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
FAX(AAVSO): (617) 354-0655

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Volume 56 Number 6 June 2000

Daily Mean Sunspot Numbers for June 2000

Day	Mn. Raw Ra	s.d.	Mn. RaK	s.d.
1	109	5.2	91	4.1
2	103	4.9	88	4.3
3	99	4.5	84	3.3
4	105	5.6	89	4.2
5	126	4.8	109	3.9
6	139	5.3	125	4.4
7	140	6.2	124	4.9
8	159	6.4	140	5.1
9	155	7.1	131	6.0
10	157	8.9	129	6.4
11	200	11.0	160	8.5
12	197	12.1	173	8.3
13	208	8.8	188	6.7
14	219	10.6	189	7.4
15	204	8.1	177	5.7
16	184	8.2	164	5.8
17	183	8.7	157	6.3
18	189	7.1	165	4.3
19	183	9.1	165	5.3
20	207	9.3	169	6.4
21	177	8.2	140	6.0
22	172	6.0	144	4.1
23	168	4.5	147	3.4
24	162	6.9	142	4.7
25	159	5.4	135	3.6
26	173	7.6	142	4.4
27	167	7.4	141	5.0
28	150	5.8	127	4.7
29	157	6.4	127	4.8
30	159	6.0	133	3.6
31	---	---	---	---

Means: 163.6 139.8

No. of Observations: 1045

Days	ID	Name	Days	ID	Name
14	AAP	A.Abbott	9	LERM	M.Lerman
4	ANDE	E.Anderson	19	LEVM	M.Leventhal
19	ATON	A.Attanasio	17	LIZT	T.Lizak
10	BARH	H.Barnes	10	LUBT	T.Lubbers
15	BATR	R.Battaiola	5	LWT	T.Lohvinenko
14	BEB	R.Berg	25	MALK	K.Malde
8	BLAJ	J.Blackwell	12	MARE	E.Mariani
17	BMF	M.Boschat	29	MARJ	J.Maranon
22	BOSB	B.Bose	17	MCE	E.Mochizuki
26	BRAB	B.Branchett	8	MILJ	J.Miller
14	BRAD	D.Branchett	12	MMI	M.Moeller
25	BROB	R.Brown	10	MUDG	G.Mudry
19	CARJ	J.Carlson	15	OBSO	IPS Radio Obs.
26	CHAG	G.Morales	12	RICE	E.Richardson
21	CKB	B.Cudnick	26	RITA	A.Ritchie
10	CLZ	C.Laurent	27	SCGL	G.Schott
15	COLB	B.Collins	10	SCHG	G.Scholl
24	CR	T.Cragg	10	SIMC	C.Simpson
9	DEMF	F.Dempsey	8	STEF	G.Stefanopoulis
24	DRAJ	J.Dragesco	28	STQ	N.Stoikidis
27	DUBF	F.Dubois	15	SZAK	K.Szatkowski
27	ELR	E.Reed	19	THR	R.Thompson
7	FEEC	C.Feehrer	28	URBP	P.Urbanski
26	FLET	T.Fleming	19	VALD	D.Del Valle
15	FUJK	K.Fujimori	10	VARG	A.Vargas
23	GIOR	R.Giovanoni	18	WILW	W.Wilson
9	GOTS	S.Gottschalk	13	WITL	L.Witkowski
10	HAYK	K.Hay	28	YESH	H.Yesilyaprak
14	HRUT	T.Hrutkay			
18	IBRA	A.Ibrahim			
23	JAMD	D.James			
8	JEFT	T.Jeffries			
13	JENJ	J.Jenkins			
18	KAPJ	J.Kaplan			
12	KNJS	J&S Knight			

No. of Observers: 63

New Reporting Addresses (see Ed. Notes):

Sunspot Reports:

email: solar@aavso.org

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

SID Reports:

email: noatak@aol.com

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

Mean k-corrected (RaK) and Smoothed Mean (Rsm) Values of the American Relative Sunspot Number (Rev. 2)

	Mn. RaK		Rsm
Oct 1996	1.4		8.5
Nov	16.1		9.4
Dec	12.0		10.0
Jan 1997	5.5		10.1
Feb	7.9		10.4
Mar	7.9		12.6
Apr	15.3		15.2
May	17.8		17.0
Jun	13.8		19.0
Jul	7.7		21.2
Aug	22.8		23.4
Sep	43.9		26.6
Oct	22.6		30.1
Nov	37.7		33.0
Dec	38.9		36.5
Jan 1998	31.1		40.9
Feb	34.8		46.1
Mar	57.8		50.8
Apr	49.0		53.9
May	54.7		56.3
Jun	60.4		59.6
Jul	66.1		62.8
Aug	88.5		65.3
Sep	92.3		67.0
Oct	48.9		68.0
Nov	68.8		70.7
Dec	86.4		76.0
Jan 1999	59.6		81.8
Feb	67.0		84.6
Mar	66.6		84.3
Apr	65.2		86.8
May	101.6		92.9
Jun	142.1		96.0
Jul	122.9		97.4
Aug	98.0		100.8
Sep	77.5		106.1
Oct	121.8		112.4
Nov	143.0		115.8
Dec	86.5		116.3

Editor's Notes

New Email Address for Sunspot Reports

In an effort to assure that all reports sent via email are included in the monthly processing (see *Missing Data and Bulletin Errors* in the paragraph below), the file transfer and processing arrangements for emailed solar data at AAVSO has been revised. Beginning with the July report, please send your email sunspot reports to the address printed on the front of this issue.

