Solar Bulletin

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS - SOLAR DIVISION

Carl E. Feehrer, Editor
9 Gleason Rd.
Bedford, MA 01730

Email: cfeehrer@hotmail.com

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

Day	N	Raw	s.d.	Ra	s.d.	s.e.
1	33	126	9.2	94	3.8	0.66
2	36	97	7.2	75	3.0	0.50
3	28	130	8.1	96	4.3	0.81
4	26	134	10.5	100	5.1	1.00
5	33	110	6.1	88	3.8	0.66
6	30	125	9.1	97	4.4	0.80
7	29	117	6.9	89	2.8	0.52
8	29	98	5.3	75	2.2	0.41
9	32	91	4.6	**69**	2.7	0.48
10	42	95	3.8	72	2.4	0.37
11	31	109	6.8	83	3.7	0.66
12	33	111	5.6	84	2.6	0.45
13	32	123	6.6	94	3.3	0.58
14	38	117	5.3	86	2.7	0.44
15	33	118	5.5	92	2.3	0.40
16	40	117	5.2	93	2.6	0.41
17	37	118	5.7	90	3.2	0.53
18	30	119	5.8	88	2.2	0.40
19	32	100	6.4	77	3.2	0.57
20	30	125	7.0	93	3.8	0.69
21	39	137	5.2	105	3.0	0.48
22	41	122	5.3	101	2.7	0.42
23	43	148	5.8	112	3.0	0.46
24	41	147	5.5	118	3.2	0.50
25	34	136	6.1	108	2.6	0.45
26	29	137	7.8	106	3.4	0.63
27	38	153	6.1	116	3.1	0.50
28	43	135	5.7	106	2.6	0.40
29	40	146	6.3	116	3.4	0.54
30	38	144	6.2	115	2.9	0.47
31	37	169	8.8	**135**	3.7	0.61

Means: 34.7 124.3 96.0

Total No. of Observers: 75

Total No. of Observations: 1077

Table II. March Observers

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

Day	RG	S:G	Day	RG	S:G	Day	RG	S:G	Day	RG	S:G
1	7.0	8.0	**9**	6.4	4.2	**17**	6.9	7.1	**25**	7.9	7.2
2	5.6	7.3	**10**	6.8	4.0	**18**	6.7	7.8	**26**	7.6	8.0
3	8.5	5.3	**11**	7.5	4.5	**19**	6.0	6.7	**27**	8.8	7.4
4	8.7	5.4	**12**	7.4	5.0	**20**	8.5	4.7	**28**	7.5	8.0
5	7.2	5.3	**13**	7.9	5.6	**21**	9.5	4.4	**29**	8.4	7.4
6	7.9	5.8	**14**	7.8	5.0	**22**	8.1	5.1	**30**	7.9	8.2
7	7.7	5.2	**15**	7.3	6.2	**23**	9.2	6.1	**31**	8.2	10.6
8	6.6	4.9	**16**	6.8	7.2	**24**	8.8	6.7	**Mn.**	**7.6**	**6.3**

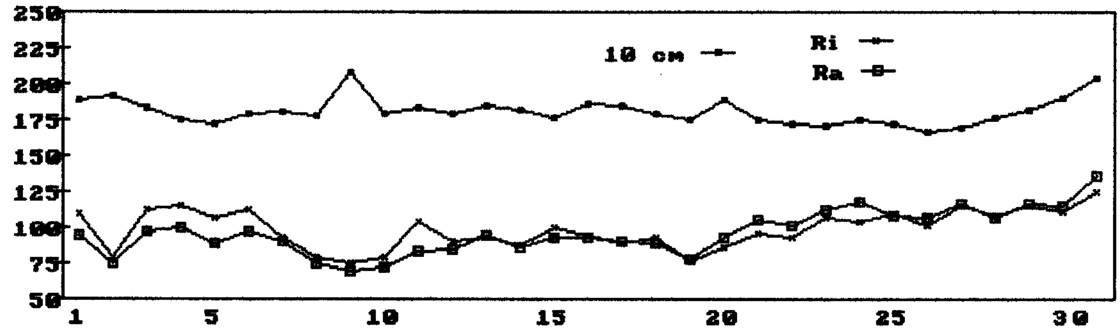


Fig. 1. 10 cm Solar Flux and Comparison of Ri (provisional) and Ra Estimates for March (r=0.823)
(Ri Source:http://sidc..oma.be/index.php3)
(!0cm Source: http://www.drao.nrc.ca/icarus)

