THIRTEEN DECIBELS DOWN AND OFF THE GRID

or

BACKPACK QRP

By Jim Smith K3RTU

WHY LEAVE YOUR NICE COMFORTABLE SHACK TO OPERATE "OFF THE GRID" WITH A QRP RIG CARRIED IN A BACKPACK?

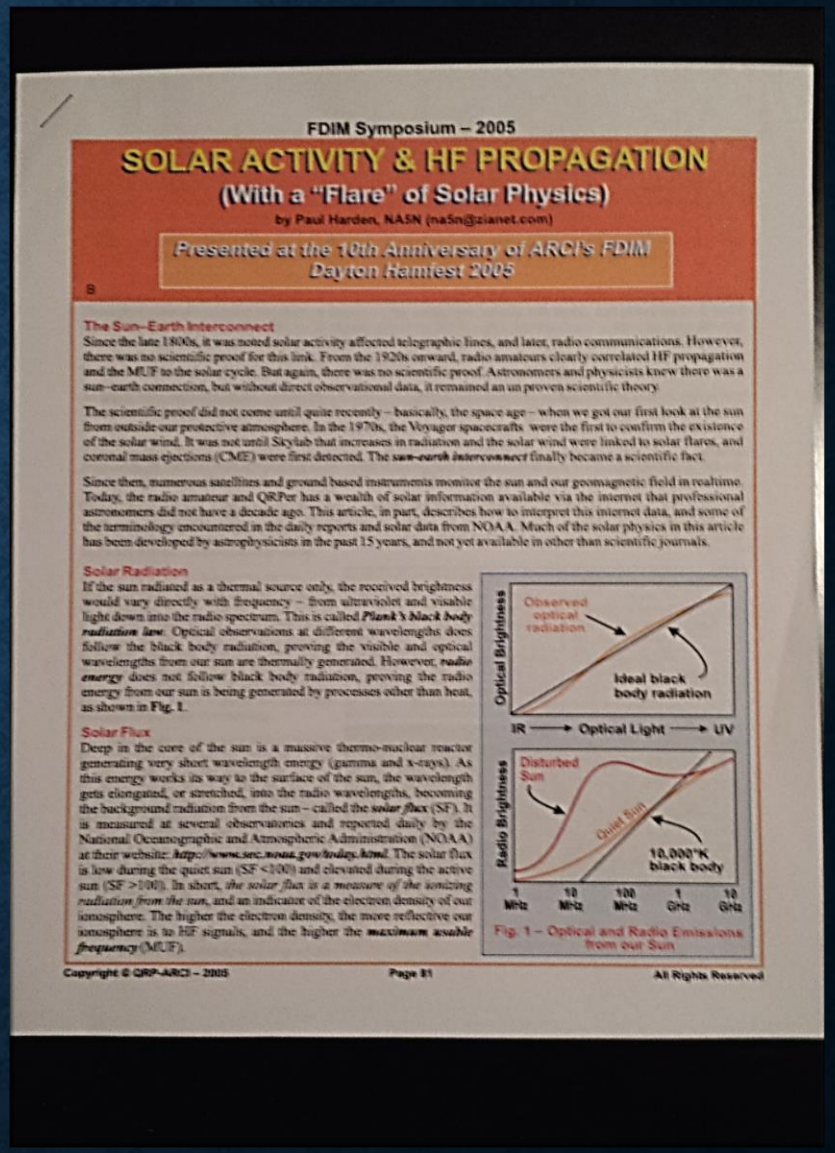
- You will get some exercise.
- You can enjoy nature and, and at the same time, your favorite hobby.
- You will have a chance to get back to the **basics of amateur radio**.

BASICS OF AMATEUR RADIO

- Putting a temporary station together off the grid and out of a BACKPACK can help sharpen your basic skills.
- Keeping mindful of **propagation predictors** helps make your operation more successful.
- **Striving to get the most out of your rig, power source, and antenna helps you sharpen your skills and basic knowledge.**

SOLAR ACTIVITY & HF PROPAGATION (WITH A "FLARE" OF SOLAR PHYSICS)

- This short document by Paul Harden, NA5N is readily found on the internet.
- It does a terrific job explaining HF Solar Physics to someone without a PhD.
- MUF, solar flares, A and K indices and solar flux are all demystified.
- Plenty of propagation hints useful to QRP enthusiast are provided.



FDIM Symposium – 2005

SOLAR ACTIVITY & HF PROPAGATION

(With a "Flare" of Solar Physics)

by Paul Harden, NA5N (na5n@zianet.com)

Presented at the 10th Anniversary of ARCI's FDIM Dayton Hamfest 2005

8

The Sun–Earth Interconnect

Since the late 1800s, it was noted solar activity affected telegraphic lines, and later, radio communications. However, there was no scientific proof for this link. From the 1920s onward, radio amateurs clearly correlated HF propagation and the MUF to the solar cycle. But again, there was no scientific proof. Astronomers and physicists knew there was a sun–earth connection, but without direct observational data, it remained an un proven scientific theory.

The scientific proof did not come until quite recently – basically, the space age – when we got our first look at the sun from outside our protective atmosphere. In the 1970s, the Voyager spacecrafts were the first to confirm the existence of the solar wind. It was not until Skylab that increases in radiation and the solar wind were linked to solar flares, and coronal mass ejections (CME) were first detected. The ***sun-earth interconnect*** finally became a scientific fact.

Since then, numerous satellites and ground based instruments monitor the sun and our geomagnetic field in realtime. Today, the radio amateur and QRPer has a wealth of solar information available via the internet that professional astronomers did not have a decade ago. This article, in part, describes how to interpret this internet data, and some of the terminology encountered in the daily reports and solar data from NOAA. Much of the solar physics in this article has been developed by astrophysicists in the past 15 years, and not yet available in other than scientific journals.

Solar Radiation

If the sun radiated as a thermal source only, the received brightness would vary directly with frequency – from ultraviolet and visable light down into the radio spectrum. This is called ***Plank's black body radiation law***. Optical observations at different wavelengths does follow the black body radiation, proving the visible and optical wavelengths from our sun are thermally generated. However, ***radio energy*** does not follow black body radiation, proving the radio energy from our sun is being generated by processes other than heat, as shown in **Fig. 1**.

Solar Flux

Deep in the core of the sun is a massive thermo-nuclear reactor generating very short wavelength energy (gamma and x-rays). As this energy works its way to the surface of the sun, the wavelength gets elongated, or stretched, into the radio wavelengths, becoming the background radiation from the sun – called the ***solar flux*** (SF). It is measured at several observatories and reported daily by the National Oceanographic and Atmospheric Administration (NOAA) at their website: ***http://www.sec.noaa.gov/today.html***. The solar flux is low during the quiet sun (SF <100) and elevated during the active sun (SF >100). In short, *the solar flux is a measure of the ionizing radiation from the sun*, and an indicator of the electron density of our ionosphere. The higher the electron density, the more reflective our ionosphere is to HF signals, and the higher the ***maximum usable frequency*** (MUF).

Fig. 1 – Optical and Radio Emissions from our Sun

THINGS TO CONSIDER

- Select a rig that is light weight and draws as little receive current as possible. Don't try to lug your station rig on the trail as it was never designed to draw minimal amounts of receive current.
- Select an antenna or antennas carefully. Choose antennas that are light weight, can be broken down easily into a backpack and can be easily deployed.

YOUR RIG

- Many new QRP rigs are small, light weight, easy on **receive current**, multi-mode and some even have all the "bells and whistles". Having one with a built in antenna tuner and a speech processor is a real plus.
- If you prefer to operate only CW your choices of rigs is even greater. Also CW only rigs are more easily built from kits or homebrewed. They also draw far less current on receive.*
- * More on rigs later!

SSB VS CW QRP

If you've never become proficient with CW or just don't like CW don't let this stop you from trying your hand at BACKPACK QRP. I use both CW and SSB; most times with equal success!