If you would like to receive notification via email each month that your report was received, please let me know at my hotmail address. As before, Observers who send their reports via postal mail should continue to send them to the regular AAVSO address.

To avoid possible duplication or loss, please do not send reports to my hotmail address or to my residence. Use that address for comments, suggestions and other concerns.

SID Analyst Found

I'm pleased to report that Mike Hill (A87) has volunteered to take on the task of analyzing the monthly SID data. Mike has contributed to the SID program for several years, has built his own receiving equipment, and is very familiar with the analysis of SID recordings. I think I speak for all of us who record SIDs in thanking him for aiding in the continuation of this interesting program.

Mike expects to begin his analyses with the July data--an exciting time to start, given the significant amount of flare activity on the sun at this time--and to make his first report in the Bulletin to be published in mid-August. Please send your SID data to the appropriate address printed on the front of this issue.

Missing Data and Bulletin Errors

Two items here:

(1) Several observers have notified me that their (emailed) reports were not included in the monthly compilations, even though the reports had been mailed early enough to be received by the 10th of the month. In each instance, I was able to locate the missing report and verify that it was mailed on time. All observers who filed reports during these months have now received credit for their contributions.

I've been told that this problem has occurred from time to time in past years and have now taken steps to try to eliminate it (see *New Email Address for Solar Reports* above). Please review the list of contributors each month. If your name does not appear and you believe that you posted your report in time for it to arrive by the 10th-of-the-month deadline, please advise me of that at my hotmail address. I will then check at headquarters and, if I don't find your report, will request that you send a copy.

(2) Shortly after the May Bulletin was mailed, I received an email from Jim Carlson (CARJ), who noted--quite correctly as it turned out--that several of the values presented in the revised table of smoothed means (Rsm) presented in that issue remained incorrect. A newly revised table, now complete through December 1999, accompanies this mailing. Many thanks, Jim, for identifying the problem.

Report Formats

We continue to have difficulty with the wide variety of reporting formats associated with each month's body of data sent by electronic mail. Much time is spent recoding information contained in reports that do not conform to the format generated by the Sunkey.exe program. Perhaps more importantly, there is always the possibility that errors will occur during the recoding process.

I recognize that not all observers can or want to use the Sunkey.exe program. It can be difficult to use and, it is not helpful to many who work with operating systems other than MS-DOS, etc. For my own reporting, I prefer the alternative discussed in the next paragraph.

On the AAVSO/Solar website later this month, you will find a new entry called the "Solar Reporting Form". This is a simple ascii file that was created by a close variant of Sunkey.exe and that can be displayed with almost any word processor or text editor. The form eliminates most of the header information associated with Sunkey.exe because the Division has that information on file as a result of your earlier reports, and it embodies the column and character spacings that are required for a report to proceed smoothly through our processing software. A completed report can be pasted into the body of your email message or sent as an attachment. Instructions for filling out the form are included on the website. Use of the form can be further simplified by copying and pasting repetitive information (e.g., observer ID and ng, sg, ns,ss dashes if you don't report on those categories) on each new data line. It would be very helpful if observers who email their reports and who do not use Sunkey.exe would use this form in preference to worksheets and formats of their own devising. I am hopeful that we can soon replace Sunkey.exe and our processing routines with modern programs that are easier to use and that place fewer constraints on the formats in which data are entered. Until those can be written, however, your willingness to work within the current system is much appreciated.

A blank copy of the *AAVSO - Solar Division Sunspot Report form* is included in this mailing for those who report their observations via regular mail. Use of this form by those observers rather than of alternative formats also aids the data entry process and reduces the likelihood of error.

Observer Records

As many of you are aware, the Solar Division began a program in January 1999 to accumulate statistics on the numbers of observations made by each contributor over time. The primary purpose of this was to reward those observers who had contributed 1000, 1500, 2000, etc. observations by citing their accomplishments in the Bulletin and at the annual AAVSO meeting in the Fall, as has historically been done with contributors to the AAVSO variable star programs.

Unfortunately, although the individual observers' reports remain in the database, cumulative records of observations were not maintained as planned. For the most part, this problem has been solved within what I hope to be an acceptable margin of error. All available data since January 1999 have been reviewed, and contributions made by observers from the starting date through June of this year have been tabulated. The database for February 2000 remains a problem, however--particularly that portion associated with reports that were *emailed* to the former editor. In the coming months, I will get in touch with particular observers whose data appear to be missing and request that they send copies of their observations for February if they are able.

American Sunspot Numbers on the AAVSO Website

Beginning with January 2000 data, raw and k-corrected American Relative Sunspot Numbers based on observations received by the 10th of the month will now routinely be posted on the Solar Division pages of the AAVSO website. The primary purpose of this practice will be to provide the results of observers' work to organizations and other interested parties who do not subscribe to the Solar Bulletin. Up-to-date records of smoothed means will also be maintained there.

Final Note

Much time has been spent in the last few months restoring the functions of the Division and in trying to improve its product. I believe that that activity is nearing completion, and I am anxious to move on. I hope it will soon be possible to return to the discussions of sunspot grouping and to get started on other topics of interest. I have received suggestions from several observers concerning possible new initiatives for the Division and for interests they would like to see addressed in the Bulletin and on the website, and I would like to hear from more of you. I cannot promise to address all of your inputs in a timely way or necessarily to your satisfaction, but I will do the best I can.