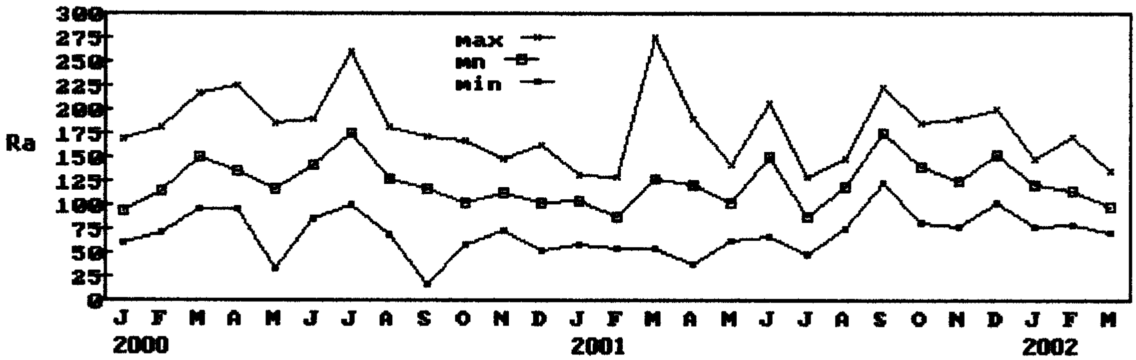


Fig. 2. Maximum, Mean, and Minimum Ra Values for Each Month from January 2000 to Present.

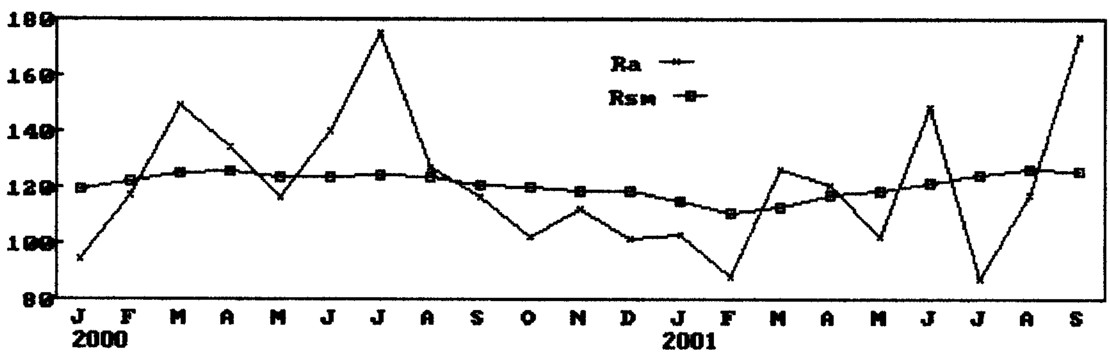
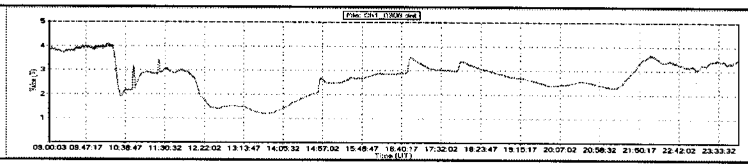


Fig. 3. Monthly Ra and Smoothed Sunspot Numbers (Waldmeier method).

Editor's Note:
This month I would like to welcome Martin Goetz (GOEM) and Edward Blankenship (BEU) to the group of AAVSO sunspot observers. Martin lives in Copenhagen, Denmark, and Edward lives in Stafford, Va.

