Solar Bulletin

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS - SOLAR DIVISION

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Volume 58 Number 4 **April 2002**

Table I. Mean Sunspot Numbers (Ra) for April 2002 [boldface = maximum, minimum]

Day	N	Raw	s.d.	Ra	s.d.	s.e.
1	45	172	7.6	130	2.9	0.43
2	44	164	8.1	124	2.6	0.39
3	29	182	11.5	128	3.6	0.67
4	45	160	7.5	117	2.9	0.43
5	42	175	9.0	130	4.5	0.69
6	42	186	8.1	140	3.5	0.54
7	38	186	6.7	147	3.1	0.50
8	34	195	9.3	149	4.1	0.70
9	31	194	8.9	152	4.2	0.75
10	44	201	7.8	152	2.8	0.42
11	41	220	8.2	**163**	3.9	0.61
12	27	212	10.3	162	3.4	0.65
13	27	215	11.0	159	4.5	0.87
14	34	200	9.4	152	3.7	0.63
15	39	184	8.1	139	2.8	0.45
16	40	155	6.9	117	2.9	0.46
17	50	139	5.6	106	2.3	0.33
18	48	158	6.7	116	2.7	0.39
19	43	143	7.7	111	3.3	0.50
20	39	140	7.4	104	3.8	0.61
21	45	125	6.2	99	3.4	0.51
22	34	140	5.9	102	2.3	0.39
23	41	166	5.9	125	3.7	0.58
24	49	208	7.6	162	4.4	0.63
25	32	195	10.6	146	5.4	0.95
26	33	152	9.1	110	3.8	0.66
27	39	120	5.4	88	2.3	0.37
28	32	104	6.3	**77**	3.2	0.57
29	31	107	6.1	79	3.2	0.57
30	39	113	5.4	89	2.8	0.45
31	---	---	---	**---**	---	---

Means: 38.6 167.1 125.8

Total No. of Observers: 78

Total No. of Observations: 1157

Table II. April Observers

```
15 AAP  P.Abbott
 6 ANDE E.Anderson
15 ATON A.Attanasio
13 BARH H.Barnes
 9 BATR R.Battaiola
13 BEB  R.Berg
 7 BERJ J.Berdejo
 2 BEU  E.Blankenship
 3 BLAJ J.Blackwell
10 BMF  M.Boschat
25 BOSB B.Bose
27 BRAB B.Branchett
14 BRAD D.Branchett
24 BRAR R.Branch
24 BROB R.Brown
 3 BURS S.Burgess
 9 CAMP P.Cambell
13 CARJ J.Carlson
28 CHAG G.Morales
25 CKB  B.Cudnik
12 CLZ  C.Laurent
14 COMT T.Compton
30 CORA A.Coroas
17 DELS S.Delaney
 7 DEMF F.Dempsey
23 DGP  G.Dyck
16 DRAJ J.Dragesco
26 DUBF F.Dubois
25 ELR  E.Reed
16 FEEC C.Feehrer
17 FERJ J.Fernandez
20 FLET T.Fleming
19 FUJK K.Fujimori
23 GIOR R.Giovanoni
 3 GOEM M.Goetz
 4 GOTS S.Gottschalk
 6 HAYK K.Hay
12 HRUT T.Hrutkay
24 JAMD D.James
14 JEFT T.Jeffrey
11 JENJ J.Jenkins
10 JENS S.Jenner
25 KHAR R.Khan
22 KNJS J&S Knight
 1 KUZM M.Kuzmin
14 LERM M.Lerman
21 LEVM M.Leventhal
18 LIZT T.Lizak
16 LUBT T.Lubbers
 9 MARE E.Mariani
15 MARJ J.Maranon
 4 MAV  D.Matsnev
20 MCE  E.Mochizuki
 6 MILJ J.Miller
18 MMI  M.Moeller
 5 MUDG G.Mudry
 2 MUSP P.Musialski
14 PARN N.Parker
24 RITA A.Ritchie
23 SCGL G.Schott
 7 SCHG G.Scholl
 9 SIMC C.Simpson
30 STAB B.Gordon-States
20 STEM G.Stemmler
14 STQ  N.Stoikidis
22 SUZM M.Suzuki
 2 SZAK K.Szatkowski
19 SZUM M.Szulc
21 TESD D.Teske
 4 THR  R.Thompson
13 TJV  J.Temprano
25 URBP P.Urbanski
15 VALD D.delValle
14 VARG A.Vargas
15 WILW W.Wilson
23 WITL L.Witkowski
 6 WKW  K.Watts
 7 YESH H.Yesilyaprak
```

