

# Practical Radio Application

*“for new technician licensees”*



Written by K4OCD

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# **Practical Radio Application**

## *“for new technician licensees’ ”*

**CQ CQ CQ Calling all newly licensed amateurs...**

**Great! You have a new technician class license... now what?**

**Well if it wasn't enough learning all the information required to pass the FCC element 2 for technician license privileges, implementing the knowledge is almost a daunting task. If you are feeling overwhelmed, you're not alone!**

**The concept for this orientation came about from the many questions asked over the course of several technician level classes I have participated in. The goal is to expand on what you have already learned, assisting you in evaluating equipment, features and specifications as well as to teach you basic operation and communication skills on simplex and repeater frequencies using your new frequency privileges.**

**The focus throughout is on currently available equipment, trends and technology most commonly used by technician class operators in the VHF/UHF bands. To that extent we will discuss radios, power sources, antennas, feed lines and connectors. We will also discuss your first QSO (conversation); how to call someone and how to answer a call; as well as net operations and “net-etiquette”. Lastly you will find useful information such as the local repeater frequencies and settings, club membership and meeting schedules.**

**It is my hope that this information will open the doors to amateur radio and you will find it a fun, useful and rewarding hobby!**

**73 - Jeremy K4OCD**

**Let's jump right in! You want a radio... but which one?**

## Radios: (Transceivers)

**HT (“Handy Talkie”)** – The term handie talkie originated from Motorola when they introduced a portable hand held transceiver. Referred to as portables, hand held radios or simply an “HT”; these radios are all-in-one solutions and are great for new amateurs. Operation is as simple as having a charged battery, tuning to the desired frequency, setting a tone or offset if required and pressing the PTT button (push to talk) to TX (transmit). HTs prove valuable in emergencies where immediate use is needed (i.e. no setup time) and when participating in community activities where mobility is essential. HTs do however come with some limitations, for instance HT to HT range is limited due to antenna characteristics such as gain loss and elevation. Additionally, they have limited power output; this is why they are often associated with repeater use where the RX (receiving station) has a significantly elevated antenna.

**Pros** – All-in-one solution - transceiver, power supply and antenna, Portable

**Cons** – Limited power output (range) characteristic Static and/or “dropping out”,  
Battery life

**Type** – Most common

mono-band (2m (aka 146mhz)), **dual-band (2m/70cm (aka 440mhz))**,  
Tri-band (2m/70cm + 6m (54mhz) or 1.25m (220mhz)) There are even HTs capable of doing 4 bands (6m, 2m, 1.25m and 70cm with output limitations, example is the Yaesu VX-7r which is 5W except on 220 which is 300mW)

2m (VHF)– most common frequency for local communications

70cm/440mhz (UHF)– second most common frequency for local communications and cross band repeat applications like shelter operations

6m/54mhz (VHF)– offers propagation for DX “type” communications however limited to AM/FM mode with an HT as they do not normally offer TX on SSB. Some HTs do RX SSB

1.25m/220mhz (VHF)– similar to 2m however rarely used and few HTs offer this frequency.

**Batteries** – (see power supplies / batteries)

**Accessories** – speaker/mic, headset, “AA” battery holder, rapid charger/dock, car plug/charger

**Activity** – Compare features between 2 HTs – Understand each specification, note each item that is superior and inferior between the 2 units. Look carefully at features, accessories and battery options. Other considerations might be ease of and adaptability to your specific desired use. To that end, one might choose to download the owner’s manual from the manufacturer’s web page to better compare the units. Skimming through the owner’s manual (often downloadable from the manufacturer’s website) can offer great insight to the unit’s functionality and operation characteristics.

<b>Feature</b>	<b>Brand A</b>	<b>Brand B</b>
<b>Price</b>		
<b>Band</b>		
<b>Mode</b>		
<b>Memory</b>		
<b>Power (input)</b>		
<b>Battery Type</b>		
<b>Batt Volts / mAh</b>		
<b>Charge Time (rapid charger)</b>		
<b>RX Consumption</b>		
<b>TX Consumption (High)</b>		
<b>TX Pwr Output (13.8v)</b>		
<b>RX Image Rejection</b>		
<b>RX Sensitivity VHF/UHF</b>		
<b>Audio Output</b>		
<b>Squelch Type</b>		
<b>Antenna Connector</b>		
<b>Size (w x h x d ) exc. antenna</b>		
<b>Weight</b>		
<b>Pros</b>		
<b>Neutral</b>		
<b>Cons</b>		

**Mobile** – Mobile radios offer significantly more power output and therefore range while being comparable to HTs in price however they are not all-in-one solutions. Mobile radios require the additional purchase of an antenna and feed line as well as an external power supply. Most mobile radios are single and dual band 2m and 70cm while some multi-mode mobiles offer HF.

**Pros** – More power output than HT (more range)

**Cons** – Requires external power source and antenna, not as portable

**Installation options** – many mobile radios have removable control units for dash mount, while the radio may be installed under a seat or in the trunk, can be used as a base unit

*High end mobile units like the iCom IC-706MKIIg and Yaesu FT-857 or 897 are suitable for base/mobile/portable use as well as multi-mode operation (HF, VHF, UHF – AM, FM, SSB, CW)*

**Multi-mode (mobile)** – Multi-mode radios are those that offer additional functionality in communications such as AM, CW and SSB as well as FM as in the previously listed radios. Most multi-mode radios are suited for HF, VHF and UHF communications and are an excellent choice for mobile as well as base operations for those amateurs that will be upgrading in licenses class and plan to work HF. Like mobile and base radios, they require the addition of an antenna and power supply.

**Pros** – Multi mode operation, HF for future license privilege upgrade

**Cons** – Expensive over mobile FM radios

**Base** – Base station radios are generally geared toward HF and are large and not very portable. They offer many of the same features as mobile and multi-mode units while adding functional advantages such as better ergonomics, easier accessibility to radio control functions and more power. *(future discussion topic)*

**Amplifiers** – Amplifiers are available for HTs, Mobile and Base stations, from solid state to tube, double digit wattage increase to kilowatts. If your operating location is in a fringe area, you might opt to purchase an “amp” and use with an external antenna. Of course an external antenna is a must for RF safety. See [www.mirageamp.com](http://www.mirageamp.com) for more information on inexpensive solid state amps. *(future discussion topic)*

## **Programming Considerations -**

**Squelch** – The squelch function is used to suppress receiver noise. An open squelch is one where all noise is heard. Some radios employ an auto squelch where the squelch level or threshold is managed to eliminate the ambient RF noise. Most mobile and base as well as some HTs use a analog squelch dial to adjust the cutoff level. Generally speaking, to set the squelch of your radio, you would turn the dial counterclockwise to open the squelch, once you hear the ambient noise, turn the knob clockwise to just past the point the noise is cutoff. You have now set the squelch.

