Palmer Station Site Visit Report

May 2, 2008 to May 21, 2008

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ABSTRACT

In May 2008, Robert Newsome visited Palmer Station, Antarctica for the Stanford University VLF Group's annual NSF grantee visit for contract A-306-P: Stanford University VLF Antenna. This report summarizes the objectives of the visit, the status of the equipment at the beginning of the visit, and the accomplishments made during the visit. Recommendations for future work are made.

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Introduction

This report has been produced as a result of my three-week stay at Palmer Station, Antarctica as the annual NSF grantee visitor for the A-306-P contract (Stanford University VLF Antenna). The purpose of this document is multi-pronged:

1. Summarize the objectives of the visit.
2. Summarize the accomplishments made during the visit.
3. Summarize the status of the VLF antenna and its associated equipment.
4. Make recommendations for future work that needs to be performed on the VLF antenna and/or its associated equipment.
5. Record wisdom accrued during visit for the benefit of future Stanford University VLF Group visitors.

This report is merely the 2008 installment of a long series of trip reports generated each year by that year's grantee visitor. Many of the more recent reports (including those of Christopher Barrington-Leigh in 2000, Ryan Said in 2004, and Morris Cohen in 2006) can be found in TerraLab stored near the VLF receiver documentation.

This report should be stored alongside those so that it may be easily referenced by future visitors.

Terminology

Much of this report makes reference to work done at various locations in and around Palmer Station. It is assumed that the reader is already familiar with these locations (i.e., TerraLab, the Backyard, the Glacier, etc.).

Moreover, much of this report makes reference to work done in the Backyard and on the Glacier at the junction boxes. There are four (4) such junction boxes, and they house the connectors that join the five (5) sections of 1000-ft VLF cable. In this report, I refer to the junction boxes by the following names:

- *Junction Box 1* (JB1) – located in the middle of the Backyard, halfway between TerraLab and the foot of the Glacier.
- *Junction Box 2* (JB2) – located at the foot of the Glacier.
- *Junction Box 3* (JB3) – located about 40% of the way up from the foot of the Glacier toward the Antenna.
- *Junction Box 4* (JB4) – located about 80% of the way up from the foot of the Glacier toward the Antenna.

In referring to the five (5) sections of 1000-ft VLF cable, I designate each one by its termination locations. Thus, JB2-JB3 is the section between Junction Box 2 (JB2) and Junction Box 3 (JB3); TerraLab-JB1 is the section between TerraLab and Junction Box 1 (JB1); JB4-Preamp is the section between Junction Box 4 (JB4) and the Preamp; and so forth.

The connectors inside each junction box are designated by the direction in which their attached cable proceeds from the junction box:

- *Uphill connectors* (always male connectors) are attached to cables that, if followed to their ultimate end, lead to the Antenna.
- *Downhill connectors* (always female connectors) are attached to cables that, if followed to their ultimate end, lead to TerraLab.

The connectors themselves are assembled out of several parts, some of which are dealt with specifically in this report. I refer to the ring used to attach and separate two connectors as the *attachment ring*, and I refer to the shell of a connector that is clamped to the cable and can be unscrewed and removed to expose the connections inside as the connector's *backend*.

Finally, the VLF cable itself contains 18 wires, grouped into six (6) trunks. Each trunk contains three wires (two that carry a differential voltage and a third that acts as ground), and the three wires together deliver one signal from the Preamp back the Receiver (or power from the Receiver up the Preamp). I refer to each trunk as a *triplet*. Each of the 18 wires is labeled by the pin letter it is attached to at each of the connectors. (Note that one wire uses the same pin letter for all the connectors.)

Table 1 describes the triplets. Note that two pins on each connector (Pin F and Pin G) are not connected to wires.

Table 1 – Triplets inside the VLF cable

Triplet	Purpose	Source	Destination
C-M-N	N/S	Preamp	Receiver
J-K-T	E/W	Preamp	Receiver
A-B-L	Vertical (not used)	Preamp	Receiver
H-R-S	Power	Receiver	Preamp
Q-U-V	Calibration	Receiver	Preamp
D-E-P	Spare	N/A	N/A

Visit Objectives

In this section, I describe the objectives of my visit. The general visit objectives are those common to all of our Palmer Station NSF grantee visits. The particular visit objectives are those objectives that were specific to my visit.

