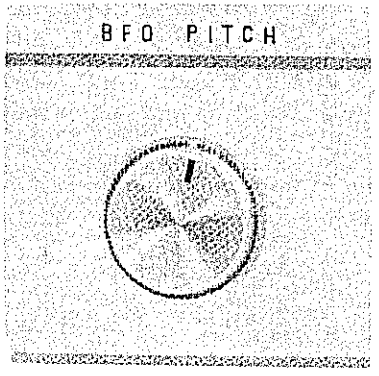
The AVC switch normally should be left in the SLOW position. This means that the internal automatic gain control circuit has a slow reaction time; this is best for normal AM broadcast signals which have relatively constant strength. The FAST position provides a fast reaction time for the internal automatic gain control; this is best for code and SSB signals, also for stations which seem to fade and flutter in strength. Use the position which results in the most steady signal sounds.

The ANL switch is a handy feature. Its primary purpose is to reduce electrical noise interference on the radio waves. However, you must realize that **no** ANL circuit can possibly remove **all** noise interference. There may be conditions where you just can't understand the radio signals because of too much noise and static—and **ANL** doesn't seem to solve the whole problem. This is normal. Also, in some cases, with **ANL** ON, the signal level may appear to drop slightly; this too is normal.

Operating Notes—continued

The MODE switch determines the type of signal you can receive. For standard broadcast and international short wave stations, use the AM position. However, if you want to tune in to code or single side band signals, you must use the SSB/CW position.



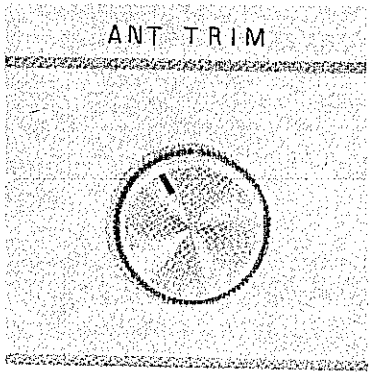


Single Side Band and Code signals must be tuned with care. Much of the activity on the Ham bands is in code or SSB (single side band). If you want to listen to these signals, set **AVC** to FAST and **MODE** to SSB/CW. Set **BFO PITCH** to the center position to start and then tune in the station.

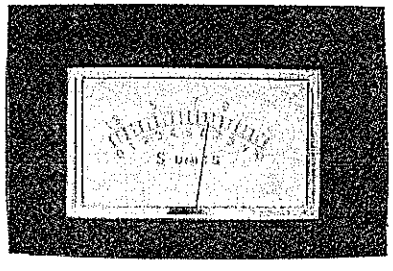
If you are listening to a Morse Code signal, adjust **BFO PITCH** for the pitch of tone of code which best suits you.

If you are listening to an SSB signal, that takes more practice. If the **MODE** switch is in AM position, an SSB signal will only make a fluttering sound, you wont be able to understand anything. When you do come across such a sound, set **MODE** to SSB/CW. Then, very slowly and carefully tune **BAND SPREAD** and **ANT TRIM** for maximum meter reading. Now, very slowly and carefully adjust **BFO PITCH** to one side or the other until the voice sounds normal; when improperly adjusted, voices will have a low, gutteral, unintelligible sound or will sound like "donald duck". Tuning of SSB signals takes a little patience and practice.

If you attempt to tune a normal AM type signal with **MODE** set to SSB/CW, you will have a very annoying background tone which varies in frequency as you adjust the tuning controls. If this happens, just remember to set **MODE** to AM.



The ANT TRIM (antenna trimmer) control helps to adjust the Receiver circuitry to the antenna you are using. Since each frequency has its own particular optimum antenna length, and you can only have one antenna connected, the **ANT TRIM** control helps to match the Receiver to the antenna. Always check the adjustment of **ANT TRIM**; it sometimes can make quite a difference in reception. Any time you make a major change in tuning, recheck **ANT TRIM** setting.



The Meter is marked in S units. This stands for a relative indication of signal strength. Often you will hear SWLers and Hams talk about the strength of a signal in "S" units. The Meter is marked from 0 to S-9 and then +10 and +30 dB. The numbers below, 0-10, are just added for an additional reference.

Often, QSL cards and station signal reception reports have a place for indicating the strength of the signal; this is where the Meter comes in handy. The Meter is accurate only when the **RF GAIN** control is set maximum clockwise: if **RF GAIN** is set below maximum, the Meter does not indicate S-units accurately. So, whenever you want to check signal strength, set **RF GAIN** to maximum.

You can use 12 volts DC to power your Receiver. For example, if you want to mount the Receiver in a vehicle, or take it on a field trip, a source of 12 volts DC will operate it. Connect the 12 volt DC power to the connector on the rear; if you are using this in conjunction with a vehicle, **be sure you use a 12 volt negative ground electrical system** (almost all current U.S. vehicles use negative ground systems). Be sure you connect the external power leads with the correct polarity: + to + and - to -.

A good Antenna is an absolute necessity. We have said it before, but it doesn't hurt to remind you of that. You can have the finest receiver in the world--without an antenna you wont receive anything.

A pair of headphones is a great asset for serious SWLing. They make it much easier to hear and understand some of those weak and distant stations. We strongly suggest you consider purchasing a pair of communications headphones--8 to 2000 ohm impedance type. Your Radio Shack store has a couple of good choices.

The LOG scale on the Main Tuning Dial is a very handy tuning reference device. It is much easier to remember the number of the Log scale than it is to try to remember a number on one of the Band scales. Once you find a station on a particular band, note the band and the Log scale reading. If you want to return to that station at another time, just use the proper Band and then return to the same Log scale reading. When you enter notes in the **Country Log** (later on in the Manual), always note the Log Scale reading too.

Dial Scanning is a simple technique for quick tuning of the Short Wave Bands. As we have noted before, reception conditions vary on the different bands and according to the time of day, time of year and solar activity. Thus, you wont always find the same station at the same place; sometimes certain bands will be "dead" and others just jumping with activity.

