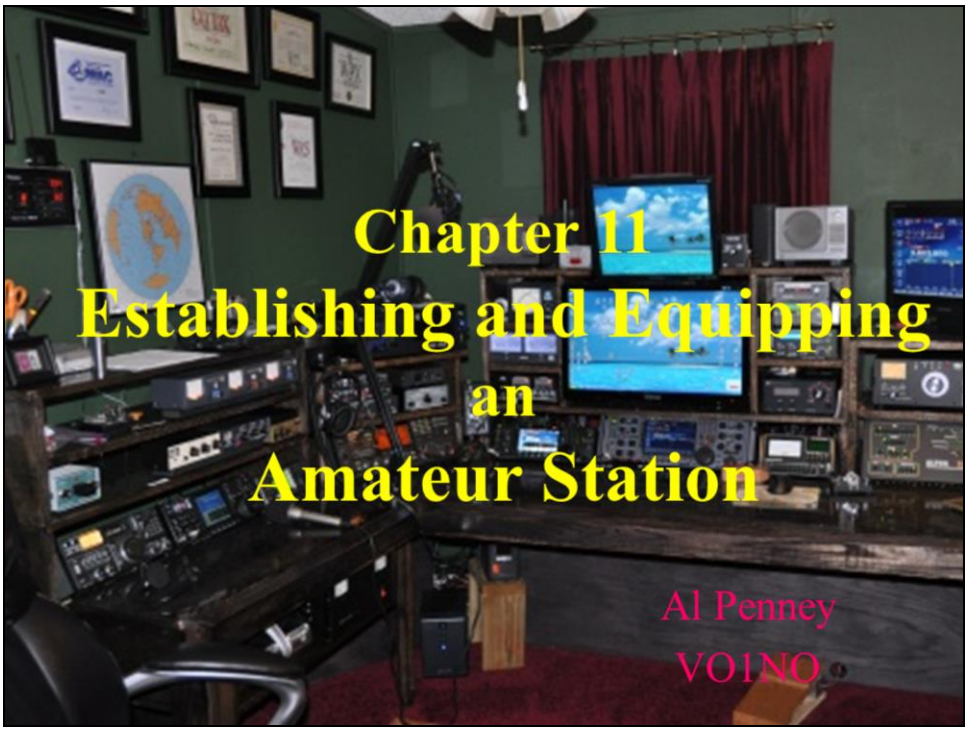
Chapter 11
Establishing and Equipping
an
Amateur Station
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Objectives

- To become familiar with:
  - The equipment necessary for various modes;
  - The basic operation of this equipment;
  - The accessories necessary for a station; and
  - The relative position of this equipment in the transmission path of the station.

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Where to get Equipment?

- Dealers
- Hamfests
- Online Swapfests
- E-bay

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Dealers

- Canada
  - Radioworld, Toronto and Calgary
  - GPS Central, Calgary (Now Radioworld)
  - Muir, Victoria (used equipment, online only)
  - Fleetwood Digital Products, Surrey
  - Burnaby Radio Communications Ltd.
  - MacFarlane Electronics (Towers, Ant, Radios)
  - Alfa Radio, Edmonton (Alfa Spid Rotators)

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Dealers

- USA
  - Ham Radio Outlet (HRO) is world's biggest.
    - 13 stores in USA
    - Online orders accepted
  - DX Engineering
  - Lentini Communications (online only)
  - Texas Towers (towers, aluminum and cable)

DX ENGINEERING

tt texastowers.com

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Dealers

- Try TCA (**The Canadian Amateur)** and **QST** Magazine for other dealers who sell online.
- **After sales service** is important.
- Warning – warranties may not apply in Canada!

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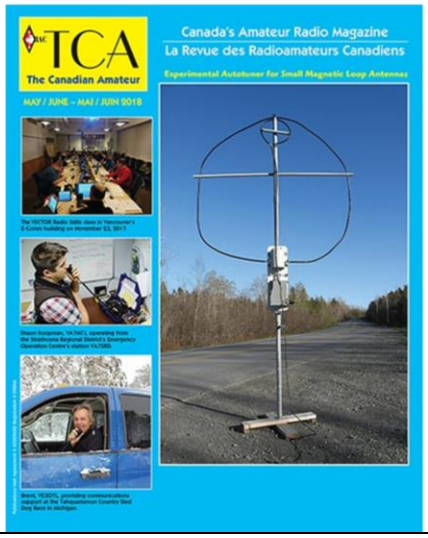
TCA and QST



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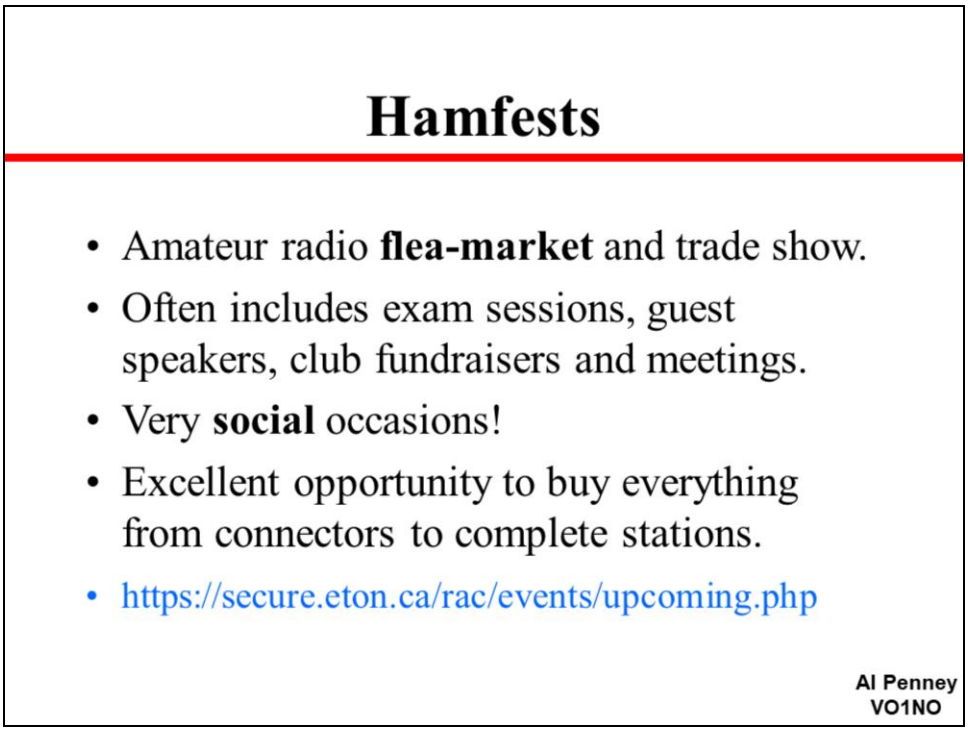

A **Hamfest** is a convention of amateur radio enthusiasts, often combining a trade show, flea market, and various other activities of interest to amateur radio operators (hams). In the United Kingdom the term **rally** is more commonly used for amateur radio conventions. "Hamfests" were noted as early as 1924 in the U.S.

Activities

Hamfests are events organized by amateur radio enthusiasts, for social gathering and promotion of the amateur radio hobby. Typically annual or semiannual events held over a weekend, they can last from several hours to several days. Most feature a flea market where the attendees buy and sell radio and related equipment. The equipment found at a hamfest can vary significantly from the newest high-tech gear to used, refurbished, or even antique equipment. Haggling or bargaining is the most common means of sale. Equipment that originally sold at great expense to commercial users (such as public safety agencies) can often be found at a fraction of the price. Likewise, accessories which are no longer available from manufacturers may be found, and many sales of complete systems are made to buyers who only need one or two components. Junk boxes are common, frequently containing scraps and remnants from finished projects or equipment long-since gone. Some hamfests feature demonstration and sales booths manned by vendors

and manufacturers of commercial amateur radio equipment. Hamfests may also include meetings of amateur radio clubs, seminars on technical, operational, or legal aspects of amateur radio, and license examination sessions.

The Dayton, Ohio Hamvention, the International DX Convention, the HAM RADIO event in Friedrichshafen, Germany, and the Central Coast Amateur Radio Club Field Day near Sydney in Australia are events where manufacturers most commonly introduce new products to the amateur radio marketplace.

Hamfests worldwide

In the United States, hamfests are a popular tradition; at regularly scheduled hamfests in the USA begin with an event such as a waffle breakfast, with proceeds going to the sponsoring organization or a worthy charity. Larger hamfests almost always include one or more food vendors, staffed by volunteers, with the proceeds going to a local high school or other charity.

It is not unknown for a seller to ask more for a single part from the box than for the entire box, the intent being to have less stuff when it's time to go home than the seller arrived with. Larger old items are often referred to as boat anchors with the suggestion that they are obsolete and of such low value that this is the only use left for them. Numerous jokes are based on this concept, and some sellers will tie ropes to handles, or post signs on especially large and heavy items seeking customers who own aircraft carriers. Regular attendees often visit their first hamfest in search of some piece of equipment, but end up returning due to the social aspect.

In the current century, the Internet has come to be used to advertise and sell ham radio equipment, downgrading the sales of useful used equipment at all hamfests. Thus, hamfests' social aspects have become more of a reason to attend as well as to learn from the numerous lecturers and forums. Door prizes and raffles also occur. Also, inspection of the vast array of commercially made new radio equipment (conveniently available in one place) and the extensive inclusion of computers and computer parts and software for sale rise in importance at these events.

The Dayton Hamvention is generally considered to be the world's largest hamfest. It is held each May (formerly at the Hara Arena in Trotwood, Ohio near Dayton) at the Greene County Fairgrounds and Expo Center in Xenia, Ohio. The Hamvention offers forums, exhibit space and a flea market. Average attendance is around 25,000; there were 28,417 visitors in 2018. Many amateur radio enthusiasts go out of their way to attend the

Hamvention, travelling from all over the United States, Canada, Mexico and various parts of the world and even as far as Australia, Japan and Russia.

The second largest hamfest in world is the Orlando HamCation in Orlando, Florida with over 23,000 visitors per year and 74 years running. Smaller regional hamfests include the 60 year young Shelby Hamfest in North Carolina, hosting 5,000 to 7,000 visitors per year, Huntsville Hamfest in Alabama, Ham-Com in the Dallas area and SEA-PAC in Seaside, Oregon. Hamfests can also be as small as a few hundred local attendees.

The largest hamfest in New England (and the Northeastern United States) is the New England Amateur Radio Festival, commonly known as NEAR-Fest, which is held twice a year, May and October, at the Deerfield Fairgrounds in Deerfield, New Hampshire. Deerfield is located approximately 15 miles (24 km) east of Manchester on Route 43.

Two of the largest Hamfests in Canada are HAM-EX, held by the Peel Amateur Radio Club (PeelARC) and the Mississauga Amateur Radio Club (MARC), once a year at the Brampton Fall Fairgrounds just north of Brampton, Ontario, and the York Region Amateur Radio Club (YRARC), on the first Saturday of November each year at the Newmarket Community Centre Newmarket, Ontario. Both of these Hamfests typically attract over a thousand visitors each year. Many smaller Hamfests are also held in every province across Canada each year. A full listing of Canadian Hamfests can be found on the Radio Amateurs of Canada (RAC) website.

In Western Australia, the biggest Hamfest is run by the Northern Corridor Radio Group. They held their first few at the former Carine TAFE College site. Following its closure their hamfests have been held in Bassendean, a suburb of Perth. 2007 saw a demonstration of military radio equipment and a demonstration of a tesla coil. These were in addition to the "bring and buy" tables and stands for various retailers and groups.

The International Exhibition for Radio Amateurs known as HAM RADIO in Friedrichshafen, Germany, is Europe's largest and most well-known hamfest (17,080 visitors in 2015), which includes a trade show and "youth days". The first HAM RADIO took place in 1976 with 62 exhibitors.

In India, Hamfest has been popular since 1991. In 2009, it was held in Bangalore, along with Golden Jubilee celebrations of Bangalore Amateur Radio Club VU2ARC [18] Two ham conventions, with mostly forums, were held by the National Institute of Amateur Radio in Hyderabad in recent years which uniquely coupled the events with major DXpeditions, allowing foreign hams to operate from the rare locales of Andaman I and Lakshadweep I.

Japan, the primary source for new commercially made ham equipment, hosts

at least one large annual hamfest with world-wide attendees.


ENIGMA
Cipher Machine

Online Swapfests

- Many **clubs** have listings on website.
- RAC lists some: https://www.rac.ca/used-and-swap/
- Kitchener Waterloo Amateur Radio Club (KWARC) has a popular online swapshop: http://www.kwarc.org/cgi-bin/cgiwrap/kwarc/arcdbs
- Another online swapfest: https://hamshack.ca/
- Lots of equipment and parts sold on E-bay.

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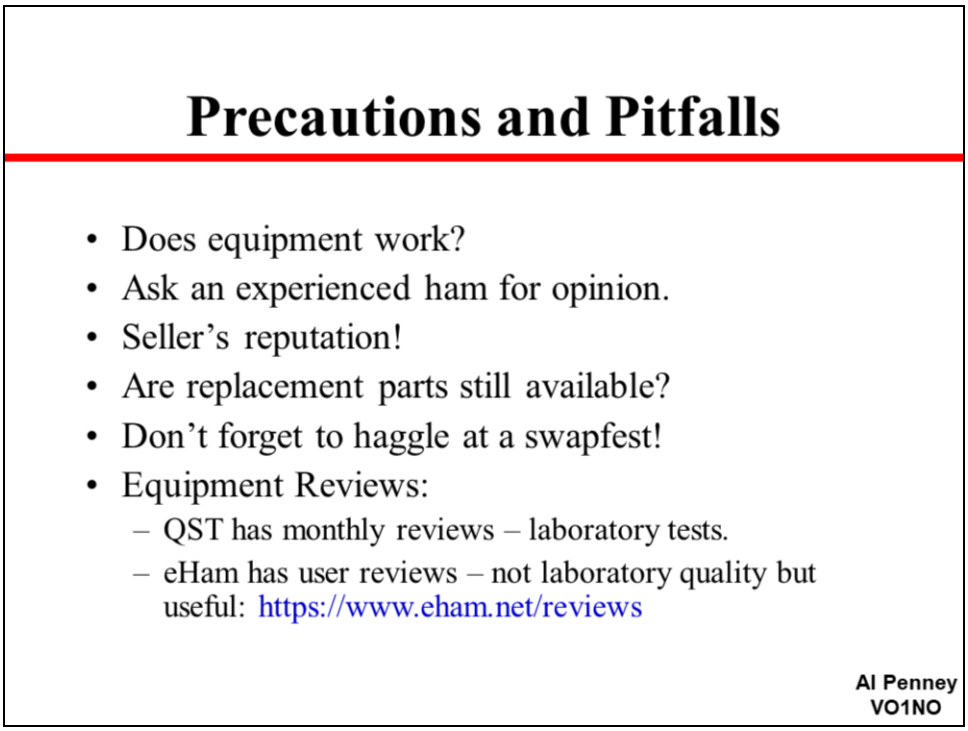


Today there is a considerable amount of ham radio equipment available. This ham radio equipment offers very good value, and today it is generally very reliable. While buying equipment new has many advantages, it be more costly than buying used ham radio equipment. By buying used ham radio equipment considerable cost savings can be made. While there are advantages to buying used ham radio equipment, there are also some pitfalls and it is necessary to be very careful not to buy an item that may have faults in it and one that may negate any savings that can be made.

Although the second hand sales advertisements are not as extensive as they used to be, there is still a good selection of used ham radio equipment available. Looking at the advertisements at the back of many ham radio magazines, or in the used ham radio equipment lists of many dealers, a huge variety of all sorts of equipment can be seen. Transmitters, receivers, HF transceivers, VHF / UHF handhelds, SWR meters and much more ham radio equipment can be seen.

Define what is needed

When buying any equipment, whether ham radio equipment, or anything else, it helps to know exactly what is wanted. Some thought beforehand defining what is needed always helps. Points to

consider for a transceiver may include, bands to be covered, power output, modes of operation - FM, SSB, digimodes, etc., receiver filter requirements, general facilities needed, size, possibility of portable of mobile operation . . . .

Having identified the type or types of ham radio equipment that may fill the requirement, it is possible to look at reviews in the magazines, and see whether the reviews were favourable. In addition to this there may also be reviews on the Internet, or there may be a friend who knows what the particular item of ham radio equipment is like. In this way it is possible to find out as much as possible about the equipment before settling on a particular item or items.

New or used ham radio equipment

One of the first considerations when buying ham radio equipment is whether to buy new or second hand. It is obviously much nicer to buy something new, but the financial realities sometimes mean that the cost of new equipment cannot be justified. Also the lower cost of used ham radio equipment means that with a given budget much better equipment can be bought than if it were purchased new.

As a result, used ham radio equipment can offer an ideal solution, but there are a number of pitfalls:

•The used ham radio equipment is likely to be outside the manufacturers warranty period

•If bought through a private sale, no guarantees will be offered.

•The used ham radio equipment will be older than if bought new and may not be as "up to date" and may not have as many facilities.

•The used ham radio equipment will be older than any bought new and not be as reliable.

•The equipment may not have been treated well as a result may not be as reliable.

•The used ham radio equipment may have been modified, and the modifications may not have been done well.

This is not a full list of the risks of buying used ham radio equipment. However it gives an idea of the points to look out for. However it is not all bad news. Some very good bargains are available, and most people are very satisfied with the equipment they buy. However a foreknowledge of some of the problems is to be fore-armed. If aware of the problems, they can usually be avoided.

Dealer or private sale

Another important choice that has to be made when buying used ham radio equipment is whether to buy through a private sale, i.e. from an individual, or from a dealer. Each has its own advantages and disadvantages. A summary of them is shown below:

Advantages and disadvantages of a private sale

Advantages:

•The price may be cheaper as the private individual does not have profits and sales taxes to incorporate into the price

•The private individual may be just keen to sell the used ham radio equipment and save the trouble of selling it through a dealer.

•The private seller may be known and will offer known equipment

Disadvantages:

•The price is likely to be higher as the dealer will need to incorporate profit and sales taxes.

It is not always a simple choice to make. Sometimes it is better to use a recognised dealer, but against this costs are likely to be higher, whereas there are some bargains to be bought through private sales, although the level of risk is higher.

Points to watch

There are a number of key points that can be looked at to give the used ham radio equipment a check-over. The points naturally depend upon the type of equipment, its age and the technologies used. Also th points given are not a totllay exhaustive list, but give an indication of the points that may be considered.

•***Check the controls operate correctly:*** When trying the equipment out ensure that all the controls operate correctly all the switches work properly. Switch operation and drift often give a good indication about the overall condition of the equipment. If the switches do not operate very well then it is a sign that it has been well used and there could be other problems. Particularly with older equipment ensure that the bandswitch does not cause problems with drift. Try tuning the equipment into a a station with the BFO on and see what happens when the switch is touched, or switched to one band and then back again.

•***Check for drift:*** Drift of the local oscillator is also very important. It is not very common on the new synthesized rigs but it is fairly common on some of the older equipment. Obviously a certain amount is acceptable on very old items which only have a single conversion. However on equipment which is not so old and has two or more frequency conversions with a

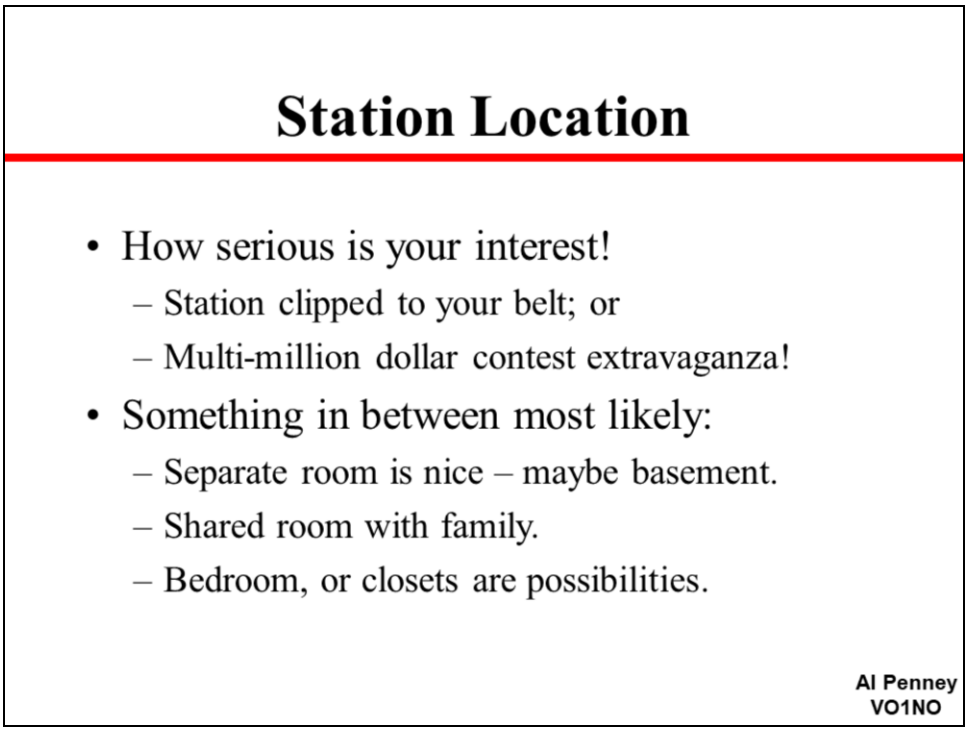
crystal controlled first conversion should have very little drift indeed. Unfortunately it can be quite difficult to cure and very annoying during long periods of operation.

•***Check for general appearance:*** If the used ham radio equipment looks well cared for then the chances are that the owner has been careful. Even so take into consideration the fact that it may well have been cleaned up ready to sell. However if this has been done then there are usually some visible signs. If it has been cleaned then it does not mean that it is not a good buy, but this has to be taken into account when assessing its real condition.

When buying used ham radio equipment, remember that servicing is another very important factor. However reliable equipment is these days there is always the possibility that something will go wrong at one time or another. When the equipment is new it can always be returned to the dealer, but for older equipment it is often a different matter. For example there are still a lot of the pieces of equipment on the market which were manufactured fifteen or more years ago. Many of them are now no longer supported by their dealers and distributors, and often it can be a matter of do it yourself, particularly with the much older items. For valve equipment it should be remembered that even though most valves are still available that they are becoming increasingly more expensive.

Summary

Buying used ham radio equipment can offer a very good alternative to buying equipment new. It can provide a route to obtain much better value for money. While there are pitfalls, these can often be avoided with care, although even buying used ham radio equipment through a dealer can give some significant benefits with additional safeguards, but at additional cost.