**Offset** – Offset is used to allow receive audio on one frequency while transmitting on another, this function is usually used in repeater operation. (see also - the frequencies chapter)

**Tone** – Used most often with repeaters to signal the repeater to accept and retransmit the transmission. A tone can also be used in simplex operation to activate the RX of a radio employing the tone-squelch function. This allows the radio to block all receiver noise and only activate receive audio when the specified tone is present. (see also - the frequencies chapter)

## **Additional Thoughts –**

Avoid using a repeater frequency for general testing of your equipment other than to test access to that specific repeater.

Always set your radio to an unused simplex frequency when programming your equipment. Specifically Yaesu HTs as they require the PTT button for exiting certain menus. It's very easy to make mistakes, ie. an unidentified transmission.

Observe the band plan in the frequencies you operate. Share the air! Keep transmissions short and allow others to use the frequency / repeater. Remember, this is a common hobby we all share.

Check your HT battery voltage and be sure batteries are always charged and ready for use. A common mistake with HTs is low battery voltage. The tell tale sign is “dropping out” on transmission.

Do not transmit without an antenna or a “dummy load” attached to your transceiver. Doing so could damage the PA circuit (power amplifier). A dummy load is a 50ohm load that converts RF energy to heat, thereby allowing testing of the transmitter without RF transmission.

HT antennas have limited power ratings, generally 10 watts or less. Do not use an HT antenna on mobile or amplified radios unless they output less than 10 watts.

Observe RF safety; do not transmit with high wattages in close proximity of people / animals. Never touch an antenna when transmitting.

## Power supplies

**Linear** – Larger, heavier and more expensive power supply. Generally offer 13.8v with many having variable power output adjustments and rated by amps. These are designed to transform A/C to D/C in a very clean manner with little to no electrical noise. Due to the nature of the conversion process, these power supplies are less efficient and produce more heat than switching supplies.

**Switching** – Small, light and lesser expensive type of power supply. Generally offer 13.8v and are rated by amps output. Due to their conversion process, switching supplies are more efficient and generate less heat than linear supplies.

**Peak Output** – Choosing your power supply is easy. Decide the item or items that you will power, calculate the maximum current each item will draw adding the total and choose a supply that will peak to that amperage. Practically speaking, when connecting 2 radios, while transmitting on one, you most likely won't be on the other and therefore may discount for that.

**Volts** – 13.8 volts is the most common voltage in ham radio. This is due to the “float” and charging voltage of a lead acid battery, allowing ham radio equipment to be designed and work universally in a portable environment. This is commonly referred to as a 12 volt system. Radio equipment generally will work within a range as stated by the manufacturer from a voltage slightly below 12 volts to one above 13.8, often as high as 16 volts.

**Amps, Ah & mAh** – Ampere, the measure of current. The amp hour / milliamp hour is a very helpful measure of “capacity” when talking about batteries. The measure is simple, take the current consumption of a device (written in the radios specifications) say 19mA (from the Yaesu FT-60r power save on standby), now simply divide the battery capacity as rated (the FT-60r NiMH is rated at 1400 mAh) by the consumption which will equal 73.68 hours. Now that's assuming the radio is only on, not scanning, and not receiving any signals. Let's look at TX, the FT-60r specifications note a 1.3A consumption on transmit at 5w, therefore the same 1400 mAh battery will be exhausted in 1 hour (remember 1.3 A is 1300 mA) of continuous transmit. Of course you won't be continuously transmitting but this gives you the theory behind calculating the capacity of a battery.

The advantage to this simplistic approach to judging battery life is this; the capacity of any given battery will differ depending on the battery voltage. For instance a 9.6 volt 650 mAh battery will perform equally with a 7.2 volt 850 mAh battery given the radio has the same power / consumption specifications. So as you can see, looking solely at the battery capacity in mAh will not net a realistic result with regard to the battery life.

So with that said, let's look at batteries:

## Batteries –

**Alkaline** – 1.5 volts per cell – Up to 10x the Ah capacity of rechargeables - One time use, store bought, readily available. Compared to rechargeable, they are expensive to use over time, the advantage is availability. Anyone serious about EmComm should consider having a portable / HT and a “AA” battery holder for backup.

**NiCd** – 1.2 volts per cell – “old” style rechargeable battery technology. Limited life, i.e. limited recharge cycles. They also have “memory effect” that greatly reduces their capacity over time. The best way to extend the life of a NiCd and prevent significant “memory” effect is to fully discharge the battery before charging each time.

**NiMH** – 1.2 volts per cell – NiMH is an advancement on the NiCd with up to 40% more capacity (Ah) over NiCd for the same physical size. They also provide longer service life and offer a much higher resistance to “memory effect”. They can also tolerate 3 – 4x more charge cycles than NiCd.

**LiIon** – 3.6 volts per cell – The newest chemistry / battery technology commercially available. They have a higher capacity in Ah and a higher per cell voltage than the NiCd and NiMh batteries while weighing in at some 30% less. They have significant tolerance to recharge cycles and poses no “memory effect”. In amateur radio, the primary advantage is the significantly smaller radio size but this comes with a disadvantage as noted below.

*Note – An advantage of an HT with a NiCd or NiMH battery pack for EmComm use is this; when using “AA” batteries as a backup power source, the HT will perform similar to the factory specification with regard to power output due to the similarity in the number of and rated voltage of each cell. Compared to a LiIon unit that might have only 2 cells (7.4 volts) to achieve the same voltage with “AA” would require 6 cells, which would not be physically possible to install in the radio. Currently available radios using LiIon offer a 2 cell “AA” holder, that’s 2 cells or 3 volts on Alkaline power, or worse 2.4 volts for NiCad or NiMH... this results in a minimal power output and reduced functionality, realistically speaking... monitoring capabilities only unless you are within range of the receiving party using the lowest output setting of the radio.*

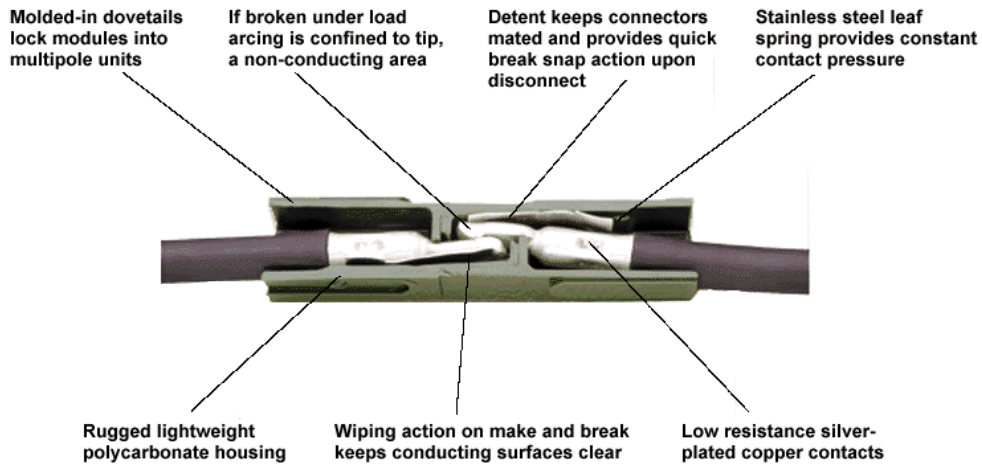
**AGM (absorbent Glass Mat), Gel and “Flooded” Lead Acid** batteries are all similar in that they have 2 volts per cell and are desirable for applications where a “ready state” is necessary. A “ready state” is where the battery is constantly under charge aka “float”. The “float” is the state of charge where the battery is held at a constant voltage, usually with no or minimal current draw, thereby maintaining the battery at its “full” capacity. They are also suitable for applications with high current requirements such as multiple radios and equipment or HF units with high wattage outputs.