To aid you in finding the best frequencies to listen to, do the following:

1. Choose the band you want to check.
2. Set **BAND SPREAD** maximum clockwise.
3. Slowly turn **MAIN TUNING** across the band. In places you'll hear nothing, then squeals, code, music, voices, etc.
4. When you have located sections of great activity, fine-tune the desired station(s) with **BAND SPREAD.**

Additional information on Short Wave Listening and using your Receiver is available from many sources. Many things you just must learn by experience; but, books and reference material can be of great help. Your Radio Shack store has a few books you should consider obtaining:

RADIO AMATEUR'S HANDBOOK by ARRL
INTRODUCTION TO SHORT WAVE LISTENING
AMATEUR CB/SWL RADIO STATION LOG BOOK

Each of these has helpful information and ideas. The Log book is an absolute must if you intend to do much serious SWLing. Other places to look are some of the periodicals specializing in Short Wave Listening and Communications. There are a number of fine SWL clubs and organizations which can be of further assistance. Also, your local library is a good source for reference and help.

CONTROLS AND

Band Spread Dial This is the "fine tuning" dial scale. It is accurate only when the MAIN TUNING control is used to set the dial pointer directly over one of the red Band Spread calibration points ⌖. See **Band Spread and Dial Calibration.** BAND SPREAD moves this dial.

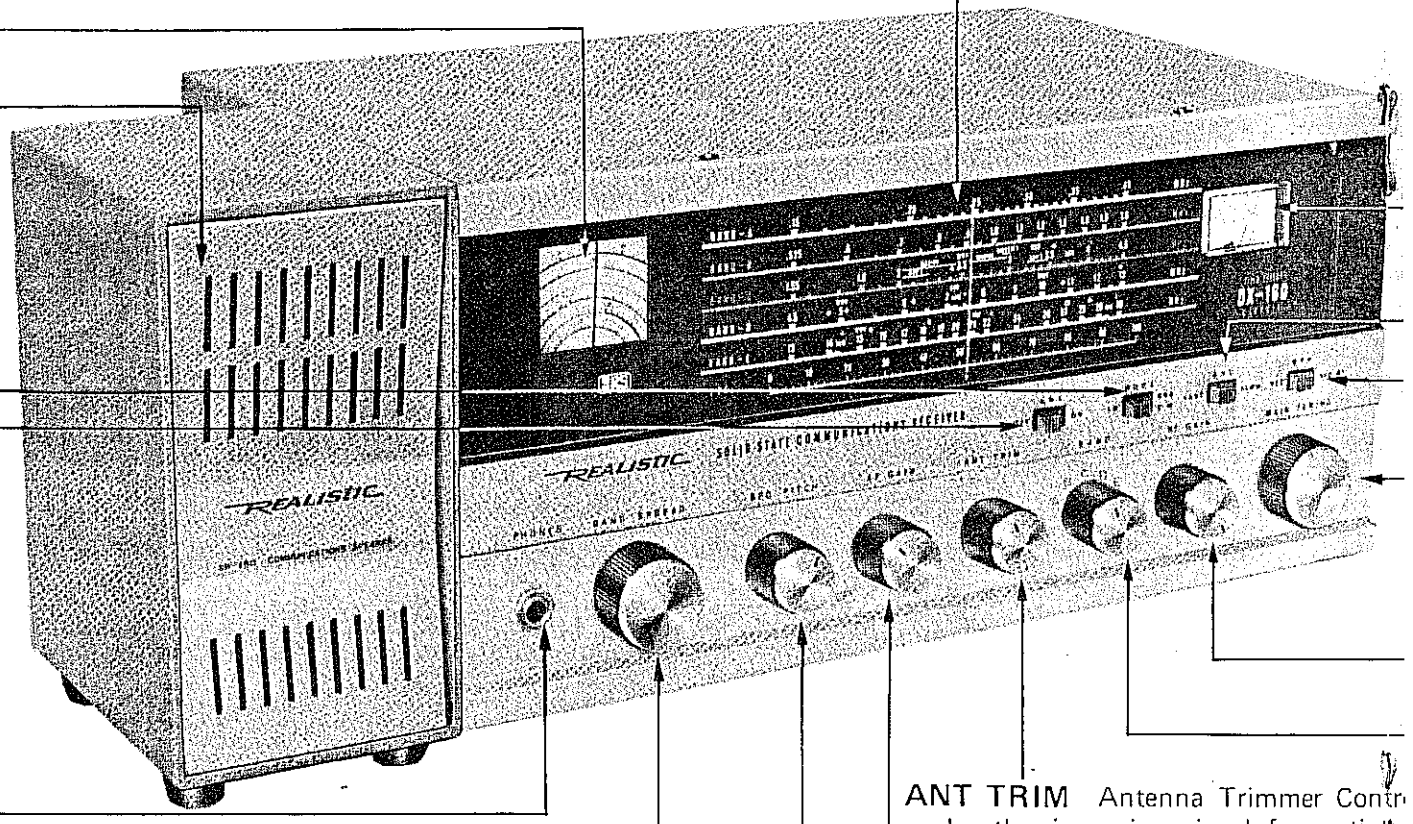
Speaker Insert the Speaker plug into the SPK jack on the back of the Receiver. Unless you have Phones connected, you will hear the sounds through the Speaker.

MODE Determines the proper mode of detection for the Receiver. For normal voice signals, use the AM (amplitude modulation) position. For Code and Single Side Band signals, use the SSB/CW (single side band/"continuous wave" or code) position. The SSB/CW position provides the necessary beat frequency tone for receiving Single Side Band and Code signals. Use this position in conjunction with BFO PITCH control.

ANL The Automatic Noise Limiter switch helps to cut out annoying man-made and other types of interfering noise. When noise is a problem, set to ON; for normal listening, use the OFF position.

PHONES Plug any communications-type 8-2000 ohm headphones into this jack for private listening. Headphones provide for more precise listening, especially in areas where background noise is a problem. They also make it easier to hear some of those hard-to-hear DX signals. When a plug is inserted, the Speaker sound is automatically disconnected.

Main Tuning Dial Shows the frequency you are tuned to. Special radio services or bands of frequencies are indicated on each band. The white and red ⌖ marks are calibration marks for Band Spread calibration.



BAND SPREAD Provides fine tuning for any of the bands of operation. It turns the Band Spread Dial.

BFO PITCH Beat Frequency Oscillator Pitch Control is for adjusting the tone of a code signal or to achieve proper voice sound of a Single Side Band signal. It functions only when MODE is in the CW/SSB position.

ANT TRIM Antenna Trimmer Contr
peaks the incoming signal for optim
reception. Set it to provide maxim
S-Meter reading—you may have to reset
each time you make major MAIN TU
ING changes.

AF GAIN Is the Volume and powe
control. Turn clockwise to turn power o
and increase volume. Turn maximu
counterclockwise to turn power OFF.

