Xpol Radar

Operation Manual

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Prepared for

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Submitted by

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A. Assembling

- Tools needed:
- ½” wrench or socket drive for attaching counter weight arms to pedestal.
- ¾” wrench for pedestal; counter weight nuts.
- 9/16” wrench for antenna mounting nuts and bolts.
- 9/64” hex drive for waveguide screws.
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- Main Parts:
- RF Pod (~700 lb)
- Seavey Inc. 6’ diameter dual-pol antenna with A-sandwich dish-dome (96 lb)
- Orbit AL-4016 pedestal (~400 lb)
- Counter weights (2) and arms (2) (~109 lb)
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Figure 1. RF box on the shipping pallet.

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Figure 2. The antenna crate.

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Figure 3. The pedestal crate.

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- Miscellaneous parts:
- 2 counter weight arms.
- 2 counter weight plates. 1 to be attached to each counter weight arm.
- 4 counter weight stainless steel nuts (1/2” diameter).
- 8 ¼-20 antenna mounting stainless steel nuts, bolts, washers and lock washers
- 32 waveguide stainless steel screws and lock washers (8/32 socket cap screws, 3/8” long), between antenna and pedestal and pedestal and radar pod.
- 2 flexible waveguides (48” long) between antenna and pedestal. Waveguide flange with “O” ring groove should connect to the antenna.
- 2 flexible waveguides (30” long on trailer) between pedestal and radar pod.

Waveguide flange with “O” ring groove should connect to radar pod bulkhead plates.

- 8 waveguide “O” rings. 4 should be inserted in pedestal waveguide choke flanges, and 4 should be placed in the flexible waveguide choke flanges.
- Positioner Power cable.
- Positioner Controller cable
- GPS and cable
- Ethernet cable
- Pod power cable
- Break release box and cables – to be connected to 115 VAC and to the azimuth “Control” and to the elevation “Service” connectors.
- Secure the RF box on the trailer:
- The RF box is secured on the wooden pallet with lag bolt. Unscrew the bolts.
- Using lifting straps and a hoist, lift and transfer the RF box on the trailer as shown in Figure 4.
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Figure 4. RF box lifting with straps.

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- Mount antenna on the pedestal and connect waveguides:
- Uncrate the antenna as shown in Figure 5
- Point the pedestal elevation axis to 90 degrees, so the antenna face plate is horizontal as shown in Figure 6, using the break-release box. The blue masking tape can be removed.
- Attach the counter weight arms.
- Attach one counter weight to each arm (if not already on the arms).
- Place (two people can lift) the antenna on to the plate pedestal face plate – rotate so the two waveguide ports are on the same side as the pedestal head connector plate.
- Line up the mounting blot holes and use the ¼-20 stainless bolts, nuts, washers

and lock washers to secure the antenna on the pedestal plate.

- Connect the 48” long flexible waveguides between the pedestal and the antenna as shown in Figure 6. Both, the antenna and the pedestal waveguide flanges are marked as “Ch1” and Ch2”. Ch1 is vertically and Ch2 is horizontally polarized antenna port. Make sure to use “O” rings in each flange and use lock washers with the waveguide screws. Similarly, connect the flexible waveguides between the pedestal and the radar pod.

