Solar Bulletin

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS - SOLAR COMMITTEE

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

Day	N	Raw	s.d.	Ra	s.d.	s.e.
1	35	82	4.9	64	2.4	0.41
2	37	97	6.2	73	2.9	0.48
3	27	87	5.2	**63**	2.3	0.44
4	30	108	7.0	75	3.6	0.66
5	36	118	6.7	91	3.7	0.62
6	39	113	6.0	88	3.0	0.48
7	34	125	7.1	96	3.3	0.57
8	31	125	7.9	102	4.2	0.75
9	28	136	8.1	107	3.3	0.62
10	29	172	8.0	126	3.5	0.65
11	30	173	8.2	**131**	4.0	0.73
12	22	187	9.6	131	3.4	0.72
13	26	172	9.5	125	3.2	0.63
14	36	153	6.9	122	2.6	0.43
15	26	175	9.6	126	5.5	1.08
16	28	175	9.4	127	4.1	0.77
17	29	172	10.2	125	4.3	0.80
18	37	172	10.7	128	4.2	.069
19	33	159	8.3	127	4.9	0.85
20	34	152	7.8	123	5.6	0.96
21	32	133	8.4	102	3.7	0.65
22	39	127	5.6	93	3.3	0.53
23	34	111	5.8	82	2.3	0.39
24	33	105	5.7	78	2.5	0.44
25	33	110	5.5	80	3.0	0.52
26	29	125	5.8	95	4.1	0.76
27	22	134	5.7	99	4.4	0.94
28	33	128	5.6	94	2.9	0.50
29	33	145	6.4	110	3.4	0.59
30	25	154	7.1	114	3.3	0.66
31	30	142	5.0	107	2.9	0.53

Means: 31.3 137.6 103.5

Total No. of Observers: 73

Total No. of Observations: 970

Table II. October Observers

10	AAP	P.Abbott
5	ANDE	E.Anderson
16	ARAG	G.Araujo
18	BARH	H.Barnes
9	BATR	R.Battaiola
6	BEB	R.Berg
12	BERJ	J.Berdejo
12	BMF	M.Boschat
13	BOJP	P.Bojda
18	BOSB	B.Bose
25	BRAB	B.Branchett
12	BRAD	D.Branchett
21	BROB	R.Brown
17	CARJ	J.Carlson
31	CHAG	G.Morales
15	CKB	B.Cudnik
15	CLZ	C.Laurent
12	COMT	T.Compton
31	CORA	A.Coroas
29	CR	T.Cragg
12	DELS	S.Delaney
3	DEMF	F.Dempsey
17	DGP	G.Dyck
18	DRAJ	J.Dragesco
15	DUBF	F.Dubois
22	ELR	E.Reed
3	ERRA	A.Errico
15	FEEC	C.Feehrer
21	FERJ	J.Fernandes
14	FLET	T.Fleming
21	FUJK	K.Fujimori
2	GARE	E.Garcia
15	GIOR	R.Giovanoni
7	GOEM	M.Goetz
5	GOTS	S.Gottschalk
5	HALB	B.Halls
7	HAYK	K.Hay
8	HRUT	T.Hrutkay
14	JAMD	D.James
2	JEFT	T.Jeffrey
11	KAPJ	J.Kaplan
18	KHAR	R.Khan
16	KNJS	J&S Knight
3	KROL	L.Krozel
6	LARJ	J.Larriba
3	LERM	M.Lerman
25	LEVM	M.Leventhal
4	LUBT	T.Lubbers
20	MALK	K.Malde
6	MARE	E.Mariani
29	MARJ	J.Maranon
21	MCE	E.Mochizuki
6	MILJ	J.Miller
18	MMI	M.Moeller
2	MUDG	G.Mudry
16	OBSO	IPS Observatory
12	RICE	E.Richardson
19	RITA	A.Ritchie
19	SCGL	G.Schott
1	SDP	D.Sharples
8	SIMC	C.Simpson
7	STEF	G.Stefanopoulis
18	STEM	G.Stemmler
23	STQ	N.Stoikidis
25	SUZM	M.Suzuki
10	TESD	D.Teske
13	THR	R.Thompson
9	TJV	J.Temprano
20	URBP	P.Urbanski
3	VALD	D.delValle
13	VARG	A.Vargas
3	VIDD	D.Vidican
10	WILW	W.Wilson

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 October 2002

Day	RG	S:G	Day	RG	S:G	Day	RG	S:G	Day	RG	S:G
1	4.0	10.5	**9**	9.2	4.8	**17**	10.5	6.4	**25**	6.5	6.9
2	5.2	8.7	**10**	10.9	5.8	**18**	9.6	7.9	**26**	7.8	6.0
3	4.7	8.5	**11**	10.6	6.3	**19**	8.9	7.9	**27**	8.0	6.8
4	4.9	12.0	**12**	11.4	6.4	**20**	8.5	7.9	**28**	8.0	6.0
5	6.0	9.7	**13**	11.0	5.6	**21**	7.5	7.7	**29**	9.5	5.3
6	6.2	8.2	**14**	10.1	5.2	**22**	6.0	11.2	**30**	10.6	4.5
7	6.9	8.1	**15**	11.3	5.5	**23**	5.6	9.8	**31**	9.5	5.0
8	7.6	6.5	**16**	10.8	6.2	**24**	5.7	8.4	**Mn.**	**8.16**	**7.27**