SELECTING A LOCATION

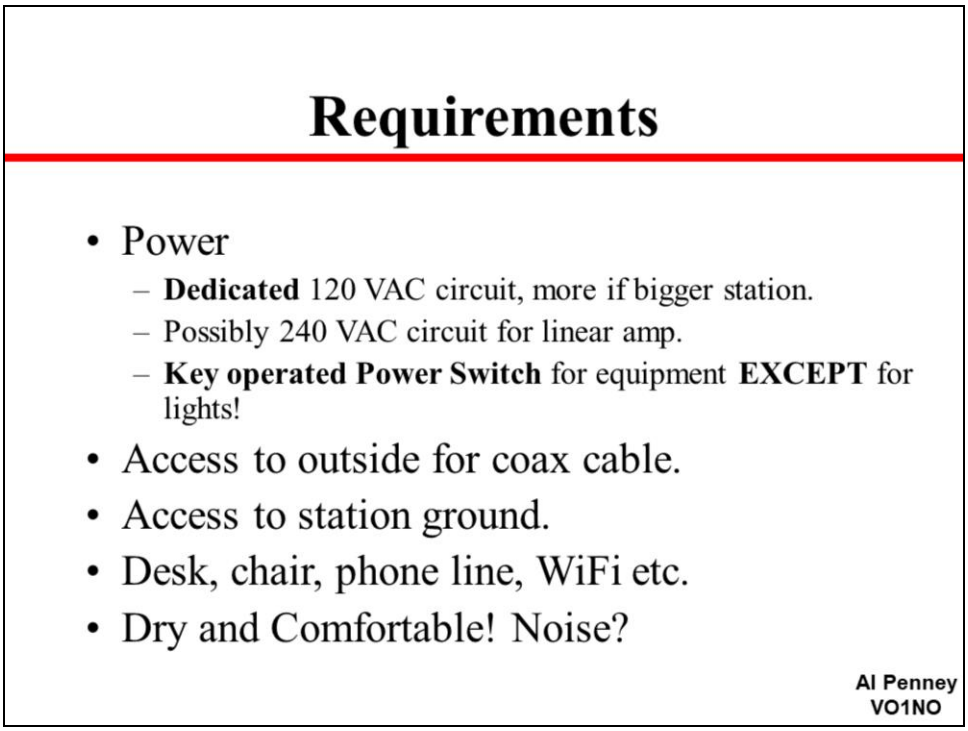
Selecting the right location for your station is the first and perhaps the most important step in assembling a safe, comfortable, convenient station. The exact location will depend on the type of home you have and how much space can be devoted to your station. Fortunate amateurs will have a spare room to devote to housing the station; some may even have a separate building for their exclusive use. Most must make do with a spot in the cellar or attic, or a corner of the living room is pressed into service.

Examine the possibilities from several angles. A station should be comfortable; odds are good that you'll be spending a lot of time there over the years. Some unfinished basements are damp and drafty—not an ideal environment for several hours of leisurely hamming. Attics have their drawbacks, too; they can be stifling during warmer months. If possible, locate your station away from the heavy traffic areas of your home. Operation of your station should not interfere with family life. A night of chasing DX on 80 m may be exciting to you, but the other members of your household may not share your enthusiasm.

Keep in mind that you must connect your station to the outside world. The location you choose should be convenient to a good power source and an adequate ground. You may need access to a telephone jack and WiFi. There

should be a fairly direct route to the outside for running antenna feed lines, rotator control cables and the like.

Although most homes will not have an “ideal” space meeting all requirements, the right location for you will be obvious after you scout around. Weigh the trade-offs and decide which features you can do without and which are necessary for your style of operation. If possible pick an area large enough for future expansion.



STATION POWER

Amateur Radio stations generally require a 120-V ac power source. The 120-V ac is then converted to the proper ac or dc levels required for the station equipment. Power supply theory is covered

in the **Power Supplies** chapter, and safety issues are covered in the **Safety** chapter. If your station is located in a room with electrical outlets, you're in luck. If your station is located in the basement,

an attic or another area without a convenient 120-V source, you will have to run a line to your operating position, ensuring it is safely installed and not overloaded.

Station Layout

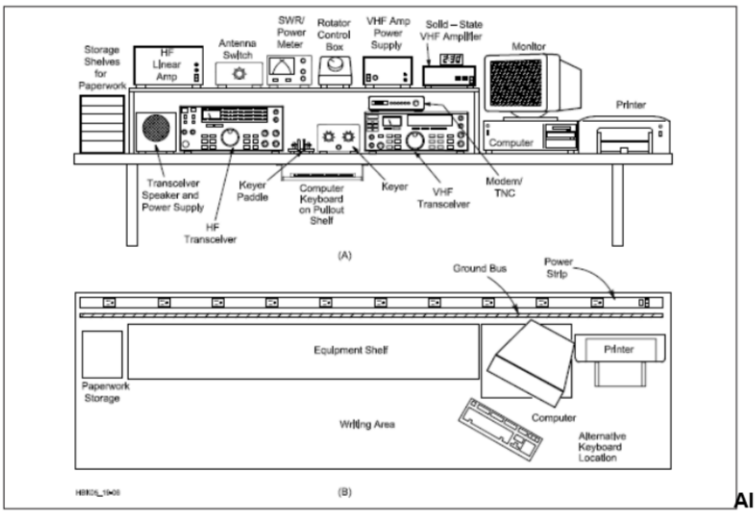


Fig 19.6—Example station layout as seen from the front (A) and the top (B). The equipment is spaced far enough apart that air circulates on all sides of each cabinet.

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STATION LAYOUT

Station layout is largely a matter of personal taste and needs. It will depend mostly on the amount of space available, the equipment involved and the types of operating to be done. With these factors in

mind, some basic design considerations apply to all stations.

The Operating Table

The operating table may be an office or computer desk, a kitchen table or a custom-made bench. What you use will depend on space, materials at hand and cost. The two most important considerations are height and size of the top. Most commercial desks are about 29 inches above the floor. This is a comfortable height for most adults. Heights much lower or higher than this may cause an awkward operating position. The dimensions of the top are an important consideration. A deep (36 inches or more) top will allow plenty of room for equipment interconnections along the back, equipment about midway and room for writing toward the front. The length of the top will depend on the amount of equipment being used. An office or computer desk makes a good operating table. These are often about 36 inches deep and 60 inches wide. Drawers can be used for storage of logbooks, headphones, writing materials, and so on. Desks specifically designed for computer use often have built-in shelves that can be used for equipment stacking. Desks of this type are

available ready-to-assemble at most discount and home improvement stores. The low price and adaptable design of these desks make them an attractive option for an operating position.


21.276.610
1.255.21
IT'S NICE
UP NORTH
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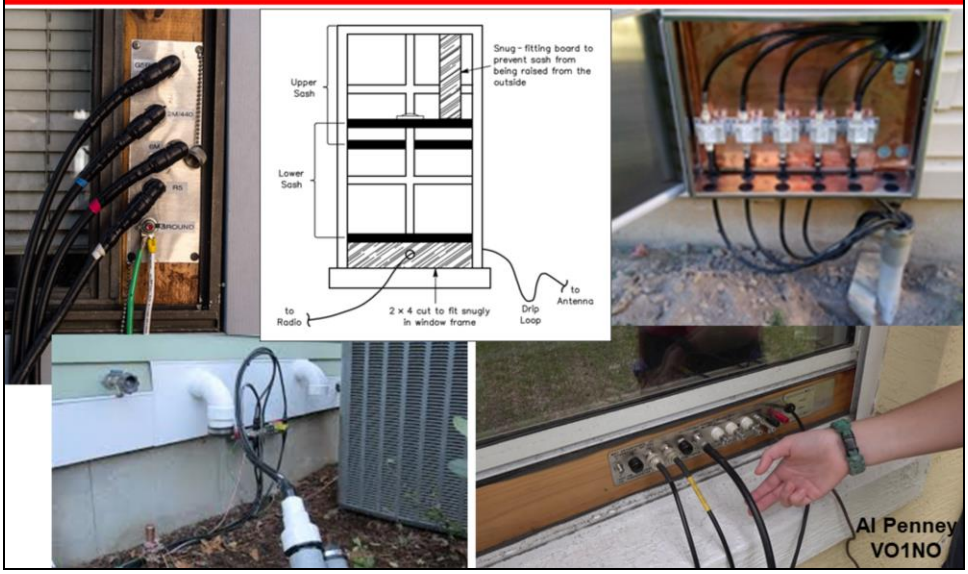
Bringing Coax Cable Inside



VHF and UHF Station

- Basic VHF/UHF FM station very easy to set up and operate.
- Synthesized frequency selection.
- **FM repeaters** most common mode on VHF.
- **SSB, CW and Digital** modes also used.
- Must have a way to determine **operating frequency!**

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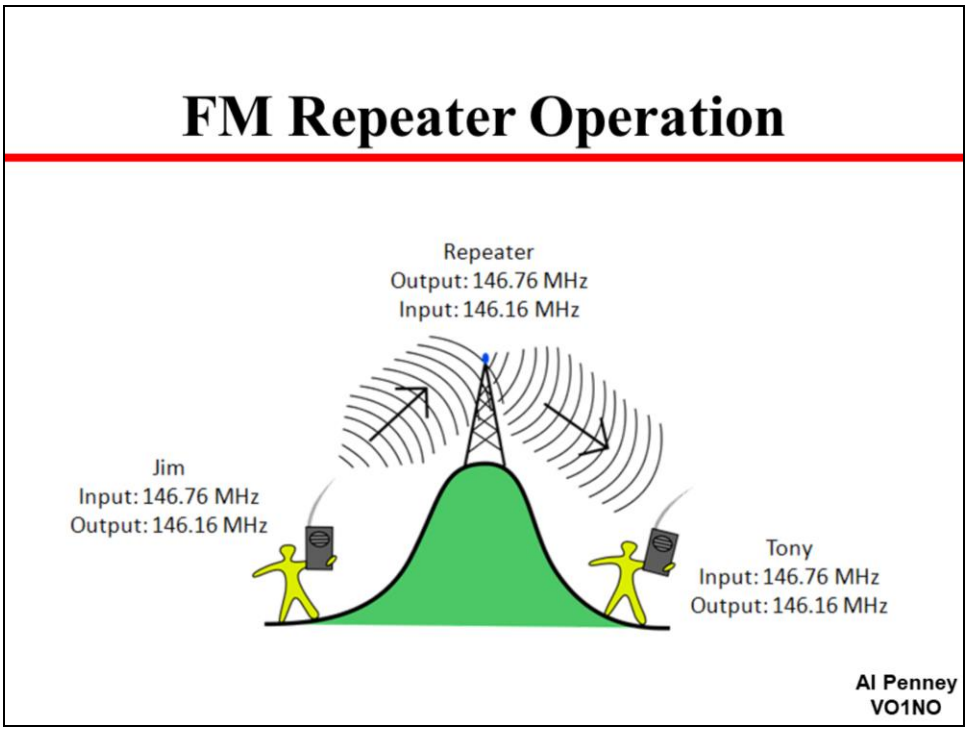


An **amateur radio repeater** is an electronic device that receives a weak or low-level amateur radio signal and retransmits it at a higher level or higher power, so that the signal can cover longer distances without degradation. Many repeaters are located on hilltops or on tall buildings as the higher location increases their coverage area, sometimes referred to as the radio horizon, or "footprint". Amateur radio repeaters are similar in concept to those used by public safety entities (police, fire department, etc.), businesses, government, military, and more. Amateur radio repeaters may even use commercially packaged repeater systems that have been adjusted to operate within amateur radio frequency bands, but more often amateur repeaters are assembled from receivers, transmitters, controllers, power supplies, antennas, and other components, from various sources.

Introduction

In amateur radio, repeaters are typically maintained by individual hobbyists or local groups of amateur radio operators. Many repeaters are provided openly to other amateur radio operators and typically not used as a remote base station by a single user or group. In some areas multiple repeaters are linked together to form a wide-coverage network

Frequencies

Repeaters are found mainly in the VHF 6 meter (50–54 MHz), 2 meter (144–148 MHz), 1.25-meter band (1¼ meters) (220–225 MHz) and the UHF 70 centimeter (420–450 MHz) bands, but can be used on almost any frequency pair above 28 MHz. In some areas, 33 centimeters (902–928 MHz) and 23 centimeters (1.24–1.3 GHz) are also used for repeaters. Note that different countries have different rules; for example, in the United States, the two meter band is 144–148 MHz, while in the United Kingdom (and most of Europe) it is 144–146 MHz.

Repeater frequency sets are known as "repeater pairs", and in the ham radio community most follow *ad hoc* standards for the difference between the two frequencies, commonly called the *offset*. In the USA and Canada two-meter band, the standard offset is 600 kHz (0.6 MHz), but sometimes unusual offsets, referred to as *oddball splits*, are used. The actual frequency pair used is assigned by a local frequency coordinating council.

In the days of crystal-controlled radios, these pairs were identified by the last portion of the transmit *(Input)* frequency followed by the last portion of the receive *(Output)* frequency that the ham would put into the radio. Thus "three-four nine-four" (34/94) meant that hams would transmit on 146.34 MHz and listen on 146.94 MHz (while the repeater would do the opposite, listening on 146.34 and transmitting on 146.94). In areas with many repeaters, "reverse splits" were common (i.e., 94/34), to prevent interference between systems.

Since the late 1970s, the use of synthesized, microprocessor-controlled radios, and widespread adoption of standard frequency splits have changed the way repeater pairs are described. In 1980, a ham might have been told that a repeater was on "22/82"—today they will most often be told "682 down". The 6 refers to the last digit of 146 MHz, so that the display will read "146.82" (the output frequency), and the radio is set to transmit "down" 600 kHz on 146.22 MHz. Another way of describing a repeater frequency pair is to give the repeater's output frequency, along with the direction of offset ("+" or "plus" for an input frequency above the output frequency, "−" or "minus" for a lower frequency) with the assumption that the repeater uses the standard offset for the band in question. For instance, a 2-meter repeater might be described as "147.34 with a plus offset", meaning that the repeater transmits on 147.34 MHz and receives on 147.94 MHz, 600 kHz above the output frequency.

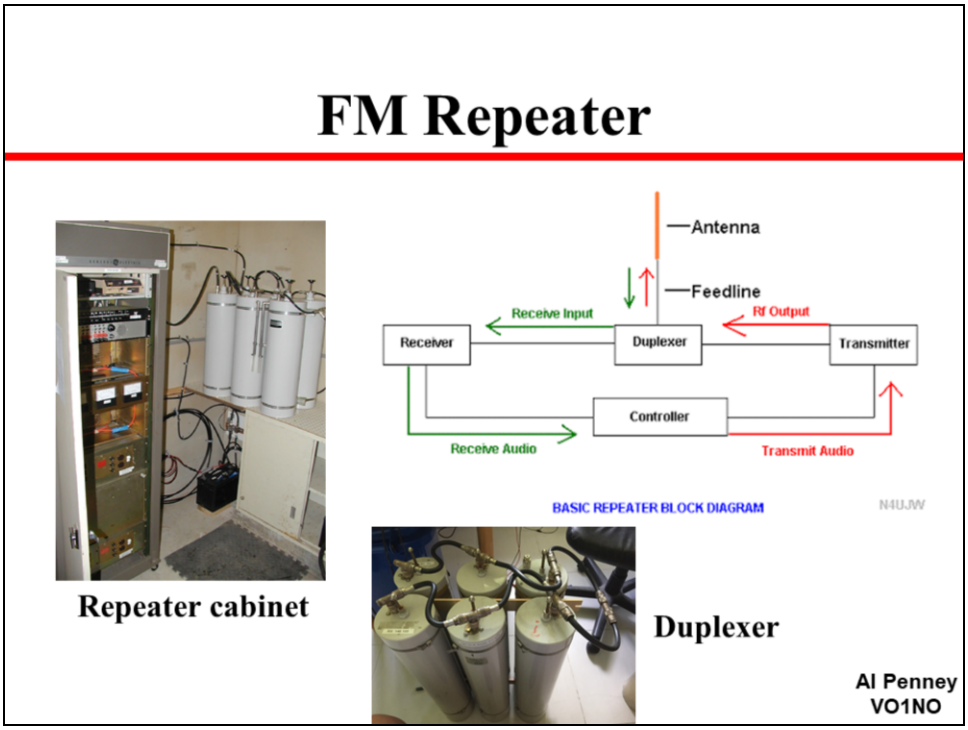
Operating terms

•**Timing Out** is the situation where a person talks too long and the repeater

timer shuts off the repeater transmitter.

•**Kerchunking** is transmitting a momentary signal to check a repeater without identifying. In many countries, such an act violates amateur radio regulations. The term "Kerchunk" can also apply to the sound a large FM transmitter makes when the operator switches it off and on.

•**Lid** refers to a poor operator (radio methods) usually from improper training from other Amateurs or exposure to different types of operation such as CB radio.



The most basic repeater consists of an FM receiver on one frequency and an FM transmitter on another frequency usually in the same radio band, connected together so that when the receiver picks up a signal, the transmitter is keyed and rebroadcasts whatever is heard.

In order to run the repeater a repeater controller is necessary. A repeater controller can be a hardware solution or even be implemented in software.

Repeaters typically have a timer to cut off retransmission of a signal that goes too long. Repeaters operated by groups with an emphasis on emergency communications often limit each transmission to 30 seconds, while others may allow three minutes or even longer. The timer restarts after a short pause following each transmission, and many systems feature a beep or chirp tone to signal that the timeout timer has reset.

Internet linking

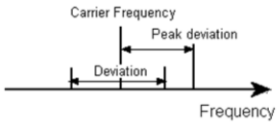
Repeaters may also be connected over the Internet using voice over IP (VoIP) techniques. VoIP links are a convenient way to connecting distant repeaters that would otherwise be unreachable by VHF/UHF radio propagation. Popular VoIP amateur radio network protocols

include D-STAR, Echolink, IRLP, WIRES and eQSO. Digital Mobile Radio (DMR), D-STAR, Fusion, P25 and NXDN all have a codec in the user radio and along with the encoded audio, also send and receive user number and destination information so one can talk to another specific user or a Talk Group. Two such worldwide networks are DMR-MARC and Brandmeister.

For example, a *simplex gateway* may be used to link a simplex repeater into a repeater network via the Internet.

FM Deviation

- In an FM signal, Deviation refers to **amount** the signal **deviates** from carrier frequency.
- Amount **proportional to amplitude of applied signal**, not the frequency.
- **Under deviation** = weak received audio.
- **Over deviation** = distorted and broken audio.



Deviation is proportional to the AMPLITUDE of the signal

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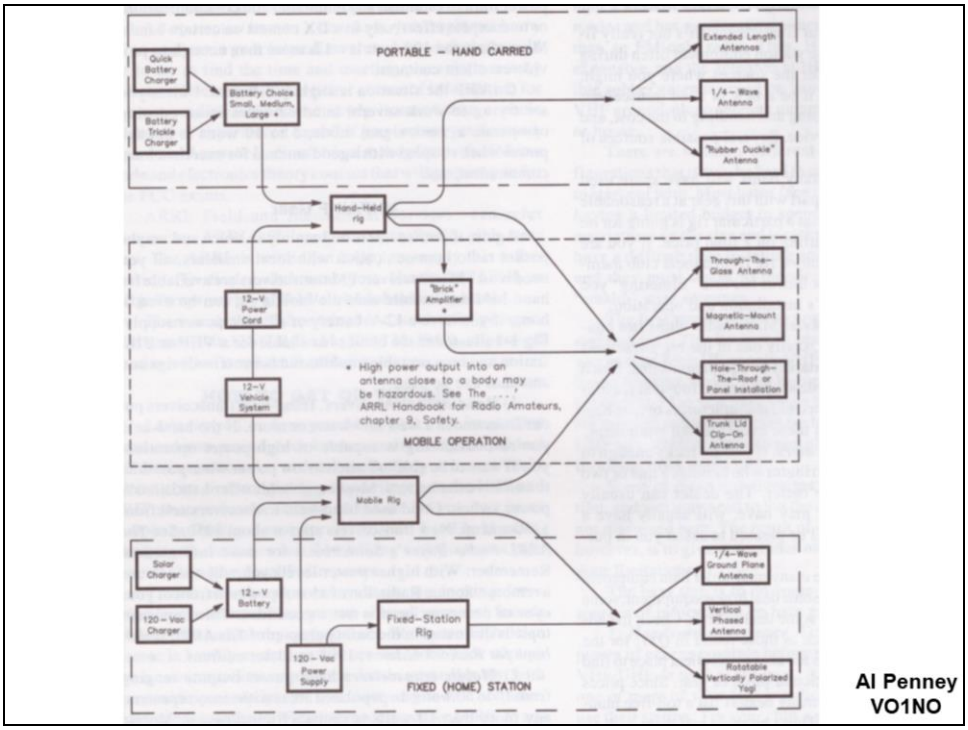
When dealing with FM you will come across the term Peak Deviation which means the MAXIMUM amount by which the frequency of the signal may deviate from the carrier frequency.

Deviation is the frequency change from the carrier frequency both above the carrier frequency and below.

The amount of the deviation is proportional to the amplitude of the applied signal and NOT the frequency of the applied signal. Thus the louder you speak into the mic the greater the voltage that will be applied to the stage and the greater the deviation.



When setting up an amateur radio station, or replacing some older gear, it is wise to spend some time looking at the market and seeing just what you want.

There is a host of equipment: handheld; mobile as well as base station that can be used.

For VHF and UHF there is a different variety of equipment available to that available for the HF and other bands. As a result it is necessary to look at what is needed and what best fits the requirements.

VHF / UHF equipment choices

There are many different types of VHF / UHF amateur radio equipment from which a choice can be made:

•***Handheld Transceivers :*** Handheld radio transceivers are widely available for the VHF and UHF bands. It is possible to buy single band handhelds as well as dual and even some triple band ones. The most popular bands are 2 metres and 70 centimetres. These handhelds offer a comparatively low cost entry methods of these bands. They typically come with a short antenna and battery charger for their batteries. They also normally have a connector that

enables them to be connected to an external antenna. External microphones, and supply connectors are also available.

The key feature of these handhelds is their size. They are very easy to carry and are very lightweight making them ideal for hand portable operation. They can also often be powered in an automobile and they can also be used within a base station.

Programming of these handhelds is something to consider - some are easy to programme than others. As operation on the VHF and UHF bands tends to be on specific channels, these transceivers often need to be programmed with the various simplex and repeater channels along with the CTCSS tones needed for local repeater access. This can be done manually, but these days it tends to be done using a PC (there is less software available for Apple Macs). This makes it very much easier.

It is worth remembering, when using the internal microphone, and the supplied set to antenna, that it may be advisable to use a low power setting. The antenna is likely to be next to the eyes and brain, and this is not always a good idea as long term exposure might lead to local heating might damage the eyes or give rise to headaches. It is possibly much safer to use an external microphone. It is worth noting that generally links between RF power exposure and health a often not widely proven, but it does not hurt to reduce the exposure to RF as much as possible.

Mobile Transceivers: Another popular area for operation at VHF and UHF is mobile operation. Accordingly there is a wide choice of mobile transceivers that can be bought. These transceivers offer higher power and more facilities as well as better performance when compared to the handheld transceivers. These mobile VHF / UHF transceivers may also be used for base station use. They are typically powered from a 12 Volt supply and small low cost supplies are widely available from many amateur radio and other electronic supplies stockists.

Like the handhelds, the VHF / UHF mobile transceivers that can be bought tend to cater mainly for the FM market. A few multi-mode HF / VHF / UHF transceivers can be bought. These can provide a useful complete station in a single box solution for mobile operation, or even base station use.

