INSPIRE
INTERACTIVE NASA SPACE PHYSICS IONOSPHERE RADIO EXPERIMENTS

The INSPIRE Journal

Volume 15 December 2006

INSPIRE's New Look

As you can see above, INSPIRE has a new logo. The "dragon" logo, designed by Elea Mideke in 1991, has served us very well, but it was thought that an update was in order. The logo was created by Edge Advertising of Washington DC as part of a complete redesign of the INSPIRE web site (http://image.gsfc.nasa.gov/poetry/inspire/). Go to the new web site (at the same old address) and take a look. Let us know what you think.

In this issue you will find:

Table of Contents

The INSPIRE Journal
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The INSPIRE Journal is a publication of The INSPIRE Project, Inc., a nonprofit educational/scientific corporation of the State of California. The purpose of the INSPIRE Project, Inc., is to promote and support the involvement of students in space science research. All officers and directors of the corporation serve as volunteers with no financial compensation. The INSPIRE Project, Inc., has received both federal and state tax-exempt status (FEIN 95-4418628). The *Journal* is published once per year in December.
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Contributions to the *Journal* may be sent to:

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New Web Site and Logo

If you haven't already done so, check the new INSPIRE web site at the old address:

http://image.gsfc.nasa.gov/poetry/inspire/

You will see the new INSPIRE logo at the top of each page. Content has been updated and reorganized to make things easier to find.

The INSPIRE Journal Online

This issue of *The INSPIRE Journal* will appear online as soon as possible. Click on "The INSPIRE Journal" button to find the latest online version and an archive of all previous *Journals.*

An important feature of the online version of the *Journal* is the inclusion of sound files for each data session and for any additional analysis that is done. All photos will also appear in color online.

The plan for the future is to stop the sale of subscriptions to paper copies of the *Journal.* The online version would then be the only one available. A big advantage is that it is free!

INSPIRE Article Published in *The Physics Teacher*

Jill Marshall, of the University of Texas in Austin, Texas, has had an article entitled "INSPIRE: A VLF Radio Project for High School Students" published in:

The Physics Teacher -- January 2007 Volume 45, Issue 1

The Physics Teacher is the journal of the American Association of Physics Teachers (AAPT). Jill has been a supporter of INSPIRE since the days of the SEPAC mission on the space shuttle in 1991-92.

Order Form no Longer Included in the Journal

The order form on the web site (http://image.gsfc.nasa.gov/poetry/inspire/2006/orderform.html) is the one to use when ordering from INSPIRE.

Write for *The INSPIRE Journal*

The procedure for contributing articles for *The INSPIRE Journal* could not be simpler! Just send it in! Any format is acceptable. Electronic format is easier to work with. A Word file on disk for either the PC or Mac platform is preferred. An email message will work, too. If that does not work for you, a paper copy will do. Any diagrams or figures can be scanned in.
What about topics? Anything that interests you will probably interest most INSPIRE participants. As long as the topic is related to natural radio or the equipment used, it will get printed. The deadline for submissions is December 1. Don't worry about the deadlines though. If you miss a deadline, you will just be very early for the next edition!

We at INSPIRE are looking forward to hearing from you!

THE INSPIRE VLF-3 RECEIVER
Theory of Operation

Robert Bennett
Las Cruces, NM

PURPOSE

In June of 2006, the author was visiting with Bill Pine and a discussion of the VLF-3 occurred. One issue that Bill raised was the absence of both technical information and trouble shooting guidance for the receiver. I agreed that the lack of information is a problem and volunteered to write articles for the Journal on VLF-3 theory and trouble shooting.

BACKGROUND

The VLF-3 is the third receiver developed by The INSPIRE Project. The VLF-3 replaced the VLF-2 receiver which was the standard INSPIRE receiver for over 10 years. The VLF-2 had to be replaced because existing stocks of the receiver had been depleted and some of its components were no longer manufactured. It was not economically feasible to attempt another production run of the VLF-2. Like its predecessors, the RS-4 and the VLF-2, the VLF-3 was designed to satisfy three important constraints.

1. The receiver must be low cost, provided as a kit and simple enough for high school students to assemble and use. The receiver is to be lightweight and easily transportable. The cost goal was to be in the $100 range per kit.
2. The receiver must be designed to use a simple, short (3 to 10 feet long) vertical antenna. The vertical antenna forms an E-Field probe to pick-up natural radio signals.
3. The receiver must be powered from common, easy to obtain batteries such as the 9 VDC primary cell (Fro example IEC type 6LR61, NEDA 1604A or Radio Shack 23-553).

RECEIVER OVERVIEW

The signals of interest lie in the 300 HZ to 20 KHZ portion of the spectrum. The design chosen for the VLF-3 is a combination of filtering and direct amplification. That is, the desired signal is filtered to remove undesired out-of-band signals and amplified until the desired signals are strong enough to record on a portable stereo cassette recorder. Helliwell[1] reports that medium latitude whistlers have a field strength ranging from about 5 μV/M to 4 mV/M. Most inexpensive

[1] "WHISTLERS and RELATED IONOSPHERIC PHENOMENA", Robert Helliwell, Stanford University Press, 1965

portable stereo cassette recorders require an input level of about 1mV (mic input) for adequate recording. Assuming a 1- to 3-meter antenna, the total receiver gain needs to be about 30 DB. These two considerations form the basic technical requirements for the receiver.

Perhaps the best way to technically describe the receiver is to present a block diagram showing the individual stages and describe each stage's purpose in general terms. After the general description, the circuitry for each individual stage will be described. Detailed circuit theory will not be presented; however, some sections of the receiver contain uncommon circuit features, these will be covered in more detail. Figure-1 presents a block diagram for the VLF-3. Figure-2 contains the complete circuit diagram. Please refer to the Figures for the following discussion.

1. Antenna Circuit.

Starting on the top of Figure-1, the first block or stage of the receiver is the "antenna circuit". The antenna circuit connects the external antenna and ground to the input stage of the receiver. The antenna circuit has both binding posts and a BNC connector. For most applications the antenna and ground are connected to the appropriate binding posts. The BNC connector is included for test purposes and use by advanced experimenters. More information about possible applications for the BNC connector is covered in a later paragraph.