General Objectives

The general objectives of my visit are summarized as follows:

- Recalibrate the VLF Antenna/Receiver system.
- Estimate the area of the Antenna.
- Inspect the Antenna, repairing damage to any of its cables and make sure that the mast is not leaning due to summer melting of its ice foundation.
- Inspect the Preamp, repairing anything that might not be right with it.
- Inspect the VLF cable and all the junction boxes and connectors, repairing any damage.
- Inspect the Receiver setup in TerraLab, repairing anything that might not be right with it.
- Inspect the computers and the data acquisition software, repairing anything that might not be right with them.
- Make recommendations for future work and/or future changes to the VLF Antenna/Receiver system.

Particular Objectives

In addition to the general objectives described above, this particular visit involved some additional objectives. About three (3) weeks before my arrival, our VLF Antenna/Receiver system began failing. For a day or two, the system would intermittently stop collecting VLF data. The outages would last anywhere from less than an hour to several hours. After about three (3) days, the data stopped being collected altogether. Initial investigation by the Palmer Station Research Associate noted the burn marks on the connectors at JB2 and suggested that at least one of the problems was located somewhere along the VLF cable itself (between the Receiver and the Preamp)[1].

Thus, a particular (and primary) objective was to repair the Antenna/Receiver system. Of course, this objective needed to be met before progress on any of the general objectives could be made.

VLF Equipment Status

The following subsections summarize the status of the VLF equipment upon my arrival. Modifications to the status of any piece of equipment made during my trip are summarized in the section title "Visit Accomplishments".

Figure 1 – The Antenna at the top of the Glacier.

Preamp and Antenna

The Preamp and Antenna were generally in very good shape upon my arrival, and no changes were made.

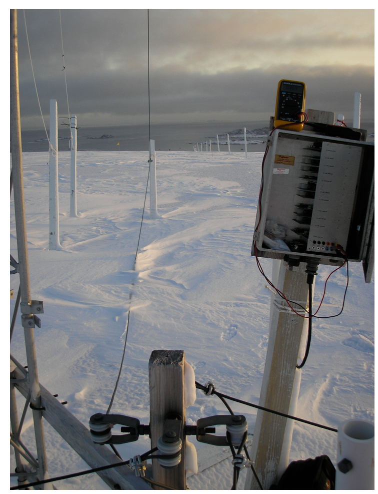

Figure 2 – The bottom of the Antenna cable frozen into the ice in the west direction. The same was true of the east direction, but not the north or the south directions.

The Antenna mast was not tilted in any direction (due to melting of the ice foundation over summer). There was a moderate amount of slack on the Antenna cables, and the bottom part of both the east and west sides of the Antenna were frozen into the ground.

The Preamp looked great – no corrosion or weather damage. It was noted that between the two screws used to close the Preamp, one required a Phillips head screwdriver and one required a flathead screwdriver. Thus, two different screwdrivers needed to be carried up to the top of the Glacier in order to open the Preamp.

Cable and Junction Boxes

The cable and junction boxes required the most attention. On the JB2-JB3 cable, about 300 feet (give or take 100 feet) from JB2, two breakings of the cable jacket were found about five (5) feet apart from each other. The breakings were roughly as deep as the jacket width itself, but one of the

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[1] This was determined by applying a known DC voltage to various pin pairs at the beginning of the VLF cable at TerraLab and measuring the voltage on those pin pairs in downhill connectors at various points along the VLF cable. All of the voltages made it to JB1, but not many made it to JB4.

breakings also involved the severing of the wire associated with Pin S (of the power triplet) on the connectors. The breakings did not look natural (like cracks due to cold and ice), and may have been introduced artificially (perhaps the cable got snagged on sharper pieces of ice on the glacier during its initial rollout, or it got stepped on by a crimp-on spike during someone's maintenance of the cable or posts) and then exacerbated over time with weather.

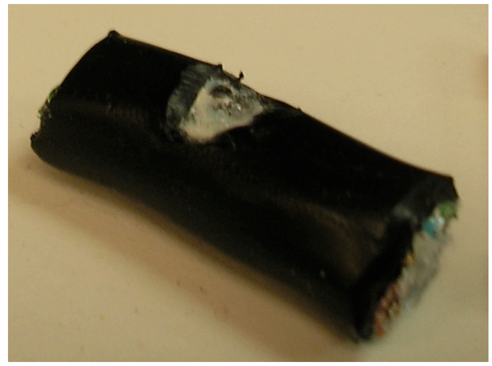

Figure 3 – The damage to the JB2-JB3 cable, cut out from the rest of the cable.