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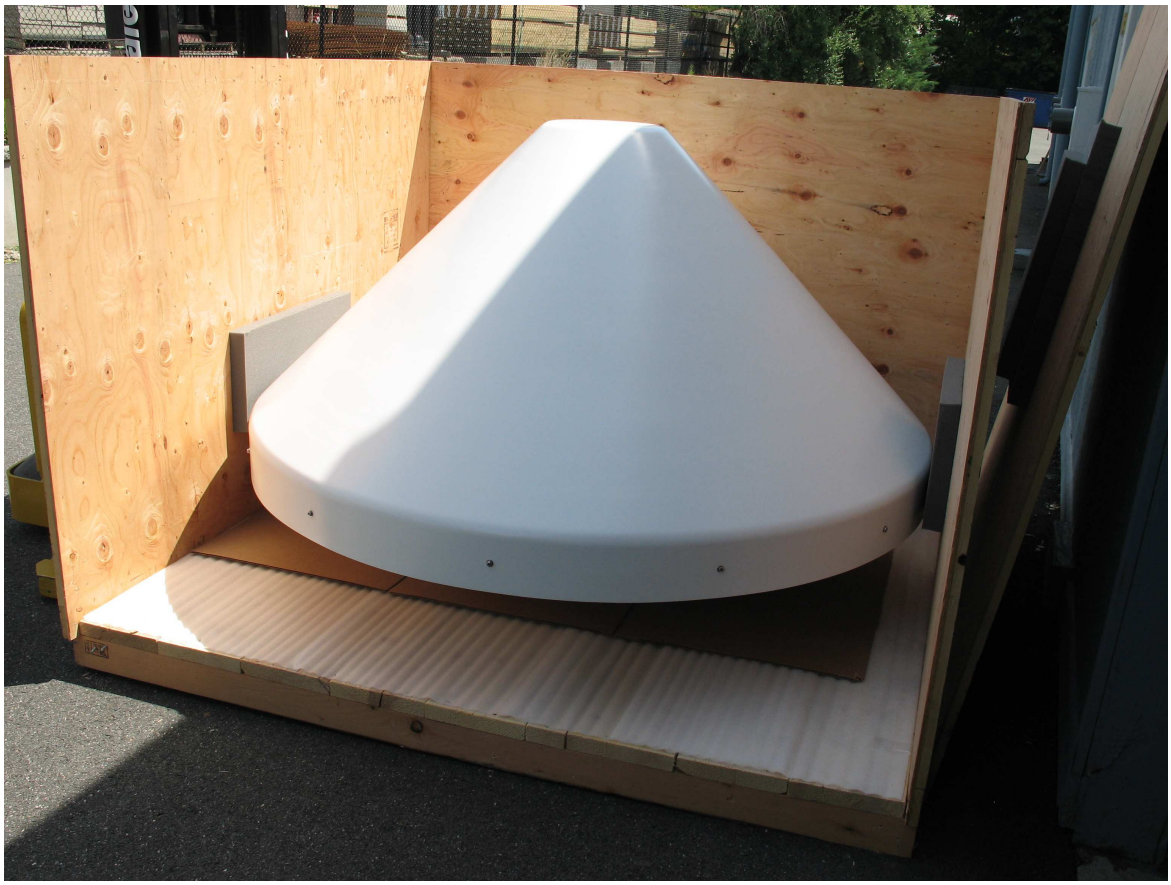

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Figure 5. Remove the top and one of the sides of the crate to free the antenna. There are no bolts securing the antenna to the crate.

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Figure 6. Waveguide connection between the pedestal and the antenna.

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B. Radar Operation

Starting procedure:

- Level the Trailer.
- Connect the pod network cable.
- Provide line or generator AC power to the pod.
- Power has to be split phase 230 VAC : GND, Line #1, Neutral, Line #1; Line #1 to Line #2 should be 230 VAC, Line to GND and Line to Neutral should be 115 VAC. Power connector wiring: L-shaped pin is GND ; opposite of GND is Neutral; the two remaining pins are Line-1 and Line-2.
- Open the pod cover.

- Turn on *X1/Y1* (Dry-Air and APC Pedestal UPS) , *X3* (Tripp-Lite system UPS) *and Y3* (air conditioner) circuit breaker switches. In cold weather, turn on *X2/Y2* (heater) instead of *Y3* (Air Conditioner power).

- Turn on the APC and Tripp-Lite UPS-s. The computer will automatically turn on and boot Linux.

- Enable the RF to radiate by removing the RF box cover, and turning the black rotary switch marked "XMIT CONT" from "STBY" to "TX ON". Put the cover back on the transceiver.

- Close the pod covers.

- Turn on the Pedestal Power switch (located at the pedestal base) to *On* position and the Safe/Operat*e* switch to *Operate*. Point the pedestal to zero Azimuth and zero (horizontal) Elevation. Switch the pedestal to *Safe* mode and measure and record the azimuth pointing direction with a compass. This azimuth offset can be entered into the radar control GUI to absolutely align the radar data in azimuth. Switch the pedestal to *Operate*.