Reporting Addresses

Sunspot Reports **-- email:** solar@aavso.org
postal mail: AAVSO, 25 Birch St. Cambridge, MA 02138
FAX *(AAVSO):* (617) 354-0665
SES Reports **-- email:** noatak@aol.com
postal mail: Mike Hill
114 Prospect St. Marlboro, MA 01752
Magnetometer Reports **-- email:** capaavso@aol.com
postal mail: Casper Hossfield
PO Box 23, New Milford, NY 10959
FAX: (973) 853-2588 or (407) 482-3963

Table III. Means of Raw Group Counts (RG) and Ratios of Spots to Groups (S:G) in April

Day	RG	S:G	Day	RG	S:G	Day	RG	S:G	Day	RG	S:G
1	7.1.	14.2	**9**	11.5	6.9	**17**	7.4	8.8	**25**	12.2	6.0
2	7.7	11.3	**10**	11.3	7.8	**18**	8.5	8.6	**26**	9.9	5.4
3	8.8	10.7	**11**	11.6	9.0	**19**	7.5	9.1	**27**	7.4	6.2
4	7.6	11.1	**12**	11.2	9.0	**20**	7.3	9.2	**28**	6.1	7.1
5	8.7	10.1	**13**	11.3	9.0	**21**	7.8	6.0	**29**	7.6	4.1
6	10.5	7.7	**14**	11.2	7.9	**22**	8.5	6.5	**30**	8.5	3.3
7	10.5	7.7	**15**	10.7	7.2	**23**	10.0	6.6	**31**	---	---
8	11.5	7.0	**16**	9.4	6.5	**24**	12.6	6.5	**Mn.**	**9.4**	**7.9**

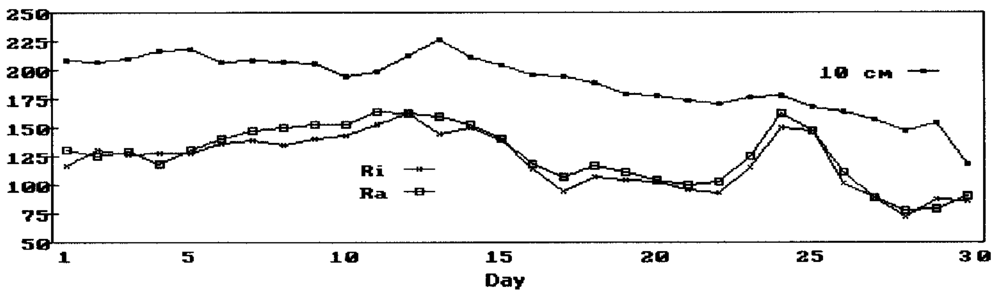

Fig. 1. 10 cm Solar Flux and Comparison of Ri (provisional) and Ra Estimates for April (r = 0.967).
(Ri Source:http://sidc..oma.be/index.php3)
(!0cm Source: http://www.drao.nrc.ca/icarus)

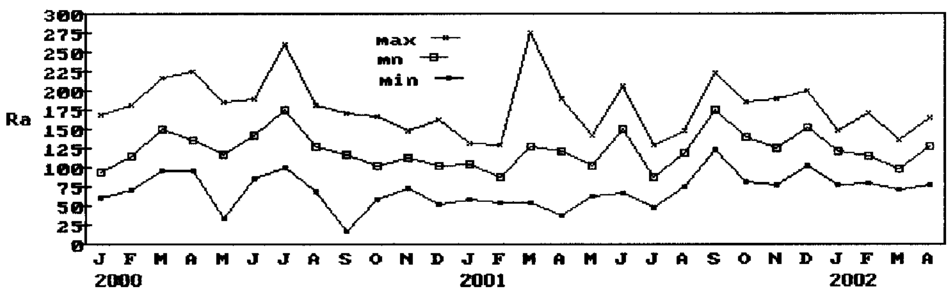

Fig. 2. Maximum, Mean, and Minimum Ra Values for Each Month from January 2000 to Present.