•***Base Unit Transceivers:***

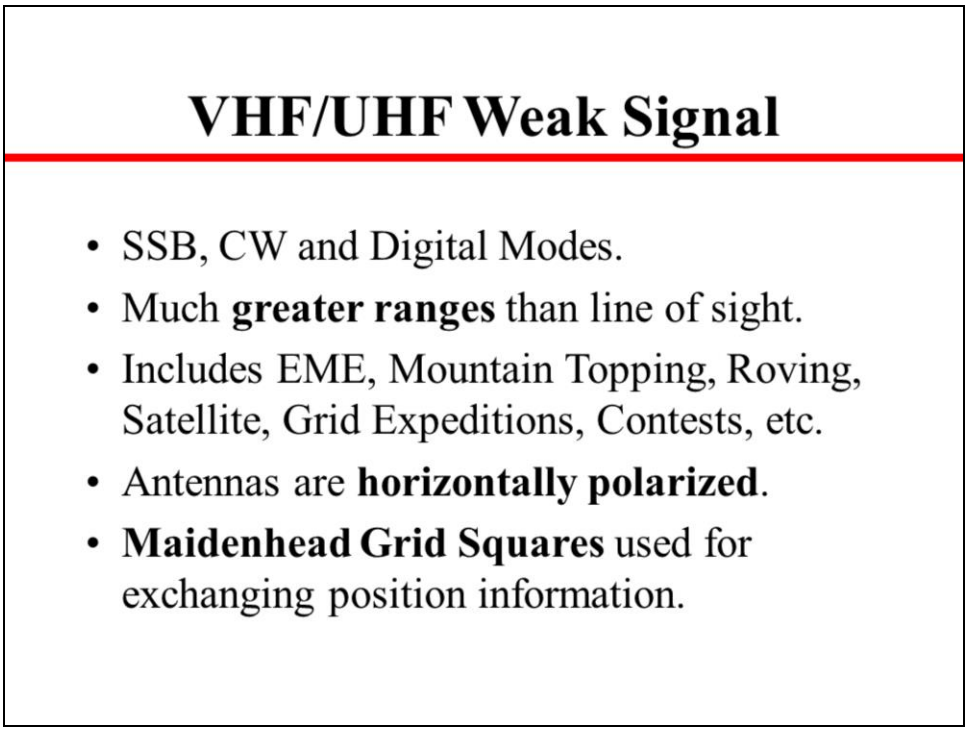
•Comparatively few multi-mode VHF / UHF base station transceivers can

be bought these days.

There are some HF / VHF / UHF transceivers that are available, but these can compromise performance to achieve the very wide coverage.

There is a really good selection of equipment available for the VHF and UHF bands. A careful look through the advertisements in the amateur radio magazines will reveal the extent of the selection.

Before buying any equipment, it is always good to read as many reviews as possible. These can be seen in the various amateur radio magazines, and books. A large number can also be found on-line as well.



A VHF Contest Primer Steve Kavanagh, VE3SMA

Introduction

This article is intended as an introduction to VHF/UHF contesting for those who have never tried it before, but are familiar with HF contesting. Many of you probably have HF + 6m or HF/VHF/UHF transceivers and have never really put the higher band capabilities to much use, except perhaps for communicating through the local repeaters. If you have listened in the SSB/CW portions of the VHF/UHF bands, you may have heard little or nothing. These segments are populated by many who are primarily interested in working good dx and may not be very active unless there is good propagation.

The characteristics of VHF/UHF propagation mean that most of the time it is quite difficult to hear distant stations (compared to HF…but much easier than you would think if you are used to 2m FM only), making these bands more like 10m at the bottom of the sunspot cycle than they are like 20m. But as any experienced contester knows, during a major contest you can often make lots of QSOs on 10m, even without much cooperation from the sun. The same is true of VHF contests…the bands come alive, propagation or not.

Activity

There are a number of VHF/UHF-only contests throughout the year, though

not as many as on HF, plus there are a few events which include both HF and VHF. Here is a list of the major ones (with asterisks beside those valid for sCCOre Award and a second asterisk for contests with a club competition). January ARRL VHF Sweepstakes* * April Ontario QSO Party (CCO, up to 2m only)* April-May Spring VHF Sprints (K9JK/W4SHG) May San Bernardino Microwave Society 2 GHz & Up Contest June ARRL June VHF QSO Party* * SMIRK 6m contest (Six Meter International Radio Klub) ARRL Field Day July RAC Canada Day Contest (up to 2m only)* CQ World Wide VHF Contest (6m & 2m only) August ARRL UHF Contest ARRL 10 GHz & Up Contest (1 st weekend) September ARRL September VHF QSO Party* * ARRL 10 GHz & Up Contest (2 nd weekend) Sept.-October Fall VHF Sprints (Southeastern VHF Society) December RAC Canada Winter Contest (up to 2m only)* As a beginner you will likely find that the three major ARRL contests in January, June and September are the most interesting, though the Sprints can be enjoyable for those with a good single band capability.

Another interesting way to get your feet wet is to add VHF capability to your Field Day, OQP or RAC contest efforts. Most VHF contest activity is on SSB (always USB), with somewhat less on CW. Weak signal digital modes are starting to be used. (NOTE – the WSJT suite of digital modes are now very popular). FM is used in some areas, but not a lot in Ontario (except in the OQP and RAC contests, and on Field Day), and there are usually rules restricting what frequencies can be used.

Crossmode contacts with one station on SSB and the other (usually weaker) station on CW are common. In general VHF contest rules allow one QSO with each station per band, regardless of mode, with the exception of Field Day, OQP and the RAC contests where a phone and a CW QSO are allowed with each station on each band, as on HF. Many VHF-only hams are not highly skilled at CW, though most are quite willing to use it when the going is tough. This gives experienced HF CW contesters something of an edge in VHF events.

The HF contester’s abilities to copy in QRM and run at high rates are less useful in VHF contests but can provide a small advantage. The most active bands are 2m and 6m, since most operators are equipped (or better equipped) for these two bands, because the propagation is usually better, and because the antenna beamwidths are wider than on the higher frequencies, meaning more people can hear a CQ. It is very common for two stations to make an initial contact on 50 or 144 MHz, and then QSY to whatever other bands they have in common. It is also quite accepted practice in VHF contests to make schedules by email, etc., before the contest to increase the likelihood of a contact. Operating techniques are much like HF contests but are usually conducted at a somewhat slower pace, with longer CQs, slower CW and repeated exchanges, since signals are often weaker and possible QSO rates lower.

Many single operators use SO2R, SO3R and SO4R setups, so if you hear nothing interesting on a given band, there may be several people listening while CQing on another band, so a CQ is often worthwhile.

The VHF and up contests employ scoring based on the Maidenhead Grid Locator system (see http://www.arrl.org/locate/gridinfo.html) so you will need to know which one you are in. Most of the many 4-character grid squares in Ontario are never on the air, so if you feel altruistic, a contest expedition to one or more of the rare ones could be interesting. However, unless there is a big opening, such an operation is doomed to a very low score since the rare grids are all at least slightly remote from the activity centres. It could, however, add quite a bit to the CCO club totals if you put the rare multiplier in the logs of the higher-scoring members. Activity levels are usually best in the mornings and in the evenings after dark, as the combination of availability of casual operators and tropospheric propagation is best at these times. There is very little activity in the wee hours of the morning unless there is a very good opening. This means that operators (like me !) who can not stay awake continuously can be more competitive in VHF contests than on HF .

Propagation

The workhorse mode of propagation is tropospheric scattering, which can provide in contacts of up to a few hundred km on any band between 50 MHz and 10 GHz, with the maximum distance on any given band depending on your power, antenna and how clear a horizon you have at your location. Particularly in the summer (May-July) but occasionally at other times of the year, sporadic-E propagation can yield QSOs out to about 2500 km (and sometimes further in the case of double-hop propagation) on 6m, and very rarely also on 2m.

Tropospheric ducting occurs from time to time (most common in the summer and fall) and can propagate signals on 144 MHz and up with much stronger signals than tropospheric scattering and occasionally beyond 1000 km.

Strong auroras will reflect signals on 6m and 2m (and occasionally on 222 and 432 MHz) and gives good results in contests if it occurs. Most activity is on CW due to the distortion introduced by the aurora. Antennas need to be aimed at the aurora (generally north), not toward the station you are trying to work. But aurora can also be useful to induce Americans to turn their antennas north (i.e. towards Ontario !) so sometimes it is worth looking south during an Aurora for signals arriving via tropospheric scattering or ducting as well.

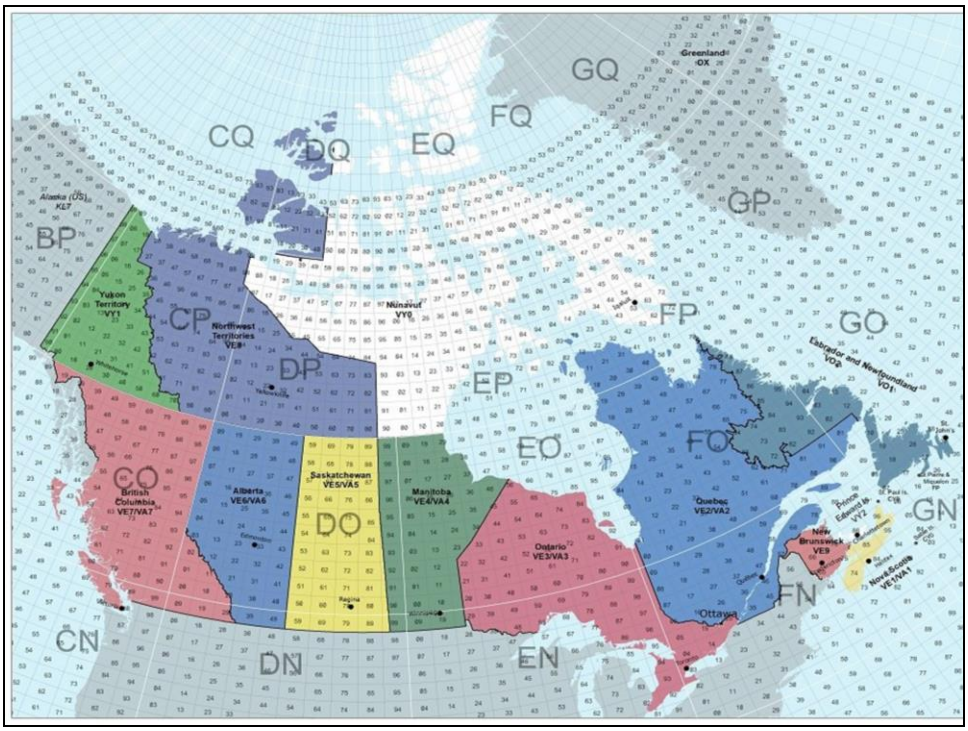
Some VHF contesters have been able to make good use of meteor scatter propagation using digital modes to pick up distant multipliers, especially on 6m and 2m.

Equipment

Equipment used by VHF contesters is extremely varied. My belief is that it is best just to start with whatever you have and get on the air ! Very few run anywhere close to the legal power limit, so smaller stations can be reasonably competitive, particularly in Canada where the overall level of competitiveness in VHF contests is not currently very high. VE3KZ has won many certificates using just an IC706MkIIG (albeit with some decent antennas at a very good location) and so have I, operating on more bands but with 10 watts or less, with all the antennas on an apartment balcony !

I am able to quite regularly work stations at over 500 km distance on 2m and much further on 6m in sporadic E openings. Antennas on VHF SSB/CW are standardized on horizontal polarization, while on FM vertical polarization is used. There is quite a bit of loss involved in communicating between antennas of opposite polarization. However, this does not mean that contacts are impossible. If you have an antenna of any sort, I encourage you to try it and see what you can do.

Don't forget that 40m dipoles and such can often be pressed into service on 6m with the aid of an antenna tuner. From KC6CQ (Palau) I even worked a bunch of JAs on 6m using 10 watts and a TH-2 tribander fed with about 150 ft of small coax ! Rovers A well organized rover (in those contests that permit this type of operation) can usually get a bigger score than a fixed station with the same gear and can add a lot more to the scores of any nearby home stations due to being allowed to work everyone again from each grid visited.



The **Maidenhead Locator System** is a geographic co-ordinate system used by amateur radio operators to succinctly describe their locations. Its purpose is to be concise, accurate and robust in the face of interference and adverse transmission conditions. The Maidenhead Locator System can describe locations anywhere in the world.

Maidenhead locators are also commonly referred to as *grid locators* or *grid squares*, although the "squares" are distorted on any non-equirectangular cartographic projection. John Morris G4ANB originally devised the system and it was adopted at a meeting of the IARU VHF Working Group in Maidenhead, England in 1980.

Because VHF DX contacts generally aren't as distant or dispersed as their HF cousins are, VHF DX awards deal with geographic divisions on a smaller scale, called grid squares. Grid squares are the basis for the Maidenhead Locator System, in which one grid square measures 1° latitude by 2° longitude. Each grid square is labeled with two letters (called the field) and two numbers (called the square). Then grid squares are divided even further into subsquares, which are denoted by two additional lowercase letters.

DXing on the VHF and UHF bands

Although DXing or making long distance contacts is traditionally found on the HF bands, an active and growing community enjoys DXing on the bands above 30 MHz. This activity also increases when the solar cycle is lower like we're currently experiencing. The excitement of extending your station's capability to these bands is being shared by more hams than ever before. The explosion in popularity of VHF/UHF DXing is similar to the explosion of HF DX enthusiasm in the 1960s, when top-quality equipment became available to the average ham. These days, the latest generation of all-band HF/VHF/UHF radio equipment puts top-notch higher frequency DXing on the shack desktop.

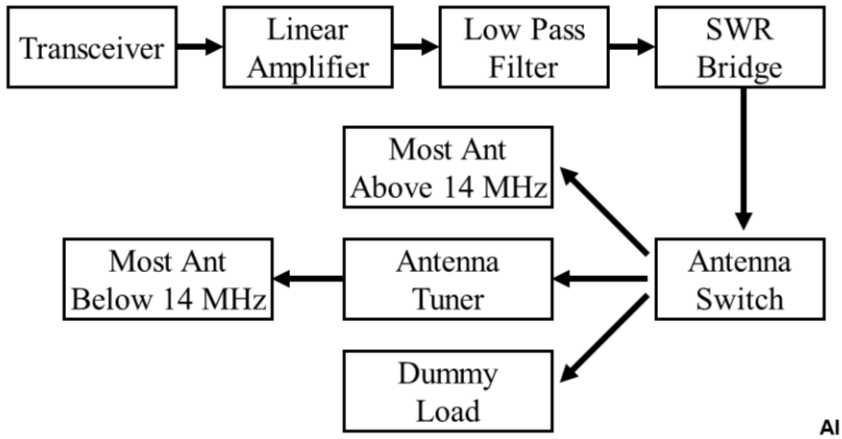
With the exception of the 6 meter band (known as the magic band because of its sudden and dramatic openings for distant stations), these higher frequencies usually don't support the kind of long-distance, transoceanic contact that's common on HF, because the ionosphere can't reflect those signals. VHF/UHF DXers look for contacts by using different methods of propagation.

The VHF and UHF bands have undeserved reputations for being limited to line-of-sight contacts because of the limitations of previous generations of relatively insensitive equipment and the prevalence of FM, which takes considerably more signal strength to provide signal quality equivalent to single sideband (SSB) and Morse code transmissions. By taking advantage of well-known modes of radio propagation, you can extend your VHF and UHF range dramatically beyond the horizon.

FN74ox

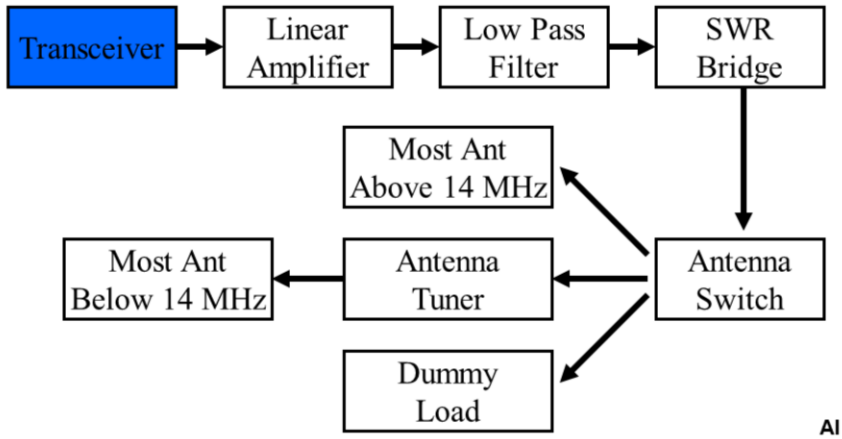

VE3WCC
24.125 GHz
Bell
ExpressVu

Typical HF Installation

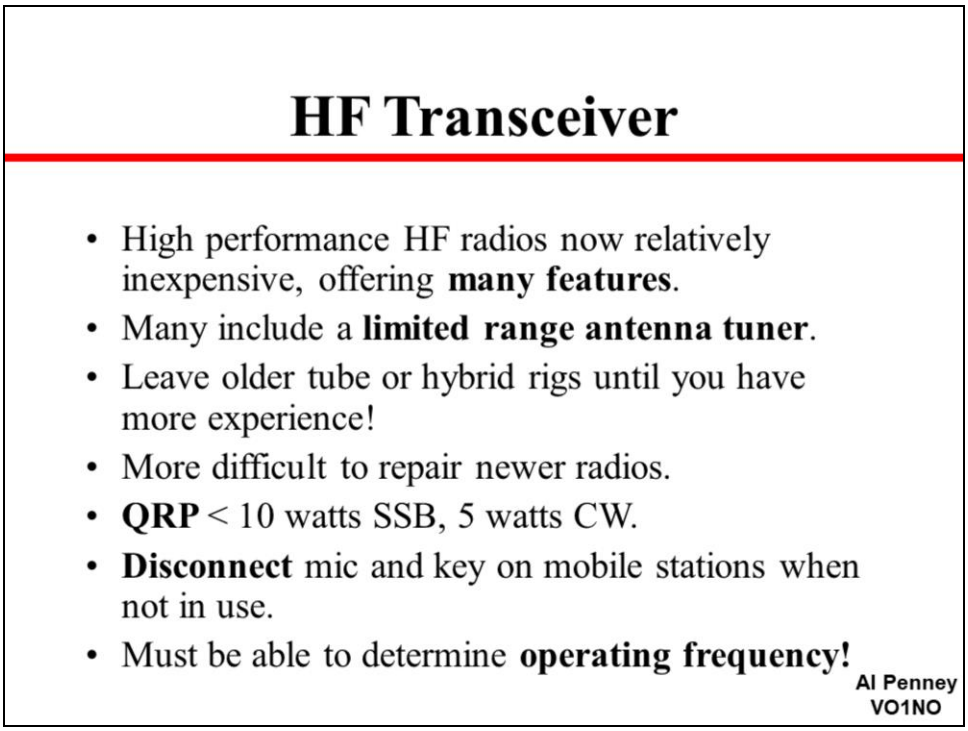


Al Penney
VO1NO

Typical HF Installation



Al Penney
VO1NO



When setting up an amateur radio station, or replacing some older gear, it is wise to spend some time looking at the market and seeing just what you want.

Although amateur radio equipment these days is very good value for what you get, it can still represent a large investment, so a little car needs to be taken when deciding on what to purchase.

Aspects like performance, specification, cost, size, power output, and the general level of the transceiver all need to be taken into account along with aspects like its suitability for portable or mobile operation.

Amateur radio HF transceiver aspects

When looking at buying a new amateur radio transceiver, it is wise to look at what its envisaged usage will be. How much will it be used, where, how much space, what antennas are available, how big is the shack, how much power can be run and is there a likelihood of interference.

All these aspect and many more need to be thought through for the existing and envisaged future usage.

There are many different manufacturers of HF amateur radio equipment, and therefore there is a good choice in many different

price brackets.

When choosing what equipment to buy, there are many factors that need to be considered.

•***Performance:*** It almost goes without saying that the performance is a prime consideration when buying an HF transceiver. The best performance is obviously good to have, but it is worth stopping to think whether the level of performance will actually be used in whatever location the set is used.

•***Computer linking:*** In these days when software is becoming an integral part of amateur radio, the level of computer linking and control possible can be a key consideration. Some digital modes these days rely on being able to control the radio using computer software. This aspect of the operation should be investigated before any purchase is made.

•***Power output:*** The power output can be a key issue. For base station and some mobile HF transceivers, a power output of around 100 watts peak envelope power is normal. Some of the top line transceivers have higher power levels than this, but normally for reaching the full power output allowed of 400 watts in some countries or kilowatts in other countries, a linear amplifier is normally used. These can often reach their full output with a drive of around 100 watts.

•***Cost:*** Cost is a key consideration for many. Buying a rig new is obviously nice, but buying second hand can save some cost, especially if done privately, although there can be additional risks. Whatever approach is taken, there is a really good selection of equipment available in a variety of price brackets.

•***Size:*** The size of the HF transceiver or rig can be a consideration for many. It is often possible to have a very compact radio station that has a high level of performance. The top of the range HF transceivers can be very large, but some of the medium budget or low budget and mobile transceivers can be very compact. When choosing an HF rig, it is possible to buy one that suits the space available.

Type of HF transceiver to buy

•***Base Unit Transceivers:*** Fixed desktop transceivers generally enjoy more features than portable devices. Commonly known as base unit transceivers, these types of devices are generally set up on a permanent location. Boasting higher output power levels than their mobile and handheld counterparts, they are commonly paired with massive antennas

that can broadcast over a large range.

Base units are commonly enhanced with amplifiers, and provided they are fittingly equipped, they can access broadcast on a variety of levels, from local to international.

•***Mobile Transceivers:*** Amateur radio mobile operation is popular with many people. To accommodate this requirement there is a good selection of mobile equipment available. This equipment is smaller and less sophisticated than some of the base station equipment. It lends itself, not only to mobile operation, but also portable operation as well, and as a result it can be very useful for emergency communications as well. Often amateur radio has provided a vital means of communications in emergencies when all other systems have been overloaded or damaged.

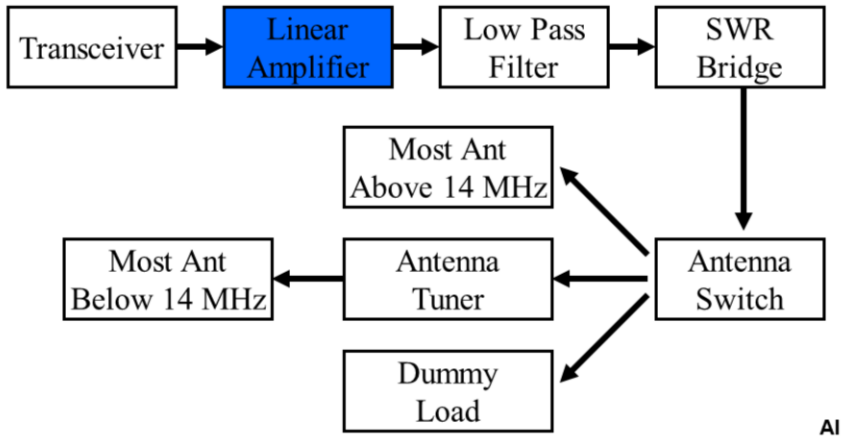
Mobile HF transceivers can also be used to good effect in a home station when a highly sophisticated rig may not be needed. It may be worth looking at these, for mobile / portable operation, or when a smaller and lower cost rig is needed.