**AGM** – “Absorbent Glass Mat” batteries are sealed, non-spillable and maintenance free. Made up of a fiberglass like separator, they are highly tolerant to vibration and can be placed at any angle or on their side. AGMs offer higher Ah capacities than the flooded lead acid type in the same physical size; when specified, can be “deep discharged” (that is, one can discharge the battery to some 25% of its rated capacity without significant harm to the cells) and are safe for indoor use as they are “recombinant” or convert the gas formed during charging back to water with an efficiency of 99+%. This also means they emit a very small amount of gas and are therefore safe in unventilated spaces.

**Gel** – Similar to the AGM, the Gel cell battery is sealed, usually non-spillable unless physically damaged and are maintenance free. They use a gel in place of the fiberglass as found in the AGM. As with AGM they are capable of deep discharge when specified and are generally safe for indoor use.

**Flooded Lead Acid** – Are the most common of all lead acid batteries. They are the same type of battery found in automobiles and are designed to be in a “ready state”. They are capable of high loads, such as found in starting a car but do not generally tolerate “deep discharging” as this will damage the cells unless noted by the manufacturer. Unlike AGM and Gel, they are not sealed and care must be taken so as not to spill the acid contents. They also emit gas when charging and are not generally suitable for indoor unventilated use. Maintenance usually consists of adding distilled water to the cells as it evaporates during charge cycles.

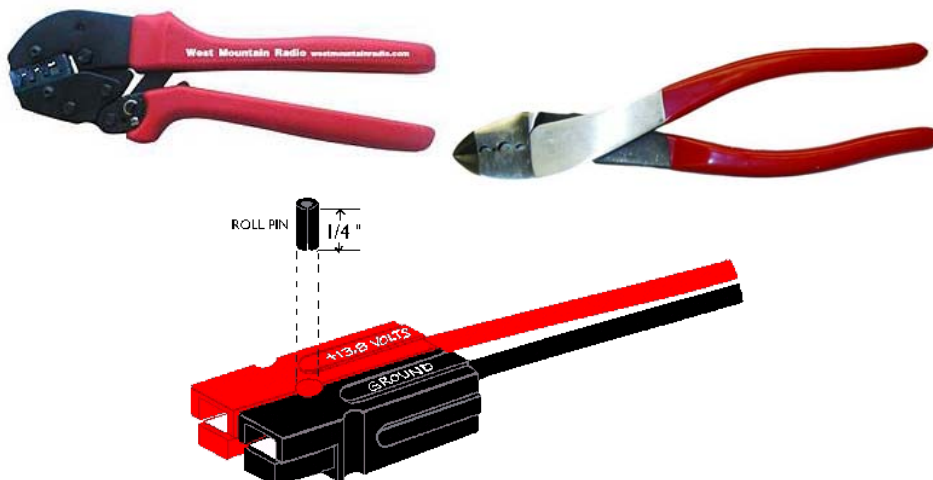
**Power Poles** – The Anderson Power Pole was designed to provide a reliable, universal, interoperable connector for high current devices. The main advantages of Power Poles in the “shack” (that’s your QTH or home station) are that once implemented, all of your gear, regardless of manufacturer, will work universally from whatever power supply you choose. Equipment can thus be readily transported from “shack” to mobile to portable (on location) between a line voltage power supply to battery without connector incompatibility. Power Poles have also been adopted by the ARES/RACES nationally as the EmComm connector of choice and presumably, all equipment will one day be universally powered as such.



**Pros** – Universal (anticipated), long life connectors (high resistance to repetitive use), high amperage ratings, easy to adapt and use.

**Cons** – Investment in connectors and crimp tool, conversion of existing connectors add to the expense.

See <http://www.andersonpower.com/products/pp/sp.html> for more information or you may find practical applications and purchase power poles and supplies from <http://www.powerwerx.com/>



**Antennas** – Your radio is only as good as the antenna that’s attached to it. This section is probably the most technical throughout this document but the information is crucial in your selecting the best antenna for your application.

**Application** – Will the antenna be connected to an HT / portable, Mobile, Base or a combination of them?

**Safety first** – If you will be installing a base or stationary antenna outdoors, be sure to ground the antenna properly. In addition to grounding, you may also choose to disconnect the antenna when not in use to further protect your equipment. A ground can be as simple as installing an 8’ copper clad rod into the soil below the antenna and running a short ground strap to the ground side of the antenna, usually the bracket that supports the antenna. But to better protect from lightning, you may also desire addition protection such as DC blocking lightning arrestors, gas discharge inline coax fuses or more elaborate grounding systems such as balancing the grounds between the antenna and the primary earth ground of the electrical system your equipment is attached to. “An ounce of prevention is worth a pound of cure”... so look into it and investigate your options, Polyphaser listed below has technical discussions online that may help to further explain the characteristics of lightning and ways to prevent or tolerate a strike.

(See [www.polyphaser.com](http://www.polyphaser.com) also [www.cushcraft.com](http://www.cushcraft.com) (under commercial, catalog, accessories - lightning arresters))

**Polarization** – Next look at the polarization you will need to communicate. Generally speaking, in the VHF/UHF bands vertical is almost exclusively used. One exception is with satellite operation where a circular or cross polarized beam may be used. Horizontal polarization is most common with HF contacts while a vertical orientation will still net acceptable results.

Vertical (HT/Portable, Mobile, Base – UHF/VHF some HF)

Horizontal (Base, special portable – HF)

Circular (Cross polarized yagi – UHF/VHF – Sat use)

**Band coverage** – HF, VHF, UHF – Mono-band, Dual-band, Tri-band, Quad-band, etc.

**Types** – Listed are the most common antenna designs and polarization

**HT** – An HT or “rubber duck” antenna is a vertical polarized –dB gain antenna. A full size antenna will always out perform the antenna supplied with your HT. Note that HT antennas are designed for the rated output of the transceiver and it’s not advisable to use them on radios that output over 5 watts unless power output is set properly.

**Vertical (collinear)** – Vertically polarized and omni-directional (omni-directional means the antenna performs equally well in a 360 degree radius). Usually require a ground plane unless tuned to a 1/2 wave length.

