Solar Bulletin

THE AMERICAN ASSOCIATION OF VARIABLE STAR OBSERVERS - SOLAR DIVISION

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Daily Mean Sunspot Numbers for July 2000

Day	Mn. Raw Ra	s.d.	Mn. RaK	s.d.
1	174	5.5	145	3.1
2	167	5.5	146	2.9
3	153	5.6	124	4.0
4	141	5.4	113	3.3
5	160	5.5	128	3.8
6	188	9.2	153	6.1
7	194	8.4	166	5.4
8	223	8.1	181	6.1
9	237	10.6	203	5.4
10	270	11.8	221	8.1
11	258	9.4	205	6.5
12	240	8.3	199	6.1
13	236	8.4	199	6.7
14	212	10.2	178	8.1
15	193	10.0	159	8.7
16	231	9.6	186	5.4
17	262	9.2	218	6.6
18	283	11.2	236	5.0
19	315	11.6	259	7.5
20	308	11.5	258	6.9
21	285	12.6	243	8.5
22	288	10.0	234	6.4
23	243	10.4	207	6.2
24	214	8.5	183	5.3
25	203	7.5	172	4.3
26	161	5.5	139	3.6
27	160	5.9	132	3.3
28	140	5.4	115	4.1
29	136	4.6	113	2.9
30	136	5.5	110	4.3
31	118	3.9	98	2.7

Means: 210.6 **175.0**

No. of Observations: 1153 **No. of Observers: 66**

Observers

Days	ID	Name	Days	ID	Name
16	AAP	P.Abbott	18	KAPJ	J.Kaplan
4	ANDE	E.Anderson	14	KNJS	J&SKnight
22	ATON	A.Attanasio	21	LERM	M.Lerman
13	BARH	H.Barnes	21	LEVM	M.Leventhal
11	BATR	R.Battiola	16	LIZT	T.Lizak
12	BEB	R.Berg	9	LUBT	T.Lubbers
11	BERJ	J.Berdejo	23	MALK	K.Malde
5	BLAJ	J.Blackwell	13	MARE	E.Mariani
21	BMF	M.Boshcat	25	MCE	E.Mochizuki
18	BOSB	B.Biswajit	21	MMI	M.Moeller
31	BRAR	R.Branch	13	MUDG	G.Mudry
25	BROB	B.Brown	5	NYLH	H.Nylander
31	CHAG	A.Chavez	16	OBSO	IPS Obs.
21	CKB	B.Cudnick	18	PENG	G.Pennington
8	CLZ	C.Laurent	3	RADS	S.Radabah
11	COLB	B.Collins	1	RANT	T.Randall
23	COMT	T.Compton	16	RICE	E.Richardson
31	CORA	A.Coroas	25	RITA	A.Ritchie
28	CR	T.Cragg	23	SCGL	G.Scholl
6	DEMF	F.Dempsey	11	SCHG	G.Schott
19	DRAJ	J.Dragesco	9	SIMC	C.Simpson
31	ELR	E.Reed	23	STEF	G.Stefanopoulis
21	FEEC	C.Feehrer	16	STEM	G.Stemmler
26	FLET	T.Fleming	31	STQ	N.Stoikidis
23	FUJK	K.Fujimori	25	SUZM	M.Suzuki
26	GIOR	R.Giovannoni	15	SZAK	K.Szatkowski
8	GOTS	S.Gottschalk	26	TESD	D.Teske
6	HALB	B.Halls	17	THR	R.Thompson
10	HAYK	K.Hay	21	URBP	P.Urbanksi
10	HRUT	T.Hrutkay	9	VALD	D.delValle
24	JAMD	D.James	17	VARG	A.Vargas
19	JENJ	J.Jenkins	25	WILW	W.Wilson
5	JENS	S.Jenner	31	YESH	H.Yesilyaprak