- Log into the server: ssh –Y radarop@*serverIP* ;
  password: *skylook* (or usually: *radarop0*)

- root password: *car747*

- cd *datadir* (first create a data directory ex. Today's date: 2009_04_15)

- start the server:

- xpold

- If the server program quits, the curser is returned, then check the log file:

- tail -f xpold.log

- Start the control and display programs:

- xpol_control &

- xpol_display &

- (an alternative display for testing is: *scopeview &*)

- the loading of the server CPU can be monitored in another terminal:

- xterm &
- htop
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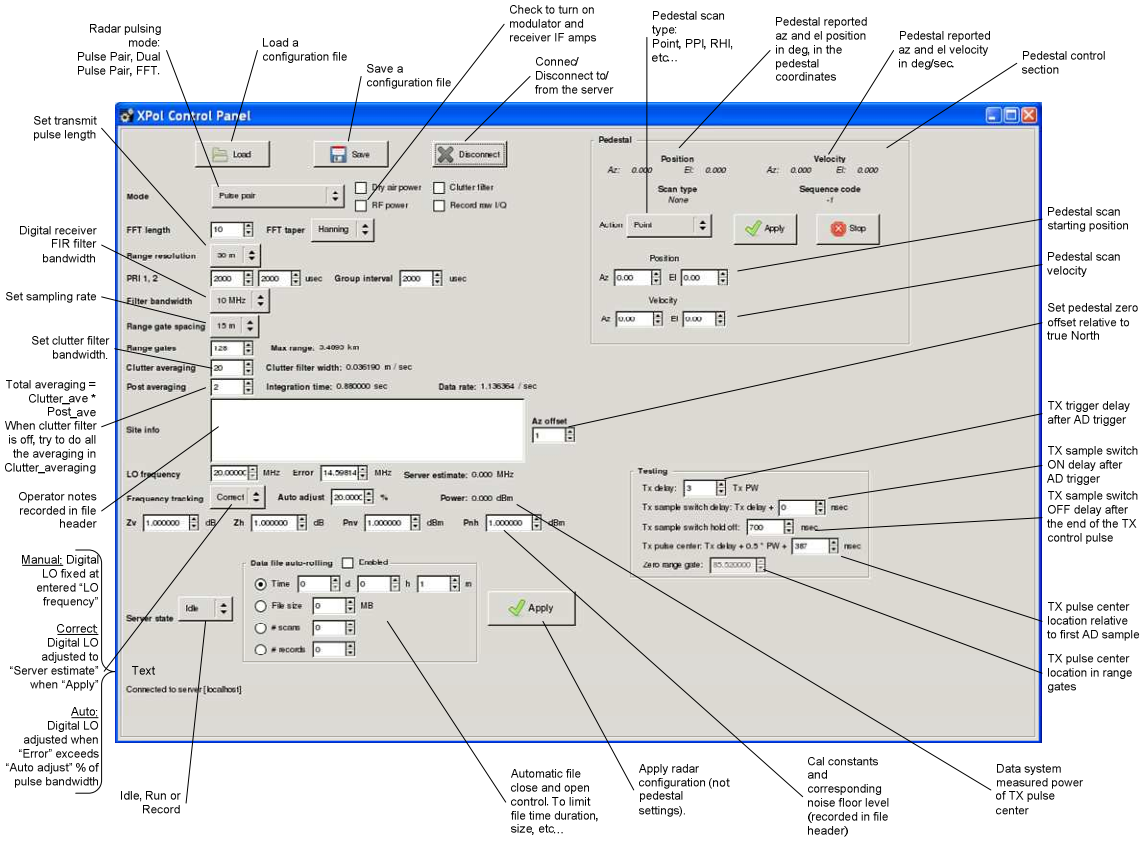

Figure 7. Xpol Control GUI.

