

Portable HF Operations

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Disclaimer: *This has been one of the most difficult presentations I've ever prepared. This is not because the subject matter is difficult, but because there are so many variants of rigs and antennas for low power portable operations available today. I apologize if I've left any one's favorite out, there were simply too many to present them all 😊 This is, however, good news for the users who each have unique preferences, requirements and constraints.*

Portable HF operating is a fast growing segment of our hobby. Transceivers, antennas and accessories are available for all operating interests. Home brew, kits and commercial products are all used.

Topics:

- What are your operating goals?
 - QRP or higher power?
 - Local portable from a park
 - Travel
 - Summits on the Air (SOTA)
 - National Parks on the Air (NPOTA)
 - Hiking
 - HF Pack (pedestrian mobile)
- Transceivers
- Batteries
- Antennas
 - EFHW (End Fed Half Wave)
 - Loops
 - Verticals
 - BuddiPole
 - Antenna supports

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What power level?

- Some operators stick with QRP (5W). When band conditions are good this works fine.
- Many operators stay with low power (i.e.: 10-15W) but not QRP
 - Portable antennas are often inefficient
 - 10W is very popular for CW
 - SSB requires >14dB more power than CW
 - Digital modes require less power
 - New battery technology makes this feasible
 - Today's batteries are light weight (LiPO)
- My personal feeling is to use a little extra power. It is no fun to go out and make no contacts and this is supposed to be FUN!
 - I like to rag chew, it is difficult when the signal is down near the noise level
 - The other operator will appreciate easier copy, it is less tiring
 - 1 S-unit is 6dB (i.e.: 4x power). That makes a huge difference on a weak signal, but is hardly noticeable on a big one
- QRP and portable are separable in my mind
 - Portable is operating away from home
 - QRP operators often use very good antennas from home

Low power operating is more challenging, its up to you how much

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Local Portable

- Many hams simply enjoy getting outside to operate
 - I used to set up out of the back of my car while my son surfed
 - 50W to a Ham Stick mounted on the car
 - 20Ah battery will provide 4-8 hours of operation
 - I enjoy going to local parks to try new equipment and antennas
 - Gets you out of the shack
 - My friend Phil, W7OX, and I have taken different antennas out to local parks and run comparisons
- This type of operation does not require the lightest set-up
 - I can leave spare stuff in the car
 - Use a wheeled cart or case to get to my operating position
 - I can bring more tools and test equipment
 - I can usually find a bench or picnic table to operate from
 - A metal fence makes a great counterpoise or ground
 - Trees are usually available to support wire antennas
- Pick a park on a hill sloping East 😊

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Travel

- This is important to me since we go visit our grandkids often
- Weight and bulk is not critical
- I don't necessarily need to run on batteries
- A few years ago my daughter was in the hospital for 2 months and my wife and I each spent half of every week tag-team babysitting our 2 1/2 year old granddaughter at their condo in San Diego.
 - I set up my TS-590s using a power supply
 - Buddipole dipole got pushed up 18' when I wanted to operate
 - I made many contacts at 20-50W on 20/40M
 - The new IC-7300 is a good choice
 - Lighter
 - Spectrum scope
 - Fun factor

Summits on the Air (SOTA)

- Going to a mountain peak to operate requires more preparation
- Need to know if there are trees to support antennas, find out where the tree line is
- Some hiking involved, puts a limit on what you can carry
 - Most stations use a small 5-10W transceiver
 - End fed half wave wire and small loop antennas are popular
- Battery (or solar) power is necessary
 - No power limits
 - Some of the HF Pack folks run 50W with military surplus radios
- This is an organized activity open to all. Check out the website if you are interested: <http://www.sota.org.uk>
 - Started in the UK
 - Active USA group
 - Stations going into the field post their locations and frequency/modes on a website so others can look for them: <http://sotawatch.org>
- Don't go alone

