Why QRP?

A Report on the Joys of Low-Power Ham Radio – Less than 5 watts

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What is “QRP?”

A telegraphy Q-signal
“QRP” = To lower one’s 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

Ground - 10,000 miles!

Pretty amazing stuff, huh?

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

MAGIC!!! That’s what it is!
Pretty Amazing Stuff

AL7FS – Jim Larsen – Anchorage
Worked All States - 67,548 watts total
& in Year 2000 ~ 1.5M Miles per Watt
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 with lightweight gear
- Excellent way to improve skills
- It’s fun!
QRP Mathematics

Varies LOGARITHMICALLY with power

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!!!
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, Yaesu FT-817 (<5 watts) on top of car!
Antarctica, Europe, VKs, ZLs, UA0s...
AA3MD
Over 125 countries confirmed in 24 mos. w/dipole.

N2RE Field Day, 2016
N2GJ with KX3 on battery power outsored other 7 stations’
total using only an end-fed 40 meter long wire!
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 db!

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?
  Lots of people, but it’s 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

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>QRP setup</th>
</tr>
</thead>
<tbody>
<tr>
<td>100w setup</td>
<td>ICOM 756 PRO III, etc.</td>
<td>QRP rig</td>
</tr>
<tr>
<td>* External Tuner</td>
<td>~21 lb.</td>
<td>* Tuner</td>
</tr>
<tr>
<td>Astron RS-20</td>
<td>4 lbs.</td>
<td>2 lbs.</td>
</tr>
<tr>
<td>TOTAL</td>
<td>25 lbs.</td>
<td>Power supply/battery</td>
</tr>
<tr>
<td>TOTAL</td>
<td>50 lbs.</td>
<td>~3 lbs.</td>
</tr>
<tr>
<td>TRANSPORT</td>
<td>Trunk of Car</td>
<td>Transport</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small Briefcase</td>
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</tbody>
</table>

* *Some rigs have internal antenna tuner units*
Power Requirements for a Day

To run for 24 hours - 10% transmit, 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.”
Kit building & Homebrewing

- Some hams 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, loops, 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!
SOTA = “Summits On The Air” is great fun!
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 DX-ing

There are two rules for QRP DX-ing:
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 – some contests just a few hours!
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 is 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 “Milli-watting”
- 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!
Digital Modes & QRPp are perfect together!

WSJT = A smorgasbord of digital software
(written by K1JT, 1993 Physics Nobel Prize winner, Dr. Joseph Taylor, AKA “just Joe!”)

Suite includes, among others:
WSPR = Weak Signal Propagation Reporter
JT65 = used mostly on HF, superseded by FT8
JT6M = optimized for meteor scatter
JT9 = experimental version
Some Commercial QRP Rigs

Elecraft offers many models in all price ranges

- Yaesu FT-817, ‘817ND, **NEW!** FT-818
- Ten-Tec Model 13XX (single band)
- Oak Hills Research 100a (single-band)
- MFJ 90xx (CW), 94xx (SSB) (single-band, *not kits!*)
- NN1G Small Wonder Labs SW40, NE40-40 (single-band)
- W6EMT (SK) Emtech (single-band)
- Kanga UK/US
- Wilderness Sierra, Cascade, SST, and NorCal 40A

And many, many, many more… (more later)
Other QRP Equipment

Direct Conversion Radios
Heath HW-7, HW-8, Ten-Tec Century 21, 22

Super heterodyne Radios
Heath HW-9;
Ten-Tec Eagle 599AT, Argonaut 505, 509, 515, 539,
Argo 556, Argonaut II, NEW! 506 “Rebel!”
A&A Engineering K9AY 20, 30, 40m
Yaesu FT-817/817ND, Kenwood TS-130V, ICOM 731
Club Projects

Northern California (NorCal) QRP Club
Sierra, Cascade, 40a, 40-9er, 38 Special

NJ QRP Club
Rainbow Tuner, SDR Cube system

St. Louis QRP Club
W6MMA, St. Louis Vertical
PHOTO GALLERY

- Equipment
- Antennas
- Websites
- Clubs
- Field Sites
- Newsletters/Journals
Elecraft KX1 (Discontinued, highly-prized!)