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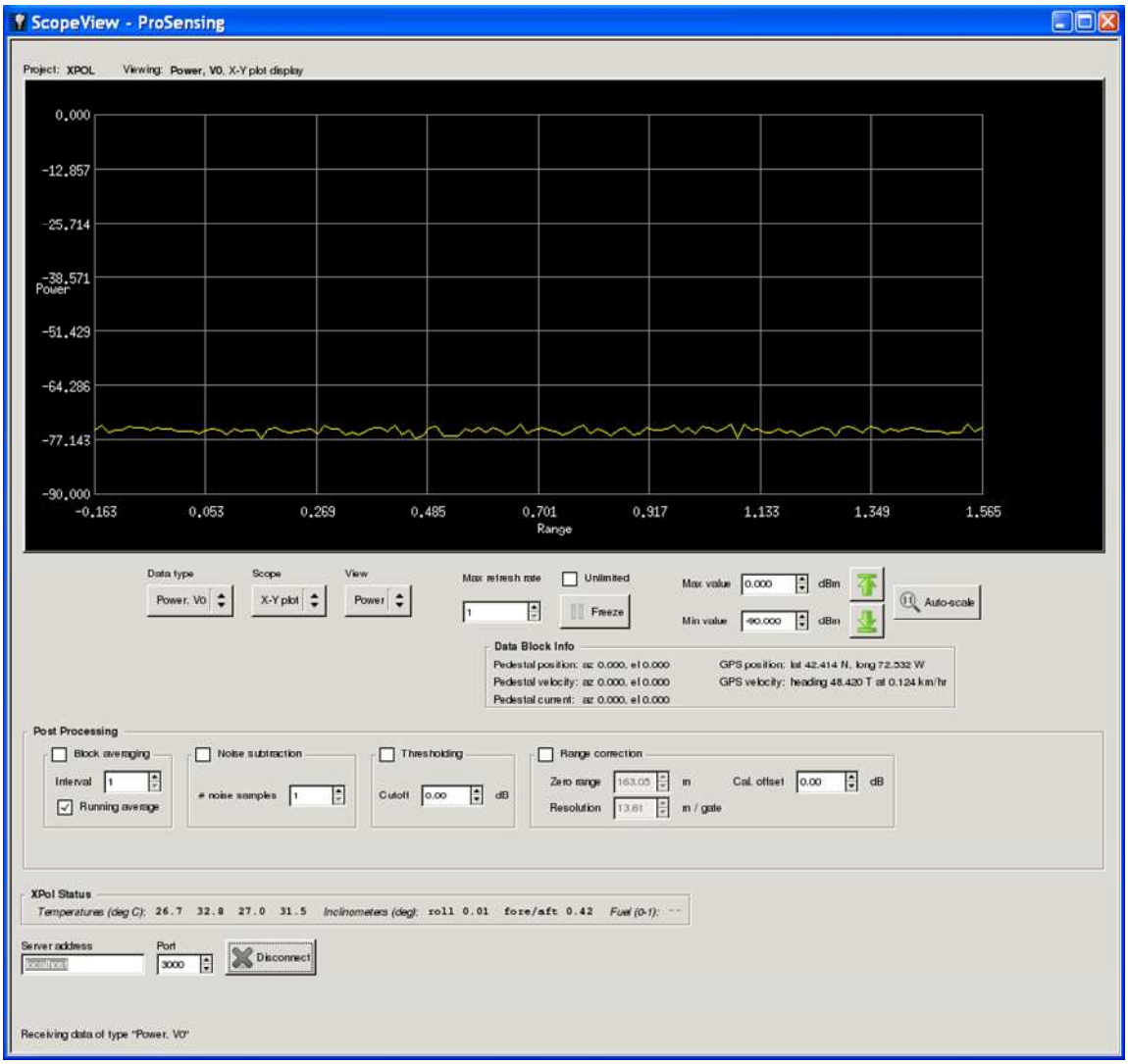

Figure 8. Xpol display without the "RF power" checked in the Control GUI. In this state the radar is operating, but the +15 V power supply is turned off, so the IF amplifiers are off (thus the noise floor is low) and the modulator is off.

