

# Why QRP?

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

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**QRP**

*Ver 2.0 5/5/18*

**Page 1**

# 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!)

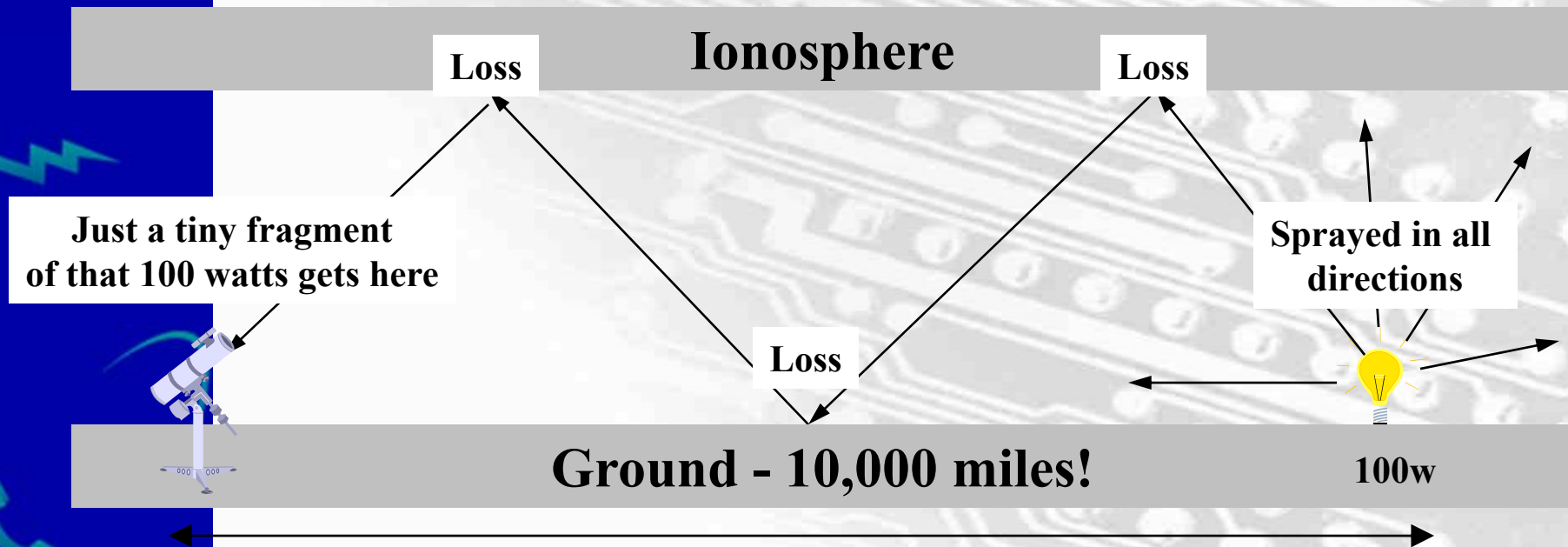
Use a “QRP” rig, or

Turn down your present radio

Only 5 watts?  
You must be  
kidding...

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# A Pretty Amazing Analogy



Pretty amazing stuff, huh?