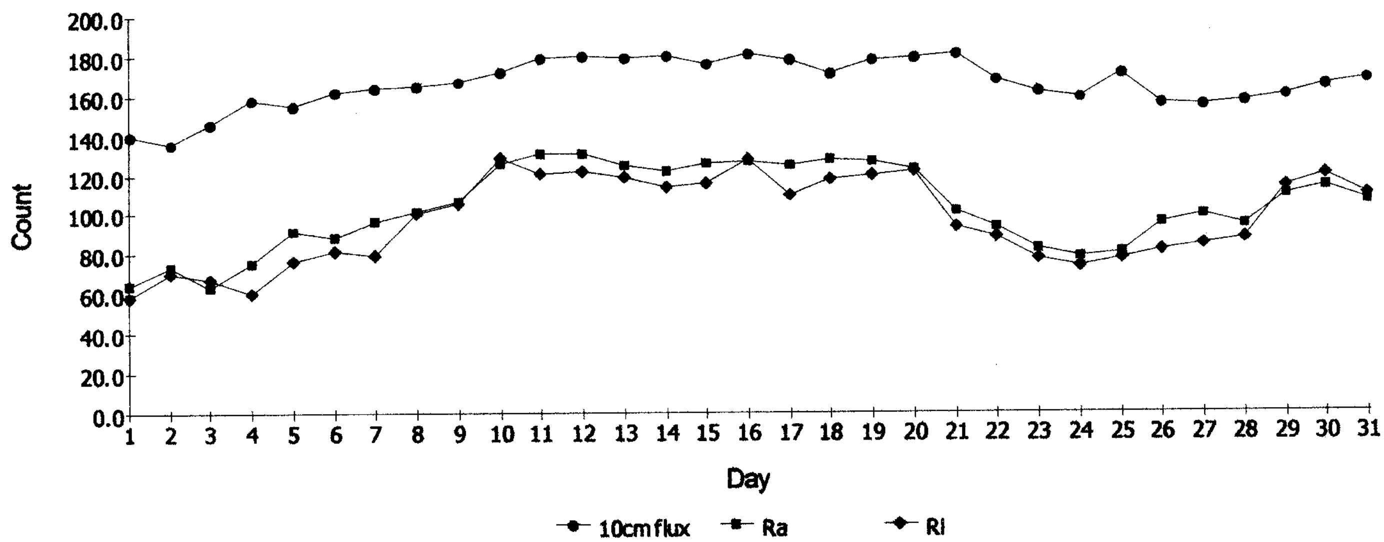


Fig. 1. 10 cm Solar Flux and Comparison of Ri (provisional) with Ra Estimates for October 2002 [r=0.957]
Ri source: http://www.sidc.oma.be/index.php3
10 cm source: http://www.drao.nrc.ca/icarus

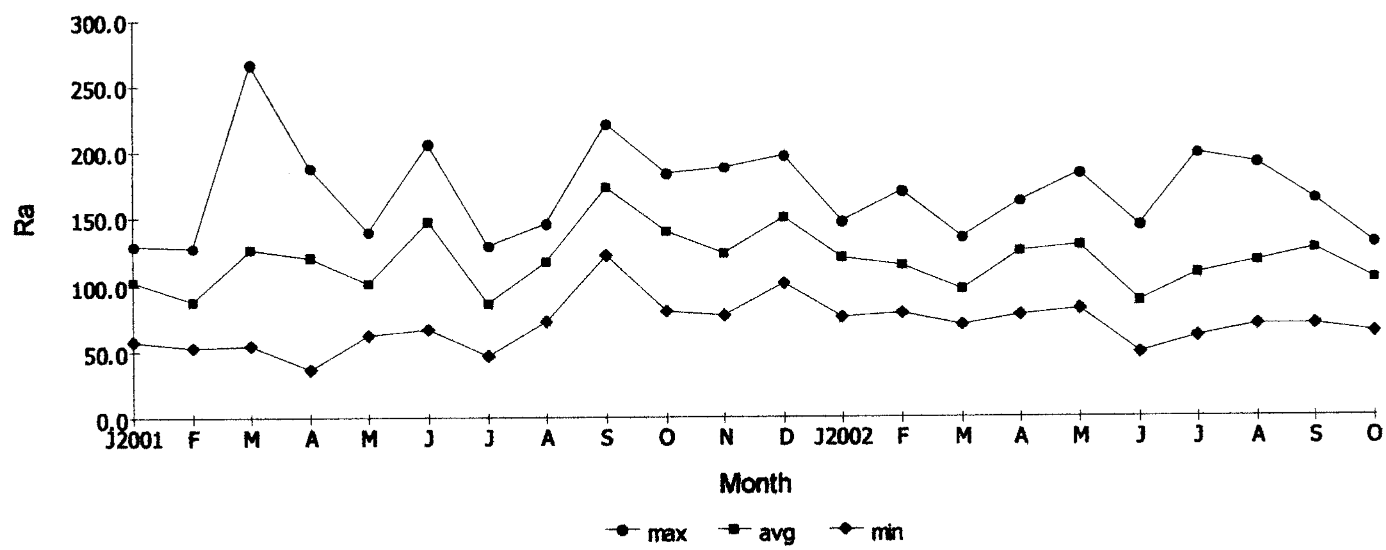


Fig. 2. Maximum, Mean, and Minimum Values of Ra for Each Month from January 2001 to Present.