•***Software defined radios, SDR :*** SDR technology is being far more widely used these days. Often the SDR receiver or transceiver occupies a box unit and uses a computer for the controls. SDR technology ahs the advantage that the performance can be changed by changing the software. Additional facilities can be added by upgrading software. Although there are hardware limitations on some areas, software can provide significant changes.

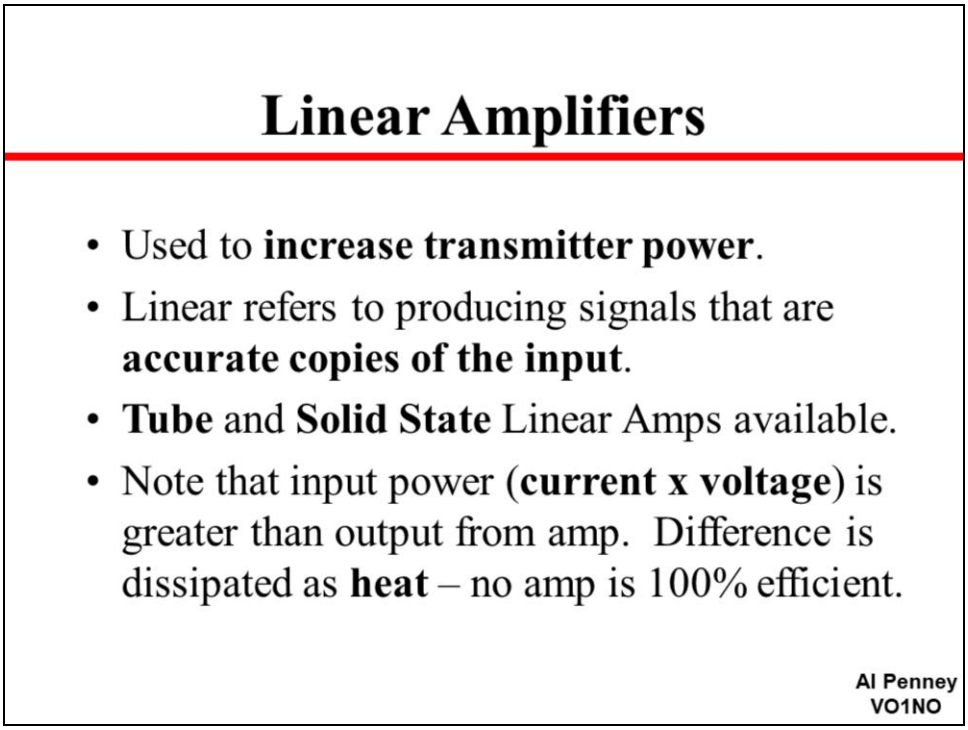
•***Kit building:*** Although it is not usual to build a complete HF transceiver from scratch these days, there are many kits available, especially for low power or QRP operation. There is a good selection of QRP low power kits for transmitters and transceivers for Morse code operation on the HF bands.


7.076.00
7.050.00
POWER
HEATER
PHONES
MIC
21.255.00
(25 Reviews)
1420000

Typical HF Installation



Al Penney
VO1NO



A **linear amplifier** is an electronic circuit whose output is proportional to its input, but capable of delivering more power into a load. The term usually refers to a type of radio-frequency (RF) power amplifier, some of which have output power measured in kilowatts, and are used in amateur radio. Other types of linear amplifier are used in audio and laboratory equipment. Linearity refers to the ability of the amplifier to produce signals that are accurate copies of the input. A linear amplifier responds to different frequency components independently, and tends not to generate harmonic distortion or intermodulation distortion.

Ham radio linear amplifiers are used where it is necessary to increase the output power from a transmitter or more usually a transceiver.

Often these linear amplifiers are needed when stations want to increase the power being transmitted to the full legal limit as many transceivers, HF, VHF and UHF do not provide this power output level.

Linear amplifiers tend to be associated more with HF operation than with frequencies above 30 MHz, however amplifiers are also

available for VHF and UHF as well.

Why linear?

Linear RF amplifiers are required where signals that have an amplitude component are used. These amplitude components carry information and for this to be accurately preserved, the signal must be amplified in a linear fashion.

Signals including amplitude modulation, single sideband, and quadrature amplitude modulation are the main ones and for amateur radio, linear amplifiers are required for single sideband.If the RF amplifier is not linear, then the signal will be distorted and this will result in intermodulation products spreading out either side of the signal to create what is termed splatter.

To ensure that no undue levels of splatter are generated so that the minimum amount of interference is caused to other users, it is essential that all additional amplifiers remain linear.

Signals that do not carry amplitude variations such as FM signals can use non-linear amplifiers like class C amplifiers which are much more efficient and do not need the same level of heat sink capability etc. They are also cheaper to manufacture.

Reasons for installing a ham radio linear amplifier

The main reason for installing a ham radio linear amplifier is to increase the signal output, thereby becoming a larger signal on the band.

The increase in power output will be reflected as a stronger signal at the receiver and will result in more contacts being made, and also being able to be heard in pile-ups when they occur.

For example, a typical HF transceiver has an output up to 100 watts. If a linear amplifier is used to increase this to, say 400 watts. This is an increase on power of 6dB. As 6dB is equivalent to an "S" point, this represents a marked increase.

Taking the power from 100 watts to 1500 watts represents a gain of nearly 12dB and this is an increase in strength of about two "S" points.

Any station increasing its strength by two "S" points would see a significant improvement in the capability of the station, and hence the stations being contacted.

Tube & semiconductor linear amplifiers

The are both tube based and semiconductor based amateur radio linear amplifiers. In view of the very high power levels used, thermionic or tube technology is still used for many amplifiers, although semiconductors are

also widely used nowadays.

Years ago vacuum time of thermionic valve technology was the only method for creating a linear amplifier with output power levels of 500 watts and above. Nowadays semiconductors are available to achieve this, although typically many transistors are operated in parallel to achieve it.

•***Tube / valve amateur radio linear amplifiers:*** Tube / valve RF linear amplifiers have been in use for many years and have provided excellent service in ham radio RF linear amplifiers. They are robust and will tolerate mismatches, although operating under poor conditions for extended periods will shorten their life.

They also require very high voltages to be used within the amplifier - often 2 - 3 kV. These voltages can be lethal, so great care is needed when working on them. Also be aware that capacitors in the amplifiers can retain their charge for a long time. Great caution is needed, and they are best worked on after they have been switched off for a while and even then care needs to be exercised, checking all points for high voltages.

These amplifiers also need time from switch on for the tubes / valves to warm up before they can be used. Despite these characteristics, these RF amplifiers provide excellent and reliable service, often lasting for many years. Some have been service for ten or twenty years and still perform well.

•***Semiconductor amateur radio linear amplifiers:*** Semiconductor linear RF amplifiers have a number of advantages. They do not use the very high voltages that the vacuum tube RF amplifiers need, and they are also ready to operate almost instantly - they do not require the warm-up period that the tube / valve linear amplifiers require. However they do require an accurate match. Semiconductors will not withstand the high peak voltages and currents that may appear if a poor VSWR is present and therefore they have protection circuits to reduce the power output under these conditions.

The choice of amplifier technology will depend upon the preferences of the operator and whether a semiconductor or tube based linear is going to suit best.

Points to consider before buying a linear amplifier

Although it sounds as if increasing the power level is like a great idea, there may be a few points to consider before moving ahead.

•***Consider the cost:*** Linear amplifiers are costly items of amateur radio

equipment. They can cost as much as the basic rig itself, or possibly even more.

•***Improve the antenna and feeder before buying a linear:*** There is no point in buying and installing a linear amplifier if a poor feeder and antenna are used. IT is far more effective and also cost effective to improve the antenna and its feeder. Only then, should buying a linear being considered.

•***Upgrade elements after the amplifier:*** The linear amplifier will significantly increase the power level and items like VSWR meters, feeders and even the antenna itself may need to be upgraded to ensure they can handle the increased power. This can be an additional cost.

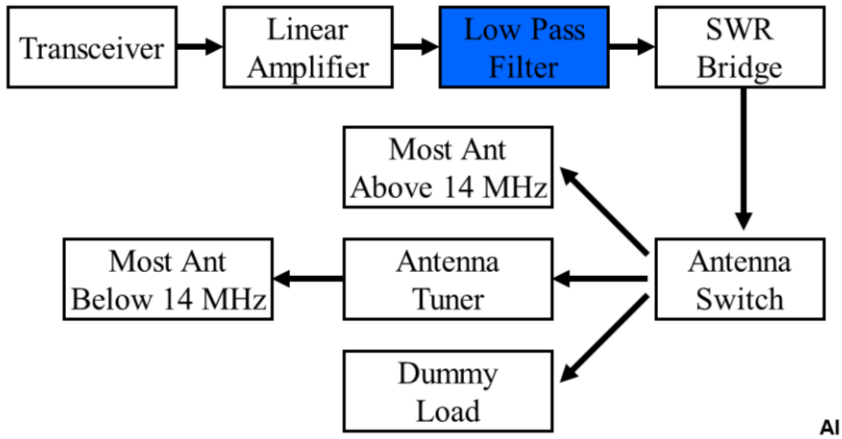
•***Keep antennas away from occupied areas:*** The use of a linear amplifier will increase the level of radiation from the antenna. Although there are still discussions about the links between radiation and health, it is always wise to keep high power levels away from where people are likely to be - raising antennas and ensuring they are away from occupied areas is an essential precaution.

•***Watch for local interference:*** Increasing the power levels being transmitted using a linear RF amplifier can give rise to interference on local domestic appliances. Care should be taken to ensure that antennas are well away from domestic receivers, and other electronic apparatus that may be affected. This is another reason to ensure that the antennas are well removed from inhabited areas.

Many amateur radio stations use linear amplifiers very effectively. They can give a significant increase in signal strength when all other avenues have been fulfilled. Using a linear will ensure that the best possible signal is radiated within he legal limits.


KENWOOD
TL-922
LINEAR AMPLIFIER
PLATE
BAND
LOADING
YAESU FL-2100B
ALPHA 78
Al Penney
VO1NO

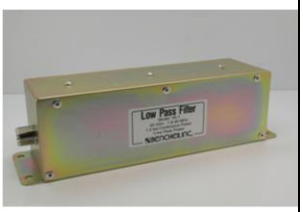
Typical HF Installation

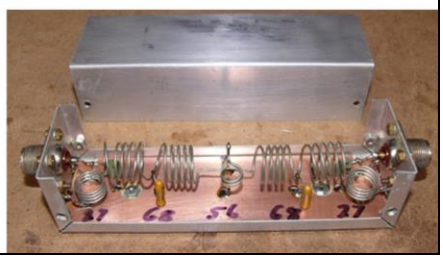


Al Penney
VO1NO

Low Pass Filter

- Attenuates Xmitter **harmonics** and spurious emissions above 30 MHz.
- **Little effect** on signals **below 30 MHz.**
- Keep **close to Xmitter**.
- Not often used now.

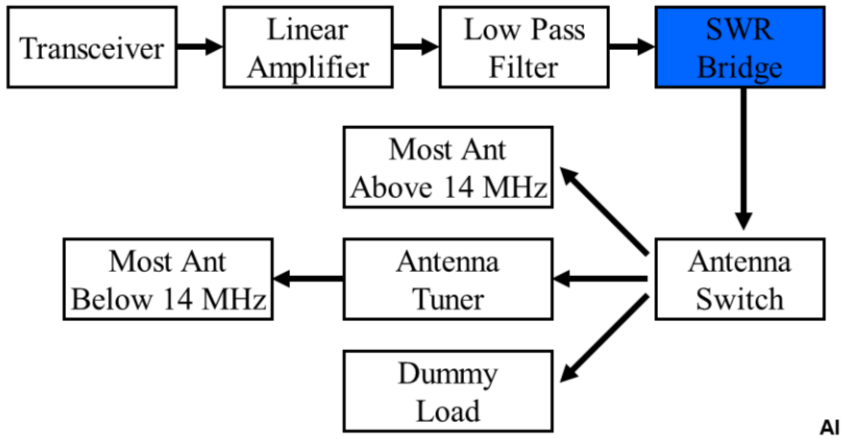




Al Penney
VO1NO

A low-pass filter is one that will permit all frequencies below a specified one called the cut-off frequency to be transmitted with little or no loss, but that will attenuate all frequencies above the cut-off frequency. High-pass and low-pass filters can be difficult to construct properly. Whenever possible, many amateurs simply buy them.

Typical HF Installation



Al Penney
VO1NO

SWR Bridge

- Constantly measures **VSWR**.
- Gives immediate indication of a **mismatch** or **problem**.
- **Cross-needle** types also show transmitted power.
- Factors to consider:
  - Frequency range (HF, V/UHF);
  - Power handling capability; and
  - Sturdy construction.

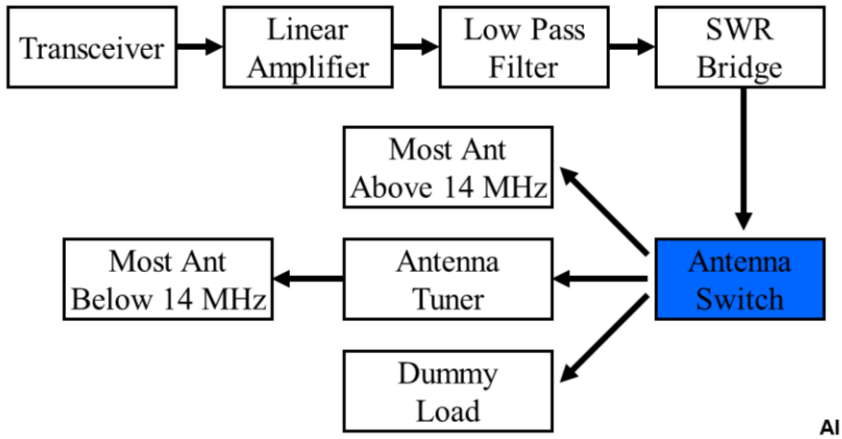
Al Penney
VO1NO

The **SWR meter** or **VSWR (voltage standing wave ratio) meter** measures the standing wave ratio (SWR) in a transmission line. The meter indicates the degree of mismatch between a transmission line and its load (usually a radio antenna). Technicians use it to evaluate the effectiveness of impedance matching efforts.

An SWR meter does not measure the actual impedance of a load (the resistance and reactance), but only the mismatch ratio. To measure the actual impedance requires an antenna analyzer or other similar RF measuring device. For accurate readings, the SWR meter must match the line impedance, usually 50 or 75 ohms. To accommodate multiple impedances, some SWR meters have switches that select the resistance appropriate for the sense lines.

An SWR meter should connect to the line as close as possible to the antenna: All practical transmission lines have a certain amount of loss, which attenuates the reflected wave as it travels back along the line. Thus, the SWR is highest closest to the load, and only improves as the distance from the load increases, creating the false impression of a matched system.

Typical HF Installation



Al Penney
VO1NO

Antenna Switch

- **Switches coaxial cable** to permit use of several antennas on one radio (or vice versa).
- Can also switch to **Dummy Load** for tuning.
- Factors to consider:
  - Power level;
  - Isolation between ports;
  - Type of connectors;
  - Number of ports; and
  - Grounding switch position.

Al Penney VO1NO

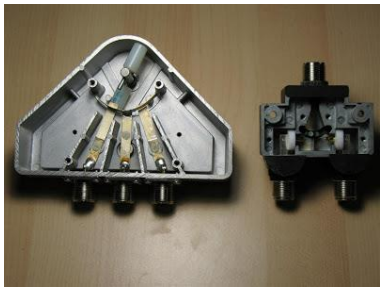
Antenna switches are extremely useful accessories in the shack. You could either connect them to the transceiver so you can switch between two or more antennas (great for quick A/B comparisons) or to one antenna so you can do compare transmitted audio or reception on different transceivers.

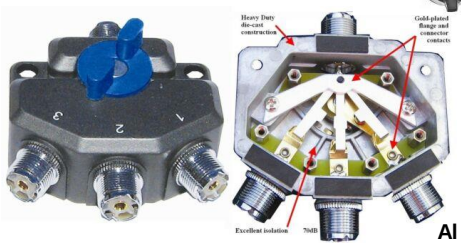
A manual antenna switch comprises a flip or rotary switch with some antenna sockets. Leads need to be kept short and the whole thing needs to be in an earthed metal case. Connecting wires must be very short (to minimise stray inductance, capacitance and loss) while switch contacts must be heavy enough to withstand sometimes high transmit powers.

You can buy antenna switches commercially. But they can be expensive. But also beware some cheap antenna switches which can be very shoddily built (even if they claim they can do 1 kW!)

Internal Construction

- Well built switches have internal channels to isolate ports & maintain constant impedance.
- Avoid wafer switch types.





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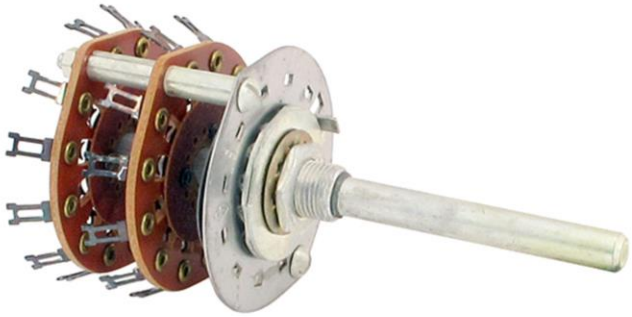
When it comes to internal design and construction, all of these switches share common design concept (especially the A/B (SPDT) type) - a moveable contact "finger" engaged by the lever and a couple of contact points in the same cavity. They are not "true coaxial switches" and in my book they are far from "great"! This design is just a notch better than an "open frame relay" type A/B switch. There are problems with poor port-to-port isolation, insertion loss, SWR, frequency response, reliability and power handling, etc - all common problems for many "ham grade" (read "inexpensive") coax switches.

Wafer Switch - Avoid

- Great for other purposes, but not antenna switches!



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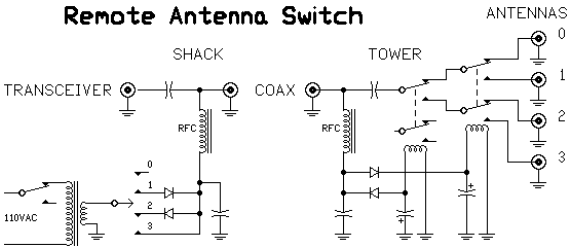
Remote Antenna Switches

- Switch located at antennas.
- Permits one coax run to antennas.
- May need a control line, or use coax.



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The **Ameritron RCS-4** is a remote controlled coax switch that selects one of four outputs by supplying all control voltages through the coax. The elimination of control cables gives you a fast, neat and inexpensive installation with only one coaxial line for four antennas. Designed for 1.5-100 MHz operation with up to 2.5 kW PEP, 1.5 kW average. Loss at 30 MHz less than 0.1 dB. VSWR is under 1.25:1 for 1.5-60 MHz. Requires 120 VAC.

You get two units -- the switching box that can be tower, mast or wall mounted and the control console that is located at your operating station. The attractive indoor console has bright LED antenna selector indicators. A steel enclosure provides 100% shielding to prevent RFI and TVI. Switching time is 50 ms. SO-239 connectors provide reliable connections. The weatherproof switching box uses three heavy duty 10 ampere contact relays on a rugged G-10 fiberglass circuit board. Quality components are used throughout the entire unit to ensure maximum life for the sometimes difficult-to-reach switching box.

The RCS-4 provides safe operation with 14 volts control voltage. It operates from 120 VAC adapter.
This remote switch does *not* require a separate control cable.

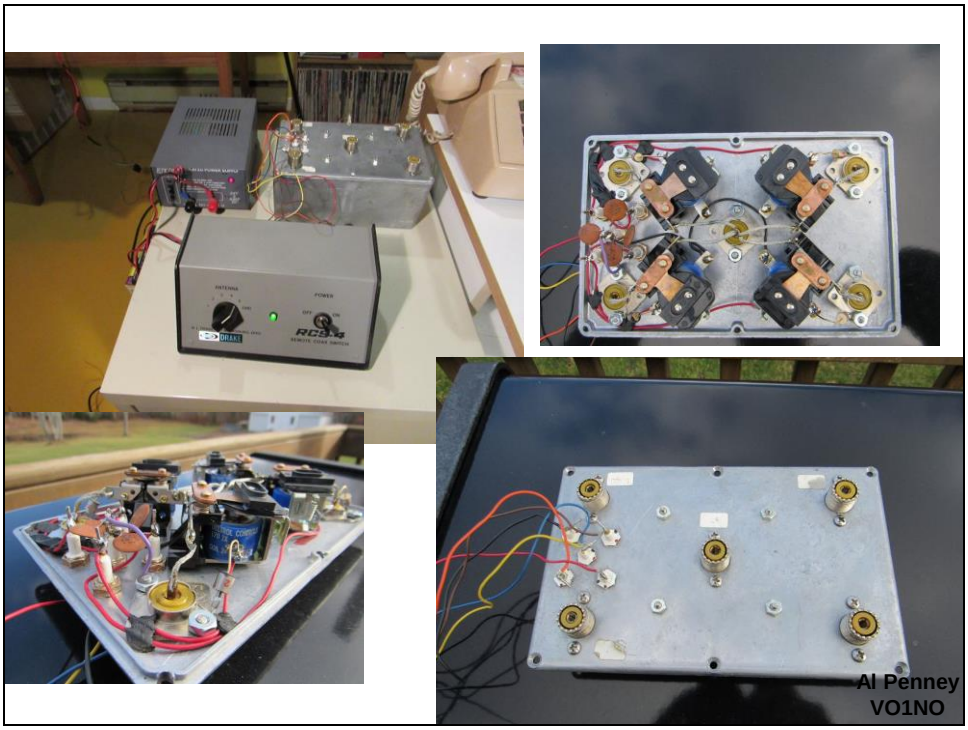
Many years ago I built a remote antenna switch that allowed feeding up to 4

antennas from the same feedline. The feedline also was used for the control signal, so no additional wires were needed.It was a very simple circuit. The switch box at the top of the tower contained 5 coax connectors, two DPDT relays, two diodes, an RF choke and a couple capacitors. The control box in the shack contained 2 coax connectors, a 60-Hz power transformer, a 4-position switch, an RF choke, two diodes and a couple capacitors. In the diagram below, the relays are shown in the un-energized position.

The electrolytic capacitors in the switch box may not be needed, depending on the relays. I believe I used 0.1 uF for the coupling and bypass capacitors and something like 22 or 47 uH for the RF chokes. (For VHF, smaller chokes might be required to avoid in-band resonances.) The diodes are garden-variety 1N4xxx-series power supply rectifiers. The transformer was chosen to provide the correct relay voltage. You may need to add resistors in series with the relay coils to fine-tune the voltage.

Jim K5LAD has posted a complete construction article on his personal web site.