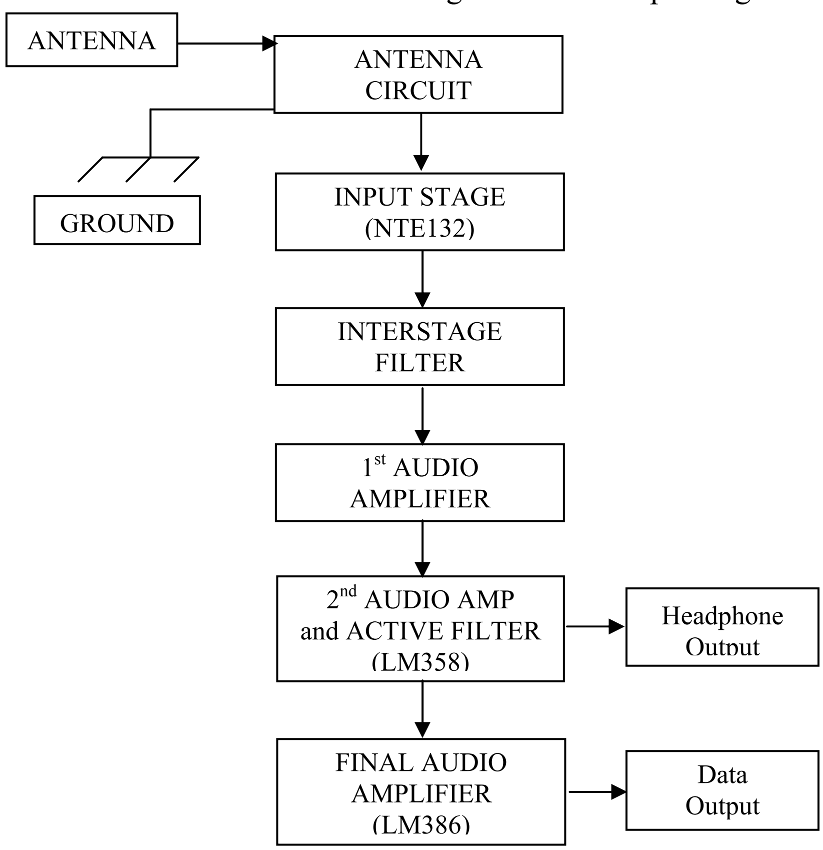


Figure-1. Block Diagram of the VLF-3 INSPIRE Receiver.

The antenna circuit is totally passive and contains an inductor plus several capacitors and resistors. Referring to the schematic in Figure-2 (top left corner), note that two components are always in the circuit (L1 and C1) and the rest are switched into the circuit by closing switch S1. L1 and C1 form a low pass filter whose purpose is to attenuate signals in the AM broadcast band. This low pass filter has little impact on VLF signals. When switch S1 is closed, two changes are made to the antenna circuit. First resistors R1 and R3 are placed in the circuit forming an attenuator between the antenna and the input stage. This attenuator reduces the signal provided by the antenna by 6 DB. Second

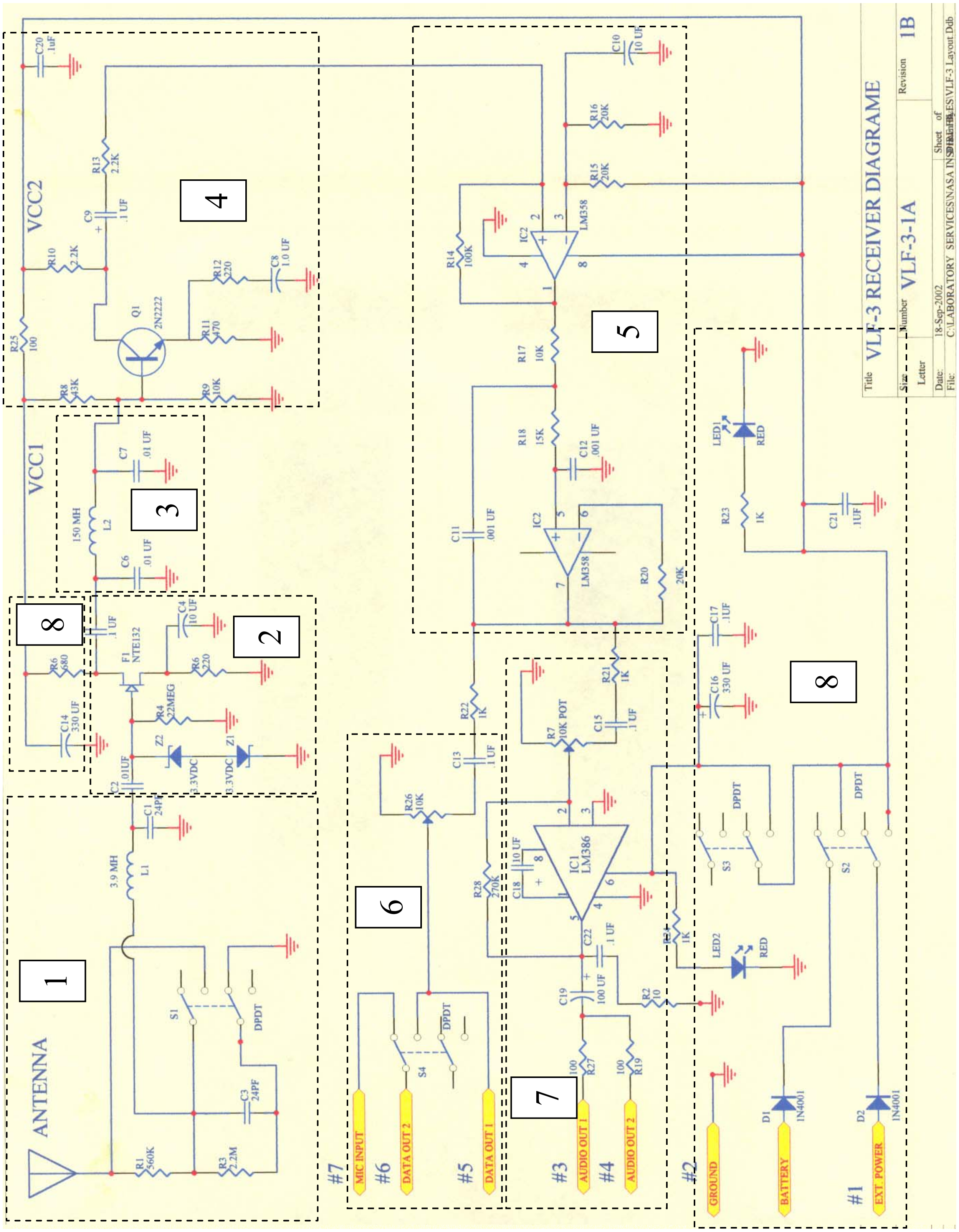


Figure-2 Schematic diagram of the INSPIRE VLF-3 receiver.

another capacitor, C3, is placed in the circuit. This capacitor further lowers the cutoff frequency of the low pass filter L1/C1.