Additionally, both the uphill and downhill connectors in JB2 exhibited burn marks on their mating surfaces. The uphill connector was missing Pin H (of the power triplet) altogether, as if it had burned out. Inside the uphill connector, even more burn markings were observed and six (6) of the wires did not make electrical contact with their pins. In testing two connectors, the downhill connector still seemed to function correctly.

Figure 4 – The connectors at JB2. (a) Burn marks on the downhill connector. (b) Burn marks (and a missing pin) on the uphill connector. (c) Improper weatherproofing of the uphill connector.

In the course of examining the connectors at each junction box, problems in safely separating two joined connectors (without damaging the wire-to-pin contacts inside) were encountered. Normally, one separates connectors by unscrewing the attachment ring that joins the connectors. However, if one is holding the wrong connector backend while attempting to do this, the backend may begin to unscrew before the attachment ring does (perhaps due to the cold). Because the backend is clamped to the cable but not to the pin header, this action can begin pulling the wires off the pins. This tendency was observed at JB1, JB2, and JB3, although it was not observed at JB4 or at the Preamp.

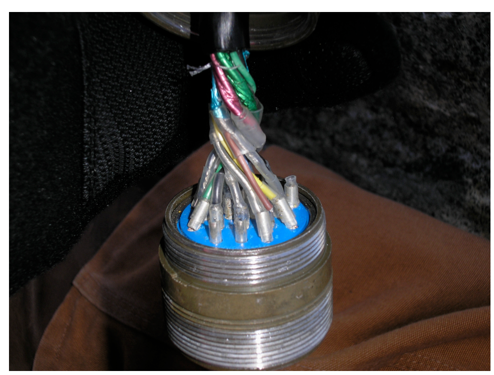

Figure 5 – The twisting damage exhibited on one of the JB1 connectors.

This problem resulted in damage (likely incurred after the VLF antenna failed and investigation began) to the connectors at JB1. In the downhill connector at

JB1, Pin C (of the NS triplet) and Pin P (of the spare triplet) had been disconnected from their wires. In the uphill connector, Pin H (of the power triplet) had been disconnected from its wire.

Receiver

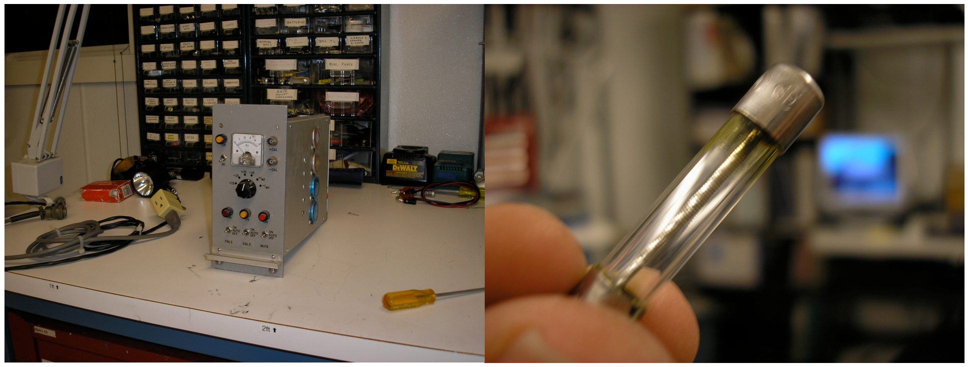

Figure 6 – (a) The power supply box and (b) the blown fuse found inside of it.

The Receiver (by which I mean all the hardware in TerraLab, not counting the computers) looked to be in good shape. The only problem observed was with the Power Supply Box (which also houses the calibration injection circuitry), which did not properly generate the ±35 VDC that is sent up the VLF cable to power the Preamp. This was due to a blown ½ amp fuse inside the Power Supply Box.

Computers and Software

The computers and data acquisition software had been operating without problems for a long time (around two years?) before I arrived, and I found nothing about them that needed attention. I left everything unchanged and operating as it had been.

Visit Accomplishments

In this section, I discuss the objectives that were met during my visit.

