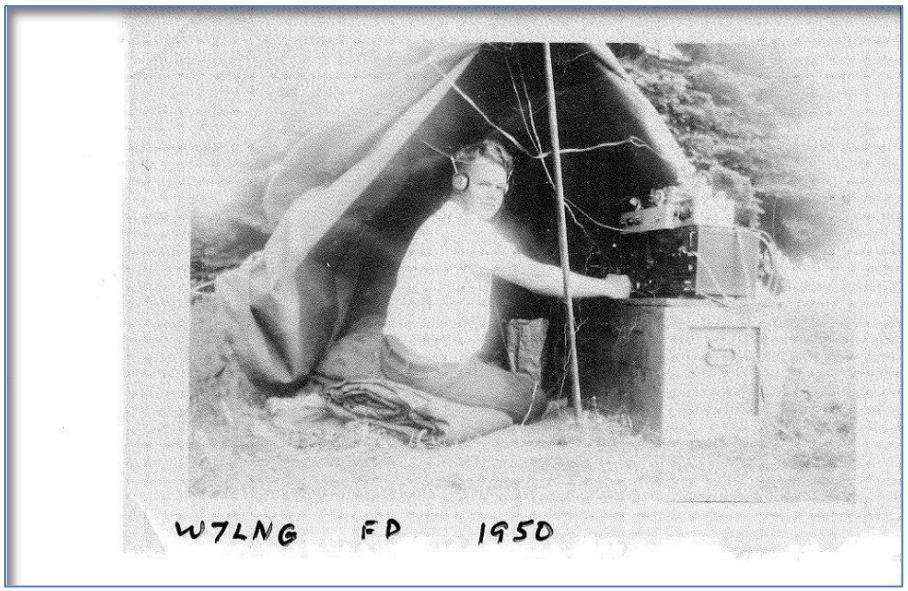
Portable Operations



A Practical Overview

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Revision 2 – 03.01.2018

Presentation Topics and Format

- Define what is “working portable”
- Classify some categories of Portable Operations and provide examples.
- Discuss why you should consider working portable?
- Discuss 4 main areas to consider for portable operations and provide some practical examples for setup or gear that can be used.
- Second half of the presentation will be a display of portable gear and allow for participants to ask questions and discuss their own “portable” setups and experiences with other club members.

What is “Working Portable”?

- There are not a lot of encompassing definitions for “working portable” or portable operations… ARRL Op guide??

- Very subjective and open to interpretations!

Generic Definition de W4ALF:

Partaking in Amateur Radio Tx/Rx, with equipment, away from your normal QTH.

Portable Ops Classification

1. Public Service and Emergency Communications:

   Volunteer for Paddlefest/ARES/RACES/MARS

2. Events and Activities:

   Field Day/Flight of the Bumblebee/Dxpeditions/NPOTA

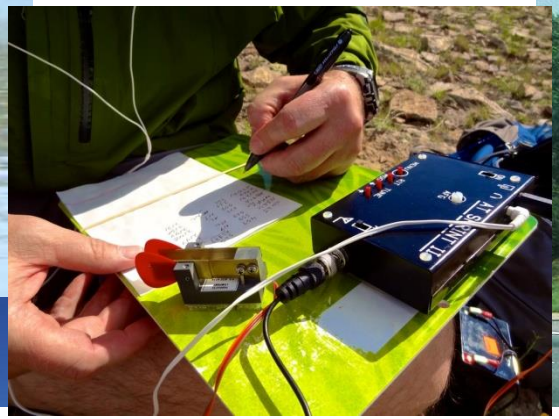
3. Leisure Portable:

   Park bench ops/IOTA/SOTA/Hiking & Camping/Vacation

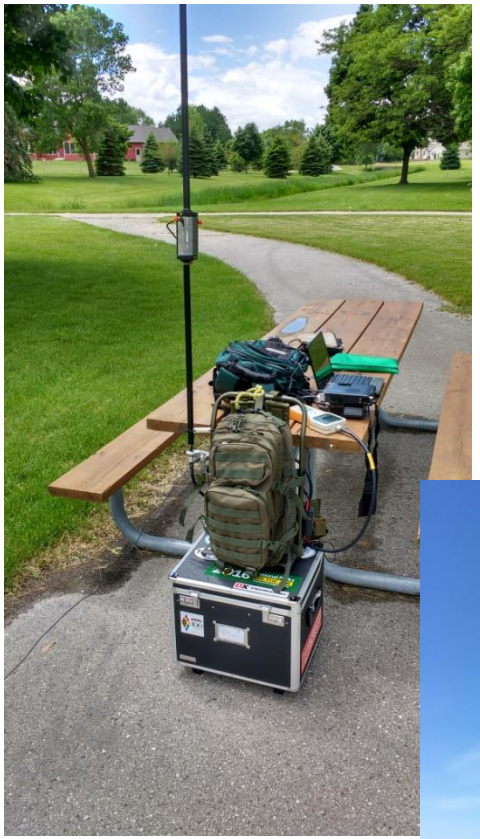
4. Mobile:

   Car VHF Roaming/Maritime/Airplane/Pedestrian Mobile/Bike

Do you work “Portable”?



Yes. I work Portable!



Why Work Portable?

- Volunteer and provide emergency communications for the community.
- Experiment and test different portable “Setups” designed for mobility. Big or Small!
- It’s good to get out of the house - you can combine hobbies!
- Low noise levels for operating.
- It’s a different skill set in the hobby you can “hone” – operating and equipment.
- Satisfy your sense for adventure - IOTA/SOTA/Dxpeditions…
- Pairs perfectly with QRP and small portable rigs/antennas

4 Main Considerations

1. Location

Are there trees for antennas/is there shade or cover for me? Place to sit or op comfortably? Power source on site or bring your own? Will there be people at the site? QRM? Weather that day Rain/Hot/Cold? What is the accessibility to the site where I will actually be setting up to operate?

2. Power Source

Power source at location? Bring a Battery? What Size do I need? What Kind of Battery? Do I need a generator?

3. Rig

What kind of rig do I need or rig type should I take? What power output of the rig is necessary or practical?

4. Antenna System

What kind of antennas can I use? Mono-band? Multiband? Support for Antenna? What kind of feed line type to use? If I need to put a dipole in a tree, how do I get it up there? What if there are no trees at the op site?

Location, Location, Location

- Will the location limit my power source needs/requirements?
- Is there a tree to support wire antennas?
- Park benches or convenience facilities e.g. Washrooms? Where do I sit and operate? Is there shade from sun or shelter from rain? Weather is always a factor.
- If I am hiking in, how much does my gear weigh added to all my pack gear.
- How far is the spot I picked from my vehicle?
- Is it near other people? Do I want that?
- Is it near possible sources of QRM and QRN?
- What other supporting gear will I need to make the trip successful?
- Build a checklist of items you need or layout the gear on garage floor and take an inventory.
- Are other hams going to be operating there as well? Band pass filters and Antenna separation distance becomes a factor.

Power Source

What to do if there are no “outlets”?

- Generators

  Require gas or fuel

  Must be rated for your power requirements “Watts”

  Cons: can be bulky and noisy both Decibel levels while running and can cause RFI.

Generac weighs about 50lbs
Provides about 2000W running watts of power
Costs about $500 – 12V at 8.7A
At half load can run for about 3.5 HRS
Has built in inverter for 120v AC

Batteries Not included

Battery Types:

Off the store shelf:

Alkaline/carbon Zinc generic/ Nimh/NiCD rechargeables/lithium high drain

Gnrl. Capacity range up to 1500 mah sometimes more. These can actually work ok for very small QRP rigs!

Large Capacity Batteries – measured in AH or Amp Hours <1 AH up to 150+ AH per Batt.

Lead Acid

Flooded Std. Lead Acid

AGM – Absorbed Glass Mat

Gel – Silica Gel chemistry prevents spillage if case broken

Lithium Ion - LIPO and LIFEPO4 – Lithium Ion Polymer and Lithium FerroPhosphate

Require Special Charger - are very light - sometimes only 30% or less of lead acid equivalent. Used in Radio Control hobby extensively. Can withstand High discharge rates. LIFEPO4 has more stable chemistry than LIPO. W4ALF's choice for QRP.

Lead Acid Batteries

Battery Types for Lead Acid

Std. Flooded Lead Acid – Cheap but heavy. Depth of Discharge 50% to attain same cycle life, need more charge top off

AGM absorbed Glass Mat –Sealed, maintenance free, depth of discharge 80% to attain same cycle life

Gel Cell batteries contain a silica type gel that the battery electrolyte is suspended in, this thick paste like material allows electrons to flow between plates but will not leak from the battery if the case is broken. In gnrl - Works better for low discharge rates and higher ambient temps requires special charger.

