



Why QRP?

A Report on the Joys of
Low-Power Ham Radio

George Heron, N2APB
2419 Feathermae Ct.
Forest Hill MD 21050
n2apb@amqrp.org
www.amqrp.org
www.njqrp.org



What is “QRP?”

A telegraphy Q-signal

“QRP” = To lower ones power

“QRP?” = Can you lower your power?

Five watts RF output power (or less!)

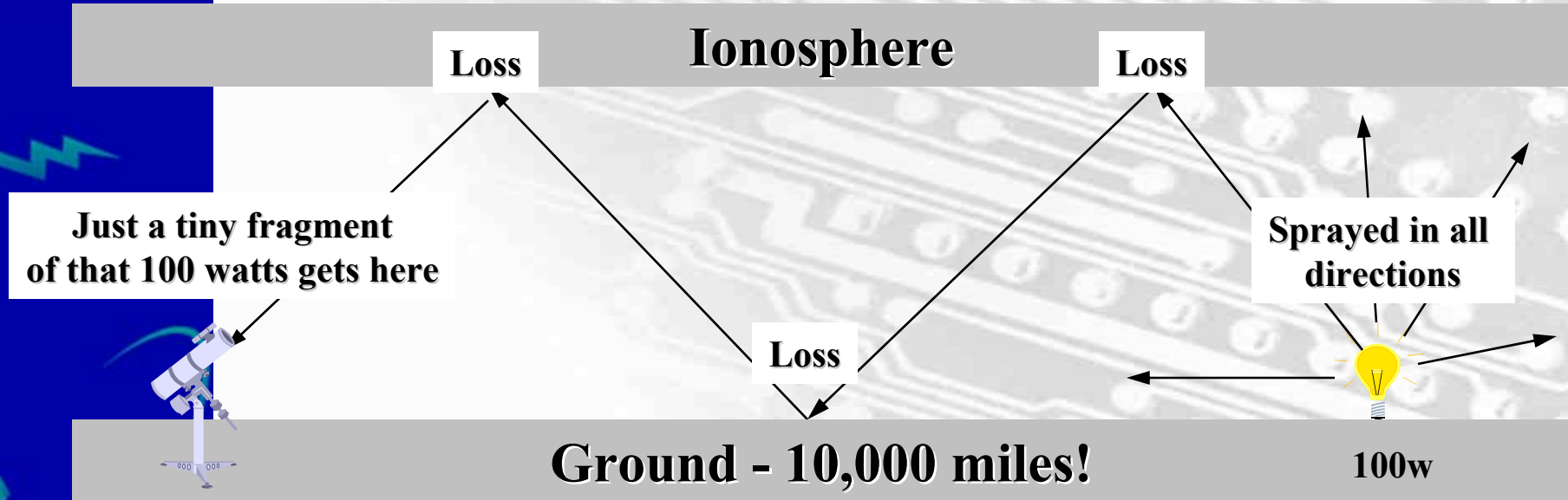
Use a “QRP” rig, or

Turn down your present radio



**Only 5 watts?
You must be
kidding...**

A Pretty Amazing Analogy



Pretty amazing stuff, huh?

Now...replace the 100w light bulb with a 3 watt flashlight.



Part 97, FCC Rules

“Run only the power necessary to maintain the desired communications.”

There is of course room for interpretation here...



Why QRP?

- Signal strength allows it
- Safer for you, your family, and the public
- Quality and simplicity of equipment
- Joys of homebrewing & kit-building
- Backpacking
- Excellent way to improve skills
- It's fun!





QRP Mathematics

Varies LOGARITHMICALLY with power

$$\text{Gain (db)} = 10 * \log(P2/P1)$$

ONE S-unit is 6 db

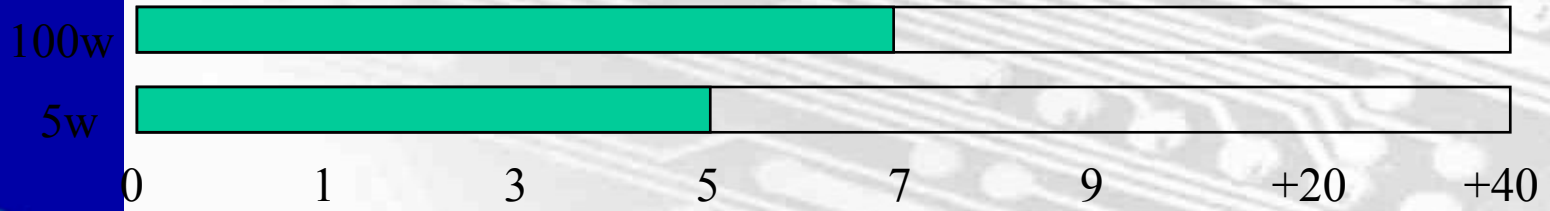
Example:

Increase from 5 to 100 watts (20x)

20x increase in power = *13 db gain*

13 db gain gives gain of only *TWO S-units!!!*

Signal Strength



WHAT DOES THIS MEAN?

Your 5 watt signal *CAN* be heard.



Proof That It Works

W3EAX Field Day, 1988

1200 QSOs with 3 radios & a pair of beams.

May, 1997 contest

31 countries with a mobile whip in 8 hours.

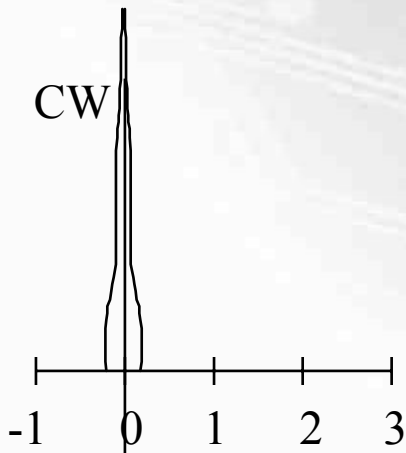
QRP Mobile

Antarctica, Europe, VKs, ZLs, UA0s...

AA3MD

Over 125 countries cfmd in 24 mos. w/dipole.