D FUNCTIONS

S-Meter Shows the relative strength of signals. It is calibrated in "S" units and dB above S-9. Its calibration is accurate only when **RF GAIN** is set to maximum.

AVC Automatic Volume Control switch provides automatic volume control action as suitable for either AM or Code and Single Side band signals. Use FAST for Code and SSB; use SLOW for all other signals.

OPR Operate switch, when you set it to Receive (REC), you hear normal sound from the Phones or Speaker. In the Stand By (STD BY) position, the Receiver remains on, but voltage to the RF, IF and Audio circuits is disconnected—and so you wont hear any sound.

MAIN TUNING Use it to tune the Receiver to the desired frequency. It moves the pointer back and forth across the Main Tuning Dial. When you are going to use the **BAND SPREAD** for accurate tuning, set dial pointer to one of the ✦ calibration marks.

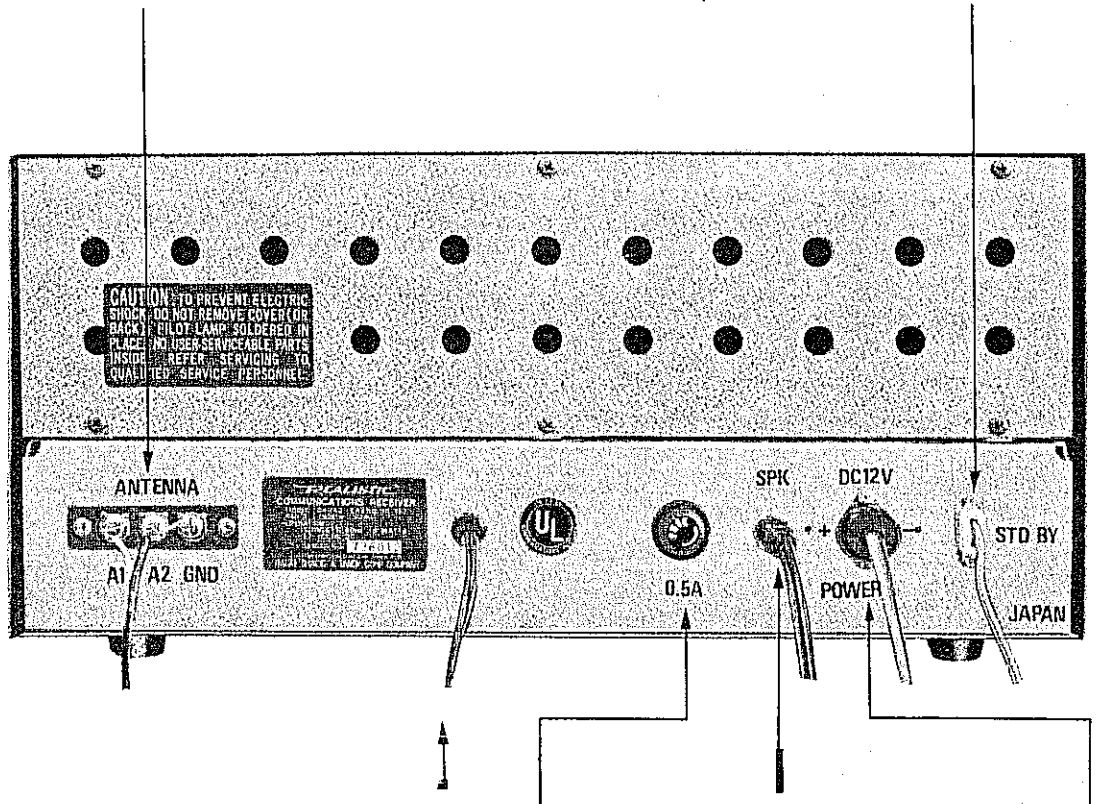
RF GAIN Adjusts the sensitivity of the Receiver. For most sensitive reception, set to maximum. If signals are very strong (making the S-Meter move all the way to the right), reduce **RF GAIN** setting as required. Note that the S-Meter gives accurate S-unit readings only when **RF GAIN** is set to maximum.

BAND This is the Band Selector switch. Set it to the desired band of operation.

REAR PANEL

ANTENNA Connect antenna wires to these terminals. For most antennas, connect to the A1 terminal. If you are using a balanced antenna, remove the jumper wire between A2 and GND and connect the antenna wires to A1 and A2. Connect a solid ground wire to GND screw terminal.

STD BY Provides remote Standby-Receive control of the Receiver. Connect a remote set of switch contacts to the plug provided. Contacts should close for Receive; open the contacts for Stand By. When you use these remote control contacts, leave front panel **OPR** switch in STD BY position.



Line Cord Plug into a source of 120 - 115/220-240V. 50Hz AC power.

Fuse Protects the Receiver in the event of excessive current drain. If the Fuse blows, replace only with a 0.5 Amp type.

SPK Connect the Speaker to this jack

DC 12V For operation from a 12 volt DC, **negative ground** power source, connect leads to the plug provided. Be sure to observe proper polarity.

Band Spread and Dial Calibration

BAND SPREAD is like a fine tuning control. But, it can be an accurate tuning control too—

providing MAIN TUNING is set properly.

NOTE: The calibration of the Main Tuning Dial is not accurate unless the Band Spread Dial is set maximum clockwise (high end of frequency).

You will notice that the Band Spread Tuning Dial has six scales on it. From the top down:

Log scale:	0 to 100
10-11M scale:	CB channels 1-23 (11 meters) and 28 to 29.7 MHz
15M scale:	21 to 21.45 MHz
20M scale:	14 to 14.35 MHz
40M scale:	7 to 7.3 MHz
80M scale:	3.5 to 4.0 MHz

These 10, 15, 20, 40 and 80 meter bands are all Amateur Radio or "Ham" Bands. To achieve proper calibration of the Band Spread Tuning Dial for these Bands, use **MAIN TUNING** to set the dial pointer to the appropriate **red** ⌖ mark on the Main Tuning Dial Scale.

For 10-11M, use Band E, red ⌖ just to the left of 30.
For 15M, use Band E, red ⌖ just to the right of 22.
For 20M, use Band E, red ⌖ between 14 and 15.
For 40M, use Band D, red ⌖ between 7 and 8.
For 80M, use Band C, red ⌖ just above 4.