Sudden Ionospheric Disturbance Report

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



Sudden Ionospheric Disturbances (SID) Recorded During March 2002

(Analysis performed by Michael Hill, SID Analyst)

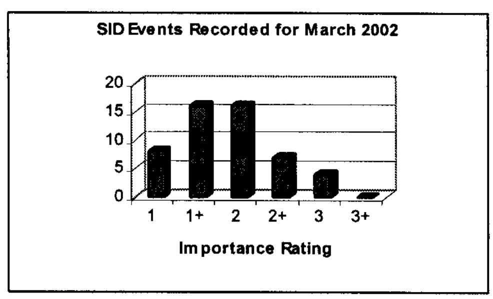
Date	Max	Imp	Date	Max	Imp	Date	Max	Imp
020301	1122	1	020312	1909	1	020328	2150	2
020301	1409	1-	020313	1027	1-	020329	0743	1
020301	1532	1-	020313	2211	2	020329	0912	1-
020301	1630	2	020314	1653	1+	020329	1135	1+
020301	1714	1	020316	1451	1+	020329	1252	2
020303	1824	2+	020317	0455	1-	020329	1923	2
020307	1355	2	020317	0540	1+	020330	0708	2
020307	1625	1-	020317	1020	2+	020330	1202	2
020307	1754	1+	020317	1437	1+	020330	1300	3
020307	2055	2+	020317	1539	2	020330	1939	1
020307	2257	2	020317	1705	2	020331	1014	1-
020308	0905	1	020317	1930	2+	020331	1101	3
020308	1113	1+	020318	1150	1+	020331	1453	1+
020308	1455	1-	020319	1145	3			
020308	1653	1+	020321	1535	2			
020308	1758	2	020322	1107	2+			
020309	0910	1-	020323	1433	2			
020309	1059	1-	020323	1918	2			
020309	1425	1	020324	1758	2+			
020309	1841	3	020325	1040	1+			
020310	0136	1-	020326	1521	2			
020310	0505	1+	020326	2003	1+			
020310	1105	1	020327	1303	1+			
020312	0837	1+	020327	2044	1+			
020312	1314	1-	020328	1803	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) Reported in at least two observer reports
2) Visually analyzed with definiteness rating = 5
3) Reported by overseas observers with high definiteness rating

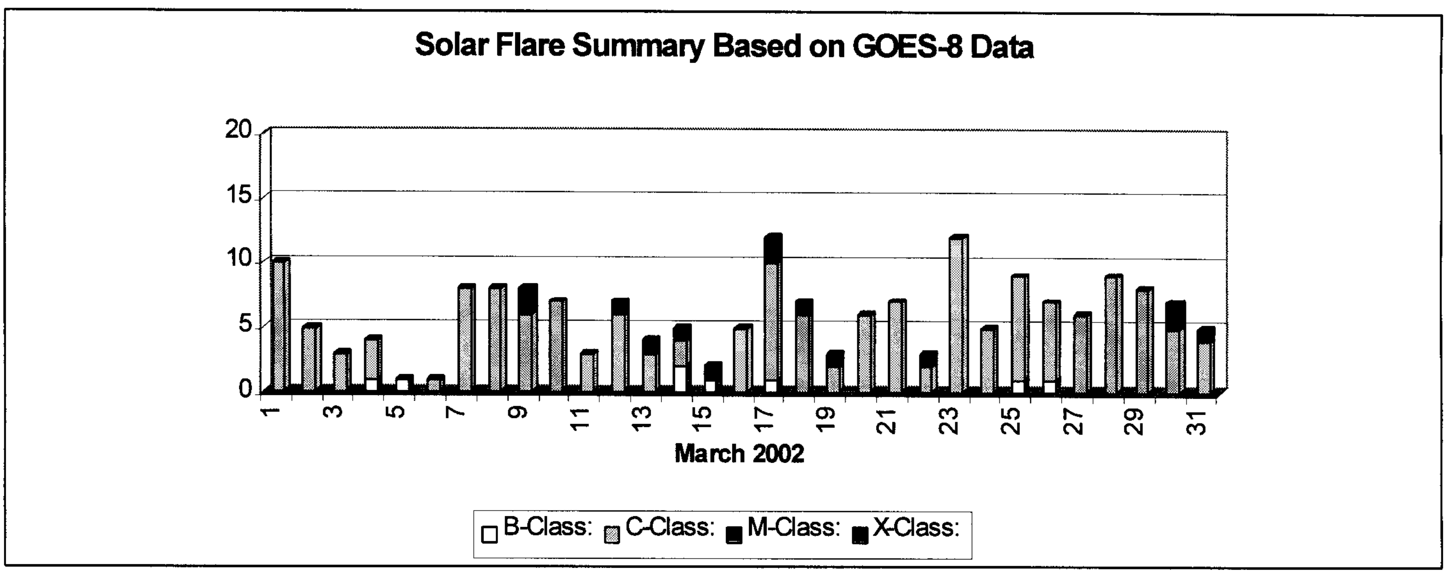
Observer	Code	Station(s) monitored
C Hossfield	A05	NAA
A Clerkin	A29	NAA
J Winkler	A50	NAA,
D Toldo	A52	NAA, NWC, XXX
J Ellerbe	A63	ICV
P King	A80	FTA
A Panzer	A83	NAA
W Moos	A84	FTA, ICV
M Hill	A87	NAA
G Difillipo	A93	HWU
T Poulos	A95	NAA
R Battaiola	A96	HWU
J Wallace	A97	NAA
NJAA	A98	NAA
M King	A99	HWU
P Campbell	A100	NLK
F Steyn	A102	NWC



