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)