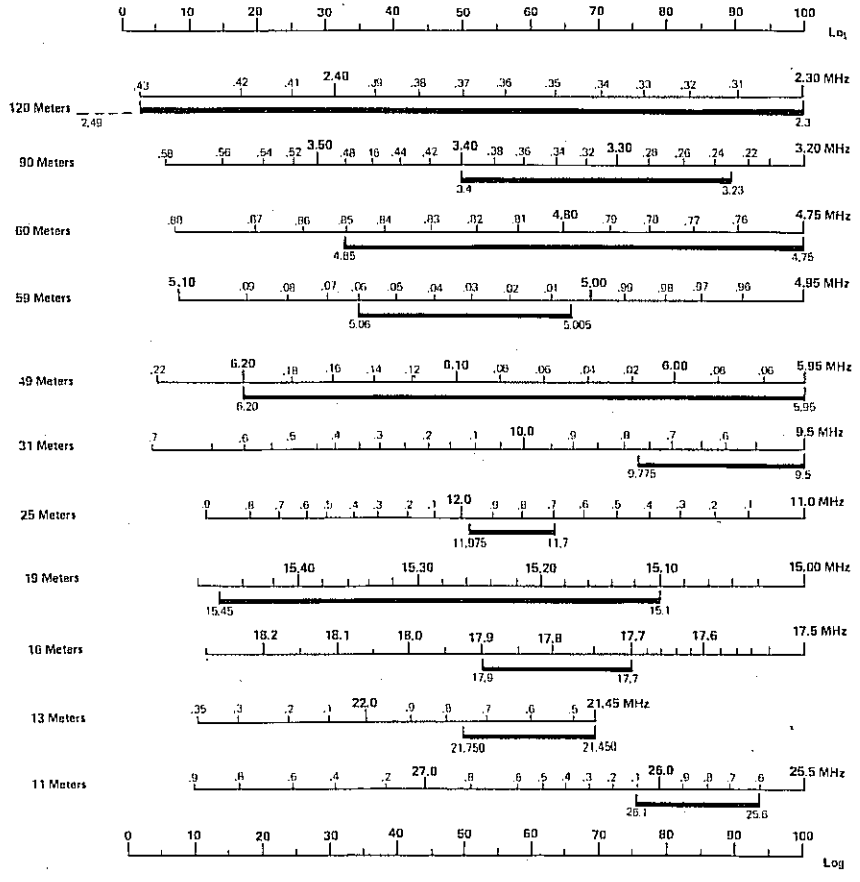
If you want to accurately tune to frequencies in the International Short Wave Bands, you can use the chart at the right. First, set **MAIN TUNING** to the appropriate **white** ⌖ mark on the Main Tuning Dial Scale and then adjust **BAND SPREAD** to tune in the desired station. To determine the precise frequency, read the Log scale and then look at the chart. Use a vertical straight line (a ruler will help) and line it up with the Log reading. Read the frequency on the appropriate scale.

The following table will help you determine the correct Band, set the **MAIN TUNING** to the proper **white** (or red in three cases) ⌖ point and identify the **BAND SPREAD** frequency coverage.

To Tune the following International Short Wave Band:	Set MAIN TUNING to ⌖ at (white except where noted):	This International Short Wave Band Covers:	The Band Spread Dial Scale Covers:
120 meters	2.43 MHz	2.3-2.5 MHz	2.3-2.43 MHz
90 meters	3.59	3.2-3.4	3.0-3.59
75 meters	4.0 (red)	3.9-4.0	3.5-4.0
60 meters	4.88	4.75-4.85	4.75-4.88
59 meters	5.1	5.0-5.06	4.95-5.1
49 meters	6.22	5.95-6.2	5.92-6.22
41 meters	7.3 (red)	7.1-7.3	7.0-7.3
31 meters	10.7	9.5-9.775	9.5-10.7
25 meters	12.9	11.7-11.975	11.0-12.9
19 meters	15.45	15.1-15.45	15.0-15.45
16 meters	18.2	17.7-17.9	17.5-18.2
13 meters	22.35 (red)	21.45-21.75	21.0-22.35
11 meters	28.0	25.6-26.1	25.5-28.0

For calibration of the Ham Bands, look at the previous table.
For calibration of 75, 41 and 13 meters, see the Ham Band Spread Dial.

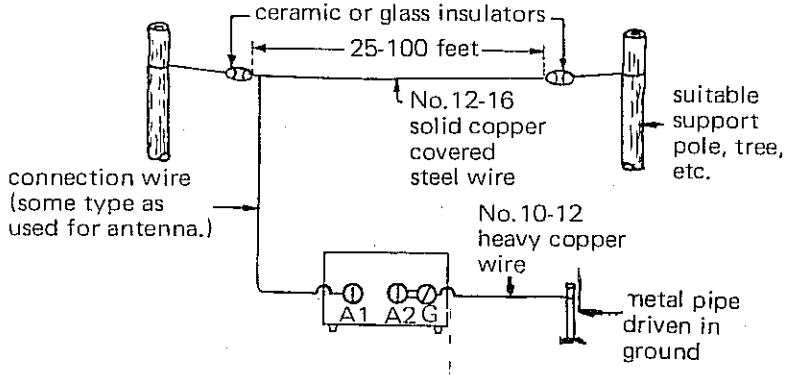
DX-160 INTERNATIONAL SHORT WAVE BAND SPREAD CALIBRATION CHART



ANTENNAS

An antenna is a vital part of your Receiver installation. The better the antenna, the more signals you can receive--and the better you will receive them.

For a simple antenna, follow the illustration provided. Your local Radio Shack store has a couple of short wave antennas already packaged in a kit form. Either one will be fine. It is very important that you mount the antenna as high as possible and away from power lines, buildings and metal structures. These antennas will give you good reception over all the bands.



However, if you want to obtain the very best reception on one specific band of frequencies, your antenna must be a certain length. Below we have listed two charts. The first chart gives an antenna length for best reception on any one band. The second chart gives the antenna length best suited for a specific Ham Radio band. These antenna lengths are approximately 1/2-wave length for the band noted.