- N1AL 6/8/2011

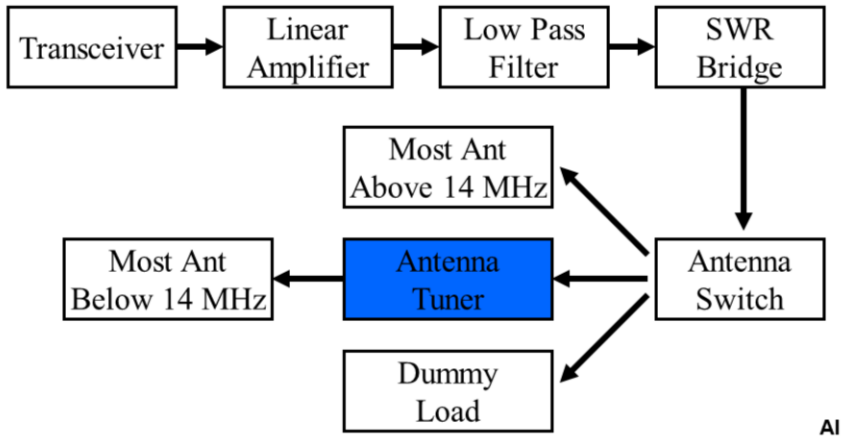


Homebrew Remote Antenna Switch at VO1NO.

The Drake control box originally used 120VAC, and had a transformer to convert that to 36 VAC. I modified it to operate on 24VDC (what the relays in the switchbox need). I also had to include a voltage divider for the 12 volt LED that replaced the original neon light.

The capacitors and diodes serve to prevent the back EMF from getting into the receiver when the relays are switched off.

Typical HF Installation



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Antenna Tuning Unit (ATU)

- AKA Transmatch, Matchbox, Coupler etc.
- **Matches impedance** of antenna system to that required by Xmitter (usually 50 Ohms).
- Often not required on antennas > **14 MHz**.
- Lower bands are **much wider** in terms of percentage of bandwidth, so ATU needed.
- External ATU has **greater range** than those fitted inside modern transceivers.

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Antenna tuner, **matching network**, **matchbox**, **transmatch**, **antenna tuning unit** (**ATU**), **antenna coupler**, and **feedline coupler** are all equivalent names for a device connected between a radio transmitter and its antenna, to improve power transfer between them by matching the specified load impedance of the radio to the combined input impedance of the feedline and the antenna.

Antenna tuners are particularly important for use with transmitters. Transmitters are typically designed to feed power into a reactance-free, resistive load of a specific value, very often 50 ohms. However the antenna and feedline impedance can vary depending on frequency and other factors. If the impedance seen by the transmitter departs from the design load, circuits in modern transmitters automatically cut back the power output to protect the equipment from the consequences of the impedance mismatch.

In addition to reducing the power radiated by the antenna, the mismatch can distort the signal, and in high power transmitters may overheat the transmitter. Because of this, ATUs are a standard part of almost all radio transmitting systems. They may be a circuit incorporated into the transmitter itself, or a separate piece of equipment connected between the transmitter and the antenna. In transmitting systems with an antenna separated from the transmitter and connected to it by

a transmission line (feedline), there may be yet another matching network (or ATU) where the feedline connects to the antenna, to match the transmission line's impedance to the antenna.

Transmitters in cell phones and walkie-talkies have an ATU circuit inside permanently set to work with the installed antenna. In multi-frequency communication stations like amateur radio stations, and high power transmitters like radio broadcasting stations, the ATU is adjustable to accommodate changes in the transmitting system. Matching the transmitter, feedline, antenna, or their environment by adjustment of the ATU is an important procedure done after any change the system, with an instrument called an SWR meter typically used to measure the degree of match or mismatch.

Antenna Tuning Unit (ATU)

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Antenna Tuning Unit (ATU)

- Features to consider:
  - Power Rating;
  - Type of circuit (L, T, Pi – T most common);
  - Tuning range – depends on circuit and component values. Bigger values = greater range.
  - Antenna input – coax and/or balanced;
  - SWR meter;
  - Dummy load; and
  - Antenna switch.

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WHAT IS AN ANTENNA TUNNER?

You have to learn how to hook them up to your tranceiver properly and tune them correctly to make your radio "think" that it is feeding it's signal into a "perfect or near perfect 50 ohm laod called your antenna!
An antenna tuner, (transmatch), doesn't really TUNE your antenna OR ANY PART OF IT!

What an antenna tuner or transmatch does do, however, is transform the impedance at the antenna feed output at the radio to a value that your transceiver can handle, (typically 50 Ohms).
When thinking about antenna tuners and SWR, it's important to remember that **the tuner has no effect whatsoever on the SWR between itself and the antenna.**
It's the SWR between the transmitter and the tuner that is changed with the tuner controls.

In layman's terms, all a tuner does is act as a kind of adjustable impedance transformer between the radio and the antenna. It takes whatever impedance the antenna system presents, up to the design limits of the tuner, and attempts to convert it back to 50 Ohms--or something reasonably close to that value for the transceiver. When the

transceiver "sees" a 50 Ohm impedance, it is able to load or produce it's maximum designed RF output into the system because it is designed to operate into a 50 ohm load.
Your rig "thinks" it's seeing a 50 ohm antenna on it's output!
That power is transferred through the antenna tuner, to the feed line and, ultimately, to the antenna--**minus any losses incurred along the way.**
If you have high loses and a poor excuse for an antenna, you will have a poor excuse for a good signal no matter how well your tuner "tricks" your radio. Much of the power will be lost as heat in the tuner and very little will get to the other station!

These losses are the reason that the highest efficiency feed-line for each individual case is desirable and why some amateurs use ladder line on HF, which has the least loss per foot, which means maximum power at the input terminals of the antenna.

HOW TO HOOK UP AND USE
So now that you have a better understanding of what an antenna "tuner" actually does, let's hook one up in a typical HF station.

The rf moves from the transceiver to the SWR/WATT meter, then finally thru the "tuner" and out to the antenna.
You just learned how to hook it all up! Just remember that our goal is to make the transceiver think all is well, and in order to "read" the SWR and Power out pertaining to "all is well".....at the radio's output....the swr meter must be between the radio and the tuner. NOT ON THE ANTENNA SIDE!

Now Let's learn how to "tune" that "tuner"

Most antenna tuners have an inductance rotary switch and two capacitors. (refer to photo at top of page) The capacitors are often labeled ANTENNA and TRANSMITTER. In some antenna tuners the inductance switch is replaced with a continuously variable inductance, popularly known as a roller inductor.

Let's assume you're using a tuner with an inductance switch, because they are the most common**.**

SHOCK HAZARD! NEVER TRANSMIT WITH THE TUNER COVER OFF AS IN THE NEXT STEP!
TURN OFF THE POWER TO THE RADIO!

Place both capacitor controls at their mid-range positions. Don't trust the knob

markers if this is your first experience with the tuner! If you are comfortable with the next procedure, remove the cover of the tuner and turn the knobs until the moving capacitor plates are only half meshed with the stationary plates. If the knobs are pointing to half scale with the reference markings on the knobs and front cover, consider yourself lucky.
If not, loosen their Allen screws and rotate the knobs so that they point to mid scale.
Re-tighten the knobs, **replace the tuner cover and you're ready to go.**

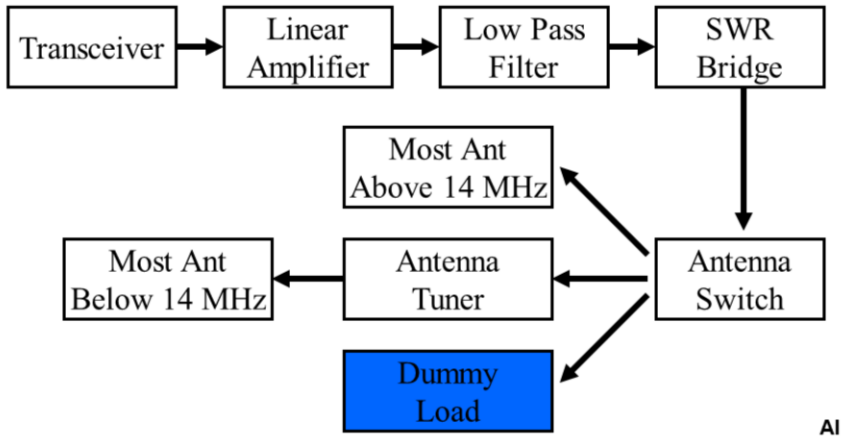
Turn the radio on and tune receiver to an un-used frequency on the band you desire, listen for a few seconds, with the antenna and transmitter controls at mid scale, move the inductance switch to each of it's positions until you hear the loudest noise or signals coming into your radio. Then, rotate the antenna and transmitter controls until you get to the absolutely loudest noise or signal level on the radio. All three of these controls interact with each other so practice on several bands to get the "feel" of the procedure.
Select your final band of operation and repeat the procedure above. When noise peaks out using your ears and the S meter, your tuner settings should be very close for final operation.With your rig set to low power monitor the frequency to assure that it is not in use, send your ID then transmit a continuous carrier while you tweak the antenna and transmitter controls for the lowest reflected power reading with the highest output power as read on the Swr/Watt meter. You may find that you have to vary the position of the inductance switch a position or two either way to get your best match.
Play it safe and un-key before turning the inductor switch...**un-key first**....turn the switch...key up....repeat as needed until lowest SWR and maximum output. Be gentle to your radio; keep the key-down periods as short as possible.
Depending on the impedance at the antenna input (and the overall design of the tuner) you may not be able to obtain a flat 1:1 SWR on all frequencies and bands.
Also important to remember is that your Swr will change, go up, as you tune further away from the frequency you used to "trick" your radio! So re-check and re-tune as needed as you move around the band.
You can get an idea of your SWR bandwidth by starting with your original frequency, and using the procedures above withlow power, (don't move any knobs or switches after best setting)....sweep or tune your VFO up and down the band while watching the SWR readings and note the frequency where the SWR reaches 2:1 at the higest and lowest frequency. Stop there!

Example: If your on 40 meters at say...7.262mhz as your starting point, and your SWR is 2:1 at 7.292mhz and the highest swr going the other way is 2:1 at 7.259mhz, then your "safe tuning range" without retuning the antenna tuner

would be about 60khz.
Keep in mind to use very low power and ID because your signal may be heard for a split second as you tune across the band! When that transmit key is down, someone somewhere can hear you. Even a dummy load gets out somewhere!
Remember your "TRICKING" your way around a good antenna!

Editors note:
In reality, there is no "tricking" involved anywhere and we were playing with words here like "tricking, fooling", etc.
It is useful to employ a matching device, the antenna tuner, between the transmitter and the antenna feeder when antennas with complex impedances are used..... so the transmitter will "see" a 50 -52 ohm load even though a significant mismatch is present at the antenna feed point. The tuner, matchbox or transmatch as it is sometimes called, **will not** correct the actual SWR condition on the feed line OR antenna, but it will resonate the antenna system **as a whole that the radio "sees" on it's output** and allows the transmitter to deliver as much power to the antenna system as possible within the design parameters of the tuner. The transmitter now can produce it's rated power out **to the tuner** in the hopes that the tuner can do it's job and get most of that power into the antenna system with some efficiency.
Bottom line: Your transmitter will not know that you are trying to "load up" those old rusty bed springs or that poor excuse for an antenna! Just because you're now seeing that "magic" 1 to 1 VSWR reading on the meter does not mean you have changed the design of those old rusty bed springs or whatever you're trying to us as an antenna!!!
The more efficient your antenna system.....the better! 73

Typical HF Installation



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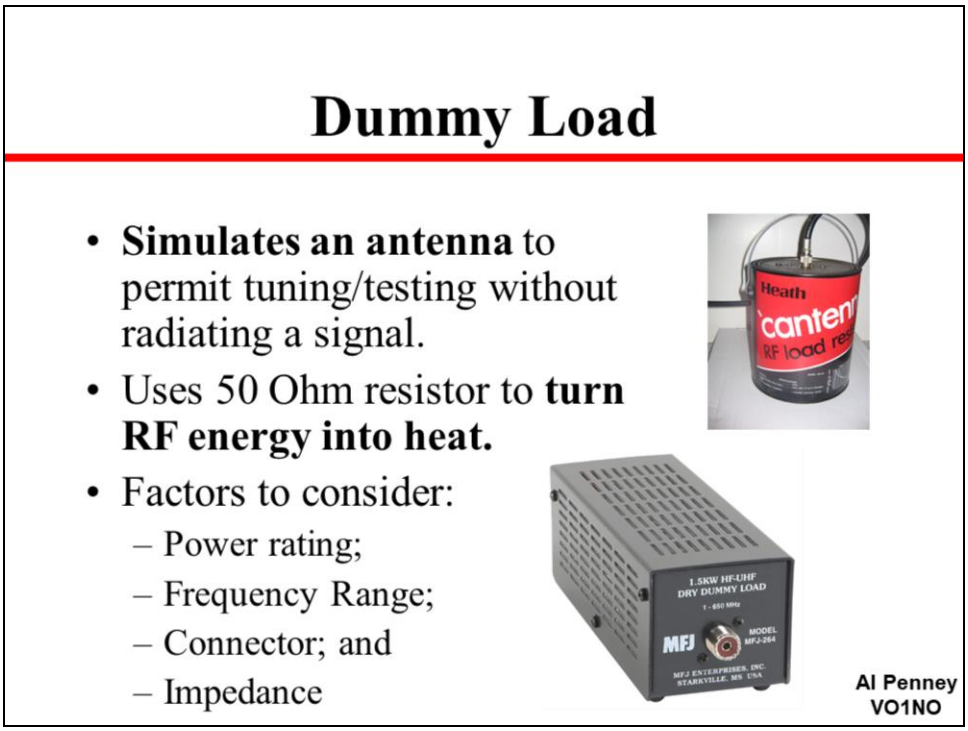

A **dummy load** is a device used to simulate an electrical **load**, usually for testing purposes. In radio a **dummy** antenna is connected to the output of a radio transmitter and electrically simulates an antenna, to allow the transmitter to be adjusted and tested without radiating radio waves.

In radio this device is also known as a **dummy antenna** or a **radio frequency termination**. It is a device, usually a resistor, used in place of an antenna to aid in testing a radio transmitter. It is substituted for the antenna while adjusting the transmitter, so that no radio waves are radiated (although, as no dummy load is an ideal dummy load, some radiation will occur.), so that the transmitter does not interfere with other radio transmitters during the adjustments. If a transmitter is tested without a load attached to its output terminals such as an antenna or a dummy load, the power will be reflected back into the transmitter, often overheating and damaging it. Also, if a transmitter is adjusted without a load, it will operate differently as compared with a load, and the adjustments may be incorrect.

The dummy load ordinarily should be a pure resistance; the amount of resistance should be the same as the impedance of the antenna or transmission line that is used with the transmitter (usually 50 Ω or 75

Ω). The radio energy that is absorbed by the dummy load is converted to heat. A dummy load must be chosen or designed to tolerate the amount of power that can be delivered by the transmitter. Typically it consists of a resistor attached to some type of heat sink to dissipate the power from the transmitter.

The ideal dummy load provides a standing wave ratio (SWR) of 1:1 at the given impedance.

Veterinarian-grade mineral oil, an inexpensive source for mineral oil, is frequently used by amateur radio operators as coolant in RF dummy loads.

Emergency Power

- Ability to operate without power grid is a **core capability** of Amateur Radio.
- Hams have a **long history** of providing emergency communications during disasters.
- Emergency Power includes:
  - Portable generators;
  - Batteries; and
  - Solar panels etc.

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Emergency Power – Handy-Talkies

- **Extra (charged) battery packs**.
- Battery pack that uses non-rechargeable cells.
- Larger gel-cells with power cord for HT.

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The most economical way to supply power to that charger or any other electrical equipment during a power outage for your ham radio station or your home is to use a portable generator of the appropriate wattage for your needs and run extension cords into the shack or home to power your equipment. A safer system is to have a certified electrician install a power transfer switch, connected to the shack's main electrical panel. Just fire up the generator, run a single extension cord into the transfer switch and power the circuits you need through the main circuit breaker of your home. This eliminates the risk of electrical back feed injuring utility workers repairing downed power lines.

Small portable gasoline-powered electric Generators can provide power for ham radios and station equipment, computers, TVs, small kitchen appliances, lights and other comforts of civilization when you are out roughing it in the woods or in an emergency situation at home. If cell and land line phones are out, you won't be! If power lines are down, odds are the land line telephone is dead also.

Portable Generators can be put to work on sites that have no electrical service, providing clean, reliable power to operate the Amateur Radio station and other desired survival equipment. Most are gasoline-powered, a few run on diesel, and some models have multi-fuel capabilities, running on gasoline, propane or natural gas. These are

generally full-featured machines with engine idle control, GFCI receptacles and 120 Volt full power switch.

Solar Panels

- Solar panels can keep a **12 VDC battery** charged during prolonged outage.
- Enough to keep an HF or VHF rig on the air.

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Antenna Analyzers

- Device that connects to antenna system to determine **SWR, Resonant Frequency, Impedance, Feedline Loss etc**.
- Factors to consider:
  - Frequency range;
  - Type of connector;
  - Graph display; and
  - USB port.
- **Not used inline**.

Al Penney VO1NO

An antenna analyzer is a useful tool for adjusting commercial as well as homemade antennas.

The primary use of an antenna analyzer is to determine the current res onant
frequency of an antenna to allow adjustment to the desired frequency; however antenna analyzers can also be used for other tasks, including:

* SWR, Complex Impedance, Vector Impedance measurement
* Return Loss, Inductive Reactance, Capacitive reactance
* Electrical length of a section of coaxial Cable (Select models)
* Feedline loss of a length of Coaxial cable
* Frequency Counter and signal generation
* Graphing display (Select Models)
* Memory for storing graphs (Select models)
* Multi language display (Select models)
* Frequency range scanning (Select models)

A table of Antenna Analyzers and available features can be found at the following link:

https://static.dxengineering.com/global/images/chartsguides/c/cma-caa500markii_it.pdf

Selection of an appropriate analyzer is **primarily** based on the range of

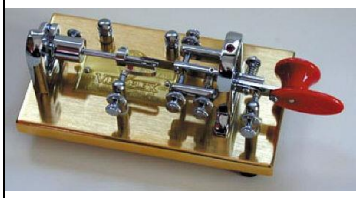
RF frequencies that you need to measure.
Secondary consideration would be the need
for features that are available only on certain analyzers.

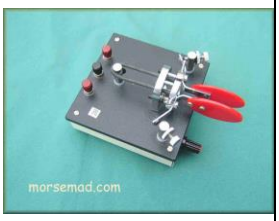
In general, HF only analyzers are less expensive than those that also include V HF,UHF
and microwave capabilities. Some analyzers can handle reference impedance SWR measurements
for standard impedances other than 50 ohms, such as 25,
75 and 100 ohms. Depending on the analyzer, the RF connector may be
BNC, PL-259 or N connector; some include N to PL-259 adapters.

Some analyzers have memories and the ability to connect to a USB port on you r
computer to download memorized measurements for later reference and anal ysis.
This can be very useful for "what has changed" investigation.

Morse Keys

- Three ways to key a CW Transmitter:
  - **Straight key**;
  - **Semi-automatic key**, or "**Bug**"; and
  - **Electronic keyer**.





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Straight keys

A *straight key* is the common telegraph key as seen in various movies. It is a simple bar with a knob on top and a contact underneath. When the bar is depressed against spring tension, it forms a circuit and allows electricity to flow. Traditionally, American telegraph keys had flat topped knobs and narrow bars (frequently curved), while British telegraph keys had ball shaped knobs and thick bars. This appears to be purely a matter of culture and training, but the users of each are tremendously partisan. Straight keys have been made in numerous variations for over 150 years and in numerous countries. They are the subject of an avid community of key collectors. The straight keys used in wire telegraphy also had a *shorting bar* that closed the electrical circuit when the operator was not actively sending messages. This was to complete the electrical path to the next station so that its sounder would operate, as in the operator receiving a message from the next town. Although occasionally included in later keys for reasons of tradition, the shorting bar is unnecessary for radio telegraphy, except as a convenience when tuning the transmitter.

The straight key is simple and reliable, but the rapid pumping action needed to send a string of dots (or *dits* as most operators call them) poses some significant drawbacks.

Transmission speeds vary from 5 words (25 characters) per minute, by novice operators, up to about 30 words (150 characters) per minute by skilled operators. In the early days of telegraphy, a number of professional telegraphers developed a repetitive stress injury known as *glass arm* or *telegrapher's paralysis*. "Glass arm" or "telegrapher's paralysis" may be reduced or eliminated by increasing the side play of the straight key by loosening the adjustable trunnion screws. Such problems can be avoided by using a good technique.

Semi-automatic key

A popular side-to-side key is the semi-automatic key or *bug*, sometimes known as a *Vibroplex key*, after the company that first manufactured them. The original *bug*s were fully mechanical, based on a kind of simple clockwork mechanism, and required no electronic keyer. When the paddle is pressed to the left it makes a continuous contact suitable for sending dashes (or *dahs*, as most operators call them). When the paddle is pressed to the right, it kicks a horizontal pendulum which then rocks against the contact points, sending a series of short pulses (*dits*) at a speed which is controlled by the position of the pendulum's weight. A skilled operator can achieve sending speeds in excess of 40 words per minute with a '*bug*'.

Electronic keyers and paddle keys

Like semi-automatic keys, the telegrapher operates an electronic keyer paddle by swinging the lever from side-to-side. When pressed to one side, the keyer electronics generate a series of *"dahs*"; when pressed to the other side, a series of "*dits*." Keyers work with two different types of keys: single paddle and double paddle keys. Like semi-automatic keys, pressing the paddle on one side produces a *dit* and the other a *dah*. Single paddle keys are also called *single lever keys* or *sideswipers*, the same name as the older side-to-side key design they greatly resemble. Double paddle keys are also called "*iambic*" keys or "squeeze" keys.

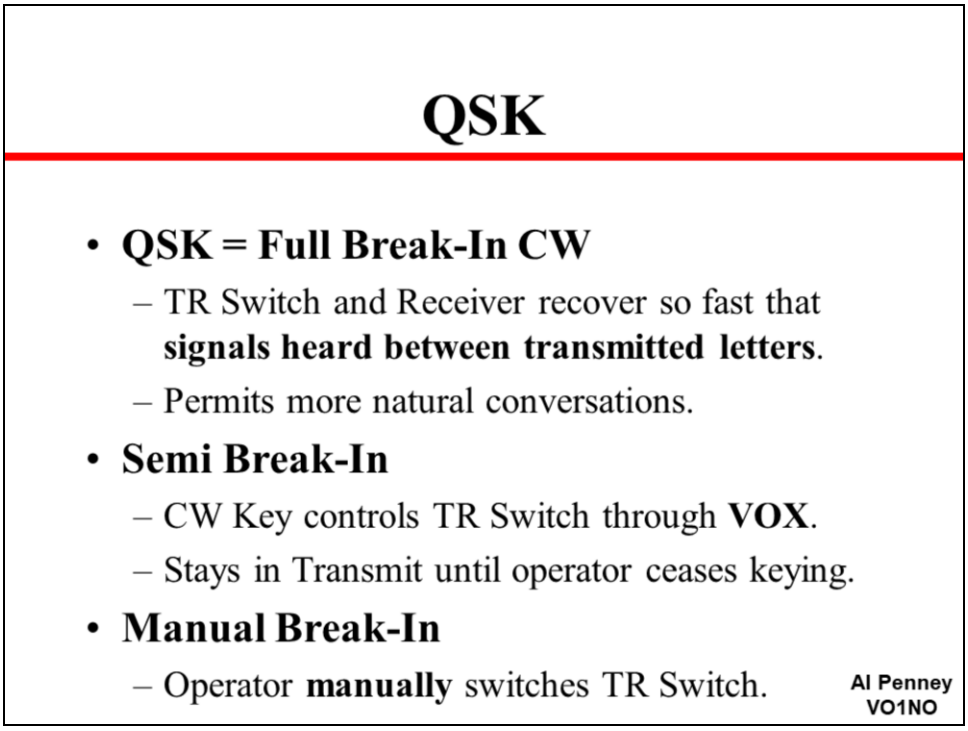
Single paddle keys are essentially the same as sideswiper keys with separate contacts on the left and right. Double-paddle keys have two arms, one for each contact, both arms held away from the common center by a spring; pressing either of the paddles towards the center makes contact, the same as pressing a single-lever key to one side. For double-paddle keys, squeezing both paddles together makes a double-contact, which causes the keyer to send alternating dits and dahs.