Solar Events

March was a little less active than last month. Although there were quite a number of SID events recorded, most had a lower importance rating than what we saw last month. There were 186 X-Ray flares observed by the Goes-8 Satellite. Of these, there were only 13 M-Class flares and no X-Class. All others were C-Class or below. Even with so many lower class flares, observers recorded 63 SID events – a testament that we are seeing the smaller events with more regularity. Five of the events were not part of the GOES X-Ray data set. The busiest days were the 8th, the 17th and the 28th.

There were a lot of reports submitted this month. I am happy to see an increase in activity. Some of you are new and are still having troubles with the equipment, but this is to be expected in the beginning. Even if you have some off days, don't worry about it. The data you do submit is still important as part of the overall data set. Just keep at it and remember that we are all always trying to improve our sensitivity in small ways so that we can see the smaller SID events. Don't forget to take the time change this month when calculating UT times. Most of us now add 1 less hour to the local time to get UT.



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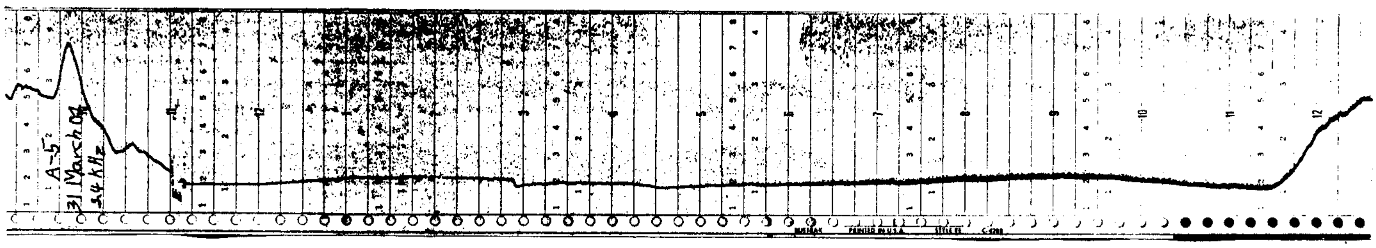
SUDDEN IONOSPHERIC DISTURBANCES SUPPLEMENT

Casper H. Hossfield, SID Sup. Editor
PO Box 23
New Milford, NY 10959, USA

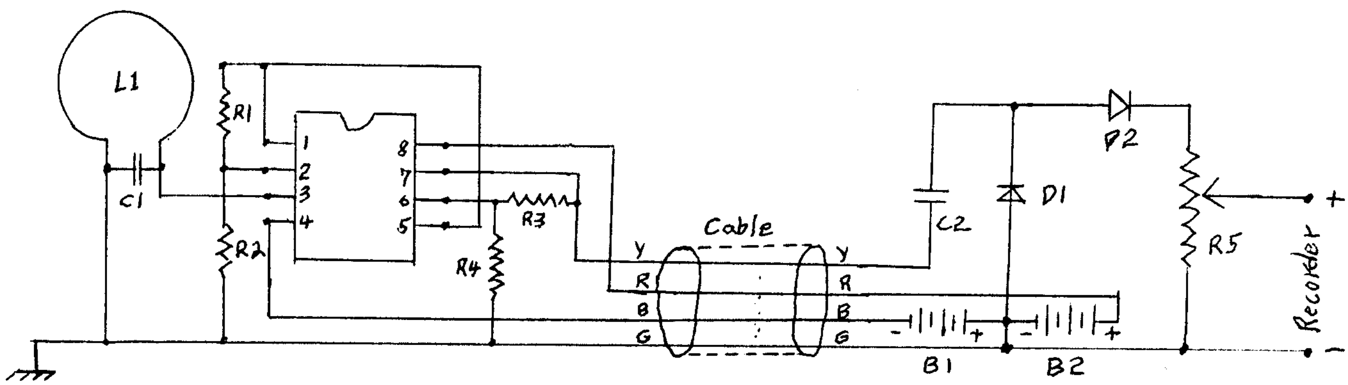
SUDDEN IONOSPHERIC DISTURBANCES RECORDED DURING MARCH 2002

