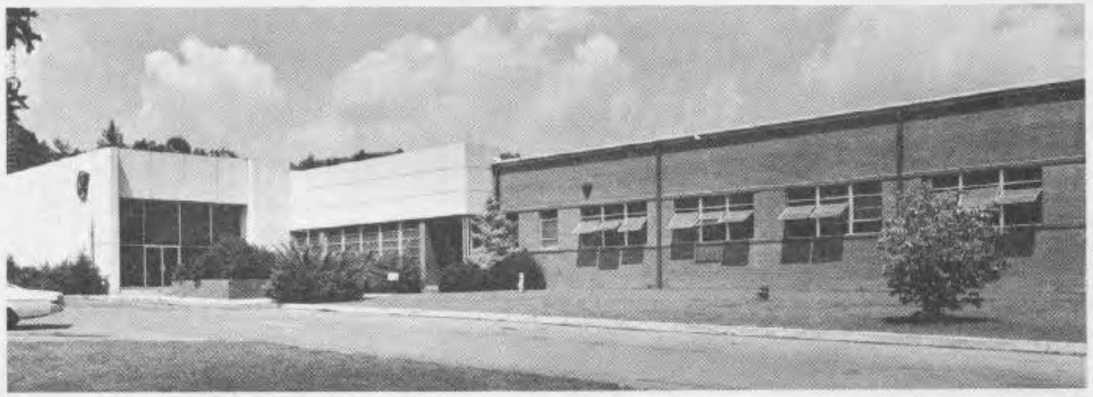
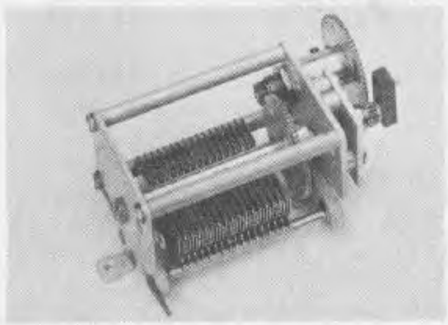
Your authorized Hammarlund dealer –



Other World Famous HAMMARLUND Products

MILITARY TRANSCEIVERS

AMATEUR RECEIVERS & TRANSCEIVERS



VARIABLE AIR CAPACITORS

TWO WAY FM COMMUNICATIONS

HAMMARLUND
MANUFACTURING COMPANY
73-88 HAMMARLUND DRIVE, MARS HILL, NORTH CAROLINA 28754
704-689-5411 / TWX 510-935-3553 / CABLE: SUPERPRO - NEW YORK
EXPORT DIVISION – 13 E. 40th STREET, NEW YORK, N. Y. 10016