- Up to 4 bands
- CW Transmit, multi-mode receive
- Internal AA batteries
- 1-2 watts output
Elecraft KX2

- 80-10 meters
- 10 watts output
- Internal AA batteries
- All mode
- Person-mobile operation with whip antenna
Elecraft KX3

- 160-6 meters
- 15 watts output
- Internal AA batteries
- All mode + optional Panadapter PX3
- KPA100 amplifier for base station use
- Best QRP Field Day rig ever!
Ultimate3S QRSS/WSPR Kit

- The Ultimate3S QRSS/WSPR Transmitter Kit transmits various QRSS, Hell, Opera, PI4 and WSPR slow-signal modes on any LF, MF, HF or VHF band (all amateur bands from 2200m to 2m or 222MHz).
- From QRP Labs - http://www.qrp-labs.com/
The “Pixie”

Bruce Hopkins - KL7H built his for 3.920 and 3.933. Check-ins were successful with net control on both Motley and Snipers Nets.

• Simple 250mW transceiver 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
Small Wonder Labs’
“SW40+”

- 40m 2W CW transceiver
- Improved, simplified
Small Wonder Labs’
“White Mountain 20m SSB”

- 20m 2W QRP SSB transceiver
- Solid design
- Easy construction
The “Sierra” by Wilderness Radio

- All band CW transceiver
- Superhet, VFO
- Dig display & key options
- Removable band modules
- Rivals quality of rigs 5x $
- ARRL Handbook cover ‘96
The NorCal 20

- 20m superhet CW
- great front end
- Norcal kit for 3rd world countries
The NorCal 40A

- 40m 2W CW transceiver
- Grandfather deluxe
• 4 band superhet CW rig
Index Labs’ “QRP Plus”

- Super stable QRP rig
- Great user interface
Ten Tec Argonaut 515

- QRP for CW and SSB
NEW Yaesu FT-818

QRP all-mode, 6 watts, 160-6m, 2m and 70 cm bands   (Due April 2018)
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
N2APB SDR Cube

- A self-contained, portable SDR Transceiver.
- Embedded digital signal processing with a Softrock RF front end.
- No PC required!
- See http://www.njqrp.club
- Also http://www.sdr-cube.com/
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
- QRP paddles

This is what N2APB takes on biz trips (along with “Halfer” half-wave end-fed wire for 30m). Easily fits in small briefcase!
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 being electronic-related
- Unfinished kit … yields superior quality
Mini-Keys from Whiterook

- 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 QRP information
  QRPP from NorCal
  QRP Quarterly from ARCI
  SPRAT from G-QRP
QRP Websites

- QRP ARCI is superset of all QRP clubs
- http://www.qrparci.org

Welcome to the QRP Amateur Radio Club International home page.
New Jersey QRP Club

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 what you think.

Vote on THIS club QSL design!
Field Day Results

http://www.njqrp.club
The NorCal home page

- Northern California QRP Club
- www.norcalqrp.org/
The G-QRP Club

Welcome to the GQR Club

Formed in 1974, the GQR Club is a non profit organisation run entirely by volunteers to promote Low Power Radio. Whether you have a ham licence or not - everyone is welcome. Our quarterly magazine SPRAT provides a fascinating read containing articles of varying complexity, from simple test equipment, to fully functioning radio transmitters and receivers. Membership fees are about as low as you will find anywhere and our club sales service to members is second to none.

Please explore our pages and if you would like to join us we would love to welcome you to our membership.

Recap…again, “Why QRP?”

- You can throw a QRP station in your backpack but you don’t need to be portable to enjoy QRP operation
- Conserves power and enables re-use of bandwidth
- Hone building and operating 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 Clubs (1 of 2)

New Jersey QRP Club (NJQRP)
Website at http://www.njqrp.club
Kits: SDR Cube stack
Activities: Free membership, “virtual” meetings using TeamViewer, club projects, radio field outings

Northern California QRP Club (NorCal)
Website at http://www.norcalqrp.org
Kits: Various
Activities: Free membership, regular social gatherings, club projects, radio field outings
QRP Clubs (2 of 2)

QRP Amateur Radio Club International (QRP ARCI)
Website at http://www.qrparci.org/
Activities: Publish “QRP Quarterly” magazine, Four Days in May (FDIM) at Dayton Hamvention, contests, awards

G-QRP Club
Website at http://www.gqrp.com/
Kits: The GQRP "Limerick Sudden" 40m Transmitter Kit to match the Sudden Receiver, and matching antenna tuner unit
Activities: Publish “Sprat” magazine, annual convention

SARA Socorro Amateur Radio Assn. has a list of QRP Links:
• http://www.socorroara.org/links.html#qrp
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

... and many, many more!
Acknowledgements

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- ARRL www.arrl.org