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

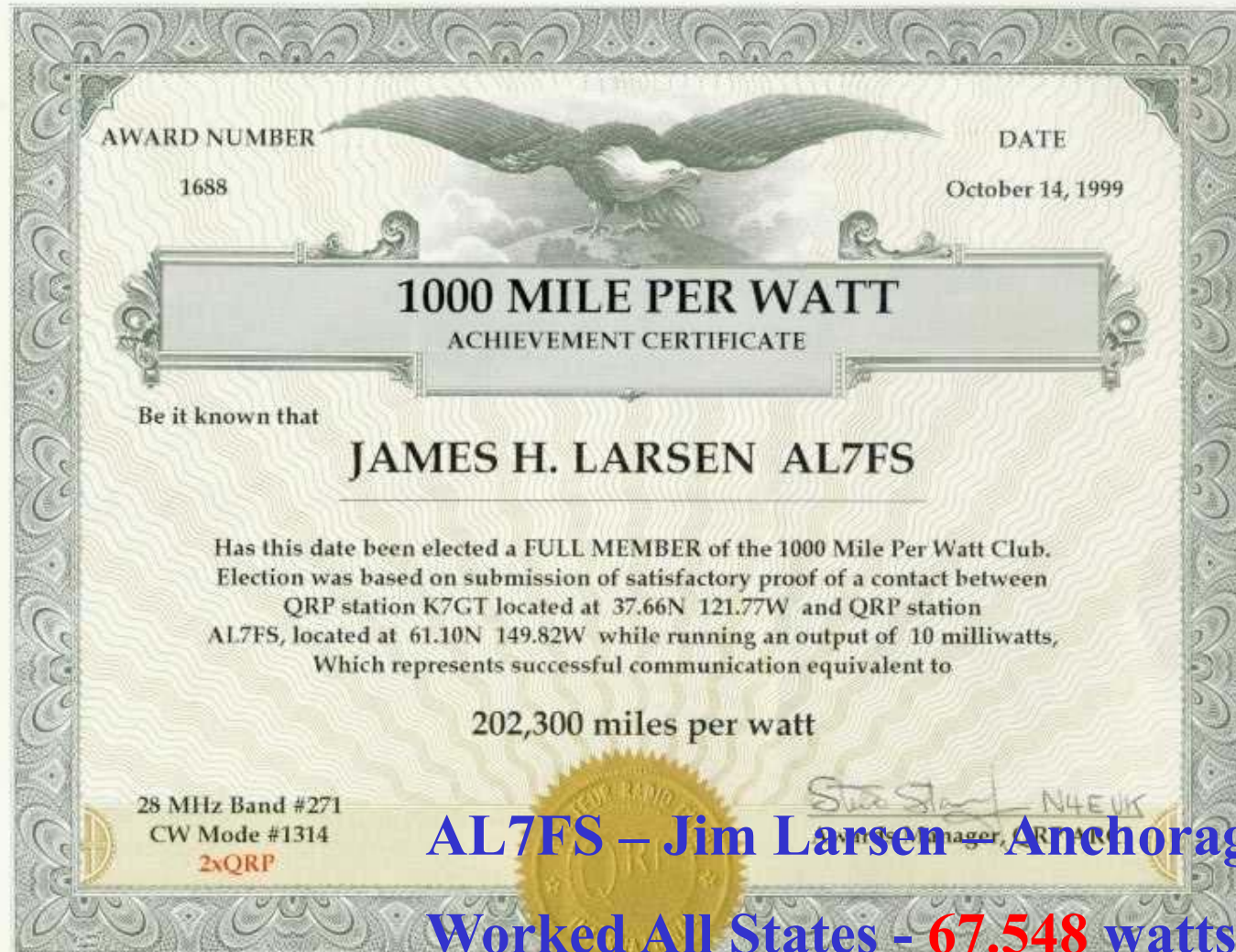
**MAGIC!!! That's what it is!**

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# Pretty Amazing Stuff



**& in Year 2000 ~ 1.5M Miles per Watt**

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## Part 97, FCC Rules

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

**There is of course room for interpretation here...**

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# 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!

??

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# 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)

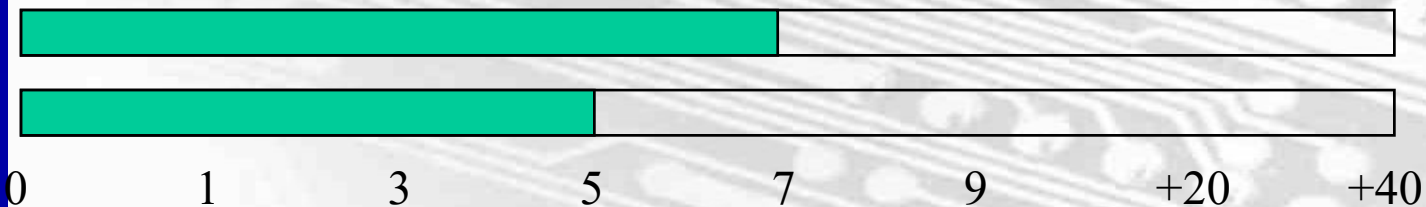
*20x* increase in power = *13 db gain*

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

# Signal Strength

100w

5w



**WHAT DOES THIS MEAN?**

**Your 5 watt signal *CAN* be heard.**

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# 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**

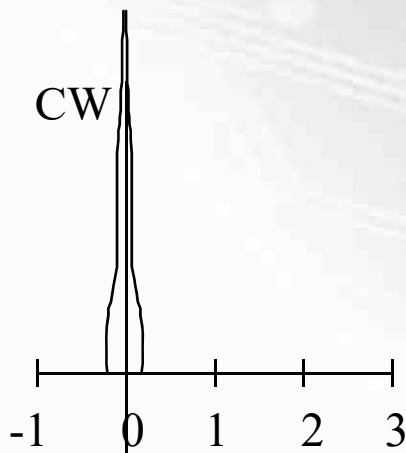
**Over 125 countries confirmed in 24 mos. w/dipole.**

