

SIMPLE AURORA MONITOR ~SAM-III~

3-AXIS GEOMAGNETOMETER

SOFTWARE SETUP GUIDE

Revision history on last page



SAM Software Setup Guide

Table of Contents

Section		Page
l.	Introduction	1
II.	Getting Started	3
III.	Configure SAM_VIEW	18
IV.	Connect Sensor and Check Chart	33
V.	Posting Real Time SAM_VIEW Chart Images on internet	35
VI.	Internet Veiwing	39
VII.	Filter Options in SAM_VIEW	40
VIII.	Additional Application Programs	49
IX.	SAM Magnetogram Image Size	54
х.	Configuration File SAM.INI	57
	Document History	60



Basic software installation procedures

I. Introduction

This software setup guide is written to be followed in order from beginning to end. If you decide to skip a section or not read it at all, you do so at your own peril. The information in this guide is simply a starting point to get you into position for learning on your own.

If you are new to the study of geomagnetism, a good place to start is the *Geomagnetism Tutorial*. This article has additional references and may be downloaded from:

http://www.reeve.com/Documents/SAM/GeomagnetismTutorial.pdf

The SAM and SAM-III magnetometer measures Earth's magnetic field at the location of its sensors. Because of sensor sensitivity to environment temperature, they are best used for measuring relative changes over small time periods, typically one day. The sensors measure the magnetic induction along their cylindrical axis and generally are aligned with the X, Y and Z components of Earth's magnetic field. The measured induction values may or may not match values predicted by geomagnetic modeling programs or even by nearby geomagnetic observatories. There are many reasons for this, such as the sensor's local magnetic and temperature environment and the much higher cost and accuracy of professional instruments. This should be kept in mind when setting up your SAM or SAM-III system.

Earth's internal field changes on time scales of years, centuries millennia and longer. However, its external field changes on much shorter time scales. Therefore, SAM and SAM-III are perfectly suited for studying the external geomagnetic field.

This guide describes the applications programs that have been written by Karsten Hansky for use with the SAM. The programs are

SAM_INI.exe – Version 2.0 or later must be used with the SAM-III or SAM-II-X. The initializing program uploads basic parameters to the SAM processor, such as date/time, sensor configuration, and K-index and alarm threshold values. Among other things, SAM_INI sets up the processor module so that it can operate in a stand-alone mode and provide alarm and signal outputs. It also sets up the processor to scale and offset the raw sensor data before display and before sending to the viewing and logging program (SAM_VIEW). The initializing program also can be used to download the parameters from the SAM processor. SAM_INI normally is used only on initial setup and later if setup changes are needed or the SAM/SAM-III real-time clock needs to be reset

- SAM VIEW.exe Version 2.4b or later must be used with the SAM-III or SAM-II-X. The viewing program controls the data display and logging of data from the SAM or SAM-III processor. It builds and formats the data charts (magnetograms) and optionally provides raw data filtering and correction. The current chart is viewed in real time in SAM VIEW. The charts also can be sent to a website using the file transfer protocol (FTP) and viewed from the internet. SAM VIEW also can be used for "offline" viewing of magnetograms and archived data and for converting a logged data file to a format compatible with SAM STAT and SAM BROWSER. Note: SAM VIEW displays relative values with respect to the measured magnetic induction at the end of the previous UTC day. For example, say the measured field components were 23,000 nT for Bx, 5,000 nT for By and 43,000 nT for Bz at 2359:59 UTC. At 0000:00 SAM VIEW normalizes these to 0 nT for Bx, 0 nT for By and 0 nT for Bz and displays the zero values at the beginning of the day. As the external field changes throughout the day and if there is any temperature drift, then the displayed values change accordingly. It is important to remember that SAM VIEW does not alter the original data in any way and that the original data is stored by SAM VIEW in a directory determined by the user
- **SAM_STAT.exe** Statistics program that provides charts similar to the Bartels diagrams
- SAM_BROWSER.exe Browser program that provides display of archived SAM data files
- **SAM_CONVERT.exe** Conversion program that does bulk conversion of logged data files to a format compatible with SAM_STAT and SAM_BROWSER

SAM_STAT, **SAM_BROWSER** and **SAM_CONVERT** use the settings from **SAM_VIEW**. These settings are saved in the **SAM.ini** configuration file, which is located in the c:\windows directory. Information on **SAM.ini** is provided in Sect. X.

Very little information exists that is not provided in this guide. Some features and functions are not well documented. The SAM and SAM-III are like any other piece of technical equipment – you cannot learn about it unless you use it and experiment with it and do some of your own research.

You cannot harm anything by using the wrong software setting. If you have a question on a specific parameter, function or feature or run into setup problems, please join the SAM-International Yahoo group at http://tech.groups.yahoo.com/group/SAM-INTL/ and ask fellow members.

SAM and SAM-III users should feel free to experiment

II. Getting Started

After completing construction and checkout of the SAM processor module as specified in the SAM Construction Manual, it is time to setup and use the application software. The first step is to use the initialization software, SAM_INI.exe, and then the magnetogram viewing software, SAM_VIEW.exe. These applications and others are described in this manual.

A. Connection to Serial Port

The SAM must be connected to a PC's serial port and the PC must be running on a full-time basis if you want logs of geomagnetic activity. If you plan to view the SAM chart images on the internet or other network, the PC must have full-time access to the internet or other network.

No permanent connection to a PC is necessary if you operate the SAM in stand-alone mode. The SAM operates in the stand-alone mode by default. The SAM firmware includes default settings for three sensors and mid-latitude K-index values. If you wish to change the default settings, you will need a temporary connection to a PC so you can run SAM_INI.exe to set the various parameters as described later in this section.

Since most modern PCs do not have serial ports but do have USB ports, you will need a USBserial adapter. Some experimentation may be needed to find the most reliable adapter. USBserial adapters with both Prolific and FTDI chipsets and drivers have been used. However, the IoGear GUC232A seems to work the best. Not all USB-serial adapters are the same, and not all USB implementations in PCs are the same.

The free program PortMon for Windows (by SysInternals) can be used to troubleshoot the serial port. If PortMon shows traffic in one direction but not the other, and the SAM is known to be working and previously passed the **RS232 test** during construction testing, there may be a problem with the USB-serial adapter. If it uses the FTDI chip and drivers, then try an adapter that uses the Prolific chip and drivers. **See also the SAM-III Construction Manual for information on trouble-making USB-Serial adapters and troubleshooting.**

B. Serial Port Output - For Reference Only

With the operating system firmware installed and power applied, the SAM or SAM-III continuously sends a data stream on the serial port. It will send the data stream even if no sensor is connected. The following operating system firmware is required:

PlatformOperating system firmwareSAMSAM_ENG.HEXSAM-II-XSAM2X_ENG.HEXSAM-IIISAM3_ENG.HEXSAM-IIISAM3T_ENG.HEX (required for external temperature sensor)

SAM data is uploaded through the serial port to a PC one line at a time at an interval determined by the setup in SAM_INI (typically 1 or 2 seconds, or more). The output interval is set to 10 seconds by default. This setting directly affects the size of the data files. The table below shows an example data stream followed by definition of each field.