Most electronic keyers include *dot and / or dash memory* functions which free

the operator from the need to perfectly time his transitions from dits to dahs or vice versa. With dit or dah memory, the operator's keying action can be about one dit ahead of the actual transmission. The electronic keyer adjusts the timing so that the output of each letter is machine-perfect. Electronic keyers allow very high speed transmission of code.

Using a keyer in what's called "*iambic*" mode requires a key with two paddles: One paddle produces *dit*s and the other produces *dahs*. Pressing both at the same time produces an alternating dit-dah-dit-dah sequence, which starts with either a dit or dah depending on which side was pressed first.

An additional advantage of electronic keyers over semiautomatic keys is that code speed is easily changed with electronic keyers, just by turning a knob. With a semiautomatic key, the location of the pendulum weight location and the pendulum spring tension and contact must be re-balanced to change the dit speed.



Full Break-In

In amateur radio Morse code operations, **QSK** or **full break-in operation** describes an operating mode in which the transmitting station can detect signals from other stations between the elements (dots and dashes) or letters of the Morse transmission. This allows other stations to interrupt the transmitting station if necessary, and allows a conversational style of communications.

"QSK" is one of the Q-code signals established for radiotelegraph operators in the first decade of the 1900s. The three letter code "QSK" literally means "*I can hear you between my signals; you may break in on my transmission.*" Although Morse code is no longer used for commercial or professional purposes it continues in the amateur radio hobby.

With *QSK* or *full break-in* operation the silent periods of the Morse code enables Morse operators to listen between their transmitted signals, and thus enables a conversational style of communication.

QSK operation is a technique where very fast T/R RF switches are controlled automatically and directly by the actions of the telegraph key upon which the sending operator is creating the Morse code

signals. In QSK operation the T/R switches are capable of automatically and rapidly switching the radio antenna or antennas between the transmitter and receiver during the short (dot duration) silent periods between Morse code signals. Such T/R switches generally have stringent timing, reliability, and power handling specifications and are quite expensive.

Installation of suitable switches increases station cost compared with non-QSK operation.

With full break-in operation, the receiving operator can interrupt a sending operator in mid-character, similar to the way in which normal human voice conversations allow mid-syllable interruption of speakers by listeners.

Semi break-in operation

***Semi break-in* is a technique used by stations where slow (T/R) antenna switches are controlled indirectly by the telegraph key** which lack the faster switching of *full break-in* stations. Semi break-in hardware T/R switches are not required to switch as fast or to have the same long term reliability as their more expensive full break-in counterparts. Instead of using the telegraph key to directly control antenna switching, semi break-in radio transceiver equipment typically uses the telegraph key to control T/R switches indirectly, but still automatically, by passing the telegraph key information (usually in the form of a keyed audio tone) through a radio transceiver's *Voice-operated switch or VOX* circuitry.

Manual break-in operation

***Manual break-in* is a technique used in a rudimentary Morse code radio station set up where antenna change over (T/R) switches are not controlled by the telegraph key**. Instead antenna change over is accomplished manually by mechanical switches separate from the telegraph key on which the operator sends the Morse code. With such a simple manual turn over system there is no possibility of the sending operator listening between signals or symbols and therefore no possibility for the receiving operator to interrupt the sending operator. Instead the receiving operator must wait until a transmitting operator has indicated the end of transmission by means of a turn over prosign and has manually changed the antenna over from transmitter to receiver. Such *manual break-in* operation leads to a very slow and stilted style of Morse code conversations.

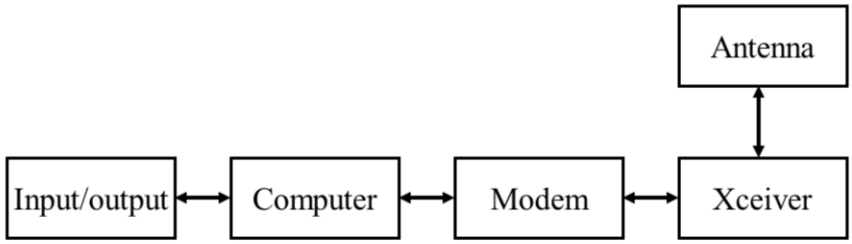
Receiver AGC recovery time considerations

Not all radio receivers are amenable to QSK operation.

Adding fast robust T/R switching externally to a transmitter/receiver combination (transceiver) will not necessarily result in good QSK operation. Adding such fast switching externally to a transceiver may create transients within receiver circuitry that makes signal copy: very noisy at best, and difficult, or impossible at worst.

Apart from the requirement for fast robust T/R switches, the main factor affecting good QSK operation is the ability for the radio receiver to recover its sensitivity quickly whilst operating quietly (without popping noises) during and after the fast transient signals created by the fast T/R switch operation. Many receivers have **automatic gain control (AGC) circuits** with time constants that take many milliseconds to recover their sensitivity and volume level after a strong transient signal is presented to their antenna input port. Without modifications or AGC circuit re-design such receivers are not suitable for QSK operation. In cases of slow responding AGC circuitry operators may accept the thumping noise and loss of AGC functionality and choose to turn their receiver AGC function off, instead operating their receivers using only manual gain control during QSK operation.

Digital Modes



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Digital Modes

- Input/Output – fancy name for **keyboard and Monitor**!
- Modem – turns the **digital signal** from the computer into an **audio signal** that can be transmitted. Also **keys the transmitter**.
- Modem also converts **received audio signal** into **digital format** and sends it to computer.
- Often called Terminal Node Controller (**TNC**).
- TNC now replaced by computer **sound card.**

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TNC / Modems

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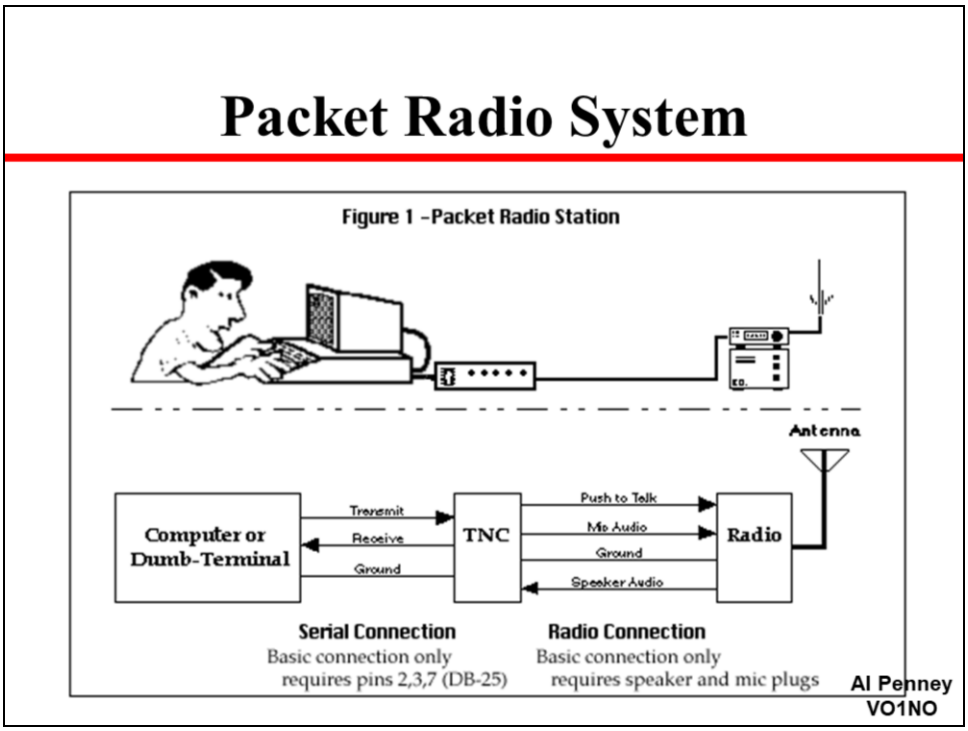

Packet radio is a digital radio communications mode used to send packets of data. Packet radio uses packet switching to transmit datagrams. This is very similar to how packets of data are transferred between nodes on the Internet. Packet radio can be used to transmit data long distances.

Packet radio is frequently used by amateur radio operators. The AX.25 (Amateur X.25) protocol was derived from the X.25 data link layer protocol and adapted for amateur radio use. Every AX.25 packet includes the sender's amateur radio callsign, which satisfies the US FCC requirements for amateur radio station identification. AX.25 allows other stations to automatically repeat packets to extend the range of transmissions. It is possible for any packet station to act as a digipeater, linking distant stations with each other through ad hoc networks. This makes packet radio especially useful for emergency communications.

*Main article: AX.25*Packet radio can be used in mobile communications. Some mobile packet radio stations transmit their location periodically using the Automatic Packet Reporting System (APRS). If the APRS packet is received by an "igate" station, position reports and other messages can be routed to an internet server, and made accessible on a public web page. This allows amateur radio operators to track the locations of vehicles, hikers, high-altitude balloons, etc., along with

telemetry and other messages around the world.

Packet Radio - What It's All About

Packet seems to offer something different from other facets of Amateur Radio, yet it can be used for everything from a local QSO to a DX contact thousands of miles away, for electronic mail, message transmission, emergency communications, or just plain tinkering in the world of digital communications. It presents a new challenge for those tired of the QRM on the low bands, a new mode for those already on FM, and a better, faster means of message handling for those on RTTY. Packet is for the rag chewer, the traffic handler, the experimenter, and the casual operator.

A ham can get involved very easily with relatively small out-of-pocket expenses. All you need is a transceiver, a computer, and a TNC or special packet modem and software. A two-meter rig is preferred, since that's where most of the packet activity is located. You probably already have the rig and the computer, so all you need to buy is the TNC, which costs just over $100, or the special modem and software, which sell together for about $50.

The TNC, the Terminal Node Controller, is a "little black box" that's wired between the computer and the radio. It contains software for controlling the outgoing and incoming transmissions for your station and a modem that converts the data from the computer into AFSK tones for transmission and changes the tones that are received by the radio into data for the computer. The TNC modem works much like a modem that's used to connect your computer to the telephone lines. It's a simple matter of wiring up a plug and a couple of jacks to become fully operational on packet. If you prefer to use the small modem instead of a TNC, you'll need special software for your computer to replace the software in the TNC. Either method works equally well.

Packet is communications between people either direct or indirect. You can work "keyboard to keyboard" or use electronic mailboxes or bulletin board systems to leave messages. Due to the error checking by the TNC, all of it is error free, too. (That is, as error free as the person at the keyboard types it!) As the data is received it's continuously checked for errors, and it isn't accepted unless it's correct. You don't miss the information if it has errors, however, because the information is resent until it is correctly received.

The data that is to be transmitted is collected in the TNC and sent as bursts, or packets, of information, hence the name. Each packet has the callsign or address of

who it's going to, who it's coming from and the route between the two stations included, along with the data and error checking. Since up to 256 characters can be included in each packet, more than three lines of text can be sent in a matter of a couple of seconds. There is also plenty of time between packets for several stations to be using the same frequency at the same time.

If all of this sounds confusing, don't let it bother you, because the TNC or special packet software does everything for you automatically. Packet radio might seem very confusing at first, but in a day or two you'll be in there with the best of them. In this series I'll be telling you all about packet radio - how you get on the air and how to use it. We'll talk about the little black box, the TNC, and tell you about all its inner-most secrets. We'll discuss mailboxes, bulletin board systems, and the packet networks that allow you to work stations hundreds, even thousands, of miles away using just a low powered rig on 2 meters, 220 or 450. The world of packet radio awaits you!

http://www.choisser.com/packet/

Sound Card Mode Interfaces

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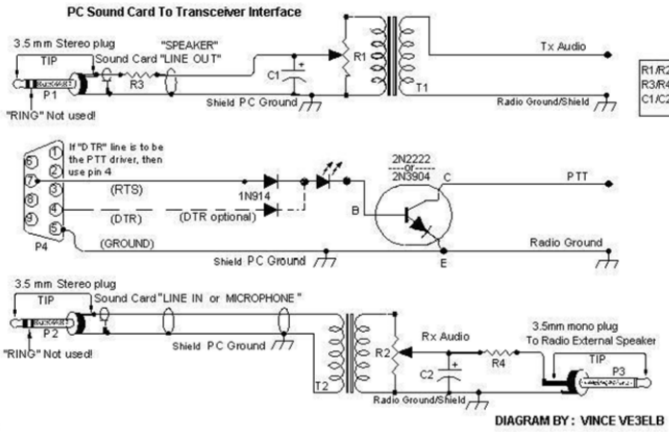
Homebrew Sound Card Interface



R1/R2=10k ohm variable resistors
R3/R4=470 ohm resistors
C1/C2=50v 1uf caps T1/T2=audio isolation transformers

T1/T2 Specifications:
Coil Turns Ratio: 1:1
DC Resistance - Primary: 51 Ohms ±5%
DC Resistance - Secondary: 70 Ohms ±5%
Impedance: 600-900 Ohms
Freq. Response: 300 Hz To 5 Khz
Insulation Resistance: More Than
100 Megohms At 250VDC

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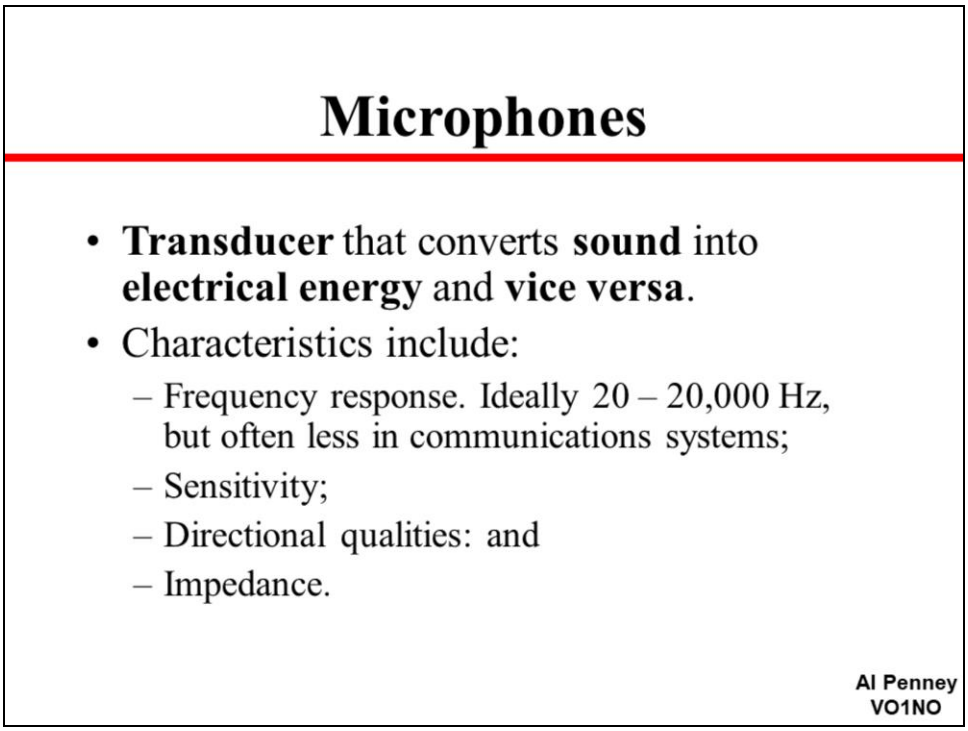

A **microphone**, colloquially named **mic** or **mike** is a device – a transducer – that converts sound into an electrical signal.

Several types of microphone are in use, which employ different methods to convert the air pressure variations of a sound wave to an electrical signal. The most common are the dynamic microphone, which uses a coil of wire suspended in a magnetic field; the condenser microphone, which uses the vibrating diaphragm as a capacitor plate; and the piezoelectric microphone, which uses a crystal of piezoelectric material. Microphones typically need to be connected to a preamplifier before the signal can be recorded or reproduced.

Types of Microphones

- **Crystal** – piezoelectric effect.
- **Dynamic** – coil moving in magnetic field.
- **Condenser** – diaphragm forms one plate of a capacitor.
- **Electret** – similar to Condenser microphone.
- **Carbon** – Carbon granules change resistance as they are disturbed by sound.

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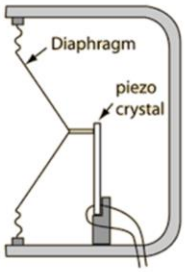
Crystal Microphones

- Uses **Piezoelectric Effect** – crystals produce a voltage when subjected to pressure.
- High impedance, 10 megohms or more.
- Often used with tube radios.



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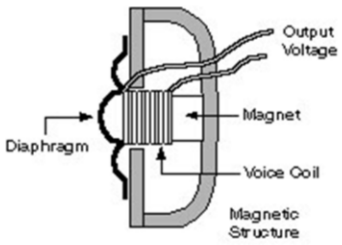
A **crystal microphone** or **piezo microphone** uses the phenomenon of piezoelectricity—the ability of some materials to produce a voltage when subjected to pressure—to convert vibrations into an electrical signal. An example of this is potassium sodium tartrate, which is a piezoelectric crystal that works as a transducer, both as a microphone and as a slimline loudspeaker component. Crystal microphones were once commonly supplied with vacuum tube (valve) equipment, such as domestic tape recorders. Their high output impedance matched the high input impedance (typically about 10 megohms) of the vacuum tube input stage well. They were difficult to match to early transistor equipment and were quickly supplanted by dynamic microphones for a time, and later small electret condenser devices. The high impedance of the crystal microphone made it very susceptible to handling noise, both from the microphone itself and from the connecting cable.

Piezoelectric transducers are often used as contact microphones to amplify sound from acoustic musical instruments, to sense drum hits, for triggering electronic samples, and to record sound in challenging environments, such as underwater under high pressure.

Dynamic Microphones

- **Coil** attached to diaphragm moves in a **magnetic field**, generating current.
- Same principle as a **loudspeaker**.
- Robust, inexpensive and resistant to moisture.



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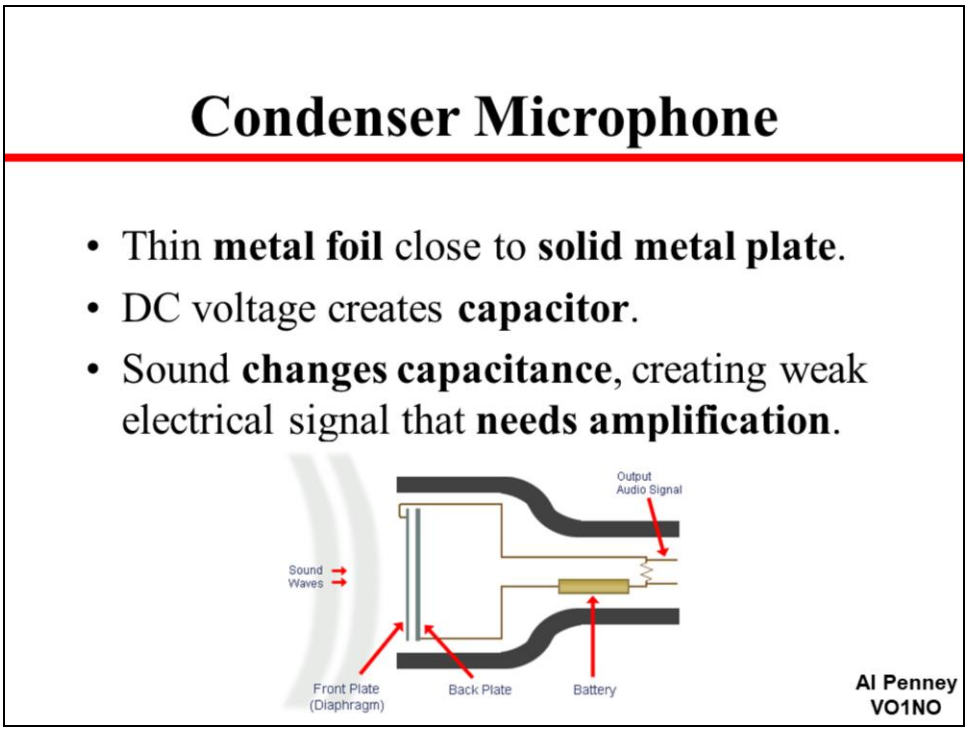
The **dynamic microphone** (also known as the **moving-coil microphone**) works via electromagnetic induction. They are robust, relatively inexpensive and resistant to moisture. This, coupled with their potentially high gain before feedback, makes them ideal for on-stage use.

Dynamic microphones use the same dynamic principle as in a loudspeaker, only reversed. A small movable induction coil, positioned in the magnetic field of a permanent magnet, is attached to the diaphragm. When sound enters through the windscreen of the microphone, the sound wave moves the diaphragm. When the diaphragm vibrates, the coil moves in the magnetic field, producing a varying current in the coil through electromagnetic induction. **A single dynamic membrane does not respond linearly to all audio frequencies**. For this reason, some microphones utilize multiple membranes for the different parts of the audio spectrum and then combine the resulting signals. Combining the multiple signals correctly is difficult; designs that do this are rare and tend to be expensive.



As the name implies the condenser or capacitor microphone relies on changes in capacitance for its operation.

The actual condenser microphone element consists of a thin membrane in close proximity to a solid metal plate. The membrane acts as the diaphragm and is electrically conductive. Older microphones used a thin metal foil but more modern types may use a plastic coated with gold or aluminium. One common type is gold-sputtered mylar.

This construction creates a capacitor which may be in the region of 10 to 50pF. For the condenser microphone to operate it requires a DC voltage to be applied. This can be supplied by the battery shown, but for high end microphones it may also be supplied along the coaxial line to the microphone – this is known as phantom power. The most common voltage this is 48volts.

This voltage not only provides the voltage needed for the microphone to operate electrically but also pulls the diaphragm taut.

When sound waves hit the microphone, the diaphragm moves backwards and forwards. This changes the level of capacitance and as a result small voltage changes are seen across a high load

resistor connected across the microphone element. .

As the impedance of the condenser microphone is very high, a buffer amplifier is needed. This has the effect of converting the signal so that it has a much lower impedance. This amplifier is also powered either from the internal battery or from the phantom power line.

Condenser microphone features

The very low mass an inertia of the diaphragm results in the microphone having a flat and extended frequency response. In fact condenser microphones offer the widest frequency response an best transient response of any microphone allowing them to faithfully pick up the attack of a drum or the "pick" of an acoustic guitar. Also, condenser microphones usually offer much higher sensitivity and lower noise than dynamic microphones.