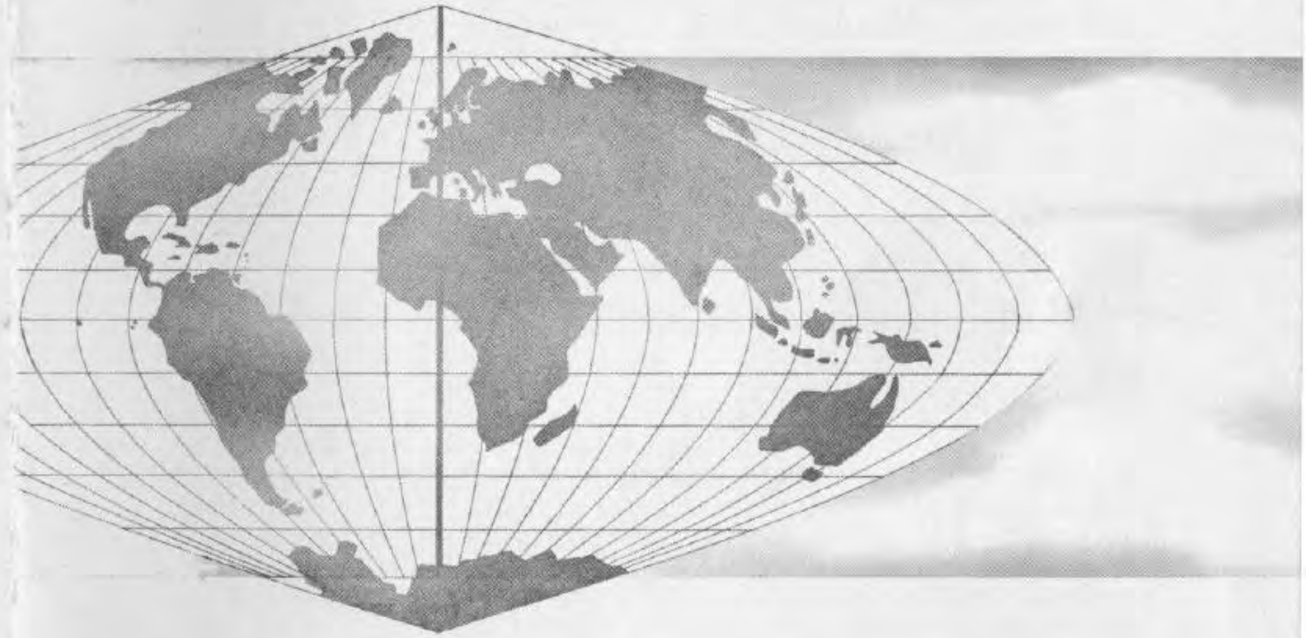
Established 1910

A. GIANNINI SCIENTIFIC COMPANY G.S.

INDUSTRIAL, AMATEUR, COMMERCIAL AND MILITARY COMMUNICATIONS EQUIPMENT / VARIABLE AIR CAPACITORS

HAMMARLUND

SHORT WAVE LISTENING RADIOS



Your Window On The World

Established 1910

HAMMARLUND
MANUFACTURING COMPANY
73-88 HAMMARLUND DRIVE, MARS HILL, NORTH CAROLINA 28754

Price 25¢

HAMMARLUND SHORTWAVE RECEIVERS

HQ—100A

AN SWL STANDOUT

The HQ-100A offers the discriminating S.W.L. the best dollar value on the market today. Continuously tunable from 540 KCS to 30 MCS including the Amateur and CB bands as well as all short wave bands.

Sensitivity and selectivity of the HQ-100A place it in the really "Hot Class."

Some of the operating features include: • Variable selectivity with a new "Q Multiplier" circuit. • Electrical bandspread for easy and accurate tuning. • Automatic noise limiter. • Receives AM, CW and Single Side Band. • 9 tube superheterodyne circuit with solid state power supply.

For the short wave listener the HQ-100A offers the most wanted features—and at a popular price.

HQ—145A

ONLY THE HQ-145A
OFFERS ALL THESE FEATURES:

• 11 tube superheterodyne with improved automatic noise limiter. • Dual conversion on 10.0-30.0 MCS band for superlative image rejection (including 20, 15, and 10 meter amateur bands). • Frequency range 540 KCS to 30 MCS in four bands. • Flip-top lid for easy access to top of chassis. • Crystal filter with six-position switch for additional selectivity—plus adjustable slot filter with up to 60 db attenuation and signal strength readings. • Adjustable high-stability, temperature-compensated BFO for SSB and CW reception. • Unusually high sensitivity provides an average 10:1 signal to noise ratio with 1 microvolt signal.

HQ—180A

GENERAL COVERAGE VERSATILITY
WITH
UNEQUALLED AMATEUR BANDSPREAD

. . . Features which make this receiver unexcelled for general coverage (540 KCS to 30 MCS) and amateur reception, include Triple Conversion—17 tube superheterodyne circuit—silicon rectifiers, improved electrical and mechanical stability, tunable BFO for CW.

For SSB reception at its very best, the HQ-180A combines a linear product detector, selectable sideband, and vernier IF passband tuning. Selectivity is adjustable from 500 cycles to 6 KCS and a tunable slot filter provides heterodyne and adjacent channel attenuation of up to 60 db.

The Hammarlund HQ-180A is consistent with the universally recognized Hammarlund policy of *"No compromise with quality."*

THE WORLD AT LARGE

"Big Ben" in London tolls right in your living room! Moscow's men and women announcers, speaking to you in painfully correct British English, come in like local news commentators! From behind the Bamboo Curtain and the Iron Curtain comes singsong Chinese, gutteral German, and languages and dialects too numerous to mention!

You hear the marine telephone operator, time signals from the U. S. Naval Observatory, "ham" radio operators all over the world, and news and views in as many versions as there are stations on the air!

Short Wave Listening or SWL'ing, is a real sport with a real challenge. Compare it to fishing if you will, for you veritably will be "fishing" among more than a million and a half radio transmitters 'round the world!

IN THE BEGINNING

At the turn of the 20th century, scientists thought that radio waves traveled in straight lines. Much as Columbus proved the world was round, so did Marconi's experiments with radio waves prove that these electrical pulses of sound would permit communications around the world.

Since the first successful experiments in 1901, the theory of propagation of radio waves has been much refined and the secrets of communication over long distances laid bare. Measurements and tests proved that there are electrical layers above the earth which reflect signals back to earth hundreds and thousands of miles away. The angle of reflection of the signal, and in turn, the distance covered, depends on the frequency of the transmitted signal at a particular time of day and year. Most of you have experienced this effect in the evening hours when suddenly you hear many out-of-state stations on your broadcast receiver.

Over the years, many more radio stations have been built with more powerful transmitters for communication and propaganda. Today there are thousands of stations around the world you can tune in with a good shortwave receiver. Day or night, you can open your own private "window on the world." Music, news, ships at sea, amateur radio operators, airport control towers and planes high in the air, police and fire calls and satellites in space are yours for the listening.