The circuitry associated with switch S1 was specifically added to help reduce the pulse interference generated by close LORAN transmitters. Even though the frequency of LORAN (100 KHZ) is outside the pass band of the VLF-3, the LORAN signal is often strong enough to produce intermodulation in the first active stage of the receiver, which gets passed through the receiver to the recorder as a series of pulses or clicks. Closing S1 reduces all the input signals by 6-10 DB. The added capacitor C3 lowers the cut off frequency of low pass filter C3/L1/C1, which further reduces LORAN interference. The added circuitry will eliminate all but the most severe cases of LORAN interference. This circuitry is also effective against MF and HF transmitters that are close enough to cause interference.

It is important to realize that LORAN suppression (closing S1) also degrades receiver performance in two ways. First all signals, including the desired natural radio signals, are attenuated by 6 to 10 DB. Second resistor R1 will generate thermal noise when in the circuit. This resistor is in the highest gain part of the receiver and its thermal noise will be very evident in the receiver output. This additional noise will tend to mask some weaker desired signals. The bottom line is; don't use LORAN suppression unless it is absolutely necessary.

The VLF-3 also contains a "ground" terminal. The ground terminal connects to the receiver's circuit common. It is important to connect this terminal to a ground stake. The ground stake can be as simple as a foot long metal rod driven into the ground. In the author's experience, the LORAN suppression circuits won't work if the ground terminal is left unconnected. When unconnected, the VLF-3 is referenced to Earth potential through stray capacitance and is floating at some undefined voltage above ground. Thus, the Earth return needed to make the input attenuator work is not present.

2. Input Stage

The second block in the diagram of Figure-1 is the "Input Stage". This stage consists of the field effect transistor (FET) F1 (an NTE132 device) and associated components. F1 is the first active device in the receiver's signal path. The main purpose of this stage is to convert the very high impedance of the antenna to a lower value so that the signal can be more efficiently amplified. In the frequency range 300 HZ to 20 KHZ, the E-Field probe antenna has impedance between 30 and 800 MΩ[2]. The input stage converts this very high impedance to a value in the 100-Ohm range and also provides about 3 dB signal gain. Three points are worth noting concerning the input stage; refer to Figure-2 for the following discussion. First, the back-to-back Zener diodes Z1 and Z2 are included to protect the FET from damage due to static. Static discharges and distant lightning can induce voltage at the antenna terminal sufficient to damage the FET. The diodes clamp the input voltage to the FET to between +3.3 and –3.3 Volts. Second, capacitor C2 establishes the receiver's low frequency cut off point and also provides DC isolation for the antenna. This capacitor's value was chosen to reduce 60 hertz power grid interference. Finally, the FET Gate resistor R4 is the main component that determines how much of the voltage captured by the antenna will actually be amplified in the receiver. Stated a different way, R4

[2] For information on the impedance of short E-Field probes, see "VLF RADIO ENGINEERING" by Watt, Pergamon Press. 1967.

determines the ultimate sensitivity of the receiver. The value chosen for R4 (22MΩ) is a compromise value considering costs, component availability, circuit board layout and receiver sensitivity. For maximum sensitivity a value >100 MΩ should have been chosen; however, use of such a high value would significantly increase costs.

3. Inter-Stage Filter

The next stage shown in Figure-1 is the inter-stage low pass filter consisting of inductor L2 and capacitors C6 and C7 (see Figure-2). In Figure-2, these components are located in the signal path between F1 and Q1. The inter-stage filter is needed because the input stage is broadBand and capable of amplifying signals in the LF, MF and HF bands in addition to the VLF band. Even though the antenna circuit provides some filtering to reject signals in the MF and HF bands, a strong signal (for instance from an AM broadcast station) will get through and be audible in the receiver output. The low pass filter has an upper cut off frequency of about 12 kHz and strongly attenuates signals above about 20 kHz.

4. First Audio Amplifier

The next stage shown in Figure-1 is the first audio amplifier. This is a conventional discrete component design using a 2N2222A transistor (Q1). This stage provides the first significant signal gain in the receiver, about 10 DB.

5. Second Audio Amplifier and Active Filter

The fifth stage shown in Figure-1 is the 2^{nd} audio amplifier/filter. This stage uses ½ of the LM358 integrated circuit (IC2) as an amplifier with a gain of about 15 dB and its frequency response is flat from about 300 HZ to well over 100 kHz. This is followed by the second part of the LM358 configured as a Sallen-Key second order low pass filter. This filter had unity gain and its frequency response is flat from about 300 HZ to approximately 20 KHZ.[3]

6. Data Output

The output of the 2^{nd} audio amplifier/filter is coupled through a resistor, blocking capacitor and level control (R22, C13, and R26) to the left channel of the stereo data output jack (see Figure-2). The potentiometer R26 serves as the level control. The left channel signal is also applied to switch S4, which selects either an external input (labeled "Mic Input" on the schematic) or the radio output for the right channel. Thus the left channel always contains the radio output and the right channel can be either the radio output or a signal from an external source such as a microphone or a WWV receiver. The output at the data jack has sufficient amplitude to drive a recorder but will not adequately drive a headset or speaker.

[3] Additional details about this circuit can be found in "OPERATIONAL AMPLIFIERS-Design and Applications", Tobey and Graeme, McGraw-Hill, 1971.