capaavso@aol.com
Fax 973 853 2588
Fax 407 898 1563



A Simple, Easy-To-Build, SID (Sudden Ionospheric Disturbance) Receiver

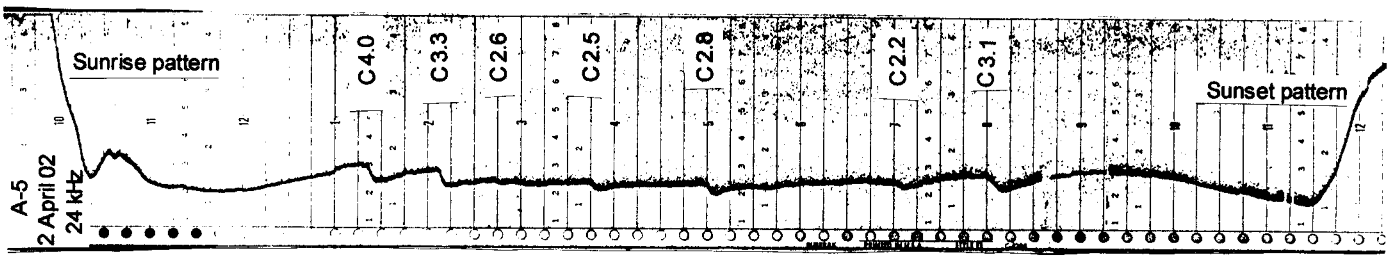
The chart above was recorded with a very simple fixed-frequency receiver and shows a small SID starting at 1452 UT on 31 March 02 recorded as an inverted SES (Sudden Enhancement of Signal). Despite the simplicity of the receiver this tiny event produced by a low energy C-5.2 x-ray solar flare is very clearly recorded and easily seen on the thin interference-free trace as a definiteness 5 event. This receiver is so simple and easy to build that most anyone could build it in one afternoon. Except for the loop antenna, you can buy all the parts to build this receiver for under US $8.00 at Radio Shack and tune it to a VLF (very low frequency) radio station and be ready to record SIDs on your computer or a strip chart recorder you can find on eBay. If you make the loop antenna from 44 feet or 13.4 meters of #18 seven-wire thermostat cable from Home Depot or any electrical supply house it will have a predictable inductance and you can tune it to any frequency you desire without the need of a signal generator or oscilloscope. Below is an easy to follow circuit diagram for the receiver that shows how to hook the loop antenna to about $8 worth of Radio Shack parts, a TL082 IC (integrated circuit), four resistors, two diodes, one capacitor, a 5000 ohm volume control and two 9-Volt batteries to make a very sensitive receiver that is complete and ready record solar flares as SIDs.



C-1	0.0022 mfd	U-1	TL082 Dual Op Amp
C-2	0.01 mfd	D-1, D-2	1N914 Diode
R-1, R-3	100 K 1/4 Watt	B-1, B-2	Snap-On Terminal 9-Volt Battery (Lasts ~ 10 Days). Replace Later With Wall-Mount-Type 12-Volt DC Power Supplies
R-2, R-4	3.3 K 1/4 Watt		
R-5	5 K linear taper	Cable	4-Wire telephone cable color coded Yellow, Red, Black, Green