**N2RE Field Day, 2016**

**N2GJ with KX3 on battery power outsourced other 7 stations' total using only an end-fed 40 meter long wire!**

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# CW vs. SSB



CW signal bandwidth = 100 Hz

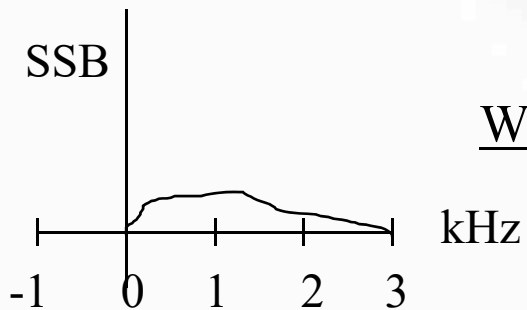
SSB bandwidth = 2000 Hz

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?  
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

Conventional 100w setup	ICOM 756 PRO III, etc.	~21 lb.
	* External Tuner	4 lbs.
	<u>Astron RS-20</u>	<u>25 lbs.</u>
	<b>TOTAL</b>	<b>50 lbs.</b>
	<b>TRANSPORT</b>	<b>Trunk of Car</b>
QRP setup	QRP rig	2 lbs.
	* Tuner	2 lbs.
	<u>Power supply/battery</u>	<u>3 lbs.</u>
	<b>TOTAL</b>	<b>7 lbs.</b>
	<b>TRANSPORT</b>	<b>Small Briefcase</b>

*\* Some rigs have internal antenna tuner units*

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# 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

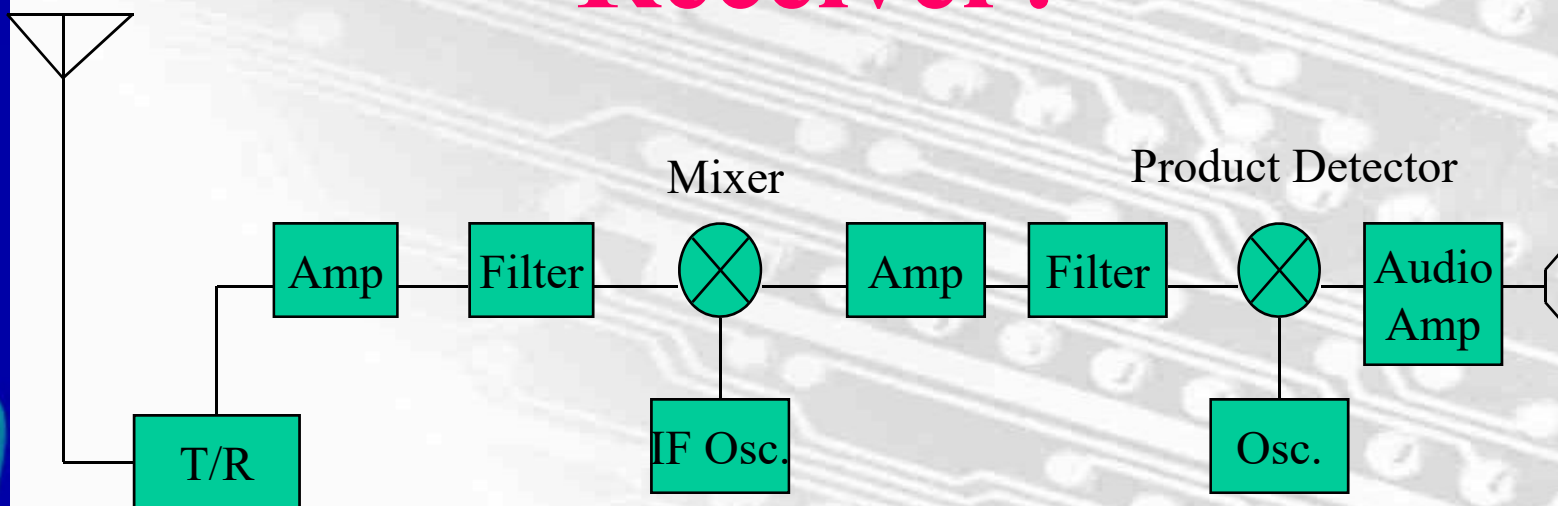
Receive - 100 milliamps...Xmit - 500 milliamps

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



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# What's in a SuperHet Receiver?