Most important characteristic is the one below:

deep-cycle battery is a lead-acid **battery** designed to be regularly deeply discharged using most of its capacity. In contrast, starter **batteries** (e.g. most automotive **batteries**) are designed to deliver short, high-current bursts for cranking the engine, thus frequently discharging only a small part of their capacity.

Batteries for marine applications and solar applications are deep-cycle type.

- W4ALF Recommendation: Go with AGM/Gel Cell deep-cycle for 100W type rigs with high draw on TX. This usually means batteries that will be >10AH in capacity.

Lithium Ions: LIPO & LIFEPO4's

Lithium Ion Polymer LIPO and Lithium ferrophosphate LiFePO4.

Come in S's 1s 2s= 7.4 V 3S=11.1V for LIPO 4S=14.8V [S per cell nominal 3.7V full charge voltage 4.2V per cell]

LIFEPO 3S 9.9V 4S 13.2V [S per cell nominal 3.3V per cell and full charge at 3.6V]

C rating: is the Continuous Discharge Rate e.g. 2.2AH batt with 40C rating can handle 2.2x40 = 88 amp continuous discharge

Pros:

batteries are extremely lightweight and can withstand high discharge rates from use. Hold charge over time. Can be acquired in a variety of final voltages.

Cons:

Require special charger and charging procedures/can be expensive per AH in Comparison/LIPOS have more volatile battery chemistry than LIFEPO's. should not be discharged under minimum voltages per cell as to not damage battery cells

W4ALF Recommendation: Most all my Batts up to 10AH are LIPO/LIFEPO4 type.

Can be acquired online and are used extensively in the Radio Control community.

Eflite/Zippy/Turnigy/Bienno Power/K2 with BMS/Battery Tender

Duty Cycles for Ham Radio Modes

Duty cycle/factor is the ratio of the transmitted signal's on-the-air time to the total **operating** time during the measurement period expressed as a percentage. Duty cycle is important because it is one of the factors that will determine what are the battery capacity requirements will be.

Table 11-2

Operating Duty Cycle of Modes Commonly Used by Amateurs

Mode	*Duty Cycle*	*Notes*
Conversational SSB	20%	1
Conversational SSB	40%	2
SSB AFSK	100%	
SSB SSTV	100%	
Voice AM, 50% modulation	50%	3
Voice AM, 100% modulation	25%	
Voice AM, no modulation	100%	
Voice FM	100%	
Digital FM	100%	
ATV, video portion, image	60%	
ATV, video portion, black screen	80%	
Conversational CW	40%	
Carrier	100%	4

1. Without Speech Processing 2. with Speech Processing / Gnrl Rule: Digital modes 80%-100% Duty Cycle

Battery Capacity Calculation

RxT= Rx Time

RxAh = Amp Hours current draw on Receive

TxT= Tx Time

TxAh = Amp Hours current draw on Transmit

Df = Duty Factor – Duty Cycle expressed as a fraction

[Duty Cycle = is the time that a device spends in its active state as a fraction of the total time under consideration]

(RxT *RxAh) + (TxT*TxAh)*Df = Amp Hours Required To Operate

Battery Capacity Calc Example?

- **For my Yaesu FT-817 transceiver, operating CW with 5 watts output, we get the following.**
- Receive current: 400mA (0.400 A)
- Transmit current: 2.0 A
- Assume transmit 40% the time and 60% Receive, so if we use one amp hour as the basis (.40 and .60 total for 1 HR)and assume a 40 percent transmit duty cycle operating CW (refer to previous slide).
- Receive current = 0.400 A X 0.6 hour = 0.240 Amp-hour
- Transmit current = (2.0 A X 0.4 hr) X 0.4 duty factor = 0.320 Amp-hour
- Total current capacity required [add both]: 0.240 Ah + 0.320 Ah = 0.560 Amp-hours.
- A 10-Ah battery will last approximately 10/0.56 = 17.86 hours.
- This does not take into account you will not deplete battery to complete discharge. There are factors you can use that help account for this…

Rigs

For Portable - there usually 2 main categories:

Barefoot = approx. 100w output

Pros: more power out for voice/dx

Cons: requires larger Power Source!

QRP = defined here as 1W to 5W/10W SSB output approx.

Pros: Can accomplish similar goals than 100w especially when coupled with CW mode. 5W to 100W 13db change = 2 S units

Cons: Not great Pile up buster for DXpeditions sometimes [still can be done though] and best when coupled with modes like CW and digital (JT65 or FT8?).