Hiking

- Minimal size and weight is important
- Know where you are going to operate and plan for antennas
 - If it is unknown you may want to carry a loop and small tripod
 - An Alex Loop, EFHW or Super Antenna's MP1 vertical can be set up and taken down in a few minutes
 - If it takes too much time and effort you won't do it
 - The Super Antennas MP1 works well with an elevated counterpoise
 - Counterpoise just a few feet off ground
 - Wire is the lightest, End Fed Half Wave (EFHW) is a good solution if there are trees around
 - A 20' Crappie pole makes a convenient support for wire antennas
- Battery power
- I recently read of a ham on a bicycle tour who used his portable radio to contact family while in areas with no cell coverage
- Don't go alone

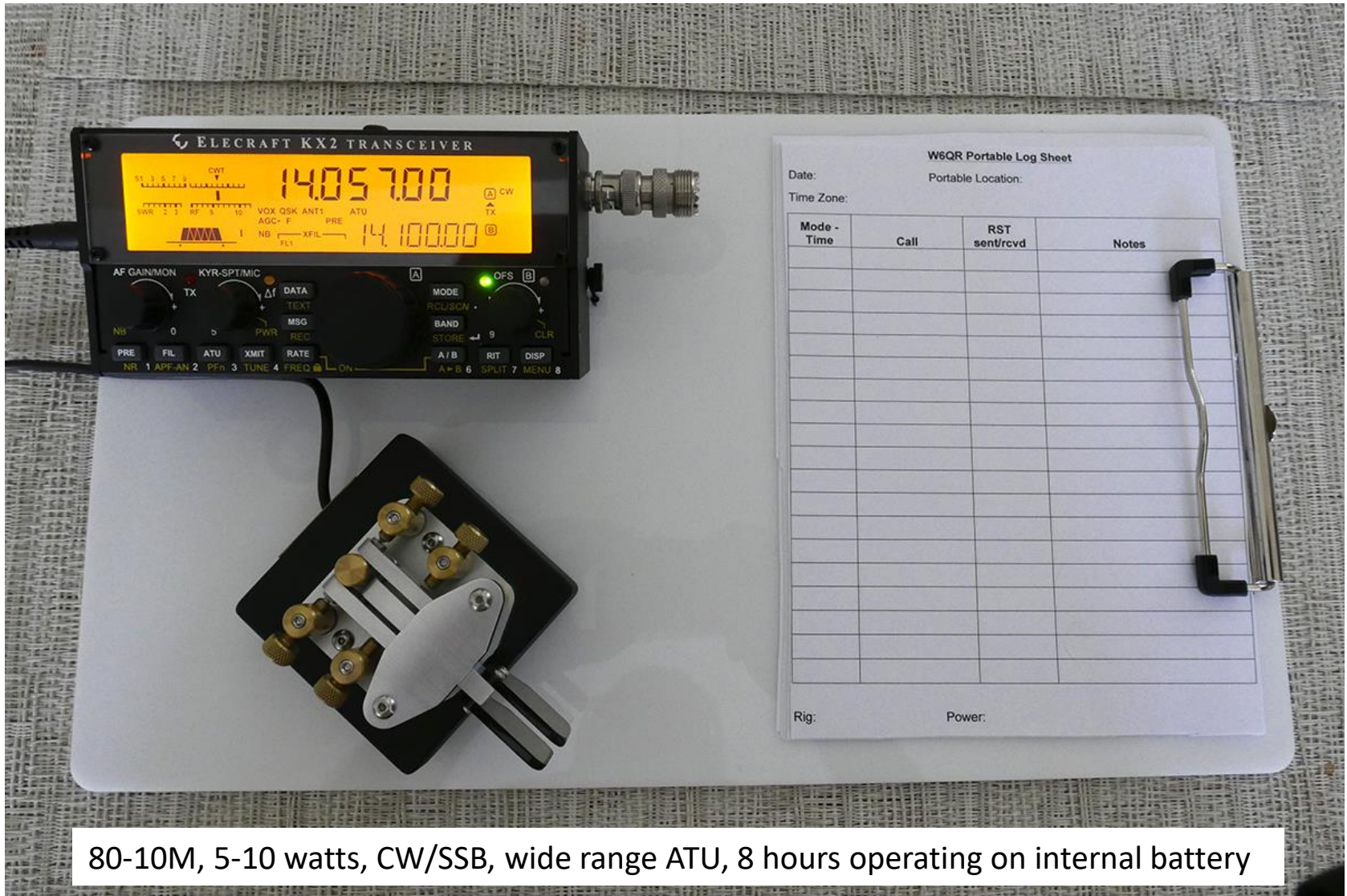
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HF Pack