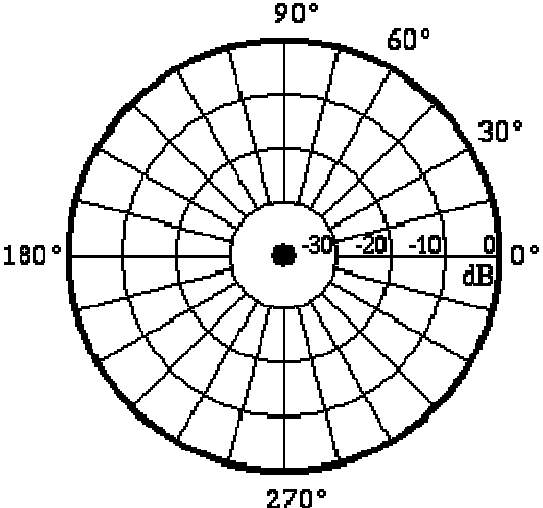
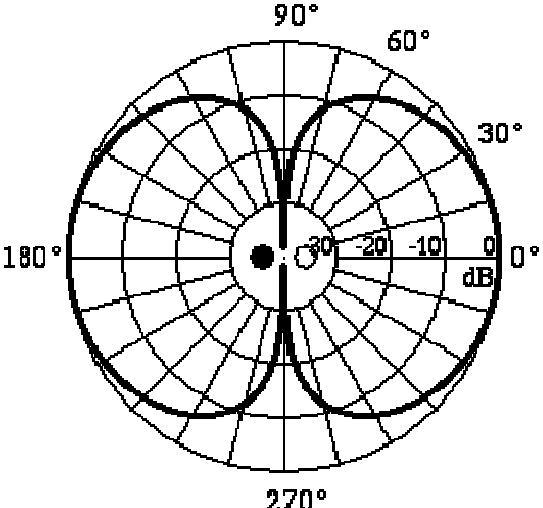
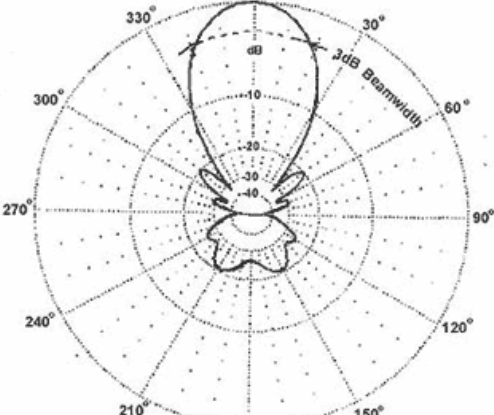
**J-Pole** – “J” shaped hence the name, this is an easy antenna to build using copper plumbing. Rugged and dependable, the J-Pole is a good antenna for field use such as shelter operations or on-location emergencies. The J-Pole does not require a ground plane and can be mounted at or near ground level.

**Dipole** – A dipole is a relatively simple antenna, using a center feed point and typically cut to 1/2 wave length. The directivity (RF pattern) is perpendicular to the length and are most commonly used in the horizontal phase. Not requiring a ground plane, the radiation pattern and SWR values are significantly effected based on distance to ground. As a rule of thumb, one should mount a dipole at least a 1/2 wave length from ground unless a high takeoff angle is desired such as “local” HF use. (Cloud burning)

**Yagi** – The yagi is a “beam” antenna in that the driven element, reflector and directors are mounted to a beam in the direction of radiation. These can be vertical, horizontal or cross (circular) polarized. The primary advantage to a yagi is that they can focus the RF in one direction while significantly reducing emission and/or reception from the sides or behind. This is beneficial when requiring significant gain or when communicating with a station in a known direction.

**Other Types** – Cubical Quad, Dicone, Wire, etc.

Simplistic look at radiation patterns

	<p>Vertical (Collinear) Omni-directional</p>
	<p>Dipole Bi-directional</p>
	<p>Yagi Uni-directional</p>

**Ground Plane** - A ground plane is a conductive surface that is at the base and perpendicular to the antenna in use, usually required with vertical antennas that are not 1/2 wave length. The ground plane influences the radiation pattern in that it reduces take off angle (that's the upward directivity of the antenna) and thereby increases horizontal gain by concentrating the RF radiation in a usable field.

**Wave length** – 1/4, 1/2, 5/8 etc.

Generally speaking, an HT antenna has a dB loss over full length antennas 1/4 wave and better.

Many antenna designs implement “loading coils” allowing for a shorter antenna while electrically maintaining the proper wave length. Some incorporate multiple coils to increase gain by combining wavelengths or allowing multi-band use.

Dipoles and yagi antennas are usually 1/2 wave length.

1/2 wave length antennas typically do not utilize a ground plane.

**Gain** – Antennas are rated by dB (decibel) gain or loss. Decibel is the “relative” measure of the difference in power intensity using a logarithmic formula. As a rule of thumb, 3dB would be twice as much gain while -3dB would be a reduction by half.

dB – Decibel, the relative measure of power intensity using a logarithmic formula or scale.

dBd – Decibel as it relates to a dipole (bi-directional radiation) as a relative comparison.

dB<sub>i</sub> - Decibel as it relates to an isotropic (spherical and non-directional) as a relative comparison

Unity – No increase or decrease relative to the reference.

Mathematically speaking, 0dBd (unity) = 2.15dB<sub>i</sub> due to the fact that a dipole concentrates its energy in 2 directions whereas an isotropic doesn't favor any one direction and is spherical in pattern.

Pay close attention to the antenna manufacturers claims. If an antenna is rated in dB there is really no basis of comparison. If the antenna is rated in dBd or dB<sub>i</sub>, you are able to compare the antenna gain.

**Peak Wattage** – Antennas often are rated by peak wattage. This is an important consideration as transmitting with more power than rated can damage the antenna. Many antennas have “coils” to tune to a specific wave length; these coils are susceptible to damage from excessive RF energy. Be sure to select an antenna that will perform at your desired output power level.

**SWR** – Standing wave ratio is a calculation of forward verses reflected power due to mismatch in impedance of the antenna and feed line. Typically an antenna should be tuned to 1.5:1 or better when measured with an SWR meter to prevent damage to the radio. While a valuable tool

in the amateurs shack, you may not have one at your disposal. Most new VHF/UHF antennas come pre-tuned from the factory but don't hesitate to ask another amateur to test and tune your antenna if you are in doubt as to its performance.

### **Mounts –**

**UHF** – Most common type of antenna mount. Found in both base and mobile applications.

**BNC** – Common to HT “rubber duck” antennas. Convenient twist lock but being phased out by manufacturers in favor of the SMA.

**SMA** – Common to HTs, very small connector style facilitates miniaturization of equipment.

**NMO** – Developed by Motorola and primarily seen in mobile applications. This type is less common than the UHF mount.

**Coax** – Not all coax is equal. Like all things, there are fundamental differences that make up the products quality, price and performance characteristics. Listed here are the most common types of 50 Ohm coax available:

**LMR-400** – Most expensive, and highest quality of the types listed here, LMR400 is well shielded feed line that comes in hard as well as “flex” variants. It exhibits the lowest loss values at just 1.5dB per 100 feet in the 2m band. Great for base station applications where longer runs are required.