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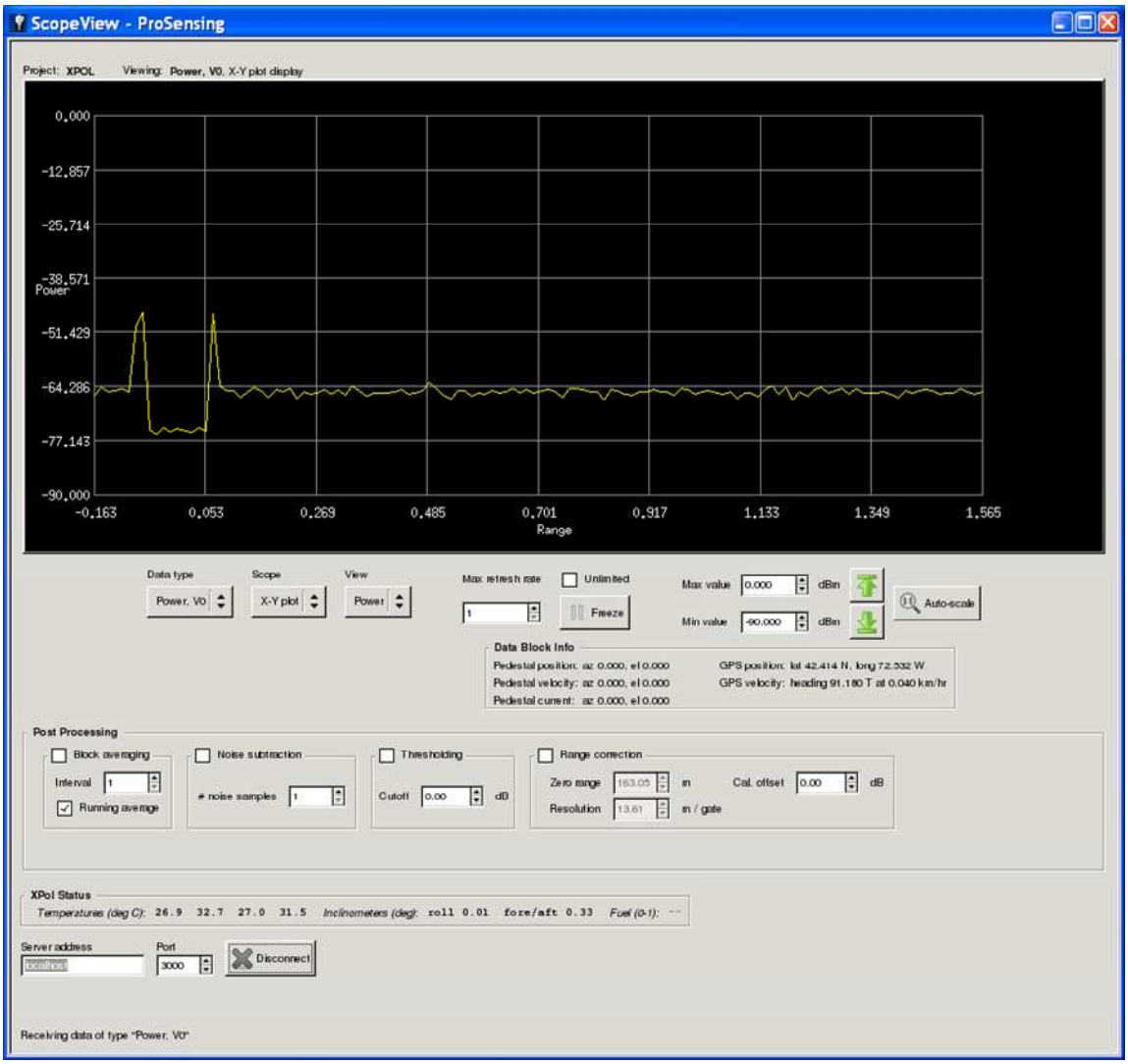

Figure 9 Xpol display immediately after the "RF power" is checked in the Control GUI. In this state the radar is operating, but modulator heater delay (~4 minutes) has not yet passed (or the radar is not switched to the "Radiate" state in the radar box). The dip in the noise floor is the due to the TX Pulse Sample switch looking at the un-amplified TX sampling receiver path, connected to Ch1 (V-pol).