Reporting Addresses

Sunspot Reports:

email: solar@aavso.org

[postal mail]: AAVSO. 25 Birch St., Cambridge, MA 02138

SES Reports:

email: noatak@aol.com

postal mail: Mike Hill, 114 Prospect St., Marlboro, MA 01752

Magnetometer Reports:

postal mail: Casper Hossfield, PO Box 23, New Milford, NY 10959

FAX: (958) 853-2588

Smoothed Mean Sunspot Number (Rsm) for January 2000: 118.4

Means of Group Counts Reported by Sunspot Observers in July, 2000

Day	Mn. Grps.	Day	Mn. Grps.	Day	Mn. Grps.	Day	Mn.Grps.
1	11.8	**9**	11.2	**17**	14.5	**25**	10.9
2	10.9	**10**	12.7	**18**	14.7	**26**	10.1
3	10.4	**11**	12.8	**19**	16.5	**27**	11.3
4	8.8	**12**	12.3	**20**	14.8	**28**	10.2
5	9.6	**13**	11.8	**21**	14.2	**29**	10.0
6	9.6	**14**	10.6	**22**	14.4	**30**	10.0
7	9.9	**15**	8.9	**23**	12.3	**31**	8.5
8	10.4	**16**	5.4	**24**	10.6		

Editor's Notes

FAX Number Error in the June Bulletin

The AAVSO FAX number printed in last month's Bulletin (v. 56, 6) is incorrect. The correct number appears on the front of this issue. Fortunately, FAXs that were sent were intercepted by a second machine, but we believe that at least one report was lost before the error was discovered. Please check the list of contributors. If your name does not appear and you FAXed your report by the 10th of the month, please send another copy.

Analysis of SID Reports

As indicated in last month's Bulletin, Mike Hill (A87) has volunteered to analyze the monthly contributions from SID observers. His analysis of the July data accompanies this issue. Mike has also begun a review and analysis of the backlog of reports that developed when the services of our previous analyst were lost. Although the results of these earlier reports will not appear in the Bulletin, they will be posted to the website in accord with earlier practice, and observers will be given credit for their work.

Website Version of Reporting Form

Judging from the reports received at the end of July, a number of observers have tried the text-version of the reporting form that is now on the AAVSO/Solar Division website and that was discussed in last month's Bulletin. The appearance of those reports as received at AAVSO is excellent, and most passed through our analysis programs without incident. Thanks so much for enlisting in this experiment!

I want to encourage as many observers as possible to use either this form or the SUNKEY.exe program. Either of these approaches greatly reduces the recoding job and the likelihood of error that it can entail.

Two additional points need to be made in regard to use of the text form:

1) Please do not enter the date of a day in which no observation was made. The processing software requires that only days for which data were collected appear in the report. If observations were made on days 1, 2, 3, 27, and 28, but not on days intervening between 3 and 27 and not on days after 28, the report should contain only 5 lines.

2) Observer IDs must be entered as upper case letters and properly aligned in the | | field.

Finally, I want to emphasize that this version of the text form is only an intermediate step. I hope to replace it soon with a version that can easily be completed online or after downloading and that can then be sent as a simple email message. This should make things easier for everyone.

Feedback on Estimation of Group Means
I have occasionally wished that I could compare the group estimates I make each day with the estimates other observers make, particularly since these weigh so heavily in the final Wolf value. On the assumption that others might share that wish, a program has been written that accumulates and averages the estimates of groups reported by observers for each day of the month. The outputs of the program for July are presented in the table above. If you find this feedback helpful, please let me know, and updated versions will continue to be published in future issues.

If you compare your results with the tabled values, it is *extremely* important to bear in mind that these values are simply raw averages. They represent an unadjusted measure of the central tendencies of distributions of reports made by observers of varying skill levels across a range of seeing conditions at different times of day.

Given those considerations, an observer should *not* attempt to scale his/her estimates over time on the basis of comparisons with the averages. What you see is what *you* see! If you are using an appropriate aperture (50mm-80mm), if you are following the *three step procedure* of scanning at 40x-50x, 60x-80x, and, weather conditions permitting, 80x-100x, and if you are counting everything that you see and evaluating it properly, then your estimate is "correct", given your observing conditions. (Note that the same caution should be observed in comparing your results with those found on various Internet sites since these may be obtained with equipment and procedures quite different from yours.)

Gyrator II Schematics and Related Equipment
A number of requests have been received in the last few months for information on the design of the Gyrator II circuit, the A-D converter, and the antenna. In order to make this information available to both current and potential members of our organization and to reduce the costs of reproduction and mailing, appropriate pages from the SID Technical Bulletins and Solar Bulletins will be posted on the AAVSO/Solar website and can be downloaded from there. Plans for the receiver circuit will appear by the end of August and will be followed by the converter and antenna articles. If you are unable to acquire the information in this way, please notify me and I will arrange to have it sent via regular mail.