Band A = Antenna length, 1870 feet (probably far too long for you to erect—you can obtain good reception even with shorter antennas)
Band B = Antenna length, 470 feet (see above note)
Band C = Antenna length, 185 feet
Band D = Antenna length, 67 feet
Band E = Antenna length, 24 feet

80 Meter Ham Band = Antenna length, 125 feet
40 Meter Ham Band = Antenna length, 66 feet
20 Meter Ham Band = Antenna length, 33 feet
15 Meter Ham Band = Antenna length, 22 feet
10 Meter Ham Band = Antenna length, 16 feet

If you are interested in putting up an antenna for a specific frequency, you can use the following formula to determine the 1/2-wave length required:

$$\text{Length of 1/2-wave antenna in feet} = \frac{468}{\text{Freq. in MHz}}$$

For example, if you want to pick up International Short Wave signals specifically in the 19 Meter band (15.1 to 15.450 MHz). Pick a frequency in that range, such as 15.35 MHz. Using the formula:

$$\text{1/2-wave antenna} = \frac{468}{15.35} = 30.5 \text{ feet}$$

So, put up an antenna 30-1/2 feet long; that will give you best reception for the 19 Meter International Short Wave Band.

For lots more information about antennas, purchase a copy (of **THE RADIO AMATEUR'S HANDBOOK** from your local Radio Shack store.

To insure good reception, you must always connect a Ground wire to the GND screw on the back of the Receiver. Use a heavy gauge wire for this; connect the other end either to a cold water pipe (**not** hot water and **not** a natural gas pipe) or to a metal rod driven into the ground.

Also, for lightning protection, we very strongly urge you to use a lightning protector/arrestor on your antenna. Your Radio Shack store has them. This will protect your Receiver from damage and may even protect your house from fire in case of lightning strikes.

FREQUENCY CONVERSION

Your Communications Receiver is calibrated in Megahertz (MHz)—as most communications-type receivers are. However two other terms are used quite often—you should know what they are and how to convert from each one to the others.

First, **Megahertz.** This stands for millions-of-Hertz (or cycles-per-second as we used to call Hertz). A Megahertz is 1,000,000 Hertz (Hz for short) or 1,000,000 cycles-per-second. Mega means million.

Second, **Kilohertz.** This stands for thousands-of-Hertz. A Kilohertz is 1,000 Hertz. We use the abbreviation kHz; thus, 1 kHz. Kilo means thousand.

Third, **Meter.** The term Meter, as applied to Short Wave Listening, refers to the wavelength of a radio frequency. In many parts of the world, frequencies are listed in Meters; for example, International Short Wave Stations in the 19 Meter band. European radio equipment and stations often refer to the wavelength of a station or band (in meters), rather than the frequency (in MHz or kHz).

The relationship of these three terms is:

1 MHz (million) = 1000 kHz (thousand)

Thus, to change 9.62 MHz to kHz, we multiply by 1000.

9.62 MHz x 1000 = 9620 kHz

To go the other way, from kHz to MHz, divide by 1000. Thus, a station at 3780 kHz is

$$\frac{3780 \text{ kHz}}{1000} = 3.780 \text{ MHz}$$

To convert MHz to meters, use this formula:

$$\text{Meters} = \frac{300}{\text{MHz}}$$

Example: What is the wavelength of 7.1 MHz?

$$\frac{300}{7.1 \text{ MHz}} = 42.25 \text{ meters}$$

To convert meters to MHz, use this formula:

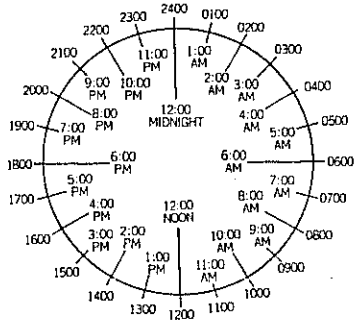
$$\text{MHz} = \frac{300}{\text{meters}}$$

Example: What is the frequency of a station on a wavelength of 19.5 meters?

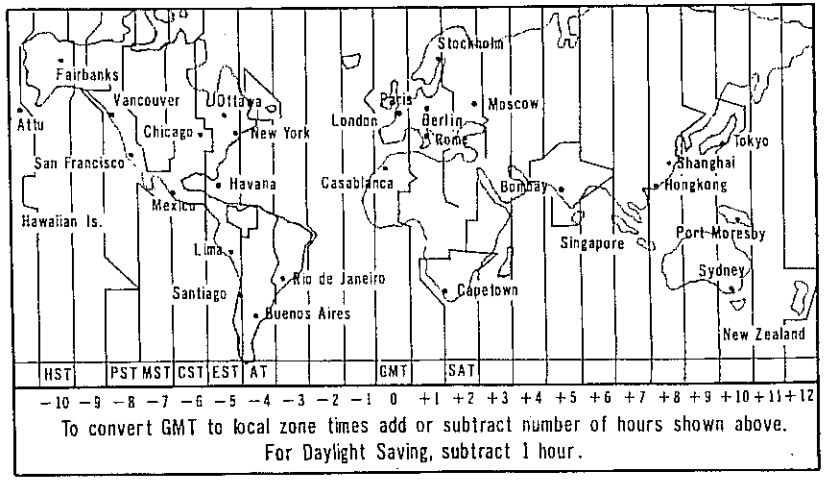
$$\frac{300}{19.5 \text{ meters}} = 15.385 \text{ MHz}$$

TIME CONVERSION

A 24-hour clock is used to tell communications time. One AM is 0100; four AM is 0400; Noon is 1200; 3:30 PM is 1530; 8:45 PM is 2045. This simple method precludes any confusion between AM and PM. (See Chart).



GMT (Greenwich Mean Time—the time at Greenwich Observatory, England) is the basis for telling time in International Broadcasting. To convert from GMT to local time or any other time zone, add or subtract the hours shown on the INTERNATIONAL TIME MAP (below).



Example: 2300 GMT is 1800 EST (Eastern Standard Time). This is equivalent to 11:00 PM in London, Eng., 6:00 PM in New York or 8:00 AM in Tokyo (the next day).

NOTES ON OPERATING ON EACH BAND

This section will give you some specific ideas of what to look for on each band. It can be a helpful guide while operating the Receiver.

BAND A—.15 to .40 MHz (150 to 400 kHz) is not often found on Short Wave Receivers available in North America. There are a number of interesting signals down in this range. If you live near the ocean or a large lake or inland water-way, you will come across many ship and navigational signals. There are a number of aeronautical and marine radio beacons in these bands. You may even come across some weather signals. In Europe and Continental Asia this band is used for standard broadcast stations (these are termed long-wave stations). If you have a very fine antenna and conditions are just right, you may be able to hear these signals from North America.

BAND B—.535 to 1.6 MHz (535 to 1600 kHz) is the standard AM broadcast band. In most countries around the world these frequencies are very active with local radio stations. You are most familiar with this band, so we don't need to tell you much about it.

