QRP Transceiver Projects

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Evolution of 40 Meter CW Transceiver

- **R1** high performance direct conversion receiver
- **Rockmite 40** – performance left something to be desired
- Goal: Build a *real* homebrew transceiver for 40 CW, consisting of:
  - **R1** DC receiver and a proven VFO circuit
  - 3 stage **MKII** 5W+ transmitter
  - **Universal VFO** – Suitable for **R1** and its successor, the **Mini-R2**
  - **Norcal Keyer**
  - Upgrade to **Mini-R2** receiver
Receiver (R1)

- Good performance
- Very low distortion audio amp
- Built with 3Khz filter
- No provision for removing audio image/opposite sideband
- No AGC

“High-Performance Direct-Conversion Receivers” by Rick Campbell, KK7B, QST, August 1992
Rockmite 40 Meter Transceiver

- Crystal controlled DC Receiver
- 8-pin PIC microcontroller, built in keyer
- Pushbutton reverses offset to yield a second oper. frequency.
- Introduced in 2002 by K1SWL

http://www.smallwonderlabs.com/Rockmite.htm
Some Desired Features

• 40 meter CW band
• 5+ watts output
• Smooth T/R switching/semi break-in keying
• Built-in keyer
• Receiver incremental tuning (RIT)
• Good performance (not too worried about parts count or DC power consumption)
• Enough audio output for small speaker
• Portable
MKII Transmitter

- 3 stage design, up to ~7.5 watts output if desired (or a bit more?), depending on supply voltage and drive setting
- Automatic T/R switching for use with a receiver
- Side tone oscillator
- Spot circuit
- 2N3904 crystal oscillator/VXO, inexpensive 2SC5739* driver and power amp
- Common parts for T/R switching and side-tone oscillator
- See Wes’ website for notes on MKII transmitter

http://w7zoi.net/mark2.html

“An Updated Universal QRP Transmitter” by Wes Hayward, W7ZOI, QST, April 2006

*Obsolete, check with Bill Kelsey, N8ET at http://www.kangaus.com/
Transmitter

“An Updated Universal QRP Transmitter” by Wes Hayward, W7ZOI, QST, April 2006
“Ugly” Construction

- Ugly Construction involves building circuits on top of a double or single-sided copper clad board
- The copper ground-plane provides a low impedance ground and mechanically supports the parts
- Stand-offs: high value resistors (10 Megohm or greater), terminal strips/posts, or small copper islands glued onto the copper.
Variable Frequency Oscillator (VFO)

- Universal VFO (UVFO) design (KK7B)
- ~60Khz tuning range (bottom end of 40M)
- I and Q outputs for a receiver
- Single output provided to drive a transmitter.
- RIT built in.
- Variable capacitor with reduction drive

http://www.kangaus.com/
Variable Frequency Oscillator (VFO)
Norcal Memory Keyer

• PIC12F6293 microcontroller (pre-programmed)
• Three 40-character memories
• Iambic, straight key and bug mode; beacon modes
• Variable speed control via paddles (option for potentiometer control if desired).
• 7-to-18 volt input power range with 5V regulator built in
• Side-tone from keyer is injected into the audio circuit
• “FB” sent by the keyer at power up through the sidetone if functioning correctly.

http://www.norcalqrp.org/nckeyer.htm (now retired)
5V Reg.

Keyer Chip

Output Transistor (to key rig)
<table>
<thead>
<tr>
<th>Keys Used</th>
<th>PAR (press and release)</th>
<th>PAH (press and hold)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mem switch</td>
<td>Send memory 3</td>
<td>Record memory 3, O? Beacons: BE and BA</td>
</tr>
<tr>
<td>Mem + dit</td>
<td>Send speed</td>
<td>Paddle set of speed, pot options, main menu</td>
</tr>
<tr>
<td>Mem + dah</td>
<td>Send memory 2</td>
<td>Record memory 2: M?</td>
</tr>
<tr>
<td>Mem + both</td>
<td>Send memory 1</td>
<td>Record memory 1: T?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CW</th>
<th>Menu Item</th>
<th>Pressing a dit</th>
<th>Pressing a dah</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory + Dit Menu (PAR mem to advance to the next menu)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Speed set from paddle</td>
<td>Increase speed 1 wpm</td>
<td>Decrease speed 1 wpm</td>
</tr>
<tr>
<td>P</td>
<td>Pot / paddle speed control</td>
<td>Selects pot speed control</td>
<td>Selects paddle speed control</td>
</tr>
<tr>
<td>C</td>
<td>Calibrate pot speed control</td>
<td>Enters the calibration routine</td>
<td>Restores default pot calibration</td>
</tr>
<tr>
<td>B</td>
<td>Bug / straight key mode</td>
<td>Enables bug mode (dah = key)</td>
<td>Disables bug mode (default)</td>
</tr>
<tr>
<td>A</td>
<td>Iambic mode A or B</td>
<td>Enables iambic mode A</td>
<td>Enables mode B (default)</td>
</tr>
<tr>
<td>R</td>
<td>Reverse paddle mode</td>
<td>Reverse dit and dah switches</td>
<td>Returns dit and dah to normal</td>
</tr>
<tr>
<td>AU</td>
<td>Autospace on / off</td>
<td>Turns on character autospace</td>
<td>Turns off autospace (default)</td>
</tr>
</tbody>
</table>

| Memory + Dah Menu (PAR mem to exit) |
| M? | Record memory 2 | Records a dit | Records a dah |

| Memory Switch Menu (PAR mem to advance to next menu) |
| O? | Record memory 3 | Records a dit | Records a dah |
| BE | Beacon mode - sends mem 1 | Starts the beacon going | Exits the menu |
| BA | Beacon alternate mode | Selects alternate beacon sends of mem 1 and mem 2 | Selects send of mem 1 only (default) |
| ST | Side tone on/off | Turns off the side tone | Turns the side tone on |

| Memory + Both Menu (PAR mem to exit) |
| T? | Record memory 1 | Records a dit | Records a dah |
Transceiver Enclosure
SONAR FR-104 VHF Monitor
Enclosure

Re-Purposed SONAR Case

Unwanted holes filled with “J. B. Weld”

Front Panel Overlay
Construction
Front Panel
Receiver Mini-R2

- DC Phasing Receiver (single signal)
- Based on R1, successor to original R2
- Audio sufficient for headphones or small speaker
- Slightly better performance than R2 and R1

“A Small High Performance CW Transceiver” by Rick Campbell, QST, November 1995
On The Air

• Contacts
  – V31WA Belize
  – SC8N Sweden
  – CS95A Madeira Is.
  – P40ADI Aruba
  – OK5W Czech Rep.
  – HB9LCW Switzerland
  – Numerous states (incl. FL, CA, WA, CA )
Possible Improvements

• Adjustable T-R delay
• Selectable bandwidth audio filter (Wide/Narrow)
• Switch for second tuning range
• Internal speaker
• Louder spot signal
• 30, 20 or 15 Meter version
• ??
Build Something!

• **Not** as difficult as you think!
• Many excellent published designs (QST, CQ, ARRL Handbook, Web)
• “Bag” kits avoid gathering of parts
• Larger projects (e.g. receiver, transceiver) can usually be broken down into modules
• Learn by doing
• Loads of fun to put it to work in your station