CW vs. SSB



CW signal bandwidth = 100 Hz

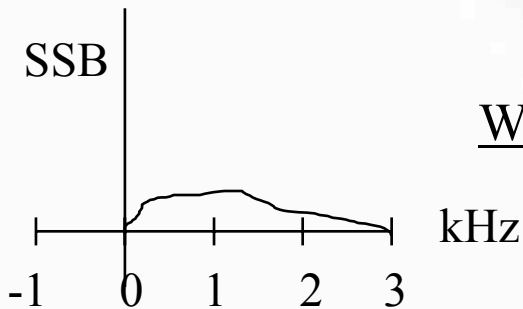
SSB bandwidth = 2000 Hz

Morse has much lower throughput...but...

Average power density

CW - 1 watt/Hz

SSB - 0.05 watts/Hz



Which leads to...

Gain = $10 * \log (1.00/0.05) = 13 \text{ db!}$

Output power = 100w

5w CW is equivalent to 100w SSB!



What Does This Mean?

- Most (but not all) QRP QSOs are CW QSOs
- Thus, if you plan to try QRP...
 - Learn code, practice code, use code, dream code, etc.
- So who does QRP SSB/digital?
 - Lots of people
 - An even bigger challenge than CW QRP



QRP With 100w XCVRs

Most can be reduced to 5w from the front panel

Some require re-adjustment of internal controls

Some require physical modification, but you can also...

1) Use an RF-switched, 50 ohm, high-power attenuator

2) Play with ALC

nearly all 100w radios can drive amplifiers

certain voltage into the ALC jack reduces RF output

can often get down to the milliwatt range



QRP “Optimization”

- 1) Size & weight increase with maximum output power
- 2) Minimize current draw
 - No lamps (except LEDs)
 - No digital display unless LCD
 - Maximize TX efficiency
- 3) Use few components & pack the board tightly
- 4) Use ICs if possible
- 5) Sensitive RX - If you can't hear 'em, you can't work 'em

Size and Weight vs. Max. Power

Conventional 100w setup	Icom 735, etc.	12 lbs.
	Tuner	6 lbs.
	<u>Astron RS-20</u>	<u>25 lbs.</u>
	TOTAL	43 lbs.
	TRANSPORT	Trunk of Car
QRP setup	QRP rig	2 lbs.
	Tuner	2 lbs.
	<u>Power supply/battery</u>	<u>3 lbs.</u>
	TOTAL	7 lbs.
	TRANSPORT	Small Briefcase



Power Requirements for a Day

To run for 24 hours - 10% xmit, 90% receive:

Conventional, compact HF rig (IC-706, Yaesu FT-890)

Receive - 2 amps...Xmit - 4 to 20 amps (avg. 10 amps)

TOTAL CONSUMPTION - 67.2 A-H (a car battery)

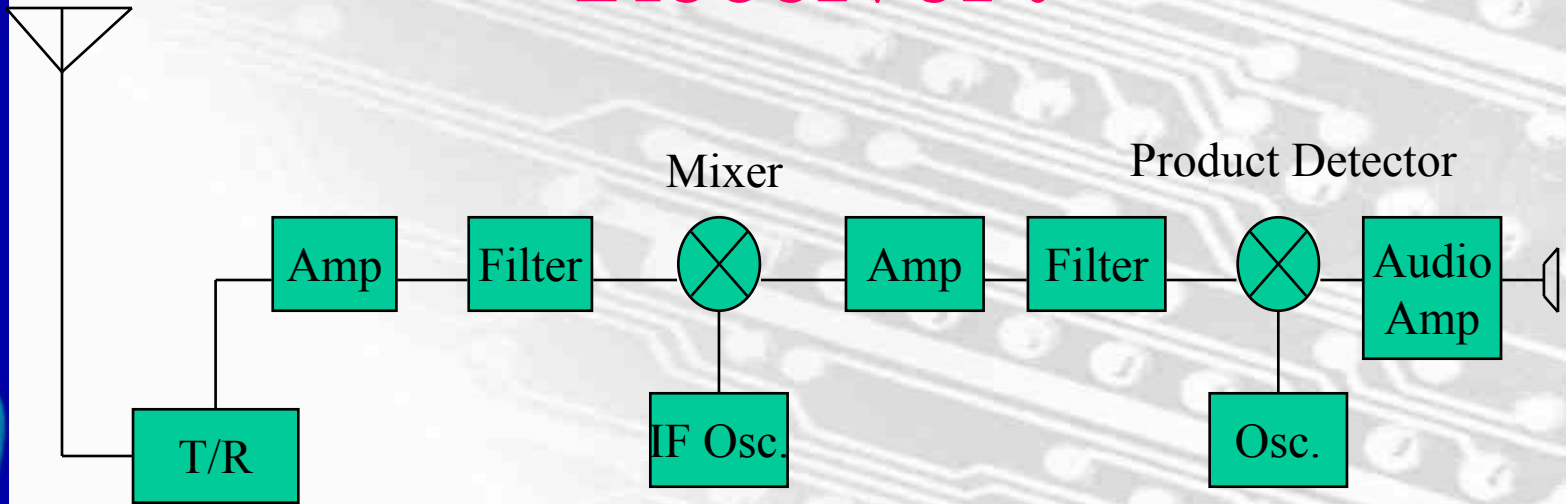
QRP-optimized rig

Receive - 100 milliamps...Xmit - 500 milliamps

TOTAL CONSUMPTION - 3.36 A-H (a 3-lb. gel cell)



What's in a SuperHet Receiver?



THIS IS THE SINGLE MOST IMPORTANT PART OF A RADIO

WELL-DESIGNED QRP RECEIVERS CAN OUTPERFORM “BIG RIGS.”