**THIS IS THE SINGLE MOST IMPORTANT  
PART OF A RADIO**

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

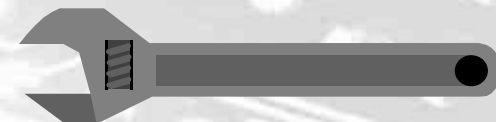
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# Kit building & Homebrewing

- 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!)

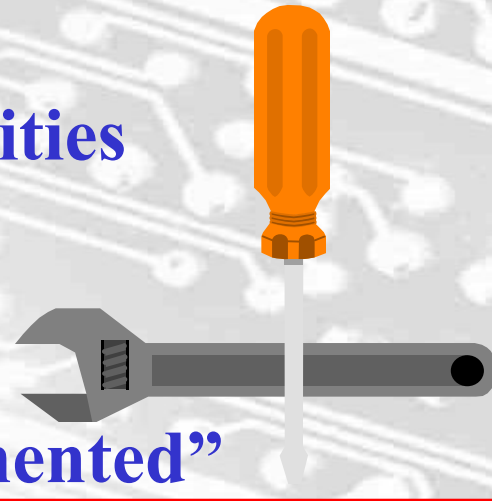
SCAF audio filters, electronic keyers

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**

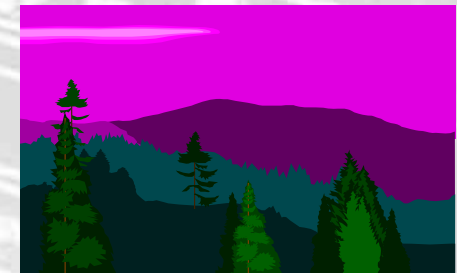
**dipole cut to proper length, with coax & rope**

**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)

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# 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!**

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# 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)



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# 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

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# 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!**

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# 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**

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## 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**

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# 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*



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# Elecraft KX2

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





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# 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

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# N2APB's "38 Special"

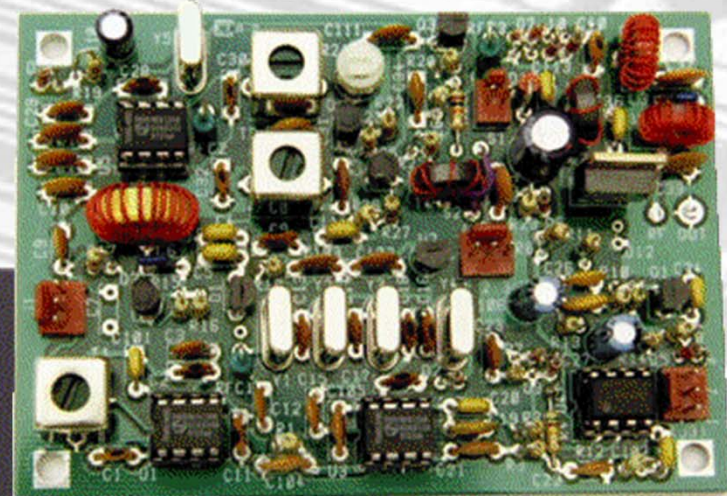


- Custom cabinetry in LMB enclosure

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# Small Wonder Labs' "SW40+"



- 40m 2W CW transceiver
- Improved, simplified

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# Small Wonder Labs' "White Mountain 20m SSB"



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

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# The “Sierra” by Wilderness Radio