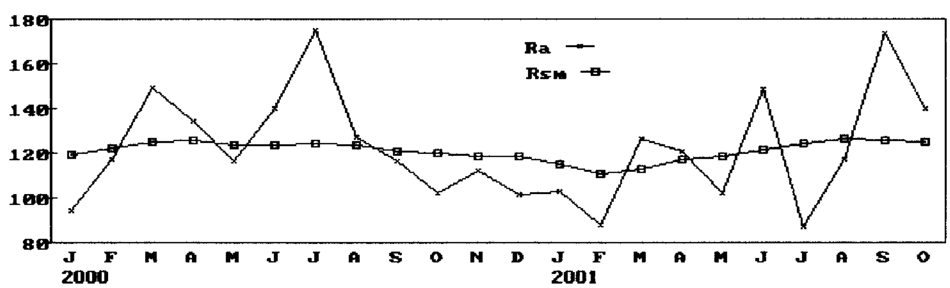

Fig. 3. Monthly Ra and Smoothed Sunspot Numbers (Waldmeier method).

Editor's Note:

This month I want to welcome Pawel Musialski (MUSP) to the group of AAVSO sunspot observers. Pawel lives in Zabre, Poland. Thank you for your report.

Sudden Ionospheric Disturbance Report

Michael Hill, SID Analyst
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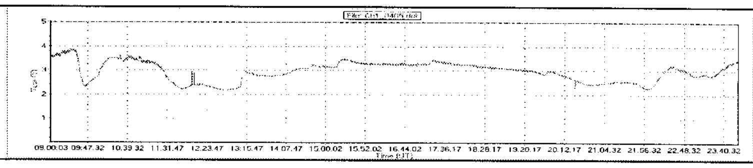
noatak@aol.com



Sudden Ionospheric Disturbances (SID) Recorded During April 2002

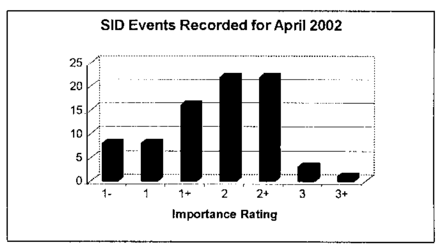
(Analysis performed by Michael Hill, SID Analyst)

Date	Max	Imp	Date	Max	Imp	Date	Max	Imp
020401	1533	2	020409	1304	2+	020417	0656	1
020402	0438	1+	020409	1555	2	020417	0810	3+
020402	1324	2+	020409	1914	2+	020417	1127	1-
020402	1409	1+	020410	0650	1+	020417	1342	2
020402	1445	1	020410	1230	3	020417	1700	2+
020402	1500	1	020410	1424	2	020418	0700	2
020402	1546	1	020410	1542	2	020418	0907	2
020403	1425	1+	020410	1850	1-	020418	1051	1+
020403	2001	1+	020410	1906	2+	020418	1518	2
020404	0435	2+	020411	0610	2	020419	0703	1+
020404	1050	2+	020411	0906	1-	020419	0753	1-
020404	1418	1	020411	0931	1	020419	0905	1+
020404	1437	1-	020411	1626	2+	020419	1647	2
020404	1533	2+	020411	1838	2	020419	1820	2+
020405	1314	1+	020412	1313	1+	020420	1211	2+
020405	1442	1	020412	1344	1+	020420	1544	2+
020405	1521	2	020412	1604	2+	020422	1215	2+
020405	1720	2	020412	1758	3	020422	1415	2
020406	0617	2+	020413	1334	1+	020424	1555	1-
020406	1045	1+	020414	0452	1+	020424	1604	2
020406	1409	2	020414	0652	2	020424	2155	2+
020407	0520	1	020414	0736	2	020427	1540	2+
020407	0823	2+	020414	1342	2+	020429	0942	1+
020407	1426	2+	020415	1731	2	020430	0823	2
020407	1515	1+	020416	1046	2+	020430	1119	2
020409	0042	1-	020416	1313	3	020430	1420	2+
020409	0734	2	020416	1540	1-			

Importance rating : Duration(min)	-1: <19	1: 19-25	1+: 26-32	2: 33-45	2+: 46-85	3: 86-125	3+: >125

The events listed above meet at least one of the following criteria
1) Reported in at least two observer reports
2) Visually analyzed with definiteness rating = 5
3) Reported by overseas observers with high definiteness rating