BAND C—1.55 to 4.5 MHz. There are many varied signals within this band. From 1.55 to 2 MHz you will hear many broadcast stations and if you are near the ocean or large bodies of water, you will pick up maritime signals (ship, ship-to-shore and navigational signals). In some areas you will pick up Ham Operators between 1.8 and 2.0 MHz; they are limited in power and to certain geographical areas, so you wont always be able to hear them.

Between 2 and 3 MHz, you should pick up some governmental services, marine and aircraft signals. Near 2.2 there is a distress calling channel. This band also includes the 120 meter International Short Wave band (see **Band Spread and Dial Calibration**).

At 2.5 MHz, the National Bureau of Standards transmits very precise time signals and gives periodic propagation reports. Many countries around the world have special time standard broadcasting signals at various other frequencies (both on this band and others)—for example, 3.33 MHz is a Canadian station, CHU; Australia has one at 4.5; Chile has one at 4.298; many European countries use 2.5.

The 90 and 75 meter International Short Wave bands are also here, plus the 80 meter Ham Band. Hams are fun to listen to—set the **MAIN TUNING** to calibrate the Band Spread Dial for 80 meters and try it. You'll hear code signals from 3.5 to 3.8 and voice from 3.8 to 4.0.

BAND D—4.5 to 13 MHz. This and Band E are the best ones for Short Wave Listening. Certain times of the year and day, these bands are just full of signals.

The technique of DX chasing (looking for distant station signals) requires a certain degree of electronic detective work. Although some activity always prevails on the bands, you will find your time more enjoyably employed if you spend time preparing before chasing DX. Check WWV stations for propagation reports, do some reading research, keep an up-to-date SWL Log Book and then review it regularly.

Later on, we have given you a brief list of International Short Wave Stations in the form of a **Country Log**. Look it over, follow it and use it.

The 59 and 60 meter bands (4.75-4.85 and 5.005-5.06 MHz) provide domestic broadcast signals for much of the world. However, you will be able to pick up many of these signals from wherever you are. This has been referred to as the **Tropical Band** since many of the stations are located in Central and South America. Sometimes, North American SWLers also pick up Africa too. Best reception is the winter months and in the early evenings.

The 49 meter band (5.95-6.2 MHz) has some very popular and strong International Broadcast stations and reception should normally be quite good.

The 41 meter band (7.1-7.3 MHz) is shared with two or three services, so you may run into interference between these services. Ham radio stations (40 meter Ham Band) and strong International Short Wave stations will be very prominent here.

Notes on Operating on Each Band—continued

The 31 and 25 meter bands (9.5-9.75 and 11.7-11.975 MHz) are very good bands for both day and night reception.

You can pick up time standard signals at 5.0, 10 and 7.335 MHz. The first two are WWV and the last is CHU. If you can't get one, try another.

BAND E—13 to 30 MHz offers more fine listening. WWV has time standard signals at 15, 20 and 25 MHz; CHU has one at 14.67 MHz. There are 4 Short Wave bands here, plus 3 Ham bands and the CB frequencies. The sun spot cycle greatly effects DX reception within this band. The peak of the present cycle passed about in 1968 and the minimum is expected about 1976; the greater the sun spot activity, the better the reception at these higher frequencies. So, don't be surprised if reception is not as good as some of the lower bands.

The 19 meter International Short Wave Band (15.1-15.45 MHz) provides excellent daytime listening. Some night listening may be noted during the summer.

The 16 meter International Short Wave Band (17.7-17.9 MHz). During periods of sun spot activity, some really astounding DX reception is possible—especially during the day.

The 13 and 11 meter Short Wave Bands (21.45-21.75 and 25.6-26.1 MHz) are similar in reception conditions to the 16 and 19 meter bands. Reception may be superior with sun spot activity.

The Ham bands are very active. 20 meters (14.0-14.35 MHz) is always busy. You will hear code from 14 to 14.2 and voice above that. DX will be most prominent near dusk and dawn. 15 and 10 meters (21.0-21.45 and 28-29.7 MHz) at times will be very active; other times they will be "dead".

There is always activity on the Citizens' Band (11 meters, channels 1 through 23 on the Band Spread Dial), especially in areas near large cities.

MORSE CODE AND RADIO TERMS

Familiar Short Wave and Amateur Radio Terms

AF Gain Control—same as volume control

AM (Amplitude Modulation)—the amplitude of the transmitting signal is varied at an audio rate

ANL (Automatic Noise Limiter)—reduces impulse noises (ignition, static, crashes, etc.)

ANT—Antenna

AVC (Automatic Volume Control)—controls the gain of the radio frequency amplifying circuits automatically (i.e. reduces gain on strong signals)

BFO (Beat Frequency Oscillator)—provides a special internal signal so that CW (code) signals can be heard

CQ—a general call used by radio amateurs to establish contact. Caller will talk to anyone who answers. Can also be used specifically (CQ/DX, when calling only DX stations, or CQ Chicago, when calling stations only in Chicago)

CW (Continuous Wave)—unmodulated signal wherein intelligence is transmitted by interrupting signal to produce dots and dashes (code)

DX—distant stations

FM (Frequency Modulation)—the transmitting frequency is varied at an audio rate

QRM—interference from other signals

QRN—interference static

QRX—Stand-by

QSL—usually a card which verifies contact or acknowledges specific transmission

QSO—a contact between two stations

QSY—change operating frequency

RF Gain Control—radio frequency gain control: controls the sensitivity of the radio frequency amplifier stage

RST—readability, strength, tone (refers to a system of rating the quality of reception of code signals)

SWL—short wave listener

73's—best regard

88's—love and kisses

XYL—wife

YL—young lady

SSB—Single Side Band.

Associated Public Safety Communications Officers, Inc. Official Ten-Signals List (Police, Fire, etc.)