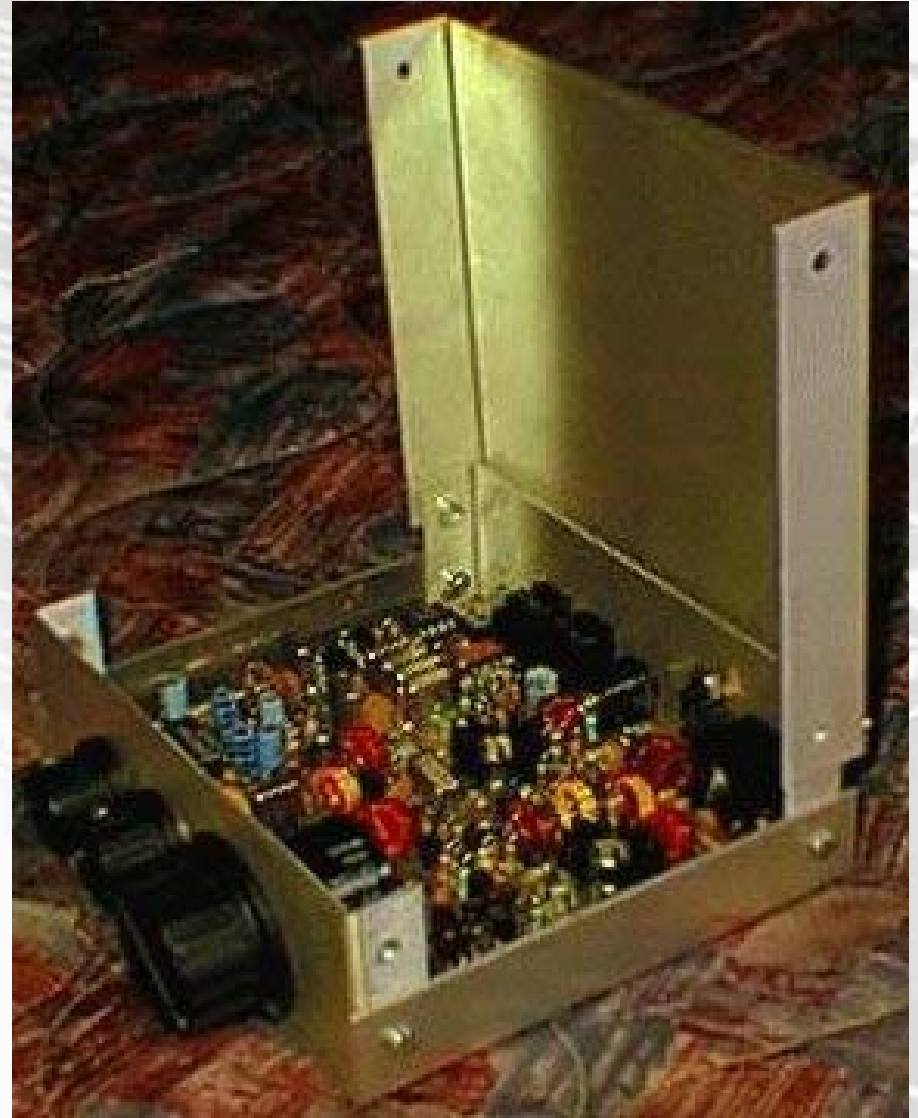


- All band CW transceiver
- Superhet, VFO
- Dig display & key options
- Removable band modules
- Rivals quality of rigs 5x \$
- ARRL Handbook cover '96

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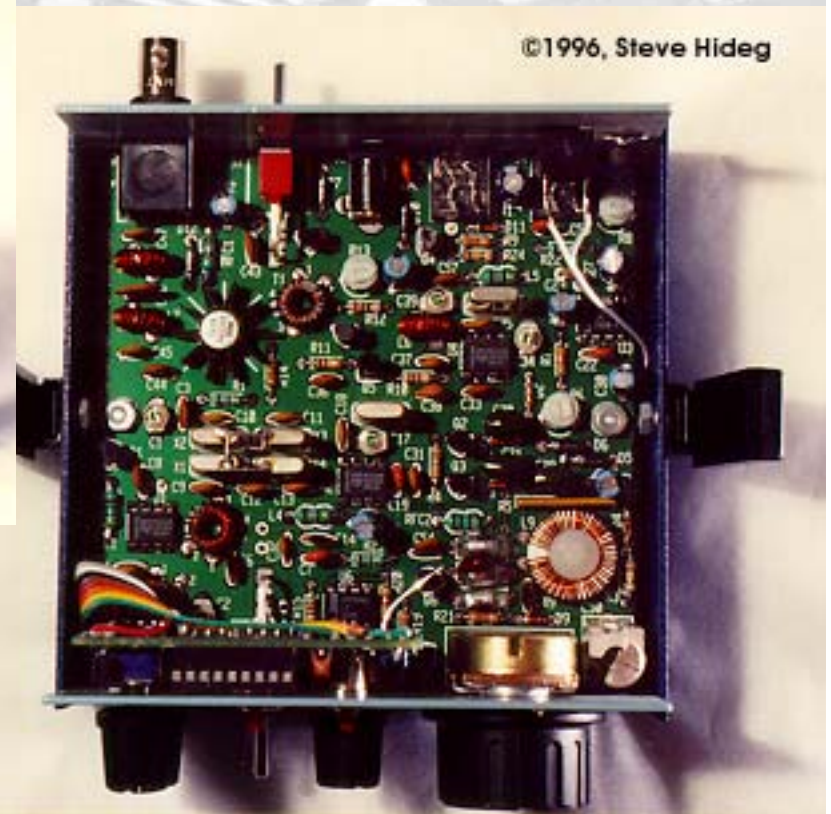
# The NorCal 20