- HF Pack is operating while hiking
- This is mostly SSB
- A whole organization has grown up around this activity
- These are the folks who led the FT-817 craze
 - There are many accessories available for the 817 that were driven by the HF Pack needs
 - Tuners
 - Packs
 - Filters
- The Super Antennas MP1 is a favorite of the HF Pack crowd who operate while moving. You need to drag a wire trailer (i.e.: counterpoise) for this type of operation.
- Many HF Pack folks use military surplus radios at up to 50W
- Check out their website: <http://hfpack.com>

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W6QR 10 Watt Portable CW Station



80-10M, 5-10 watts, CW/SSB, wide range ATU, 8 hours operating on internal battery

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Transceivers

- What are your operating interests?
- What bands do you want to operate?
- What modes do you need?
 - CW
 - SSB
 - Digital
- How much power do you want?
 - SSB needs higher power
 - QRP can be very frustrating
- Is weight an issue?
- What is your budget?
- You will need an antenna tuner, field antennas are often a compromise
 - I always suggest an internal tuner, you need some flexibility away from home with compromise antennas
 - LNR EFT-MTR does not need a tuner on 40/30/20M. It was designed as a companion for the CW only transceiver in the photo
- I use transceivers with an internal battery pack. I use an external LiFePO battery as my main power in the field and the internal battery as backup.



A Sampling of Low Power Portable Transceivers

Portable Transceiver Summary						
Manufacturer	Model	Pout (W)	DC Current (ma)		Weight (oz)	Notes
			Receive	Transmit		
Elecraft	KX1	4	36	700	11	Keyer, Tuner, 40/20M, 80/30M options, Kit, CW
	K1	5	55	1000	23	Keyer, Tuner, 2 or 4 bands 80-15M, CW
	KX2	10	150	2000	13	Keyer, Tuner, 80-10M, CW/SSB/Digital
	KX3	15	200	3000	24	Keyer, Tuner, 160-6M, CW/SSB
Hendrick's QRP Kits	PFR3	5	47	800	8	Keyer, Tuner, 40/30/20M, CW only, Kit
Yaesu	FT-817	5	450	2000	41	Keyer, 160-6M, 146/440MHz, CW/SSB/FM
LNR	Mountain Topper	4	15	750	7	Keyer, 40-15M, CW
	LD-5	8	350	2000	19	Keyer, 40-15M, CW/SSB
You Kits (Vibroplex)	HB1B	5	60	800	14	Keyer, 80/40/30/20M

All models shown have internal batteries except the LNR models. Tuners may be options.

Batteries for Portable Operation

- The Electric RC Model community has driven the development of light weight, high current, rechargeable batteries
- Lithium Ion Polymer (LiPO) chemistry has proven to be the best for these applications.
- These batteries have a very high energy density and must be used properly
- LiPO batteries can not be charged with NiMH chargers, they require special charging controls that insure the cells are balanced
- LiFePO_4 cells are the latest development. These are recommended for high current applications and are non-explosive. This is what I recommend and use.
- I suggest 12V batteries. 8 hours of intermittent use requires approximately:
 - 2.5Ah for 5W
 - 5Ah for 10W
 - 20Ah for 50W