CHOOSING AN ANTENNA

- Your antenna will be the difference between success and failure and should be your primary area of concern!
- Verticals, dipoles, and end fed wires can all work well.*
- Your antenna should be one that is EASY TO DEPLOY!
- **Trees or a lack of trees often determines the antenna type you might have to use.**

*more on types of antennas later

OFF THE GRID WITH BATTERIES

BATTERY TYPES

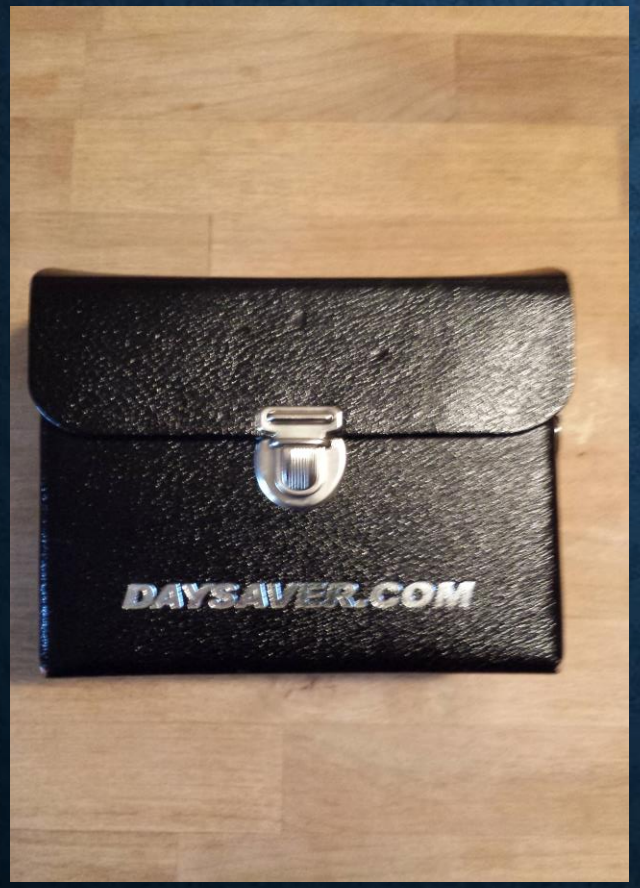
- Sealed Lead Acid (SLA) batteries (12 volt) come in many sizes. Fortunately, they are inexpensive, but unfortunately they are heavier and larger than other types to carry in a backpack!
- Lithium batteries provide far superior performance in the weight verses Ampere hour category, but they are expensive!
- NiMH batteries are a cheap/lightweight alternative to expensive Lithium or heavy SLA's.
- Many rigs have battery compartments for AA batteries for QRPp.


Cabela's
Rechargeable 12-Volt DC Battery 8.0 Ah
Recycle
Made in China
Sealed Rechargeable Battery
POWERSONIC
MODEL PS-1250 F1
12 Volt 5.0 Amp. Hr
Warning:
Risk of fire, explosion, or burns.
Do not disassemble.
Do not incinerate.
Do not heat above 60°C.
WERKER
WKA12-2.3F
Pb

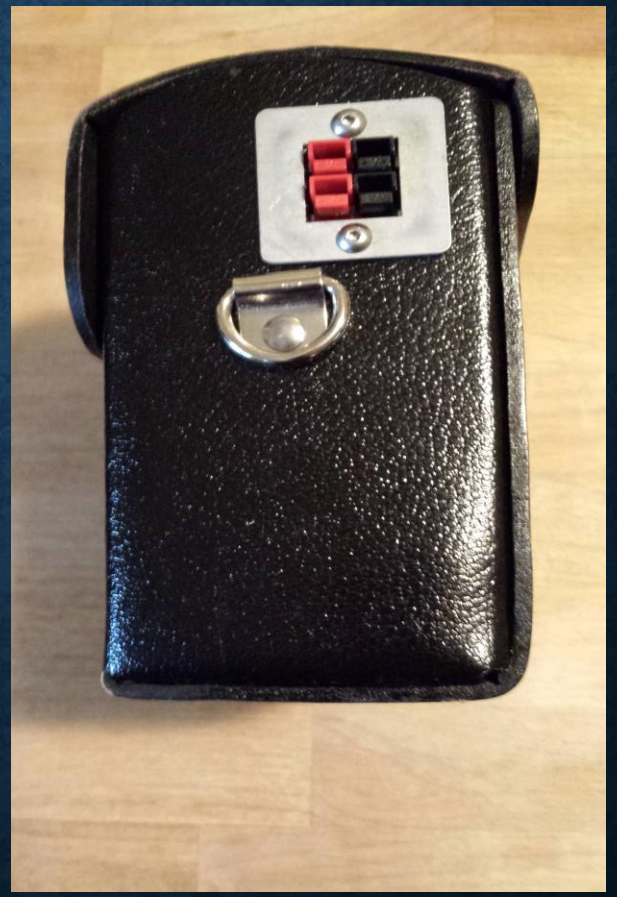
AN 8 AMPERE HOUR SLA / WEIGHT 6 LBS…. OVER TWICE THE WEIGHT OF THE FT-817 NEXT TO IT.

14.5 AH LITHIUM BATTERY

Weight only about 2.5 lbs

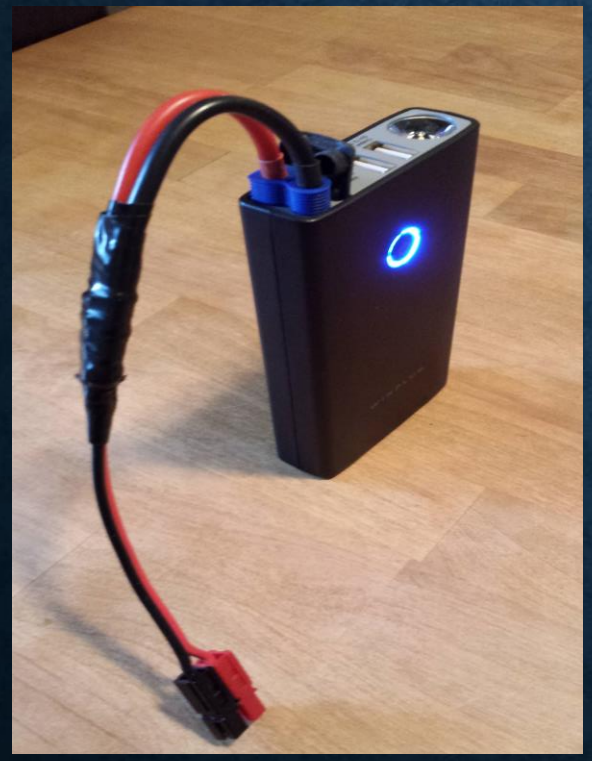


Power poles aid in hook up

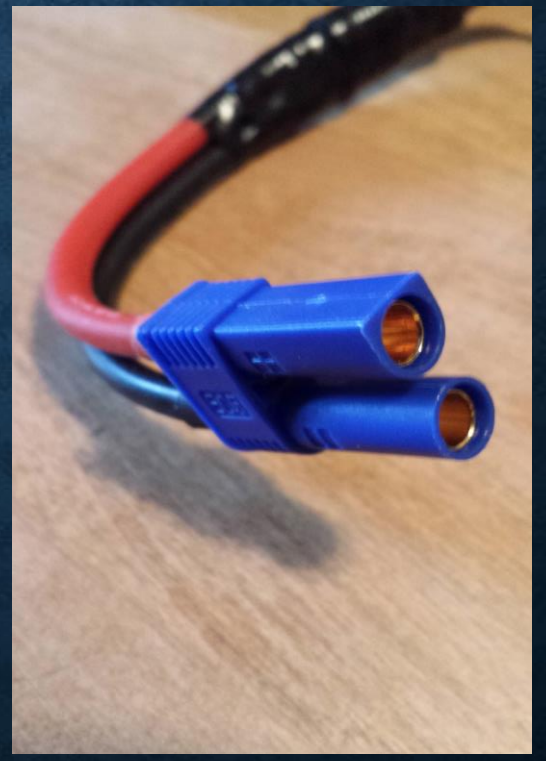


A SOURCE OF LITHIUM RECHARGEABLE BATTERIES: AUTO JUMP START BATTERIES

Lithium auto jump start batteries are readily available like this 2.7 Ah



EC5 connectors are used on this battery type: Check out Amazon



A LIGHTWEIGHT RECHARGEABLE NICKEL-METAL HYDRIDE

SOLAR PANELS

- Solar panels are great for recharging batteries or maintaining a charge.
- However, they can be **expensive, heavy,** and **don't easily fit in a backpack**.
- For QRP Field Day type operation or a camping trip they shine, but **for just a few hours of operation in the field they could prove impractical.**