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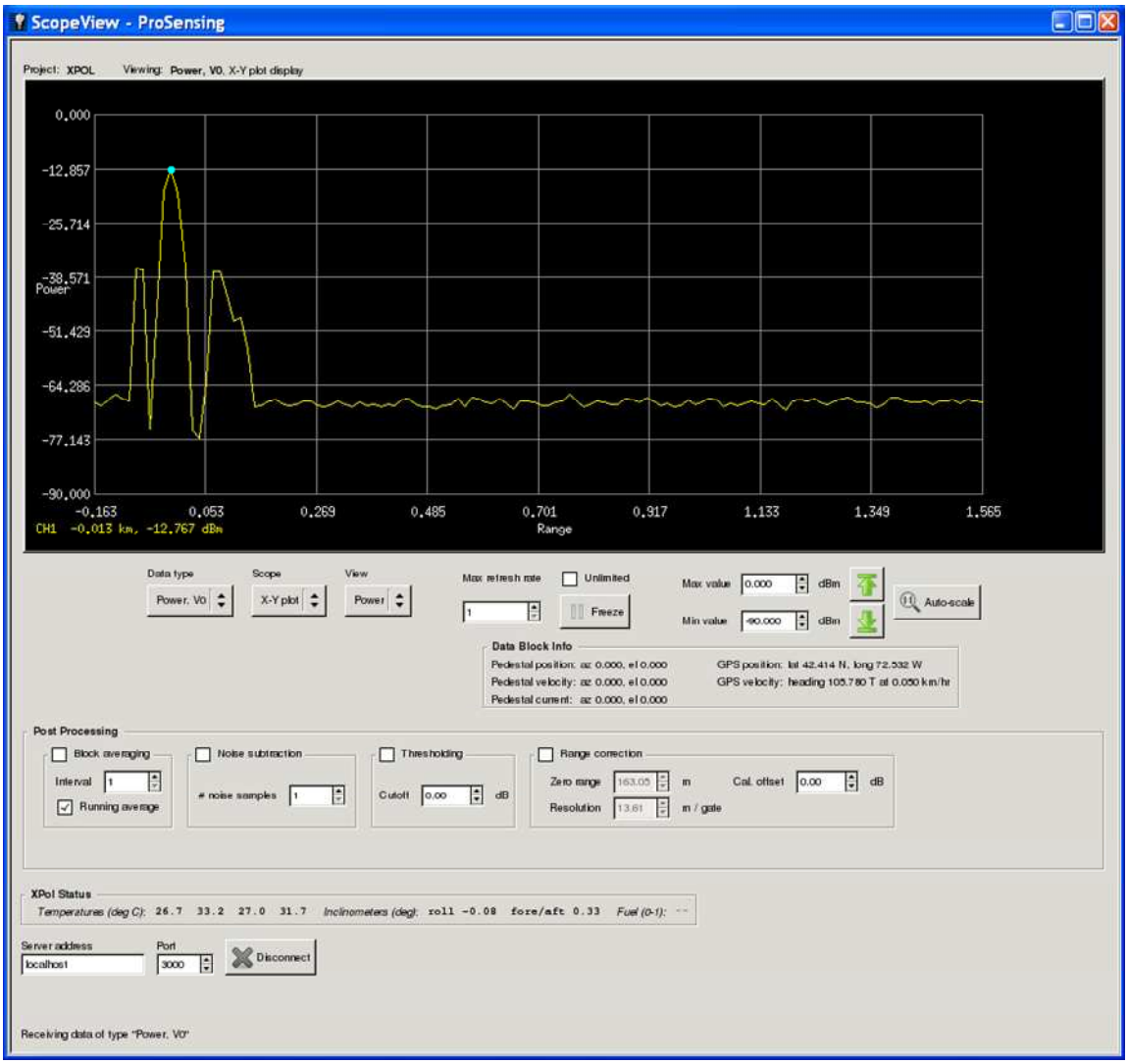

Figure 10 Xpol display while radiating. Here the radar was configures to 30 m range resolution and the output waveguides were terminated so there is no return from scatterers.

Data System memory Limit:

- The Xpol data system has a 125 MB data block limit per averaging interval. The formula to calculate this data block memory usage is the following:

  125E6 > *Cave* Ngates*Npulses*RGS**2*8/3.75

  where:

- *Cave* is the Clutter filter averaging,
- *Ngates* is the number of range gates,
- *Npulses* is the number of pulses per group (2 in Pulse Pair, 3 in Dual Pulse Pair, FFT_length in FFT mode and 2*FFT_length in FFT2 and FFT2I modes),
- *RGS* is the range gate spacing in meters,
- 2 is for I and Q,
- 8 is for double precision calculation in the CPU, and
- 3.75 is the range gate spacing after the hard coded 2 FIR decimation implemented on the digital receiver from the 80 MHz AD clock to 40 MHz I/Q sample rate.