Thank you all for your reports.

Clear Skies,

CEF

AAVSO - SOLAR DIVISION SUNSPOT REPORT

OBSERVER ID

MONTH/YEAR

OBSERVER NAME AND ADDRESS

☐ REFRACTOR ☐ REFLECTOR ☐ CATADIOPTRIC

APERTURE (   ) in / mm   FL (   ) in / mm

☐ OBSERVATIONS DIRECT
☐ HERSCHEL WEDGE ☐ FILTER EYEPIECE FL (   ) in / mm

☐ OBSERVATIONS PROJECTION
DIAMETER OF PROJECTED IMAGE (   ) in / mm

☐ APERTURE STOP USED   DIAMETER (   ) in / mm

Day	S	T	g	s	R	ng	sg	ns	ss	Remarks
1										
2										
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INCLUDE IN ALL REPORTS

S = seeing (P, F, G, E)   T = Universal Time (24 hr)
g = number of groups   s = number of spots
R = 10g + s   (whole disk)

OPTIONAL   (hemisphere locations)

ng = # northern groups   sg = # southern groups
ns = # northern spots   ss = # southern spots

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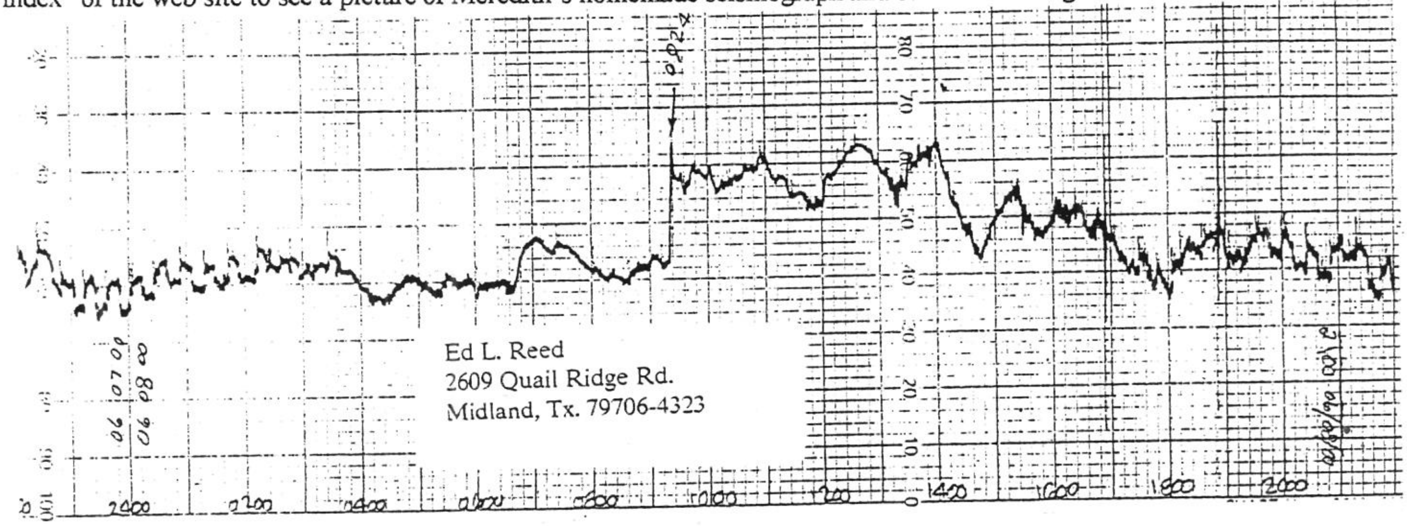
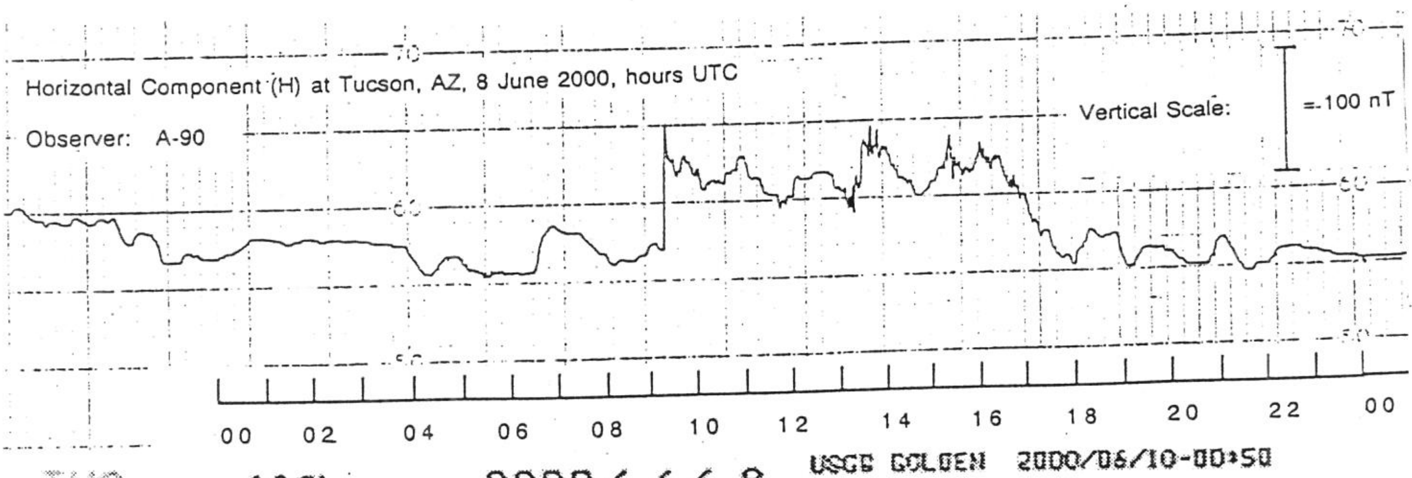
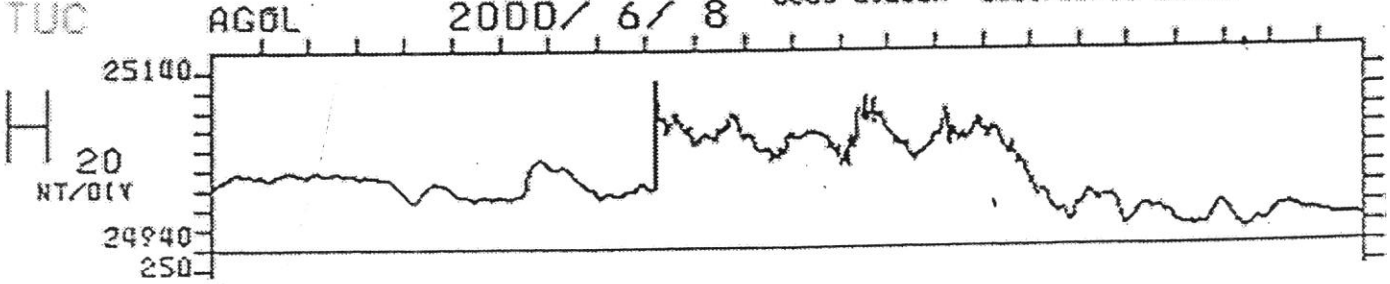
Casper H. Hossfield, Editor
PO Box 23
New Milford, NY 10959, USA
capaavso@aol.com
Fax 973 853 2588

