Orion PLL Project

Rev C Performance Summary and Applications

Orion Performance Results

REV A

- PLL max output:
  - 500MHz: +15 dBm
  - 1152 MHz: +15 dBm
  - 3000 MHz: +15 dBm
  - 4400 MHz: +16 dBm
- Phase noise
  - 500 Mhz: -104 dBc/Hz
  - 1152 Mhz: -91 dBc/Hz
  - 3000 MHz: -82 dBc/Hz
  - 4400 MHz: -87 dBc/Hz

REV C (SN 037)

- PLL max output:
  - 500MHz: +14.7 dBm
  - 1152 MHz: +17.6 dBm
  - 3000 MHz: +17 dBm
  - 4400 MHz: +16 dBm
- Phase noise
  - 500 Mhz: -108 dBc/Hz
  - 1152 Mhz: -101 dBc/Hz
  - 3000 MHz: -93 dBc/Hz
  - 4400 MHz: -72 dBc/Hz

Orion Phase Noise Experiments

- No difference in phase noise between 10MHz and 25MHz reference oscillators (SiLabs)
- Removed components and exercised the “MCU Off” feature:
  - Removing RS232 chip had no measurable effect.
  - Removing the REF gate chip and replacing with a jumper improved the measured phase noise by about 1dB.
  - Removing the 5V regulator and powering with an external 5V supply improved phase noise by about 7 dB.
  - “MCU Off” improved phase noise at Fc+30KHz by about 6 dB, but worsened at Fc+1KHz by about 2 dB.

Orion Performance Results

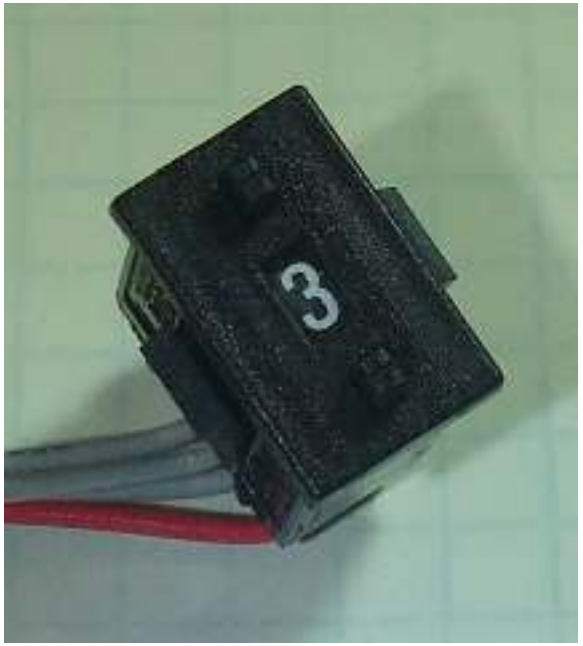
- Overall, the Rev C performance is measurably better than the Rev A board.
- Some phase noise improvement can be gained by re-working the 5V supply.

Accessory Projects

- Heat-spreader for 5V regulator and RF buffer
  - A machined block of metal.
  - Moderate precision needed.
  - A limited number (3 - 6) of “hand-carved” versions could be produced. Cost: about $10 each (depending on cost of material).
  - If interest exceeds this QTY, we’d need to look at outsourcing. Cost: unknown, but would depend heavily on QTY.

Accessory Projects (cont'd)

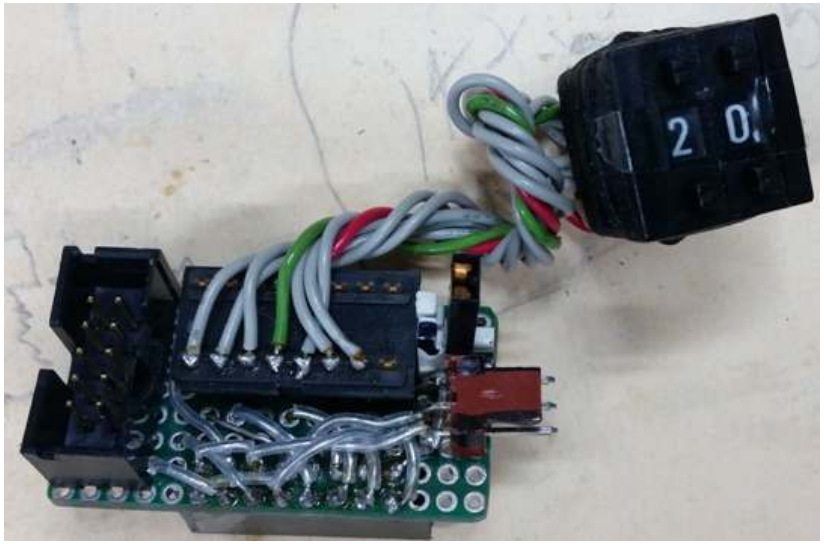
- Channel select daughter board
  - Small PCB that accepts an 8-pos DIP switch or a BCD switch. *Note: BCD switch requires modification to achieve full 0-9 digit range.*
  - Provisions for PTT pushbutton and breakouts for RS-232 and power leads.
  - Piggyback with the next available QRP club PCB order.
  - PCB cost unknown but likely in the $2 each range (a guesstimate)
  - Some local availability of piece-parts, but otherwise, kit-builder would provide remaining parts.