Wake On LAN:

- If there is a power outage, the server will shut down automatically, but the UPS will maintain power to the network card. Once the power is restored to the system, the server can be rebooted using the free Linux software: “wakeonlan”.

- UCAR (Xpol6): wakeonlan 00:30:48:7b:80:20

- This over the network server power turn-on only works if the power to the network card of the server is kept on (by the Tripp-Lite system UPS). If this UPS shuts down, for whatever reason, then the server has to be turned on manually the first time (the power switch has to be manually pressed on the right side of the front panel).

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Shutdown procedure:

- Switch the radar to IDLE mode (from RUN or RECORD).

- Point the antenna in the desired stow position. Survival mode stow position, in extreme wind, is horizontal in elevation (el=0) with the azimuth break release activated.)

- Stop the *xpold* server program by typing <*ctrl*><*c*>.

- Shut down the server PC:

- sudo poweroff

- password: skylook (or radarop0)
- Open the pod cover.
- Turn off the UPSs, Tripp Lite and APC.
- Turn off all the breaker panel switches
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C. Troubleshooting

The transmitter is not radiating

- Make sure that the High Voltage lid in the radar box is screwed down tight.
- Check that the "RF Power" checkbox is checked in the Control GUI.
- It takes about 3-5 minutes for the magnetron heater delay to pass after the "RF Power" checkbox is activated before the modulator starts triggering the tube.
- Make sure that the server is in the "Run" or "Record" mode.
- Make sure that the server is running: the radar data should be changing in the Display_GUI.

The sensitivity is weak – TX pulse power is low

- More than likely this is an indication that the receiver is not frequency locked.
- Check the "Server Estimate" IF frequency. This should be about 20 MHz +-10 MHz.
- Change the frequency tracking to "Manual", set the "LO Frequency" to 20 MHz, and open the receiver bandwidth to 20 MHz. Then press "Apply" and after a few seconds, check the "Server Estimate" LO frequency – should be between 10 and 30 MHz – and check the peak TX pulse power of the V-channel (Ch1) in the Display GUI (should be around -12 dBm) or the "Power" value in the Control GUI (also should be around -12 dBm. After a few minutes, switch to "Correct" frequency tracking mode and close the receiver bandwidth to better match the transmit pulse width (range resolution).

The RF Enclosure is over-heating

- Check that the Air Conditioner is on:
- Check that the Y3 breaker switch is turned on.
- Check that the Air Conditioner control switch is turned to “High Cool”. This switch is inside the RF enclosure, on the inside section of the Air Conditioner. The switch should be rotated so the “High Cool” label is pointed down.
- Check that the AC power plug is connected to the Breaker Panel.

The RF Enclosure is too cold

- Check that the X2/Y2 breaker switch is turned on.
- Check that the heater (small silver box in the RF Enclosure) is switched on.
- Check that the power plug is connected to the Breaker Panel.

Maintenance

Pedestal

- Check the pedestal for any moisture every few months or more often if possible. The Dry Air generator should be kept running if there is any possibility of condensation to occur.
- Once a year the pedestal bearings and gears should be lubricated as instructed in the pedestal operation manual (hard copy provided).
- **Make sure to install the supplied pair of locking braces every time the radar is transported. The break release box should be used (connectors are labeled “El” (service connector) and “Az” (control connector) to free both the elevation and azimuth axes to install and tighten the locking brace bolts.**

RF Enclosure

- Check the enclosure for moisture as often as possible. The enclosure is sealed so condensation should be minimal.

- Check for loose connectors after every transit.

Radar Section

- After a year or two of continuous operation the magnetron power will start to drop and will need to be replaced. Drop-in replacement magnetrons are manufactured by EEV and NJR and can be purchased for under $1000. The new magnetron should work immediately, but if the frequency of the new magnetron is different, it may be necessary to adjust the DRO LO oscillator in the high voltage section of the RF Box. The DRO is a small rectangular device, mounted on the component shelf behind the magnetron. Instructions on adjusting the DRO frequency are written on the cover on blue tape. The cover has to be removed and the frequency tuning screw has to be turned until the radar IF frequency, indicated in the Control GUI, is close to 20 MHz. DRO freq. adjustment: CW=increases; CCW=decreases the radar IF frequency.

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