A SMALL 1.5 WATT SOLAR PANEL(15” X 6.5”) AND A CHARGE REGULATOR – SOLD BY HARBOR FREIGHT

BACKPACK

- Choose a backpack or sling bag that you can comfortably carry for some distance. **Student backpacks are cheap, but just don't cut it**
- You might try carrying two smaller bags to distribute the weight, but **try not to overly weigh yourself down**.

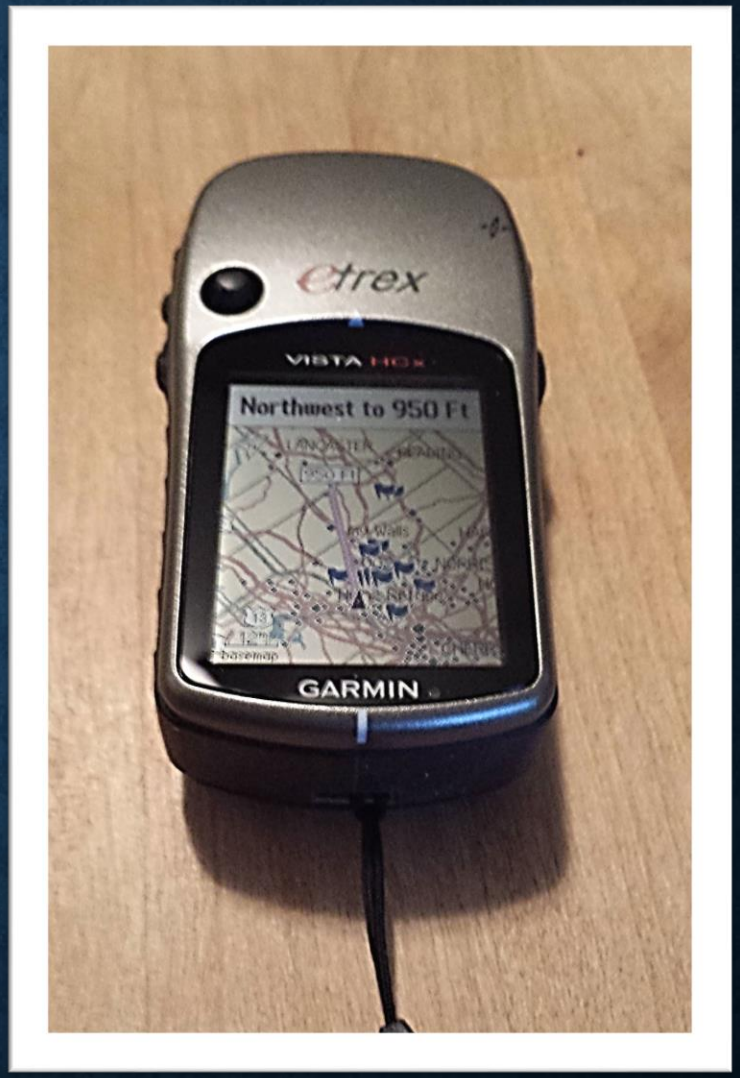
SITUATIONAL AWARENESS AND SAFETY

ALWAYS KNOW WHERE YOU ARE AND WHAT IS AROUND YOU!

Be aware at all times of your location and your surroundings! During Fall and Winter hunters are active! Be sure to stay out of hunting areas and seriously consider wearing a blaze orange vest or hat if planning to be even near hunting areas.

A HANDHELD GPS IS A MUST IN A LARGE UNFAMILIAR AREA

Today a handheld GPS is fairly cheap. It will not only show your position, but also your heading, and even tracks the path you've taken. The topographical display maps give a very good picture of the terrain.



BE ALERT FOR LIGHTNING STRIKES

Lightning strikes can sneak up on you easily and can be deadly. Whether out in the open or under trees you can become a target for deadly lightning strikes! SO BE ALERT!

MUST HAVES TO CARRY ALONG

- Smart phones are helpful to carry, and provide spotting for SOTA activities and DX spotting in general. A dual band HT with a ¼ wave whip is also a good safety backup. Load any nearby repeater frequencies in the memory ahead of time.
- A FIRST AID KIT, WATER BOTTLE and insect repellent are MUSTS. Remember it's easy to get dehydrated which is potentially dangerous. Also carrying a small waterproof ground cover can serve as a poncho or if nothing else will keep your butt dry and off wet ground.

FIRST AID KIT

Your **FIRST AID KIT** need not be large or elaborate, but it is something you definitely should have with you. **You might never need it, but if you don't have one you might regret it.**

ANTENNAS

YOUR ANTENNA: FIRST AND FOREMOST

- Even the best QRP transceiver is only as good as the antenna connected to it!
- Over the last decade I've used: dipoles, verticals, EFHW's, random length wires, and random length wires fed with a 9:1 UNUN in both horizontal and sloper configurations.
- You can usually carry at least one if not two of these with enough coax* to connect to your rig. End fed wires and verticals are especially easily deployed. * more on coax later

VERTICALS

- The Buddistick by Buddipole Corp. and the MP1 by Super Antenna both work well and easily breakdown to fit in a backpack.
- The wire counterpoises or radials this antenna type uses take up little space in a backpack.
- Mounting can be performed in a number of ways. I prefer using an aluminum rod as a mount and walking staff.

BUDDISTICK VERTICAL

The **Buddistick** mounted on the 42” aluminum rod with four counterpoise wires or radials. Unfortunately when I took the photo I couldn’t get this fat, old guy to leave it alone and get out of the photo.