Anyone can become an expert SWL. All it takes is a good receiver and the gradual increase in knowledge that comes with experience. In the following pages, we will explore some of the things you will have to know to become an expert—it's easy!

THE SIGNAL

Although no one can see, feel or taste a radio signal, we know much about how it behaves and what it will do under certain conditions. It is helpful to understand how the signal is broadcast. Every station makes use of a powerful transmitter which turns music, or the spoken word, into energy that is radiated from the station's antenna. This radiated power of the transmitter may run into millions of watts to carry this information to listeners thousands of miles away. A diagram of a conventional radio transmitter is shown below. This is a simplification of the equipment used.

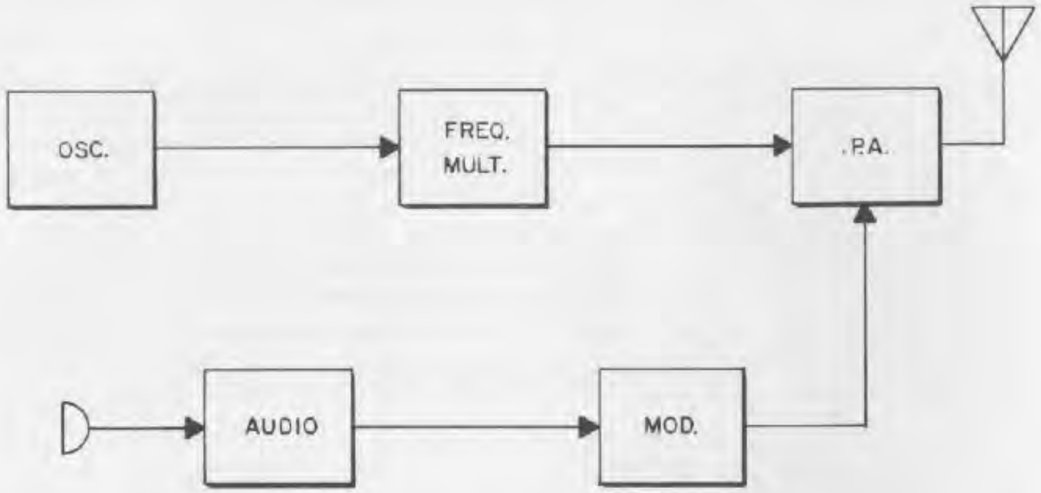


Fig. 1 Radio Transmitter

Every station broadcasts on a specific assigned frequency. The oscillator determines this frequency. Technically, the oscillator frequency must be changed one or more times before the radio signal is broadcast. The "frequency conversion" stages are tuned to make these changes. The power amplifier magnifies the strength of the signal and sends it to the antenna which radiates it into the atmosphere.

To add program material, a microphone or other device, is used to start the audio frequencies on their way to the antenna. An audio amplifier increases the strength of the voice or music to match up with the signal and the modulator changes the radio energy in the power amplifier so that the signal at the antenna now consists of radio energy which carries the program material.

PROPAGATION

The radio waves from the antenna travel outward between the ground and the ionosphere. As we go higher in frequency, the radio waves exhibit certain characteristics. At broadcast frequencies, 550 kcs to 1600 kcs, the waves are principally ground waves and find a consistent path along the ground to the receiving antenna. As we go higher in frequency, more and more of the waves begin to hit the ionosphere and are bent back to earth. This is called skip and accounts for most of the radio transmissions from 3 to 30 mcs. Here the length of the skip is determined by the height and the density of the ionosphere. The higher and less dense the layer, the shorter the skip. The frequencies higher than 30 mcs do not bend back to earth as much; as we go higher in frequency, they do not bend back at all but go straight through the ionized layer into space. Reception of TV and FM is limited by this effect. For good Very High Frequencies (VHF) and Ultra High Frequencies (UHF) reception, both the transmitting and receiving antenna should "see" each other. In other words, they should be in a direct straight line path.