B.1. SAM

DD.MM.YY HH:MM:SS: 1 2 DDDDD, T.T (this row is for illustration and not part of the data stream)

03.01.10 00:00:04: Y , -7940, 0.0 (this is actual data stream) 03.01.10 00:00:15: Y , -7940, 0.0 03.01.10 00:00:25: Y , -7940, 0.0 03.01.10 00:00:36: Y , -7940, 0.0 03.01.10 00:00:46: Y , -7940, 0.0 03.01.10 00:00:57: Y , -7940, 0.0 03.01.10 00:01:07: Y , -7940, 0.0

B.2. SAM-III and SAM-II-X

DD.MM.YY HH:MM:SS: X,DDDDD,Y,DDDDD,Z,DDDDD

27.07.10 10:24:17: X,17399,Y,41481,Z,-12052 27.07.10 10:24:19: X,17395,Y,41484,Z,-12052 27.07.10 10:24:21: X,17395,Y,41484,Z,-12052 27.07.10 10:24:23: X,17395,Y,41481,Z,-12052 27.07.10 10:24:25: X,17393,Y,41484,Z,-12052 27.07.10 10:24:27: X,17389,Y,41484,Z,-12055 27.07.10 10:24:29: X,17389,Y,41481,Z,-12054 27.07.10 10:24:31: X,17383,Y,41481,Z,-12054 27.07.10 10:24:33: X,17383,Y,41481,Z,-12054 27.07.10 10:24:35: X,17383,Y,41484,Z,-12054 27.07.10 10:24:37: X,17383,Y,41484,Z,-12054

B.3. Data fields

- a) Fields DD.MM.YY HH.MM.SS are day, month, year, hour, minute and second. The example in B.1. shows date 3 January, 2010 and time 00:00:04 on the first line and 3 January, 2010 00:00:15 on the second line. The data interval is 10 second data in this example
- b) Fields 1 and 2 or X, Y and Z are the orientation of each sensor as setup by SAM_INI. The example in B.1. shows sensor 1 is oriented for Y measurement and sensor 2 is not equipped (,)
- c) Field DDDDD is the magnetic induction data value read from each sensor. Note for SAM: If only one sensor is equipped (default), then field 2 will have a comma in both field 2

and DDDDD for sensor 2. The example in B.1. shows the magnetic induction for sensor 1 is -7940 nT and sensor 2 is not equipped (,)

d) SAM or SAM-III with temperature sensing firmware only: Field T.T is temperature if the optional temperature sensor is equipped. If not, the field will show 0.0. The example in B.1 shows the temperature sensor is not equipped (0.0). The SAM-III and SAM-II-X do not support optional temperature at this time

C. Additional Serial Port Information

If you use the SAM in the logging mode as described in the next section, a permanent connection to a PC serial port is required. You may wish to setup the SAM software so it starts automatically when the PC reboots after a power failure or other reason. In this case, you must ensure the PC serial port is fully operational before the SAM software starts. If the serial port is not yet available when SAM starts, it will not find the serial port and stop. The SAM software will not make another attempt to find the port and manual intervention will be required.

One way of ensuring that SAM does not start before the PC serial port is available is to use a startup delay program. One such program that has been tested is Startup Delayer by R2 Studios (http://www.r2.com.au/).

This program applies user set time delays to a list of programs.

🛿 Startup Delayer - Active			
File Actions Language Help			
🕂 🥒 😫 🙆 🐨 🕄			
Filter: 🙈 All Users + Whitham D. Reeve			~
Program	A Delay	Param	^
SAM View010410	00:02:30	log	F
☑ T WeatherLink 5.9.2	00:01:30		F
☑ ¾ Nex Storm	00:01:00		F_
☑ ④ GeTTime	00:00:30		F
C:\Program Files\Tools&More\FTP-Watchdog\FTP_Setting_1min.ftpwd	-		F
C:\Program Files\Tools&More\FTP-Watchdog\FTP Setting 2min.ftpwd	-		F
ScanSoft PDF Create! 4-reminder	-	-r "C:\Docu	F
☑ SSBkgdUpdate		-Embedding	F 🗸
2			>
.aunch Delay: 2 minutes, 30 seconds			

D. Software Installation

The software files provided on the supplied CD are the latest appropriate versions at the time of shipment. <u>Follow the next two steps carefully</u>. This is all you have to do to install the software. There is no separate Setup program:

1. Create a new directory for the SAM programs (for example, C:\SAM). The SAM applications run on PCs setup for Windows 2000, Windows XP and Windows 7. For Windows 7, it is recommended that the SAM application files NOT be run from the Program Files folder, C:\Program Files.

2. <u>Copy all document files and folders</u> from the CD to the directory you just created and go to that directory. Move all files in the Software Applications folder to the new directory. Extract the zipped runtime library files to the same directory.

E. Initializing the SAM Processor

E.1. SAM (original 1- or 2-axis). Note: SKIP TO SECTION E.2 FOR SAM-III and SAM-II-X

Open SAM_INI.exe (Note: <u>BE SURE YOU ARE USING SAM_INI.exe AND NOT SAM_INI.exe</u> Version 2 or later)

)ate and time setup	COM - Port selection
)ate: 2/2009 ▼ Set da	te 🔸 📃 📃 🗾
"ime: 03:11:12 AM + Set tin	ne 🔶 🛛 🖉
AM-parameters Global parameters ✓ Daily reset at 2nd sensor connected? ✓ Permanent display light? Activate digital input? ✓ Date and time on RS232? Sensors 1st Sensor: Y Correction [%]: 100 0ffset [nT]: -82000 -82000	Output Output interval [s]: 1 RS232 Mode: Relative value Analogue output interval [nT]: 1st channel: 1025 1025 1025 1025 1025 Mode 2nd analogue channel: K-Index Alarm at K: 4
K-index K0 <= 10 K1 <= 15 K2 <= 2	5 Set default values 😵
K3<= 50 K4<= 90 K5<= 1	52 Receive parameters 🔶
	Send parameters 🔶
K6 <= 225 K7 <= 370 K8 <= 6	500 Evit program

Click on File – Load Parameter Set and open one of the following files:

- default_1sensor.sai (if you use one sensor), or
- default_2sensor.sai (if you use two sensors)

COM-Port Selection

On the upper-right, click on the COM-Port selection drop-down to select the COM-Port you will be using.