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Battery Sizing

- First pick your rig, then decide how long you want to operate
- Example: KX3 operating for 4 hours
 - 200ma Rx
 - 2000ma Tx (10W out)
- Unless you are operating a contest with continuous operation I suggest using 20% Tx ratio for CW or SSB
- Rx: $200\text{ma} \times 4 \text{ hours} \times 0.8 \text{ duty cycle} = 640 \text{ ma-hours}$
- Tx: $2000\text{ma} \times 4 \text{ hours} \times 0.2 \text{ duty cycle} = 1600 \text{ ma-hours}$
- Total = 2240 ma-hours
- Most transceivers need >12 volts to operate properly
- A LiFePO battery pack that delivers 3 amp-hours at 12V is available from Bioenno for \$50 (add \$12 for a charger)
 - Shop around carefully, there are many inferior brands that don't last long
 - LiPO batteries maintain their voltage during use better than other chemistries
 - Buy a battery pack that has more than enough capacity, the voltage goes down fast when the charge gets low
 - Buy a proper charger, the one I have will charge many cell configurations and also will charge from my car battery
 - Avoid the *Battery Tender* style “equivalent batteries”. These are not rated for continuous duty.

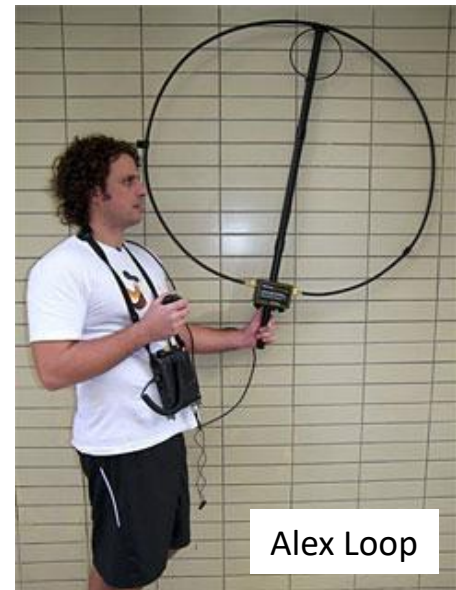
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Portable Antennas

- Low horizontal wire antennas are cloud warmers, most of the radiation goes up at high angles
 - Small and light
 - Good for local contacts
 - Relatively high efficiency
 - Get the center (or end) up >20' for good performance on 20M
- Small loops are popular but inefficient
 - Typical 3' loop <50% on 40M, 65% on 20M
 - Very close to a low dipole for continental US paths
 - Easy set-up



LNR EFHW in packed configuration



Alex Loop

Portable Antennas – cont'd

- Verticals with 2-3 elevated radials are pretty efficient but have low gain at low angles and a high angle null, not as good for local contacts
 - Radials on the ground add loss, reduce efficiency
 - Radials a foot or two above ground are best
 - Equal to a low dipole for coast-to-coast contacts
- The MFJ 18xx series loaded telescoping whip antennas will work in a pinch
 - I will often set up my KX2 with one to see if there is any activity on the band before spending time setting up a better antenna
 - Based on field comparisons these antennas are only 50% efficient on 20M using 2 elevated radials

Portable Antennas – cont'd

- What do I use?
 - I prefer an EFHW up 20-25'. Most low power contacts are local (i.e.: Western USA), so a high angle radiator works well. It is very light and easy to set up if you have trees around.
 - Easy to home brew. 38' wire end fed through a 9:1 Unun and 25' RG-8x works well on 20M
 - Wide range ATU required
 - My second choice is the Super Antennas MP-1 vertical. It beats the EFHW for cross country contacts. It is heavier and more involved to set up. Mounts on a tripod. Commercial product.
 - My third choice is a loop. Less efficient than an EFHW but very easy to deploy. The bandwidth is very narrow and they can be tedious to tune and keep tuned. Mounts on a tripod.
 - Alex and Chameleon Loops work well
- Make sure you try them out locally before going out into the field
 - I like to set up in a local park
 - Try possible installations
 - Compare antennas
 - Make sure you can tune the antenna on all desired operating bands

Field portable antennas involve compromises; you can't expect base station performance
Most portable antennas will require antenna tuners