Summary of AAVSO Solar Committee Activity for the Period from October 2001 to September 2002
[Presented at the October 26, 2002 Annual Meeting in Somerville, MA]

Chair: Carl E. Feehrer

As reported at earlier meetings, the Solar Division continues to benefit from the presence of the *Solar Bulletin* and related sunspot and SID data on the AAVSO website, and from media attention being paid to the Sun during the maximum. The Division continues to attract new contributors to both of its observation activities. During the period, 90 observers have filed sunspot reports and 20 observers have filed SID reports.

Sunspot Reports

During the period, 876 sunspot reports containing a total of 13,352 observations were received and processed. As shown in Figure 2 below, a larger number of reports has been received in this period than in the previous period as a result of growth in the size of the observer group.

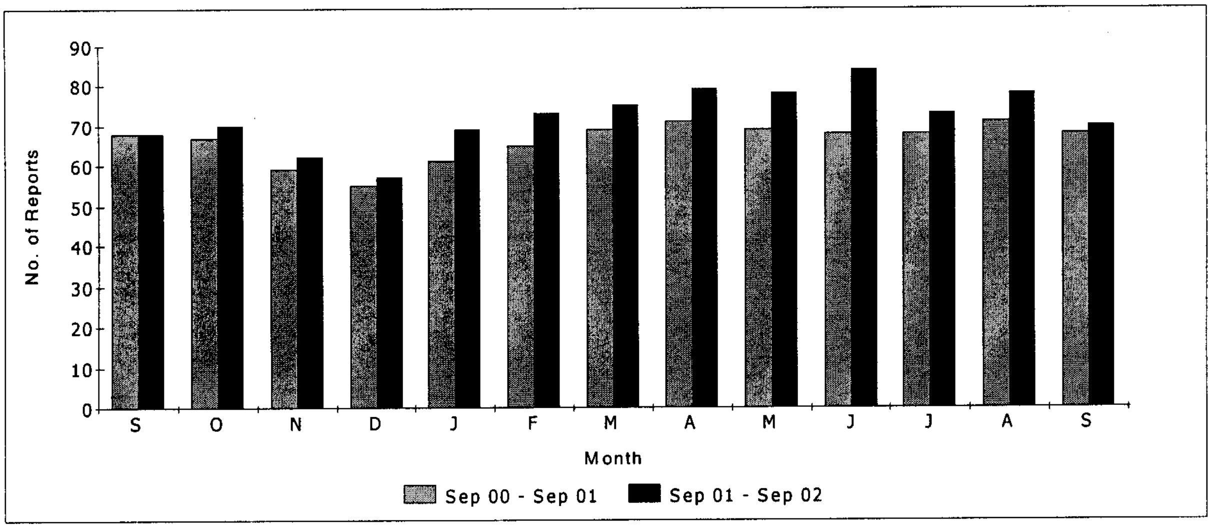


Fig. 1. Number of Sunspot Observer Reports Received During Corresponding Periods.

SID Reports

- One hundred ninety-nine reports based on the monitoring of seven different VLF stations were received and processed. Mike Hill, SID Analyst and Chair of the SID group has developed new procedures for automating the reduction and reporting of flare data. His reviews of activity during the period and of the revised procedures are presented at the end of this report.

Website Activity

- The number of solar images contributed to the Solar Photo Gallery by observers became large enough last month so that it was necessary to reorganize the collection. Since the group provides good coverage of the appearance of the disc over most of the maximum, I hope at some point to put together an album of selected images that could be of value in teaching new observers the art of sunspot grouping.

- Figure 2 below presents the numbers of downloads from the AAVSO/Solar website during the reporting period, and Figure 3 presents the subset of downloads associated with the Solar Bulletin.