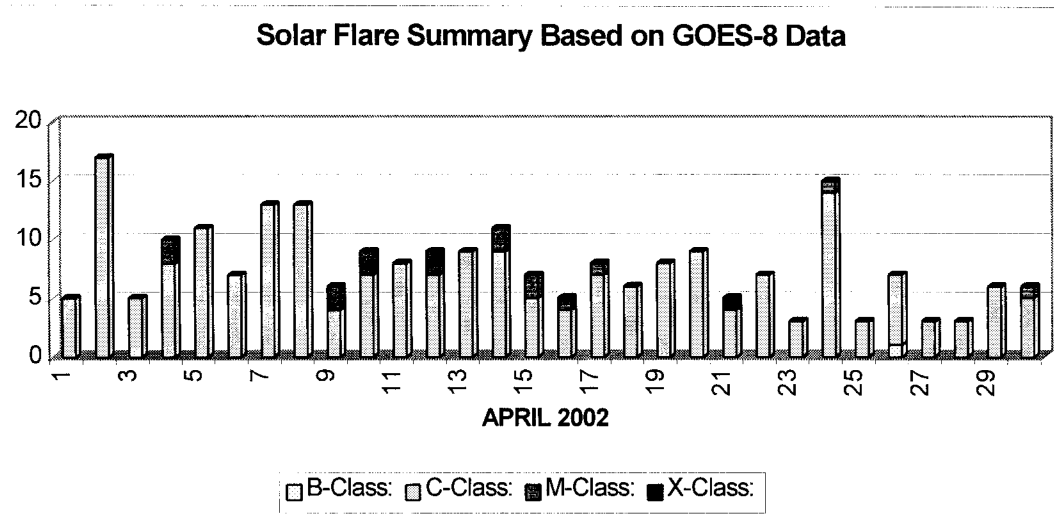
Observer	Code	Station(s) monitored
A Clerkin	A29	NAA
J Winkler	A50	NAA, NPM
D Toldo	A52	NWC, NAA
J Ellerbe	A63	ICV
W Moos	A84	FTA, ICV
M Hill	A87	NAA
G Difillipo	A93	HWU
T Poulos	A95	NAA
R Battaiola	A96	HWU
J Wallace	A97	NAA
NJAA	A98	NAA
M King	A99	HWU
P Campbell	A100	NLK
F Steyn	A102	NWC, NAA



Solar Events

I was a little shocked when the first three reports came to me with confessions of equipment problems. I was wondering what RF anomaly was taking place last month. Luckily, no more equipment failures cropped up; except, of course, for a couple of missed days by me, after forgetting to restart the data acquisition after copying off the latest daily files. We all run into troubles, but the great thing about having multiple observers in common geographic areas and monitoring the same stations is that, when one is down, the SID Program continues due to this wonderfull overlap. Better luck this month to you guys with the "anomalies".

April turned out to be a very active month. There were a lot of flares in the first half of the month and the second half started out with a bang with a large CME event on the $17^{th,}$ followed by some spectacular Auroras – or so I hear. Its always cloudy here in New England when these things happen – darn! There were 232 Reported XRA flares based on the GOES-8 data set. Of these, 16 were M-Class flares and 1 was an X-Class. Our observers reported a total of 80 correlated events this month. Ten of these events were not correlated with the GOES-8 data set. Most were rated with an importance rating of 2 and 2+, with a couple of 3 and 3+ events, as well. The busiest days were the 2^{nd}, 4^{th}, 5^{th}, 10^{th} and, of course, the 17^{th}.