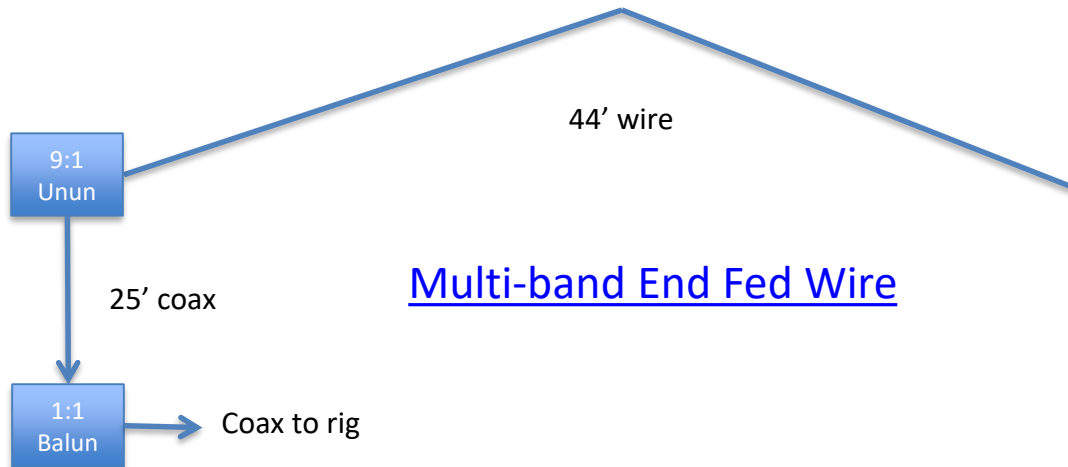
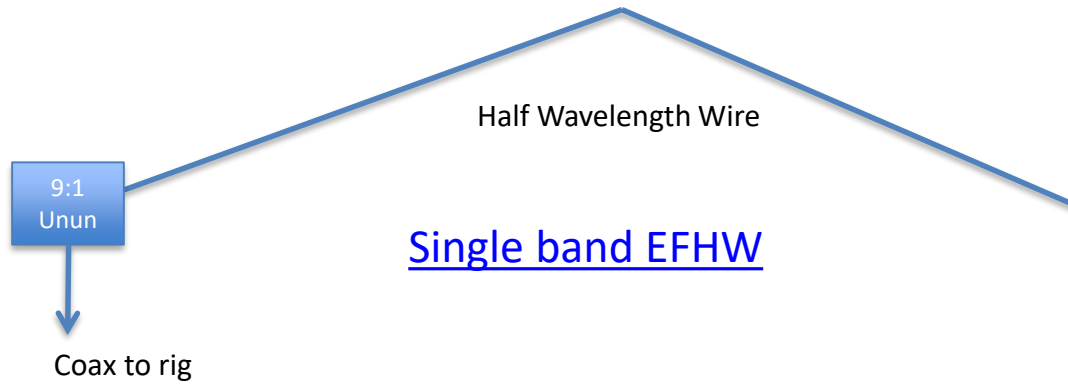
End Fed Wire Antennas

- I'm partial to the end fed wires
 - Lightweight and compact
 - I use a round 4-8oz fishing weight to get a center rope up in a tree 20' or so
 - If the foliage is sparse a tennis ball over the weight makes it safer
 - End Fed Half Wave (EFHW) works best
 - A Hendrick's SOTA tuner works well for QRP power levels
 - A 9:1 un-un gets the high end impedance into the range of most built in tuners
 - Wire length of 15% longer than a half wave works well, VSWR 3:1 typ.
 - 9:1 Unun provides no isolation for the coax feedline shield, a 1:1 balun is needed for power levels >10W to prevent shield current flow and antenna detuning
 - Jumpers can be used to change bands by adding/subtracting series wires
- Multi band option is a 44' wire for 40-15M using a 25' coax feedline
 - Outer shield of coax acts as a counterpoise making antenna length 69'
 - Use a 9:1 un-un at the end of the antenna wire and a 1:1 balun at the rig end of the coax. The 1:1 balun is needed to keep RF from directly getting on your rig and all your cables (i.e.: key, mic)
 - Don't need to change wire lengths to change bands
 - Need a good tuner in your rig (KX3/KX2 works fine)
 - For 40 & 20M a 4:1 balun is better, VSWR <3.5:1 relaxes tuner requirements