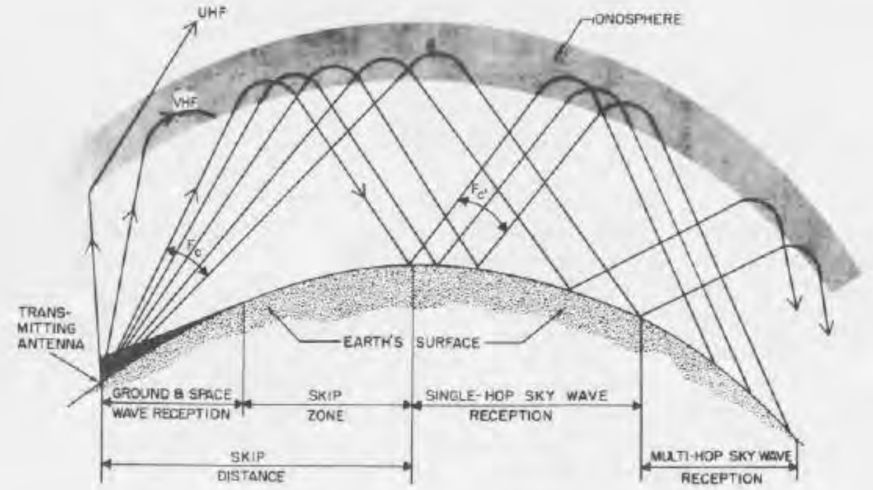


Fig. 2 Radio Waves

When the signal leaves the antenna it radiates into the atmosphere. Depending on the time of day and year, the signal will radiate in waves until it strikes the ionosphere. The ionosphere is a layer of electrical particles surrounding the earth and constantly changing in thickness and height above the earth. The ionosphere is influenced by the violet rays of the sun which cause changes in the density and height of the layers. Sunspots also affect radio transmissions and their activity will affect reception of short wave signals.

In the range of 3 to 30 mcs, where most of the SWL art is practiced, the skip phenomenon is sometimes a multi-hop path. The radio signal may bounce back and forth between earth and ionosphere several times. Each "skip" adds extra distance until the signal covers many thousands of miles. Each skip weakens the signal and a sensitive receiver is a must for good reception.

MAJOR DIVISIONS		FREQUENCY RANGES
VLF	Very Low Frequency	10 KC-30 KC
LF	Low Frequency	30 KC-300 KC
MF	Medium Frequency	300KC-3,000 KC
HF*	High Frequency	3 MC-30 MC
VHF	Very High Frequency	30 MC-300 MC
UHF	Ultra High Frequency	300 MC-3,000 MC
SHF	Super High Frequency	3,000 MC-30,000 MC

*Most SW listening is done in this part of the spectrum.

Fig. 3 Radio Spectrum

The wide range of a good shortwave receiver permits some portion of the spectrum to be heard at any time of day or year. Such a receiver may be found among the many Hammarlund products.

THE RECEIVER

The ability of your receiver to convert the weak radio signal to an audible one is a measure of its sensitivity. The greater the sensitivity, the better the received signal. Naturally, you want the most sensitivity you can get in your receiver.

The ability of your receiver to distinguish between signals close together is a measure of its selectivity. The ease of tuning is enhanced by the greater selectivity of the receiver.

Other features of a good SWL receiver include a good Automatic Volume Control (AVC) or Automatic Gain Control (AGC) circuit. Since signal voltages received vary in strength or "fade" during transmission, a good receiver provides circuitry to increase sensitivity during fading periods and reduce sensitivity when the signal builds up. This A.V.C. circuit maintains the listening volume at a fairly constant level despite large changes in the received signal.

Superheterodyne receivers are the best for good SWL receivers. A block diagram below illustrates the general layout of such a receiver.

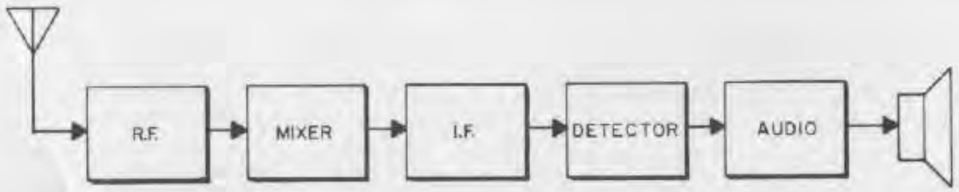


Fig. 4 Superheterodyne

Receiver Functions & Controls

A good shortwave receiver should provide as many functions and controls as are needed to carry out its purpose. The SWL receiver has several bands of frequencies which are selected by a switch. The average receiver has four separate bands; the better receiver may have as many as six.

Fig. 5

The receiver main tuning dial is used to select a particular section of the shortwave spectrum. The receiver bandspread dial provides for fine tuning. This bandspread acts to expand a portion of the main tuning dial and permits easier and more accurate station location and tuning. This is accomplished with the second tuning dial or "bandspread" which extends or stretches the subdivisions of the main tuning dial, thereby providing necessary elbow room for short wave signals.

For instance; the 16 meter band in which many overseas broadcasters operate, extends from 17.7 to 17.9 megacycles or approximately two inches of the bandspread dial of a Hammarlund receiver. If the same tuning ratio were applied to the dial of a normal broadcast receiver, these frequencies would occupy only about 1/4 inch! Obviously, far sharper tuning is required for the higher frequency bands.

A "Q" multiplier is useful in adding selectivity to the IF stages particularly when other station are causing interference to the wanted signal.

An Automatic Noise Limiter or "ANL" is another useful adjunct; its purpose is to minimize static bursts and ignition interference.