SUDDEN IONOSPHERIC DISTURBANCES RECORDED DURING JUNE, 2000

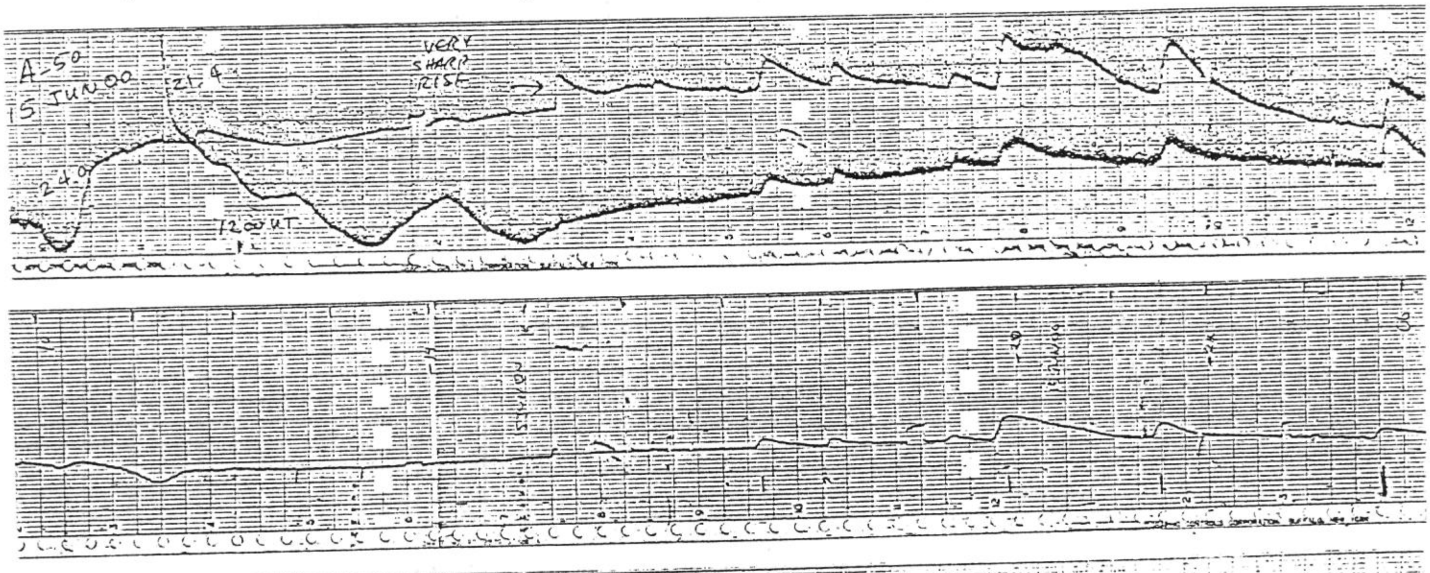
June produced a very interesting and unusual magnetic storm that included a very fast sudden commencement. A recording of the 8 June magnetic storm below was made by AAVSO sunspot observer, Ed Reed, who recently built a McWilliams magnetometer. Ed lives in Midland ,Texas, USA and is an amateur radio operator. That, plus his interest in building homemade instruments, explains his interest in solar activity other than sunspots. Beneath Ed's magnetogram is another made by Jim Mandaville near Tucson, Arizona, USA. At the bottom of the page is the recording of the storm made by the United States Geological Survey, USGS, magnetic station in Tucson. Notice how well both McWilliams torsion balance magnetometers dupicate the USGS fluxgate magnetometer's recording. The magnetic storm was caused by coronal mass ejection that produced a shock wave that hit the Earth's magnetosphere quite suddenly as can be seen by the very sudden rise in the trace starting at 0910 UT. A very interesting recording of this sudden impulse made at Denver, Colorado, USA, by Meredith Lamb can be seen at his web site, << http://www.geocities.com/meredithlamb/page054.html >>. Meredith made the recording on his homemade seismograph that samples at 3.3 samples/second and a chart speed of 10 minutes/cm. Its higher resolution shows that the impulse lasted actually about three minutes. The mass of his seismograph is magnetically suspended and that is the reason it recorded the magnetic impulse. The seismograph senses acceleration rather than displacement and that is the reason it only recorded the sudden impulse but not the rest of the storm. Magnetometers have sensors that measure displacement. Click on "back to main index" of the web site to see a picture of Meredith's homemade seismograph and other interesting material.