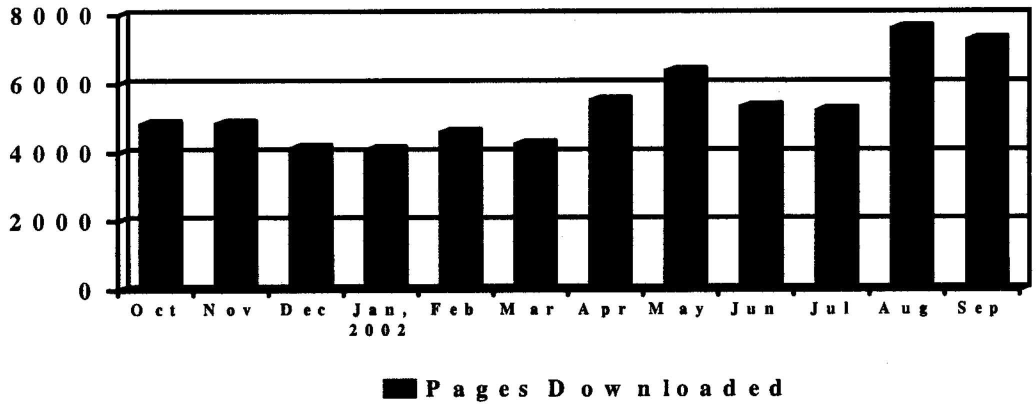


Fig2. Solar Pages Downloaded: October 01, 2001 - September 2002

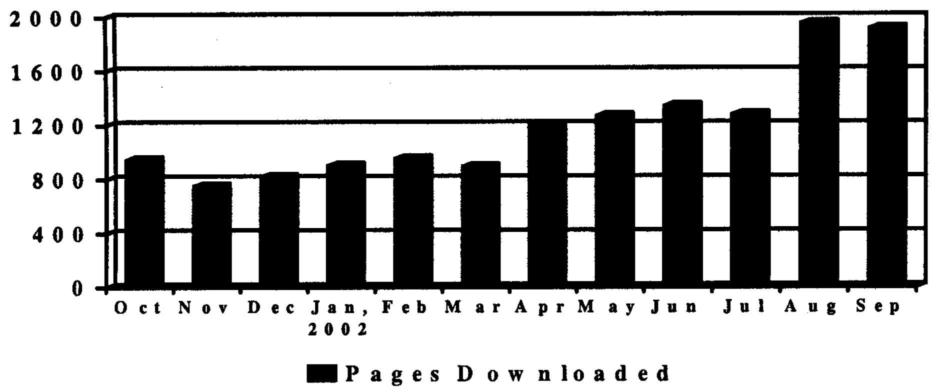


Fig. 3. Solar Bulletin Pages Downloaded: October, 2001 - September 31, 2002

- **Acknowledgments**
  The successful performance of the Solar Division up to this point is due to the dedication and hard work of our network of observers and the following people:

  - Mike Hill, Analyst and Chairperson of the SID group, and Editor of the SID portion of the *Solar Bulletin*
  - Casper Hossfield, Editor of the monthly SID *Supplement to the Bulletin*
  - Kate Davis, the AAVSO's website maintainer
  - Arthur Ritchie, a volunteer at the AAVSO who assists in the preparation of the monthly sunspot data

  It has been a pleasure to work with them. Thank you all.

Summary of SID Group Activity for the Period from October 2001 to September 2002

Chair: Mike Hill

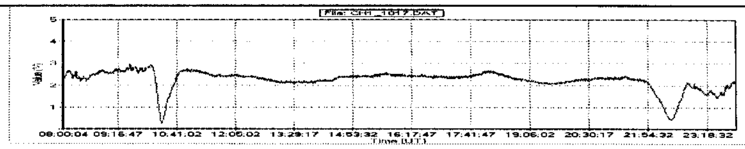
The SID Program has seen a lot of activity over the past year. As the sun passed from solar maximum and started its decrease in sunspot activity there have been periods of intense flare activity, with some of the most active months being this past July and August, fully one year past solar maximum . In August. there were 193 correlated SID events recorded by observers! (The average over the past year has been around 60.) We have an average of 15 observers reporting each month. Most observers are monitoring one station although some monitor two or three. From these observers, a total of 199 reports have been submitted over the last year, resulting in a total of 1,021 solar flare related events being recorded. I wish to thank all these observers for their dedication to this activity.

An important change to the analysis method has been in effect since June of this year. I have written a computer program that now does all the observer-to-observer event correlations. This results in a more accurate determination of event times and importance levels. When the SID program began, the analysis was done by lining up each observer's daily strip chart plots and looking for correlated events among observers. By the time I took over, computers were being used to replace the old paper chart recorders, and observers were submitting data files that listed the events they recorded. At this time, I began doing the analysis using a spreadsheet into which I entered the observer's data and then compared the events in a fashion similar to the paper strip chart comparisons. I also started using the recorded flare events of the GOES-8 spacecraft as a baseline for this comparison. The new program I have written processes the observer reports directly without having to copy the events into a spreadsheet.

The correlation process is a three step process. The program first scans all observer files and generates a list of any events that are reported by more than one observer within ±5 minutes. An average time and importance rating is computed based on all correlations. If GOES-8 flare data is available, the program then compares any remaining uncorrelated events to actual flare events and records any SID event that is within ±15 minutes of an actual flare. The program tracks the quality of each observer based on the number of correlated events to total events submitted. The final stage of correlation is based on this quality rating. If an observer has a high quality rating, then all uncorrelated events for that observer are added to the correlation list. The program then generates all the required reports for submittal to the AAVSO and the NGDC as well as an observer summary that lists uncorrelated events and the observers quality rating based on the latest data submission. Extensive testing has been done to assure that the correlation mechanism is accurate and that the results produced match the results produced by the old manual analysis. In conjunction with this program, I have also produced a *SID Analysis User Guide* that describes in detail the method I follow to perform the monthly SID analysis and report generation based on the use of this new program. This will be kept on file at the AAVSO in case I no longer am able to perform the duties of SID Analyst.