10-0	Caution	10-3	Stop transmitting
10-1	Unable copy—change location	10-4	Acknowledgment (OK)
10-2	Signal good	10-5	Relay
		10-6	Busy—unless urgent

10-7	Out of service	10-35	Major crime alert
10-8	In service	10-36	Correct time
10-9	Repeat	10-39	Urgent—use light, siren
10-10	Fight in progress	10-40	Silent run—no light, siren
10-12	Stand by (stop)	10-50	Accident (F, PI, PD)
10-13	Weather—road report	10-51	Wrecker needed
10-14	Prowler report	10-52	Ambulance needed
10-15	Civil disturbance	10-53	Road blocked at _____
10-18	Quickly	10-57	Hit and run (F, PI, PD)
10-19	Return to—	10-70	Fire alarm
10-20	Location	10-78	Need assistance
10-24	Assignment completed	10-80	Chase in progress
10-31	Crime in progress	10-89	Bomb threat
10-32	Man with gun	10-90	Bank alarm at _____
10-33	EMERGENCY	10-98	Prison/jail break
10-34	Riot	10-99	Wanted/stolen indicated

NOTE: CBers use 10-Code signals similar to this one, but in some cases, the meanings are quite different. For information, refer to **RADIO SHACK'S LOG BOOK.**

INTERNATIONAL MORSE CODE

Letter	Phonetic Sound	Dot-Dash Sequence
A	di—dah	•–
B	dah—di—di—dit	–•••
C	dah—di—dah—dit	–•–•
D	dah—di—dit	–••
E	dit	•
F	di—di—dah—dit	••–•
G	dah—dah—dit	––•
H	di—di—di—dit	••••
I	di—dit	••
J	di—dah—dah—dah	•–––
K	dah—di—dah	–•–
L	di—dah—di—dit	•–••
M	dah—dah	––
N	dah—dit	–•
O	dah—dah—dah	–––
P	di—dah—dah—dit	•––•
Q	dah—dah—di—dah	––•–
R	di—dah—dit	•–•
S	di—di—dit	•••
T	dah	–
U	di—di—dah	••–
V	di—di—di—dah	•••–
W	di—dah—dah	•––
X	dah—di—di—dah	–••–
Y	dah—di—dah—dah	–•––
Z	dah—dah—di—dit	––••
	Numbers	
1	di—dah—dah—dah—dah	•————
2	di—di—dah—dah—dah	••–––
3	di—di—di—dah—dah	•••––
4	di—di—di—di—dah	••••–
5	di—di—di—di—dit	•••••
6	dah—di—di—di—dit	–••••
7	dah—dah—di—di—dit	––•••
8	dah—dah—dah—di—dit	–––••
9	dah—dah—dah—dah—dit	––––•
0	dah—dah—dah—dah—dah	–––––

COUNTRY LOG

The following listing will be useful in spotting and identifying International Short Wave Broadcasting stations in operation around the world. The stations listed can be heard throughout the North American Continent. Transmission periods vary throughout day and night. All broadcasts (unless otherwise specified) are in English.

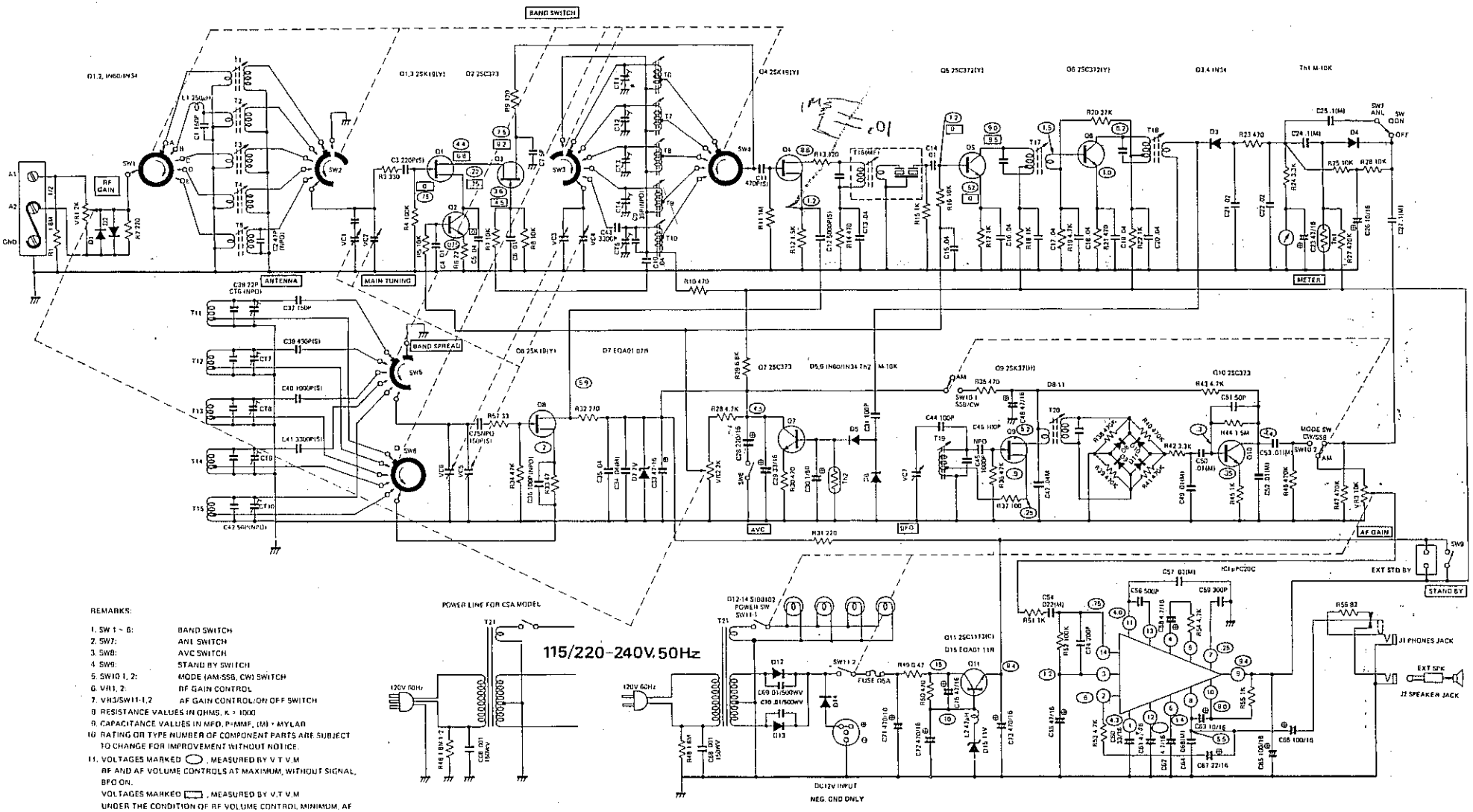
Columns are provided for LOCAL TIME HEARD (see **TIME CONVERSION**) and PROGRAM TYPE so that you may identify the broadcast you heard. You might want to note the Logging scale number too.