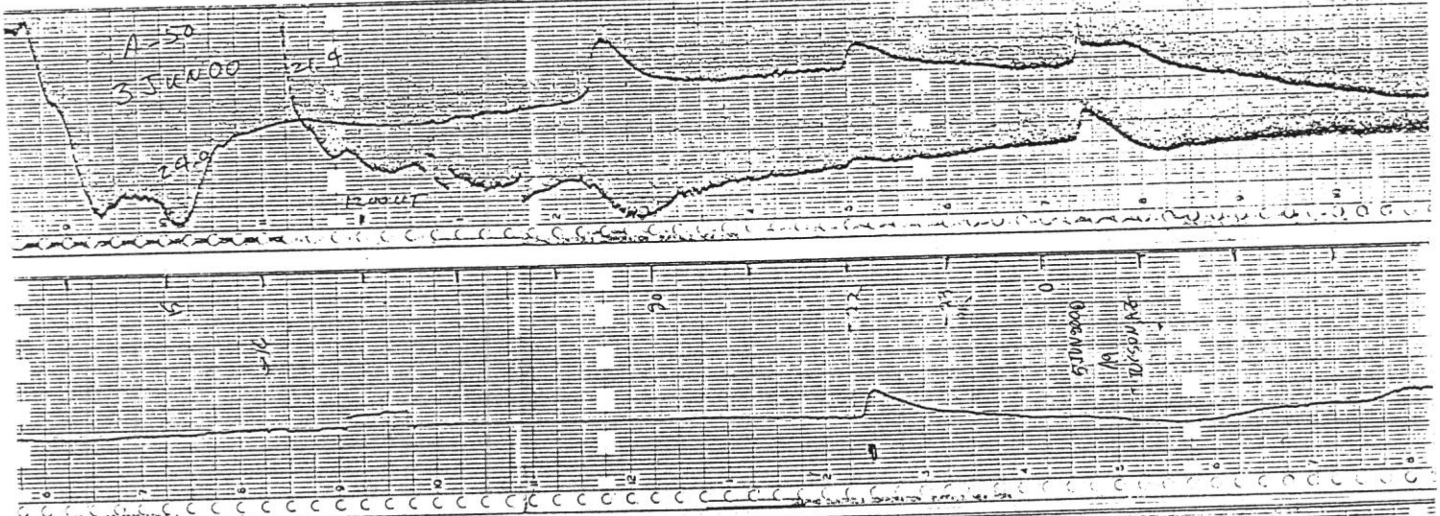


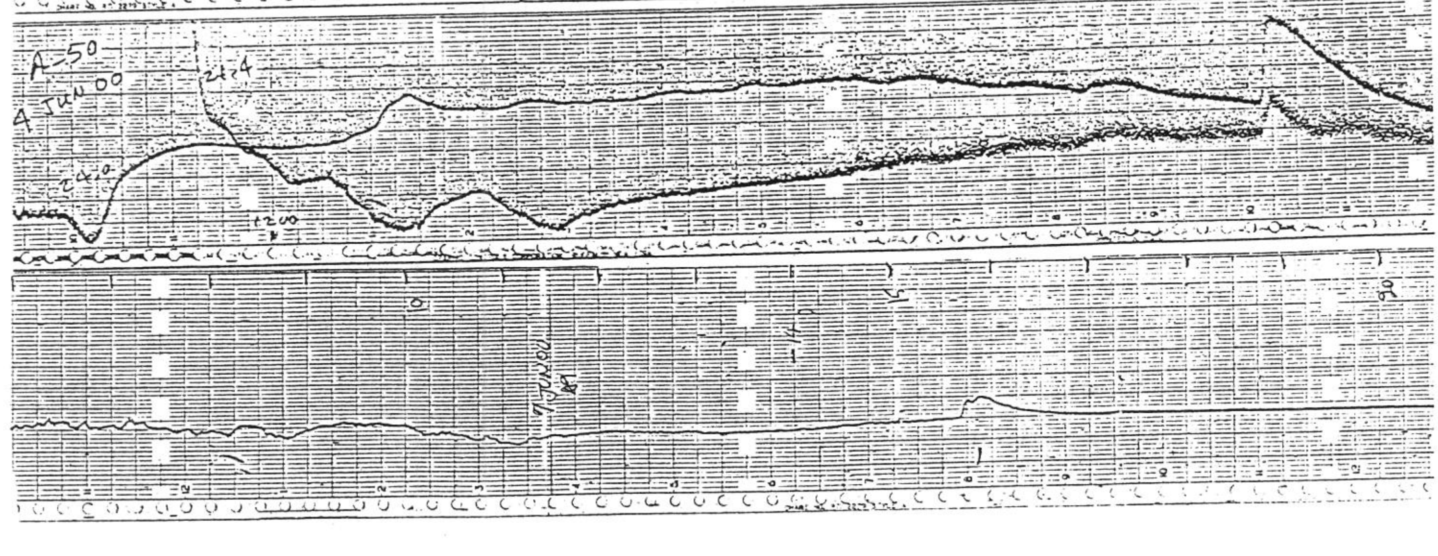




Below are recordings of solar flares detected as sudden enhancements of the signal (SES) from Very Low frequency (VLF) radio stations, NAA in Cutler, Maine, USA and NPM in Hawaii. These powerful 1-megawatt US Navy transmitters operating on frequencies of 24 and 21.4 kHz communicate with submerged submarines. 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. The first two charts shown were made on 15 June, a day of high solar activity. Those charts show 8 SESs that day.







The fluxgate magnetometer described last month in the May Solar Bulletin can be much improved by adding the integrator described below. Jack Janike says adding the integrator makes a just so so magnetometer into a magnetic observatory instrument by improving its sensitivity and temperature coefficient. Since it only requires one extra operational amplifier it is well worth adding to his fluxgate magnetometer described last month.

Simple Integrator for Improving Fluxgate Magnetometer Performance

The addition of a simple, one op-amp integrator to a fluxgate magnetometer can improve the sensor's temperature coefficient to a value on the order of 0.03%/°C. It will also insure measurement linearity to a few tenths of a per cent for fields up to one oersted.

The circuit , illustrated in Figure 41, consists of an LM741 operational amplifier connected as an integrator. It senses the emf developed at the magnetometer's dc amplifier output and develops a current sufficient to drive the sensor – and the dc amplifier output – back to a zero field state; i.e., a feedback loop. The sensor's secondary works in a dual capacity in this circuit; it senses the second harmonic emf which is generated by the magnetic field, and it also serves to act as a solenoid into which the nulling direct current is pumped. The current is proportional to the field sensed and serves to cancel the effect of the sensed field.

In this way the sensor always sees a "zero field" condition, resulting in greatly improved linearity. It also improves the temperature coefficient of the sensor to a great extent. In normal operation, without the feedback feature, the sensor t.c. is a function of the resistance of the secondary copper winding. Copper wire has an alpha constant of about 0.0039, resulting in a temperature coefficient of about 0.4% per degree C. This resistance change in the winding causes a variation in the sensor's voltage output on the order of 0.3% per degree C because the winding acts as a resistor in series with the developed emf. The resonating capacitor acts as a load to the sensor.

Since the nulling current is directly proportional to the level of the magnetic field being sensed it follows that the current is an accurate measure of that field.