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SUDDEN IONOSPHERIC DISTURBANCES SUPPLEMENT

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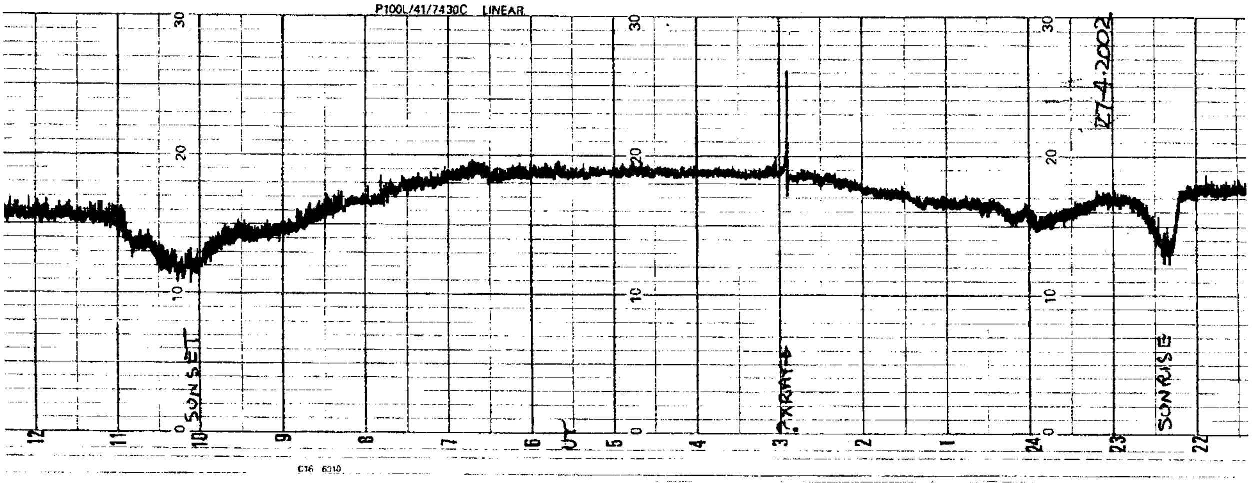
SUDDEN IONOSPHERIC DISTURBANCES RECORDED DURING APRIL, 2002

AN X-RAY TRANSIENT DETECTED AS A SUDDEN IONOSPHERIC DISTURBANCE (SID)



The chart above shows a recording of a sudden ionosperic disturbance (SID) that is apparently the signature of an X-ray transient detected by the Italian gamma ray burst (GRB) Satellite BeppoSAX. Here is the announcement of the Transient as it went out 0ver the AAVSO's GRB network:

The following is a GCN Circular circulated via the AAVSO network. For an archive and more information on circulars visit: http://lheawww.gsfc.nasa.gov/docs/gamcosray/legr/bacodine/gcn3_archive.html

TITLE: GCN GRB OBSERVATION REPORT
NUMBER: 1383
SUBJECT: XRF 020427
DATE: 02/04/27 11:16:39 GMT
FROM: Jean int Zand at SRON jeanz@sron.nl

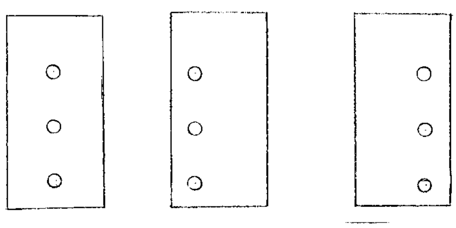
Jean in 't Zand, Fabrizio Reali, Stefano Granata, Paul Lowes and Luigi Piro report on behalf of the BeppoSAX team:

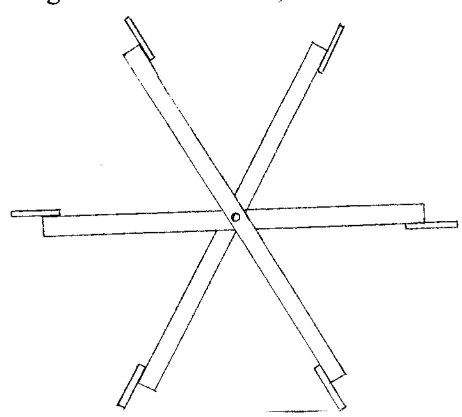
BeppoSAX Wide Field Camera unit 2 detected a fast X-ray transient on April 27 at 3:48:40 UT. Quick-look analysis shows that it lasted 1.1 min, with a rise time of 0.1 min. The 10-28 to 2-10 keV hardness ratio is similar to the X-ray rich GRBs like 981226 and type-I X-ray bursters. The Gamma-Ray Burst Monitor covered this event, but no obvious signal was detected. We strongly suspect that this is an X-ray rich GRB or X-ray flash rather than an X-ray burst because 1) the time profile is unusual for an X-ray burst; 2) there is no evidence for softening in the decay; 3) the galactic latitude of -44.2 deg is unusual for an X-ray burst. We strongly encourage follow-up observations. The refined WFC position is: R.A. = 22h09m33.6s (332.3900 deg) Dec.-65d19m36.6s (-65.3268 deg) (Eq. 2000.0) with an error radius of 3 arcmin (99% confidence).