7. Final Audio Amplifier

The last block in Figure-1 is the final audio amplifier. Its circuit is on the lower left of Figure-2. The final audio amplifier uses a LM386 IC (IC1). The output of the second audio amplifier/filter is applied to the LM386 through a resistor, coupling capacitor and volume control potentiometer (R21, C15 and R7). The IC amplifies the input signal increasing its level sufficiently to drive a set of headphones or a small speaker. The audio output phone jack is a stereo unit with the same signal being applied to both left and right channels. The resistor R27 is used to protect the LM386 IC in the event that a mono headset is accidentally plugged into the audio output jack. Capacitor C19 is used to block DC from the amplifier preventing it from reaching the headset. Note that the final audio amplifier is not powered when the receiver main power switch is turned on. This audio amp has its own power switch, S3. This switch allows the audio amp to be turned off when not needed to conserve battery power.

8. Power Supply

Referring to the schematic of Figure-2 (lower left), note that the radio can use two power sources. Either an internal 9 VDC battery or an external 9-14 VDC source can be used. The diodes D1 and D2 serve to isolate the two power sources. The diodes prevent the external source from attempting to charge the internal battery and vice versa. Note that if a rechargeable 9 VDC battery is installed internally the battery cannot be recharged by connecting a charger to the external power input. These diodes also protect the receiver's circuitry from damage if a battery should be connected with reversed polarity.

Power for all portions of the radio is applied through the main on-off switch S2. When S2 is on, all circuits are energized except for the final audio amplifier. The main power buss is decoupled by capacitor C21. LED-1 is also energized any time the main power switch is on. The main power buss is also filtered and decoupled by capacitor C14 and resistor R25 before it is applied to the FET stage. These two components prevent the high level signals present in the later stages from being coupled via the power buss into the sensitive input stage. Should this coupling occur, the radio will oscillate. The main buss is also coupled through switch S3 to the final audio amplifier. The buss to the final amp is also decoupled by capacitors C16 and C17 for reasons discussed above. LED-2 will be illuminated anytime the final amp is powered.

The BNC Antenna Connector.

A BNC connector is provided as an alternate connection point for an antenna. Before anything is connected to this connector, the impedance at this point must carefully be considered. The effective impedance at the BNC connector is in the 20MΩ range. Normally, BNC connectors are used with coax cables with impedance nominally in the 50-75 ohm range. If a 50 or 75-Ohm device is connected to the VLF-3 BNC connector, there will be a severe impedance mismatch that will degrade the VLF-3 performance.

The author has found three acceptable ways to use the receiver's BNC input.

1. When portable operation is desired, connect a short telescoping whip antenna to the BNC connector. Commercially made telescoping antennas with lengths of from 1 to 6 feet with attached BNC connectors are readily available. These antennas were designed for use with handheld radios and scanners. The author uses the VLF-3 with a 6-foot telescoping whip and stereo headset to walk around an area testing for the presence of 60 Hz, LORAN and AM broadcast interference. This simple test can help locate the quietest location in a given area. When using such a setup, be careful to keep the antenna well away from the headset cord.

2. It is possible to exploit the impedance mismatch to reduce interference. The author experimentally determined that by using a 20-foot long length of RG-8M to connect the antenna to the receiver, LORAN interference was eliminated without use of the receiver's built in LORAN suppression. This is desirable because it eliminates the extra broadband noise generated by the built-in suppression circuit. The coax provides shunt capacitance to ground sufficient to eliminate the interfering signal.

3. Finally, the author has used the BNC connector to connect a signal generator to the receiver for various sensitivity and response measurements. An interface box is required. The interface box contains a 50-Ohm resistor to ground and a series 24-pF capacitor. The capacitor simulates a short antenna and this interface box is commonly called a dummy antenna. The dummy antenna must be well shielded. The authors unit was built inside a short length of copper water pipe with BNC connectors on each end.

Our Preferred Way to Assemble The VLF-3 Receiver

Joachim Köppen
International Space University
Strasbourg/Illkirch, FRANCE

Editor's note: At the International Space University in Strasbourg, France, in the summer of 2006, Natural Radio was one of the topics covered. Some of the students assembled, tested and gathered data with INSPIRE VLF-3 receivers. The following assembly technique was designed by Joachim Koppen and used at that session. The result using this procedure was quite positive. All receivers were built successfully and worked fine.

We shall do the assembly of the VLF-3 receiver in a somewhat different sequence than described in the instructions because it will make testing and eventual fault-finding much easier.

Here is the procedure followed:

1. We assemble each section and test it before proceeding to the next section. Thus we can better locate any malfunction.

2. We start building from the output end. Ttesting is done by listening to the output. As we add the other sections, the receiver becomes progressively more sensitive, and this we can also verify.