Scanned images of the circuits and accompanying text--as well as other documents relating to Solar Division activities--can be found on the website by completing the following procedure:

Go to the AAVSO homepage:

http://www.aavso.org

Click on *Observing Programs*. Scroll down to and click on *Solar Division*. Click on *Gyrator II - An Improved Gyrator Tuned VLF Receiver*.

In this regard, I would like to thank Art Stokes, the designer of the receiver, for his willingness to help those who are constructing and tuning SIDs equipment. Art can be contacted at the following email address:

astokes@gwis.com

Solar Filter Review
The September issue of *Sky and Telescope* (Sky Publishing, Inc.) contains an article on the *Baader Astro-Solar Safety Film* filter material that may be of interest to observers.

Clear Skies
-CEF

Solar Events

The AAVSO has a new SID Analyst !

Hello All . . . I would like to introduce myself as the new SID Analyst. My name is Mike Hill or A87 as I am known to the systems that process our data.

I have been interested in watching the sun for over 25 years since I built my first telescope and projected images of the sun onto a white cardboard screen. Watching sunspots come and go proved fascinating.

Twelve years later, as part of one of my college courses, I did a research paper on the solar-terresrial connection and the status of theoretical understanding of the mechanisms that serve to propogate the solar forces and materials into our atmoshpere. The status in 1987 was one of confusion, and the concencuss was that there was much work to be done. Since then, the scientific community has sent an arsenal of instruments around the sun, the earth, and the space in between to scrutinize the entire path of the energy that pours forth in immense quantities from the sun, and so deliberately affects our very life here on earth. The idea of this connection once again proved fascinating to me . . .

It was with great pleasure, therefore, after years of watching the surface of the sun, that I came upon the SID Monitoring program in Peter Taylors wonderfull book called "Ovserving the Sun" and I knew immediately that this was for me. For I would not only be monitoring the sun, I would be monitoring one of the local environments it directly affects. The solar-terrestial connection, for me personally, had been made!

My passion for astronomy has followed many trails over the years, but always back to the sun. I have built three telescopes and a Stellafane Award Winning spectrohelioscope. (See the site "www.stellafane.com".) I built my first Gyrator in 1996 which was followed by a dual gyrator of which so far only one channel is operational. I enjoyed working under the watch of Jospeh Lawerence. He was very helpful to me and has been very beneficial to the SID program as a whole. His efforts have set a solid foundation from which the program can proceed, and I am very pleased to be the new SID analyst in his wake. With what capacity I can do so outside of my other responsibilities, I hope to bring energy and longevity to this position.

I have limited electronics background but found building VLF hardware rather understandable. I couldn't design the stuff though – we'll leave that to the engineers among us. I do some software work and plan on automating as much of the analysis as possible. As is always the case with data processing software, however, the data format is key. So, I am going to be pushing for all of you to submit data according to a certain set of formats. For those who cannot, I am working on ways to automate conversion functions as well. I will talk more of this as time goes on. For now just keep sending your data, preferably directly to me, and we will keep contributing to the ocean of data that is currently being collected to finally understand the complex and powerfull solar-terrestrial mechanisms taking place. Our data might just prove helpful to someone pursuing a line of investigation that leads to an important discovery.

An Active Month

July was an active month. Most notable was the 10-12th period which sported 17 M-class flares and 2 X-class. This all culminated in a very severe solar storm commencing on the 14th. Although both X –class flares were detected, only 7 of 17 of the M-class were reported by SID observers. The 18th-20th time frame was also very active. Observers reported 3 of 6 M-class flares and 7 of the 20 C class flares. All of the C-class flares were above a level of about C4.0