Date and Time Setup

When SAM_INI is first opened, the Date and Time fields show the values from the PC's clock. The SAM_VIEW charts discussed later assume times are in Coordinated Universal Time (UTC). Using UTC as a common time reference allows correlation of charts from different time zones and parts of the world. Unless the PC clock uses UTC, the charted time scale may be confusing, so it is best to manually change the date and time to UTC using these fields. If you are unsure of how to convert your local time to UTC, go to http://tycho.usno.navy.mil/what.html for instructions.

To set the Date or Time using SAM_INI, follow these procedures:

- Set the date or time fields in SAM_INI to the desired values. Typically, the time will be set ahead by several seconds, say to the next minute
- Put SAM in Command mode by pressing F1 (display should show Command:)
- At the desired time hack, press the **Set time** (or **Set date**) button in SAM_INI. The date or time should change to the values set in SAM_INI

If you experience problems, see Send INI data to the SAM at the end of this section

For initial setup to become familiar with the SAM, leave the other SAM parameter settings at their default values. All SAM parameters are described next.

SAM Parameters

Global Parameters

- ☑ Daily Reset at <u>0</u> UTC (restarts logging at designated time)
- □ 2nd Sensor Connected (☑ if you have two sensors)
- Permanent Display Light (uncheck to enable backlight timer)
- Activate Digital Input (SAM processor detects external relay or switch closure)
- ☑ Date and Time on RS232 (sends date and time at the beginning of each data message from the SAM processor; this option must be checked when using SAM_VIEW.)

<u>Note</u>: The time stamp used in the SAM data files stored on the PC is based on the real time clock in the SAM itself. Since the SAM uses a crystal oscillator, the setting can drift due to manufacturing tolerances, aging and temperature. Each crystal is slightly different and the drift rates are slightly different. A future version of SAM_VIEW may be capable of using the the PC's clock for time stamps. The PC's clock can be manually synchronized easily to within a couple hundred milliseconds of UTC using the PC real-time clock and common time synchronization protocols.

<u>Sensors</u>

<u>1st Sensor</u> Correction (%) 100 Offset (nT) -82000

2nd Sensor Correction (%) 100

Offset (nT) -82000

<u>Note</u>: The Correction and Offset parameter values shown above are good starting points for the FGM-3 sensor. You can change the values to compensate for local anomalies. The sensor output can be represented by the simple linear equation y = mx + b, where m is the slope, or Correction, and b is the axis intercept, or Offset. If you use an FGM-3h sensor, which is more sensitive than the FGM-3, you will need to change the Correction to 43% and Offset to [TBD] nT.

These are experimental values and you may need to adjust them according to your location and variations. The best way to set the Correction and Offset parameters is to compare your SAM_VIEW charts with a nearby observatory. If your variations are much higher or lower than the observatory values, then change the parameters accordingly. This essentially is a trial and error process, which compares your results to a presumably more accurate system. It may take weeks or months of trial and error to find the optimum settings.

<u>K-Index</u>

Default value	Multiplier
K0 ≤ 5	K8 x (5/500)
K1 ≤ 10	K8 x (10/500)
K2 ≤ 20	K8 x (20/500)
K3 ≤ 40	K8 x (40/500)
K4 ≤ 70	K8 x (70/500)
K5 ≤ 120	K8 x (120/500)
K6 ≤ 200	K8 x (200/500)
K7 ≤ 330	K8 x (330/500)
K8 ≤ 500	K8 x (500/500)

<u>Note</u>: The default K-index values may not be correct for your station. To adjust each value (K1 through K8) in the proper ratio, multiply the new upper limit for K8 by the multiplier shown in the table above. For example, if the new K8 value is 1200, then K3 would be set to $1200 \times (40/500) = 96$ and K6 would be set to $1200 \times (200/500) = 480$. See *Geomagnetism Tutorial* for additional information on K-index and how to set it for your station. This article may be downloaded from

www.reeve.com/Documents/SAM/GeomagnetismTutorial.pdf.

The K-index settings in SAM_INI only affect the K-index hardware alarm and there is no harm if they are set incorrectly (except that an alarm may or may not be issued to indicate a geomagnetic storm).

<u>Output</u>

Output Interval (s)

Use a short interval (2 s) for testing and when fast response is needed. Use a

	longer interval for long-term studies and normal operation. An output interval of 10 s (6 values/minute) is a good setting for most installations in that it provides a satisfactory data interval and also provides time for SAM_VIEW to apply filtering (if filtering is used). This setting directly affects the size of the data files
Absolute Value	Use this setting for most installations; this setting does not affect SAM_VIEW because SAM_VIEW generates its own relative values starting with 0 nT at 00:00 UTC
Relative Value	Compares measurements to first one of the day; this setting results in steps if the SAM experiences a power failure
Absolute + Relative Values	Sum of relative and absolute values
Absolute + Relative Values + K-Index	Sum plus K-Index
Analog Output Interval (nT) 1st Channel	1025, defines the resolution of the 1st analog output (10-bit +1)
2nd Channel	1025, defines the resolution of the 2nd analog output (10-bit +1)
Mode 2nd Analog Channel K-Index	2nd analog channel provides an output proportional to the K-Index
Magnetic Flux of 2nd Sensor	2nd analog channel provides an output proportional to magnetic flux
Alarm at K	When the K-Index reaches the threshold set here, a relay in the SAM processor is activated, providing a set of Form A dry contacts for alarm or indication purposes. The SAM alarm function considers only the changes in the last 20 minutes, so the threshold has to be reached within 20 minutes to activate the alarm. The

recommended setting is K=4 because a change to K=4 within 20 minutes is a good indicator that a magnetic storm is starting. Also, when the threshold is reached, the keyboard LED turns ON.

E.2. SAM-III and SAM-II-X (3-axis)

Open SAM_INI.exe Version 2.0 or later

Date and time setup	COM - Port selection
Date: 7/27/2010 🗾 Set date 🔶	COM4 _
Fime: 21:35:14 PN 😴 Set time ➡	0%
SAM-parameters	
Permanent display light?	
	Output interval [s]: 10
	RS232 Mode:
J ✓ Date and time on RS232?	Absolute value
Sensors	Alarm
X-Sensor: Y-Sensor: Z-Sensor:	Alarm at K: 5
Lorrection [%]:	
Offset [nT]:	- Set default values 📀
1-82000 1-82000 1-82000	
-K-index	Receive parameters 🔶
K0 <= 10 K1 <= 15 K2 <= 25	
	Send parameters 🔶
K3 <= 50 K4 <= 90 K5 <= 152	
K67- 225 K77- 370 K87- 600	Exit program

SAM_INI opens with default settings, but another settings file can be loaded if available. The default settings file is SAM3_default.SAI. To open it click on File – Load Parameter Set and select the file.

COM-Port Selection

On the upper-right, click on the COM-Port selection drop-down to select the COM-Port you will be using.