**RG8x** – Most common quality feed line for VHF/UHF use with a low loss characteristic of between 3 and 4 dB per 100 feet in the 2m band. Well shielded and flexible, this cable is good for patch cables between transceiver and test equipment as well as mobile and short run installations.

**RG58** – The least expensive listed here, with a loss characteristic of 6.8 dB per 100 feet in the 2m band. I have listed RG58 as an example of feed line one should try to avoid purchasing for use in long runs. This cable type is often found on magnet mounts.

**RG174** – RG174 is generally used for “adapter” cables such as attaching an external antenna feed line with an UHF connector to an HT with SMA. RG174 is very “lossy” but this type of cable is sparingly used and sections over 1 meter (about 39 inches) are rarely seen.

**LMR-100** – LMR100 is similar to RG174 with a much lower loss value.

Loss greatly increases with frequency. It is paramount that you use the highest quality feed line you can afford, with the shortest runs as the frequency increases. Remember, 3dB loss is equal to ½ as much.

## **Connectors / Adaptors - (most common)**

**UHF** – Most common connector used in amateur radio, good for HF/VHF/UHF frequencies. SO239 is the socket (female) while the PL259 is the plug (male) version of the UHF connector. They are relatively easy to assemble by the hobbyist using simple tools (cutters) and a soldering iron. Often found in silver or nickel plated outer shells, it is recommended that nickel plated be used where the connector will be disconnected often. Silver is usually more expensive, harder to disconnect due to friction and offers a slightly better conductivity value.

**SMA** – SMA is most common connector type found on HTs.

**BNC** – BNC connectors can be found on a variety of equipment from scanners to HTs to even base station radios. More common in past years, many manufacturers are migrating to SMA for its smaller size.

**N – N** connectors are 50 Ohm impedance matched, weather resistant and great for all frequencies including UHF. It is the recommended connector for UHF installations due in part to the low insertion loss and 50 Ohm matching.

**Weathering** – Of the listed connector types, only N is weather resistant. In outdoor applications, it is recommended that the installer of other connector types use coax seal to wrap the connector. see <http://www.coaxseal.com/> for more information. This product is sold by most every amateur equipment dealer.

**Insertion Loss** – Insertion loss is the dB loss due to the addition of cable, connectors or other equipment such as an SWR/Power meter between the transceiver and the antenna. As a rule of thumb, the less distance and connectors, the more signal will reach the antenna and vice versa, the better RX will be.

See <http://www.piccentric.com> (amateur radio – resources) for an extensive list of adapter combinations.

## Common Connector Combinations

			
<b>UHF M – UHF M</b>	<b>UHF F – UHF F</b>	<b>UHF Bulkhead</b>	<b>UHF F – UHF M Elbow</b>
			
<b>UHF M – SMA M</b>	<b>UHF M – SMA F</b>	<b>UHF F – SMA M</b>	<b>UHF F – SMA F</b>
			
<b>BNC F – SMA M</b>	<b>UHF M – BNC M</b>	<b>UHF F – BNC M</b>	<b>BNC M – SMA F</b>
			
<b>UHF M – BNF F</b>	<b>UHF F – BNC F</b>	<b>BNC F – SMA F</b>	<b>BNC M – BNC M</b>
			
<b>BNC F – BNC F</b>	<b>NMO M – UHF F</b>	<b>UHF F – NMO F</b>	<b>UHF M – N F</b>
			
<b>N M – N M Elbow</b>	<b>N M – N F Elbow</b>	<b>N F – N F</b>	<b>N M – N M</b>

UHF Male is also specified as PL-259 (PL as in plug) – UHF Female is also specified as SO-239 (SO as in socket)

## Frequencies –

**Band** – A “band” is a range of frequencies set aside for a specific purpose. Common amateur bands in the VHF / UHF frequencies are:

6m (50-54mhz), 2m (144-148mhz), 1.25m (222-225mhz often called 220) these are all VHF (very high frequency)

70cm (420-450mhz often called 440) is an ultra high frequency (UHF)

**Band Plan** – A band plan is a universally recognized guide to frequency usage. This helps keep order on the frequency bands and assist operators in making better contacts for the mode they are attempting since other operators will also be tuning into the appropriate frequencies. See <http://www.arrl.org/FandES/field/regulations/bandplan.html> for a complete band plan list.

**Simplex / Duplex** – Simplex is where both RX and TX station use a single frequency to communicate. This is in contrast to repeaters and duplex operation where one frequency is used to monitor (listen) while another is used to transmit. I have listed the simplex frequencies for the most common bands on my website at <http://www.piccentric.com> (amateur radio – frequencies)

**National Calling Frequency** – The national calling frequency is a single frequency observed by amateurs in each band for calling simplex. The advantage is that an operator can theoretically go to an unfamiliar area and make contact with a local operator, maybe for local information, to obtain repeater frequency and setting information etc. The national simplex calling frequencies are 146.520 (2m), 223.500 (1.25m) and 446.000 (70cm)

Notice that the frequencies are in steps, 15khz on 2m and 25khz on 220 and 70cm. These are called “tuning steps” and are there to prevent interference from adjacent frequency use. Here is an example illustrating the “bandwidth” of FM phone, if you were to transmit on 146.530 (that’s between the national calling 146.520 and a simplex channel of 146.535) you will most likely render 146.535 useless to others as well as interfere on 146.520. Keeping proper steps allows more users to operate with little or no interference.

## Simplex Frequencies

Band	Frequency
<b>80m</b>	3.950 <u>Hurricane Watch Net</u> (active when storms are within 300 miles of land fall)
<b>20m</b>	14.325 <u>Hurricane Watch Net</u> (active when storms are within 300 miles of land fall)
<b>6m</b>	51.500, 51.520, 51.540, 51.560, 51.580, 51.600, 52.490, 52.510, <b>52.525</b> , 52.540, 52.550, 52.570, 52.590 (50.125 USB, 50.400 National AM Simplex)
	<b>144.200 USB</b> , 144.200 - 144.275 USB
<b>2m</b>	146.400, 146.415, 146.430, 146.445, 146.460, 146.475, 146.490, 146.505, <b>146.520</b> , 146.535, 146.550, 146.565, 146.580, 146.595, 147.405, 147.420, 147.435, 147.450, 147.465, 147.480, 147.495, 147.510, 147.525, 147.540, 147.555, 147.570, 147.585
<b>1.25m</b>	223.420, 223.440, 223.460, 223.480, <b>223.500</b> , 223.520, 223.540, 223.560, 223.580, 223.600, 223.620, 223.640, 223.660, 223.680, 223.700, 223.720, 223.740, 223.760, 223.780, 223.800, 223.820, 223.840
<b>70cm</b>	445.9125, 445.9250, 445.9375, 445.9500, 445.9625, 445.9750, 445.9875, <b>446.0000</b> , 446.0125, 446.0250, 446.0375, 446.0500, 446.0625, 446.0750, 446.0875, 446.1000, 446.1125, 446.1250, 446.1375, 446.1500, 446.1625, 446.1750
	<b>Frequencies in bold denote national calling</b>