The antenna compensator or trimmer helps match the receiver circuits to the antenna.

The "S" meter is useful to peak receiving signals by visually indicating the strongest point of the received signal and providing a reference level of signal strength.

The "BFO" or Beat Frequency Oscillator is needed to copy CW or code signals and a new mode of transmission, Single Sideband. Better receivers may also include a crystal filter which varies the IF bandwidth of the receiver in fixed steps for increased selectivity and an adjustable "Notch Filter" which is used to reduce the level of the signals of unwanted stations close to the frequency of the selected station.

Crystal calibrators are a useful accessory and provide audible markers every 100 kcs for accurate frequency calibration.

In noisy locations, a "Noise Silencer" is a valuable listening aid, reducing ignition and similar noises electronically.

The latest in SWL equipment is the HQ series of receivers which incorporate many or all of these features. They are the culmination of decades of specialization in communications receivers for the Armed Forces, commercial users and amateur radio operators brought to its peak in Hammarlund short wave receivers. The simplified operation and the extra-performance of Hammarlund receivers are no longer confined to two-way communications. Today's extraordinary short wave broadcasts justify the use of communications receivers for SWL's. The HQ receivers, in addition to the standard broadcast band (540 to 1600 kcs), cover the entire radio frequency spectrum to 30 mcs.

A kilocycle (kc) equals 1000 cycles; a megacycle (mc) 1,000,000 cycles. To convert MCS to KCS, multiply by 1000 by merely moving the decimal point. For example; 17.5 MC is 17,500 kcs. Since most Short Wave stations are usually listed in KCS, the reverse procedure is applied, i.e., 17,500 KCS is 17.5 MCS.

ANTENNAS

Many a good receiver has been poorly treated by a bad antenna. No matter how sensitive your receiver, it must have sufficient signal to operate efficiently. The difference between a really good antenna and a poor one is such a small one that it is a simple matter to have a real good one. Several commercial antennas which perform admirably on all bands are available. If you want to make your own, the simplest is a dipole antenna; a compromise length of 100 feet is suitable, but shorter lengths may be used if necessary. The antenna should be mounted in the clear and as high as possible.

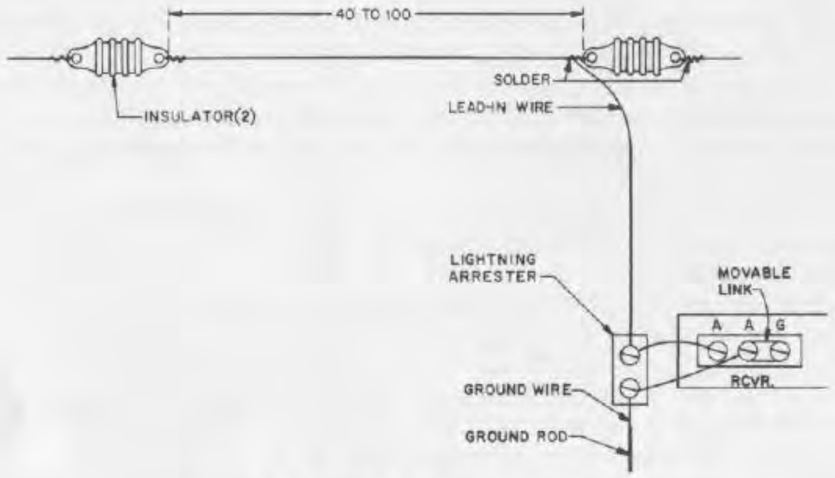


Fig. 6 Long Wire Antenna

The most common type of antenna is an "end-fed long wire" as drawn. In its simplest form, it can be hung between two trees or two anything that will hold it up in the air. The lead-in wire from the end of the antenna to the receiver becomes part of the antenna, increasing its effective length. Another effective type of antenna is the folded dipole as shown below.

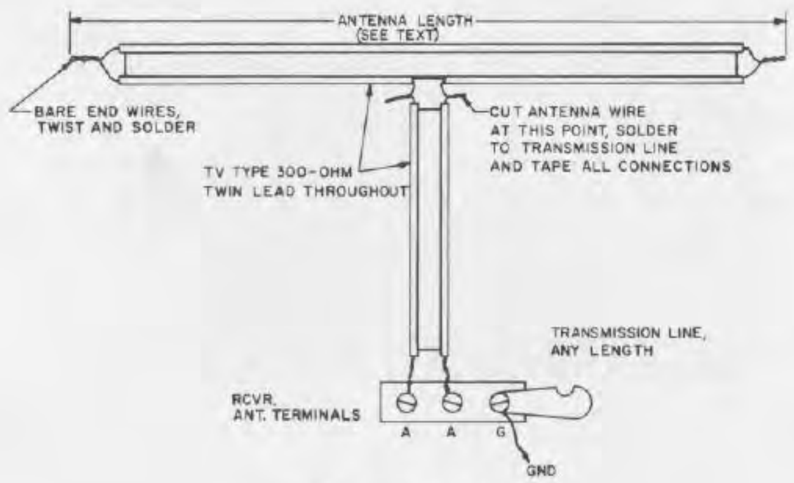


Fig. 7 Folded Dipole

As most electronic parts houses stock antenna wire, insulators, lightning arrestors, etc.; you should experience no difficulty assembling as complete an SWL antenna as you wish.

