

# 1997-1998 Stanford ELF/VLF AGO experiment Upgrade v2.2

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## 1 Introduction

This year new antennae are to be installed at P1, P2, P3, and P4. An associated gain change (reversing that of last year) is needed in the line receivers at those sites. Also, P1, P2, P3, P4, and P5 will get two of the currently-recorded (Navy frequency) VLF receiver cards replaced by new dual (two-channel) receiver cards. This will add two to the number of sampled channels overall.

## 2 Outdoors: Antenna Upgrade

AGO2, AGO1, AGO3, and AGO4 receive an antenna upgrade. Prepare the lumber for each site by drilling  $\frac{7}{16}$  and  $\frac{13}{64}$  holes as shown below:

Prepare rope for each site by cutting and tying:

- four 34-foot lengths with a 10-inch loop (bowline) at one end (these are guys)
- one 24-foot length with a 10-inch loop (bowline) at one end (for horizontal line)
- four short lengths, long enough to tie a loop (bowline) around a 4x4

Refer to the drawing (“Bill’s diagram”) diagramming the new antenna. From my experience at AGO2, I suggest the following procedure.

1. Check with a compass set for grid “declination” that the crossed antenna is aligned correctly and identify the Grid N/S axis. Stake out the Grid N/S and Grid E/W directions by placing stakes some distance away in line with the current antenna axes. With a marker, label GN, GS, GE, GW on the sides of the existing central 4x4 post.
2. If necessary, raise the old antenna. An intermediate alternative is to dig a trench in the N/S direction in order that the new antenna lower limb is in line with (or just below) the lower limb of the existing N/S antenna.

Figure 2. Lumber and drilled holes.

3. Bolt the 2x4's to the 4x4's as shown in Bill's diagram. Screw in the eye bolts to the two  $\frac{13}{64}$  holes.
4. Mark two points 8 feet from the center of the old antenna, along the N/S axis. Dig deep holes at each point. You will also need to dig out two of the four anchors of the old antenna in order to raise the new.
5. Lay the 22' posts on the ground and arrange the new antenna loop with the free ends to end up in the center of the bottom limb. Tie the corners of the antenna to the eye bolts.
6. Slip the loops in the 34' lengths of rope over the tops of each 2x4 (two guys per post). The 24' length of rope will provide tension between the two posts so as to protect the antenna loop from doing so. Loop its tied end over the top of one post. Tie its free end around the top of the other post, making it a little bit shorter than the antenna length, remembering that nylon will stretch somewhat.
7. For each post, use a short length of rope to tie a snug loop through the top hole in the 2x4 and through the guy and taut line loops. This will hold the other lines in place at the top of the post.
8. Raise the two posts simultaneously into the two holes. Adjust the height and position of each so as to ensure the new antenna is coplanar with the old. A secondary consideration is to make the new antenna as square as possible.
9. Secure posts with deadman anchors. The angle between the guy and post should be greater than  $45^\circ$ , and the angle between the two guys on one post should be less than  $90^\circ$ .
10. Tension upper nylon rope so as to make the antenna slightly taut.

DIP	1	2	3	4	5	6	7
Colour	Red	Yellow	Blue	Grey	Black	Red	Yellow
Old	N/C	IF-5dB	IF-10dB	IF-15dB	IF-20adB	IF-20bdB	Com
New	N/C	C2-5dB	C2-10dB	C2-15dB	C2-20dB	N/C	Com
DIP	14	13	12	11	10	9	8
Colour	Brown	Orange	Green	Purple	White	Brown	Orange
Old	5V Pull-up	N/C	IF-Monitor	RF-Monitor	RF-10dB	RF-20dB	RF-30dB
New	5V Pull-up	C1-20dB	C2-Mon	C1-Mon	C1-5dB	C1-10dB	C1-15dB

Table 3.1. Front Panel connections.

11. Crimp supplied connectors onto antenna leads and replace old antenna with new, keeping the coiling sense in same orientation.

### 3 Indoors: Receiver Upgrade and Calibration

Below are the changes to be made to the ELF/VLF receiver rack to accomodate the new antenna, two new filter cards, and to change the set of sampled channels.

#### 3.1 Rewiring the FRONT PANELS for the modules' new cards

The boards inside two of the narrow-band modules are being replaced with dual hiss filters. The remaining narrow-band module, the one we want to keep, is NAA 24.0 kHz. These new boards need different front panels from those appropriate for the narrowband boards. However, the new card design minizes the wiring differences for the front panels, so that we will simply use the rotary switches and terminals from the existing modules' front panels, make one wiring change, and reinstall them on new silkscreened panels.

We are shipping five and carrying one new panels to the ice, so we will have none for two sites of the five. For these sites, a paper overlay should be made to relabel the existing panels.

Table 3.1 shows the soldered connection assignments between the dip / ribbon-cable and the BNC's and rotary switches on the front panels. The "RF" and "IF" on the old front panels becomes Channel 1 and Channel 2, respectively, on the new. The necessary changes are as follows:

- In order that the silkscreened text on the front be correct, we are substituting the blue anodized front panels themselves. The new ones have text on both sides: One side, overwritten with "VOID", is like that which is being replaced. We want to use the other side, labelled "Stanford U. Hiss Filters".
- Because the BNC terminals don't come out from the back, their connections must be unsoldered in order to move them. The rotary switches, in contrast, just get unscrewed from the front.