General Objectives Met

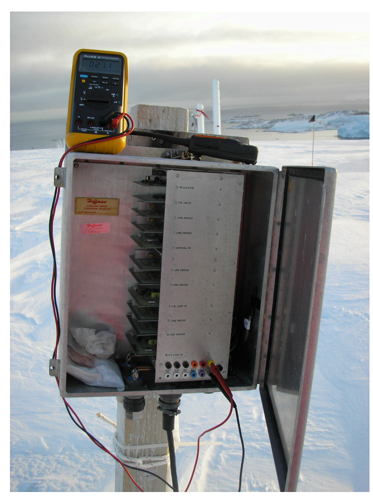

Figure 7 – Calibration at the Preamp.

The antenna was recalibrated on May 19, 2008 between roughly 1800 UT and 2030 UT. The appendix contains the resulting calibration data tables and graphs. Broadband data was recorded during the calibration process and burned to DVD. However, it was found after the fact that the recording did not actually start until near 1830 UT despite the fact that the VLF DAQ software's recording schedule was set up to begin recording at 1730 UT. Thus, the lower frequencies of the calibration process were not captured in the recorded broadband data. Fortunately, the 30 second 50 Hz to 50 kHz frequency sweep at the end of the calibration process was captured. After the calibration process was finished, the injected calibration tone strength was set to 70.0 mV at 5 kHz, which corresponds to an injected calibration strength at the Preamp of 21.9 mV and a value of V_{CAL} of V_{CAL} = 10.9 mV.

At the Antenna, the bottom parts of both the east and west halves of the E/W loop were slack enough to be frozen into the ice of the Glacier. Rather than digging out the two cables (risking inadvertent damage in the process) and adjusting the slack of all the Antenna cables, the cables were left as is and the Antenna area was measured. The area was estimated (using Morris Cohen's method from 2006) to be A_{ANT} = ?? m^2. However, this method[2] overestimates the area as it does not account for droop in the cable between the top and the outside edges of the Antenna.

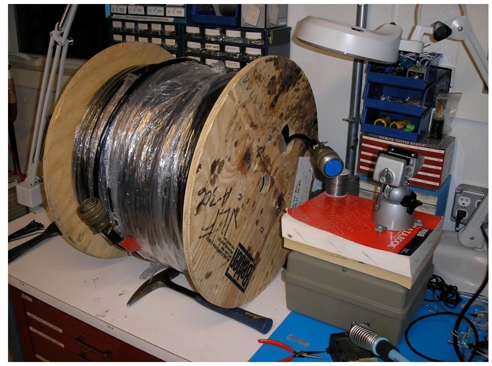

Figure 8 – Connectors attached to the new spool of 1000 feet of VLF cable, the night before installing it.

To address the problems with the JB2-JB3 cable, the entire cable was replaced with a brand new cable. The cable's downhill connector at the JB3 end was preserved (that is, the connector on the old cable was cut off and used in the same location on the new connector). The cable's uphill connector at the JB2 end (which had been damaged) was replaced with what appeared to be an old connector no longer being used that I found in storage at TerraLab. The downhill connector at JB2 (also damaged) was replaced with a brand new connector. At JB1, two (2) of the three (3) wire-to-pin contacts damaged by the twisting motion of opening the connectors were repaired. These were the contacts associated with Pin C on the downhill connector and with Pin H on the uphill connector. The wire-to-pin contact associated with Pin P on the downhill connector was not repaired it was located in the middle of the 18 connections (very hard to get to with a soldering iron in the wind and snow/rain) and was only apart of the spare triplet (which is neither connected to the Preamp or to the Receiver).

In the Receiver setup in TerraLab, a ½ amp fuse inside the power supply box (which generates the ±35 VDC power) had been blown causing power not to be delivered to the Preamp. The fuse was the middle fuse of the five (5) fuses in the power supply box. The fuse was replaced.

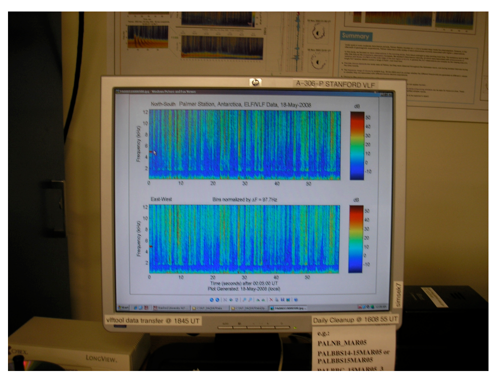

Figure 9 – The first spectrogram after the Antenna/Receiver system was working again.