Sudden Ionospheric Disturbance Report

Michael Hill, SID Analyst
114 Prospect St
Marlborough, MA 01752 USA
noatak@aol.com



Sudden Ionospheric Disturbances (SID) Recorded During October 2002

(Analysis performed by Michael Hill, SID Analyst)

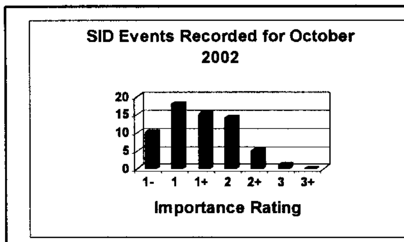
Date	Max	Imp	Date	Max	Imp	Date	Max	Imp
021003	0220	1+	021015	1334	1-	021022	1253	1
021004	0043	2	021015	1354	1-	021022	1537	1
021004	0153	2	021015	1419	2	021025	0701	1-
021004	0425	2	021016	1151	1-	021028	1206	1
021004	0501	1+	021016	1239	1	021029	1528	1+
021004	0538	2	021016	1604	2+	021029	1632	2
021004	0911	1+	021016	1612	2	021030	0500	2
021004	1031	1	021016	1620	3	021030	1530	2
021004	1109	1	021017	1209	1+	021031	0925	1
021004	1256	2	021017	1807	2+	021031	1032	2+
021004	1557	1+	021018	0939	1	021031	1623	1
021004	1709	1	021018	1009	1-	021031	1632	1+
021005	0235	1-	021018	1527	1+	021031	1653	1+
021005	0521	1+	021019	1828	1+			
021005	0728	1-	021020	0042	1			
021005	0750	1	021020	0341	2+			
021005	0857	1	021020	0515	2+			
021005	1048	1+	021020	0615	1-			
021006	0449	1+	021020	1037	1+			
021006	1017	1	021020	1402	1			
021006	1159	2	021020	1428	2			
021011	0836	1	021021	1145	1-			
021013	1757	1+	021021	1205	1			
021014	0943	2	021021	1227	1-			
021014	1424	1	021022	0415	2			

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) Event reported by two or more observers within ±5 minutes
2) Event matched to GOES-8 XRA event to within ±15 minutes and event time < 1000 UT
3) reported by observer with a quality rating > 8 (scale 1-10)

Observer	Code	Station(s) monitored
A Clerkin	A29	NAA
D Toldo	A52	HWU NAA NWC
S Hansen	A59	CFH NAA
J Ellerbe	A63	ICV
W Moos	A84	DHO
M Hill	A87	NAA
G DiFillipo	A93	HWU
T Poulos	A95	NAA
R Battaiola	A96	HWU
J Wallace	A97	NAA
M King	A99	HWU
F Steyn	A102	NAA NWC
E Smith	A105	DHO

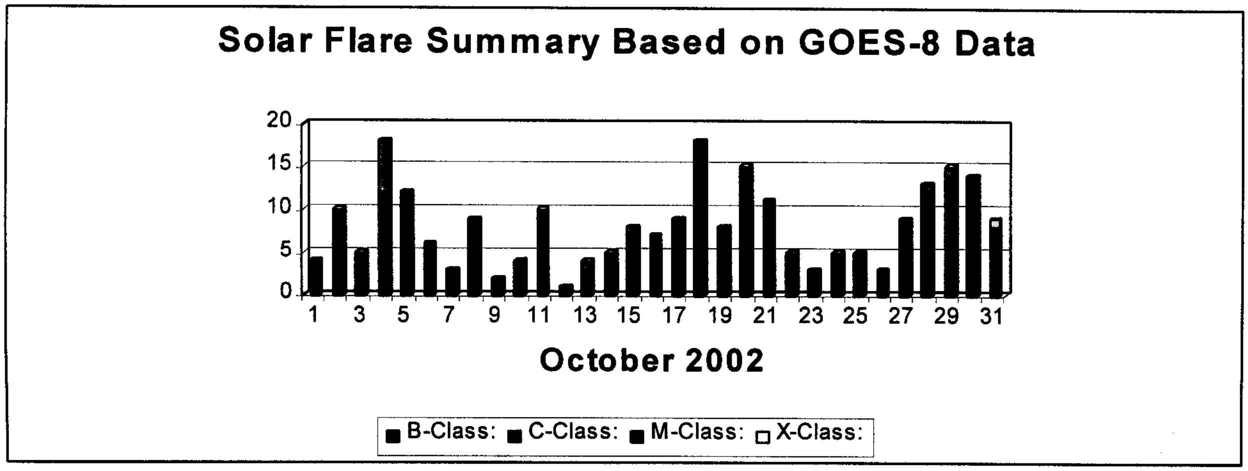


Solar Events

October has been a fairly active month, although on the downward trend as was last month. There were 250 GOES-8 X-Ray Flares recorded. Of these 22 were M-Class and one X-Class event. The rest were lower level C and B Class events. Observers here recorded a total of 63 coordinated SID events. Most of these had a lower than average importance rating with 6 recorded with an importance rating of 2+ and higher.