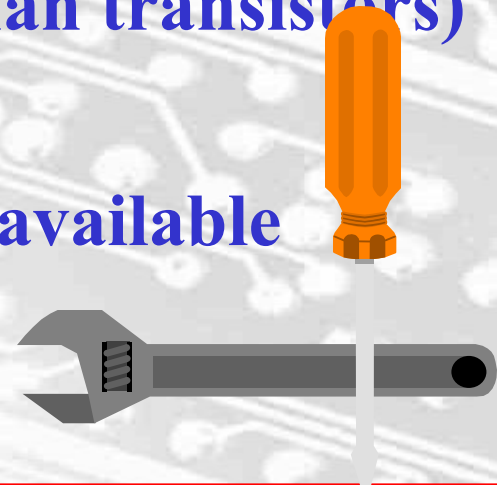


Kitbuilding & Homebrewing

We are natural builders and experimenters

Complete radios have been built from old TVs
(Tubes are harder to kill than transistors)

Thousands of schematics are available





Kits

Hundreds of kits are currently available

Single- and multi-band transceivers

Antenna tuners (automatic ones, too!)

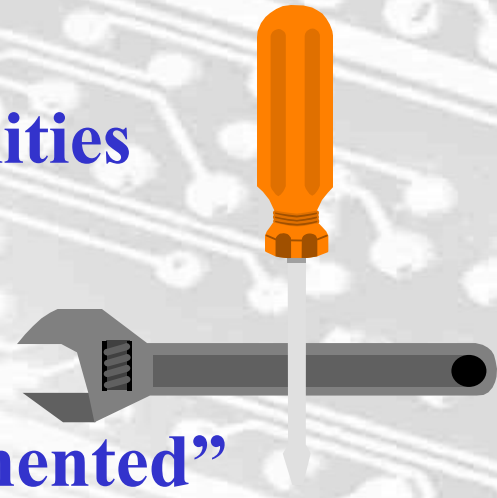
SCAF audio filters, electronic keyers

Made for a wide range of abilities

“U-scrounge-em”

“Bag-o-parts and a board”

“Complete and fully documented”



Antennas!!!

The most important part of ANY station

A radio hooked to a dummy load will hear nothing

Good coax

Good antenna tuner (with non-resonant antennas)

Well-built antennas

Beams work wonders, as do full-size loops

Dipoles and verticals work OK, too

*A poor antenna system hurts your
receiver AND transmitter*



Taking to the Field

Mountaintop operation adds to a radio's performance!

Complete station:

single-band rig

dipole cut to proper length, with coax & rope

straight key or iambic paddles w/electronic keyer

gel cell battery

pen & paper for logging

nice campsite with tall trees





QRP DXing

There are two rules for QRP DXing:

- 1) Listen, listen, listen**
- 2) When in doubt, see rule #1**

Put your signal where and when the others ain't

Let others QRM each other, and pick your spot

Try to get in BEFORE the pileup starts! (see rule #1, above)



QRP Contesting

Great way to pick up QSOs, countries, states, continents

Good operators with good ears

Equipment & antennae are optimized

Lots of QRP-only contests

Sponsored by clubs

Many QRP categories in larger contests

My favorite: **FIELD DAY**

You DO have a chance!



Will I Be Heard? ... a simple test

100w vs. 5w = 13 db difference

Switch in a 10db or 20 db attenuator (on receive)

Assuming identical receivers and local conditions,

If you can still hear the other station,
the other station can hear you.

(not QUITE accurate because noise power drops, too, but a good test)



A Favorite Thing to Hear...

“HOW much power are you
running? A watt?
Really? No way.”

“Way.”



VHF QRP? Yes!

5 watts into a 20-element Yagi can do VERY well
Much 1296, 2304, 3456, and higher equipment must be
homebrewed, and is already QRP

On 6 meters, 5w and a dipole is more than adequate
Sporadic-E season is upon us
Lots of people DO have beams
Use THEIR antennas to your advantage



Even More Challenging

QRPP - aka “Milliwatting”

Defined as less than 1 watt

Big antennas can make up for low power

Worked CN (Morocco) at 200 mW

AA2U has DXCC at under 100 mW

Even modest antennas work well, though

MD - FL on 30m - dipoles & 25 mW output

SSB/Digital

Wider bandwidth, lower power spectral densities!



Some Commercial QRP Rigs

Ten-Tec Model 13xx (single band)

Oak Hills Research 100a (single-band)

MFJ 90xx (CW), 94xx (SSB) (single-band, *not* kits!)

S&S Engineering TAC I, ARK-series (single-band)

K1SWL Small Wonder Labs SW40, Rockmite, DSW-40

W6EMT Emtech (single-band)

Kanga UK/US – R2pro, Binaural Rx,

Wilderness Sierra, Cascade, SST, and NorCal 40A

And many, many, many more... (See References page)



Other QRP Equipment

Direct Conversion Radios

Heath HW-7, HW-8

Ten-Tec Century 21, 22

Superheterodyne Radios

Heath HW-9;

Ten-Tec Argonaut 505, 509, 515, Argo 556,
Argonaut II

A&A Engineering K9AY 20, 30, 40m

Index Labs (defunct) QRP+, QRP++

Yaesu FT-301S, K'wood TS-130V, Icom 731

Club Projects

American QRP Club

**Micro908 Antenna Analyst, Sniffer FSM,
DDS Daughtercard, PSK-80 Warbler, 80m
Squirt Antenna, 4017 Transverter, more!**

Columbus QRP Club

MRX-40 ultra-compact receiver

St. Louis QRP Club

W6MMA Antenna, St. Louis Vertical

Northern California (NorCal) QRP Club

NorCal Keyer, BLT Tuner, Crystals



Support Groups for Addicts

The American QRP Club (AmQRP) www.amqrp.org

QRP Amateur Radio Club International (ARCI)

Internet QRP Club (QRP-L mailing list)

<http://mailman.qth.net/mailman/listinfo/qrp-l>

G-QRP (U.K.), I-QRP (Italy),

NorTex, NorCal, Columbus, NJ, CO & MI Clubs

Adventure Radio Society, Knightlites (NC)