Particular Objectives Met

The particular objective of my visit (which was to get the Antenna/Receiver system working properly again) was accomplished by performing the work on the cables, connectors, and power supply box described in the paragraphs above. The cause of the Antenna/Receiver system's failure was due to

[2] Morris' method treats the droop in the bottom part of the cable as an additional piece of a circle added to the antenna area.

the combination of:

1. The severed wire (associated with the connectors' Pin S) in the middle of the JB2-JB3 cable.
2. The damaged uphill connector at JB2.
3. The blown fuse in the power supply box at TerraLab.

It is difficult to say what exactly caused these three problems. Thus, instead of presenting a theory for what exactly happened, I will merely make a few observations:

Figure 10 – The elements that caused the Antenna/Receiver system to fail.

1. Both of the damaged areas on the JB2-JB3 cable had been taped over (although not in a weatherproof way) and taped to the supporting guy wire. Very few other locations on the cable had been taped in this way. This suggests that the damaged areas had been previously noticed (before they actually became points of failure). Perhaps the cable had sustained this damage awhile ago – someone stepped on the cable with their crimp-on spikes while maintaining the posts, or the cable got snagged on a sharper piece of glacial ice during its initial rollout – and then wind and weather worked the damage into a failure point.
2. At JB2, the uphill connector – which suffered the majority of the damage (the one with the most intense burn marks, the altogether missing Pin H, and the multiple damaged wire-to-pin contacts) – had not been assembled correctly. The system that clamps the weatherproofing jacket to the cable had not been tightened and was not actually located in the position that it should have been located.
3. The burn marks on the uphill connector at JB2 were centered around the pins of the H-R-S triplet, which delivers the power from the Receiver setup at TerraLab up to the Preamp at the top of the Glacier. On the downhill connector, the burn marks on the mating face are in the same location and seem to merely be a result of more serious burning that happened on the uphill connector.

Recommended Future Work

In this section, I describe my recommendations for future work that needs to be done. These are classified into work that should be done immediately, work that should be done some time in the next year, and work that needs to eventually done in the long term.

Immediate

Tasks that need to be accomplished as soon as possible are:

- Send an entire set of new Amphenol 20-pin connectors (enough to replace all the junction box connectors from TerraLab to the Preamp) to Palmer as there are no more spare uphill (male) connectors and only 2-3 spare downhill (female) connectors left in TerraLab.
- Send one (1) or two (2) spools of 1000 feet of VLF cable, as the last spare spool was used to replace the JB2-JB3 section of cable.
- Post notices in each of the junction boxes cautioning people to the potential for damaging the connectors if they are opened incorrectly.
- Replace one of the two (2) screws on the Preamp so that both screws require either flathead screwdrivers or Philips head screwdrivers (as opposed to the current situation where each of the two screws requires opposite types of screwdrivers).

Next-Year

Tasks that are not urgent but that should be accomplished roughly in the next year are:

- Clean the Hero Inlet ground. It was recently replaced altogether (February 27, 2008) and should not have to be cleaned until the austral summer of 2008-2009. Cleaning the ground in winter may be difficult due to ice freezing to the ground.
- Replace the connectors at JB1, which were damaged by the twisting motion of opening the connectors. At the very least, the wire-to-pin contact associated with Pin P of the downhill connector at JB1 should be repaired (if only for completeness' sake, as that wire is only a spare wire and does not actually play a functional role in the Antenna/Receiver system).

Long-Term

Describe future work that should eventually be done, but dies not need to be done urgently.

- Move the Antenna to avoid the worsening crevasse problem on the Glacier. Currently, the cable path to the Antenna runs up the north side of the public path up the Glacier. This side has experienced significant encroachment of crevasses over the last several years, and the cable path now actually passes outside of the "safe" area a few times in the vicinity of JB4 and the Preamp. In the short term, the Antenna can be moved closer to the south side of the public path (along with the cable path leasing up to it), but ultimately the Antenna will need to be moved to a new location altogether. This has been a known problem for several years.

Accrued Wisdom

In this section, I pass on a few of the lessons I learned over the course of my trip. This section may hopefully be helpful to future grantee visitors. Our research group tends to send a new person to Palmer Station each year, and that person has to learn the ins and outs of working at Palmer Station from scratch each year. By recording a few of the lessons the visitor learns each year, our group should be able to accrue wisdom about working at Palmer Station despite the fact that it is usually a new person that is sent each year.

Some of the things I learned were:

Figure 11 – The tent I pitched at the foot of the Glacier. Inside the tent I had a generator, a soldering iron, a heat gun, a can of gas, and lots of tools.