I attended the AAVSO Fall meeting this past month and had a wonderful time. I got to meet a couple of fellow observers and make contact with some possible new ones. Of note was a meeting with the current head of the local planetarium here in Boston at the Museum of Science. He is interested in doing some solar work to show to school children during field trips. Along with sunspot and H-Alpha observing, he may also put together a setup to monitor for SIDs using a real time display. What a treat that would be to have kids see a flare in H-Alpha coming from an active region they see in white light and also see the effects on our ionosphere through the results of the SID monitoring station. If that doesn't turn them on--well, I guess astronomy may not be for them.

During the morning presentations by the committee chairmen, I was asked to give a few words about the SID group. I presented a summary of the work we have submitted over the past year as well as a short summary as to the new method of SID analysis that I now use. I also gave a very brief description of what SID Monitoring is all about for those variable star nuts (I'm one of them too!) and sunspot observers who always wondered what this "SID Group" was all about. I think it was well received.



SOLAR BULLETIN of the American Association of Variable Star Observers. Vol. 58, No 10, October, 2002

SUDDEN IONOSPHERIC DISTURBANCES SUPPLEMENT

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SUDDEN IONOSPHERIC DISTURBANCES RECORDED DURING OCTOBER, 2002

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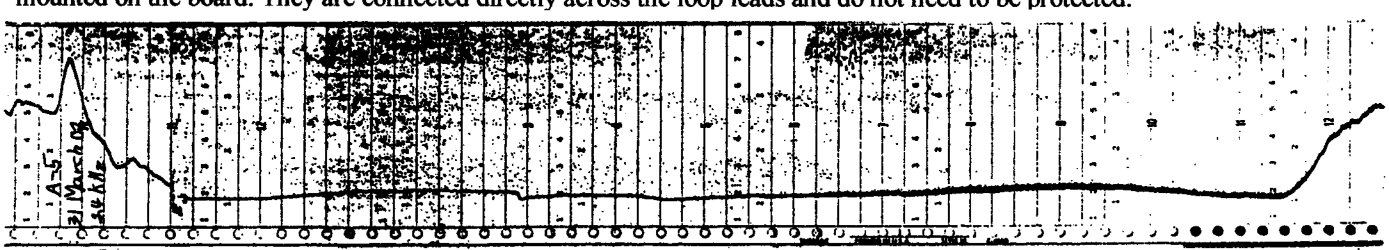
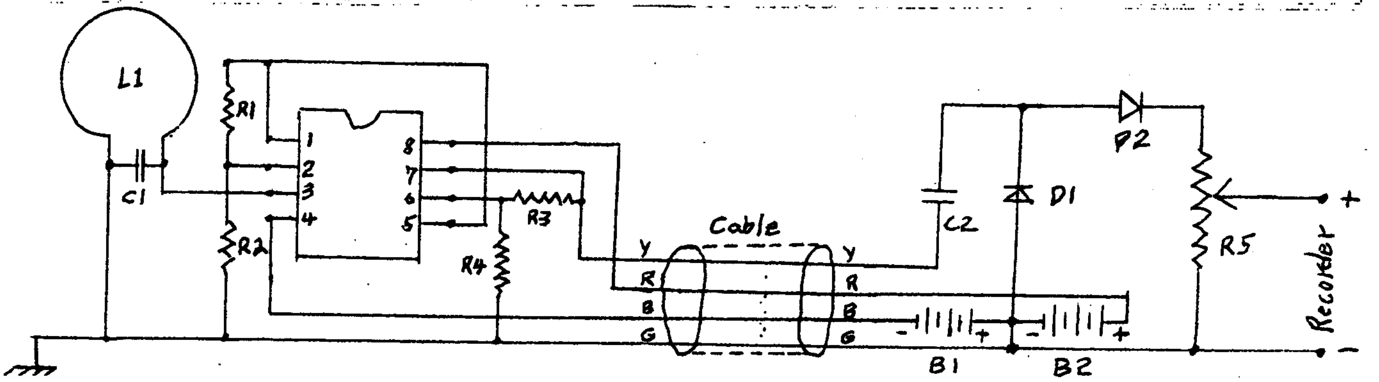
A Simple Easy to Build VLF Receiver to Detect Solar Flares and gamma Ray Bursts

Here is an updated version of the simple VLF receiver first described in the April SID Supplement of the Solar Bulletin. You can build it in one afternoon from about $10 worth of Radio Shack parts. The loop antenna that goes with it will take another day to build from stuff you can buy at Home Depot or a similar store. The design is based on the principle known to all amateur radio operators that the most important part of a transmitting or receiving system is a good antenna and a well matched transmission line. I meet the first requirements by building a hexagonal loop antenna that measures 1 ½ meters (59 inches) across the diagonals and winding it with 24 turns of # 14 stranded copper wire. I meet the second requirement by eliminating the transmission line altogether. The receiver is built right on the loop antenna so there is no need for a transmission line between the antenna and the receiver. After the signal is amplified 900 times it is sent over a transmission line consisting of ordinary 4-wire telephone wire to a recorder driver. There is no need to match this transmission line to the recorder driver because the signal has already been amplified 900 X. There is plenty of signal to make up for any lost on the transmission line. I call this a "Loop Antenna Receiver" because the loop is the receiver. It is the LC resonant circuit for the receiver and owes its success to being a large high-Q loop with much greater aperture than small loop antennas usually used with sudden ionospheric disturbance (SID) receivers. The low resistance of the #14 wire gives the loop a high Q, about 400 compared to about 20 for small loop antennas wound with #26 wire that are used by most SID observers. The receiver has a pass band of less than 500 Hz which compares favorably with other SES (Sudden Enhancement if Signal) receivers in use today.