Under these conditions the resistance of the secondary winding is of little consequence because it is very small in proportion to the total resistance of the feedback circuit; i.e. R3, plus R4 plus the secondary resistance. The feedback current is monitored by measuring the voltage drop across these resistors. If the voltage drop was measured across only R3 and R4 the t.c. effect of any change of resistance in the secondary winding would be virtually nil. However, measuring it across the entire circuit provides a reference back to the common point of the magnetometer, precluding the necessity of requiring the measurement indicator to be floating above "ground."

The resistors, R3 and R4, add some loading to the sensor output, resulting in a decrease in its output proportional to the total value of the resistance. This is easily overcome by increasing the gain of the dc amplifier (or the ac amplifier, if used).

The values of R3 and R4 determines both the maximum amount of feedback current that the integrator can supply and the resulting emf that is developed across them. If the resistor values are relatively high (say 5000 ohms total) a small change in the magnetic field will result in a relatively large change in the voltage indication. In this manner field variations of a few gamma can be determined easily.

The maximum emf that can be realized across R3-R4 is about 4 volts, using the ±5 volt supply recommended for IC-1. If it is desired to have the emf to the meter, **M**, directly related to the field, the resistance values must be adjusted to provide an indication of 1.000 volt for a field of 1.000 oersted applied to the sensor. If greater resolution is desired then the resistance values should be selected to provide a reading of 1.000 volt for an applied field of 0.1000 oersted. This higher resolution, however, constrains the upper limit to about ±0.4 oersted (the ±4 volt limit from the op-amp) . However, this range is, in general, quite suitable for measuring terrestrial fields.

If the integrator, IC-1, is powered from a ±12 volt source the resistance values can be selected so that a field of 1 oersted will enable a reading of 10.000 volts to be obtained. It is not necessary, of course, to have the voltage reading directly proportional to the field. For example, the resistance values can be selected so that a field of 0.5 oersted provides a reading of 2.500 volts – or any other value desired. There has to be some trade off between sensitivity (resolution of field) and the voltage reading. The field indication meter, **M**, may be a digital or analog voltmeter (or both). Its range should be compatible with the maximum voltage expected (on the order of 4 volts if the integrator supply is ±5 volts). The integrator output may be either + or – so a polarity reversing dpdt switch between the output and the meter is advisable if an analog meter is used.