Date and Time Setup

When SAM_INI is first opened, the Date and Time fields show the values from the PC's clock. The SAM_VIEW charts discussed later assume times are in Coordinated Universal Time (UTC). Using UTC as a common time reference allows correlation of charts from different time zones and parts of the world. Unless the PC clock uses UTC, the charted time scale may be confusing, so it is best to manually change the date and time to UTC using these fields. If you are unsure of how to convert your local time to UTC, go to http://tycho.usno.navy.mil/what.html for instructions.

To set the Date or Time using SAM_INI, follow these procedures:

- Set the date or time fields in SAM_INI to the desired values. Typically, the time will be set ahead by several seconds, say to the next minute
- Put SAM in Command mode by pressing F1 (display should show Command:)
- At the desired time hack, press the **Set time** (or **Set date**) button in SAM_INI. The date or time should change to the values set in SAM_INI

If you experience problems, see Send data to the SAM at the end of this section

For initial setup to become familiar with the SAM-III, leave the other SAM_INI parameter settings at their default values. All SAM-III parameters are described next.

SAM Parameters

Global Parameters

- Permanent Display Light (check to activate the LCD backlight at all times; uncheck to enable the backlight timer). If the backlight timer is activated (box is unchecked), the backlight automatically turns off after 10 seconds. It can be turned on again by pressing F4 on the keyboard
- Activate Digital Input (SAM processor detects external relay or switch closure)
- ☑ Date and Time on RS232 (sends date and time at the beginning of each data message from the SAM processor; this option must be checked when using SAM_VIEW.)

<u>Note</u>: The time stamp used in the SAM data files stored on the PC is based on the realtime clock in the SAM itself. Since the SAM uses a crystal oscillator, the setting can drift due to manufacturing tolerances, aging and temperature. Each crystal is slightly different and the drift rates are slightly different. A future version of SAM_VIEW may be capable of using the the PC's clock for time stamps. The PC's clock can be manually synchronized easily to within a couple hundred milliseconds of UTC using a PC's realtime clock and common time synchronization protocols.

<u>Sensors</u>

<u>X-Sensor</u>	
Correction (%)	100
Offset (nT)	-82000

<u>Y-Sensor</u>

Correction (%) 100 Offset (nT) -82000

<u>Z-Sensor</u>

Correction (%)	100
Offset (nT)	-82000

<u>Note</u>: The Correction and Offset parameter values shown above are good starting points for the FGM-3 sensor. You can change the values to compensate for local anomalies. The sensor output can be represented by the simple linear equation y = mx + b, where m is the slope, or Correction, and b is the axis intercept, or Offset. If you use an FGM-3h sensor, which is more sensitive than the FGM-3, you will need to change the Correction to 43% and Offset to [TBD] nT.

These are experimental values and you will need to adjust them according to your location and variations. The best way to set the Correction and Offset parameters is to compare your SAM_VIEW charts with a nearby observatory. If your variations are much higher or lower than the observatory values, then change the parameters accordingly. This essentially is a trial and error process, which compares your results to a presumably more accurate system. It may take weeks or months of trial and error to find the optimum settings.

<u>K-Index</u>

Default value	Multiplier
K0 ≤ 5	K8 x (5/500)
K1 ≤ 10	K8 x (10/500)
K2 ≤ 20	K8 x (20/500)
K3 ≤ 40	K8 x (40/500)
K4 ≤ 70	K8 x (70/500)
K5 ≤ 120	K8 x (120/500)
K6 ≤ 200	K8 x (200/500)
K7 ≤ 330	K8 x (330/500)
K8 ≤ 500	K8 x (500/500)

<u>Note</u>: The default K-index values may not be correct for your station. To adjust each value (K1 through K8) in the proper ratio, multiply the new upper limit for K8 by the multiplier shown in the table above. For example, if the new K8 value is 1200, then K3 would be set to $1200 \times (40/500) = 96$ and K6 would be set to $1200 \times (200/500) = 480$. See *Geomagnetism Tutorial* for additional information on K-index and how to set it for your station. This article may be downloaded from

www.reeve.com/Documents/SAM/GeomagnetismTutorial.pdf.

The K-index settings in SAM_INI only affect the K-index hardware alarm and there is no harm if they are set incorrectly (except that an alarm may or may not be issued to indicate a geomagnetic storm).

<u>Output</u>

Output Interval (s)

Use a short interval (2 s) for testing and when fast response is needed. Use a longer interval for long-term studies and normal operation. An output interval of 10

PS222 Modo	s (6 values/minute) is a good setting for most installations in that it provides a satisfactory data interval and also provides time for SAM_VIEW to apply filtering (if filtering is used). This setting directly affects the size of the data files
Absolute Value	Use this setting for most installations; this setting does not affect SAM_VIEW because SAM_VIEW generates its own relative values starting with 0 nT at 00:00 UTC
Relative Value	Compares measurements to first one of the day; this setting results in steps if the SAM experiences a power failure
Absolute + Relative Values	Sum of relative and absolute values
Absolute + Relative Values + K-Index	Sum plus K-Index
Alarm at K	When the K-Index reaches the threshold set here, a relay in the SAM processor is activated, providing a set of Form A dry contacts for alarm or indication purposes. The SAM alarm function considers only the changes in the last 20 minutes, so the threshold has to be reached within 20 minutes to activate the alarm. The recommended setting is K=4 because a change to K=4 within 20 minutes is a good indicator that a magnetic storm is starting. Also, when the threshold is reached, the keyboard LED turns ON and red bars
:00 06:00 09:00 12:00 15:00 18:(appear below the horizontal axis of the

F. Send INI data to the SAM

Upload the settings to the SAM as follows:

• Press the F1 function key on the SAM or SAM-III to put it into Command Mode. The keyboard LED should flash ~2 Hz rate and the display will indicate COMMAND:

right)

SAM_VIEW magnetogram (illustration

- K-Index Alarm bars

• Click the Send Parameters button in SAM_INI

The SAM display should show Parameters \leftarrow PC for a moment. Upon successful upload, the SAM automatically reboots and shows INITIALIZING on the display. Upon completion of the upload, SAM_INI displays the dialog box to the right.

<u>Note</u>: If you are using a USB-serial port adapter, you may experience unreliable operation of the Send Parameters function in SAM_INI. Limited testing has shown that some adapters work better than others. Adapters with both Prolific and FTDI chips have been used successfully. It is imperative that you use Adapter hardware and associated drivers that are compatible with your operating system. If not, you may see the Error! dialog box to the right.

Also, tests with a USB-serial adapter have shown that the Error! dialog box to the right (or a similar dialog box) appears at the end of an upload even though the upload was successful. Therefore, if the progress box (below the COM-Port Selection drop-down) in SAM_INI shows a successful upload, and there was no timeout or other failure indication during upload, and the SAM





automatically initialized, then the upload was successful. In some cases, several tries are required to achieve a successful upload. Try the following procedures if you experience trouble:

Method 1:

Reset the SAM (F3 function key). After the SAM reinitializes, press the Command Mode key (**F1** function key) and then press **Send parameters** in SAM_INI.