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SUDDEN IONOSPHERIC DISTURBANCES SUPPLEMENT

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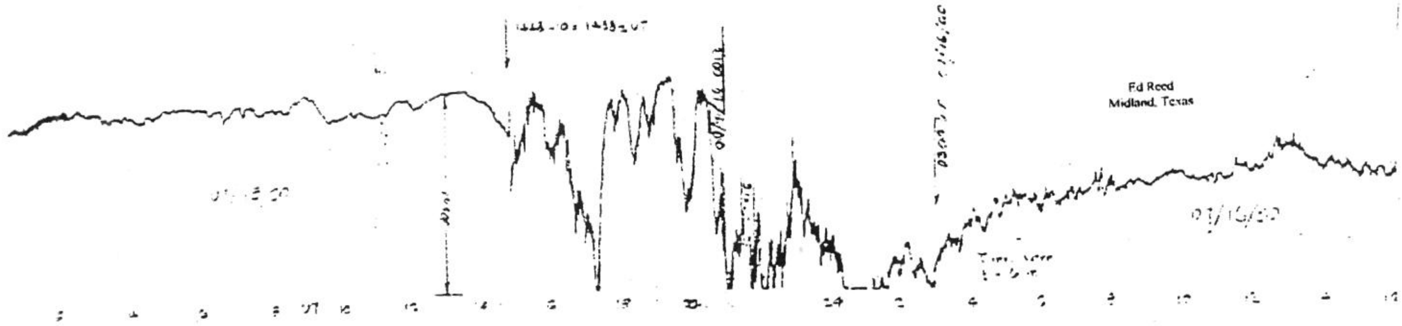
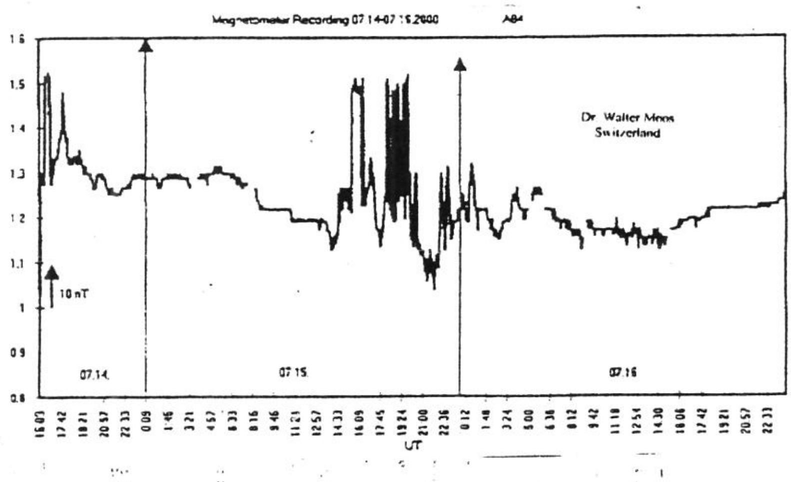
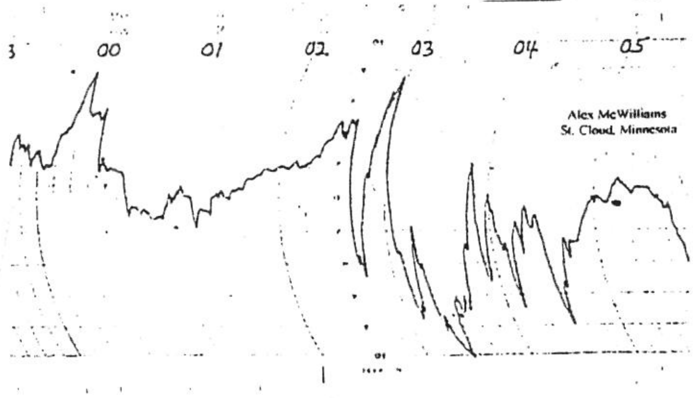
SUDDEN IONOSPHERIC DISTURBANCES RECORDED DURING JULY, 2000

Two previous issues of the Solar Bulletin described how an amateur can build a homemade fluxgate magnetmeter. The basic magnetometer was described in the May issue and an integrator to inhance its performance and make it into a professional observatory type instrument was described in the June issue. In this July issue Jack Janicke, author of "the Magnetic Measurements Handbook", describes how to make your own fluxgate from a US$4.00kit he has kindly made available for amateurs who like to build their own scientific instruments. The kit comes with four pages of complete instructions how to build your own fluxgate with two strips of Permaloy 80 that come with the kit. Jack has annealed these strips in a hydrogen atmosphere for maximum performance. Everything you need to know to build a fluxgate is right there in the four pages of instructions. There are complete details how to make the coil forms and how to wind the coils and test them. You can order the kit by email << magres@webspan.net >> or write to Jack at 122 Bellevue Avenue, Butler, NJ 07405 USA. The $4.00 kit includes shipping and handling. For about US$35.00 you can build a professional quality, observatory type magnetometer, that will make recordings of magnetic storms that are hard to tell apart from those made by a nearby US Geological Survey magnetic observatory.