3. Do your assembly carefully, at your own pace, please!
   This workshop is NOT a speed contest!

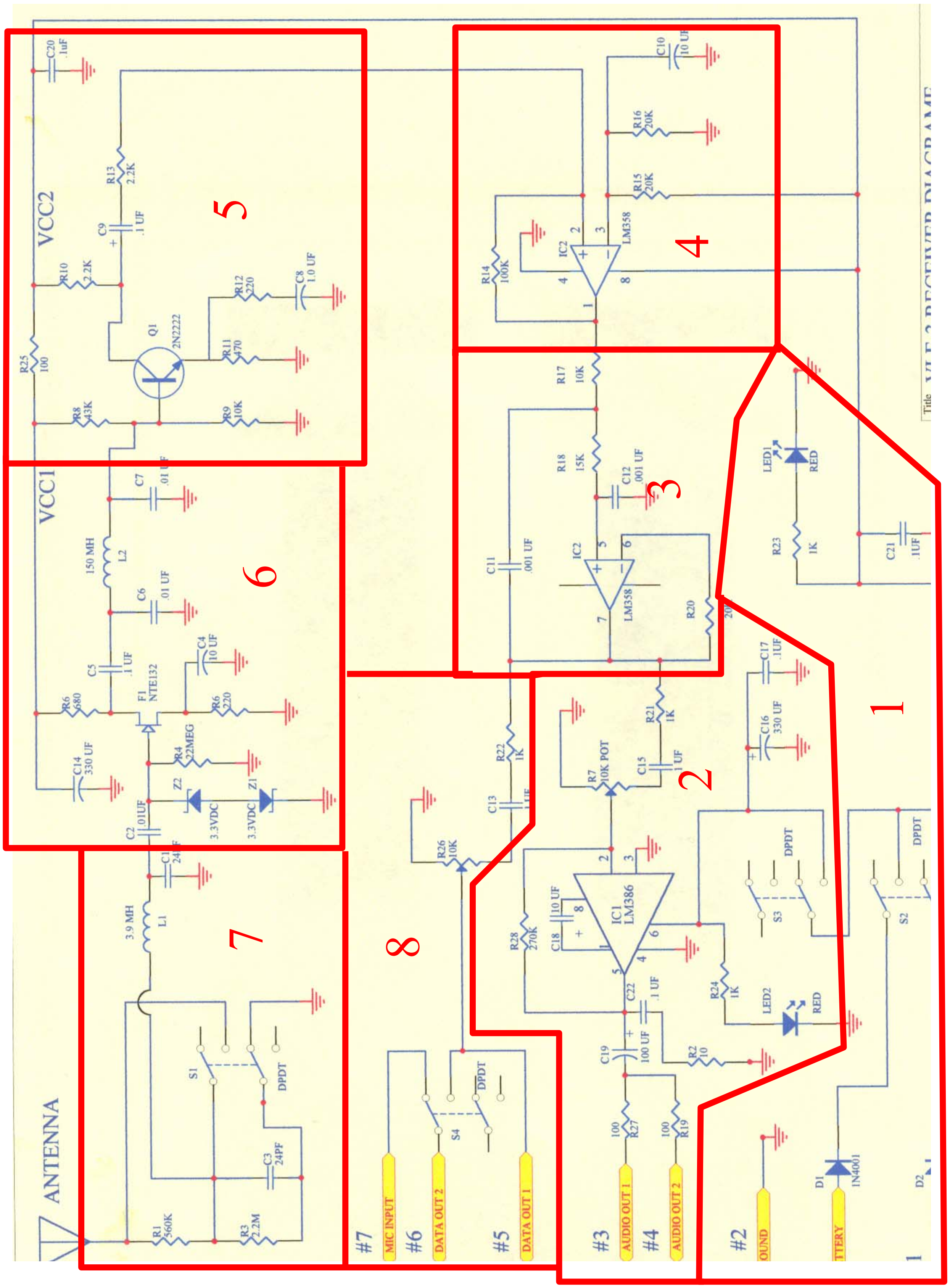
(Please refer to the schematic diagram on the following page.)

Section 1: This is just the (provisional) connection of the battery to supply power to the circuit board.

TEST: If the Receiver Power switch is 'on', the associated LED should light up.

Section 2: The final audio amplifier, the Audio Level control, the Audio Power switch and the (provisional) connection to the Audio output socket. Make sure that you install the IC socket in the correct orientation!

The different sections are shown in the circuit schematic:



Section 2 (continued): TEST: Connect earphone to socket, turn up fully the Audio Level control, and touch the "hot" solder lug of the potentiometer with your finger: you should hear a humming noise (the 60 Hz noise from the main supply). Turning down the level control should make the hum less loud. Also, touching pin 2 of the LM 386 IC with the finger should also bring up the hum.

Section 3: This is an LM358 dual operational amplifier (IC2) that serves as a low-pass filter. Solder in the IC socket in correct orientation.

TEST: Touch pin 5 of this IC or the free end of R17 with your finger. You should hear again the hum, slightly louder.

Section 4: This is the audio amplifier (the other part of IC2) responsible for most of the gain.

TEST: Touch pin 2 of this IC, and you should get a much louder hum.

Section 5: This is a low-noise audio preamplifier, with transistor Q1, which is already in place.

TEST: Touch the centre pin of the transistor (or the point where R8 and R9 meet) and the hum should be even louder.
Probably it will be sufficient to come close to this point, in order to hear a weak hum. Often it sounds a bit like music of another world, because the hum is also rich in harmonics of 60 Hz power line noise.

Section 6: This is the high-impedance front end amplifier with a FET (F1), already in place)

TEST: At full audio level, it should be sufficient for your hand to come close to this section, especially the "hot" end of the back-to-back zener diodes, to hear the hum of the mains.

Section 7: This is the switch close to the antenna terminal.

TEST: After the board is attached to the front panel, and all connections are done, the antenna terminal should be sensitive against a hand in its vicinity.

Section 8: Install the Data Level control and the Mic./Data switch.

TEST: Probably not necessary;

Follow the Instructions for placing the circuit board to the front panel and making all the connections. This integration may be a bit tricky, but don't push too hard if things do not slide in place easily.

A Practical Antenna for the INSPIRE Project Receiver

Chris Waldrup
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As soon as I bought the INSPIRE receiver and got it working, I began to think about the antenna that I would need. I have come up with an easy to build, inexpensive antenna that can be mounted on a camera tripod that I would like to share.

The components that are needed to build the antenna are as follows:

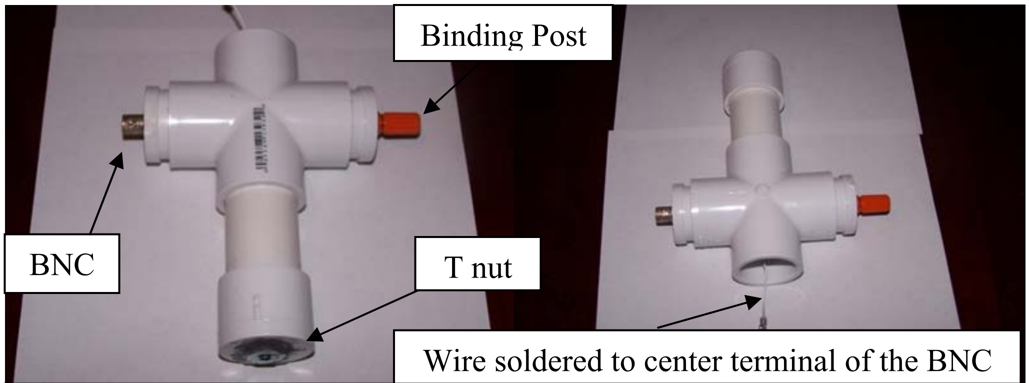
Quantity	Description		Source
1	Female Panel Mount BNC jack with solder lug		electronics supply
1	5 Way Binding Post (to connect to ground rod)		electronics supply
1	Stainless Steel Antenna, 72 inch collapsible		Pacific Antenna.
1	¼-20 inch T Nut (to attach to tripod)		Lowe's
1	1 inch schedule 40 PVC cross adapter		Lowe's
2	1 inch schedule 40 PVC plugs		Lowe's
1	1 inch schedule 40 PVC flat bottom end cap		Lowe's
1	rubber stopper, 1 inch top diameter		Lowe's
1	1 inch schedule 40 PVC pipe, 4 inches long		Lowes
1	crimp-on ring terminal	to attach BNC wire to antenna	electronics supply
1	2-56 nut		Ace Hardware
1	2-56 screw, ½ inch long		Ace Hardware