- If you need to do some types of work (like replacing cable connectors) out in the Backyard or on the Glacier that might span more than a day, it is useful to check a tent out from storage and set it up as a remote working space. You can store a generator in the tent overnight. Use of a tent removes the weather variable from your work schedule (although it does not remove the daylight variable from your work schedule).
- In transiting the Backyard, the easiest route that I found was along the north side of the spine that runs from near TerraLab to near the foot of the Glacier. (Note that when you are in the Backyard, it is hard to tell where the spine is. However, you can see it more clearly from up on the Glacier. The VLF cable runs roughly along the spine through the Backyard). This route is not particularly easy to find, but you will probably stumble upon it if you walk through the Backyard enough times. This route is most useful if you have to carry something heavy through the Backyard (like a generator or a spool of VLF cable).
- On the first day of your visit, go through all the spare VLF parts you can find in TerraLab to familiarize yourself with what things you have available to you should you need them later in your visit. Do the same in T-5 and in the old VLF Hut (also known as the Clean Air Room). In TerraLab, read through all the documentation you can find: especially Ryan Said's calibration notes and the various trip reports. Diagram out all the connections between boxes in the Receiver to familiarize yourself with how it works.
- On the first day that weather permits, go up to the Antenna at the top of the Glacier (following the VLF cable) to familiarize yourself with it. Open a few of the junction boxes along the way, and open and inspect the connectors (although be careful you do not inadvertently damage them in doing so).

Open the Preamp when you get to the top[3], and have a look inside. Make sure you take crimp-on spikes with you, and make sure they fit before you leave TerraLab (as you need a screwdriver to adjust the size of some types of crimp-on spikes).

Appendix

In this appendix, we present the tables and plots associated with calibrating the Antenna/Receiver system. The calibration was performed on May 19, 2008.

Table 2 – Frequency calibration table

Freq. (Hz)	2 V_{rms} Injected Signal				70 mV_{rms} Injected Signal				Time (UT)
	Cal Out	Preamp	BB N/S	BB E/W	Cal Out	Preamp	BB N/S	BB E/W	
50	2.037	0.5690	0.107	0.103	0.0693	0.0195	0.0047	0.0050	1755
100	1.988	0.5970	0.185	0.196	0.0694	0.0209	0.0073	0.0077	
150	2.008	0.6220	0.224	0.247	0.0707	0.0217	0.0085	0.0094	
200	2.030	0.6260	0.254	0.287	0.0709	0.0219	0.0095	0.0106	
300	2.027	0.6280	0.301	0.344	0.0702	0.0220	0.0110	0.0124	
400	2.017	0.6250	0.334	0.382	0.0707	0.0220	0.0121	0.0137	
500	2.017	0.6210	0.366	0.409	0.0704	0.0219	0.0130	0.0146	
600	2.004	0.6200	0.381	0.425	0.0706	0.0220	0.0138	0.0152	1816
700	2.004	0.6220	0.399	0.437	0.0701	0.0218	0.0141	0.0155	
800	2.013	0.6250	0.413	0.448	0.0699	0.0218	0.0145	0.0132	
900	2.013	0.6260	0.423	0.456	0.0703	0.0219	0.0149	0.0161	
1k	2.011	0.6250	0.429	0.461	0.0699	0.0218	0.0151	0.0162	
2k	2.011	0.6270	0.457	0.483	0.0695	0.0217	0.0158	0.0167	
3k	2.003	0.6260	0.466	0.490	0.0691	0.0216	0.0160	0.0169	
4k	2.000	0.6280	0.473	0.497	0.0706	0.0220	0.0165	0.0174	
5k	1.999	0.6300	0.480	0.503	0.0700	0.0219	0.0167	0.0175	
6k	1.996	0.6310	0.483	0.505	0.0703	0.0220	0.0167	0.0175	
7k	2.010	0.6380	0.486	0.508	0.0698	0.0218	0.0165	0.0173	1835
8k	2.004	0.6380	0.481	0.502	0.0707	0.0221	0.0165	0.0173	
9k	1.999	0.6370	0.471	0.491	0.0706	0.0220	0.0160	0.0168	
9.5k	1.996	0.6360	0.465	0.484	0.0702	0.0218	0.0157	0.0165	
10k	2.002	0.6390	0.460	0.479	0.0699	0.0217	0.0155	0.0161	
11k	1.997	0.6360	0.444	0.463	0.0702	0.0217	0.0148	0.0155	
12k	2.005	0.6360	0.428	0.445	0.0698	0.0213	0.0140	0.0147	
13k	1.999	0.6300	0.411	0.427	0.0701	0.0211	0.0132	0.0138	
14k	2.003	0.6250	0.394	0.409	0.0694	0.0206	0.0124	0.0130	
15k	1.996	0.6140	0.377	0.391	0.0704	0.0205	0.0119	0.0125	1851
16k	1.996	0.6030	0.362	0.374	0.0702	0.0199	0.0112	0.0117	
17k	1.990	0.5890	0.358	0.374	0.0703	0.0194	0.0105	0.0110	
18k	1.997	0.5760	0.349	0.364	0.0697	0.0186	0.0099	0.0103	
19k	1.992	0.5570	0.338	0.351	0.0696	0.0178	0.0092	0.0096	
20k	2.014	0.5470	0.330	0.343	0.0695	0.0171	0.0085	0.0089	
21k	2.011	0.5260	0.315	0.327	0.0703	0.0164	0.0077	0.0081	
22k	2.012	0.5070	0.298	0.310	0.0696	0.0155	0.0070	0.0072	