Resistor R3 is a fixed value and R4 is a trimpot which enables the emf to be adjusted to a desired value. A reference source, such as a Helmholtz Coil or calibration solenoid (described in this text) is required in order to properly set up the magnetometer and integrator. The sensor should be inserted into the reference coil and the coil assembly rotated for an exact null (zero reading) of the magnetometer output across the DC Signal Output terminals. The integrator must first be disabled. This is accomplished by removing the jumper (J) in the feedback loop circuit. The jumper can consist of a simple spst DIP switch, a plug-jack combination or a solderable lead. A dc milliameter or a dc voltmeter must be in place across the DC Signal terminals. Do not apply power to the reference coil during the nulling process.

When null has been obtained the jumper should be reinserted and the calibration coil position should not be disturbed for the remainder of the calibration procedure. An appropriate current should then be applied to the reference coil to generate the desired field. and the value(s) of R3-R4 selected to provide the desired voltage at **M**.

If a meter is connected across the DC Signal Output terminals it should always indicate zero when jumper (J) is in place, regardless of the field applied to the sensor, except when the integrator current limit is exceeded. As an applied field is changed the meter will indicate some deflection but then return to zero in less than a second – a function of the integrator time constant. With the integrator RC values shown (R1 and C1) it takes a little less than one second for the integrator to return the sensor field to zero. If a larger value of R1 or C1 is used the time required will be longer, and if R1 and C1 have lesser values the integration time will be shorter. Keep in mind that R1 and R2 must be of equal values. A difference between these values will result in the meter across the DC Signal Output (if used) indicating a value other than zero.

If the current demand from the integrator (that value required to bring the system to zero) is exceeded the meter across the DC Signal Output terminals will indicate a value other than zero. For example, if the system is set so that a field of 0.1 oersted results in a voltage indication of 1 volt at meter **M**, then an applied field of 1 oersted would require an indication of 10 volts, which far exceeds the ±5 volt capability of the integrator supply. In this case the Output Meter would not remain at zero. No damage to the circuit would result, but measurement of fields greater than 0.4 oersted, for example, would be meaningless.

Capacltor C1 should be a high dielectric constant component, such as a polypropylene or polystyrene type. A 0.1 μF 50 vdc value is recommended (Digi-Key part number P3104-ND, or equivalent, priced at $0.98). Resistors R1, R2 and R3 may be either carbon film or metallized film types, either 1% or 5% and having a rating of 1/4 watt. The trimpot, R4, can be one of the Digi-Key Series 3006 (Bourns Trimmer Potentiometer) priced at about $1.40. The integrator op-amp is an LM741 or equivalent. Substitution of components may be made.

The magnetometer may be made multi-range by switching in and out various resistance values to set up, for example, full-scale ranges of 1.000 oersted and 0.1000 oersted or whatever range value is commensurate with the indicating meter used and the sensitivity desired.

The following table may be used as a guide for the total value of the feedback resistance (R3+R4) for the three types of sensors furnished by MRI at this time.

Typical values of R3 + R4, using a ±5V integrator supply are:

For FM-210: H = 1 oersted, E = 1.000V, R ≈ 330Ω
useable to 2.0 oersteds (200,000 gamma)
resolution: 100 gamma/mV
H = 0.1 oersted, E = 1.000V, R ≈ 3700Ω
useable to 0.3 oersted (30,000 gamma)
resolution: 10 gamma/mV

For FM-340: H = 1 oersted, E = 1.000V, R ≈ 480Ω
useable to 2.0 oersteds (200,000 gamma)
resolution: 100 gamma/mV
H = 0.1 oersted, E = 1.000V, R ≈ 5200Ω
useable to 0.3 oersted (30,000 gamma)
resolution: 10 gamma/mV

For FM-400: H = 1.0 oersted, E = 1.000V, R ≈ 210Ω
useable to 2.0 oersteds (200,000 gamma)

resolution: 100 gamma/mV
H = 0.1 oersted, E = 1.000V, R ≈ 2200Ω
useable to 0.3 oersted (30,000 gamma)
resolution: 10 gamma/mV

Important note: If an ac amplifier is used be certain that it is operated in the **non-inverting mode**; otherwise the integrator will not function properly. See IC-2 in the FGM-300 diagram.