Maryland Milliwatts



PHOTO GALLERY

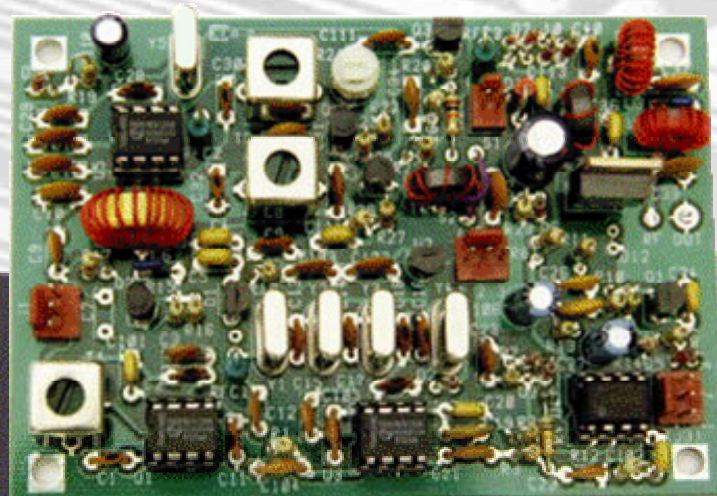
- **Equipment**
- **Antennas**
- **Websites**
- **Clubs**
- **Field Sites**
- **Newsletters/Journals**

The NorCal 40A



- 40m 2W CW transceiver
- Grandfather deluxe

Small Wonder Labs' "SW40+"



- 40m 2W CW transceiver
- Improved, simplified

The “Sierra” by Wilderness Radio

©1996, Steve Hideg



©1996, Steve Hideg



- All band CW transceiver
- Superhet, VFO
- Dig display & key options
- Removable band modules
- Rivals quality of rigs 5x \$
- ARRL Hndbk cover '96

The NorCal 20



K1ZZ Doug Hendricks KI6DS Dave Fifield AD6A

- 20m superhet CW
- great front end
- Norcal kit for 3rd world countries



OHR



- 4 band superhet CW rig

Index Labs' "QRP Plus"



- Super stable QRP rig
- Great user interface

Small Wonder Labs' "White Mountain 20m SSB"



- 20m 2W QRP SSB transceiver
- Solid design
- Easy construction

Argonaut 515



©1995 Steve Hideg

- QRP for CW and SSB

QRP

Heathkit HW-8



- 4 band direct conversion CW QRP rig

The “Tuna Tin 2”



- Simple Tx, less than 1W
- W1FB original design

“Herring Aid” Receiver



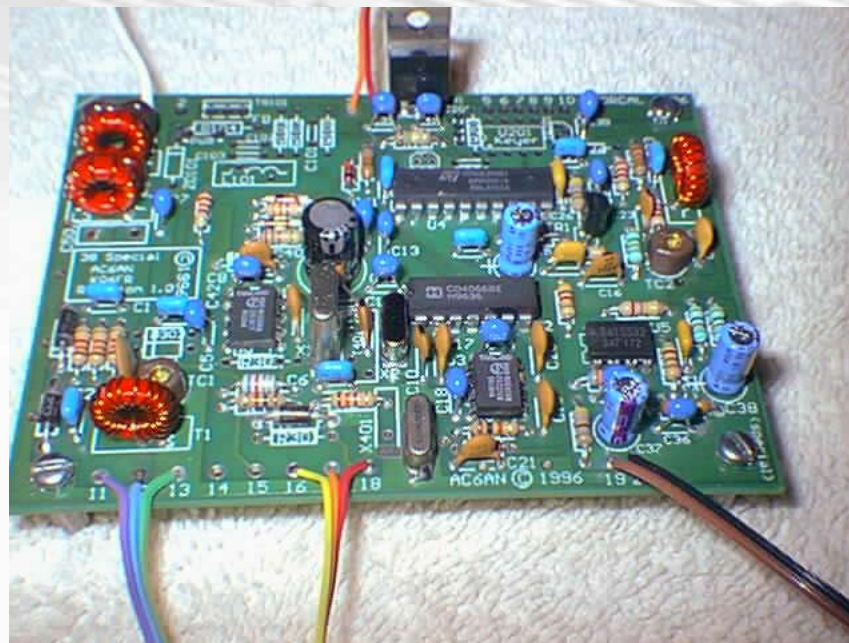
- Simple Rx project
- Mate to Tuna Tin 2 transmitter

The “Pixie”



- Simple 250mW xcvr kit from HSC Electronics

The NorCal “38 Special”



- 30m superhet CW kit from NorCal Club
- 2W output, wide VXO
- Very popular as instructional kit

N2APB's "38 Special"