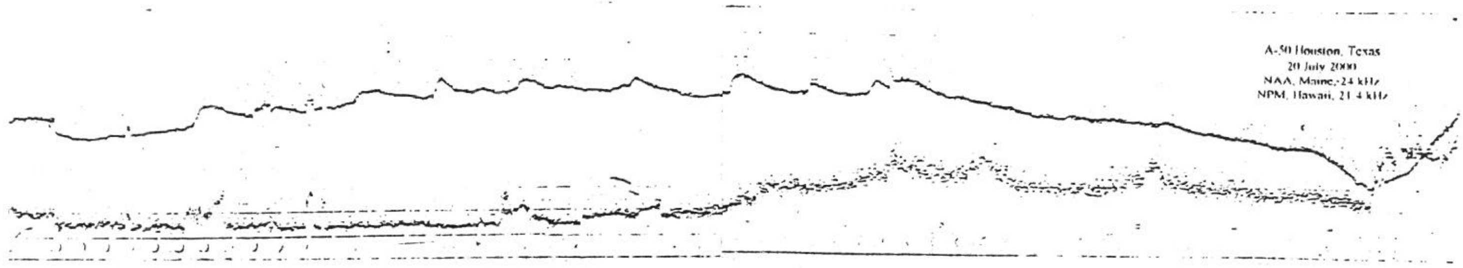
Below are magnetograms of a magnetic storm that started with a sudden impulse at about 1438 UT on 15 July and ended about 14 hours later near 0400 UT on 16 July. The recordings were made by Ed Reed in Midland Texas, Dr. Walter Moos, A-84, in Switzerland and Alex McWilliams in St. Cloud, Minnesota.