However the basic microphone element requires a low noise preamplifier to ensure that the microphone element is not loaded. It also requires power for the capacitor and preamplifier. This is normally provided as phantom power from the mixer, or from a small battery within the microphone.

As a result of the high sensitivity, **these microphones can be overloaded by very loud sounds**, so care needs to be taken in selecting them for applications where they will not be overloaded.

The condenser microphone is not as robust as the dynamic microphone as its internal construction is relatively delicate. Whilst this results in a low inertia system that gives a good response, it also means it is less robust.

The other main issue to be aware of when using a condenser microphone is to **avoid humid environments**. High levels of humidity have been known to cause internal flashover between the diaphragm and the back plate of the microphone element.

Condenser microphone summary

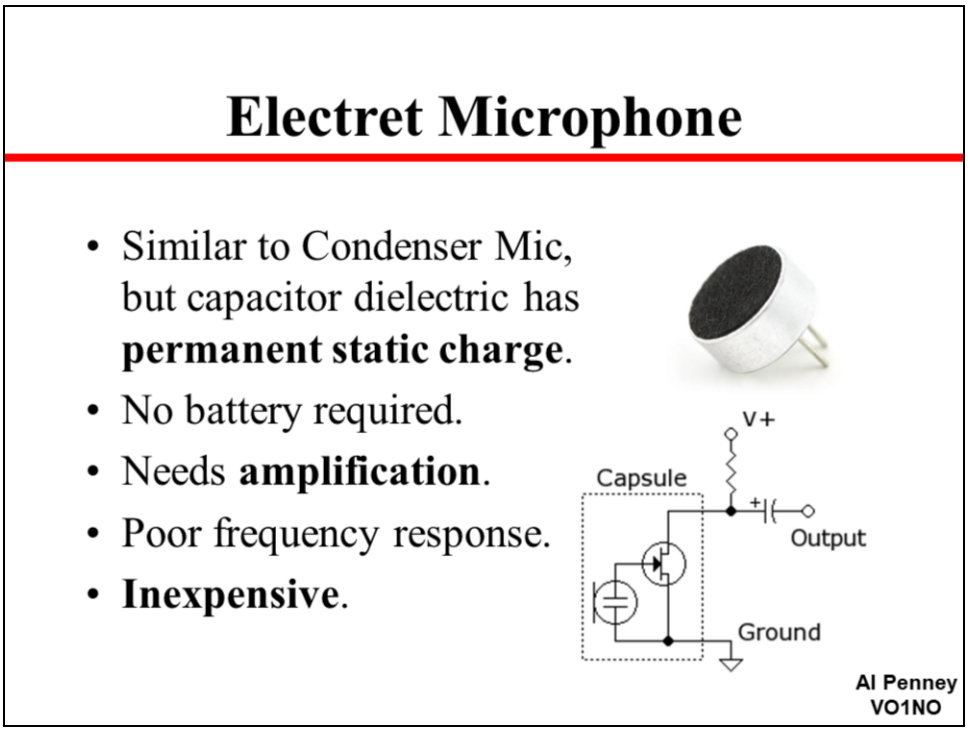
The condenser microphone has many advantages and a summary of their key features is given below.

Output impedance typically around 200Ω or less.

Impedance of the transducer itself is very high – many MΩ.

Typical frequency response can be as good as 20 Hz to 20kHz or better.

Care needs to be taken when using and handling these microphones. They can be damaged more easily that dynamic microphones.



An **electret microphone** is a type of electrostatic capacitor-based microphone, which eliminates the need for a polarizing power supply by using a permanently charged material.

An *electret* is a stable dielectric material with a permanently embedded static electric dipole moment (which, due to the high resistance and chemical stability of the material, will not decay for hundreds of years). The name comes from *electr*ostatic and magn*et*; drawing analogy to the formation of a magnet by alignment of magnetic domains in a piece of iron. Electrets are commonly made by first melting a suitable dielectric material such as a plastic or wax that contains polar molecules, and then allowing it to re-solidify in a powerful electrostatic field. The polar molecules of the dielectric align themselves to the direction of the electrostatic field, producing a permanent electrostatic "bias". Modern electret microphones use PTFE plastic, either in film or solute form, to form the electret.

History

Electret materials have been known since the 1920s and were proposed as condenser microphone elements several times, but they were considered impractical until the foil electret type was invented

at Bell Laboratories in 1961 by James West and Gerhard Sessler, using a thin metallized Teflon foil. This became the most common type, used in many applications from high-quality recording and lavalier use to built-in microphones in small sound recording devices and telephones.

Types

There are three major types of electret microphones, differing in the way the electret material is used:

Foil-type or diaphragm-type

A film of electret material is used as the diaphragm itself. This is the most common type, but also the lowest quality, since the electret material does not make a particularly good diaphragm.

Back electret

An electret film is applied to the back plate of the microphone capsule and the diaphragm is made of an uncharged material, which may be mechanically more suitable for the transducer design being realized.

Front electret

In this newer type, the back plate is eliminated from the design, and the capacitor is formed by the diaphragm and the inside surface of the capsule. The electret film is adhered to the inside front cover and the metalized diaphragm is connected to the input of the FET. It is equivalent to the back electret in that any conductive film may be used for the diaphragm.

Unlike other condenser microphones, electret types require no polarizing voltage, but they normally contain an integrated preamplifier, which does require a small amount of power (often incorrectly called polarizing power or bias). This preamp is frequently phantom powered in sound reinforcement and studio applications. Other types simply include a 1.5 V battery in the microphone housing, which is often left permanently connected as the current drain is usually very small .

Electret Microphone

The electret microphone is a form of condenser microphone, but they utilise a dielectric that remains permanently charged removing the need for an external supply.

The electret microphone has gained widespread usage as a cheap but effective microphone for many applications.

Although some high quality versions are available, it is at the low end of the market where it has really gained its main usage.

Electret microphone construction

The key to the electret microphone is the dielectric that is used between the two plates of the capacitor that form the microphone.. This dielectric retains a permanent charge equivalent to around 100 volts.

The electret microphone dielectric is typically manufactured by heating a form of plastic whilst held within an electric field. As a result it takes on the charge which it retains. Although there is some leakage it can take a hundred years of more to fall appreciably.

Electret microphone performance

Within an electret microphone the diaphragm is thicker than in other microphones – this means that these microphones generally have a poor high frequency response, and a resonance at 5 kHz or a little more.

This peak in response can typically be reduced by cutting the treble if required and this can generally be achieved without affecting the speech frequencies unduly.

It is also found that most electret microphones have a falling bass response.

Electret microphone use

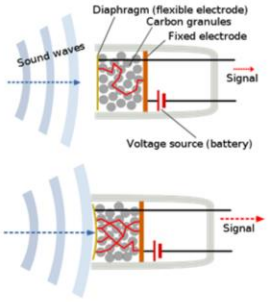
Electret microphones need a high input impedance buffer and preamplifier. This is normally contained within the Amateur transceiver.

These drawbacks can be overcome relatively easily and often electret microphones can make an attractive proposition in view of their low cost.

They are also used in many items of electronic equipment where their performance is quite adequate and their low cost very attractive.

Carbon Microphones

- Two plates separated by **carbon granules**.
- Sound changes **resistance** of carbon granules.
- Sensitive, high output.



Al Penney
VO1NO

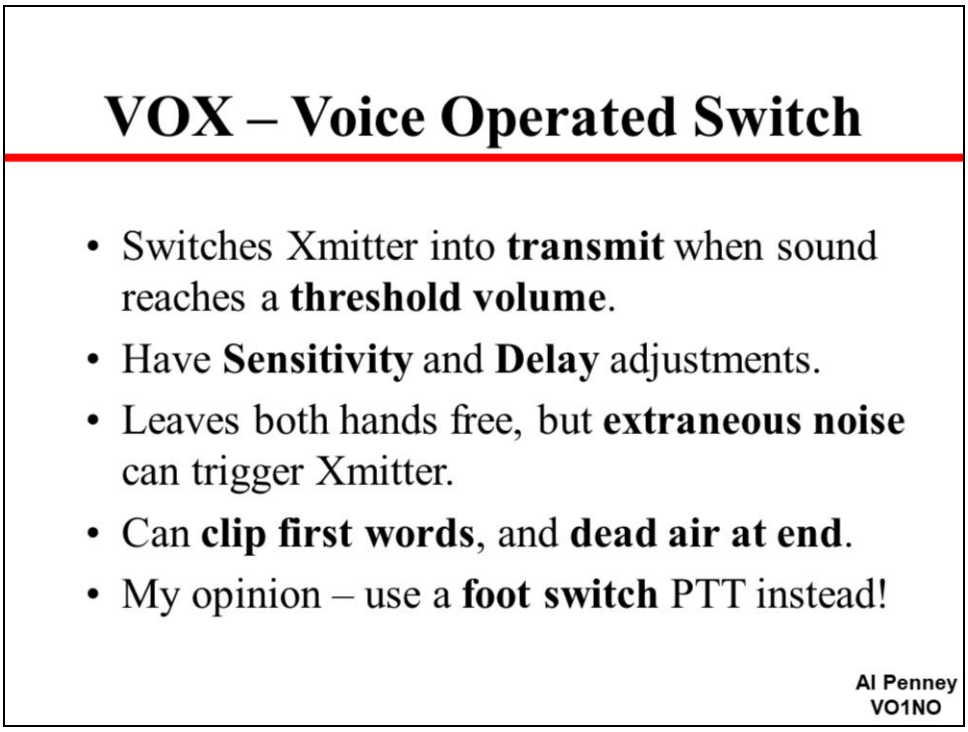
The **carbon microphone**, also known as **carbon button microphone**, **button microphone**, or **carbon transmitter**, is a type of microphone, a transducer that converts sound to an electrical audio signal. It consists of two metal plates separated by granules of carbon. One plate is very thin and faces toward the speaking person, acting as a diaphragm. Sound waves striking the diaphragm cause it to vibrate, exerting a varying pressure on the granules, which in turn changes the electrical resistance between the plates. Higher pressure lowers the resistance as the granules are pushed closer together. A steady direct current is passed between the plates through the granules. The varying resistance results in a modulation of the current, creating a varying electric current that reproduces the varying pressure of the sound wave. In telephony, this undulating current is directly passed through the telephone wires to the central office. In public address systems it is amplified by an audio amplifier. The frequency response of most carbon microphones, however, are limited to a narrow range, and the device produces significant electrical noise.

Before the proliferation of vacuum tube amplifiers in the 1920s, carbon microphones were the only practical means of obtaining high-level audio signals. They were widely used in telephone systems until the 1980s, while other applications used different microphone designs

much earlier. Their low cost, inherently high output and frequency response characteristic were well suited for telephony. For plain old telephone service (POTS), carbon-microphone based telephones can still be used without modification. Carbon microphones, usually modified telephone transmitters, were widely used in early AM radio broadcasting systems, but their limited frequency response, as well as a fairly high noise level, led to their abandonment in those applications by the late 1920s. They continued to be widely used for low-end public address, and military and amateur radio applications for some decades afterward.

The principal advantage of carbon microphones over other microphone designs is that they can produce high-level audio signals from very low DC voltages, without needing any form of additional amplification or batteries. The carbon microphone, by virtue of using a power supply, gives a power gain. This can readily be demonstrated by connecting a battery, microphone and earphone in series. If the microphone and earphone are brought in contact the system will oscillate. This is only possible if the power gain around the loop is greater than unity. The microphone's low-voltage performance is particularly useful in remote locations served by very long telephone lines, where the electrical resistance of the wires can lead to severe DC voltage drop. Most all-electronic telephones need at least three volts DC to work, and so will often become useless in such situations, whereas carbon transmitter telephones will continue to work down to a fraction of a volt. Even where they do work, electronic telephones also suffer from the so-called "cliff effect", whereby they abruptly stop working when the line voltage falls below the critical level. In particular, this means that one telephone on a "party line" may tend to "hog" all the line current, cutting the others off. With carbon microphones, all receivers on the same line will still operate, albeit with reduced output.

Carbon microphones are also widely used in safety-critical applications such as mining and chemical manufacturing, where higher line voltages cannot be used, due to the risk of sparking and consequent explosions. Carbon-based telephone systems are also resistant to damage from high-voltage transients, such as those produced by lightning strikes, and electromagnetic pulses of the type generated by nuclear explosions, and so are still maintained as backup communication systems in critical military installations.



In telecommunications, a **voice operated switch**, also known as **VOX** or **voice-operated exchange**, is a switch that operates when sound over a certain threshold is detected.[1] It is usually used to turn on a transmitter or recorder when someone speaks and turn it off when they stop speaking. It is used instead of a push-to-talk button on transmitters or to save storage space on recording devices.

The circuit usually includes a delay between the sound stopping and switching direction, to avoid the circuit turning off during short pauses in speech.

Unlike manual push-to-talk (PTT) operation, VOX is automatic; the user can keep his or her hands free while talking. But VOX also has some significant disadvantages that explain why PTT is still common.

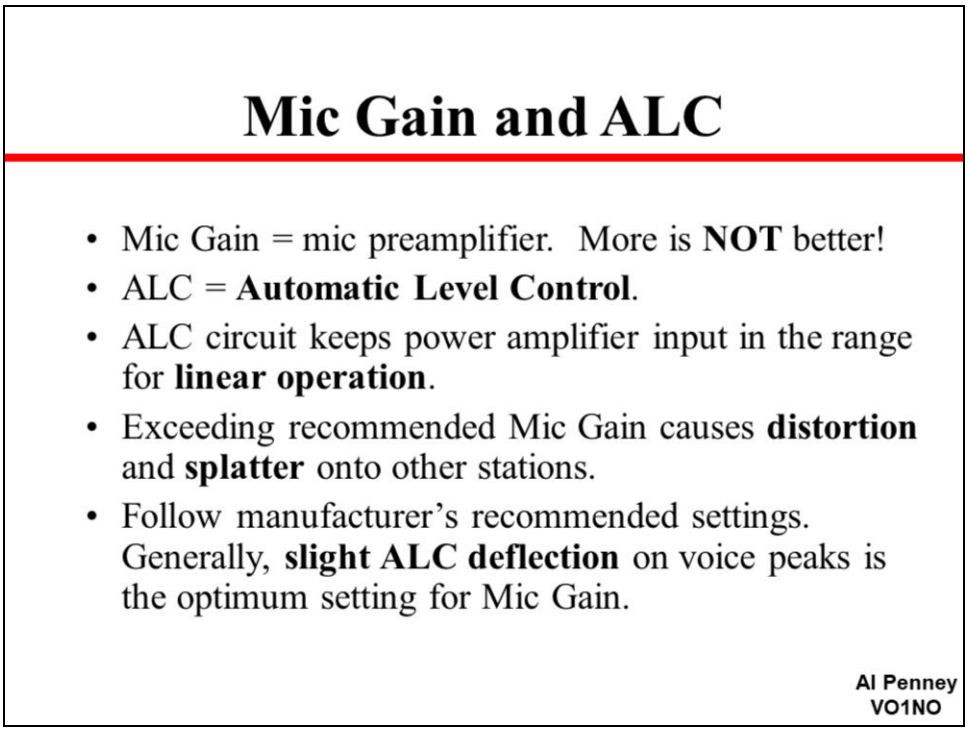
Most VOX circuits have a sensitivity adjustment, but unwanted (and sometimes undetected) VOX triggering can still occur on background noise, heavy breathing or a side conversation. Conversely, it may not activate when desired on speech that is too weak.

The VOX in a two-way radio can also be triggered by the loudspeaker carrying the other side of the conversation. This problem can be minimized with an "anti vox" feature to decrease VOX sensitivity when

the receiver is active.

Transmitters and recorders have short but finite activation times that may clip the beginnings of phrases. Some modern VOX circuits eliminate this problem by recording or transmitting a delayed version of the input signal. An older way of overcoming this, used by pilots, and astronauts, as some of the first users of VOX, was to habitually preface every transmission with "uh" in place of keying the microphone.

VOX uses a "hang" timer, typically 1-3 seconds, to remain engaged during brief speech pauses. This means the last several seconds of each transmission or recorded segment are always silence.



Use An ALC Meter
To Avoid Distortion & Interference

An Automatic Level Control (ALC) circuit governs the signal strength going into the power amplifier in a ham radio transmitter. It keeps the amplifier input in the designed range for linear operation.

Depending on the ALC circuit design and how hard it is driven (by the microphone output level and mic gain setting), the ALC circuit can distort the signal and cause interference.

This article is about how to operate a transmitter at the optimum point—where the average signal level is as high as possible without noticeable distortion or interference. The key is knowing how to use the ALC meter.

Choosing an optimum amount of ALC activity is easy if the radio manufacturer tells you the ideal ALC meter reading. The Elecraft K3, Flex Radios, and Yaesu FT DX-3000D are good examples.

It's not as easy when the recommended range on the ALC meter is wide. You might be tempted to operate at the top of the range for a more powerful signal, but the signal quality may suffer.

This article summarizes practical advice about using an ALC meter from two experts on amateur radio signal quality.

The final section summarizes access to ALC meters for blind and vision-impaired hams.

The article does not apply to digital modes, such as PSK31, that are more sensitive to nonlinearity from ALC action than are voice modes.

Average Power Of SSB Signals

The average power of a typical single sideband signal is much lower than the peak power. For uncompressed speech a typical SSB peak to average power ratio is 14 dB. Audio processing can improve this ratio, but depending on the radio and on voice characteristics, a typical signal peaking at 100 watts might have an average power of only 4 - 10 watts.

A High ALC Reading Is Tempting

G8JNJ found that "with modest ALC action" the average output power from his FT-897D for a single sideband phone signal was 10 dB below a single tone at maximum peak power. By amplifying the audio input and pushing the ALC reading to the top of the scale, he could increase the average power by 3 dB.

Which raises the question, what is the optimum ALC level for your radio?

Signal Distortion

The clarity of your signal depends in part on the particular ALC circuit in the transmitter and how hard it is driven (as indicated by the ALC meter reading).

For radios with a wide recommended range on the ALC meter, W2IHY advises keeping the ALC reading in the lower part of the range to avoid distortion. For example, he reports that Icom 746/756 PRO-series radios can produce noticeable distortion when the ALC reading is in the upper part of the bracketed range on the meter scale.

His warning is borne out by my tests with an IC-746PRO. In Monitor mode I recorded the audio signal from the earphone jack using Audacity software. With the mic gain high enough to drive the ALC reading into the upper third of the range, speech is muffled—noticeably less clear and crisp.

This result matches guidance in the Icom user manual. With the stock Icom HM-36 microphone, the recommended mic gain control setting is between 10 and 12 o'clock. That corresponds to ALC readings in the bottom half of the range bracketed on the meter.

Interference

Interference on adjacent frequencies is another problem with high ALC levels. Your contact will not hear this splatter, but hams operating on nearby frequencies might, and it can show up on a bandscope.

The transceiver testing authority, Rob Sherwood, NC0B, describes in his

Dayton Contest University 2008 video the ALC-caused splatter from his mobile rig at the default settings.

In one test G8JNJ turned up the audio input to his FT-897D so the ALC meter reached the top of the scale. A spectrum analyzer connected to a second radio showed a 20 dB increase in his signal 10 kHz from the carrier. His article includes a photo of the broadened signal spectrum.

Additional Speech Compression

Ideally, compression increases the perceived volume of speech and the average power. However, when G8JNJ fed compressed audio into the FT-897D, phase distortion in the radio triggered the ALC circuit, resulting in minimal improvement in the average power.

By contrast, some hams report their average signal power is 30 watts or more at 100 watts peak power, and they get good signal reports. This demonstrates a wide variation in the performance of speech processors and ALC circuits.

On my Icom 746PRO, mid-range COMP settings (corresponding to low COMP level readings on the multi-meter) cause noticeable distortion of the audio.

Signal Intelligibility

Single sideband audio components in the 1600 - 3200 Hz range have a big effect on signal intelligibility. Some microphones enhance these frequencies, and some radios have built-in equalizer functions. External audio-quality speech enhancers, such as the W2IHY 8 Band Audio Equalizer, are also available.

Conclusions

• The ALC meter is an important tool for finding the best mic gain. Check the operating manual for recommendations. Many, but not all, radios are designed to work best when the ALC meter indicates only minimal activity.

• Both experts advise keeping ALC activity low—setting the mic gain so the meter just shows ALC activity on your voice peaks (eg, 3 - 4 bars on the FT-897D).

• Alternatively, use a wattmeter to find the point where the peak power stops increasing as you turn up the mic gain, and operate just below that gain setting. Note that the average power continues to increase with mic gain, well past the onset of ALC activity. Use the ALC meter, and avoid the temptation to maximize average power.

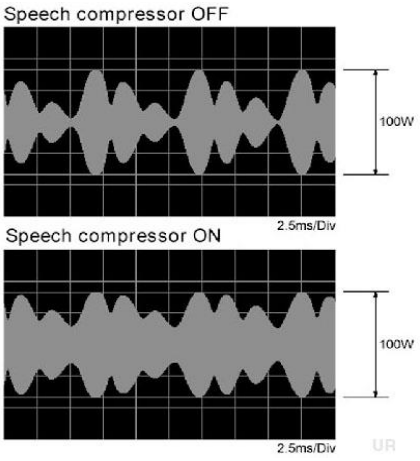
• Speech compression circuits (sometimes called speech processors) can cause distortion that decreases the intelligibility of your signal. G8JNJ advises

turning off compression in the FT-897D unless your signal to noise level is low because of band conditions.

- If possible, use a second radio or the monitor function on your transceiver to listen to recordings of your audio.
- Collect on-air signal reports in a variety of band conditions.

RF Speech Processor

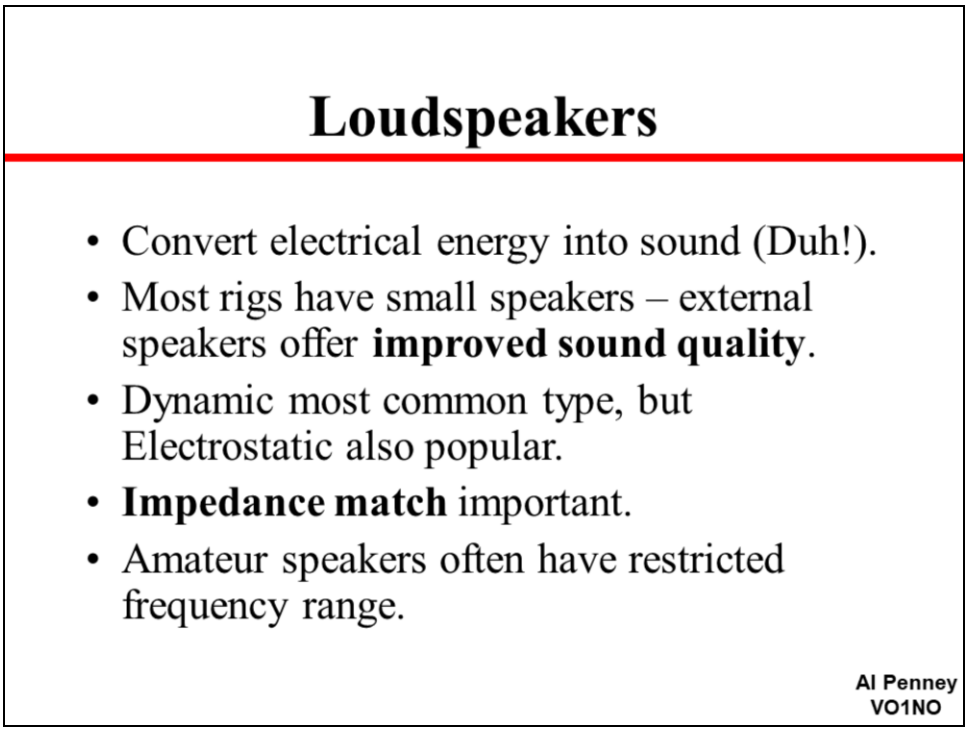
- Increases readability of signal by **increasing average power**.
- **Peak Envelope Power** (PEP) **does not increase**.
- Also called Speech Compressor.
- Do **NOT** overdrive!