Method 2:

Cycle the power to the SAM PCB. After the SAM reinitializes, press the Command Mode key (**F1** function key) and then press **Send parameters** in SAM_INI.

Method 3:

Press the small reset button on the SAM PCB. After the SAM reinitializes, press the Command Mode key (**F1** function key) and then press **Send parameters** in SAM_INI.

<u>Note</u>: There appears to be a marginal timing problem in the SAM_INI software when used with a USB-serial adapter, but the problem has not been identified. It may be necessary to close and then re-open SAM_INI.exe when experiencing upload problems. Also, it may be necessary to unplug the USB-serial adapter from the PC and plug it in again.

Only a few failures have been experienced when using a built-in serial port on a PC. This problem has not been experienced with SAM_VIEW.

Upon successful upload of the settings, the SAM is setup and ready to use. Exit SAM_INI and go to the next section.

III. Configure SAM_VIEW

<u>NOTE</u>: SAM_VIEW does not display logged data unless it is started with the "log" switch parameter. This is described later. First, you need to configure SAM_VIEW as described below. Be sure you are using SAM_VIEW version 2.4b or later with SAM-III and SAM-II-X. The latest features, described at the end of this section, are available in v2.8.

A. Setup SAM_VIEW.exe

SAM_VIEW only receives data from the SAM or SAM-III. It does not send anything to the SAM or SAM-III.

Open SAM_VIEW.exe



Click on Edit - Setup to define the components of the magnetogram



Fill in the following items:

- SAM-header
 - Owner or station name
 - Location (City)
 - Longitude (E or W) (ddd.ddE or ddd.ddW with no spaces)
 - Latitude (N or S) (dd.ddN or dd.ddS with no spaces)
 - IARU Locator. Go to http://sam-europe.de/gridconverter2.htm to find your IARU locator based on your station coordinates. Use GoogleEarth to find your coordinates first if necessary

<u>Note</u>: You may wish to use geomagnetic coordinates in Longitude and Latitude fields

- For initial setup fill in the K-Index table with the following default values
 - K0 ≤ 5
 - K1 ≤ 10
 - K2 ≤ 20
 - K3 ≤ 40
 - K4 ≤ 70
 - K5 ≤ 120
 - K6 ≤ 200
 - K7 ≤ 330
 - K8 ≤ 500

<u>Note a</u>: Generally, use the same values here that you used in SAM_INI to setup the SAM processor for standalone mode. Remember, the default values given above may not be correct for your station. The K-index values used in SAM_VIEW only affect the display of colored bars (see Sect. III. F) along the SAM_VIEW chart time axis and the K-index alarm. There is no harm if they are set incorrectly but if set too low the SAM_VIEW charts will incorrectly identifiy a geomagnetic storm by showing a red bar just above the chart time axis.

<u>Note b</u>: The version of SAM_VIEW supplied with the North American SAM Kit can be set with K8 upper limit as high as 3000.

- Alarm
 - Alarm display ON (uncheck to turn alarm OFF)
 - Alarm at $K \ge 4$ (adjust to meet your preference)

<u>Note</u>: The algorithm for determining an alarm is similar to the SAM on-board alarm display. If SAM_VIEW declares an alarm, a red bar is shown on the chart just below the time axis. The alarm is triggered when the magnetic field fluctuations reach a preset threshold within 20 minutes. A rapidly changing field indicates high probability of visible aurora.

- K-index parameters
 - 🗹 Display K-index ON
 - Display for each curve ON
 - Display color bar ON
 - 🗹 Include curve 1 for K-index ON
 - □ Include curve 2 for K-index OFF (☑ ON for 2-sensor installation)
 - □ Include curve 3 for K-index OFF (☑ ON for 3-sensor installation)
 - 🛛 Include curve 4 for K-index OFF

<u>Note a</u>: The K-Index for each 3-hour period will be displayed on the magnetogram only if *Display K-index* is checked. If *Display for each curve* is checked, the K-index for each curve selected by *Include curve 1 for K-index*, and so on, will be displayed. If *Display for each curve* is NOT checked, the magnetogram displays the largest K-Index of the selected curves. For example, if Y and Z are K2 and X is K4, the value K4 will be displayed.

<u>Note b:</u> Checking *Display color bar ON* allows SAM_VIEW to plot a color bar just above the time axis that indicates the K-Index for each 3-hour period. This is a simple graphical representation of the K-Index text discussed in Note a. The colors used are:

- K3 and below: Green
- K4 and K5: Yellow
- K6 and above: Red

<u>Note c</u>: The K-index in professional magnetometers is determined from the changes in the horizontal component of the magnetic field, that is, vector sum of X and Y. The SAM and SAM-III actually display a pseudo-K-index because it is calculated for each individual component instead of the horizontal component.

<u>Note d:</u> The best way to become familiar with the K-Index parameter settings is to load a SAM_VIEW log file (*.sam) and play with the various settings to see how they affect the magnetogram (see Sect. III. D.).

- Y-scale
 - Fixed range: +/-200 nT
 - 🗹 Autoscale ON

<u>Note a</u>: When *Autoscale ON* is checked, SAM_VIEW automatically scales the magnetograms and the Fixed range settings have no effect. To display a fixed Y-scale, uncheck *Autoscale ON*. With *Autoscale ON* unchecked, the curves may go off-scale and be invisible. See next note.

<u>Note b</u>: If you are setting up SAM_VIEW for the first time and your sensors are in a magnetically uncontrolled environment (for example, your test bench), the data will contain wild values and, if you have *Autoscale ON* turned off, very likely will be off-scale. In this case, you will not see a trace when you start SAM_VIEW in the logging mode. Therefore, for initial setup be sure that *Autoscale ON* is checked.

After the above settings have been entered, click on the **Curve 1 Color setup** button in the upper-right corner

Setup	and the second	×	
SAM-header Owner or station name:	K-index parameters ↓ Display K-index?	Color setup	
Reeve Observatory	Display for each curve?		
Location: Anchorage, AK, USA	✓ Include curve 1 for K-index?		Color ? ×
Geographic coordinates:	Include curve 3 for K-index?	Curve 3	Basic colors:
Longitude: Latitude: IARU-Locator: 149.957W 61.199N BP51AE	Include curve 4 for K-index?	Curve 4	
Remark:	Y-scale Fixed ranges C +/-60nT C +/-250nT C +/-100nT C +/-500nT	Background:	
K-index table K0 <= 5 K1 <= 10 K2 <= 20	C +/-150nT C +/-1000nT € +/-200nT	Alarm Alarm display?	Custom colors:
K3 <= 40 K4 <= 70 K5 <= 120	Autoscale?	Alarm at K>= 3 主	
K6 <= 200 K7 <= 330 K8 <= 500	C Default 🖃 Logging	Cancel V OK	Define Custom Colors >> OK Cancel

Although the software allows a lot of flexibility, it is recommended that SAM curve colors be setup according to the convention described here. This simplifies coordinated observing and makes it easier to compare charts with other users. However, you should feel free to experiment with the settings if for no other reasons than to become familiar with the SAM's capabilities.