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



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# The NorCal 40A



- 40m 2W CW transceiver
- Grandfather deluxe

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# OHR



- 4 band superhet CW rig

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# Index Labs' "QRP Plus"



- Super stable QRP rig
- Great user interface

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# Ten Tec Argonaut 515



- QRP for CW and SSB

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# NEW Yaesu FT-818



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

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# Heathkit HW-8



- 4 band direct conversion CW QRP rig

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# The “Tuna Tin 2”



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

# “Herring Aid” Receiver

Fully Built-Up Herring Aid 5 Board  
Circuit Update by Glen VK1FB  
Artwork by Doug KI6DS  
Board by Gary N2JGU  
Digital Image by Kodak DVC-323  
February 15, 1998 11:56 ET



- 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/>

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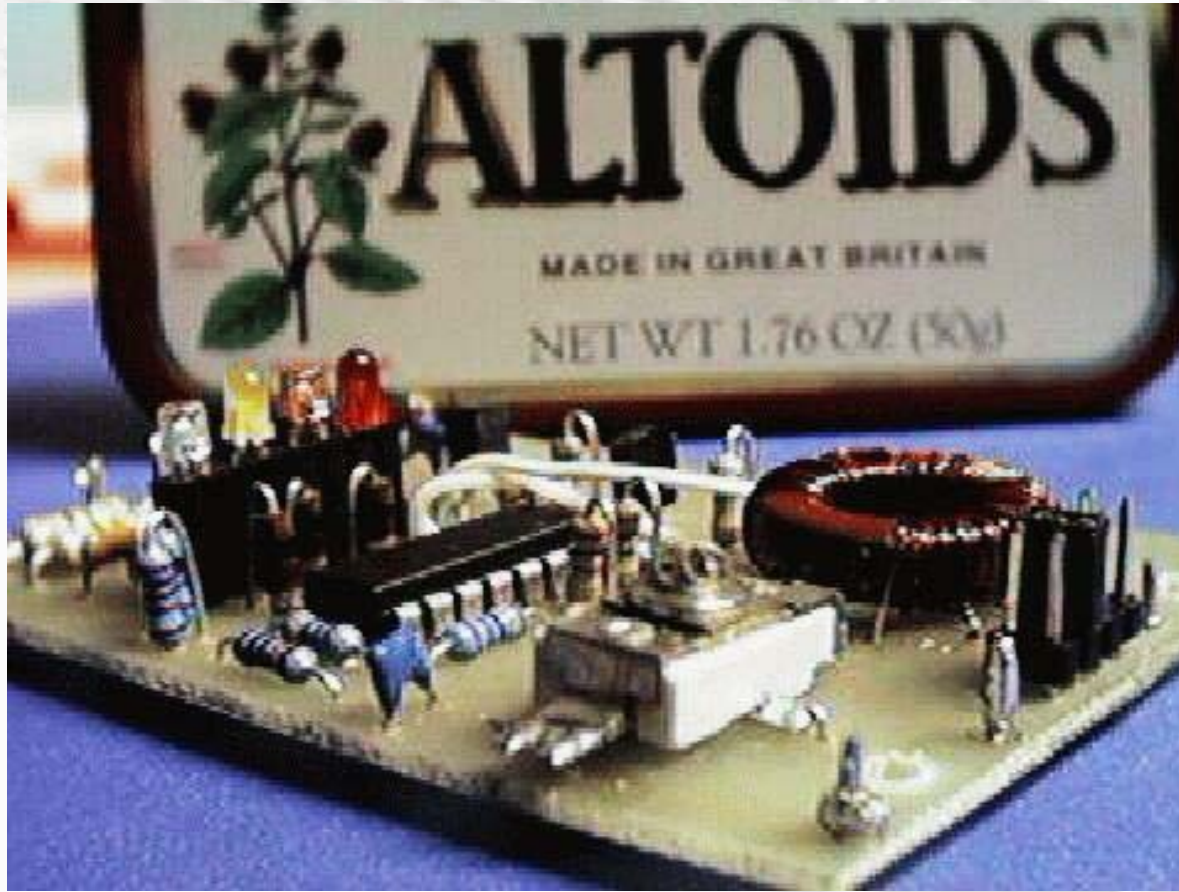