Rig Examples

100W rigs:

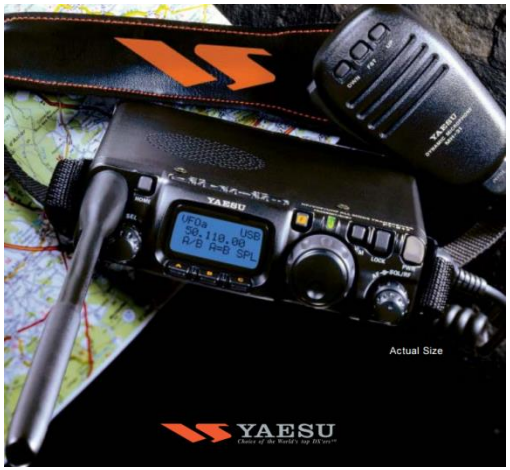
Radio	Power Out	Mode	Weight	Rx Draw	Tx Draw	Ant. Tuner
ICOM 7000	100w	VHF/HF	5.1 lbs	2A	22A	No
Yaesu FT 891	100w	HF	4.18lbs	2A	23A	No
TS-480HX/SAT	200w/100w	HF	8.15lbs	1.5A	20.5A	SAT Yes

Rig Examples

QRP Rigs:

Radio	Power Out	Bands	Modes	Weight	Rx Draw	Tx Draw	Ant. Tuner
KX3	10W-15W	160m-6M	All	1.5 lbs	150 ma	1.5-2A	Yes Opt.
Yaesu 817 ND	3W-5W	All bands *60M	All	2 lbs	450 ma	2A	No
MT3B	2W-3W	20-30-40M	CW	4.4 oz	150 ma	500 ma	No
Ubitx HfSignals	2W-10W	10m-80m	SSB/CW	N/A	100ma	500ma	No
QCX	2W-5W	17-80m one band only	CW	4.0 oz* no case	140ma	500ma	No

Other Rigs: YouKits H1b1, Hendricks PFR-3B, Elecraft KX1/K2/KX2, MFJ 9340, TENTEC 539 Argonaut/506 Rebel/507 Patriot



Antennas

Wire Antennas:

Mono-band Resonant Dipoles, half wave length

EFHW & Random Wires, 35ft, 68ft,128ft, other – see appendix…

Linked Dipole: Lengths per band determined by connectors

Doublets - open ladder line 600ohm, 44ft, 66ft (what I use for 10-40m)..

G5RV – TV pair style ladder line 300 ohm, 102/110ft ft total length

OCF Dipole – 22ft/44ft 33%/67% Ratio: 66ft Total Length

also merit mention: NorCal Doublet, Trapped Dipole, folded dipole, wire vert, mag loops.

Commercially available Antenna Systems:

Buddipole – multi part system vert/dipole/yagi

Super Antenna - small vertical

Alex loop & Chameleon Loop – shielded Loops approx. 33”

In Diameter.

Wire Antennas

Some General Rules of Thumb:

- Try to use wire antennas and open/ladder line feedline. Less lossy than coax. If you use coax, check a coax loss calculator to understand impact of coax loss on your system. Coax is OK, as long as you understand impact of loss on the bands to be used on…
- Try to make antenna length at least ½ wavelength of lowest frequency desired/ shortened versions ¼ wavelengths.
- End feds; make counterpoise about ¼ wavelength
- Height about ground should be at least ¼ wavelength
- Avoid center feed a half-wave multi-band antenna with a high impedance feedline that is close to an odd multiple of a quarter-wave long.
- Use Baluns, Ununs & Chokes 9:1/4:1/1:1 to increase efficiency of your Antenna. (This means impedance match or transformation and RF choking.)

To Coax or not to Coax?

- Coax Loss: lot of opinions on the subject. Coax is lossy - YES. Some signal loss in the form of heat that never makes it to antenna.
- Open Ladder Line is efficient albeit less convenient. Use it when you can, but not the only option
- Use a coax loss calculator to understand actual power loss and incorporate in your antenna deployment plan.
- Most coax runs are short when working portable. 100ft or less. Most being 50ft or less. Coax loss may not be as much as you think!