MP1 VERTICAL BY SUPER ANTENNA

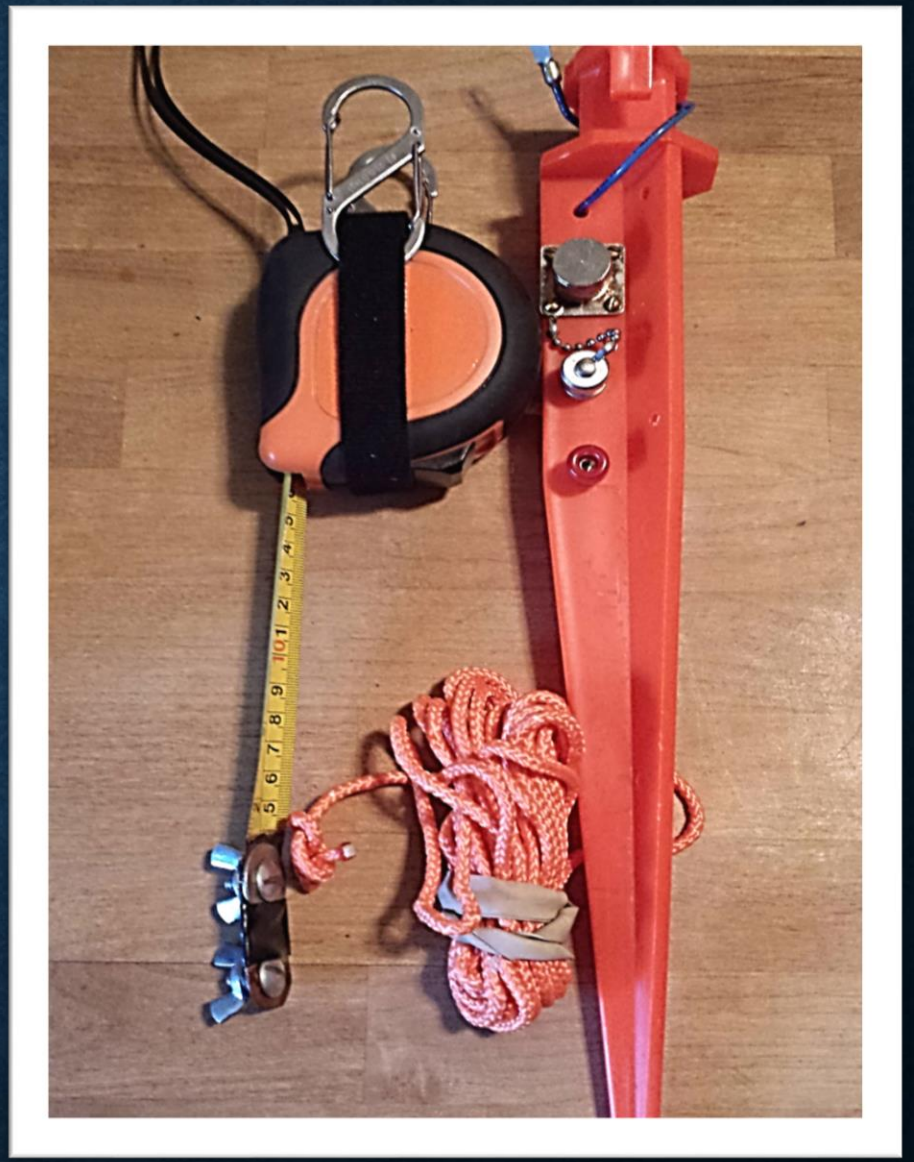
Basically the same antenna as the Buddistick, the MP1 has a **sliding sleeve** over the coil that allows for quick,easy matching for the lowest SWR.

MP1 MOUNTED ON WALKING STICK

The MP1 covering 40 through 10 meters and has produced QSO's both in N. America, S. America as well as Europe for me, much like my Buddistick. Also, as with the Buddistick it comes with all the hardware to mount it anywhere.

A TAPE MEASURE VERTICAL (TMV): EASY AND CHEAP TO MAKE AND DEPLOY

The main components used are **inexpensive** and obtainable from hardware stores. A line thrown over a limb about 18’ to 20’ high can be used to hoist the body of the tape measure up about 16’ for 20 meters.



THE BASE OF THE TMV

The feedline from the rig is attached to the connector with the center conductor going to the steel tape measure and the ground side of the conductor going to the counterpoise wires. Since this is a quarter wave, base fed vertical it has a high current at the feed point which requires a good ground plane to work.

See details: **QST, August 2014.**

TMV SUSPENDED AT ABOUT 20’

The line on the left is used to haul up the body of the tape measure. The line on the right is used to lower the tape to get the lowest SWR for the band of operation 20 through 10 meters. **There is no lumped impedance caused by the tape still in the body of the tape measure. The counterpoise wires are there, but hard to see in the grass**

WIRE ANTENNAS

END FED SLOPERS

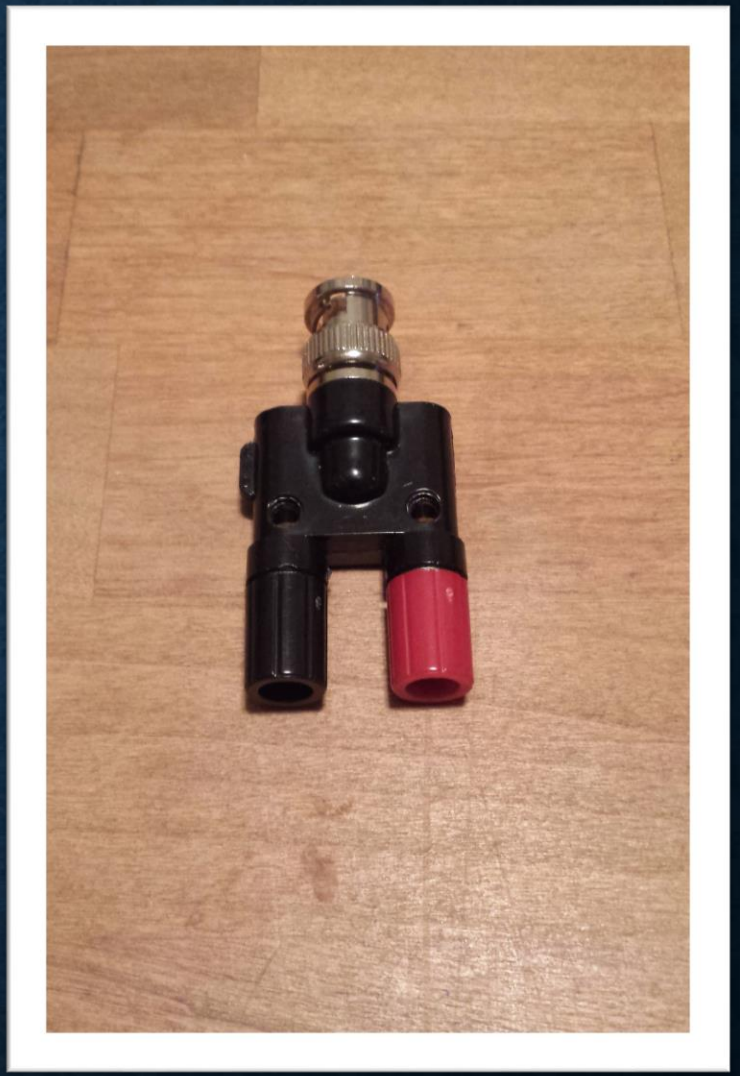
This simple type makes good, quickly, and easily deployed antennas in the field. Of course it helps to have **trees of adequate height** to mount the one end off the ground.

FEEDING THE END FED

The wire can be fed directly from the **antenna tuner** through a BNC to a dual adapter. A **50’ wire** works well for **40, 30 and 20 meters** with the use of a necessary counterpoise wire with lengths of **30’, 23’, and 17’** respectively.

ANTENNA END FED WIRE ADAPTER

With this type of BNC to dual jack adapter you can connect an end fed wire directly to your rig or tuner.



DEPLOYING END FEDS WITHOUT TREES

As an alternative to tossing a line up into a tree a backpacker can use a telescoping fiber glass pole. Some can be extended as much 31’ from as little as 44”. Most are relatively light weight.

THE ANSWER TO SETTING UP A WIRE ANTENNA WITHOUT TREES

A 44” telescoping fiberglass pole which extends to 31’ made by Jackite Corp.

The pole is easily rope guyed or tied with bungee cords to a stump, fence post or trees that are low in height.

JACKITE FIBER GLASS POLE HELD VERTICAL WITH THREE ORANGE GUY ROPES

If the pole must be guyed. **Three guy lines are usually sufficient.** A collar for the ropes can be made from a PVC pipe end cap by drilling a hole in it. **Using three tent pegs one person can get it erected in a matter of minutes.**

PVC PIPE CAP COLLAR DRILLED AND GUY LINES ATTACHED

Orange rope or another bright color is used for safety. Steel "S" hooks are used on each end of the three guy ropes to make hookup to the cap and ground pegs easier.