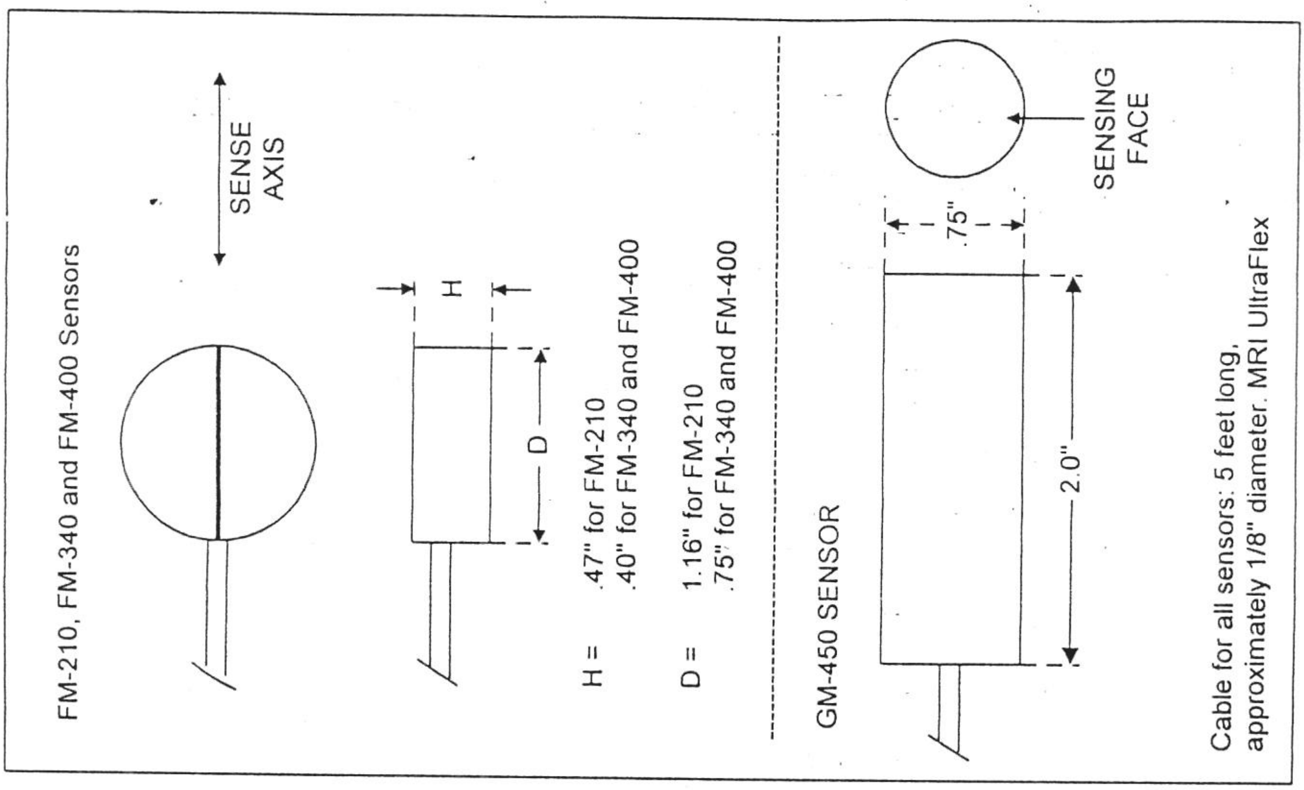
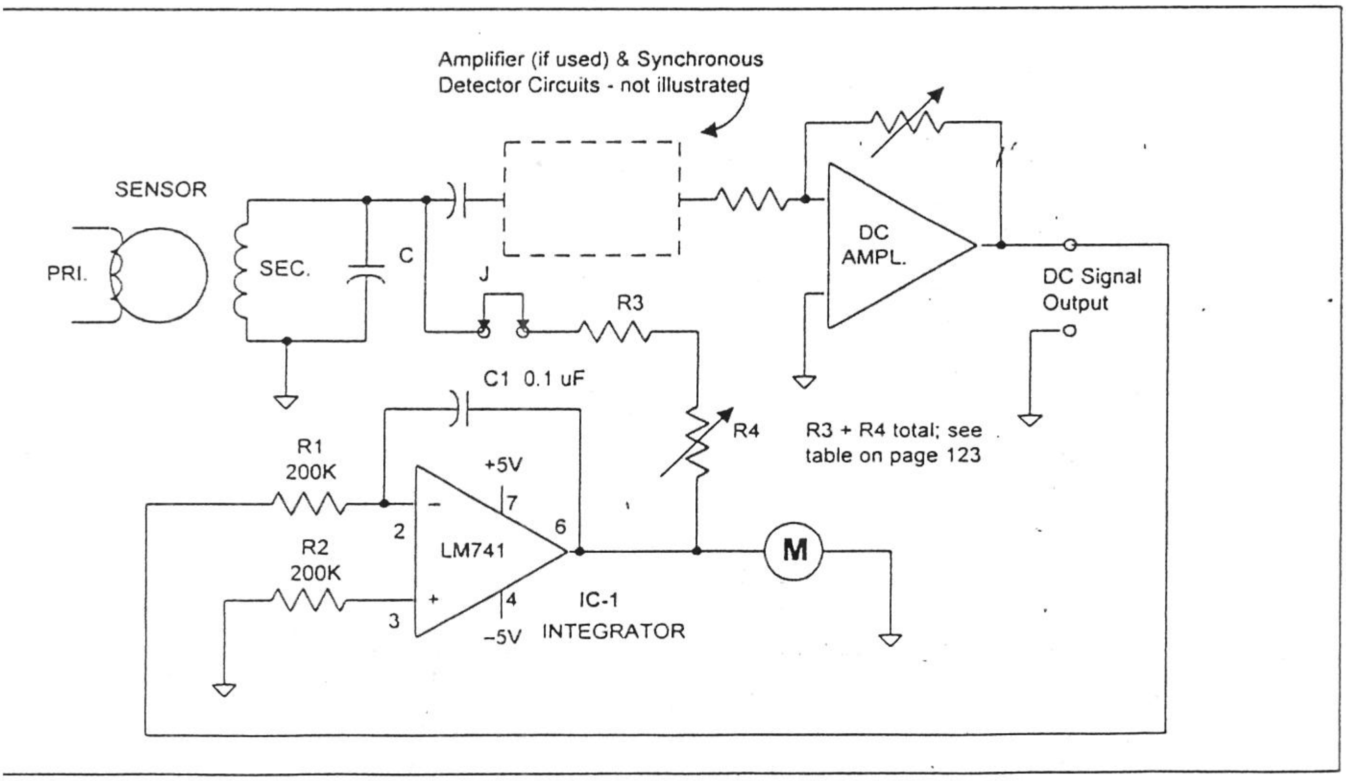


Figure 42. Outline Dimensions for MRI Fluxgate Sensors



igure 41. Magnetometer Feedback Integrator