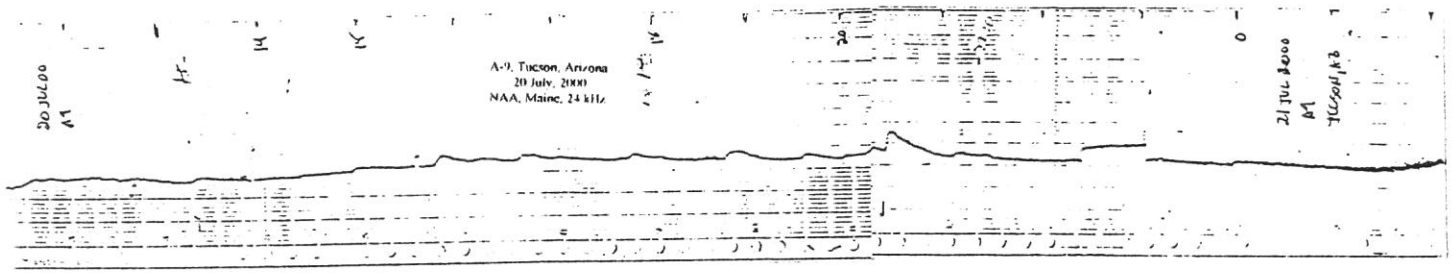


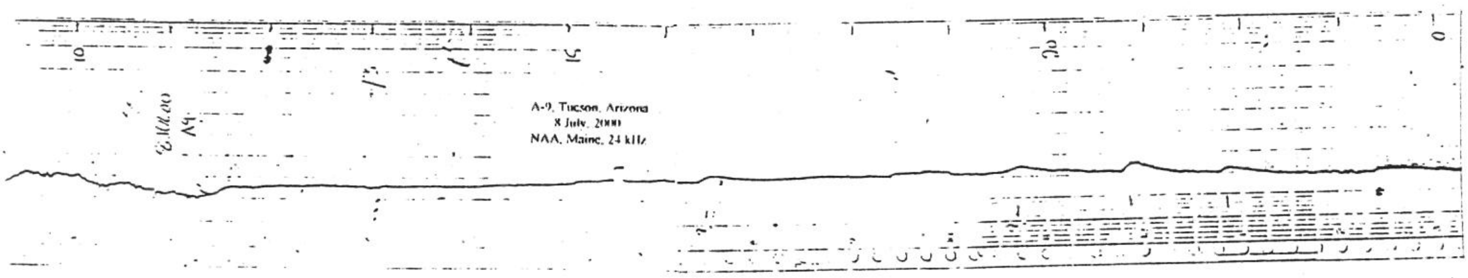


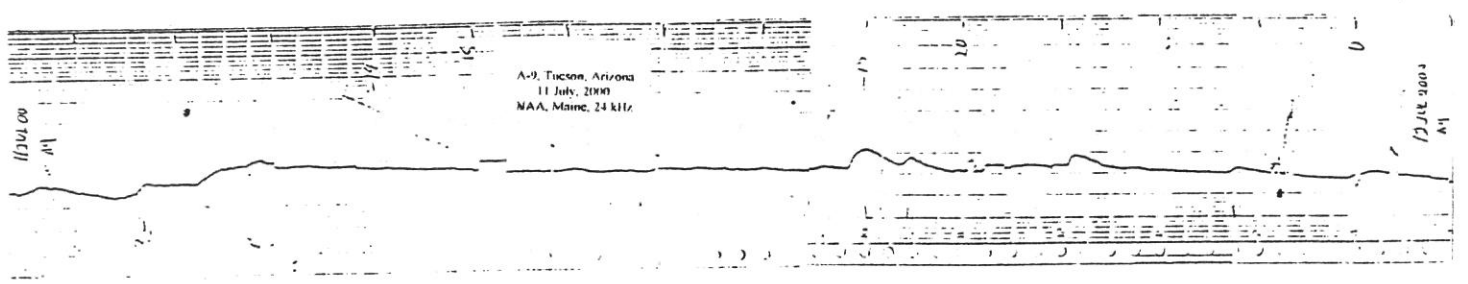


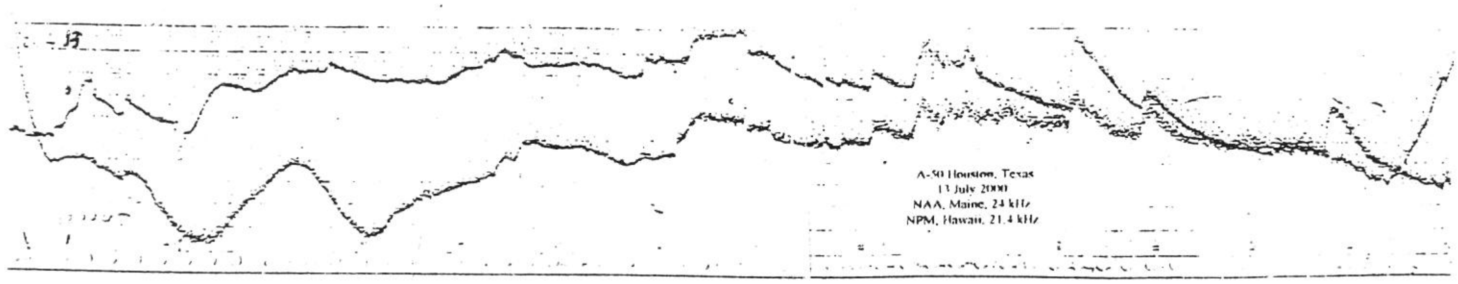
Below are recordings of solar flares detected as sudden enhancements of the signal (SES) from Very Low frequency (VLF) radio stations, NAA in Cutler, Maine, USA and NPM in Hawaii. These powerful 1-megawatt US Navy transmitters operating on frequencies of 24 and 21.4 kHz communicate with submerged submarines. Their signals are propagated in the wave-guide mode by the D-layer of the lower ionosphere which is maintained in an ionized state by ultra violate radiation from the sun. X-rays from solar flares enhance the ionization of the D-layer making it a better wave guide thereby increasing the signal strength of NAA and NPM in a few minutes. The strip chart recordings, which are made with homemade VLF radio receivers, show these sudden increases which decay more slowly as the free electrons recombine and the level of ionization returns to the normal level maintained by the Sun during the day. Charts reproduced below were recorded by Werner Scharlach, A-9, in Tucson Arizona, USA and Jerry Winkler, A-50, in Houston, Texas, USA. The multiplexed charts that record two signals, NAA and NPM, are by A-50. The charts that record a single signal, NAA, are by A-9.











Low-Cost Strip Type Second Harmonic Fluxgate Sensor

The basic theory of operation of the strip type fluxgate sensor is described on page 22 of the *Magnetic Measurements Handbook.* It is designated as a *second harmonic* type because the emf developed in its secondary, due to the ambient magnetic field that it senses, will have a frequency twice that of the signal used to drive its Permalloy cores into magnetic saturation. The cores supplied for use with this sensor are hydrogen annealed Permalloy 80 material and are classified as a *soft* magnetic material because, although it has a very high magnetic permeability, it will not retain any magnetism after being exposed to normal ambient magnetic fields – field strengths on the order of five or ten oersteds. Stressing, bending or cutting the material will cause a change in it and will result in the stressed area becoming magnetically *hard* to some extent and destroy its capability to operate as a high quality fluxgate sensor.