BACKPACK QRP TIP

Use **insulated wire** for your wire antennas. Small gauges like #22 AWG or #24 AWG work well for QRP. It is lightweight, easily handled and doesn't kink up easily. **Since it is insulated it will not be shorted out by tree leaves.**

CHALK LINE REELS TO DEPLOY END FEDS

Unspool the wire length(# 22 or 24 AWG) you want. Attach the free end to your rig. Then the winder can be easily hoisted into the air. Any wire left on the spool will not act as a lumped impedance.

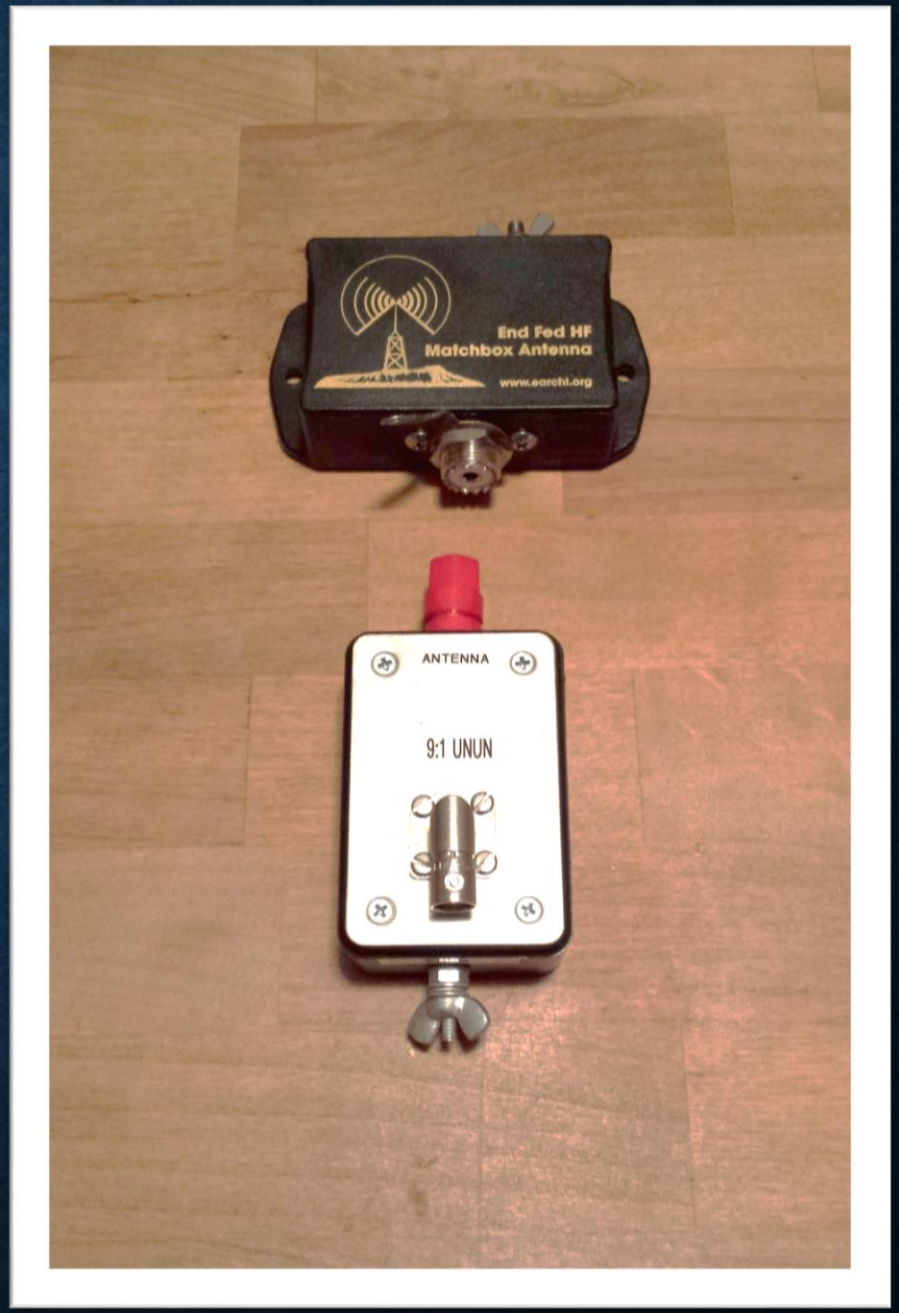
USING A 9:1 UNUN

Another end fed wire type antenna that works really well is a **random length wire** fed through a 9:1 unbalanced to unbalanced transformer or **UNUN**. You can homebrew your own for under $10. Place the UNUN between the rig's coax and the end fed wire. **An antenna tuner is required!**

THE 9:1 UNUN

These two examples of a 9:1 are both small and light. At the top is one from the **Emergency Amateur Radio Club of Hawaii*** which included 33' of Teflon coated wire. Cost $56. On the bottom is a junk box special. Cost almost nothing.

*http://www.earchi.org.



DEPLOYING THE END FED WITH AN 9:1 UNUN

Used with a wire at least **30' to 40'** long you should be able to operate from 40 thru 10 meters. The **coax, which is the counterpoise,** must be at least 30' long, allowing you to get away without additional counterpoises.

A 9:1 UNUN TREE MOUNTED

The end fed wire is attached to the right side of the 9:1 UNUN*. There are two wing nuts on either side of the 9:1 UNUN, one for the antenna and the other for additional counterpoise wires. Bungee cords are really handy to have in your backpack for tasks like this.

*www.balundesigns.com

A QRP TIP ABOUT COAX

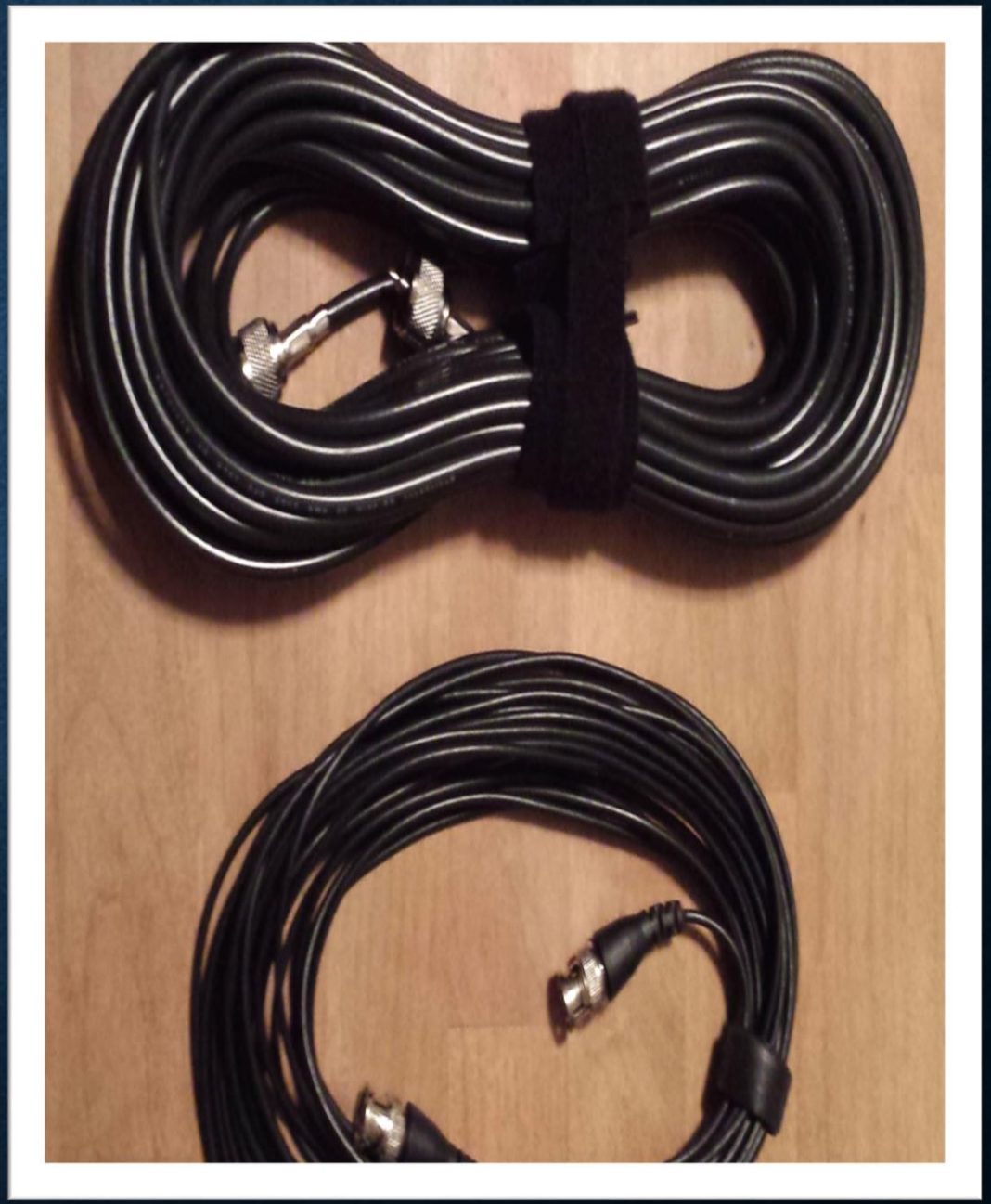
Using RG-174 coax for **QRP** rather than RG-8X or RG-58 cuts down on weight. Thinner RG-174 has higher losses than either RG-58 or RG-8X, but is far lighter and fits much more easily in a backpack. **Kept at short lengths, its loss is very minimal**, only **1db** over equal lengths of RG 58 or RG 8X.