The recording above was made by Len Anderson, A-91 who lives in South Perth, West Australia. The chart is a recording of the signal strength of naval VLF station NWC at Northwest Cape, West Australia transmitting on 19.8 kHz and about 1000 km north of South Perth. The location of the source at the high south declination, -65 degrees, and Right Ascension, 22 hours, would seem to place the source where it would illuminate the propagation path of the NWC signal at the time the transient occurred. Unfortunately Len had his chart speed set an hour slow but other than that the whole day is a nice clean interference free recording from sunrise to sunset. It is normal for Len to produce interference free recordings day after day. It seems unlikely what we see here is interference. The signature starts with a small dip as is often seen at the beginning of SIDs produced by solar flares when the distance to the signal source is about 1000 km. A dip would not proceed a burst of interference. The rise time is too fast to be resolved by the recorder's slow chart speed, one inch per hour, but is apparently less than one minute, much shorter than the fastest rise time of solar flare SIDs, which is ~3 minutes minimum. The time at maximum is also unresolved as is the early part of the fall back to normal and this too, is due to lack of time resolution in the recording system. The very last part of the return to normal signal level slows similar to response to a solar flare and unlike interference. In my opinion, this very fast time profile, which is never seen in SIDs produced by solar flares, and which could not be produced by interference, is very strong evidence that what we see here is undoubtedly a true detection of the X-ray transient as a sudden ionospheric disturbance by A-91.

A SIMPLE, EASY TO BUILD, SUDDEN IONOSPHERIC DISTURBANCE (SID) RECEIVER

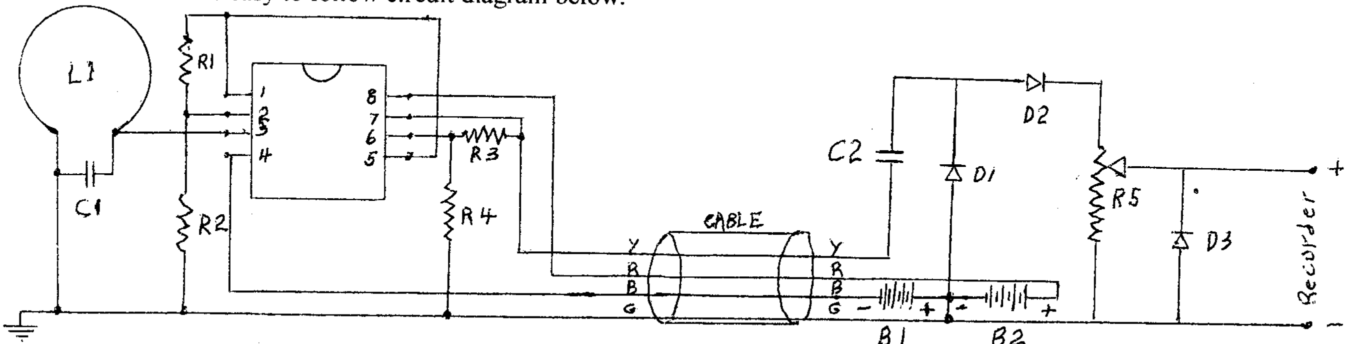
Last month in the March issue of the SID supplement I described a simple and very easy to build very low frequency (VLF) receiver for monitoring the D-layer of the ionosphere to detect solar flares. The complete receiver can be built with about $8 worth of parts from Radio Shack. One of the big advantages of this fixed frequency receiver is its standard loop antenna that can be tuned to the frequency of a desired VLF signal without the need of an oscilloscope and signal generator. This month I describe below, another standard loop antenna that might be easier to build. Its hexagonal frame is much sturdier than the octagonal frame described last month. I have also changed the number of turns to 24 so two, three or four-wire cable can be used instead of the 7-wire thermostat cable used on the 21 turn octagonal loop described last month. The thermostat cable is expensive and not readily available. I built one of these new 24-turn hexagonal loop antennas using ordinary #14 two-wire Romax cable which is easy to find at Home Depot or any electrical supply store. I do not recommend the Romax, however, because the solid copper wire is too stiff to wind on the frame easily. Instead it would probably be better to use a single strand of #14 stranded copper wire. This will not be so stiff and should be easier to wind and make a neat job, unlike the Romax that makes a messy looking loop. Alex Stewart, VE7AKV, has pointed out that this simple receiver owes its success to the high Q of its loop antenna which provides a pass band of ~800 Hz for the 21 turn #18 wire thermostat cable loop antenna. Its Q is 221 compared to only 20.8 for a loop antenna wound with about 300 feet of #26 wire, which is what is recommended for the small indoor loop antenna most people use. The much higher Q and narrow pass band the #18 wire antenna provides makes it possible to mount the receiver's amplifier right on the loop and use the tuned loop as the LC resonant circuit of this fixed frequency receiver. The whole business can then be placed outdoors away from 60 Hz electrical wiring that is the source of interference on VLF receivers. The loop antenna itself then becomes the receiver and the coaxial cable usually used to connect the loop antenna to the receiver is eliminated along with its losses and the interference it picks up. Now the fully amplified output of the receiver is brought inside the house with ordinary 4-wire telephone cable and the only thing inside is the recorder driver consisting of three diodes and a 0.01microfarad capacitor plus the 5K variable resistor gain control. This loop antenna receiver will be practically interference free if you can place it about 7 meters, 23 feet, from 60Hz electrical wiring. Alex calculated the Q of the 24-turn hexagonal loop will be 339 if you wind it with #14 wire and 851 if you use #10 wire! This is quite an improvement over the little #26 wire indoor loops with a Q of only 20.8 that most people are using. Below are drawings of how to make a sturdy hexagonal frame for the 24-turn loop antenna receiver. The diagonals of the hexagon are 1.5 meters or 59 inches long. 24 turns on this frame will have an inductance of 2508 microhenrys and require .0176 microfarads of capacity to tune it to NAA transmitting on 24 kHz. You can calculate the capacity needed to tune to other frequencies using the formula: $C=159,00/f^2L$ Where C is in microfarads, f is in Hertz and L is in Henrys.