The Permalloy strips supplied are .003" thick x .125" wide by 1.75" long. The sensor described is designed to operate in conjunction with the Model FGM-550 Magnetometer circuit described in the *Magnetic Measurements Handbook.* Although the strip sensor is a very usable fluxgate it does not have the core physical protection, operational linearity and small size of the Type FM- - - ring-core sensors normally used with that magnetometer. The object of this paper is to enable the technician or engineer to build a fluxgate sensor from basic components and to thus acquire a full understanding of the operation of this magnetic sensor. Mechanical parts – aside from the Permalloy strips – are fabricated from materials readily at hand.

Primary Coil Forms

The forms used for the primary windings and for containing the Permalloy strips are fabricated from standard, high quality 20 lb. writing paper. Two rectangles of paper 2 inches wide by approximately 2-1/4 inches long are required . A mandrel, fabricated from steel, fiberglass, copper brass or aluminum is required; the material should be .030" thick, .130" wide and about 4" long. The edges of the mandrel should be chamfered smooth. It is also advised that the mandrel be slightly tapered along its length because it must be withdrawn from the coil form after the wrapping of the form is completed.

The mandrel is placed at one end of a paper rectangle, across the 2" dimension. The paper is then wrapped about the mandrel for a total of five wraps. And adhesive must be used to enable the wrapped form to retain its shape prior to applying the copper wire windings. Glue can be used, but problems can arise in keeping the wrappings tight while the adhesive dries. A better approach is to use double-sided sticky tape. The tape should be applied to the paper when the wrapping is about two thirds complete. Thus, when the final wrap (the fifth) is made the form will be self sustaining.

The primary winding should be applied while the mandrel is still in place on the form. It is made from #28 insulated copper wire. The insulation should be one of the "solderable" types; i.e., Nypoly, Soldereze, etc. A single layer consisting of 132 turns of wire should be wound on each form. The coil on each form should be well centered. Starting the winding about 1/8" from one end will provide the proper centering. Important! the start end of the windings should be marked – tying a knot at the end of the wire will suffice. About three inches of wire should be left on each end of the coil. Polystyrene coil dope or Ambroid or Duco cement should be applied to the winding and allowed to dry.

Important! each of the two coils should be wound in opposite directions.; i.e. rotate one coil form in a clockwise direction and the other in a counter-clockwise direction while winding. The coils may be easily hand-wound – the tension exerted will provide a winding snugly fitted to the rectangular, though somewhat oblong, cross section of the form. After the coil cement dries each coil should be wrapped with one layer of insulating tape; 2 mil thick Mylar tape will do nicely. A strip of 3/4" wide tape cut to a length of 1-3/4" and wrapped lengthwise (similar to the way that the form was wrapped about the mandrel) will provide adequate protection to the winding.

When both coils are complete they should be placed next to each other with a flat side of one coil facing a flat side of the other coil. Important! the ends of the coils should match to each other with the start (knot) end of each coil next to each other. A small amount of cement should be applied to insure that the primaries retain their positions. The finsh wire ends of each coil should be cut to a length of about 3/4" and soldered to each other.

Secondary Winding

The secondary coil from is made from a short length of 9/32" diameter plastic soda straw 1-7/8" long. Any similar, thin-walled material may be used as an alternate. The secondary is wound from #38 solderable insulated copper wire. Approximately 570 turns of wire should be wound, in a two layers, starting approximately 1/8" from one end of the form. When completed, the coil should be coated with coil dope, Ambroid or Duco cement. Each of the coil lead wires should be trimmed to a length of about 2 inches. The coil can be covered with a layer of Mylar tape if additional protection of the winding is desired.

Primary/Secondary Assembly

The primary assembly should now be inserted into the secondary coil form. This may be a snug fit, depending on the buildup of the primary windings and insulation. The primary assembly should be inserted so that its two leads and the two secondary leads all exit from the same end of the completed assembly. The primary should be inserted sufficiently so that each end extends about 1/16" beyond the secondary coil form.; i.e. centered lengthwise in the secondary.

The Permalloy strips are inserted into the primary coil forms after the assembly is completed. Care must be taken not to bend or crimp the strips. Each strip should be centered in its respective form. A small amount of coil cement should be inserted into one end of each primary form to enable holding its strip securely in place. Do not cement both ends. After the assembly is completed the sensor should be cemented to a wooden or plastic base. Base dimensions are not critical; a recommended size is a strip 1/4" thick x 3/4" wide by about 3-1/4" long. Four copper terminals should be inserted in one end of the base. They may consist of pieces of copper buss bar wire – #20 size wire is satisfactory. Small holes can be drilled into the base and the buss wires, one half or three quarters of an inch long will do, should be forced into the holes. The buss "pins" should be located on the base adjacent to the exiting ends of the sensor leads. The four leads, two primary and two secondary, should be soldered to the pins.