This loop antenna receiver is meant to be located outdoors so it can be placed as far as possible from electrical wiring which is the source of most if not all of the interference that plagues SES receivers. The chart below shows an interference-free recording of the signal from NAA in Cutler, Maine, USA transmitting on 24 kHz that I made in Orlando, Florida, USA with the loop antenna 8 meters (27 feet) from the nearest 60 Hz electrical wiring. Below the chart is a simplified diagram of how to hook the parts of the receiver together. Below that is a parts list. It is not necessary to put the receiver in a weatherproof box. Two things are necessary to protect the receiver from the weather. First, all soldering flux must be removed with flux remover, something Radio Shack no longer carries. Some other radio and electronics stores do carry it. It is usually a mixture of Ethyl either, Acetone and alcohol. Probably nail-polish remover would work. After removing the flux, candle wax is dripped on the amplifier board to cover it completely and protect it from rain. The tuning capacitors for the loop are not mounted on the board. They are connected directly across the loop leads and do not need to be protected.

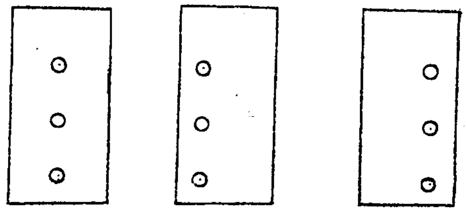


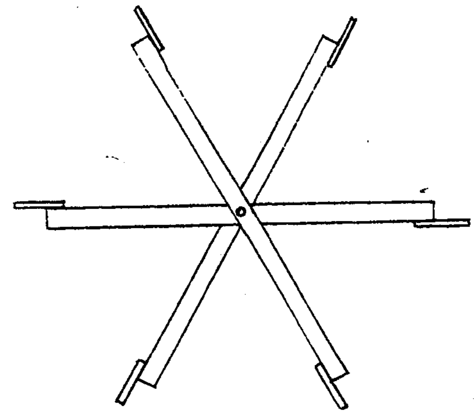


C-1 0.0022 mfd
C-2 0.01 mfd
R-1, R-3 100 K 1/4 Watt
R-2, R-4 3.3 K 1/4 Watt
R-5 5 K linear taper

U-1 TL082 Dual Op Amp
D-1, D-2 1N914 Diode
B-1, B-2 Snap-On Terminal 9-Volt Battery (Lasts ~ 10 Days). Replace Later With Wall-Mount-Type 12-Volt DC Power Supplies
Cable 4-Wire telephone cable color coded Yellow, Red, Black, Green

Below are instructions for making a hexagonal frame for the loop antenna receiver. If you follow these directions you will have a nice looking single layer loop that will have no zigzags but a less carefully made frame will probably work just as well provided you maintain the dimensions fairly close.





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.

I tuned my 1.5 meter loop with 24-turns of # 14 wire with a precision decade capacitor bank made by Cornell-Dubilier to determine the actual capacities needed. Here are accurate values for the capacitors needed to tune to some popular VLF stations.

60 kHz, WWVB Fort Collins, Colorado, USA.......0.002 mfd
25.2 kHz (no call letters) La Mourie, North Dakota, USA...0.0175 mfd
NAA 24 kHz Cutler, Maine, USA ......0.0185 mfd
37.5 kHz, NRK Grindavik Iceland ......0.008 mfd
24.8 kHz , Jim Creek, WA, USA ....0.0178 mfd
21.4 kHz, NPM Hawaii, USA...........0.023 mfd

You can make a tuner to find these stations from two Radio Shack 8-position DIP switches. These consist of eight little single-pole, single-throw switches side by side that mount on a printed circuit board. Radio Shack only carries the capacitors you need for this tuner in ceramic dielectric so you should use their ceramic capacitors. Below are the capacities for the sixteen capacitors you will need. Mount each switch on a little circuit board and connect one capacitor to each switch so when all 8 switches are in the on position all eight capacitors are connected in parallel. Leave the leads long when you solder them into the tuner so later when you have determined the combination of capacitors that tune to the station of your choice you can unsolder them with long enough leads to span the distance between the ends of your loop.

Switch Number One:

Position # 1.....100 pfd	5.....100 pfd
2.....100 pfd	6.....470 pfd
3.....100 pfd	7.....470 pfd
4.....100 pfd	8...0.001mfd

Switch Number Two:

Position # 1...0.001 mfd	5...0.0047 mfd
2...0.001 mfd	6....0.01 mfd
3...0.001 mfd	7....0.01 mfd
4...0.0047 mfd	8....0.01 mfd

These two tuners should make it possible to find your station without an oscilloscope and signal generator. Connect them temporarily with Alligator clip leads across your Loop. It will take some patience but you can choose a combinations that add up to the values given in Table 1 to get close. Then tune up and down in 100 pfd increments until you peak on a strong signal. Use a multimeter or your recorder to measure signal strength. Record the strong signal you have found for a few days to make sure it shows sunrise and sunset patterns. If it shows these patterns you have successfully tuned your receiver to a suitable signal and it should record solar flares as SESs. Unsolder the selected capacitors from the tuners and solder them across the ends of the loop. Remember the ceramic capacitors you buy from Radio Shack are rated for only 20% accuracy so if you connect the values in the table above to your loop you probably will probably be way off. I connected 20% capacitors adding up to 0.185 mfd across my loop and NAA was nowhere to be found. I added capacitors 100 pf at a time to tune in NAA. Checking later with a signal generator and counter I found the 20% error capacitors tuned to 28 kHz instead of 24 kHz where I wanted to be.