The drawing above shows how the hexagonal frame is shaped like a paddle wheel with the six ¼ inch plywood paddles mounted all facing in the same direction on the ends of three diagonals. The diagonals are 1" X 2" nominal, actual size 5/8" X 1 3/8", wood from Home Depot or any lumber supply house. Each diagonal is cut to be exactly 57 inches long. A hole is drilled in the centers of the three diagonals and they are fastened together with a bolt. I used 5/16-18 threaded brass rod and brass nuts and washers to prevent rust. The plywood paddles are 6-inches long and the width of 24 turns of whatever size wire you use so you should buy the wire first. Then you can measure how wide 24 turns will be. The paddle drawings show how the three countersunk holes for the mounting screws are centered on two paddles, offset 5/8" to the right on two paddles and offset 5/8" to the left on the other two. These offsets produce a hexagonal frame that will lay flat and the winding will not zigzag. I used #10 brass flat head wood screws ¾" long to mount the paddles on the diagonals. The paddles should extend exactly one inch beyond the ends of the 57 inch long diagonals so the distance between the ends is exactly 59 inches which is 1.5 meters. When the diagonals are set with 30 degree angles between them the distance from each paddle to the next will be 0.75 meters and the length of a turn will be 6 X 0.75 = 4.5 meters. 24 turns will then require 4.5 X 24 = 108 meters or 354 feet of wire. This is a little more than the 300 feet usually recommended but it should work OK. You should buy some extra because I have not included the thickness of the wire in my calculations. Before you start to wind the wire on the frame you should clamp the diagonals so they won't move. The center bolt cannot be made tight enough to do this. The wood for the diagonals comes in 8-foot lengths so you will have some left over. Cut two pieces about 2-feet long to clamp the diagonals while you wind the wire on the frame. Clamp these in place with C-clamps. Glue the finished winding to each paddle with 5-minute epoxy glue before removing the clamps. Now the diagonals can't slip and the wire won't slide off the edges of the paddles. The ends of the winding should pass through small holes both in the same paddle and extend out a few inches. Glue them in place too with the epoxy.