The curve colors depend on the orientation of the sensors and thus the magnetic field component you wish to measure. The colors indicated by the arrows on the palette shown above provide the best readability.

<u>Note on sensor orientation</u>: As you would expect, you could assign a particular sensor as X (N-S) but physically orient it in any random direction as determined by its long axis. In this case, the sensor will measure the magnetic field in the direction of its axis, but SAM_VIEW will display it as X. SAM_VIEW does not know you have randomly oriented the sensor.

If you have one sensor, use the following color convention for your chosen orientation:

- Bx (N-S): BLUE
- By (E-W): RED
- Bz (vertical): GREEN

If you have two sensors, Sensor No. 1 for Bx (N-S) and Sensor No. 2 for By (E-W), the corresponding curves and colors are

- Sensor 1, Bx (N-S), Curve 1: BLUE
- Sensor 2, By (E-W), Curve 2: RED.

If you have a SAM-III or SAM-II-X with three sensors, the corresponding curves and colors are

- Sensor X, Bx (N-S), Curve 1: BLUE
- Sensor Y, By (E-W), Curve 2: RED
- Sensor Z, Bz (vertical), Curve 3: GREEN

After you make the color changes, click OK to return to the Setup screen.

General	Diagram size
Comport: COM8	🔽 Standard
Interval [min]: 1	Width: 643 🗲
FTP-upload every 🚺 🚖 . interval	Height: 376 🚖
FTP-timeout [s]: 60 🗲	
FTP-command	
-	
Uutput setup	
PNG-Format (*.png)	
Generate WAP-output?	
Generate HTML-output?	
Generate preview?	
Display yesterday?	🔁 Default
Data directory:	
C:\SAM\Data	X Cancel
Magnetogram directory:	(11 - 12) - 12 - 13 - 13 - 13 - 13 - 13 - 13 - 13

Click on Logging . . . in the Setup menu.

In the General setup area, select the COM-Port connected to the SAM. This will be the same port you used with SAM_INI. Leave Interval and FTP settings alone for now.

In the Output setup area, select the picture format of your choice, *.png, *.bmp or *.jpg, from the drop-down box. Generally, *.png is the best as it provides the smallest file size.

SAM_VIEW can generate the following file types for viewing:

sam_data.png	PNG-graphic (set dimensions to 642 x 376 pixels)
sam_data_wap.png	a small PNG-graphic for WAP, fixed dimension.
sam_data.htm	Output for generating SVG-graphics.
sam_data_wap.txt	File for WAP-service (text file for direct use with mobile-phone)
sam_data.wap	File used for WAP-service (see next topic)

The sam_data.png (or .bmp or .jpg) files are generated automatically. The additional files can be optionally generated. For most installations, uncheck the additional output selections except as shown here:

Generate WAP-output?

□ Generate HTML-output?

Generate preview? (generates a smaller chart somewhat like a thumbnail image; check this box if your magnetograms are to be shown on <u>www.sam-magnetometer.net</u>)

Display yesterday? (chart will show curves for today and yesterday; uncheck this box if you do not want to display yesterday).

For SAM-III do not check the Display yesterday? box. The charting function cannot handle more than a total of four curves.

If you participate in the SAM Magnetometer Project at www.sam-magnetometer.net, you should select 🗹 Generate preview?. This image should be sent by FTP with the main image file (sam_data.png) to the website you use to display the magnetograms.

Select the directory used for the SAM data files (for example, C:\SAM\Data or the directory you created) and for the SAM magnetograms (for example, C:\SAM\Magnetograms or the directory you created). If you wish, you may put the data files and magnetogram images in the same directory.

In the Diagram size area, check the Standard box and click OK to go back to the Setup menu. DO NOT click the Default button on the Setup menu. It will reset the K-Index values to defaults.

Click OK to return to the SAM_VIEW main screen. Note: The changes are not saved unless you click OK. All changes are saved in the sam.ini file, which is located in the C:\Windows folder. This file is described in more detail in the Appendix.

Restart SAM_VIEW to make the new settings take effect.

Select View – Filter . . .

This screen allows you to use a Correction file and apply Noise and Offset filters. The Offset filter is handy during indoor testing where the sensor may detect sudden changes in the local magnetic field (such as when the sensor is bumped, the local magnetic field is disturbed by tools, and so on). This may be turned off later if necessary. <u>Refer to Sect. VII for additional information on setting and using the filters</u>. Click OK when done setting the filters to return to the SAM_VIEW main screen.

Filter	
Use correction file	
🗖 Apply noise filter	
Apply offset filter	
Threshold[nT]:	50 🜲

The Filter settings take effect immediately when checked; however, SAM_VIEW does not remember them unless you click OK.

Note: The Filter settings affect only the display and not the data itself. VII.

Select View – Legend . . .

File	Edit	View	Conver	t Lo	gging	He	lp				
200			ad curve elete cur hange of	e ve ffset					8	Ŷ	i i i i i i i i i i i i i i i i i i i
150	1993		iter gend iformatio	m							
100	1	A	ctivity								
50	1										
eger	nd an	d title	setup	C++				2	× I		
eger Curv Bx	nd an e 1: =	d title	setup	Cur By	rve 2:	_	_	2	×		
eger Curvi Bx Curvi	nd an e 1: = e 3: =	d title	setup	Cur By Cur	rve 2: rve 4:	-		2	×		
egei Curvi Bx Curvi Bz Title:	nd an e 1: - e 3: -	d title	setup	Cur By Cur B	rve 2: rve 4:			2	×		
eger Curvi Bx Curvi Bz Title: SAM	nd an e 1: - e 3: - 1 \$LO	d title	setup	Cur By Cur B DRD\$	rve 2: rve 4: - \$LO		 DR\$)	Lates	×		
egei Curvi Bx Curvi Bz Title: SAM	nd an e 1: = e 3: = 1 \$LO1 word li	d title CATION	setup (\$COC	Cur By Cur B DRD\$	rve 2: rve 4: - \$LO		 DR\$)) Lates	×		
eger Curvi Bx Curvi Bz Title: SAM Keyu F	nd an e 1: = e 3: = 1 \$LOI word li gend o Aut Rer	d title CATION st for titl options o legen e in leg- nark in l	setup setup s (\$COC e d? egend?	Cui By Cui B DRD\$	rve 2: rve 4:		 DR\$) X Ca	Lates	×		

<u>Title field</u>: Text that you place in this field will show as the magnetogram title. You can use the information fields from the Setup window such as observatory name, location and coordinates. To use these fields, copy and paste the following line into the Title field (be sure to include the spaces):

SAM \$LOCATION\$ (\$COORD\$ - \$LOCATOR\$) Latest data from \$DATE1\$ / \$TIME1\$ UTC

Valid field keywords are listed in *Keyword list for title* drop-down. Keywords listed in this dropdown are parameters that you entered in the SAM Header fields of the Setup screen. SAM_VIEW can read these from its file system and place them on the magnetogram. You are not limited to keywords – most valid text can be displayed. To learn how this works, try entering text or keywords and then viewing the magnetogram. If necessary, restart SAM_VIEW.