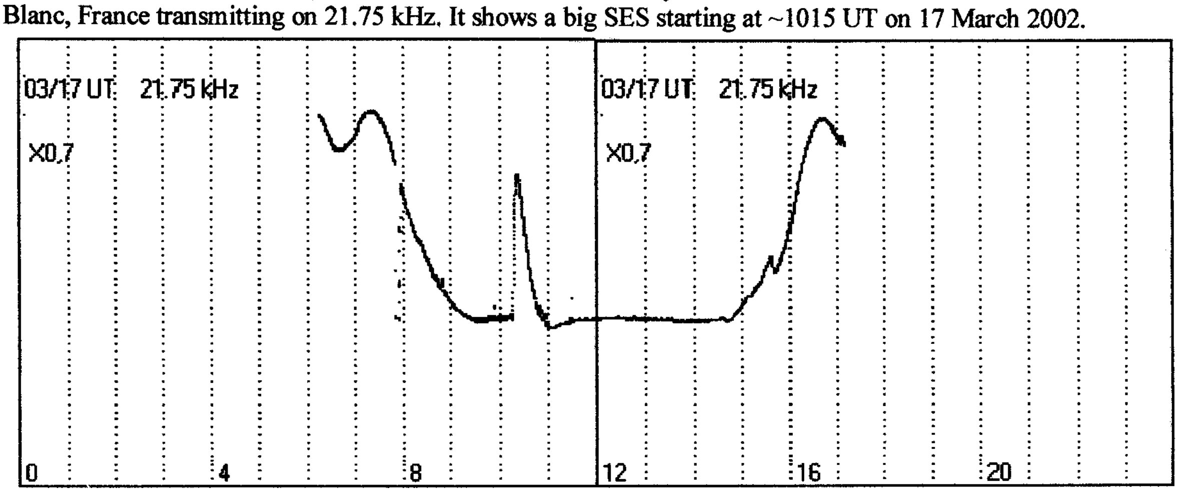
Why does this simple receiver make such nice SID recordings of tiny C-class solar flares? The reason is it has a good antenna, L-1, in the diagram above. Those of us who are ham radio operators have had it drilled into our heads from the beginning that the antenna is the most important part of a receiver or transmitter. The second most important thing is a good matched transmission line to transfer the radio energy between the antenna and the receiver. The receiver above solves this second problem by mounting the receiver right on the loop antenna so there is no transmission line and therefore no losses. The loop antenna is the receiver. It is the only LC tuned circuit in the receiver. The first requirement is met by making the loop about 1.5 meters in diameter so it has sufficient aperture to pick up a good signal. Then too, the loop is made out of # 18 wire instead of the #26 wire usually recommended so it has a high Q. Alex Stewart, VE7AKV, computed the loop's Q and had this to say: "I did a bit of math on your loop design and the Q came out in the middle 200s. You are quite right about the wire size playing a big part in the success. My wire table show #18 at 6.385 ohms/1000' while #26 is 40.81 ohms/1000'so when you toss that into the equation it makes quite a difference. My Xl came to 461 ohms and the R for 308' #18 came to 1.97 ohms versus 12.56 ohms for #26. The result was Q=234 for #18 and Q=36.7 for #26. That's quite a difference." I measured the band pass of the receiver between the 0.7 points and it is ~800 Hz. Here in Florida that is tuned sharp enough to easily separate NAA in Maine on 24 kHz from the 25.2 kHz signal from North Dakota. The azimuth angle between the two is about 70 degrees so it is not possible to null one of them without pretty much loosing both. NAA which puts in a daytime signal that measures ~2 volts on the oscilloscope is down for maintenance today and there is only a faint hint of the 25.2 kHz signal, about a tenth of a volt.

Most of the VLF receivers in use today to record SIDs by the SES method have a 10 mfd capacitor across the output to smooth the trace. What this capacitor does is smooth out low level interference and interference from lightning. My outdoor loop antenna receiver does not have a capacitor across the output. I record the rectified DC signal just as it comes from the two diodes that are a half-wave rectifier. The loop is outdoors and 27 feet (a little over 8 meters) from the house so it doesn't pick up any interference from the house's electrical wiring. It records the 24 kHz signal just the way it is sent to produce a clean smooth trace that shows tiny SESs very clearly. It does record lightning, however, but this is best left unsmoothed by a capacitor so the Rustrak's needle can return to the signal level occasionally between lightning pulses. As you can see above, this produces a clean clear edge at the bottom of the trace but fuzzy on top where the needle is often caught before it returns to the signal level. The clear bottom of the trace defines tiny SESs very nicely so there is no need for a 10 mfd capacitor across the output of this receiver. It works much better without one. A recording below has more lightning and shows this more clearly. There are six C-class events clearly enough defined to call them definiteness-five SESs. All are inverted SESs.