The direction in which the antenna is strung will affect reception to some degree. It will tend to favor signals received at right angles to its length. A north-south antenna will bring in signals with more strength from an east or west direction.

If your listening is confined primarily to one band of frequencies, the following formula will give you the correct dimensions for a dipole for that band.

$$\text{Length in feet} = \frac{468}{\text{Freq. in Megacycles.}}$$

HOW TO SET UP & OPERATE

The SWL receiver may be set up almost anywhere, although it is most convenient to locate it near both a window and an AC outlet. Your "shack" (radio room) can be as elaborate or as simple as you want to make it. Several useful accessories should be considered—a twenty four hour clock (a built-in accessory in the Hammarlund line of shortwave receivers), a 100 kc crystal calibrator (also a built in accessory on Hammarlund receivers) and a world map. A log book, a radio station frequency log, scratch paper and a headset for late hour listening complete the basic station.

The Hammarlund receiver illustrated below shows the two dials used to tune in stations from all over the world. The left hand, or main tuning dial, is calibrated for the various SW bands and the band segments are marked in red. The main tuning dial should be set as accurate as possible and the bandspread dial is brought into play to "fine tune" the station.

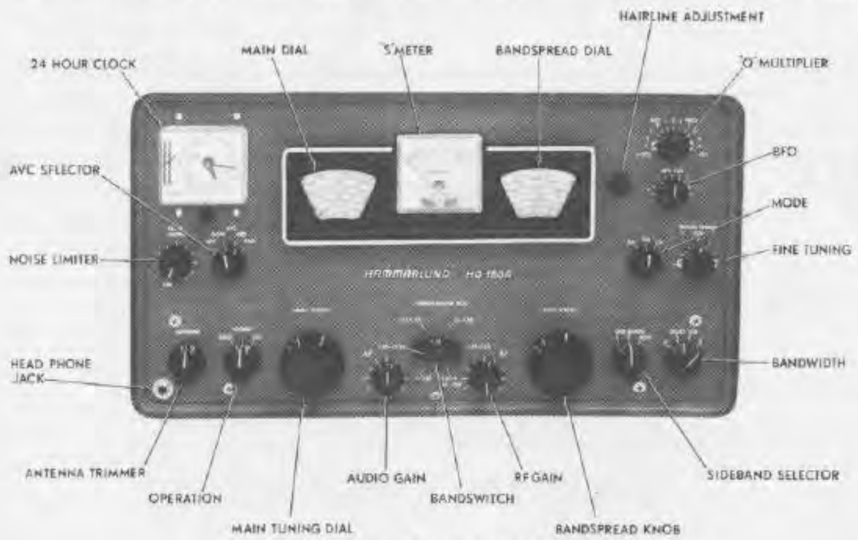


Fig. 8 Front Panel of receiver

The 100 kc crystal calibrator is used to set the main tuning dial to the nearest 100 kc check point to the desired frequency. The calibrator provides these 100 kc check points for every SW band. The calibrator and the receiver itself, may be checked for frequency by tuning in WWV or any of the several stations in other parts of the world which broadcast accurate frequencies and propagation reports.

W.W.V.

Radio station WWV at Fort Collins, Colorado and WWVH in Hawaii, broadcast continuously on the frequencies 2.5 mc, 5 mc, 15 mc, 20 mc and 25 mc. Services provided include time signals, receiver calibration and propagation forecasts which are of assistance to the short wave listener.

The chart below indicates the code groups used for propagation reporting.

Standard Frequency Stations and Propagation Reports.

Station	Freq. in MC	Location
WWV*	2.5, 5, 10, 15, 20, 25	Ft. Collins, Colo.
WWVH*	5, 10, 15	Hawaii
CHU	3.330, 7.335, 14.76	Ottawa, Canada
JJY	2.5, 4, 5, 8, 10, 15	Tokyo, Japan

* Propagation Reports Broadcast as Follows:
For North Atlantic Area—WWV, 19-1/2 and 49-1/2 minutes after the hour.
For North Pacific Area—WWVH, 9 and 39 minutes after the hour.
Code Letter W (•– –) = Disturbance Either in Progress or Expected.
U (••–) = Unstable Conditions
N (–•) = No Warning

Code Letter followed by number which gives quality of report:

1. (•– – – –)	Impossible	6. (–••••)	Fair to Good
2. (••– – –)	Very poor	7. (– –•••)	Good
3. (•••– –)	Poor	8. (– – –••)	Very Good
4. (••••–)	Fair to Poor	9. (– – – –•)	Excellent
5. (•••••)	Fair		

Fig. 9

HOW TO KEEP TIME

GMT or Greenwich Mean Time is a universal standard time system. Based on the time at Greenwich Observatory, England, GMT is the same everywhere on earth. With a handy conversion chart you can relate GMT to your local time by subtracting (or adding) the proper time adjusting factor for your local time zone. For example: 1200 GMT is noontime in England. For Eastern Standard Time, we subtract 5 hours, and arrive at seven a.m. For Pacific Standard Time, we would subtract 8 hours and it would be four a.m. in Los Angeles.

Conventional Clock	2400-Hour Clock	Conventional Clock	2400-Hour Clock
12 Midnight	0000	12 Noon	1200
1 AM	0100	1 PM	1300
2 AM	0200	2 PM	1400
3 AM	0300	3 PM	1500
4 AM	0400	4 PM	1600
5 AM	0500	5 PM	1700
6 AM	0600	6 PM	1800
7 AM	0700	7 PM	1900
8 AM	0800	8 PM	2000
9 AM	0900	9 PM	2100
10 AM	1000	10 PM	2200
11 AM	1100	11 PM	2300

Converting GMT to Local Time

Local Time	GMT
Pacific Standard Time	–8 hours
Mountain Standard Time	–7 hours
Central Standard Time	–6 hours
Eastern Standard Time	–5 hours

(Note: Add 1 hour to final answer for Daylight-Saving Time.)

Fig. 10 Table of Conversion

DX-ING

There are hundreds of broadcast stations throughout the world operating around the clock. Foreign broadcast stations can be heard from about 3,000 kcs up to 28,000 kcs. For convenience, they are grouped into "meter bands" or segments designated by numbers; the 31 meter band covers those frequencies from 9,200 kcs to 9,700 kcs; the 16 meter band, frequencies from 17,700 kcs to 17,900 kcs, etc.

International Short-wave Broadcast Bands.

Meters	Frequency Range
60	4750 kc to 5060 kc
49	5950 kc to 6200 kc
41	7100 kc to 7300 kc
31	9200 kc to 9700 kc
25	11700 kc to 11975 kc
19	15100 kc to 15450 kc
16	17700 kc to 17900 kc
13	21450 kc to 21750 kc

Fig. 11 Short Wave Band

WHERE TO LISTEN

As your prime interest is in short wave listening, you want to find the stations with a minimum of fuss. It's simple if you know where and when to listen.

There are seven bands or areas packed with stations broadcasting from various corners of the world. Here you will here the voices of London, Paris, Rome, Moscow, etc.

Experience and practice will soon lead you to the proper band at the proper time of day but until you have become familiar with the routine, here is a listing that will help you to get started in the right way.

WHEN TO LISTEN

Short Wave Bands—From the U.S.A.

Daybreak to Noon:	
16 meters	Mainly for stations to the East.
19 meters	Mainly for stations to the Northeast, East or Southwest.
25 meters	Mainly for stations to the Northeast, East or Southwest.
49 meters	Mainly for stations to the Northeast, East or Southwest.
Noon to Sunset:	
16 meters	Stations to the East which fade and are replaced by those to the South before sunset.
19 meters	East and South
25 meters	East and South
31 meters	Stations to the East
49 meters	Inconsistent
Sunset to Midnight:	
16 meters	Poor
19 meters	Poor
25 meters	Poor
25 meters	Stations from East fade around midnight. Station from the South usually quite strong.
31 meters	Stations from East fade around midnight. Station from the South usually quite strong.
49 meters	Stations are strongest from the East. North-South reception usually good.

The 13 meter band exhibits much the same characteristics as the 16 meter band; the 41 meter band follows the 49 meter band closely.

The above-listed conditions apply to the spring and autumn of the year. During the winter months evenings, the 41, 49, and 60 meter bands are loaded with short wave stations; during the summer months, these same frequencies fade and are replaced by the higher frequencies for consistent listening.

For year 'round listening, the 31 and 25 meter bands are the ones which produce the most in the way of stations.

As a general rule, the shorter wavelengths (higher frequencies) cover the greatest distances by daylight; the longer wavelengths are more effective during the evening hours.

Sun spots, which have a direct relationship to receiving conditions, operate on an 11 year cycle. As the number of sun spots increase, conditions improve on the higher frequencies particularly and the 13 meter band will enjoy a marked increase in activity from 1968 on.

Up to date information about current DX appears regularly in columns in Electronics Illustrated and Popular Electronics. A complete listing of stations may be found in the World Radio Handbook distributed by Gilfer Associates, P. O. Box 239, Park Ridge, N. J., 07656.