Click OK to go back to the SAM_VIEW main screen. The chart should show the Title at the top. Select File – Exit to close SAM_VIEW. The basic setup is done.

In the following sections, you will connect everything together and run the viewing and logging program.

B. Running SAM_VIEW in Logging Mode

SAM_VIEW does not display logged data unless it has been started with the "log" switch parameter.

The SAM and SAM-III processors transmit data on the serial port at all times. This data is not logged (saved) unless all of the following conditions are met:

- The SAM or SAM-III serial port is physically connected to a PC serial port, either directly or through a serial-USB adapter, and
- A software application on a PC has opened the PC serial port and has a means to receive the data from it, and
- The software application is setup to log and save the data

SAM_VIEW does not actually save or log data unless it is in the logging mode. In other words, simply running SAM_VIEW does not mean that SAM or SAM-III data is logged. **You must start SAM_VIEW in the logging mode if you want to actually save data.**



For easier program operation, you should create a shortcut to SAM_VIEW.exe that opens it in the logging mode. Go to the folder where SAM_VIEW.exe is located.

Right-click on SAM_VIEW.exe (or the equivalent filename with a version number in it) and select Shortcut. Put the shortcut in a convenient location such as the Desktop. Go to Properties of the shortcut and setup the target. Some Windows systems or environment settings require quotations around the target, as in: "...\sam_view.exe" log (note that the <u>log</u> switch is outside the quotation marks in the target field). Other systems do not require the quotes, as in ...\sam_view.exe log. In both cases, there is a space between exe and the <u>log</u> switch.

AM_View_v2-	6a Properties 🛛 👔 🕻
General Shortc	ut Compatibility
S.	AM_View_v2-6a
Target type:	Application
Target location	SAM
<u>T</u> arget:	\\Program Files\\SAM\SAM_Vlew_v2-6a.exe" log
<u>S</u> tart in:	"C:\Program Files\SAM"
Shortcut key:	None
<u>R</u> un:	Nomal window
Comment:	
Eind	Target
	OK Cancel Apply

You also should setup a shortcut that does not specify

the <u>loq</u> switch. You will use this one to open SAM_VIEW and then load archived data files and view them (described in Sect. III.D.). In this case, the target will be "...\sam_view.exe" (with or without the quotes, see above).

When SAM_VIEW is opened by using the logging shortcut, it will immediately start collecting data from the serial port and saving that data in the directories you specified in Setup. SAM_VIEW will not display real data unless at least one sensor is connected to it as explained in Sect. IV.

When SAM_VIEW starts in the logging mode, it will write a file to the data directory you specified in Setup. Depending on the logging interval you setup in SAM_INI, it may take a minute or so for this data file to appear (the file will appear much quicker for a short logging interval, say 2 seconds). This file will be of the form yyyymmdd.txt, where yyyymmdd is the current year, month and day. As SAM_VIEW logs data from the serial port, it appends it to this file. Therefore, this file is continuously written to whenever SAM_VIEW is in the logging mode. With sensors connected if, after you start SAM_VIEW in logging mode, you do not see any files being written within a couple minutes to the directories you specified, then SAM_VIEW is not collecting data. Check the serial port connection and COM-Port assignment. Sensor connections are discussed in Sect. IV.

Note: As previously explained SAM_VIEW normalizes the displayed data to zero at the beginning of each day or when a data file does not already exist. If the magnetic field is very quiet, zero values may be written during subsequent sampling intervals at the beginning of the day or beginning of the data file. SAM_VIEW does not display a trace until it detects a non-zero value in the data file. Therefore, if you do not immediate see a trace for a particular sensor, wait until there have been some changes in the field.

SAM_VIEW also produces a magnetogram image file called sam_data.png (the image type is determined in Setup but usually is .png). Every couple minutes SAM_VIEW produces a new magnetogram image file and overwrites the previous file. Therefore, magnetogram image files are not archived by SAM_VIEW. However, as described later, you can use SAM_VIEW or the other applications to produce magnetograms from the original data at any time.

If you stop SAM_VIEW, the data from the SAM or SAM-III processor is no longer logged. However, if you restart SAM_VIEW in logging mode during the same day, it will collect data and append it to the yyyymmdd.txt file described above. There will be gaps in this data during the time SAM_VIEW was stopped. Also, SAM_VIEW will produce new magnetogram images that will overwrite the old image, and the magnetogram also will have gaps in it corresponding to the times when data was not logged.



C. SAM_VIEW Activity Screen

When some versions of SAM_VIEW start, a small supplementary window starts with it. The Activity window provides additional information about the most recent magnetic activity by displaying the changes in magnetic induction during the last 10, 30 and 60 minutes. The text to the left, curve 1, curve 2, and so on, will change to the actual display settings for X, Y and Y, as appropriate. Display units are nT.

The Activity window is used as follows: The K-index accumulates changes over a three hour period. If the K-index reaches K6 just at the beginning of a period due to a solar event or other reason the magnetogram curve may remain fairly flat over the next few hours even though there still is high activity (K-index of K5). The window contains four lines, one for each curve

	10 min.	30 min.	60 min.	
curve 1:		0	0	nT
curve 2:	0	0	0	nT
curve 3:	0	0	0	nT
curve 4:	0	0	0	nĪ

selected in SAM_VIEW. The window can be activated or deactivated by the line Aktivitaet=1 (activated) or 0 (deactivated) in the [Diagram] section of the sam.ini file. See Appendix.

Later versions of SAM_VIEW allow you to activate or deactivate the Activity screen from the View menu. Click on View and then select or de-select the Activity.

D. Viewing Offline (Archived) Data in SAM_VIEW

SAM_VIEW can be used to view a magnetogram from any previous day using that day's .sam file. If you want to compare magnetograms for two days, say a quiet and active day, two consecutive days, or two specific dates, use SAM_BROWSER (described in Sect. VIII).



To view a magnetogram in SAM_VIEW, open SAM_VIEW. You can use the nonlogging shortcut you made in Sect. III.B. or simply double-click the SAM_VIEW file. Select View – Load Curve . . . <u>Note</u>: Be sure SAM_VIEW is not in the logging mode. If SAM_VIEW is in the logging mode, the Load curve and Delete curve selections will be grayed out.