Wire, epoxy, solder, PVC cement

The rod antenna that used to be recommended for use with this receiver has been discontinued from Radio Shack. However, a recent article in a ham radio magazine brought to my attention the 72 inch collapsible antenna from Pacific Antenna. This unit is $7.00 and can be purchased at: http://www.pacificantenna.com/Ordering.htm. Shipping is $2.50.

A rubber stopper is used to secure the antenna in the PVC fitting. I found the stopper at Lowes in the hardware section. These items can probably be purchased from many hardware stores or other sources, but they were in stock at the Lowes near my home. Electronic parts suppliers such as Mouser, DigiKey or Jameco can provide the connectors and terminals.

Building the antenna:

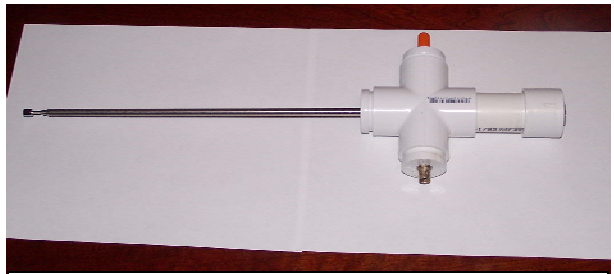


Steps 1, 2, 3, 4, 5, 6

1. A hole is drilled in the center of the flat bottom end cap only large enough to accept the barrel of the T Nut. The T nut is then glued in place with epoxy. I used JB Weld for my prototype.
2. Once the epoxy has had time to dry and the T nut is secure, the 4 inch section of PVC pipe is glued into the end cap with PVC pipe cement. The cement is rubbed onto the pipe with the foam applicator in the cement bottle, and then the pipe must be quickly positioned in the end cap. This cement sets fast!
3. Next, PVC cement is applied to the other end of the 4 inch long section of PVC pipe, and this section is pressed into one arm of the PVC cross adapter.
4. The 1 inch PVC plugs can now be drilled. A hole is drilled into the center of one for the binding post, and into the center of the other for the female BNC connector.
5. After drilling, the connectors can be mounted through the plugs. Solder two 6 inch wires to the BNC connector: one to the center terminal of the BNC (to connect with the antenna) and one to the large solder lug that will go on the inside of the PVC cap (to connect to the ground). So a cross section of the orientation will be: BNC connector, PVC cap, solder lug, and nut for BNC connector. Tighten the nuts on both the BNC connector and the binding post. Go ahead and crimp or solder the ring terminal onto the wire that is soldered to the center of the BNC connector.
6. Press the PVC plug with the BNC connector into an arm on the PVC cross fitting that is 90 degrees from where the 4 inch pipe is attached. Connect the wire that is attached to the BNC solder lug to the back side of the binding post and solder this wire in place. The PVC plug with the binding post is attached to the PVC cross fitting arm that is directly opposite the BNC connector. Press in place.
7. Drill a hole in the absolute center of the last PVC plug just large enough to allow the antenna to pass through.
8. Drill a hole in the center of the rubber stopper that is the same diameter as was previously drilled in the last PVC plug.
9. Pass the bottom end of the antenna through the PVC plug. Insert the stopper into the PVC plug from the bottom. Push the antenna through the stopper until one inch protrudes. You can see now that the stopper holds the antenna in place.

Steps 7, 8, 9

10. Attach the ring terminal (previously soldered onto the wire) to the hole in the end of the antenna with a 2-56 screw and nut.
11. Finally, press the PVC plug that is attached to the antenna rod into the top of the cross fitting and the antenna is complete. I did not glue this into place just in case I need to ever resolder the wire or replace the rod antenna.


Steps 10. 11

The receiver is connected to the antenna through a length of coaxial cable (I use RG58, RG174 or RG316) with BNC male connectors on each end. The binding post is connected to a ground spike (12 inch long nail purchased at Lowes) through a short wire with a banana plug on one end and an alligator clip on the other end.

I am happy to answer any questions or provide more detailed pictures to anyone interested. I hope that this inspires you to try an antenna project. Have fun.

"Reading" Natural Radio Spectrograms

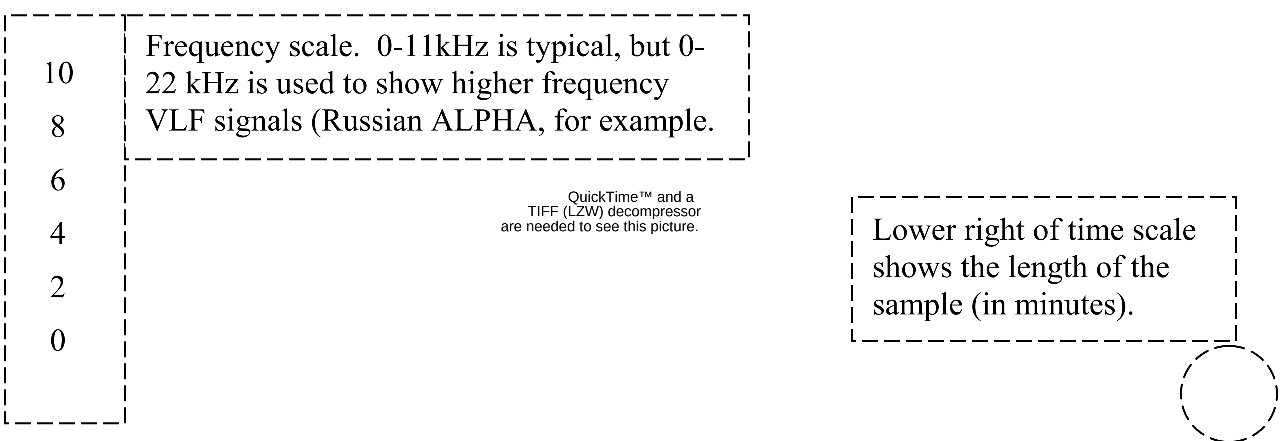
Bill Pine
INSPIRE Data Analyst
Upland, California