LENGTHS FOR LOW LOSS USING RG-174

Here are the maximum lengths you should use per band: 40 M = 45', 30 M = 37', 20 M = 32', 17 M = 28', 15 M = 26', 12 M = 23', 10 M = 22'. If you don't exceed these lengths you will only lose 1 db. By the way, one decibel equals only 1/6 of an "S" unit. For more info go to www.aa5tb.com

RG-174 COMPARED TO RG-58 & RG-8X

The **RG-174** on the bottom is **much lighter**, easier to handle and better accommodates BNC connectors standard on QRP rigs. **The RG-58 on the top is much bulkier and heavier to carry in your backpack.**



QRP RIGS

YOUR RIG

Today hams who want to operate **BACKPACK QRP** can choose from a large number of good rigs over a large price range. We will discuss here the **Yaesu FT-817nd, the Elecraft KX2, KX3, and the Icom IC-703+.** **Of course there are many, many other rigs which should only be reviewed by someone familiar with them.**

YAESU FT-817ND

This small rig has an **output of 5 watts** in all modes and covers **160 meters thru 70 cm**. It is small (6.5” long, 1.5” H, and 5.3” W). Weight is only about 2.5 lbs. It has a battery compartment for 8 AA cells or a rechargeable Ni-Cd battery pack. Narrow filters are **optional** for both SSB and CW. **It is a proven performer and a real favorite.**

SOME CONSIDERATIONS REGARDING THE FT-817ND

If you operate CW the optional 500Hz filter is a must. The FT-817nd does not have a built in antenna tuner nor a speech processor. An antenna tuner gives you flexibility with antennas and a processor is a real help when operating QRP SSB. The FT-817ND receive current is 450 mA.

FT-817ND CONTINUED

The LDG Corporation makes the Z-817 auto tuner for the FT-817nd that is light and small. It will match a wide range of impedances as will the Elecraft T1 auto tuner which is even smaller than the Z-817. **From personal experience I can attest that the Z-817 will match a very wide range of impedances.**

FT-817ND WITH LDG Z-817 TUNER

FT-817ND WITH A BASE LOADED WHIP.

A base loaded **MFJ** telescoping whip attached to the BNC connector on the face panel of the FT-817nd. **Tuning for lowest SWR is done by adjusting whip length.** Just before this photo was taken I had worked a VE6 in Calgary, running 2.5 Watts in the SSB mode on 14 mHz.

BATTERY SAVING TIPS

When using any QRP rig conserve your battery by turning off unnecessary features. For instance if your rig has a **backlit digital display** you won't need it in the day light! So **turn it off**; you could save **20 mA or more**. If signals are strong, **turn off the preamp** to save even more. **Your rig's manual should have even more tips like these.**

THE ELECRAFT KX2

This radio is a software-defined-radio (SDR). It is literally pocket size, covers all bands 80 thru 10 and transmits and receives SSB/CW/Data (built in PSK and RTTY). **It weighs in at only slightly over 16 ozs., with the antenna tuner, lithium battery, and 24 hr clock.** The KX2 has a digital signal processor


ELECRAFT KX2 TRANSCEIVER
S1 3 5 7 9 20 40 60
SWR 2 3 RF 5 10
3.933.02
LSB
ANT1
ATU
AGC-S
PRE
XFIL
FL1
20:46:55
A
TX
B
AF GAIN/MON
KYR-SPT/MIC
TX
Δf
PWR
DATA
TEXT
MSG
REC
MODE
BAND
STORE
OFS
PRE
FIL
ATU
XMIT
RATE
A/B
RIT
DISP
NR 1 APF-AN 2 PFn 3 TUNE 4 FREQ
6
7
8

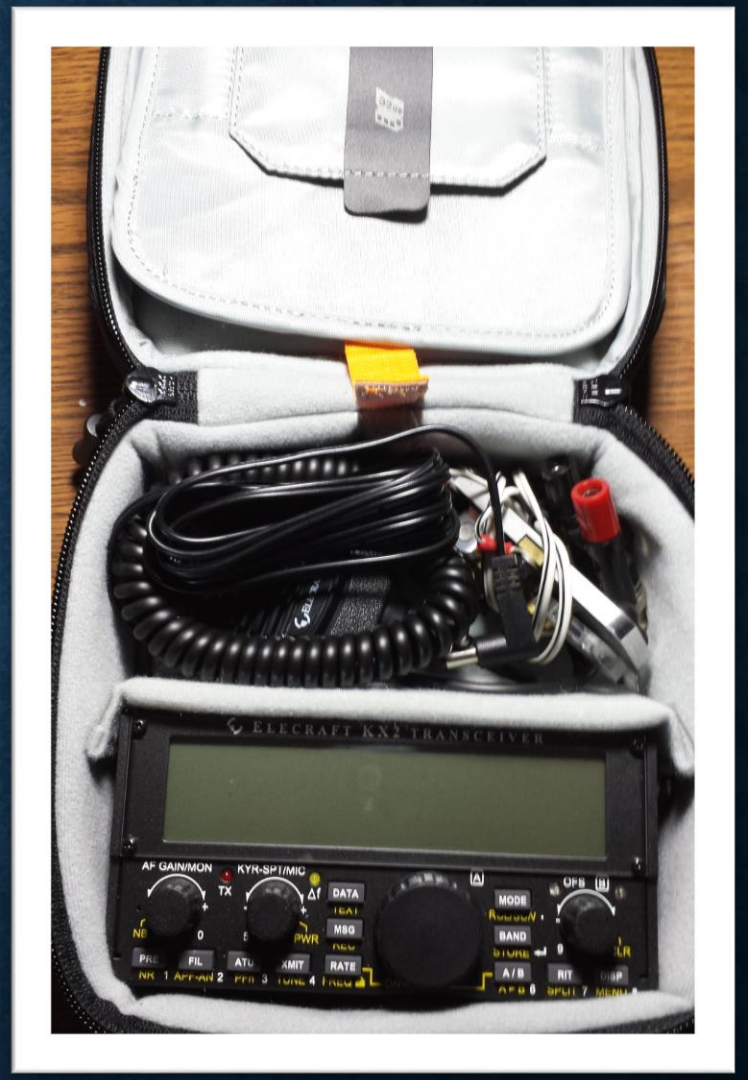
MORE ON THE KX2

It has a built in microphone to allow HT type operation, and a jack for an external microphone as well. The output power of the KX2 is 10 Watts in all modes. It has an audio peaking filter for CW, dual watch, RIT, XIT, noise reduction, keyer, speech processor and lots of filtering functions in all modes, especially in CW and data modes. PSK and RTTY can be sent and decoded (right on the panel display) without a computer or keyboard. Receive current consumption is only 150 mA.