The instructions above for the hexagonal loop antenna receiver are taken from the April SID Supplement. By now experience has shown not everybody is able to build the receiver and get it tuned to a suitable signal to record SIDs. This is especially true if you try to tune to a weak signal. For those of you who might have trouble I am here to help you. Do the best you can but if you can't get it to work please send me an email at << capaavso@aol.com >> and I'll be glad to help you get it on the air recording SIDs. I've never seen one yet that I couldn't fix. It is understandable that some might have trouble because we no longer live in a world where people build homemade radios. Amateur scientists no longer build their own homemade instruments. This is regrettable because there is much pleasure doing science with something you built yourself and that is your very own thing. Also you are very apt to have a much better understanding of how an instrument works if you built it yourself. But the way things are is the way they are and will be into the future. It is all for the good and we really do live in a better world today despite what some people will tell you. Even though things are better and commercially available scientific instruments are available, you still can't buy a good SID receiver so you will have to build your own. That is what I hope you will do so please give it a try. Gamma ray bursts (GRBs) are cutting edge astrophysics that are detected with high technology satellites that costs many millions of dollars. I'm sure you will find great pleasure in detecting one with a simple homemade radio you can build yourself on the kitchen table for a few dollars. Good luck.

Some Additional Helpful Information

The loop antenna for a VLF receiver does not have to be free and clear. VLF radio waves are subject to a principal of optics known as Brewster scattering which allows them to penetrate a small fraction of a wavelength into a conducting medium. All electromagnetic waves obey this principle. This is why the Navy uses VLf radio frequencies to communicate with submerged submarines. Their long wavelength scatters into salt water deep enough to be picked up by an underwater antenna trailed just below the surface. They also have no difficulty reaching your loop antenna hidden among trees and shrubbery and sitting right on the ground. The plane of the loop is the direction of maximum signal so orient the loop so the signal you want to record is in the plane of the loop. There is a sharp null in the direction perpendicular to the plane of the loop. The maximum is much broader than the null so an unwanted signal on a nearby frequency can nulled out while favoring the wanted signal.

The diagram shows resistors that amplify 900 X. This was OK recording the 24 kHz NAA signal in Florida but is too much amplification to record NAA from New Jersey. Here I change R-4 to 22K to give amplification of ~150X. If you use too much amplification it will saturate the amplifier and draw a straight line that cannot show sunrise and sunset patterns and record SIDs. The TL082 is a dual opamp. Each opamp is a separate amplifier whose amplification is equal to the ratio of the resistors connected to its inverting input (pins 2 and 6). When they are 100K and 3.3K each stage amplifies 30 X for a total of 900 X. If you change R-4 to 22K the total is 30 X ~5 = 150. If R4 is 10K it is 30 X 10 = 300. 33K will give 90 X. You can also draw a straight line if the amplifier oscillates and saturates the amplifier. Avoid feedback oscillation by suspending the amplifier board half way between the periphery of the loop and the center of the frame. Suspend it on the input wires and the 4-wire telephone cable which should come out perpendicular from the center of the loop for a distance of about two meters. Do not let the amplifier touch the wooden frame. If the output cable passes close to the loop the amplified signal it carries can couple back into the loop and cause feedback oscillation that draws a straight line that also will not show sunrise and sunset patterns nor record SIDs. A signal generator can also saturate the amplifier if it is coupled too tightly to the receiver. Always avoid straight lines as you tune your receiver to the station you are looking for.

If all else fails and you can't get your receiver tuned to the signal you want you may do better with a signal generator you can build from about $12 worth of Radio Shack parts. This is a Wein-bridge oscillator that produces a true sine wave with good stability and is easy to control. If you think it will help you please send me an email and I'll tell you how to build it. It will need to be set to the frequency you want to tune to with a frequency counter. If you do not have a frequency counter or a friend who can set it, you can send it to me and I'll be glad to set it for you. It is small and very light and can be mailed for 37 cents or anywhere in the world by airmail for 80 cents.

It is possible the reason you can't find a station you are looking for is it might be off the air. The Navy VLF stations all usually have a scheduled maintenance day each week and occasionally they are down for extended periods. NPM in Hawaii is presently down and has been for months. To find out about such things subscribe to the SID Network list server at: << http://mailman.mcmaster.ca/mailman/listinfo/aavso-sid-list >> and you will be able to keep up with what is happening in the SID world. You are also welcome to post questions on the list to help you get your receiver built and working and on the air to record solar flares and gamma ray bursts. There are experienced SID observers who will be glad to answer your questions and help you with any problems you may run into.........Good luck. CHH