

# Natural Radio

*News, Comments and Letters About Natural Radio*

**February 2004**

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***Natural Radio on Mars*** - As I am writing this, the second Mars Exploration Rover, *Opportunity*, successfully landed in a crater on Mars. *Spirit*, the first rover, seemed to be recovering from a technical problems, possibly a flash memory glitch, which according to some NASA speculation may have been caused by a solar event.

That sparked the question, just what are the Natural Radio opportunities on Mars? I don't think much VLF listening has been done on the planet yet, but here's some of what we know.

In September of 1997 the Mars Global Surveyor detected the presence of a magnetic field on the planet Mars. The field is polarized similar to Earth's, but is only 1/800 or less than the strength of ours. Scientists think that this is a fossil remnant of a much stronger dipole magnetic field that disappeared over 4 billion years ago. There is a bow shock and Mars does carve out a cavity in the solar wind. The cavity downwind of the planet is free of solar wind electrons and protons, but exhibits variations in polarity with the orientation of interplanetary field lines. These variations are not seen in the magnetospheres of planets with their own intrinsic magnetic fields, like earth.

However, there are strong localized fields imbedded in Mars' crust that produce areas of magnetism on the surface of the planet that are almost as strong as the magnetism on the surface of the earth. These fields form dome-like mini-magnetospheres over the regions of high magnetic activity. The ionosphere reaches much higher over this local magnetism, and researchers think that this has kept the atmosphere from further erosion. Since Mars essentially has no global magnetic field, much of the surface is exposed to the full force of the solar wind.

Mars has an ionosphere generated just like earths by ionization from sunlight. Since the atmosphere is considerably thinner and Mars is farther from the sun, the ionization is different. Coupled with the lack of global magnetic field, Mars' ionosphere behaves differently than Earth's, and it is predicted that the diurnal variation in characteristics are small.

As far as Natural Radio activity, it has been theorized that there might be sferics on Mars caused by electrical discharges in the dust devils that occur regularly on the surface of the planet. There is a cavity between the ionosphere and the surface through which sferics could propagate, and they could prove useful in providing remote sensing of soil conductivity and possibly moisture in the surface.

As far as whistlers go, it would seem that the weak magnetic field would not support the formation of the ducts necessary for whistler mode propagation, but we still have only very limited information on the Martian ionosphere and magnetic fields. Maybe we should send the next rover up with a WR-3 . . .

***Using the Dst Index for Predictions*** - Part of the fun of Natural Radio is trying to make predictions as to when activity will occur as most of us don't have the ability to monitor from home. If we are going to pack up and head for a quiet location, we'd like it to be worth the effort, especially during the winter.

This past week on the VLF\_Group list, Shawn Korgan was relating his prediction efforts and wondered why strong chorus had popped up that morning without any of the usual indicators of activity. Dennis Gallagher of NASA suggested that it would be interesting if we could watch the predictions of the Dst index and relate that to observations of VLF noise. He explained as follows:

“The reason I suggest this is because chorus waves are thought to be produced by energetic electrons injected into the ring current from the plasmasheet during geomagnetic substorms and storms. The Dst index is designed to better reflect the ring current strength than other of the geomagnetic indices.”

My usual method of predicting when I should head for my quiet site is by watching the Kp index and the real time solar wind conditions from the ACE satellite. Dst is not one of the indices that I normally watch, so I did a little further investigation.

Dst is a geomagnetic index that monitors worldwide geomagnetic activity. It is developed as an average of magnetograms from equatorial and mid-latitudes across the planet. The horizontal component of the geomagnetic field is used in the calculation. The more negative the Dst, the more intense the storm activity. Dst is calculated after the fact, just like Kp; but Dst predictions are available that might give us some early warning.

The negative Dst deflections are caused by the storm time ring current which circles the earth in the equatorial plane. This ring current flows from east to west. An eastward electric field in the solar wind which results from a southward IMF (Interplanetary Magnetic Field) can cause significant ring current injection, resulting in a negative going Dst.

Dst predictions are calculated from Bz, the southward component of the IMF; Vx, the radial solar wind speed; and n, the solar wind plasma density. These numbers are obtained from the ACE (Advanced Composition Explorer) satellite which is positioned at the L1 LaGrangian point between Earth and the Sun.

According to Dennis, storms with a Dst of -50 to -200 are common, while a Dst of -400 indicates a real whopper of a storm.

For predictions, history and much more information about the Dst index, visit the website: [http://sprg.ssl.berkeley.edu/dst\\_index/](http://sprg.ssl.berkeley.edu/dst_index/)

***ULF Reception*** – I would be interested in hearing from anyone who is using a soundcard or any other type of A/D converter to digitize ULF signals into a computer. I am trying to research this for an upcoming article. Thanks.

**Natural Radio Receivers** - I get many inquiries as to sources for assembled and kit versions of Natural Radio Receivers. Here's a new reference listing of all the ones that I know about. I'd be happy to list any others if you let me know about them.

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## **INSPIRE**

**VLF-3 Kit \$80.**

*The VLF-3 is the recently released third version of the Inspire receiver kit.*

**Bill Pine, Science  
Chaffey High School  
1245 N. Euclid Avenue  
Ontario, CA 91762**

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

## **Kiwa**

**Kiwa Earth Monitor Price: \$145.00**

*The Kiwa Earth Monitor is an excellent receiver with adjustable filtering. The antenna unit is separate from the receiver which means you can set it up outside while monitoring from the comfort of your car or tent.*

**Kiwa  
503 7th. Ave. N.E.  
Kasson, MN 55944 USA  
507-634-6134 phone/fax  
<http://kiwa.com/ethmon.html>**

## **LF Engineering**

**L-500L ELF/VLF**

**Longwire Receiving System \$85.**

**L-600S**

**H-Field Loop Receiving System \$198**

*LF Engineering makes two receivers, the L-500L which is an E-Field receiver, and the L-600S which is an H-field receiver with a loop antenna that lets you null out interference.*

**LF Engineering Co.  
17 Jeffry Road  
East Haven, CT 06513  
860-526-4759  
<http://www.lfengineering.com/>**

## **McGreevey**

**WR-3 \$100.**

*Steve McGreevey is still making the WR-3 which is an excellent portable receiver. This version has a BNC connector that lets you attach an antenna of your choice.*

**S. P. McGreevy Productions  
P.O. Box 928,  
Lone Pine, CA 93545-0928 USA  
<http://www.auroralchorus.com/wr3info.htm>**

## **North Country Radio**

**ELFRCV Earth Receiver Kit \$44.95**

*This is a low priced kit that would be great for a beginner.*

**North Country Radio  
PO BOX 53, Wykagyl Sta.  
New Rochelle NY 10804-0053  
914-235-6611  
<http://www.northcountryradio.com/>**

**Receiver Plans for those who like to build their own.**

**BBB-4** – *This is Steve McGreevey's classic Bare Bones Basic receiver.*  
<http://www.auroralchorus.com/bbb4b.htm>

**RS-4** – *This is Mike Mideke's design that was the first INSPIRE receiver.*  
<http://library.thinkquest.org/2784/inspire/schematic.html>

**IC Whistler Receiver** -- *This is John Davis' design and in the LWCA library.*  
<http://www.lwca.org/library/hardware/whistlrx.htm>

**Dual FET Whistler Receiver II** – *Eric Vogel's design.*  
<http://home.flash.net/~evogel/p1.html>