THE KX2 IN THE FIELD

THE KX2 FITS NICELY IN A SMALL PADDED CASE

This case (7”x7”x3”) has plenty of room for the KX2, hand mic, small straight key or paddles, ear buds, DC power cable, BNC to dual banana jack connector, end fed wire and counterpoise. The KX2 here has its own 2 Ah battery in it!



KX2 AND KX3

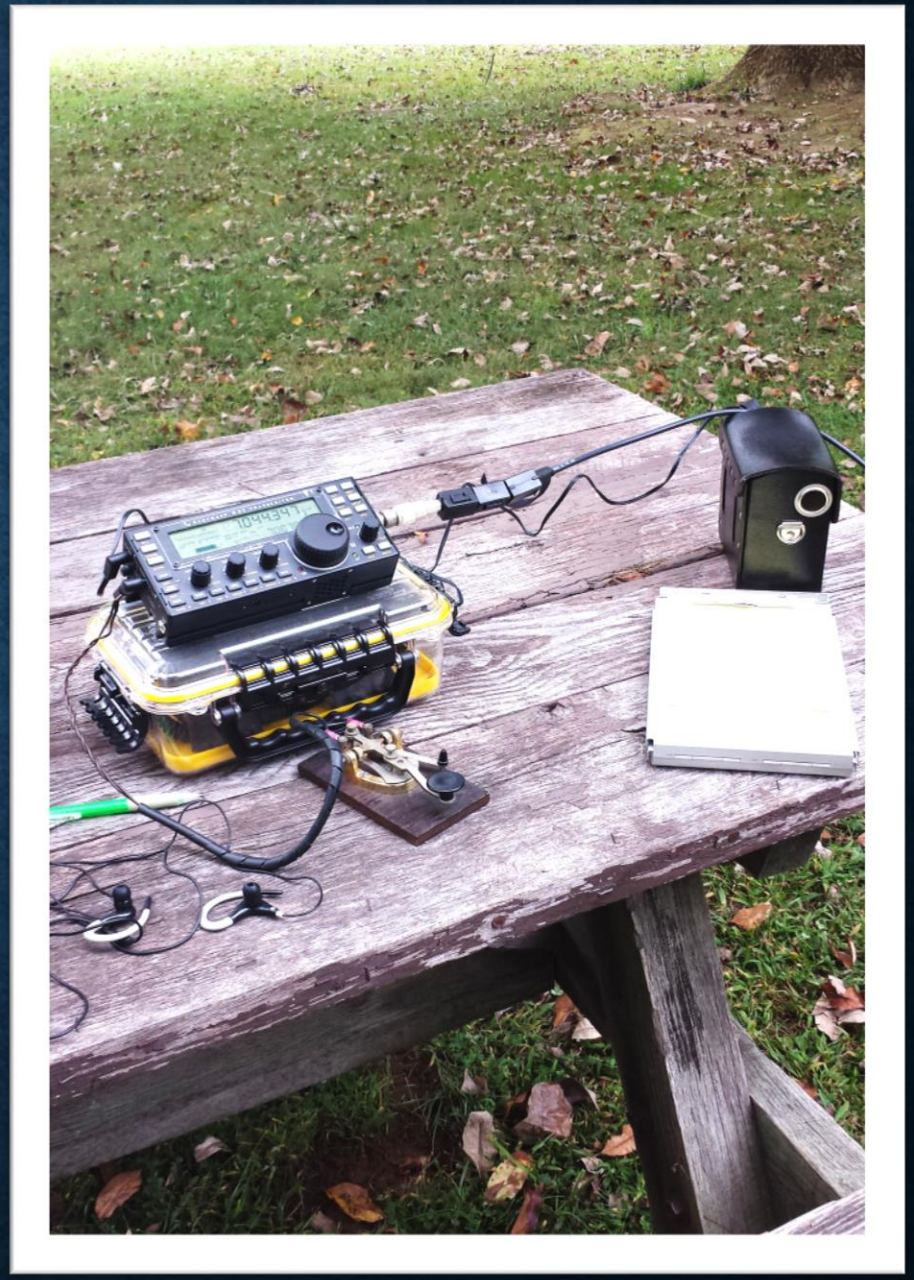
Both are SDR and capable of 10 Watts output in SSB/CW/Data, but the KX3 covers 160 as well as 6 meters. The KX3 also has space for rechargebles. Both can still work at below 9 Volts while still transmitting at 5 Watts or less. Both the KX2 and KX3 can be upgraded through the internet.

THE ELECRAFT KX3

Earlier it was mentioned that some of the newer QRP rigs have all the "BELLS AND WHISTLES". Well, here is the one! This rig has all the features and specs of most fixed station rigs you can find in the same or even higher price range. The optional internal antenna tuners by Elecraft are far superior to the tuners in most larger fixed station rigs! The KX3 is at the top of the heap of QRP rigs! Receive current draw is only 150 mA.

KX3 IN THE FIELD

The rugged plastic water proof case by PLANO and some foam padding, protects the KX3. It even has enough room to hold the microphone, keyer paddles, earbuds and wire antenna.




ELECRAFT KX3 TRANSCEIVER
18.152.35
18.095.99
USB
ANT1
ATU
AGC-F
PRE
XFL
RX
TX
MODE
ALT
REV
DATA
TEXT
SPLIT
INT
XIT
PF1
PF2
BAND↑
RCL
BAND↓
STORE
SCAN
MSG
REC
ANT TUNE
ANT
XMIT
TUNE 0
AF/RF-SQL
PBT I/II
KEYER/MIC
MON
NORM
PWR
OFS
CLR
PRE
ATTN
APF
SPOT
CMP
DLY
TX
NR 1
NB 2
NTCH 3
CWT 4
PITCH 5
VOX 6
RATE
DISP
KHZ
MENU
Δf
ELECRAFT-MH3

THE ICOM IC-703+

Unfortunately this rig is no longer manufactured. It was introduced sometime after the Yaesu FT-817. It's bigger, heavier and uses more receive current than the FT-817nd and way more than either the KX3 or KX2. Despite these negatives it does have a good built in antenna tuner, a receiver far superior to that of the FT-817nd, and a full ten Watts output. It also has a speech compressor. **If you can find one of these great rugged rigs for sale in good condition….go for it. It is a real proven performer!**


ICOM
AF-RF/SQL
HF/50MHz TRANSCEIVER IC-703
MODE
POWER
P.AMP/ATT
TUNER
PHONES
RIT/
SUB
M-CH-SHIFT
USB
28.4 15.00
F-BK COM
S1 3 5 7 9 20 40 60dB VFO A
1CH
M3 FIL NB MET
TS
RX
TX
DISPLAY
LOCK
MENU
F-1
F-2
F-3