There are numerous SWL Clubs throughout the world. Radio New York Worldwide, N.Y., N.Y. 10022 and the Newark News Radio Club, Newark, N. J. 07101, are good examples of such groups. Bulletins with late information are published regularly by these and other clubs.

Other users occupy the radio spectrum; amateur radio operators or "hams;" CB operators; ships at sea, aircraft, police, fire and other services. The chart below illustrates the major users of the radio spectrum above 30 mc.

Radio stations are interested in receiving listeners' reports and verify these by sending cards, known as QSL cards, acknowledging the reports. These listener reports may take form of a letter or a printed QSL card with blank spaces for information—usually the report consists of the time heard (in GMT), the station call, date, frequency, program identifications and strength and quality of the signal. The type of equipment used is also of interest. It is best to include an IRC (International Reply Coupon) which covers the return postage to speed delivery of your QSL card.

HAM RADIO

Various segments of the radio spectrum have been set aside for use by radio amateurs or "hams" who are licensed to operate their own radio transmitters. Communicating across thousands of miles of land and sea and across international borders, the chatter of more than 400,000 hams around the world fills the air around the clock.

Conversations are often technical in nature but there is plenty of interesting "rag-chewing" or general conversation. Hams often provide emergency communications in disaster areas using portable and vehicle mounted equipment.

The ham frequencies you will find on your Hammarlund receiver are listed below:

Ham bands found on conventional SW receiver.

Meters	Frequency in kc
160	1800- 2000
* 80	3500- 4000
** 40	7000- 7300
20	14000-14350
15	21000-21450
10	28000-29700

*Novice CW-3700-3750
**Novice CW-7175-7200

Fig. 12 Ham Frequencies

Your Hammarlund receiver is equipped to receive all types of ham transmissions. Careful reading of the operating instructions and practice with the unit will enable you to expertly tune in hams everywhere.

The ham bands react about the same as the other bands and reception will vary hourly and from day to day.

Ham stations are identified by special call letters, each station having its own sign. American hams are identifiable by W or K prefixes; English stations use combinations starting with the letter "G"; Italian hams have call signs prefixed with the letter "I" and so on.

Information about "Ham" radio can be obtained by writing to the American Radio Relay League, Newington, Connecticut 06111.

CB

A recent addition to private communication is the Citizen Band of frequencies, set up by the FCC for short range business and personal communication. It consists of 23 channels between 26.965 kcs and 27.255 kcs. These frequencies were at one time part of the amateur frequencies and may be so marked on older receivers. Your Hammarlund receiver will receive these channels as well.

Location of Citizens Band.

Ch.	Freq. in kc	Ch.	Freq. in kc	Ch.	Freq. in kc
1	26965	9	27065	17	27165
2	26975	10	27075	18	27175
3	26985	11	27085	19	27185
4	27005	12	27105	20	27205
5	27015	13	27115	21	27215
6	27025	14	27125	22	27225
7	27035	15	27135	23	27255
8	27055	16	27155		

Fig. 13

MAINTENANCE

Your SWL radio has been built to last. We know of Hammarlund receivers which are playing since 1929. Normal maintenance usually consists of no more than replacing a burned out pilot bulb or a weak tube. Unless you are technically skilled, it is usually best to seek the services of a qualified technician who is familiar with your receiver. Hammarlund has a nationwide service organization ready to correct any problems you may have.

Our factory service department is always ready to assist. For technical information, write to Customer Relations Department, Hammarlund Manufacturing Company, Mars Hill, N. C. 28754

SERVICES ON VHF (30 mc to 300 mc)

Frequency Allocation (mc)	Services
	30–50 mc BAND
30.56-32	Industrial, land transportation, public safety
33-34	Public safety, industrial
35-36	Industrial, maritime mobile, domestic public, land transportation
37-38	Public safety, industrial
39-40	Public safety
40-42	Industrial, scientific and medical equipment
42-50	Public safety, industrial, maritime mobile, domestic public, land transportation.
	108–135 mc BAND
108-118	Aeronautical radionavigation
118-132	Aeronautical mobile control towers, private aircraft, commercial aircraft, flight tests and schools, utility.
	150–174 mc BAND
150-174	(Same services as under 30-50 mc band, plus following.)
157.1	Government
157.2	Government

Classification

Aeronautical	—Commercial and private aircraft, ground stations.
Industrial	—Power, petroleum, forest products, news services, motion picture studios, businesses, construction, farming.
Land Transportation	—Common and contract carriers of freight and passengers, railroad, taxi, motor carrier, auto emergency.
Public Safety	—Police fire, forestry, highway maintenance, disaster relief, physicians in rural areas, ambulance, rescue.
Marine	—Commercial and private stations in maritime activities.

Fig. 14 Chart of Radio Spectrum