The connecting cable can be fabricated from #24 or #26 vinyl insulated, stranded wire. It should consist of two pairs – one pair for the primary or drive winding and one pair for the secondary or signal winding. Each pair should be individually transposed. An electric drill or a mechanical hand drill can be used to twist the wires. The two twisted cables should then be routed through a piece of vinyl tubing. The length of the cable is not critical; a length of three to five feet is generally satisfactory.

One end of the cable is soldered to the sensor assembly pin connectors and the other end to the appropriate connections in the FGM-550 Magnetometer (see schematic diagram in the Handbook). The cable body should be fastened to the sensor base by means of a plastic cable clamp. Be certain that any hardware holding the clamp to the base is not ferrous. Brass hardware is recommended, but do not use nickel plated brass.

Changes to The Model FGM-550 Circuit

Several component values in the Model FGM-550 circuit must be changed to adapt it to the strip type sensor. The drive frequency must be adjusted to 3 kHz. The capacitor, C1 and the resistors, R1, R2 and R3 values must be changed. See Equation 20 on page 102 of the *Magnetic Measurements Handbook* for determining the general values of these components. Another change is the value of the impedance matching capacitor, C4. This should have a value of 2 uF. A polyester or similar type having a rating of 50 or 100 volts will be satisfactory.

The strip type sensor has a relatively high ac output; on the order 1 volt/oersted. Thus, the amplifier gain setting resistors, R12 and R13 should have a total combined resistance of about 20,000 ohms, consisting of a cermet trimpot (R12) of 10,000 ohms and an appropriate fixed resistor (R13). It will be found that an amplifier gain of about 1.4 is required, indicating a feedback resistance value of 14,000 ohms.

The resonating capacitor for the "tuning" the sensor secondary (C5) will have a value of about 0.14 uF. This can be adjusted for optimum performance of the sensor.

Operational Checks

The "noise" figure of the strip sensor will be found to have a much higher value than that of a ring core sensor. The noise is a combination of fundamental (3 kHz) and odd harmonic frequencies. In the ring core sensors this is limited to a value of about 3 mV, but the strip sensor may have a noise value of a few hundred millivolts. In the ring core sensor, balance between primary winding(s) and between the primary and secondary can be easily and accurately adjusted, resulting in a very low noise level. Balancing this strip sensor would require expertise acquired only through extensive experience with fabricating this type sensor. This so-called noise is the ac emf generated in the sensor secondary when its sense axis is oriented for zero field (East-West). Fortunately the Model FGM-550 synchronous detector is a very excellent discriminator against signals other than the second harmonic of the drive frequency, thus the residual noise is really of little consequence.

The sense axis of the strip sensor is along the longitudinal axis of its primary and secondary coils. The sensor/magnetometer circuit should be calibrated and adjusted using a Helmholtz Coil or Calibrating solenoid, as described in the *Magnetic Measurements Handbook*. It will be found that the sensor is quite linear (to within 0.1% or 0.2%) up to a value of 0.7 oersted and linear to within 2% at a field intensity of 1 oersted.

Jack M. Janicke
Magnetic Research, Inc. Butler NJ 07405

Waveform across Resistor R6

Figure 1.

The waveform of the current across resistor R6 in Figure 45 of the Magnetic Measurements Handbook will not have the sharp spike attributes that are indicated in Figure 16, page 36 of the Handbook. This is because the strip sensor has an air gap in its magnetic circuit, whereas the ring core type sensor is a magnetically closed circuit.

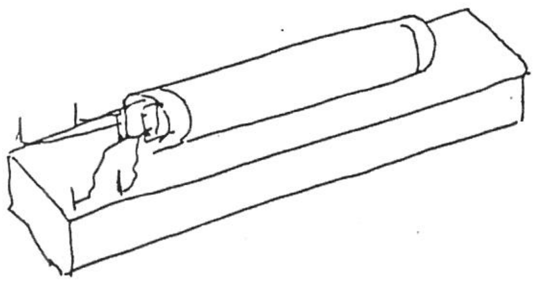


Figure 2.

Sketch of the completed strip core fluxgate sensor assembly