Coax, it's ok – It will be fine ☺

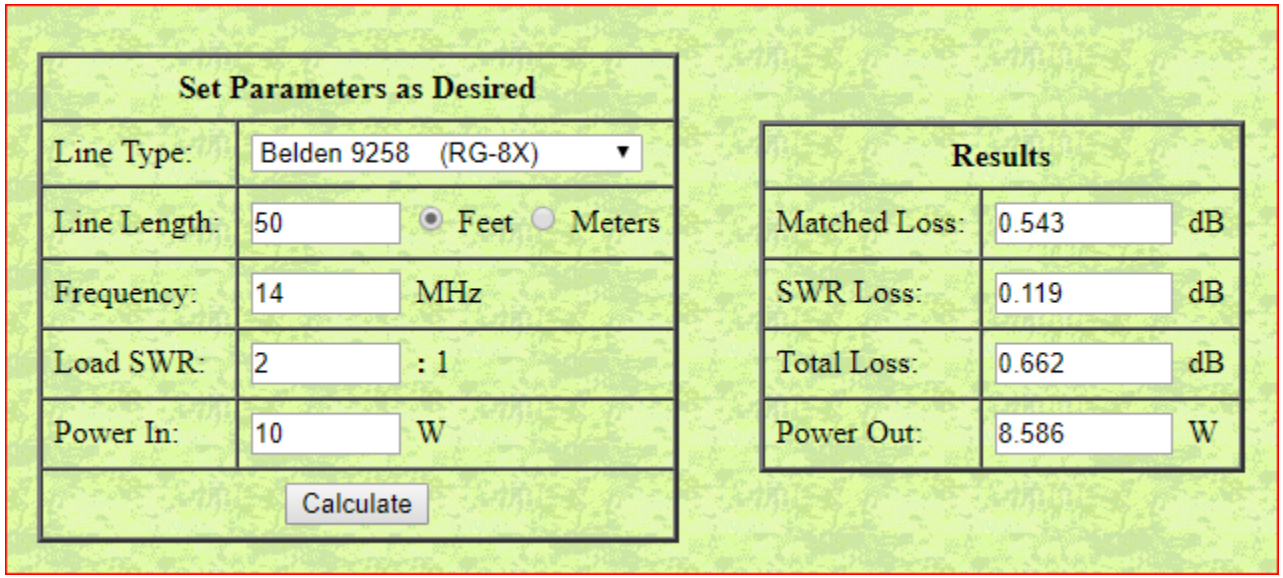
- Coax loss increases with higher Frequency. So more loss at 20m than 40m
- Use a Coax Loss Calculator to understand how much loss and whether this is acceptable for you.
- Type of Coax will impact losses: RG174 & RG58 – .66 velocity factor, RG8X - .84 velocity factor, LMR400 .85 velocity factor

Coax Loss Calculator

http://www.qsl.net/co8tw/Coax_Calculator.htm

An example of RG8X at 50ft with a 2:1 match on 20M, you can see the loss is about .5db and this is close to qrp power levels below…

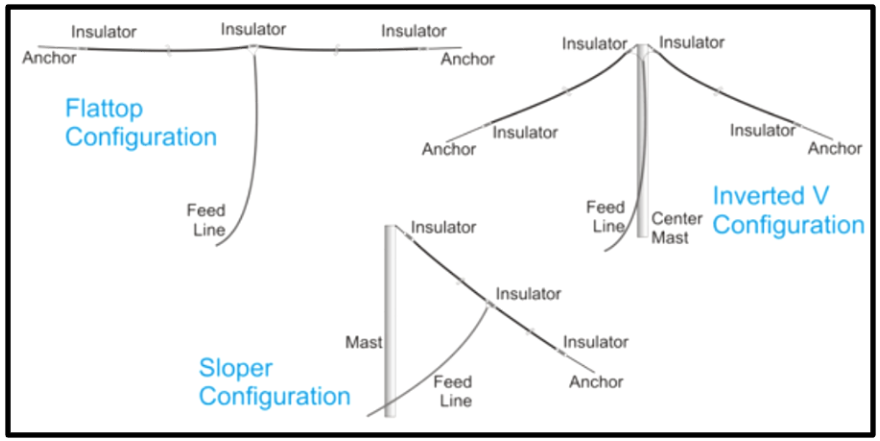
RG8X makes a good compromise of size and weight with an acceptable velocity factor.
I do use RG174 when backpacking while using resonant dipoles to minimize overall antenna system losses. Keep runs as short as possible.