For over 15 years I have used a program called SoundEdit 16 Version 2 from Macromedia to produce spectrograms of INSPIRE data. I used Version 2 (which came out in about 1995) because later versions did not include the spectrogram feature. As of 2004, Macromedia discontinued sales of the product and stopped all support in June 2005. I decided that the time had come to find new software to use in analyzing INSPIRE data. I looked at several and the most satisfactory one I found was Amadeus II Version 3.8.7, a shareware program available from http://www.hairersoft.com/Amadeus.html . There is a full feature 15-day trial version and the purchase price is $30. Using the software is pretty intuitive and the help function is good. One drawback is that the spectrograms (called "sonograms" in Amadeus) do not include a frequency scale on the plot. I created a frequency scale as a drawing object and attached it to the left side of each spectrogram. A large plus feature (for my purposes) is that Amadeus can convert sound files between many formats (SoundEdit used a unique format that was difficult to convert). I use the Audio Interchange File Format (AIFF), which is used for CDs, and the Wave (.wav) format, which is used for the sound files on the web site.

The filenames of audio files are not shown on the spectrograms. An example of a data file is:

`rb06042703u120.aiff`

where:	rb	initials of the observer (Robert Bennett, in this example)
	060427	date of observation (yymmdd)
	03u	UT time of start of file
	120	length of file in seconds (2 minutes is the typical length)



Hessdalen, Norway, 2006

Flavio Gori
INSPIRE European Coordinator
Florence, ITALY

After 4 years I went back to the Hessdalen Valley, a remote Norwegian area where I was in the 2001 and 2002 summers with the financial help of the Italian Committee for Project Hessdalen. This year I was there thanks to help from the web magazine LoScrittoio.it (http://www.loscrittoio.it) which decided to give a strong signal to the local inhabitants about the interest in the Hessdalen Phenomenon (http://www.hessdalen.org) from the Italian (http://www.itacomm.net) and international research community. Actually I understood that this was really appreciated by the local population as well as the official administration including the Mayor Mr. Ivar Wolden and the Assessor for Local Development Thor Stuedal, who visited Peder Skogaas' house. This is where we do most of our work and tests before to go into the field at Peder's Summer Farm in an even more remote area, where no electric or cellular line is present. The closest line is around 4 kilometers away. We were not able to hear any long or medium waves or any FM radio emissions. We really believe that this is almost a record in Europe.

I brought along with me a wired antenna (20 meters long with 10 meters more connectable with a couple of crocodile clips) with a wood frame with 4 little feet able to keep good ground connection in order to keep that wire well strained.

Our very first problem was that we did not have any VLF receiver to use, so decided to use the antenna and PC sound card as the receiver, as many VLF people already know it may be a good tool to use. Used inside the Peder's barn our "receiver" showed a lot of 50 Hz harmonics noise as is common in our houses. Though being in a remote area, the 50 Hz signal is very present, making our recording useless. So we decided to move north toward Peder's Summer Farm, around 20 kilometers from Hessdalen, in the Lake region.

We had to drive 45 minutes to be there. As soon as arrived we deployed our wired antenna. In order to keep our wire high (1.5 meters from the ground), we purchased 3 broom handles with a ring on up of them. Peder and I made 3 wood bases for them in order to keep them high even during a strong wind that we usually can expect at this high latitude (62° North). After doing that we connected the antenna (20 + 10 meters) to the Peder's PC using the INSPIRE Project member Richard Horne's software "Spectrogram" working in real time. This helpful feature let us observe in real time the differences in receiving signals while changing antenna bearing from North/South to East/West. East/West bearing appeared to be the best solution to receive Alpha, the radionavigational system in the 12-15 kHz region. Also, it was easy to hear and record the strong RTTY emissions around 20 kHz.

One more interesting test was performed using the 20 meters wire antenna connected to the metal of the Peder's fence. Using this particular configuration, we had an antenna about 200 meters long and this gave us a great Alpha recording. Later analysis at home gave clear evidence that Alpha signals were recorded even in the previous session with the shorter wired antenna, though the best recording is, with no doubt, the fenced one.

As I previously reported, Mayor Ivar Volden and Assessor Thor Stuedal visited us one afternoon. They arrived at 3:00 pm, leaving a couple of hours later, after a lot of friendly conversation about our activity during these days and the INSPIRE Project activities in the last 15 years. We used the INSPIRE web site in order to better show our activity, the European group as well the American one. Then, again using the web, we talked about the collaboration between *Science@NASA* web magazine (http://science.nasa.gov) and LoScrittoio.it, as the Italian link on that magazine.

We underlined the fact that one of the most important INSPIRE activities is connected to the young students, their teachers and schools, in order to let them work real science in the field, including when NASA (http://www.nasa.gov) is doing space activities. INSPIRE Project activity during all these years have shown that many works have been done during astronomy events (eclipse, meteor shower). We were especially proud to show them our collaboration with the Hessdalen Project larger Team (including Embla 2000 and the Italian Committee for Project Hessdalen) in the Valley in 2001, 2002 and 2006. Much work on Hessdalen related topics was done when in Italy, too. This work was not just analysis on audio files recorded in the Valley, but even a Conference organized in Cecina town during 2004 (March 27 and 28) when all Italian and Norwegian Researchers involved in the Hessdalen Team attended the conference. Volden and Stuedal understood us, realizing how many persons attended a well done Hessdalen Conference here in Italy. Actually it was a great success.