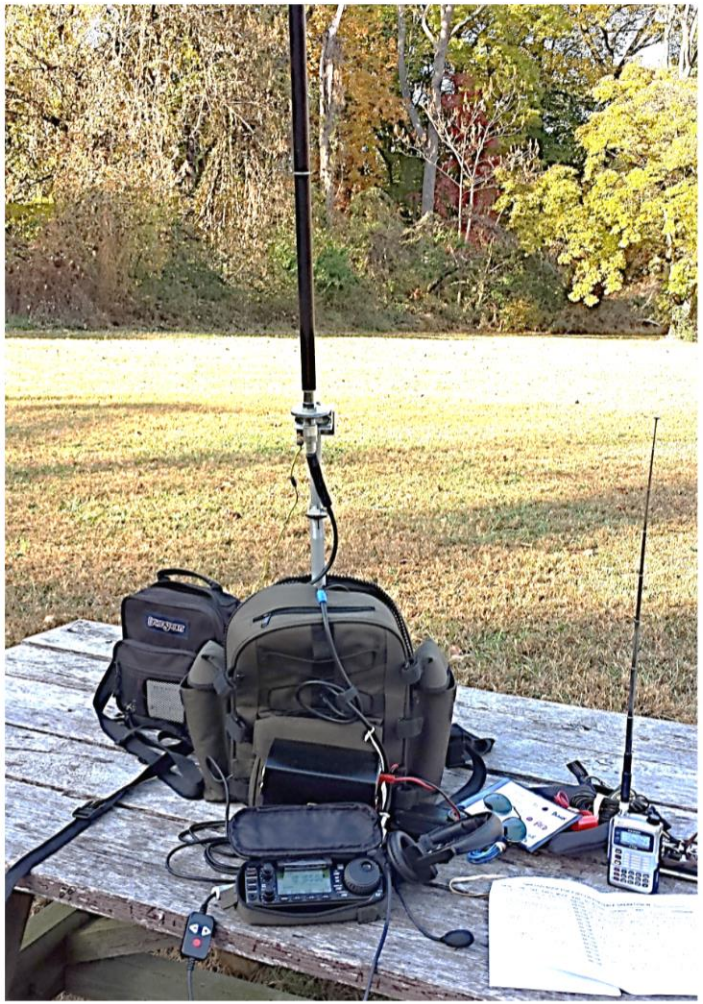
IC-703+ SPECIFICATIONS

The 703+ covers all bands 160 thru 6 meters, and can transmit and receive SSB, CW, AM, FM and Data modes.

- It can operate at a reduced voltage of 9 volts and still transmit at the 5 Watt level. Receive current is 500 mA.
- Physical dimensions: roughly 6 ½" (W), 2 ½" (H) and 8" (D) Weight 4 lb 4 oz. It looks identical to the IC-706 MkIIG.

IC-703+ PEDESTRIAN MOBILE

With its detachable control head the body of the 703+ can easily be put in a backpack with a battery and mount for a vertical. **The QRP'er can carry the backpack while controlling the rig with the detachable** control head. Seen here is the Icom, rain resistant backpack. The control head has its own case for attaching to the operator's waist.



IC-703+ AND BUDDISTICK VERTICAL BACKPACK MOUNT

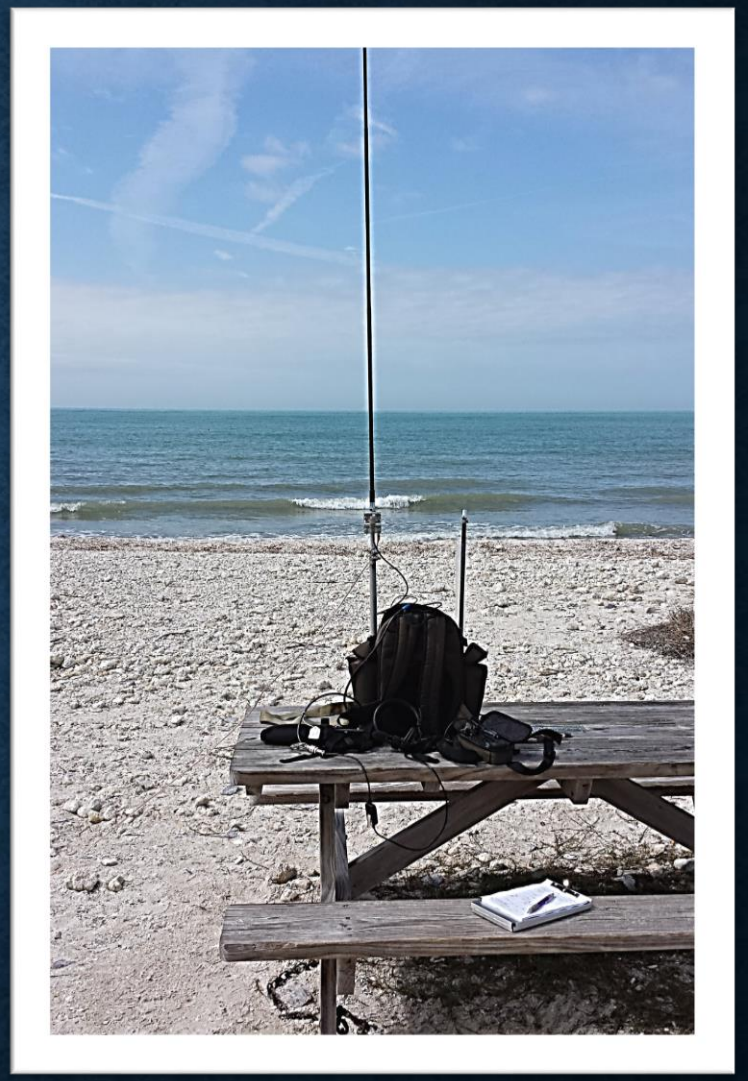
The pedestrian mobile backpack makes for an easy way to set up your rig anywhere and begin operation quickly. Simply set up on the ground, on a table, on a bench or on a fallen log. Here the 703+ was being operated on an island off Florida's west coast.

BACKPACK QRP TIP

While at a New Jersey beach during the summer or on a Florida beach during the winter try setting up your **vertical antenna** within **two** wavelength of the water for the band you plan to use. Your signal will get quite a boost from the salt water. I have been lucky enough to take advantage of this boost on several occasions. **Remember your antenna must be a vertical and it must be within two wavelengths of the water. Sorry, but it must be salt water!**

IC-703+ BACKPACK SURFSIDE

This photo shows the 703+/antenna well within two wavelengths of the saltwater on a Florida island beach. The collapsible whip was extended to a quarter wave on 28 mHz. **Within a few minutes of operation a number of Europeans were worked including a station just north of the Black Sea.**



HANDY AIDS TO SET UP AND OPERATING

A small pocket sized antenna analyzer by iPortable especially handy for adjusting a TMV

A Heil Traveler "Single Sider" headset and microphone push switch/VFO control.

SOME MORE AIDS TO SETTING UP IN THE FIELD

BACKPACK CONTENTS

Electronics

- QRP Rig / manual
- Microphone
- Key
- Battery Pack
- Ear buds
- Dual band HT

Antenna

- Insulated wire
- Coax: RG-174
- Rope / throwing weight / bungees
- 9:1 UNUN
- Multitool

Essentials

- Log / paper / pencil
- First Aid kit
- Water bottle
- Ground sheet
- GPS or map/compass if necessary.

A FEW LAST WORDS

I hope some of you who enjoy being outdoors will try BACKPACK QRP! I get out with my backpack summer, fall, winter and spring. My longest DX contact so far was 8200 miles into the eastern part of Africa to the nation of Swaziland. I've been able to work over 40 DX entities and over 30 states just occasionally operating this way.

SOURCES

Wire Antennas by John Hill KF7SQQ Available from Amazon

Solar Activity & HF Propagation – Just Google: FDIM Symposium 2005

Amateur Radio and the Great Outdoors by Ed Breneiser

Glen Thibodeaux, KF5FNP, "A Tape Measure Vertical Antenna" QST Nov 14.
"QRP and the Great Outdoors" by Jim Smith K3RTU, K9YA Telegraph. Nov 2015

"Some QRP Encounters" by Jim Smith K3RTU, K9YA Telegraph, Oct. 2016

www.AA5TB.com a lot of really good info on antennas and other subjects.

www.balundesigns.com an excellent source of baluns and UNUN's as well as information regarding end feds using UNUN's.