# Portable Paddles



- 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



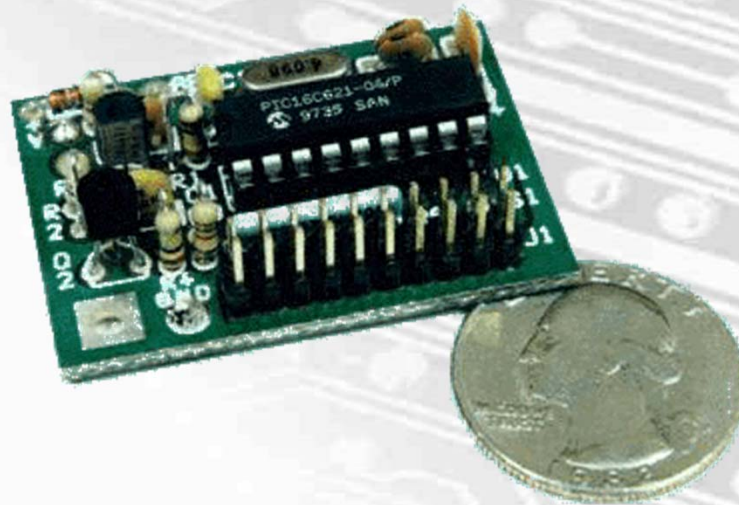
- Batteries
- Rainbow Tuner
- 38S Xcvr
- QRP paddles

This is what N2APB takes on biz trips (along with “Halfer” half-wave end-fed wire for 30m). Easily fits in small briefcase! page 56

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# 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

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# The NorCal Paddles



- First club project not being electronic-related
- Unfinished kit ... yields superior quality



# Mini-Keys from Whiterook



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

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# QRP Show & Tell



- At an NJ-QRP Club meeting



# Portable Stack from N2JS



- Equipment housed in wooden cabinetry

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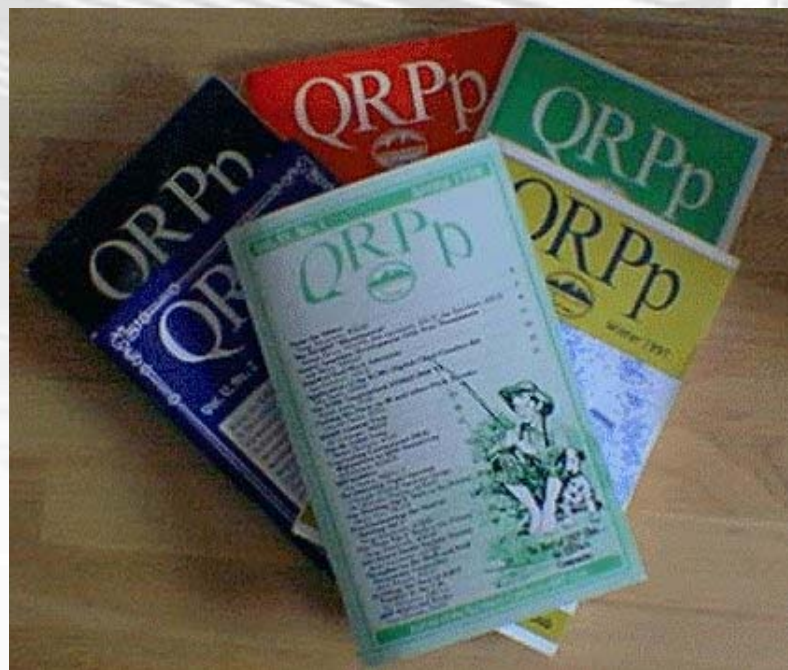


# N2CX at work on QRP Field Day



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

# QRP Publications



- The mainstay of QRP information
  - QRPPp from NorCal
  - QRP Quarterly from ARCI
  - SPRAT from G-QRP



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# QRP Websites



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

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# 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**