Proper antenna installation can really help a low power signal get out
Many folks just throw up a wire and assume it will radiate

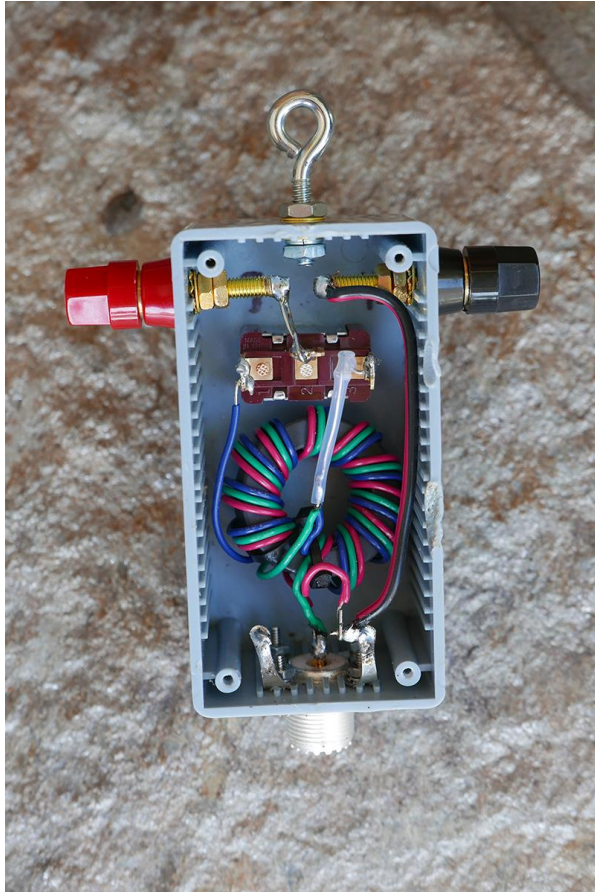
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End Fed Half Wave (EFHW)



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Home Brew 4:1/9:1 Un-un



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Budget Issues

- A simple kit with a QRP rig, battery, tuner and wire antenna could be put together for \$400-500
 - \$300-400 for the transceiver (LNR, You Kits, PFR-3B)
 - \$100-200 for antennas and accessories
 - Used transceivers and Kits can save you \$\$\$
- A KX2 with a BuddiPole or Loop antenna, battery and accessories can cost \$1,500
- I started small with the HB1B, SOTA tuner and EFHW antennas (~\$400).
- I eventually got the KX3 for travelling.
- Now I have a KX2 as well for hiking

Operating Issues

- I found that the biggest impediment to getting out in the field was not having my gear packed and organized all the time
 - For car portable trips I have a Pelican hard case that holds my IC-7300, key, headphones, battery, VSWR meter and misc. cords and cables. I have a Ham Stick mount on the car.
 - I have my other portable antennas and coax in separate bags so I can easily grab what I need
 - I have a large daypack for my KX2 kit plus antennas. It is important to have a pack that fits you properly and is designed to handle the weight you will carry (~15#).
 - KX2 kit fits in a small camera bag
 - All fragile equipment is packed in padded pouches
 - My pack also holds a 3 liter water bladder with plenty of extra room for a jacket and some food
 - Camera packs also work well for this
- I generally leave the daypack all loaded and ready to go
- I also have a small basic kit (<5#)
 - HB1B, key, ear buds, battery
 - Wire antenna (Varies)
- The latest issue of *QRP Quarterly* showed plans for a drive on mast base mount. This could easily support a telescopic fiberglass or carbon fiber pole to hold a wire antenna up 20-30'. I've added this to my car kit along with a 30' Jackite pole.
 - As a bonus I've been using it in my side yard to test antennas

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Appendix

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Helpful Books

- *Joy of QRP* by Ade Weiss, W0RSP; out of date in some respects but his discussions about planning and operating are still pertinent.
- *Low Power Communication* by Rich Arland, K7SZ; more up to date (2011) discussion of equipment and antennas.
- *The Little Pistol's Guide to HF Propagation* by Robert Brown, NM7M (SK); excellent overview without getting too technical.