- In their new configuration the switches should only have 5 possible selections each, rather than the 4 and 9 on the old panels. The allowed positions are determined by the orientation of two small rings that are visible when you remove the switches from the front panel.
- The diodes on the “IF Gain” switch are no longer needed; cut them off.
- The old “RF Gain” switch needs an additional connection to become the five-position “Channel 1 Gain” switch. The appropriate wire is an orange wire which, along with a red one, has no connection (“N/C”) on the old panel. This wire should be soldered onto the rotary switch terminal which follows counter-clockwise after the white, brown, and orange connections on the Channel 1 switch.
- Note that DIP 6 (red) is connected to a position on the “IF Gain” switch, but is listed as “N/C” in the new configuration. If the diodes are cut, it is harmless as is and can be ignored.

The suggested order of implementing these changes is as follows:

1. Remove the front panel from the chassis. Unsolder the BNC terminals; unscrew the knobs (small allen wrench) and the switches and BNC's (0.5 " hex wrench) from the front panel.
2. Remove the diodes from the lower switch.
3. Unwrap the unused orange wire, and solder it onto the next position on the upper switch. If the orange wire is not long enough, you can use a short length of hookup wire and one of the unused terminals on the switch to reach the appropriate terminal in two steps. Dress (e.g. shrink tube) the unused red wire as it was before; it remains unused.
4. By trial and error or otherwise, place the two rings on the shaft of the rotary switches so that the allowed positions of the switch correspond to the soldered connections (no connection for 0 dB). If nothing's moved, you should only need to adjust the outer, larger ring, which controls the clockwise extent.
5. Remount the components on the new panels.
6. Resolder and dress the BNC connections as they were before.
7. Test that the switches are performing as in Table 3.1. The switches should be connecting the 5V pullup to the chosen gain setting.
8. Replace the PC board, brackets, and reassemble.

	Silkscreen module name	Det Int	NB Filt	VLF 3	VLF 2	VLF 1	
	New Module Contents	Det Int	NB Filt	VLF (NAA) 24.0 kHz	Dual Filter: 0.5-1, 4-8	Dual Filter 8-16, 16-32	
Ch#	Channel Name:						
1	0.5 - 1 kHz	25			29		
2	1-2 kHz N/S	26	25				
3	2-4 kHz	27	26				
4	4-8 kHz	28			30		
5	8-16 kHz	29				29	353
6	16-32 kHz	30				30	353
7	30-40 kHz	31	27				353
8	1-2 kHz E/W	32	28				
9	NAA	33		29			353

(a)

	NB Filter	VLF	Dual	
Output Pins (IDC)	12, 14, 16, 18	20	20, 22	(b)
Output Pins (37-D)	25, 26, 27, 28	29	29, 30	

Table 3.2. (a) Backplane connections (new arrangement). Pin numbers refer to those of the 37-pin D connector. Each row of the table represents one soldered wire. (b) Pin translations board - backplane.

### 3.2 Rewiring the back side of the MOTHERBOARD (BACK-PLANE)

The output from up to nine filtered signals are sent from their modules along the motherboard to the detector / integrator. In order to have the outputs ordered nicely by frequency, we need to reroute the traces on the back (accessible side) of the motherboard. Table 3.2 shows the connections that should exist between the four signal modules and the detector integrator in their modified form. To accomplish this, all 7 old traces must be cut, and the new connections soldered on. Connections must be soldered between the pair of pins on each ROW of Table 3.2(a). The pin numbers all refer to pins on the 37-pin D connector, numbered in the backplane schematic. See also the accompanying marked photocopy of the backplane.

### 3.3 Adjusting the LINE RECEIVER gain at P1, P2, P3, P4 only

With the larger antenna, we are worried about our signals saturating. So at the four sites that receive the antenna upgrade, we need to reverse a gain increase that was performed in 1996-1997. Pull out the line receiver module and see the resistors (R12 and R13 in the Line Receiver schematic) that have been replaced. Find the one corresponding to the newly installed larger antenna (N-S), and return it to its original value of 10k.

### 3.4 Installing the cards / modules

Two modules get their cards replaced. Plus, we need to reorder the modules in the chassis so as to fit with the new traces on the motherboard. The boards that get taken out can become spares for the one remaining narrowband (Navy) frequency, 24.0 kHz (NAA).

The correct order for the modules, when looking from the front, is:

Dual Filter (8-16 kHz; 16-32 kHz)

Dual Filter (0.5 - 1 kHz; 4-8 kHz)

VLF Receiver (NAA )

NB Filter (4 channels)

Detector / Integrator

Line Receiver

Label the new front panels of the dual filter modules with the frequencies (either 0.5-1k & 2-4k or 4-8k & 8-16k) on each board.

### 3.5 Stuffing the Detector Integrator

If there are two unstuffed channels on the detector integrator card, they will need to be stuffed. See the schematic in the yellow manual. So far they have been found stuffed except for the resistors on the new channels (channels 8 and 9). These will require 5.0 MOhm and 2.2 MOhm resistors as shown in the Detector Integrator schematic. Also, the op amps for these channels will need to be supplied. In fact, op amps on the other Det-Int channels should be checked. There are two op amps per channel, and input stage and an output stage. The output stage is identified by the large cap, and should FOR ALL CHANNELS be a 242 (low power) rather than a 353 (high speed). For the input stage, put 242's on all channels with signal  $\leq$  10 kHz and 353's on all channels with signal  $>$  10 kHz.

### 3.6 Change DAU inputs

There are now 9 signals going to the DAU. Thus the Stanford inputs need to be changed from 7 differential inputs to 9 single-ended inputs. The cabling already accomodates the 9 channels. For some reason, using 8 singled ended inputs results in brownouts of the BB snapshot. So: use 8 differential and one single

ended input into the AGO data acquisition unit (DAU). Sample all channels at at least 1 Hz. Reboot DAU before calibration!!

### **3.7 Calibration**

See the new calibration tables for this year.