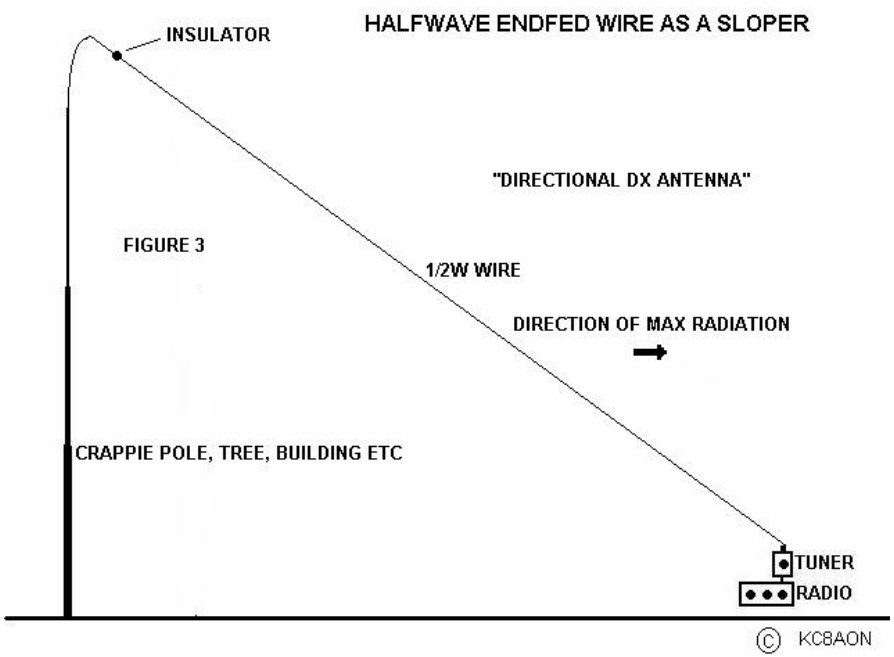


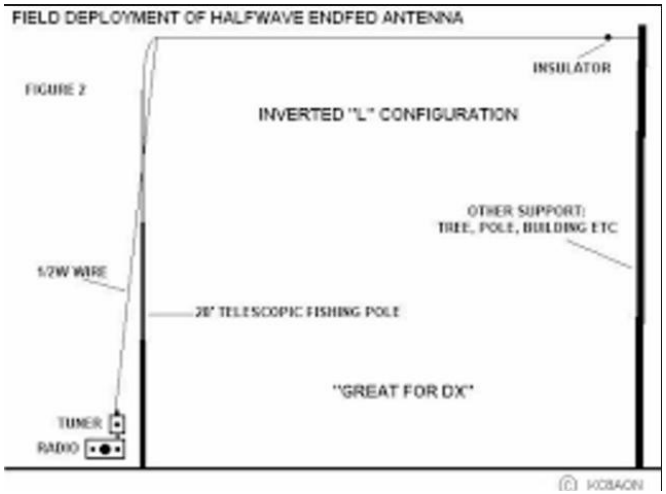
Set Parameters as Desired		
Line Type:	Belden 9258 (RG-8X) ▼	
Line Length:	50	◉ Feet ○ Meters
Frequency:	14	MHz
Load SWR:	2	: 1
Power In:	10	W
Calculate		

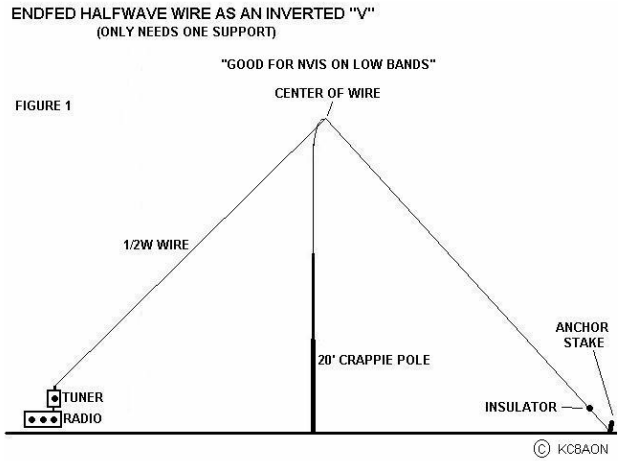
Results		
Matched Loss:	0.543	dB
SWR Loss:	0.119	dB
Total Loss:	0.662	dB
Power Out:	8.586	W