Portable Antenna Summary

Manufacturer	Model	Type	Size	Weight	Notes
Alex Loop	Walkham	Loop	~3' diameter	3#	40-10M, 20W
BuddiPole	Deluxe	Dipole	16'	10#	40-6M, 8' mast, 250W
	Long Version	Dipole	16'	13#	40-6M, 16' mast, 250W
Super Antenna	MP1	Vertical	<8' tall	2#	40-2M, requires radials, 300W
W1SR KX3 Helper	End Fed Half Wave	Dipole	40-6	0.5#	Uses 9:1 un-un, requires tuner, >100W
LNR	EFT-MTR	Dipole	40/30/20	0.25#	25W, No tuner required
W6QR	End Fed Half Wave	Dipole	Band specific	<1#	Use Hendrick's SOTA Tuner, 5W
	End Fed 44'	Multi-band Dipole	44' wire + 25' wire or coax	3-5#	Uses 9:1 un-un, requires tuner, >50W, coax acts as counterpoise

Antenna tradeoffs

Type	Pros	Cons
Alex Loop	Easy to depoly Light weight Walkable	Low power limit Expensive
BuddiPole	Easy to deploy High power limit	Large size in field Expensive
Super Antenna	Easy to depoly Light weight Walkable High power limit	Requires radials Moderate cost
End Fed Wire	Very light weight Low Cost	Need support like a tree or pole Home brew or commercial

More About Transmit Power

- I like to make contacts, not call CQ with no responses
 - Many hams will not answer a weak signal
- One S-unit is 6dB
 - One S-unit increase is huge if you are at the noise level
- You can probably hear a 3dB change in power
- QRP (5W) can be frustrating or exciting
- One S-unit more is 20W, 2 S-units is 80W
- I find 50W to be a good power level for portable operating where weight is not an issue, you always need more power on the low bands to overcome the noise
- There are 2 very good 100W transceivers small enough for portable operating
 - TS-590SG, high dynamic range, 3:1 VSWR tuner, good front end band filters, 16#
 - IC-7300, moderate dynamic range SDR, 3:1 VSWR tuner, front end band filters may be too wide for nearby big signal rejection, spectrum scope, 9.5#
- What do you do when you can't run 50W?
 - For hiking or mountain topping where weight is an issue, you are limited to 5-15W. Post your operating frequencies and times on one of the websites. That way someone may be listening for your weak signal.

Portable Operating Kit Needs

- Basic Kit (CW only)
 - Small Transceiver like an HB1B (or KX2)
 - Key
 - Ear buds
 - BNC/Binder post
 - Two 25' lengths of wire and a rope launcher (4oz fishing weight on a length of parachute cord)
 - Paper for logging, pencil or pen
- Intermediate kit (CW/SSB/Digital)
 - More capable transceiver like a KX2
 - Key, Headphones or Headset for SSB
 - VSWR meter
 - I like to use a clip board for an operating surface
 - Log book or iPad/Tablet
 - Antenna(s), coax, tripod, etc.

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Accessories

- First aid kit and/or emergency kit
- Tools and repair kit
- Extra coax and adapters
- Rope launcher (I use a tennis ball with a 4oz fishing weight inside)
- Rope (parachute cord)
- Tent pegs
- VSWR meter
- Log, paper and pen (clipboard)
 - I recently started using an iPad for field logging
- Key or Mic (headset)
- Headphones
- Battery charger
- Butane soldering iron and solder

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More Accessories

- A 21' carbon fiber telescoping crappie pole makes a good support for a wire antenna
 - 30' Jackite pole is even better but heavier
- A sling shot also makes a great antenna rope launcher
 - Bow fishing spool holds the rope
 - Parachute cord works well
 - Illegal in some states, considered a weapon
- For SSB a PC style headset works well, much to my dismay a lot of low power portable and SOTA operations are SSB.