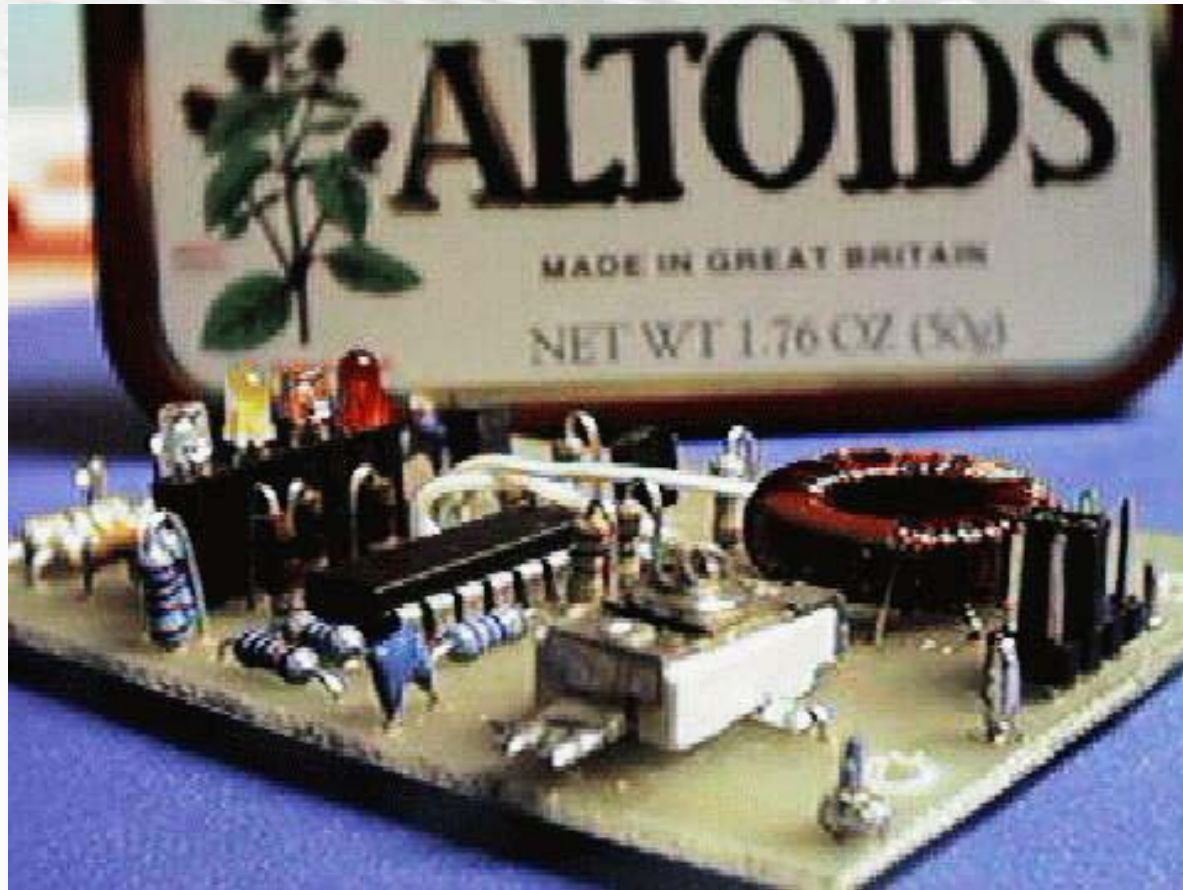
- Custom cabinetry in LMB enclosure

Portable Paddles



- N2APB enclosure for New Zealand ARC project

N2CX “Rainbow Tuner”



- Kitted by the NJ-QRP club
- Resistive (absorptive) SWR bridge w/LED indicators
- Built-in tuner suited for half-wave end-fed antennas

N2APB's "Rainbow Tuner"



- Custom enclosure with panel mounted switch for tuner inductor settings

The N2APB Field Stack



- Batteries
- Rainbow Tuner
- 38S Xcvr
- QRPpaddles

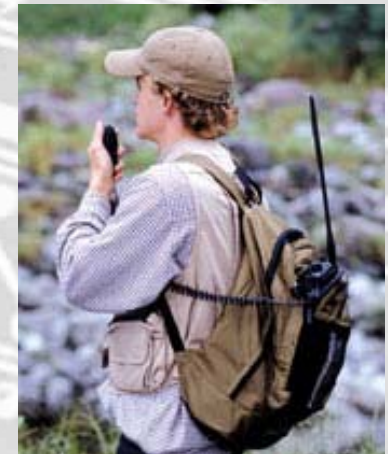
This is what N2APB takes on biz trips (along with “Halfer” half-wave end-fed wire for 30m). Easily fits in small briefcase! page 48

FT-817



The “Ultimate Backpacker”

- Battery powered (8-16V/ 380mA Rx)
- Multi-mode Portable Transceiver (5/2.5/1/0.5 W)
 - SSB, CW, AM, FM
 - 9600 Packet, SSTV, PSK31, etc.
 - Repeater CTCSS/DCS
- HF, VHF, and UHF bands
 - 160-10 meters
 - 6, 2 meters
 - 70 cm
- Extended receive: 100 kHz-56 MHz, 76-108 MHz (W-FM only), 108-154 MHz, 420-470 MHz
- Scanner: both memory and VFO