**QSOs – FM Voice “Phone” operation** – Simply stated a QSO is a conversation. There are just a few things you may want to know or be prepared for to have an anxiety free conversation. Here are the basics:

**Standard ITU Phonetics** – Write your call and first name followed by the phonetics in the space below:

Call	Phonetically			
First Name (handle)	Phonetically			
Alpha	Bravo	Charlie	Delta	Echo
Foxtrot	Golf	Hotel	India	Juliet
Kilo	Lima	Mike	November	Oscar
Papa	Quebec	Romeo	Sierra	Tango
Uniform	Victor	Whisky	X-ray	Yankee
Zulu				

**How to call someone** – You learned how to call CQ in your technician class licenses course, and while that is true, it is mainly used for HF bands, CW and SSB modes. In VHF/UHF FM phone we just call another person like this: (their call) (your call) You can add things like mobile or portable as the case may be or even the frequency your calling the person on if you know they scan and may not see the frequency you called them on in time. For instance, I might call my wife on a repeater like this: “K8KB K4OCD Mobile on 150”. If/when she hears my call; she will know that I’m on the 145.150 repeater and that I’m mobile when I’m calling her.

**How to answer a call** – Answering is as easy as saying: “this is (your call) go ahead”. If you know the call of the person calling you might say: “(their call) (your call) go ahead” and you have your conversation. *Technically speaking, per FCC part 97 rules, you are not required to identify at the beginning of a conversation however it’s not a bad habit to get into and easy enough to do.*

**ID during conversation** – As noted above you are not required to identify at the beginning of a conversation but you are required to ID at least every 10 minutes during a conversation and at the end of the conversation. ID during the conversation is as simple as giving your call like this: “(your call) for ID”, usually done at the beginning or end of a transmission within a conversation that is not ending. Many give their call every few transmissions and long before the required 10 minute point, again this is a good habit to get into.

**Share the air** – Remember, there are others that may also want to use the frequency you are on or want to get in to your conversation. A good practice is to delay a couple seconds between transmissions to allow others an opportunity to transmit. On repeaters, you should wait for the courtesy tone or wait for the carrier to drop all together, on simplex just delay a 2 second count.

**Ending your conversation** – When your conversation comes to an end you simply give your call and that you are clear or standing by or out (QRT), whatever the case may be.

## Common terms –

**Break** – Break is a term used to “break” into a conversation; a term usually reserved for priority purposes. Say for instance there was a non-priority / non-emergency conversation on a repeater frequency and you needed the frequency for priority traffic, you might say “break break (your call)” and then wait to be acknowledged. If there was a casual conversation and you would like to get into it, rather than use the term “break” you would just say “(your call)” and wait to be acknowledged.

**Clear / Out** – When you are finished with a conversation and will be clear of the frequency for others to now use it you would say “(your call) clear”. Taking this one step further, if you were finished with a conversation and would now be away from the radio you could say “(your call) out” or “QRT”.

**Emergency** – Used ONLY in an emergency. When calling emergency you say “(your call) emergency”. You will now receive priority on the frequency, so be sure that you are calling emergency only in a real emergency instance.

**Handle** – Your handle is your name, usually first name or nickname.

**Listening / monitoring** – Used to signify you are on that frequency. For instance, you are not intending to call anyone specific but would like to state you are on the frequency should someone else like to contact you, you would say “(your call) listening” or “monitoring”.

**Mobile / portable** – Giving your call followed by the word “mobile” or “portable” will tell listening stations that you are possibly in motion and/or at reduced power. This helps them to better understand your signal should it be dropping out or fading

**Standing by** – Used during a conversation that has not been completed but both parties will return momentarily. You may answer the other party “please stand-by (your call)” or if you were asked you may respond “(your call) standing by”

**Testing** – Used when you are testing your equipment settings or doing power SWR measurements. To do a test simply say “(your call) testing”, when you are finished with your test on that frequency you say “(your call) clear”. Always ID and clear on each frequency you transmit on.

**QRT** – QRT means the person will be off the frequency or their radio will be off

**QRZ** – Heard as QRzed, this is a term used to mean, “Who is calling?”

**QSL** – QSL is acknowledge

**QSO** – A QSO is a conversation

**QSY** – QSY is a change in frequency

**QTH** – Your QTH is your location, usually home.

**73** – 73 means best regards

Generally speaking, when talking on FM phone in the VHF/UHF bands, Q signals are kept to a minimum. Just speak in clear normal terms everyone can understand.

Remember – Never curse or discuss inappropriate subject matters as anyone of any age can monitor the frequency. Never use the amateur bands for business related purposes, all use must be non-pecuniary in nature.

## Repeaters:

**Types and use** - There are two main types of repeaters, open and closed. Open repeaters are those that list their frequency information and are open to all licensed amateurs to use. There may however be restrictions and one should gather information on the specific repeater or inquire with the repeater owner. Closed repeaters are those that are limited to the owners and/or members that are associated with the repeater.

Generally speaking, while open repeaters are available for anyone to use, it is customary to support the repeater by membership should you care to use it frequently.

**Offset (Duplex)** – The frequency you “monitor” a repeater on is usually the one you refer to the repeater as. For instance, a repeater with an output of 145.150 may often be referred to as “the 150 machine” (machine being the term used to refer to the repeater). The “offset” or duplex is the setting programmed into your transceiver that will shift the frequency when you transmit. Generally speaking, the offset on 2m frequencies is 600 kHz while 70cm usually uses a 5 MHz offset. Most modern transceivers automatically set the duplex offset for + or – depending on where it falls with regard to the “band plan” as laid out by a frequency coordinator.

The **frequency coordinator** is the entity responsible for assigning frequency pairs. This is done so that adjacent repeaters do not interfere with each other. A list of repeater frequencies for any given area can be found in a Repeater Directory, see [florida-repeaters.org](http://florida-repeaters.org) for more information on repeaters in Florida. For repeaters nationally visit <http://www.artscipub.com/repeaters/>

**Tone (PL or CTCSS)** – The PL (Motorola term – Private Line) or CTCSS Continuous Tone Coded Squelch System is a sub audible tone broadcasted with your transmission. It is often required by repeaters for access, in that without the tone, the repeater will not rebroadcast your transmission. This helps to eliminate interference from nearby signals or during periods of tropospheric ducting when adjacent repeaters on the same frequency pair could be further retransmitted. Equipment is usually set to tone encode, however one could also set the tone squelch setting to RX only when the tone was present. This is advantageous when you have interference and are unable to reliably squelch your radio.