EFHW & Dipole Wire Antenna Configurations





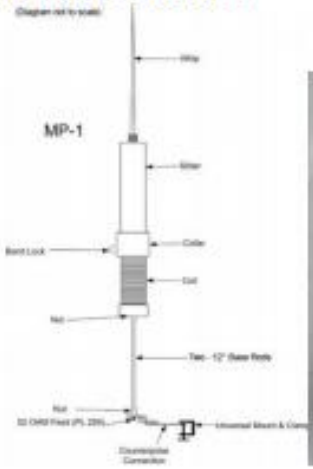




Commercial Antenna “Systems”

BuddiPole portable vertical/dipole system
40m-6m; dipole or vertical configuration
collapses to 22”
handles 250 watts
weighs less than 2 lbs

W6MMA MP-1
40m-6m
handles 300 watts



Antenna Support

- Trees! Using a throw bag and throw line can go 40ft+
- Fiberglass Masts. Easy and avail 10ft-60ft!
- Aluminum Masts – Push up or sectional. Perm option.
- Any Tall Structure, Be creative (No power poles PSE)!

31’ Jackite fiberglass pole:
collapses to 46”

33’ MFJ fiberglass pole, MFJ-1910:
collapses to 46”

/P in the Callsign?

- When operating in a location other than your normal QTH it is polite or customary to indicate this in your call sign with:
- W4ALF/7 – From a different Call district, “7” in this example.
- W4ALF/P “Typically from your same Call District, but not always just that ☺”
- Other examples you may see: /QRP “qrp power”, /M “Mobile, perhaps Car”, /MM “Maritime Mobile”, /PM “Pedestrian Mobile”

More about /P in the Callsign

- It is not required by FCC when within FCC regulated territories.
- There are regs for other countries and for those visiting into FCC regulated territories that are non-reciprocal countries. See FCC 97.119. Regs vary by country regarding placement in front or back of callsign.
- Some Examples:
- VE3/W4ALF “Alf is Ontario, CA operating”
- W4/F6HKA “Bert from FRA is at ALF’s QTH”

Parting Thoughts:

- Power- Use Batteries if you can, use formula to determine what size battery you need.
- The smaller the rig draw, the lighter the battery you can take! QRP works, try it!
- Rigs: Go with what you have. As you work more portable, it will be a natural progression towards lighter and smaller rigs. Again, enter QRP ☺
- Antennas: Don't sweat this. Pick an antenna and go with it. Part of the hobby is experimentation so try one or try many! I see many opposing views on this, with both sides using different antennas that both work!!
- Yes ladder line feed is more efficient but most antennas will work well to different degrees. I routinely use coax fed antennas working portable and have done just fine. Understand your system and losses so you are aware, then… Move one, take the antenna out and try it!
- You can use WSPR devices or Reverse Beacon Network website on your antennas to gather data about Antenna performance.

- MOST IMPORTANT THING – GRAB WHAT YOU HAVE AND GET OUT THERE!!

Go Work Portable! De W4ALF

[END PRESENTATION]

Appendix

Links:

Dipole Length Calc:
http://www.hamuniverse.com/dipivcal.html

Loss in DB Feedline Loss Calc:
http://www.qsl.net/co8tw/Coax_Calculator.htm
http://kv5r.com/ham-radio/coax-loss-calculator/

Velocity Factors for Coax:
http://www.buxcomm.com/coax-vf.htm

Wire Antenna Overview:
http://ctsara.org/Basics%20of%20Antennas%20-%20horizontals%2005072009[1].pdf

Buddipole Antennas:
http://www.buddipole.com/

Jackite (fiberglass poles) Routinely use their 28ft model:
http://www.jackite.com/

SpiderBeams Fiberglass Masts including 40,60,70ft models!!
http://www.spiderbeam.us/index.php?cat=c2_Fiberglass%20Poles.html

Appendix

Links QRP kits and Rigs (not a comprehensive list):

QRP Labs:
https://qrp-labs.com/

Sotabeams (general qrp merchandise):
https://www.sotabeams.co.uk/

Elecraft:
http://www.elecraft.com/index.htm

HF Signals Ubitx kit:
http://www.hfsignals.com/

LNR Precision (mountain toppers and ParEndFedz antennas:
https://www.lnrprecision.com/

Pacific Antennas:
http://www.qrpkits.com/dcxxb.html

Youkits H1B1:
https://youkits.com/

QrpGuys:
https://qrpguys.com/

Appendix

Suggested Readings:

ARRL portable Antenna Classics:
http://www.arrl.org/shop/ARRL-s-Portable-Antenna-Classics/

ARRL QRP Basics:
http://www.arrl.org/shop/QRP-Basics-2nd-Edition/

VK3YE Minimum QRP:
https://www.amazon.com.au/Minimum-QRP-Doing-under-amateur-ebook/dp/B016CIB51G

WA3WSJ Pedestrian Mobile Handbook:
http://w3bqc.homestead.com/WA3WSJ_s_PM_Handbook.pdf

WD8RIF Portable Ops:
http://wd8rif.com/pdf/PortableAmateurRadioOperations.pdf

Appendix

Useful formulas:

Total Dipole Length = 468/Freq in Mhz

Ohm's Law: V = I x R

V *voltage* [Volts] = I c*urrent* [Amps] * R *resistance* [Ohms]

Power Circle Formula or "PIE" Circle: P = I x E

P Power [Watts] = I c*urrent* [Amps] * E Voltage [Volts]

Power Measurement in Db:

Db= 10 x Log10(P2/P1)

P2 = Power Out/P1 Power In or Reference Power

Appendix

Useful Formulas:

Required Battery Capacity Calculation:

RxT= Rx Time

RxAh = Amp Hours current draw on Receive

TxT= Tx Time

TxAh = Amp Hours current draw on Transmit

Df = Duty Factor – Duty Cycle expressed as a fraction

[Duty Cycle = is the time that a device spends in its active state as a fraction of the total time under consideration]

(RxT *RxAh) + (TxT*TxAh)*Df = Amp Hours Required To Operate

Appendix: End Fed Wire Lengths from BalunDesigns.com

Suggested Wire lengths for Endfed with 9:1 unun [SWR indicated]:

Wire Length Feet	1.8 MHz	3.7 MHz	5.3 MHz	7.1 MHz	10.1 MHz	14.2 MHz	18.1 MHz	21.2 MHz	24.9 MHz	28.5 MHz	50.1 MHz
175	1.2	1.6	1.1	1.1	1.1	1.8	1.3	1.6	1.7	1.2	1.5
169	1.4	1.2	1.2	1.2	1.2	2.1	1.4	1.4	1.5	1.2	1.1
162	1.4	1.5	1.7	1.3	1.6	1.8	1.9	1.1	1.5	1.7	1.5
146	1.7	1.5	1.4	1.4	2.4	1.5	1.3	1.2	1.4	1.5	1.5
135	2.0	1.4	1.3	1.8	1.6	2.0	2.0	1.7	1.5	1.6	1.3
124.5	*1.3*	*1.3*	*1.2*	*1.3*	*1.7*	*1.6*	*1.8*	*1.6*	*1.4*	*1.1*	*1.4*
98.5	1.8	1.7	1.4	1.7	2.3	1.9	1.4	1.2	1.7	1.2	1.2
88.5	1.8	2.2	1.7	2.3	1.9	1.3	2.0	1.8	1.4	1.5	1.5
72	2.0	2.0	1.4	1.2	1.2	1.9	1.9	1.5	1.1	1.5	1.1
59	1.6	1.6	1.3	1.5	2.0	1.5	2.0	1.1	1.7	1.2	1.5
53	*1.6*	*1.4*	*1.2*	*1.1*	*1.5*	*1.1*	*1.9*	*1.2*	*1.1*	*1.7*	*1.1*
49	1.5	1.3	1.4	2.4	2.4	1.3	1.6	1.6	1.4	1.7	1.5
44		1.2	1.5	2.1	2.1	1.7	1.3	1.7	1.6	1.1	1.2
36		1.2	1.3	1.3	1.3	2.0	1.6	1.2	1.7	1.6	1.5
29.5				1.2	1.2	2.1	2.0	1.3	1.2	1.6	1.3
24.5				1.6	1.6	1.4	2.1	1.8	1.3	1.2	1.4

Appendix

QRP Watering Hole Frequencies CW:

- 160 Meters ~ 1.810 MHz
- 80 Meters ~ 3.560 MHz
- 40 Meters ~ 7.040 and 7.030 MHz
- 30 Meters ~ 10.106 MHz
- 20 Meters ~ 14.060 MHz
- 17 Meters ~ 18.080 MHz
- 15 Meters ~ 21.060 MHz
- 12 Meters ~ 24.906 MHz
- 10 Meters ~ 28.060 MHz