Full-featured FT-817



Elecraft K1/K2



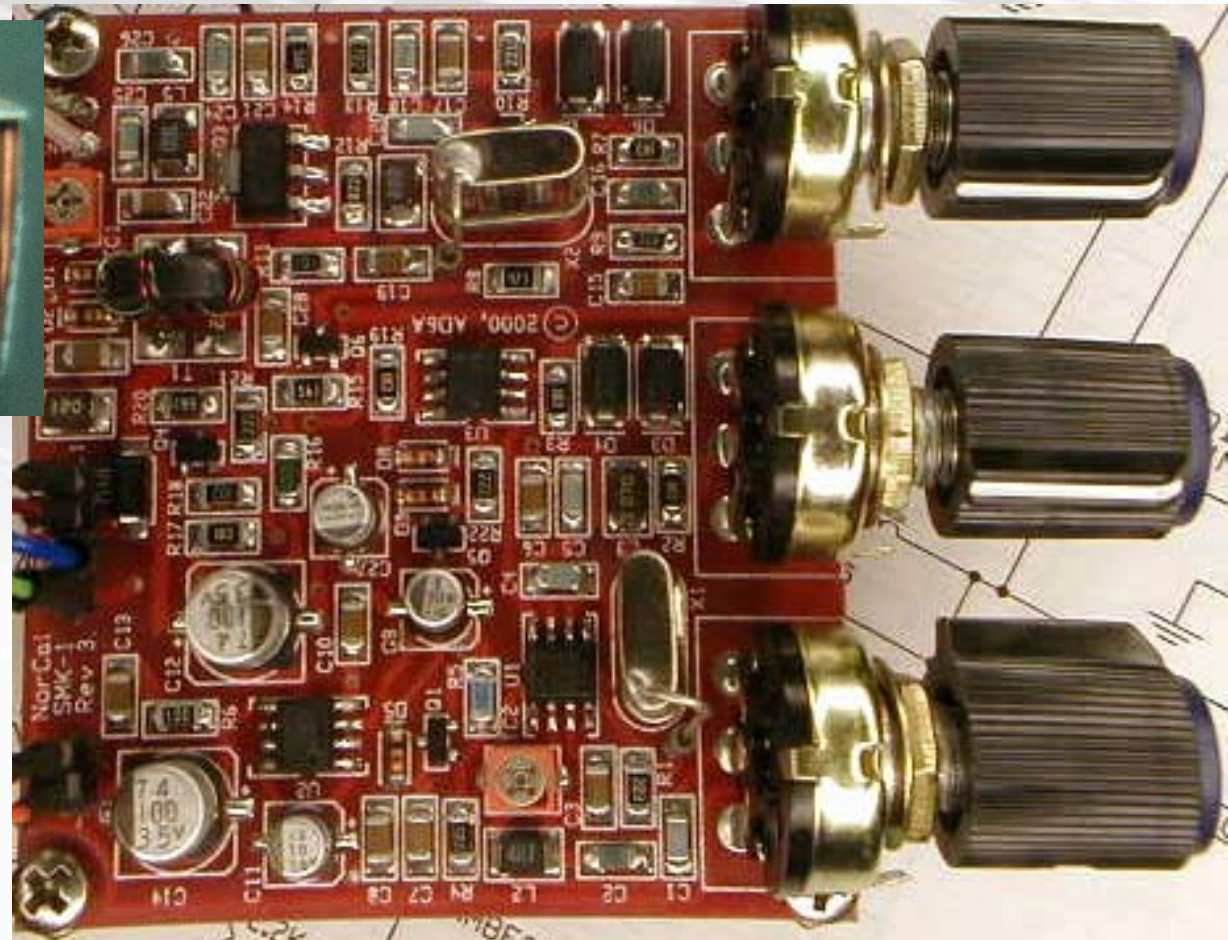
Designed by Eric WA6HHQ and Wayne N6KR

Elecraft KX1



Designed by Eric WA6HHQ and Wayne N6KR

NorCal SMK-1



Board built by
Jim Giammanco *N5IB*

40-meter QRPP Transceiver (360mW)

- Designed by Dave Fifield AD6A
- PCB and SM parts kit by NorCal \$34
- Enclosure Kit by the NJ-QRP Club \$10

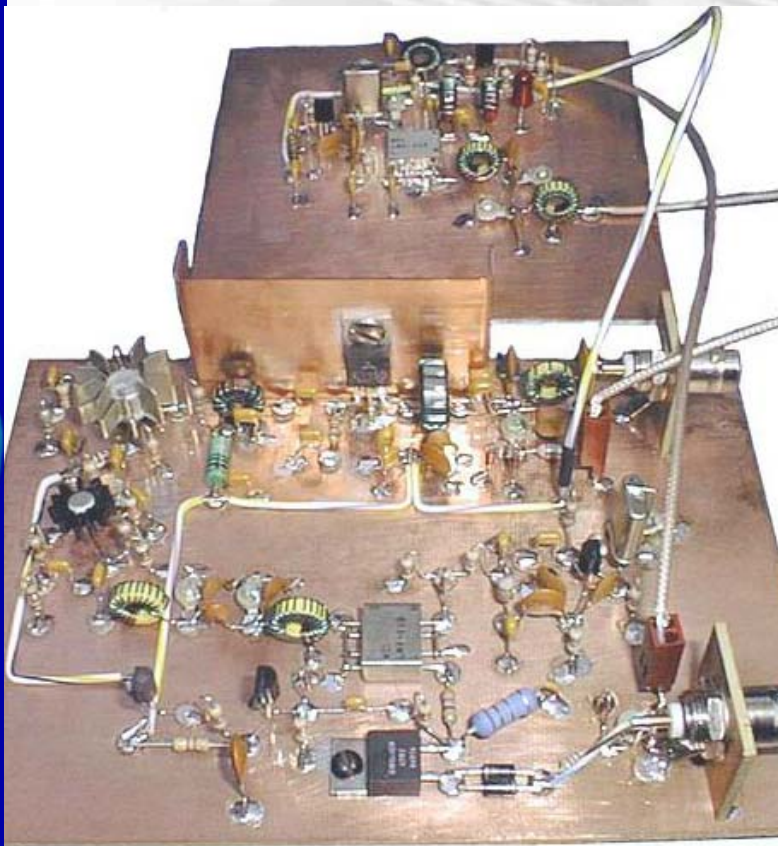
PSK-80 "Warbler"



A Simple PSK31 Transceiver for 80m(3580-3581 KHz):

- Dave Benson NN1G shared his design with the NJQRP Club to kit and sell the project world-wide.
- Named "The Warbler" for PSK's two-tone warble sound, and for the club's state bird (the mosquito!).
- At 3W PEP, the PSK-80 Warbler is great for local (200 mile radius) communications, narrow band low power club round table QSOs, and regular fireside skeds with your friends. Price: \$45.

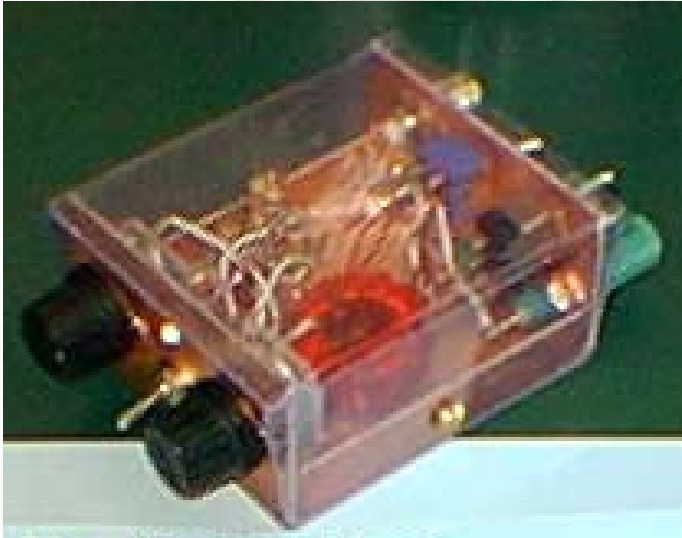
K8IQY "4017"



40m to 17m Transverter:

- Designed by Jim Kortge, K8IQY
- Clear assembly graphics by Paul Harden, NA5N
- Manhattan-style kit by NJ-QRP Club to encourage use of the 17m band, and use of Manhattan-style construction: \$35.