**Auto Patch** – The auto patch is a DTMF accessible telephone patch, access codes and rules of use are generally given to members of the repeater only.

**Courtesy Tone** – The courtesy tone is a reminder to leave a time lapse between transmissions. One reason for this is to allow the timer to reset (see TOT) as well as giving others an opportunity to get into the repeater.

**Echo Link** – Echo Link is an internet relay using repeaters for access and/or retransmission. Many repeaters offer Echo Link access and one should inquire with the repeater owner for access requirements, often membership. See [www.echolink.org](http://www.echolink.org) for more information.

**TOT Time out Timer** – The TOT prevents the repeater from transmitting continuously, for instance if a distant signal caused the repeater to transmit. It also protects the equipment from over heating. Shorter transmissions are encouraged to allow others access to the repeater and to allow emergency traffic access.



**Nets:**

**Net Control Station (NCS)** – The NCS or net control station is the station officially in charge of all traffic during a net operation. Basically, all traffic must go through the NCS, during a net; there is no direct communications with other participants unless specifically directed by the NCS.

**Net Order** – The very first thing one should keep in mind while on a net is to listen. Listen carefully to the NCS for instructions; these will include the purpose and scope of the net as well as participant requirements (if any), the preferred method for check-in and the check-in order.

Common check-in order is either by zone or call prefix. Call prefix will be either A, K, N or W for US calls whereas zones will be area specific. If you are checking into a net that uses zones, write them in the space below for future reference:


**Check-in** – Often the preferred check-in format is to give your call phonetically followed by your name when called to do so. (If you are short of time, mobile, have club news or an announcement, the NCS may call for your check-in ahead of regular check-ins) So simply listen to the NCS to call for check-ins, wait for an opportunity to respond, either by hearing the courtesy tone after another stations transmission or for the carrier to drop out (that is when your s-meter no longer registers a signal) press the PTT button and clearly speak your call phonetics followed by your first name. Then listen for the NCS to repeat back the check-in information gathered or for a request to retransmit if in the event you “doubled” (that is, you and another station were transmitting simultaneously) or if the NCS missed any of your call information called a “fill”.

It is specifically requested that you do not press the PTT button, say “this is” release and then press the PTT again to give your call. This is a previous method of checking in and you will occasionally hear the style. It’s not wrong, just no longer desired.

**It’s your turn!** Ok so you have checked in and now the NCS calls you. Listen to the request for information. Often weekly nets are “rag chews” (that is, they are just a gathering of people, to exchange information and to be advised of coming events and radio related opportunities) so you are free to tell the group what you are up to, any new equipment you have acquired or questions you might have with regard to radio, licensing, the group in general and coming events. While there are no set time limits for your comments, generally speaking participants take no more than 2 minutes; this allows everyone an opportunity to participate.

*Your QSO may go like this: “This is (your call) (insert questions or comments) back to net control, (your call)”* (remember, a net is not a conversation with any one person. It’s a forum to exchange or gather information. Therefore your comments or questions should be clear and



**Local Groups** – (list your local ARES/RACES organization and Amateur Radio Clubs below)

Club or repeater group: Net (day/time): Repeater info (freq/dup/tone): Notes:
Club or repeater group: Net (day/time): Repeater info (freq/dup/tone): Notes:
Club or repeater group: Net (day/time): Repeater info (freq/dup/tone): Notes:
Club or repeater group: Net (day/time): Repeater info (freq/dup/tone): Notes:
Club or repeater group: Net (day/time): Repeater info (freq/dup/tone): Notes:

**National Membership** –

**ARRL** – American Radio Relay League – [www.ARRL.org](http://www.ARRL.org)

\$39 per year includes the monthly QST magazine and (your call)@arrl.net email forwarding. Also receive license expiration notice and free renewal service; discounts on ham gear insurance and online access to repeater information, product review articles and past QST issues. And lots more!

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# ARRL Membership Guide: Benefits and Services

## QST delivered to your doorstep

Our banner monthly publication, **QST** is THE SOURCE for news and information on any topic that's part of, or relates to, Amateur Radio. ARRL membership assures you delivery of **QST**. You'll find more information about **QST** on the reverse side of this brochure.

## ARRL as Advocate

ARRL supports legislation that preserves and protects access to existing Amateur Radio frequencies as a natural resource for the enjoyment of all hams. ARRL is the strong voice of Amateur Radio in government matters. As a member, you have contributed to the struggle to preserve our privileges. We can never afford to do less than what is necessary to protect the future of Amateur Radio.

## Ham Radio Equipment Insurance Plan

The ARRL "All-Risk" Ham Radio Equipment Insurance Plan is available to protect you from loss or damage to your amateur station, antennas and mobile equipment by lightning, theft, accident, fire, flood, tornado, and other natural disasters (available to members who reside in the US, its territories and possessions).

## Foreign Outgoing QSL Service

Let us be your mail carrier and handle your overseas QSLing chores. The savings you accumulate through this service alone can pay your membership dues many times over. The cost of airmail postage makes this service a necessity to avid DXers and contesters.

## Operating Awards

ARRL sponsors the most popular operating awards. If you live in the US or its possessions, Canada or Puerto Rico, you must be an ARRL member to participate.

**ARRL members also have access to the problem-solving knowledge of hundreds of experts through our Technical Information Service.**

- **ARRL E-mail Forwarding Service.** Sign up for this service, and e-mail sent to your ARRL address ("your-callsign@arrl.net") will be forwarded to the e-mail account you specify.
- **Member database.** Change your mailing address and other information on-line through a private, secure link.
- **Current Product Reviews** and contest results. See them here before they are published in **QST**!

## Regulatory Information Branch provides information on:

- FCC/regulatory questions
- Antenna/tower/zoning restriction problems
- Reciprocal licensing procedures
- Legal and engineering referrals

## ARRL on the World Wide Web

You'll also find the ARRL on the World Wide Web, at [www.arrl.org](http://www.arrl.org)!

ARRLWeb carries the latest W1AW news bulletins, a hamfest calendar, exam schedules and much more. We're always adding new features to the ARRLWeb, so check it often!

Order books, CD-ROMs, software and more on the ARRLWeb Catalog, [www.arrl.org/catalog](http://www.arrl.org/catalog)

If you would like further information about any of the benefits and services listed, please contact:



**ARRL** The national association for  
**AMATEUR RADIO**

225 Main Street, Newington, CT 06111-1494 USA  
or e-mail: [HQ@arrl.org](mailto:HQ@arrl.org)  
ARRLWeb: [www.arrl.org](http://www.arrl.org)

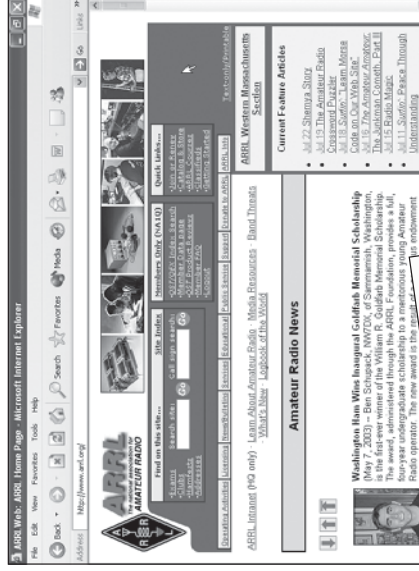
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## Members-Only Web services

As an ARRL member, you not only receive **QST**, you enjoy exclusive access to the ARRL Members-Only services on the ARRL Web site at [www.arrl.org/members/](http://www.arrl.org/members/). At this site you'll find information and services that are not available anywhere else.