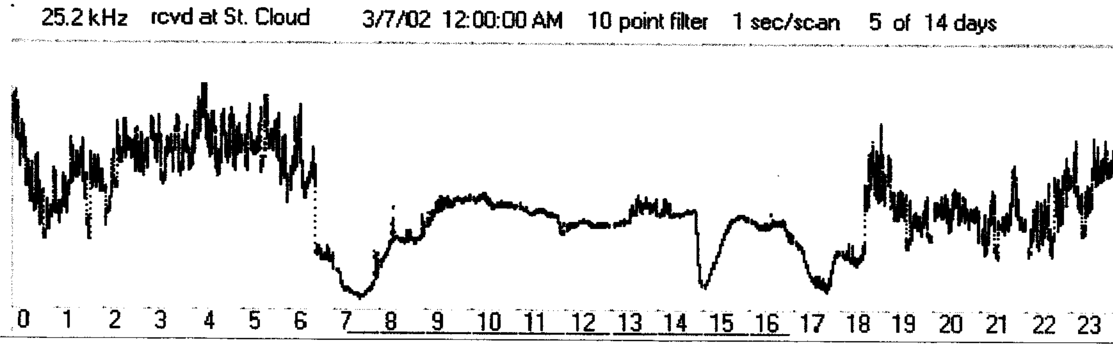


The receiver proper is mounted on the loop antenna and connected with a length of ordinary 4-wire telephone cable (from Radio Shack) to the diodes and volume control that are the recorder driver. This allows the loop antenna and receiver to be placed outdoors where it picks up less interference from electrical wiring, although it will work quite well indoors. It is important to mount the receiver in the center of the loop and bring the telephone cable out perpendicular to the plane of the loop for a distance of about 2 meters. The receiver amplifies the signal 900 X and if the cable is not brought out perpendicular it will pass too close to the loop and cause feedback and the receiver will not work. I am recording NAA in Cutler, Maine, USA from Orlando in central Florida, a distance of ~1300 miles or ~2100 km and 900X is not too much amplification for this distance. If you live closer to a strong VLF transmitter you may want to use less amplification. You can do this by changing the value of R-4 to higher values. Changing it to 4.7 K will give about 600 X total amplification. If you change it to 10K the total will be 300 X. The TL082 is a dual op amp IC and I have the two connected in tandem, each providing 30X amplification. Inputs are to the non inverting inputs in case you want to use separate individual op amps. It is important to connect the output of the loop to the high impedance non inverting input of the first op amp so the LC resonant circuit is not loaded, which would broaden its pass band response. You can only do this, however, if you use a dual power supply. If you are interested in building one of these receivers send me an email at << capaavso@aol.com >> and I'll send you some pictures showing how to make the loop antenna and set it up. The loop antenna does not have to be free and clear. It is the nature of VLF radio waves that they can penetrate salt water to communicate with submarines so the loop works very well sitting right on the ground amongst shrubbery. The loop will work quite well indoors or in the basement or very close to the house but the farther you can put it from the house and other electrical wiring the less apt it is to pick up interference.

Below is an SES recording made by Roberto Battaiola, A-96, in Italy. Roberto records the French Naval VLF station, HWU, in Le Blanc, France transmitting on 21.75 kHz. It shows a big SES starting at ~1015 UT on 17 March 2002.



Al McWilliams, A-94, Who lives in St. Cloud, Minnesota, USA made the recording below of the signal from the VLF transmitter in La Moure, North Dakota transmitting on 25.2 kHz It shows a large inverted SES reaching maximum at 1500 UT.



Jerry Winkler, A-50, in Houston, Texas, USA made the recordings below of NAA in Cutler Maine and 25.2 kHz in La Moure, North Dakota, USA. Some of Jerry's 25.2 recordings are inverted and others are normal. His recordings of NAA are almost normal