BCD Switch (available through NO5K)

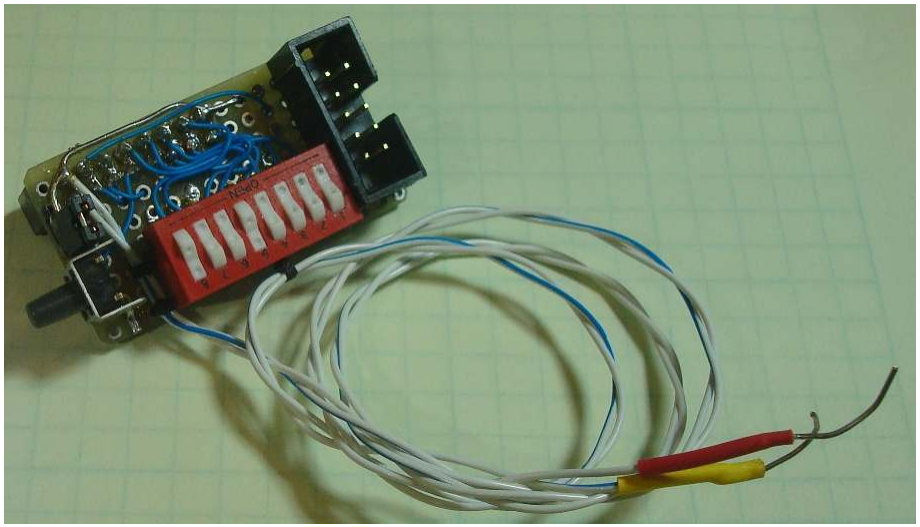
Accessory Projects (cont'd)

- Channel Selector Examples



BCD Prototype (will accept a DIPSW)

DIPSW Prototype



Applications

- LO source
  - The Orion is well suited to LO applications.
  - Filtering is needed, but there are many choices of COTS filters that cover some of the popular LO bands.
  - Locking to a common reference is particularly advantageous for multi-band transverter installations.
  - RF output can be adjusted in the channel data to cover 2 or 3 standard mixer levels.

Applications (cont'd)

- Orion users that wish to have a "multi-function" PLL device that can operate other applications on-demand should consider the following:
  - Purchase the SiLabs programming adapter ($35 from Mouser).
  - Write the PLL control code into something like an Arduino or RPi and by-pass the SiLabs processor and write your own apps.

Applications (cont'd)

- Beacon
  - The basic PLL SW has been modified to support a beacon application. Channels are reduced to make room for the Morse message data.
  - The beacon sends a repeating message that is programmed into FLASH as a "DIT-mapped" message (aka, a diode-matrix style message encoder) and has provisions for wave-shaping.
  - Commands can be encoded during the message to change channel selection or set a 3 bit digital code
    - Channel selection allows other PLL channels with different power settings to be selected (tho, frequency could be changed also)
    - Digital outputs can be used for anything desired, but are intended to allow RF power level adjustment.
  - Messages are "compiled" externally and loaded via the RS-232 connection. Currently, an Excel spreadsheet is used to produce the DIT-mapped data stream.
  - The result is a compact and flexible beacon exciter that is capable of up to 200 mW of output (requires re-working the RF buffer).

Applications (cont'd)

- Frequency Sweeper
  - Allows the Orion to output a stepped frequency sweep.
  - A PWM DAC is used to provide a DC ramp signal that changes in step with the frequency sweep.
  - Provides a crude but effective sweep generator that can be used to sweep filters or for tuning receiver IF circuits.

Future Projects

- GUI or Command-line PC application to drive RS-232 input.
  - Simplify channel programming and maintenance
  - Allow for “on-the-fly” retuning (e.g., a programmable signal generator)
- GUI for Beacon message management
  - Simplify message creation and programming
  - Could be integrated into Channel programming application.
- Looking for PC programmers to assist
- *__Might__* think about a 13GHz version of Orion (Orion-II) for next year (likely at least double the cost of Orion-I)