- **Radios On-Line.** Only members may place ads for **FREE** on this popular online classified ad service.
- **Product Review archive.** Download and view **QST** Product Reviews from past to the present.
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Please check the appropriate one-year<sup>1</sup> rate:

- \$39 in US.  Canada \$49.  
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Please indicate date of birth \_\_\_\_\_ (US funds drawn on a bank in the US).

<sup>1</sup>1-year membership dues include \$15 for a 1-year subscription to QST. International 1-year rates include a \$10 surcharge for surface delivery to Canada and a \$23 surcharge for air delivery to other countries. Other US membership options available: Blind, Life, and QST by First Class postage. If you are 21 years old or younger, a special rate may apply. Contact ARRL for details.

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< Insert local club brochures  
and/or membership applications >

< Insert local club brochures  
and/or membership applications >

## Additional resources on the web:

[Piccentric.com](http://www.piccentric.com) - My personal web page with many resources and **lots of links** to manufacturers and equipment dealers.

[ARRL.org](http://www.arrl.org) – American Radio Relay League is the premier national amateur radio operators association. Membership includes a monthly magazine entitled QST that is a must have for new and seasoned hams alike.

[FCC.gov](http://www.fcc.gov) – Specifically <http://wireless2.fcc.gov/UlsApp/UlsSearch/searchLicense.jsp> where you can search for amateur licensees by call or name. You can also log in to your own license management page using your FRN and update contact information or renew your license.

[AA9PW.com](http://www.aa9pw.com) – Online practice exams for Technician through Amateur Extra. After each practice exam you will see a chart indicating areas of weakness to assist further study.

[G4FON.net](http://www.g4fon.net) – Download a Morse code trainer program using the “Koch method”. This is the best windows based program I have found and personally used, in fact I learned Morse and passed my element 1 exam using this software. It is a free program that will teach you Morse code with just 15 – 30 minutes of practice per day! You will be ready for upgrade in no time!

[eHam.net](http://www.eham.net) – A tremendous resource for product reviews. Also a great site for practice exams when you are ready to upgrade to general or amateur extra. You can also search call signs from the search bar.

[QRZ.com](http://www.qrz.com) – A great site for keeping up to date with current news and trends in amateur radio. You can also search call signs from the search bar.

[Mods.dk](http://www.mods.dk) – An equipment information resource where you will find product manuals and information on modifying your equipment.

## Primary Equipment Dealers

AES - [www.aesham.com](http://www.aesham.com)

Gigaparts - [www.gigaparts.com](http://www.gigaparts.com)

HRO - [www.hamradio.com](http://www.hamradio.com)

Universal - [www.universal-radio.com](http://www.universal-radio.com)

Ready to learn more? I recommend ARRL's  
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## Further discussion – Advanced Topics

### Morse Code

### Amateur Extra

Dummy Loads

Antenna Towers

Amplifiers

Switches

Pre-Amps

Battery Technology

Digital Modes

WinLink2000 / Airmail

### General Class

Base Stations

SWR / Power Meters

Antenna Tuners

Grounding

Duplexers

Filters

Charging Technology

Echo Link

And much more!

**Thank you for your interest in this discussion on basic radio application. On the next page you will find an article I wrote explaining the hobby to those who may not be familiar with what we do and why we find it enjoyable and rewarding. Pass it along to someone you think will also enjoy amateur radio.**

**I'm very interested in your feedback!**

**Please email me with your comments, questions or corrections to [k4ocd@arrl.net](mailto:k4ocd@arrl.net)**

National Distribution  
Rev. 4 – April 06, 2006

## Why Amateur Radio?

Amateur radio, also known as “ham radio” has been around since the introduction of the wireless telegraph. Governed by the FCC, amateurs are allotted radio frequencies in which to operate, facilitating the hobby and when needed, emergency communications throughout the effected communities. Radio amateurs are very diverse in nature, coming from all walks of life with a common goal, to participate in an exciting and ever changing field of communications that benefits their community.

It wasn't that long ago in our county... the communications infrastructure in our surrounding communities was threatened by hurricanes Frances and Jeanne (2004) but through it all, amateur radio operators continued to communicate even when the power was out and cellular and land-line telephone systems had failed!

Some of you may remember the feeling of isolation for that period of time. Was there someone you wanted to check on and couldn't? Did you need assistance and couldn't summons it? Maybe you are self-sufficient and would like to fill the gap for those that fit these questions.

Wireless communications through amateur radio bridges the gap. It's a vital hobby to local communications and one that all may take part in; it's easy, fun and rewarding!

Let's take a quick look at amateur radio, what it is and what it's not. Over the past decades, with the marked increase in cellular, many have looked at amateur radio as a lost art... one that will soon fade into our history books

You may not know this but as recent as the last hurricanes, amateur radio logged numerous entries in our local history. While cellular communications prove invaluable to our daily lives, during times of emergency the infrastructure can become stressed or worse, fail. Amateur radio requires little to no infrastructure to operate and by nature, the operators, people just like you, are always prepared to make contact in any eventuality.

But what about Morse code, who needs it? Well, amateur radio is not Morse code; Morse code is only one aspect of the whole and one that is not required to become licensed to operate a radio. There are three levels of licensure issued by the FCC; they are Technician, General and Amateur Extra, the latter two requiring a minimal level of Morse code proficiency. As a licensed Technician you may operate the VHF and UHF bands or frequencies which are the primary frequencies for local communications both simplex (radio to radio) and through repeaters without Morse code knowledge at all!

General and Amateur Extra class levels require more advanced understanding of radio and electronics theory plus the ability to copy Morse code, for which you gain additional band or frequency privileges which will enable you to communicate all the way around the world!

Are you a parent? Amateur radio is a fun hobby for kids and one that, with your participation, can increase the amount of quality time you enjoy with each other. In many cases, amateur radio inspires a career path for kids as it opens the world of wireless and electronics to them. Best of all it's free and there are no age requirements!

Amateur radio, a hobby vital to local emergency communications and beyond! Get your “ticket” - Get on the air!

Log onto [www.piccentric.com](http://www.piccentric.com) or email me [K4OCD@arrl.net](mailto:K4OCD@arrl.net) for more information on amateur radio or visit your local amateur radio club to learn about opportunities in your area or to become licensed.

73 “Best Regards” Jeremy K4OCD (Martin County / Stuart Florida)

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