[3] Note that as of May 2008, you need both a Phillips head screwdriver and a flathead screwdriver to open the Preamp. Do not forget to bring both types with you when you go up to the Preamp.

23k	2.015	0.4870	0.278	0.290	0.0696	0.0146	0.0060	0.0062	
24k	1.983	0.4570	0.252	0.262	0.0697	0.0136	0.0050	0.0053	
25k	2.020	0.4470	0.236	0.246	0.0694	0.0127	0.0043	0.0046	1910
26k	2.018	0.4270	0.215	0.225	0.0697	0.0119	0.0039	0.0042	
27k	2.023	0.4070	0.197	0.206	0.0694	0.0109	0.0039	0.0041	
28k	1.997	0.3840	0.181	0.189	0.0692	0.0103	0.0038	0.0041	
29k	2.004	0.3660	0.171	0.179	0.0692	0.0092	0.0038	0.0040	
30k	2.022	0.3902	0.165	0.173	0.0695	0.0088	0.0037	0.0039	
31k	2.031	0.3775	0.160	0.168	0.0705	0.0080	0.0036	0.0038	
32k	1.994	0.3582	0.153	0.160	0.0701	0.0070	0.0036	0.0038	
33k	2.000	0.3466	0.147	0.154	0.0707	0.0070	0.0035	0.0038	
34k	2.012	0.3381	0.138	0.145	0.0704	0.0067	0.0035	0.0037	
35k	2.023	0.3286	0.126	0.133	0.0678	0.0062	0.0035	0.0038	
36k	2.016	0.3169	0.114	0.120	0.0681	0.0066	0.0035	0.0037	1931
37k	2.026	0.3088	0.109	0.115	0.0700	0.0070	0.0036	0.0038	
38k	2.001	0.2956	0.112	0.118	0.0696	0.0071	0.0036	0.0038	
39k	2.009	0.2880	0.132	0.139	0.0697	0.0066	0.0036	0.0038	
40k	1.998	0.2803	0.126	0.137	0.0698	0.0066	0.0035	0.0037	
40.5k	2.006	0.2758	0.081	0.092	0.0695	0.0069	0.0035	0.0038	
41k	2.008	0.2730	0.052	0.059	0.0694	0.0061	0.0033	0.0036	
42k	2.018	0.2667	0.022	0.024	0.0691	0.0061	0.0033	0.0035	
43k	2.003	0.2587	0.007	0.008	0.0695	0.0061	0.0031	0.0034	
44k	2.009	0.2525	0.004	0.004	0.0702	0.0064	0.0032	0.0035	
45k	2.005	0.2462	0.004	0.004	0.0704	0.0064	0.0031	0.0035	1950
46k	2.019	0.2406	0.004	0.004	0.0705	0.0065	0.0032	0.0035	
47k	2.028	0.2361	0.004	0.004	0.0707	0.0073	0.0032	0.0035	
48k	2.043	0.2306	0.004	0.004	0.0703	0.0072	0.0032	0.0036	
49k	1.999	0.2208	0.003	0.003	0.0701	0.0072	0.0032	0.0035	
50k	2.013	0.2160	0.003	0.004	0.7000	0.0058	0.0031	0.0034	2001