NorCal "BLT"



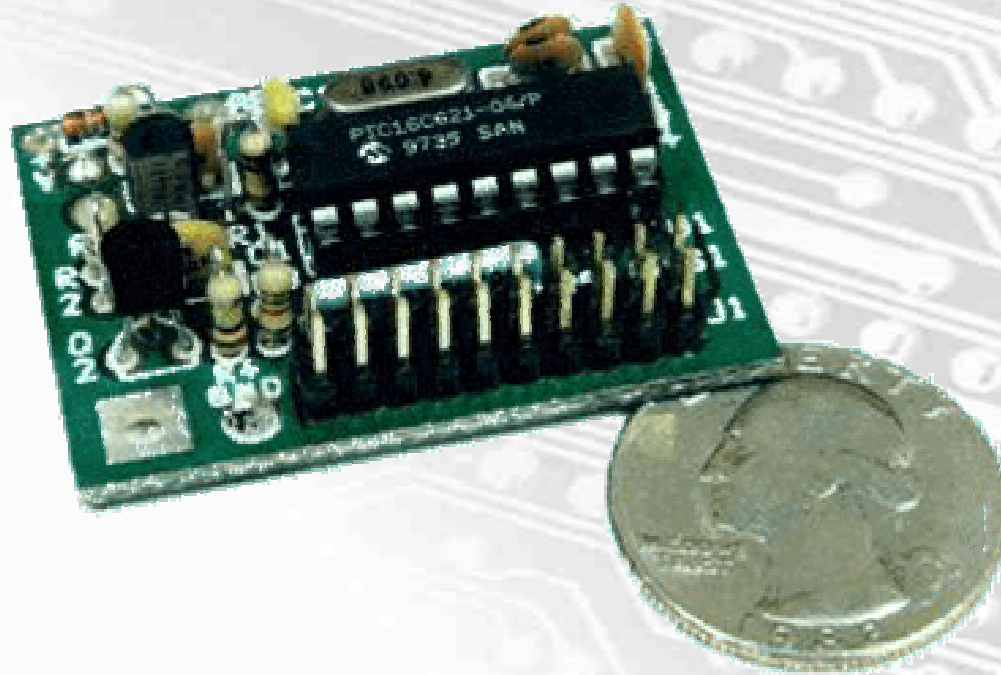
Balanced Line Tuner:

- Designed by Charlie Lofgren, W6JJZ.
- Z-Match Tuner packaged in NJQRP case.
- All parts, case, lexan cover, and shipping: \$29.

N5IB "BLT"



A Simple and Inexpensive Morse Frequency Display



- Small Wonder Labs' "Freq Mite"
- PIC microcontroller as digital frequency meter

Miniature QRP Paddles



- Original design by WK8G

The NorCal Paddles



- **First club project not electronic-related**
- **Unfinished kit ... yields superior quality**
- **Now Vibroplex Code Warrior**

The Ft. Smith P-TiCK Keyer

Jay W5JAY and Kelsey K5PWR



Adjustable Paddle and TiCK-1 keyer:

- Design by Wayne McFee, NB6M, Mike Fitzgibbon, N0MF, and Doug Hendricks, KI6DS.
- Manhattan-style
- Fits into Altoids tin
- Kits supplied by the Ft. Smith QRP Group, Jay Bromley W5JAY: price \$12.

Mini-Keys from Whiterook

Pocket
Micro-Key



MK-11

Pocket
Mini-Key



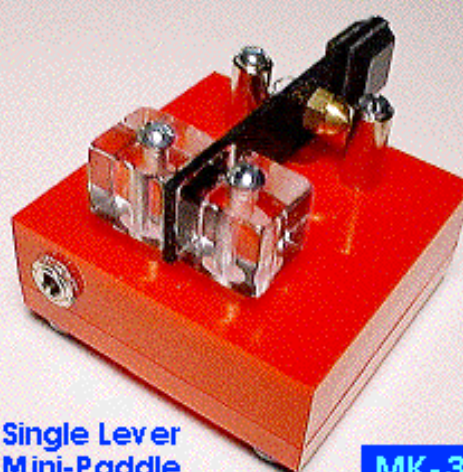
MK-22

Iambic
Mini-Paddle



MK-44

Single Lever
Mini-Paddle



MK-33

All images © 1998 The Whiterook Products Company

- Great for portable use!



Portable Antennas

- **Gusher (by N2CX)**
40m dipole, insulators, RG-174 feedline
- **Halfer (by N2CX)**
40m half wave end-fed w/ 1/4w counterpoise
- **St. Louis Vertical**
Center loaded collapsible fishing pole w/radials

The St. Louis Vertical: "SLV"



- Center-loaded multi-band half-wave vertical
- On a collapsible fishing rod w/rotor cable radials

QRP Show & Tell



- At an NJ-QRP Club meeting

Portable Stack from N2JS



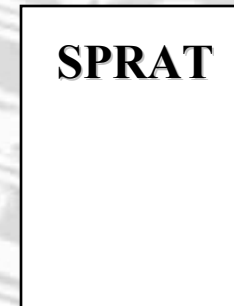
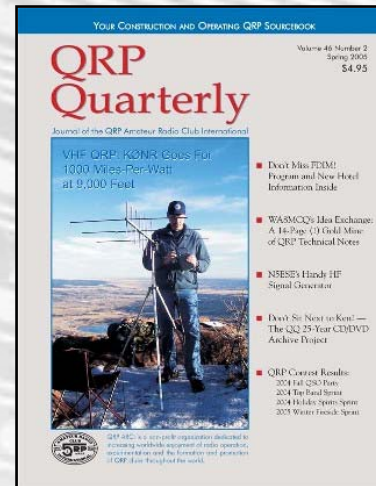
- **Equipment housed in wooden cabinetry**

N2CX at work on QRP Field Day



- Using Argonaut, Rainbow Tuner & Half-wave end-fed

QRP Publications



- The mainstay of QRPer information
AmQRP Homebrew CD Magazine
QRP Quarterly from ARCI
SPRAT from G-QRP

QRP Websites



QRP is FUN!

Low Power **BigResults**

Welcome to the QRP Amateur Radio Club International home page.

- Longest-running QRP club around (25 years+)
- <http://www.qrparci.org>

QRP

New Jersey QRP Club



About NJQRP	Events	Meetings	Projects	Cool Links
Members	Listserv	Equipment	Downloads	Site Index

Welcome!

Here's where the New Jersey QRP Club membership hangs out. You'll find our club projects, member list, activities, technical interests, and topics of general interest to the QRP community. Give us a browse and let us know

JULY

Vote on THIS club QSL design!