<http://www.njqrp.club>

**QRP**

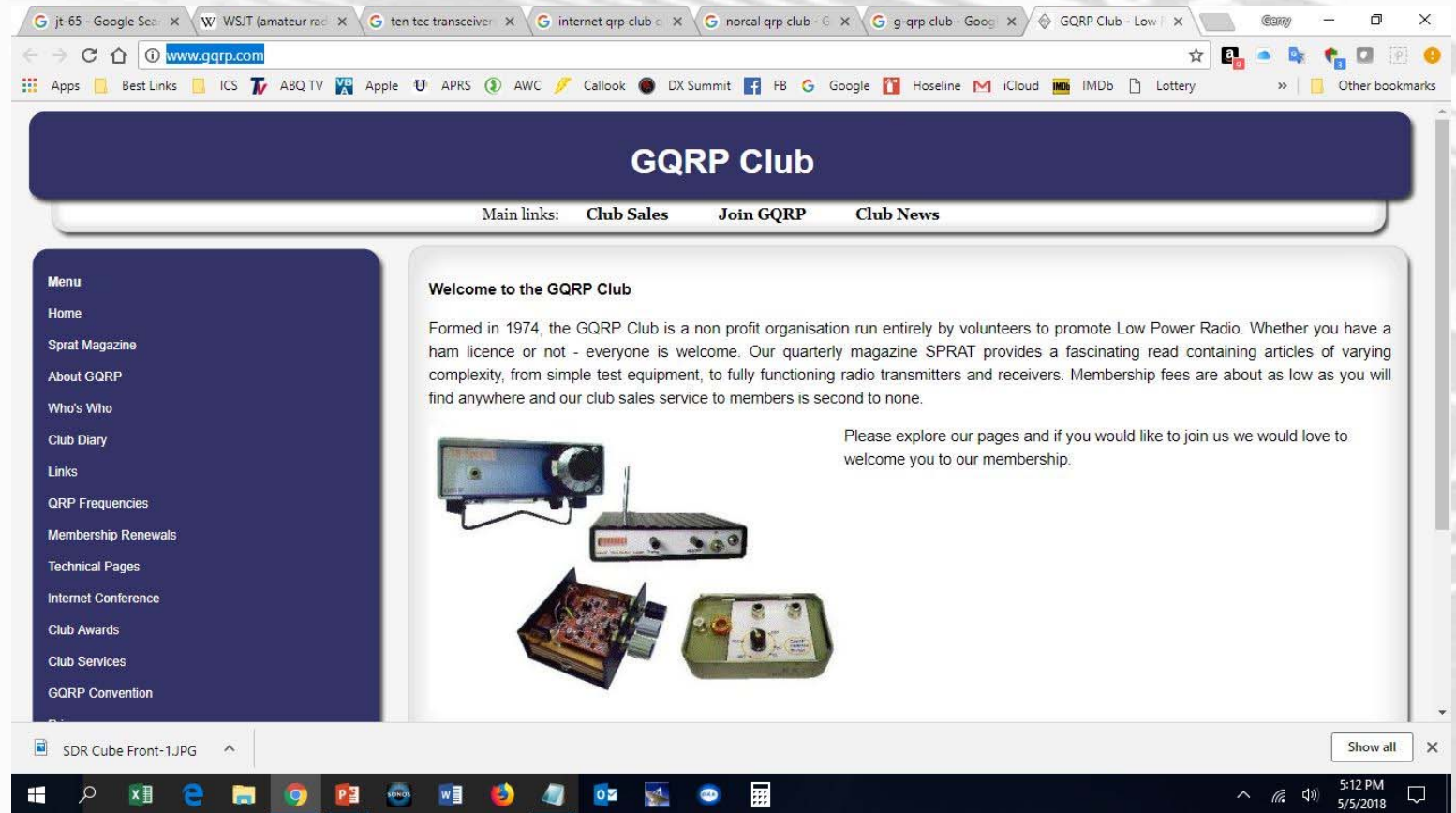


# The NorCal home page



- Northern California QRP Club
- [www.norcalqrp.org/](http://www.norcalqrp.org/)

# The G-QRP Club



• <http://www.gqrp.com/>



## 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!



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# “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?”



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# 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*

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# 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
- The Joy of QRP, by Adrian Weiss, W0RSP, ISBN 0-9614139-0-5

*... and many, many more!*

# Acknowledgements

- George Heron N2APB
- Joe Everhart N2CX
- John DeGood NU3E
- James Larsen AL7FS
- ARRL [www.arrl.org](http://www.arrl.org)