For a more complete or/and up-to-date list, check monthly periodicals on Short Wave Listening. There are many, many more stations and frequencies in constant use by all nations around the world—far more than we can list here.

CITY	COUNTRY	CALL	MHz	PROGRAM TIME HEARD
Monrovia	Liberia	ELBC	3.255	
Belize	British Honduras		3.300	
Accra	Ghana		3.366	
Paradys	S. Africa		4.810	
	Singapore	FBS	5.010	
Dar-es-Salaam	Tanzania		5.050	
Addis-Ababa	Ethiopia		5.060	
Sao Paulo	Brazil	ZTR226	5.955	
Ismaning	Germany		5.960	
Ciudad	Dominican Republic	Radio Caribe	5.970	
Jesselton	North Borneo		5.980	
Cap Haitien	Haiti	4VB	5.980	
Bucharest	Rumania		5.990	
Brussels	Belgium	ORU	6.000	
Abu Zabad	Egypt		6.015	
Salisburg	Rhodesia		6.020	
Tangier	Morocco		6.025	
Abu Ghurais	Iraq		6.030	
Daventry	England	GWS	6.035	
	Monaco	3M3	6.037	
Nanking	China	BCA22	6.040	
Djakarta	Indonesia	YDF	6.045	
Ibadan	Nigeria		6.050	
Warsaw	Poland		6.055	

CITY	COUNTRY	CALL	MHz	PROGRAM	TIME HEARD
Seckville N.B.	Canada	CKR2	6.060		
Delhi	India		6.065		
Minsk	U.S.S.R.		6.075		
Halifax	Canada		6.100		
London	England	BBC	6.110		
	Monaco				
Tokyo	Japan	FEN	6.160		
Mexico City	Mexico		6.165		
Berne	Switzerland		6.165		
Kaduna	Nigeria		6.175		
Pyongyang	North Korea		6.195		
Pyongyang	North Korea		6.250		
Cairo	Egypt		7.051		
Chiavi	Taiwan		7.100		
Brazzaville	Congo		7.105		
Naha	Okinawa	VOA	7.160		
Budapest	Hungary		7.220		
Karachi	Pakistan		7.280		
Berlin	East Germany		7.300		
Prague	Czechoslovakia		7.340		
Moscow	U.S.S.R.	Radio Moscow	7.555		
Brussels	Belgium		9.144		
Sofia	Bulgaria		9.255		
Peking	China		9.480		
Copenhagen	Denmark	OZF	9.520		
Havana	Cuba		9.531		
Lagos	Nigeria		9.535		
Berne	Switzerland		9.535		
Wellington	New Zealand	ZL2	9.540		
Prague	Czechoslovakia		9.550		
St. George's	Windward Islands	WIBS	9.550		
Bucharest	Rumania		9.570		
Roma	Italy	RAI	9.575		
Montreal	Canada	CBC	9.585		
Lourenco Marques	Mozambique	CR7BI	9.616		
Stockholm	Sweden	Radio Sweden	9.665		
Buenos Aires	Argentina	LRA	9.690		
Cuidad	Dominican Republic	Radio Caribe	9.735		
Peking	China		9.785		
Moscow	U.S.S.R.	Radio Moscow	9.805		
Barbados	Windward Island	2NX50	11.475		
Moscow	U.S.S.R.	Radio Moscow	11.570		
Cairo	Egypt		11.665		
Bangkok	Thailand	HSK9	11.670		
Karachi	Pakistan	11.674			
Stockholm	Sweden	Radio Sweden	11.705		
New Delhi	India		11.710		
Melbourne	Australia	VLA	11.710		
Hilversum	Holland		11.730		
St. George's	Windward Islands		11.735		
Rabat	Morocco		11.735		
Vatican City	Vatican	HVJ	11.740		
Montreal	Canada	CBC	11.760		
Djakarta	Indonesia		11.795		
Melbourne	Australia	VLA	11.810		
Moscow	U.S.S.R.	Radio Moscow	11.813		
Brussels	Belgium	ORU	11.850		
Elizabethville	Katanga		11.866		
Manila	Philippines	DZF2	11.920		
Brazzaville	Congo		11.925		
	Singapore	BBC-FES	11.955		
Peking	China		12.125		
Teheran	Iran	2PB	15.125		
Tokyo	Japan	JOA15	15.135		
Helsinki	Finland	O1X4	15.190		
Montreal	Canada		15.190		
Monrovia	Liberia	ELWA	15.198		
Taipei	Taiwan	BED3	15.225		
Belgrade	Yugoslavia		15.240		
Stockholm	Sweden	Radio Sweden	15.240		
Tel Aviv	Israel		15.250		
Colombo	Ceylon		15.265		
Warsaw	Poland		15.275		
Wellington	New Zealand	ZLA	15.280		
Melbourne	Australia	VLA	15.315		
Paris	France		15.350		
New York City	U.S.A.	WRUL	15.380		
Cologne	West Germany	DMQ15	15.405		
Seoul	South Korea	HLK9	17.745		
New York City	U.S.A.	WRUL	17.750		
Lisbon	Portugal	CSA44	17.870		

SCHEMATIC DIAGRAM



REMARKS:

1. SW 1 ~ 6: BAND SWITCH
2. SW7: ANL SWITCH
3. SW8: AVC SWITCH
4. SW9: STAND BY SWITCH
5. SW10 1, 2: MODE (AM-SSB, CW) SWITCH
6. VR1, 2: RF GAIN CONTROL
7. VR3/SW11-1,2 AF GAIN CONTROL/ON OFF SWITCH
8. RESISTANCE VALUES IN OHMS, K = 1000
9. CAPACITANCE VALUES IN MFD, P=MMF, (M) = MYLAR
10. RATING OR TYPE NUMBER OF COMPONENT PARTS ARE SUBJECT TO CHANGE FOR IMPROVEMENT WITHOUT NOTICE.
11. VOLTAGES MARKED ◯ , MEASURED BY V.T V.M
    RF AND AF VOLUME CONTROLS AT MAXIMUM, WITHOUT SIGNAL, BFO ON.
    VOLTAGES MARKED ▭ , MEASURED BY V.T V.M
    UNDER THE CONDITION OF RF VOLUME CONTROL MINIMUM, AF VOLUME CONTROL AT MINIMUM, WITHOUT SIGNAL, BFO ON.