Moreover we have talked about INSPIRE and Hessdalen in another Italian Conference in Firenze, our town, creating interest in other important official offices here in Italy and in the worldwide media, magazines and international radio broadcasting as Radio Budapest.
After a couple of hours conversation we agreed about the need of close collaboration between the Ålen town, the Hessdalen Valley community, The INSPIRE Project and all the research community working in the Valley with Embla 2000 and the Italian Committee for Project Hessdalen. After our stay in Hessdalen, we realized how nice it was to stay there, how fine is that area, not just for people involved in scientific research, but also for families who like spend time all together walking, biking and breathing in very clear air. I was there three times and can say how nice are the inhabitants with strangers. They have not many places to accomodate tourists, since there are very few hotels or similar houses. But things are changing, though very slowly. But you cannot think that they will ever have room for many tourists coming here. Hessdalen will remain available for a few people who will keep Hessdalen exactly the same it is now. In my opinion we have to understand that many people may like to live here and not just searching for the Hessdalen Phenomena or Northern Lights, but simply to breathe and live in an incomparable natural landscape to better experience the Valley, walking or biking all around with no impact on the environment.

Of course if you are a fisherman, you can choose to fish for salmon. Some local shops offer real time TV showing underwater salmon swimming in to the rivers. What a great idea! These short notes are just to share my idea that Hessdalen Valley, in the Trøndelag region, may be a very good place to stay for your family holiday if you want quiet, gentle, clear air places. This is an area where you can experience the good life.

If you ever go there, please take a close look at the local Market shop. Its history through the years deserves a closer look and my friend Peder Skogaas will tell us the entire story in the www.loscrittoio.it pages in short time.

Lighting Up Phenomenon

Peder Skogaas
INSPIRE Hessdalen Coordinator
Hessdalen Valley
Ålen, NORWAY

The following account of an observation of the Hessdalen Phenomenon was sent to Peder Skogaas by Eli Sesseng, secretary at the church office in Ålen. The observation was made in Singsås on Monday November 27, 2006, between (UTC) 04:15 and 04:45.

The light was just above the Tågå Mountain - a mountain between Budal and Singsås. My husband and I observed it through our bedroom window. Our house is almost straight east of the Tågå Mountain across the valley.

It was a huge moving light pulsating. Suddenly after approximately five minutes it started at a very high speed down the mountain side to the forest. It was colorless like an ordinary car light.

We could see it towards the forests. I compared the size with the houses at the Mørseth farms which are just south of the sighting site and it was much larger than the barns and main houses.

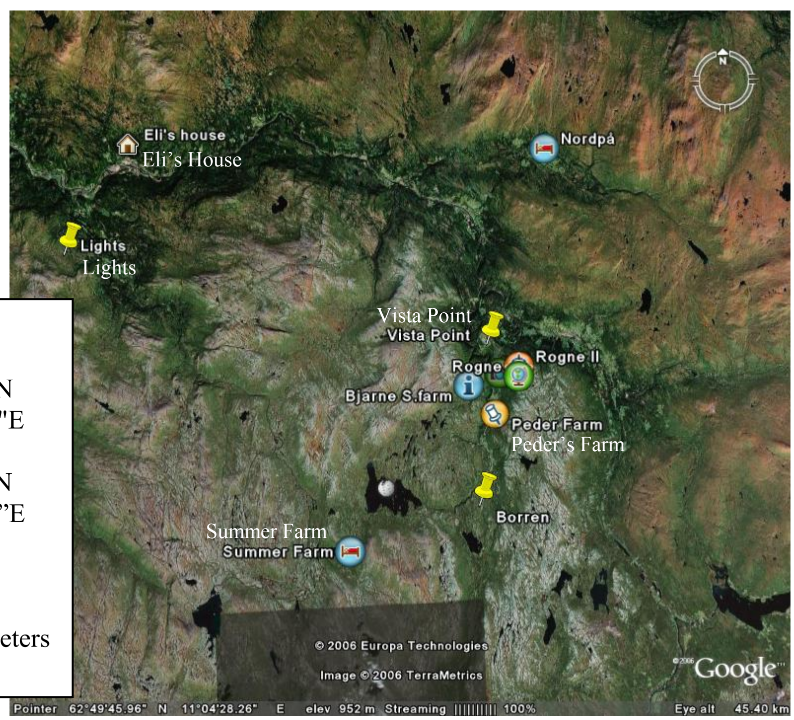
It stopped and I went to our study and picked up the binoculars and looked at it. Than it started to act like crazy - it zigzagged up the mountainside again almost at the same path and speed as it moved down and disappeared behind the top of the mountain. Now the colors were red, white and yellow.

After approximately another five minutes it turned up again above the top. It hovered down almost to the ground where it stopped for a while. Suddenly it put on a very strong light and we could see the snow shining in the light. I still looked at it through the binoculars and in a split second "it turned off" the light without moving and everything became dark.

I also was outside on the deck listening for any sounds but there were none. When I looked at the clock I realized I have seen it for about half an hour. I was not afraid only very excited to be one to see this phenomenon.

Yours
Eli Sesseng

This is a photograph showing the mountain with the path of the light indicated.



Locations (Google Earth):

Eli Sesseng's house: 62°58'8.43"N
10°43'15.13"E

Mountain side: 62°54'5.84"N
10°38'14.72"E

Distance: Approx: 7-9 kilometers

Distance from VistaPoint:
Approximately 28 kilometers to the northwest.

Colorado Field Observations – 2006

Shawn Korgan (Data)
Gilcrest, CO
BillP Pine (Analysis)
Upland, CA

Veteran observer and INSPIRE supporter Shawn Korgan submitted data for observations made in April and October, 2005. The following spectrograms of Shawn's data were made by the editor, Bill Pine.

Sunday, April 30, 2006

In these morning sessions, note the changes in the VLF signals as the Earth rotates the observing site from the nightside ionosphere to the dayside as dawn occurs. Signals at night are characterized by sferics and tweeks while on the dayside tweeks are less common. Whistlers are most common in the period from a couple of hours before dawn to an hour or so after dawn, although whistlers can occur at any time of days.

043006 1000UT 4AM MST

INSPIRE Audio File

10
8
6
4
2
0

QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

Dense tweeks. Whistlers logged in 12 minutes: 10

10
8
6
4
2
0

Tweek hooks at about 1850 kHz with harmonics of the stronger ones

QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.

This 5-second sample shows many tweeks.

INSPIRE Audio File