The loop's 0.0176 tuning capacitor will be several capacitors connected in parallel. Solder these directly to ends of the winding. Use Polystyrene or silver mica capacitors and leave them exposed to weather. I have left them out in the rain and snow for years with no problems. The receiver's amplifier should be mounted near the center of the loop and connected to the loop where the capacitors are connected with a short twisted pair of wires. Solder all connections including the wires from the telephone cable which should be brought straight out from the center of the loop for about 10 feet in a direction that is parallel to the axis of the loop. The cable carries the amplified signal and if it gets too close to the loop it will couple to it and the receiver will oscillate. If you are working without an oscilloscope you will recognize oscillation by the recorder drawing a straight line. The amplifier too can be left exposed to the weather. This sounds counter intuitive but I left my 900X amplifier in Florida exposed to the weather for over a month. It rained many times and I watched the signal on the scope and even in pouring down rain there was no tendency to oscillate at all. All the amplifier consists of is the TL082 dual op amp and four resistors mounted on a small experimenters circuit board. You can buy these parts from Radio shack for about $3 and make a new amplifier if being exposed to the weather eventually ruins your amplifier. But you must remember this. You absolutely must remove all of the resin core soldering flux residue from the circuit board with special flux removing solvent you can buy at Radio Shack, part #910-0009. If you don't do this, the first rain will leach a greenish stain into the amplifier's circuit board and it will oscillate forever after and you will have to throw it away and build a new one. Don't find out about this the hard way. Several people have built the amplifier for the 21 turn loop antenna receiver described last month. Based on their experience I have made some changes in the receiver shown in the easy to follow circuit diagram below.



C-1 0.0176 mfd
C-2 0.01 mfd
R-1, R-3 100 K ¼ Watt
R-2 3.3K ¼ Watt, R-4 see text
R-5 5K Liner Taper

U-1 TL082 Dual Op Amp
D-1, D-2 1N914 Diode D-3 5 Volt Zener Diode.
B-1, B-2 Snap-on terminal 9-Volt Battery (Lasts ~10 days). Replace Later With Wall-Mount-Type 12-Volt Power Supplies.
Cable 4-wire telephone cable color coded Yellow, Red, Black, Green

First and most important is the value of R4. I showed it as 3.3 K last month which gives an amplification factor of 900. This worked fine for me in Orlando, Florida 1380 miles from NAA in Cutler Maine but it is too much amplification if you live closer. I now recommend starting with a 15K resistor for R4. The two op amps in the TL082 are connected in tandem with the amplification factors equal to the resistance of R1 and R3 divided by R2 and R4 respectively. The first one amplifies 30X and the second one 6.6X with a 15K resistor so the pair will amplify 200X. Try this and if it is still too much the system will saturate and you will know by the straight line the recorder draws. Then try 33K to give 90X total. If 200X is not enough try 10K for 300X total or 4.7K for about 600X. The important thing is choose a resistor that won't saturate the amplifier but yet amplifies enough so you can set the recorded level where you want it with the 5K variable resistor gain control. The other change I have made is I added the 5.1-Volt Zener diode as a safety measure so the recorded voltage cannot exceed 5.1 Volts.

The circuit diagram is easy to follow even if reading electronic schematics is new to you. The diagram shows a little crescent notch at the top and you will see this same notch on the top of the TL082 when you mount it on the circuit board. The diagram is a top view of how the op amp is connected to the resistors. Mount it in the middle of a Radio Shack circuit board part #276-168. Solder four connecting leads to the bottom of the circuit board to connect to the telephone cable. Make these from 14 inch color coded test leads (part #278-1156) cut off to be about three inches long. Use green, black , red and yellow to match the colors they will connect to on the telephone cable with the alligator clips. Two leads at the top, a green and a white will connect with alligator clips to the twisted pair from the loop ends. The white one should connect to pin 3, the noninverting input of the first 30X op amp. The green lead goes to the ground lead of the system. Build the recorder driver on the same little circuit board. On the diodes the arrow points to the end of the diode that has a band. The loop antenna does not have to be free and clear so set it right on the ground and drive a ground rod beside it to connect to the ground of the whole system including the recorder driver, through the telephone cable. The loop can be hidden in shrubbery. After the correct value for R-4 has been chosen and the system is working the way you want it to you should cut off the alligator clips and solder all connections. This is important. Clean the board with solvent as mentioned above. This is also very important. You can order Radio Shack parts for the receiver online from << WWW radioshack.com >> or call 1-800 843 7422. Another thing I should mention is when you buy the lumber for the diagonals choose the straightest lumber you can find. Any lack of straightness or drilling the bolt holes off center will prevent making the distance between all of the paddles 0.75 meters. Just do the best you can and it will be good enough.