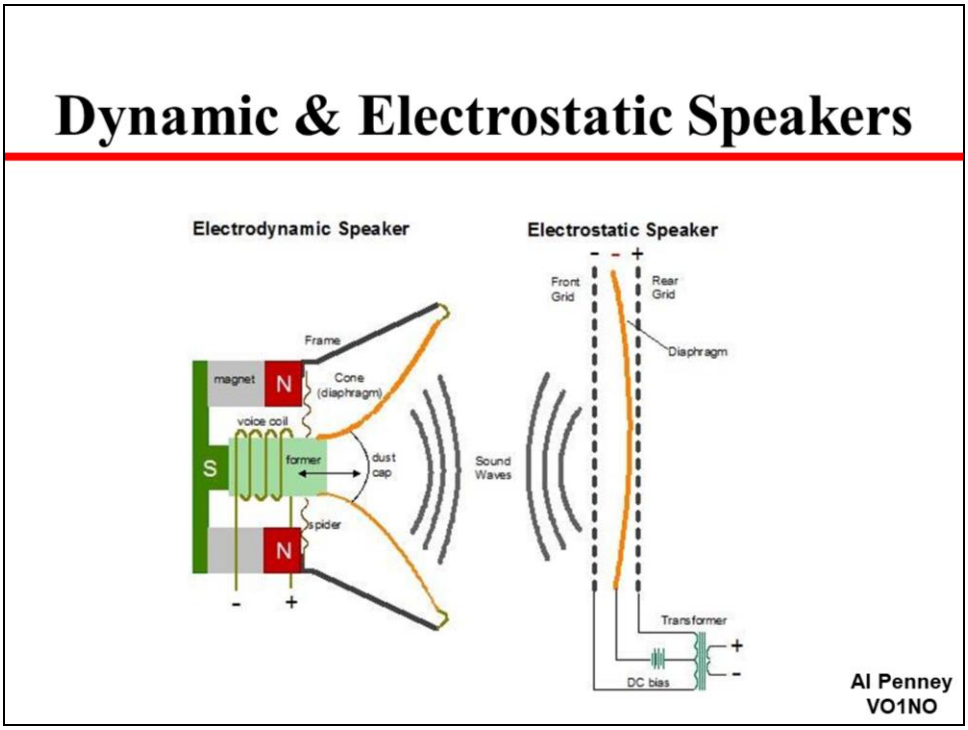
Al Penney
VO1NO

The purpose of an RF speech processor is to increase the readability of your signal at the other end of a QSO. Speech processors do not increase peak power; they increase average power output. An up to 6 dB increase in average power output in SSB service can be achieved with the proper use of a true RF speech processor.

Be careful to follow the manufacturer's instructions for adjusting mic gain and compression, or else the signal will be distorted.



A **loudspeaker** is an electroacoustic transducer; a device which converts an electrical audio signal into a corresponding sound. The most widely used type of speaker in the 2010s is the **dynamic speaker,** invented in 1924 by Edward W. Kellogg and Chester W. Rice. The dynamic speaker operates on the same basic principle as a dynamic microphone, but in reverse, to produce sound from an electrical signal. When an alternating current electrical audio signal is applied to its voice coil, a coil of wire suspended in a circular gap between the poles of a permanent magnet the coil is forced to move rapidly back and forth due to Faraday's law of induction, which causes a diaphragm (usually conically shaped) attached to the coil to move back and forth, pushing on the air to create sound waves. Besides this most common method, there are several alternative technologies that can be used to convert an electrical signal into sound. The sound source (e.g., a sound recording or a microphone) must be amplified or strengthened with an audio power amplifier before the signal is sent to the speaker.



The most common type of driver, commonly called a **dynamic loudspeaker**, uses a lightweight diaphragm, or *cone*, connected to a rigid *basket*, or *frame*, via a flexible suspension, commonly called a *spider*, that constrains a voice coil to move axially through a cylindrical magnetic gap. A protective cap glued in the cone's center prevents dust, especially iron filings, from entering the gap. When an electrical signal is applied to the voice coil, a magnetic field is created by the electric current in the voice coil, making it a variable electromagnet. The coil and the driver's magnetic system interact, generating a mechanical force that causes the coil (and thus, the attached cone) to move back and forth, accelerating and reproducing sound under the control of the applied electrical signal coming from the amplifier.

Electrostatic loudspeakers use a high voltage electric field (rather than a magnetic field) to drive a thin statically charged membrane. Because they are driven over the entire membrane surface rather than from a small voice coil, they ordinarily provide a more linear and lower-distortion motion than dynamic drivers. They also have a relatively narrow dispersion pattern that can make for precise sound-field positioning. However, their optimum listening area is small and they are not very efficient speakers. They have the disadvantage that the

diaphragm excursion is severely limited because of practical construction limitations—the further apart the stators are positioned, the higher the voltage must be to achieve acceptable efficiency. This increases the tendency for electrical arcs as well as increasing the speaker's attraction of dust particles. Arcing remains a potential problem with current technologies, especially when the panels are allowed to collect dust or dirt and are driven with high signal levels.

Electrostatics are inherently dipole radiators and due to the thin flexible membrane are less suited for use in enclosures to reduce low frequency cancellation as with common cone drivers. Due to this and the low excursion capability, full range electrostatic loudspeakers are large by nature, and the bass rolls off at a frequency corresponding to a quarter wavelength of the narrowest panel dimension. To reduce the size of commercial products, they are sometimes used as a high frequency driver in combination with a conventional dynamic driver that handles the bass frequencies effectively.

Electrostatics are usually driven through a step-up transformer that multiplies the voltage swings produced by the power amplifier. This transformer also multiplies the capacitive load that is inherent in electrostatic transducers, which means the effective impedance presented to the power amplifiers varies widely by frequency. A speaker that is nominally 8 ohms may actually present a load of 1 ohm at higher frequencies, which is challenging to some amplifier designs.

Amateur Speakers

Al Penney
VO1NO

Headsets and Speaker Mics

Al Penney
VO1NO


WWAW
Questions

Review Question 1

All amateur stations, regardless of the mode of transmission used, must be equipped with:

- a DC power meter
- an overmodulation indicating device
- a dummy antenna
- a reliable means of determining the operating radio frequency

Al Penney
VO1NO

Review Question 1

All amateur stations, regardless of the mode of transmission used, must be equipped with:

- a DC power meter
- an overmodulation indicating device
- a dummy antenna
- a reliable means of determining the operating radio frequency

< a reliable means of determining the operating radio frequency >

Al Penney
VO1NO

Review Question 2

What is one way to shorten transmitter tune-up time on the air to cut down on interference?

- Tune the transmitter into a dummy load
- Use a long wire antenna
- Tune up on 40 metres first, then switch to the desired band
- Use twin lead instead of coaxial cable transmission lines

Al Penney
VO1NO

Review Question 2

What is one way to shorten transmitter tune-up time on the air to cut down on interference?

- Tune the transmitter into a dummy load
- Use a long wire antenna
- Tune up on 40 metres first, then switch to the desired band
- Use twin lead instead of coaxial cable transmission lines

< Tune the transmitter into a dummy load >

Al Penney
VO1NO

Review Question 3

Which of the following describes full break-in telegraphy (QSK)?

- An operator must activate a manual send/receive switch before and after every transmission
- Breaking stations send the Morse code prosign "BK"
- Incoming signals are received between transmitted Morse code dots and dashes
- Automatic keyers are used to send Morse code instead of hand keys

Al Penney
VO1NO

Review Question 3

Which of the following describes full break-in telegraphy (QSK)?

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- Incoming signals are received between transmitted Morse code dots and dashes
- Automatic keyers are used to send Morse code instead of hand keys

< Incoming signals are received between transmitted Morse code dots and dashes >

Al Penney
VO1NO

Review Question 4

Why is it a good idea to have a way to operate your amateur station without using commercial AC power lines?

- So you may provide communications in an emergency
- So you will comply with rules
- So you may operate in contests where AC power is not allowed
- So you may use your station while mobile

Al Penney
VO1NO

Review Question 4

Why is it a good idea to have a way to operate your amateur station without using commercial AC power lines?

- So you may provide communications in an emergency
- So you will comply with rules
- So you may operate in contests where AC power is not allowed
- So you may use your station while mobile

< So you may provide communications in an emergency >

Al Penney
VO1NO

Review Question 5

What is the most important accessory to have for a hand-held radio in an emergency?

- An extra antenna
- A portable amplifier
- A microphone headset for hands-free operation
- Several sets of charged batteries

Al Penney
VO1NO

Review Question 5

What is the most important accessory to have for a hand-held radio in an emergency?

- An extra antenna
- A portable amplifier
- A microphone headset for hands-free operation
- Several sets of charged batteries

< Several sets of charged batteries >

Al Penney
VO1NO

Review Question 6

A low pass filter in an HF station is most effective when connected:

- as close as possible to the antenna
- midway between the transceiver and antenna
- as close as possible to the transceiver output
- as close as possible to the antenna tuner output

Al Penney
VO1NO

Review Question 6

A low pass filter in an HF station is most effective when connected:

- as close as possible to the antenna
- midway between the transceiver and antenna
- as close as possible to the transceiver output
- as close as possible to the antenna tuner output

< as close as possible to the transceiver output >

Al Penney
VO1NO

Review Question 7

A low pass filter in an HF station is most effective when connected:

- as close as possible to the antenna tuner output
- as close as possible to the linear amplifier input
- as close as possible to the linear amplifier output
- as close as possible to the antenna

Al Penney
VO1NO

Review Question 7

A low pass filter in an HF station is most effective when connected:

- as close as possible to the antenna tuner output
- as close as possible to the linear amplifier input
- as close as possible to the linear amplifier output
- as close as possible to the antenna

< as close as possible to the linear amplifier output >

Al Penney
VO1NO

Review Question 8

Which component in an HF station is the most useful for determining the effectiveness of the antenna system?

- Linear amplifier
- Dummy load
- SWR bridge
- Antenna switch

Al Penney
VO1NO

Review Question 8

Which component in an HF station is the most useful for determining the effectiveness of the antenna system?

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- Dummy load
- SWR bridge
- Antenna switch

< SWR bridge >

Al Penney
VO1NO

Review Question 9

Of the components in an HF station, which component would normally be connected closest to the antenna, antenna tuner and dummy load?

- Transceiver
- Low pass filter
- SWR bridge
- Antenna switch

Al Penney
VO1NO

Review Question 9

Of the components in an HF station, which component would normally be connected closest to the antenna, antenna tuner and dummy load?

- Transceiver
- Low pass filter
- SWR bridge
- Antenna switch

< Antenna switch >

Al Penney
VO1NO

Review Question 10

Of the components in an HF station, which component would be used to match impedances between the transceiver and antenna?

- SWR bridge
- Antenna tuner
- Antenna switch
- Dummy load

Al Penney
VO1NO

Review Question 10

Of the components in an HF station, which component would be used to match impedances between the transceiver and antenna?

- SWR bridge
- Antenna tuner
- Antenna switch
- Dummy load

< Antenna tuner >

Al Penney
VO1NO

Review Question 11

In an HF station, which component is temporarily connected in the tuning process or for adjustments to the transmitter?

- Low pass filter
- Antenna tuner
- Dummy load
- SWR bridge

Al Penney
VO1NO

Review Question 11

In an HF station, which component is temporarily connected in the tuning process or for adjustments to the transmitter?

- Low pass filter
- Antenna tuner
- Dummy load
- SWR bridge

< Dummy load >

Al Penney
VO1NO

Review Question 12

In an HF station, the antenna tuner is usually used for matching the transceiver with:

- most antennas when operating below 14 MHz
- most antennas when operating above 14 MHz
- mono-band Yagi type antennas
- tri-band Yagi antennas

Al Penney
VO1NO

Review Question 12

In an HF station, the antenna tuner is usually used for matching the transceiver with:

- most antennas when operating below 14 MHz
- most antennas when operating above 14 MHz
- mono-band Yagi type antennas
- tri-band Yagi antennas

< most antennas when operating below 14 MHz >

Al Penney
VO1NO

Review Question 13

In an amateur digital radio system, the interfaces with the computer ___.

- transceiver
- input/output
- antenna
- power supply

Al Penney
VO1NO

Review Question 13

In an amateur digital radio system, the interfaces with the computer ___.

- transceiver
- input/output
- antenna
- power supply

< input/output >

Al Penney
VO1NO

Review Question 14

In an amateur digital radio system, the modem is connected to the ___.

- amplifier
- antenna
- input/output
- computer

Al Penney
VO1NO

Review Question 14

In an amateur digital radio system, the modem is connected to the ___.

- amplifier
- antenna
- input/output
- computer

< computer >

Al Penney
VO1NO

Review Question 15

In an amateur digital radio system, the transceiver is connected to the ___.

- input/output
- modem
- computer
- scanner

Al Penney
VO1NO

Review Question 15

In an amateur digital radio system, the transceiver is connected to the ___.

- input/output
- modem
- computer
- scanner

< modem >

Al Penney
VO1NO

Review Question 16

In an amateur digital radio system, the audio connections of the modem/sound card modem are connected to the ___ .

- transceiver
- input/output
- scanner
- antenna

Al Penney
VO1NO

Review Question 16

In an amateur digital radio system, the audio connections of the modem/sound card modem are connected to the ___ .

- transceiver
- input/output
- scanner
- antenna

< transceiver >

Al Penney
VO1NO

Review Question 17

In an amateur digital radio system, the modem function is often performed by the computer ___.

- sound card
- keyboard
- scanner
- serial port

Al Penney
VO1NO

Review Question 17

In an amateur digital radio system, the modem function is often performed by the computer ___.

- sound card
- keyboard
- scanner
- serial port

< sound card >

Al Penney
VO1NO

Review Question 18

One result of a slight mismatch between the power amplifier of a transmitter and the antenna would be:

- lower modulation percentage
- radiated key-clicks
- reduced antenna radiation
- smaller DC current drain

Al Penney
VO1NO

Review Question 18

One result of a slight mismatch between the power amplifier of a transmitter and the antenna would be:

- lower modulation percentage
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- smaller DC current drain

< reduced antenna radiation >

Al Penney
VO1NO

Review Question 19

The input power to the final stage of your transmitter is 200 watts and the output is 125 watts. What has happened to the remaining power?

- It has been used to provide positive feedback
- It has been dissipated as heat loss
- It has been used to provide greater efficiency
- It has been used to provide negative feedback

Al Penney
VO1NO

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< It has been dissipated as heat loss >

Al Penney
VO1NO

Review Question 20

What may happen if an SSB transmitter is operated with the microphone gain set too high?

- It may cause atmospheric interference in the air around the antenna
- It may cause digital interference to computer equipment
- It may cause splatter interference to other stations operating near its frequency
- It may cause interference to other stations operating on a higher frequency band

Al Penney
VO1NO

Review Question 20

What may happen if an SSB transmitter is operated with the microphone gain set too high?

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• It may cause interference to other stations operating on a higher frequency band

< It may cause splatter interference to other stations operating near its frequency >

Al Penney
VO1NO

Review Question 21

How should the microphone gain control be adjusted on a single-sideband phone transmitter?

- For slight movement of the ALC meter on modulation peaks
- For full deflection of the ALC meter on modulation peaks
- For 100% frequency deviation on modulation peaks
- For a dip in plate current

Al Penney
VO1NO

Review Question 21

How should the microphone gain control be adjusted on a single-sideband phone transmitter?

- For slight movement of the ALC meter on modulation peaks
- For full deflection of the ALC meter on modulation peaks
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- For a dip in plate current

< For slight movement of the ALC meter on modulation peaks >

Al Penney
VO1NO

Review Question 22

The automatic level control (ALC) in a SSB transmitter:

- reduces the system noise
- controls the peak audio input so that the final amplifier is not overdriven
- reduces transmitter auto feedback
- increases the occupied bandwidth

Al Penney
VO1NO

Review Question 22

The automatic level control (ALC) in a SSB transmitter:

- reduces the system noise
- controls the peak audio input so that the final amplifier is not overdriven
- reduces transmitter auto feedback
- increases the occupied bandwidth

< controls the peak audio input so that the final amplifier is not overdriven >

Al Penney
VO1NO

Review Question 23

What may your FM hand-held or mobile transceiver do if you shout into its microphone and the deviation adjustment is set too high?

- It may cause atmospheric interference in the air around the antenna
- It may cause interference to other stations operating on a higher frequency band
- It may cause interference to other stations operating near its frequency
- It may cause digital interference to computer equipment

Al Penney
VO1NO

Review Question 23

What may your FM hand-held or mobile transceiver do if you shout into its microphone and the deviation adjustment is set too high?

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• It may cause interference to other stations operating on a higher frequency band

• It may cause interference to other stations operating near its frequency

• It may cause digital interference to computer equipment

< It may cause interference to other stations operating near its frequency >

Al Penney
VO1NO

Review Question 24

What is the result of overdeviation in an FM transmitter?

- Increased transmitter range
- Poor carrier suppression
- Out-of-channel emissions
- Increased transmitter power

Al Penney
VO1NO

Review Question 24

What is the result of overdeviation in an FM transmitter?

- Increased transmitter range
- Poor carrier suppression
- Out-of-channel emissions
- Increased transmitter power

< Out-of-channel emissions >

Al Penney
VO1NO

Review Question 25

You are transmitting FM on the 2 metre band. Several stations advise you that your transmission is loud and distorted. A quick check with a frequency counter tells you that the transmitter is on the proper frequency. Which of the following is the most probable cause of the distortion?

- The repeater is reversing your sidebands
- The frequency counter is giving an incorrect reading and you are indeed off frequency
- The frequency deviation of your transmitter is set too high
- The power supply output voltage is low

Al Penney
VO1NO

Review Question 25

You are transmitting FM on the 2 metre band. Several stations advise you that your transmission is loud and distorted. A quick check with a frequency counter tells you that the transmitter is on the proper frequency. Which of the following is the most probable cause of the distortion?

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- The power supply output voltage is low

< The frequency deviation of your transmitter is set too high >

Al Penney
VO1NO

Review Question 26

What do many amateurs use to help form good Morse code characters?

- A key-operated on/off switch
- A notch filter
- A DTMF keypad
- An electronic keyer

Al Penney
VO1NO

Review Question 26

What do many amateurs use to help form good Morse code characters?

- A key-operated on/off switch
- A notch filter
- A DTMF keypad
- An electronic keyer

< An electronic keyer >

Al Penney
VO1NO

Review Question 27

Why might a dummy antenna get warm when in use?

- Because it stores electric current
- Because it changes RF energy into heat
- Because it absorbs static electricity
- Because it stores radio waves

Al Penney
VO1NO

Review Question 27

Why might a dummy antenna get warm when in use?

- Because it stores electric current
- Because it changes RF energy into heat
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- Because it stores radio waves

< Because it changes RF energy into heat >

Al Penney
VO1NO

Review Question 28

What is the circuit called which causes a transmitter to automatically transmit when an operator speaks into its microphone?

- VFO
- VOX
- VXO
- VCO

Al Penney
VO1NO

Review Question 28

What is the circuit called which causes a transmitter to automatically transmit when an operator speaks into its microphone?

- VFO
- VOX
- VXO
- VCO

< VOX >

Al Penney
VO1NO

Review Question 29

What is the reason for using a properly adjusted speech processor with a single-sideband phone transmitter?

- It reduces average transmitter power requirements
- It reduces unwanted noise pickup from the microphone
- It improves voice frequency fidelity
- It improves signal intelligibility at the receiver

Al Penney
VO1NO

Review Question 29

What is the reason for using a properly adjusted speech processor with a single-sideband phone transmitter?

- It reduces average transmitter power requirements
- It reduces unwanted noise pickup from the microphone
- It improves voice frequency fidelity
- It improves signal intelligibility at the receiver

< It improves signal intelligibility at the receiver >

Al Penney
VO1NO

Review Question 30

If a single-sideband phone transmitter is 100% modulated, what will a speech processor do to the transmitter's power?

- It will increase the output PEP
- It will decrease the peak power output
- It will decrease the average power output
- It will add nothing to the output Peak Envelop Power (PEP)

Al Penney
VO1NO

Review Question 30

If a single-sideband phone transmitter is 100% modulated, what will a speech processor do to the transmitter's power?

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- It will decrease the average power output
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< It will add nothing to the output Peak Envelop Power (PEP)>

Al Penney
VO1NO

Review Question 31

Which of the following components could be used as a dynamic microphone?

- Capacitor
- Loudspeaker
- Crystal earpiece
- Resistor

Al Penney
VO1NO

Review Question 31

Which of the following components could be used as a dynamic microphone?

- Capacitor
- Loudspeaker
- Crystal earpiece
- Resistor

< Loudspeaker >

Al Penney
VO1NO

Review Question 32

In an AX.25 packet-radio operation, what equipment connects to a terminal-node controller?

- A DTMF keypad, a monitor and a transceiver
- A DTMF microphone, a monitor and a transceiver
- A transceiver, a computer and possibly a GPS system
- A transceiver and a modem

Al Penney
VO1NO

Review Question 32

In an AX.25 packet-radio operation, what equipment connects to a terminal-node controller?

- A DTMF keypad, a monitor and a transceiver
- A DTMF microphone, a monitor and a transceiver
- A transceiver, a computer and possibly a GPS system
- A transceiver and a modem

< A transceiver, a computer and possibly a GPS system >

Al Penney
VO1NO

Review Question 33

How could you best keep unauthorized persons from using your amateur station at home?

- Put a "Danger - High Voltage" sign in the station
- Put fuses in the main power line
- Use a key-operated on/off switch in the main power line
- Use a carrier-operated relay in the main power line

Al Penney
VO1NO

Review Question 33

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- Use a carrier-operated relay in the main power line

< Use a key-operated on/off switch in the main power line >

Al Penney
VO1NO

Review Question 34

How could you best keep unauthorized persons from using a mobile amateur station in your car?

- Turn the radio off when you are not using it
- Put a "Do not touch" sign on the radio
- Disconnect the microphone when you are not using it
- Tune the radio to an unused frequency when you are done using it

Al Penney
VO1NO

Review Question 34

How could you best keep unauthorized persons from using a mobile amateur station in your car?

- Turn the radio off when you are not using it
- Put a "Do not touch" sign on the radio
- Disconnect the microphone when you are not using it
- Tune the radio to an unused frequency when you are done using it

< Disconnect the microphone when you are not using it >

Al Penney
VO1NO

For Next Class:

- Review Chapter 11 of Basic Study Guide;
- Read Chapter 12 of Basic Study Guide; and
- Review the regulations.

Al Penney
VO1NO


WWW
Questions