Field Day Results

- NJ-QRP carries “journal-quality” articles, project descriptions, event coverage, etc.
- <http://www.njqrp.org>

The NorCal home page



- Northern California QRP Club
- <http://www.fix.net/~jparker/norcal.html>

The G-QRP Club

The List Calendar Who ?? SPRAT Sale News Links Hz ? Membership Technical The Club

Whos Who in G-QRP?



Welcome to the web pages of the G-QRP Club

You need to have graphics turned on to use the top menu bar. If you would rather use an alternative, click [here](#).

11089 Visits since 2nd June 1997

The club pages are maintained by Tony - G4WIF. You can e-mail me at g4wif@btinternet.com

- <http://www.kanga.demon.co.uk/gqrp.htm>
- Rev. George Dobbs G3RJV, editor of SPRAT
- "It is vain to do with more what can be done with less."
- William of Occam (c1285-1349) English philosopher and Franciscan monk.



道 *Adventure Radio Society*

Welcome to the Adventure Radio Society, a great group of men and women who combine amateur radio with their love of the outdoors. Adventure Radio Society:

- Sponsors popular events, like the Spartan Sprints, Top of the World, The Flight of the Bumblebees, and The ARS Rendezvous.
- Supports the development of imaginative radio equipment and antennas.
- Publishes our on-line magazine and information center: ***The ARS Sojourner***
- <http://www.natworld.com/ars/>

FYBO 2001 Figueroa Mt.



QRP

2. 2. 2001

2. 3. 2001



Recap...again, “Why QRP?”

You can throw a QRP station in your backpack
but don't need to be portable to enjoy QRP
operation

Conserves power and enables re-use of
bandwidth

Hone operating and building skills

It's FUN!





“Why QRP?”

Safer for you, your family, and the public

Less QRM to TVs, stereos, phones, etc.

Because it’s a challenge, and it’s fun


Working into Sweden on 100w is easy.

At one watt, it becomes “really cool.”

“Why not?”



QRP References: Clubs



The American QRP Club (AmQRP) website: www.amqrp.org
Activities: Annual QRP weekend in springtime: “Atlanticon QRP Forum”
Publication: Homebrewer CD Magazine www.amqrp.org/homebrewer
Kits: Micro908 Antenna Analyzer, Field Strength Meter, SWR Bridge, DDS VFO
HC908 Controller, and lots more Kits & Projects! See www.amqrp.org/kits.

The New Jersey QRP Club (NJQRP) website: www.njqrp.org
Activities: Monthly meetings in Princeton, hosts of Atlanticon QRP Form, QRP outings

QRP Amateur Radio Club International (QRP ARCI) website: www.qrparci.org
Activities: Annual QRP weekend in spring: Four Days in May (held at Dayton Hamfest)
Publication: QRP Quarterly

G-QRP Club website: <http://www.gqrp.com>
Publication: SPRAT (quarterly printing of QRP construction projects)
Kits: Many kits offered as club projects

Northern California QRP Club (NorCal) website: www.norcalqrp.org
Activities: Monthly meetings in Santa Clara area
Kits: Balanced Line Tuner, QRP Crystals, NorCal Keyer

QRP References: Vendors

Wilderness Radio

Website at <http://www.fix.net/jparker/wild.html>

Kits: Sierra, NorCal 40A, SST,

Small Wonder Labs

Website at <http://www.fix.net/~jparker/sml.html>

Kits: White Mountain SSB QRP xcvr, Green Mountain CW transceivers, SW40 xcvr, Freq Mite digital Morse display

Dan's Small Parts

Website at <http://www.fix.net/~jparker/dans.html>

Provider of many useful kits and parts for the homebrewer

Elecraft

Website at <http://www.elecraft.com/>

Today's "Heathkit" for QRP gear ... the K2 is eagerly awaited and coming soon

Oak Hills Research (OHR)

Website at <http://www.ohr.com/>

Provider of many fine QRP transceivers

EMTECH

Website at: <http://pages.prodigy.net/roygregson/>

Provider of the NW-series QRP transceivers, portable transmatch, etc.

HB Electronics

Website at http://users.ids.net/~hb_elec/

Provider of the "44 Magnum" 30m QRP rig (improved 38 Special)



QRP References: Literature

- QRP Power, published by the ARRL
- QRP Classics, published by the ARRL
- W1FB's QRP Notebook, published by the ARRL
- The History of QRP, by Adrian Weiss, W0RSP, ISBN 0-9614139-1-3
- The Joy of QRP, by Adrian Weiss, W0RSP, ISBN 0-9614139-0-5

... and many, many more!

George Heron, N2APB



JOB: CTO at SafeNet in Baltimore, Maryland, developing encryption technology for Windows, Unix, and wireless devices.

HAM INTERESTS: Homebrewing, QRP CW operation on HF, prototyping to merge computer and radio technologies (DSP, microcontrollers, software development for ham radio applications), field/portable operation and related equipment.

OTHER ACTIVITIES:

Microcontroller software, hardware design & build, guitar enthusiast, and design/maintenance of the NJ-QRP website. Co-leader of NJQRP and AmQRP clubs (along with Joe Everhart, N2CX)

Credits

These slides are a compilation of notes, pictures and references taken from a variety of sources and initially presented at a local amateur radio club here in northern NJ. The response was pretty favorable so we thought we'd make it generally available and viewable here on the NJ-QRP website pages:

<http://www.njqrp.org/whygrp/whygrp.htm>

Many people have contributed in the making of this set of slides: Scott Rosenfeld (NF3I), Ade Weiss (W0RSP), Frank (G3YCC), George Dobbs (G3RJV), Dick Pascoe (G0BPS), Joe Everhart (N2CX), Dave Maliniak (N2SMH) and Bruce Muscolino (W6TOY). Thank you one and all for your material, wisdom and words of encouragement! This project could not have been completed without your help.

Additionally, I borrowed images from a several websites to round out the equipment pics; most notably from the NorCal site and from Chuck Adams' web page ... thank you Jerry and Chuck!

-- George Heron N2APB