Select the curve (.sam file) you want to see and click OK. When you click OK, a file selection window will open. If necessary navigate to the folder when the .sam files are located. The filename for the .sam files includes the year-month-day. Select the desired date and click Open.

Load curve 🛛 🔀	Load SAM-Mag	netogram			? 🛛
Curve selection Curve 1 Curve 3	Look in:	Data		• • • •	
C Curve 2 C Curve 4			🗟 20090924 sam	70100113 sam	20100128 sam
		20090527 sam	20090925 sam	20100114 sam	20100120.3dm
	My Recent	20090528.sam	20090926.sam	20100115.sam	20100130.san
C Pu	Documents	20090912.sam	20100101 sam	20100116 sam	20100131.san
4:	12	20090913 sam	20100102 sam	20100117 sam	20100201 san
s DZ	1	20090914.sam	20100103.sam	20100118.sam	20100202.sam
	Desktop	20090915.sam	20100104.sam	20100119.sam	20100203.san
Use correction file		20090916.sam	20100105.sam	20100120.sam	20100204.san
Apply holse filter		20090917.sam	20100106.sam	🗐 20100121.sam	20100205.san
		20090918.sam	20100107.sam	20100122.sam	20100206.san
Threshold[nT]: 50	My Documents	20090919.sam	20100108.sam	20100123.sam	20100207.san
		20090920.sam	20100109.sam	20100124.sam	20100208.san
		20090921.sam	20100110.sam	20100125.sam	20100209.san
		20090922.sam	🚾 20100111.sam	20100126.sam	20100210.sam
	My Computer	🔟 20090923.sam	🛅 20100112.sam	🛅 20100127.sam	🛅 20100211.sam
]		>
	My Network	File name:		•	Open
	Flaces	Files of type: Ma	gnetograms [*.SAM]	•	Cancel

E. Converting SAM text data files in SAM_VIEW

The SAM and SAM-III processors send text data to SAM_VIEW, which produces a magnetogram image. SAM_VIEW also can be used to convert daily yyyymmdd.txt files to yyyymmdd.sam files for archive viewing in SAM_VIEW and for use in other SAM application programs (SAM_BROWSER, SAM_STAT).

Select Convert – SAM-data . . .

le cun	t View Co	onvert Loggin	g Help		
nT		SAM-data Magnetstrod	-> *.SAM e-data -> *.SAM	😵 🚉	🥑 🏈 prage Alaska US
50 -					
			- 10 - 10 - L	-1X - 1X - 1 - 3X	8 8 8

A file selection window will appear, Select the desired text file and click Open.

Convert					? 🛛
Look in My Recent Documents Desktop My Documents My Computer	Data SAM_VIEW I 20100921.b 20100922.b 20100923.b 20100924.b	Images xt xt xt xt	_ 	← È → III-	
My Network Places	File name: Files of type:	20100924.bt Text files [*.bxt]		- [-]	Open Cancel

A dialog box will appear but it can be ignored. Click OK and yyyymmdd.sam and yyyymmdd.log files will appear in the data directory. The .sam file may be opened in any other SAM application program.

Include remark into SAM-header	
Remark:	
J	
Magnetic field component of 1-sensor system	
V OK	

F. Reading a SAM_VIEW Magnetogram

A magnetogram is a plot of magnetic field induction (nT) on the vertical axis with respect to time of day on the horizontal axis. SAM_VIEW plots relative values at the beginning of each UTC day. That is, SAM_VIEW looks at the last sample of the previous day for each sensor and then plots all subsequent samples for the new day relative to those values. Therefore, the SAM_VIEW magnetogram always starts at zero amplitude at the beginning of the day.



G. SAM_VIEW v2.8

SAM_VIEW version 2.8 includes several new features:

- Added time/date-stamped magnetogram image. SamView has always produced sam_data.png magnetogram image files but each new file overwrites the previous one. SamView now produces a date-stamped magnetogram image, one each day, for archiving purposes. The new file is placed in the same folder as the overwritten image file and is identified by the date-stamp in its filename. The folder is specified in Edit - Setup – Logging – Magnetogram directory menu.
- Added option to use the PC real-time clock to time/date-stamp incoming data from the SAM instrument. When this option is enabled, the first 17 characters (time and date) in the incoming data from the SAM are replaced with values taken from the PC's real-time clock. It is very important that the PC clock be set accurately. The PC clock option is in the Edit – Setup – Logging menu. See also item 3. below.
- 3. Added option to use a UTC offset for systems where the PC clock option is being used (see above) and the PC clock is set to a time zone other than UTC. When the offset is used the magnetogram time axis will be corrected to UTC. The range is ±12 hours. For time zones west of the prime meridian (west of 0° longitude), the offset is negative and for east of the meridian, the offset is positive. The Offset is specified in the Edit Setup Logging menu and is given the same value as in the PC's Date and Time setup window. For example, if the Time and Date window shows the time zone (UTC-09:00) Alaska, then the offset used in SamView is –9.

- 4. Added mouse-over feature whereby the Bx, By, Bz and time values are displayed on the status bar at the bottom of the SamView window. Place the mouse anywhere on the magnetogram where traces are shown and the status bar will show Bx, By, Bz and time. No values will be shown where traces have not yet been written.
- 5. Enhanced the polar diagram to show the Bx, By, dH and time values on the polar diagram when using the mouse-over feature above and also to show the time position of the mouse on the polar diagram trace. The value of dH is the change (delta) in the horizontal magnetic component (H is the vector sum of Bx and By). Select View Polar Diagram. The polar diagram shows a 2-dimensional view of Bx and By. Now move the mouse around on the magnetogram. The values of Bx, By, dH and time corresponding to the mouse cursor position are shown in the upper-left corner of the polar diagram. Also, an **X** marks the corresponding location of Bx and By on the polar diagram trace.
- 6. Added magnetic level offset to the chart. The display will start at 0000 UTC with previous day's magnetic data at 2359. Say Bx =50 nT at 2359 the previous day. When the offset is used, the chart will show Bx = 50 nT at 0000 of the current day. If the field increases to 150 nT at 2359 of the current day, the delta Bx for the current day is 100 nT. The next day will start at 0000 UTC with Bx = 100 nT (not 150). The level Offset option checkbox is in the Edit Setup menu next to the Autoscale checkbox.
- 7. <u>To upgrade</u>: SAM_View v2.8 requires the latest sam.bpl (v4.08) and LPng.dll library files, which are packed with SAM_View_v2-8.exe in the zip file. Copy the three files SAM_View_v2.8.exe, sam.bpl and LPng.dll to the same folder as the previous version of SamView (example, C:/SAM/), overwriting the old sam.bpl file. Unlike previous versions of SamView, v2.8 does not require additional libraries. However, all other SAM applications, such as SAM.ini, SAM_Convert and SAM_Browser, require the libraries described in the SAM-III Software Setup Guide.

Open the new SAM_View. The SAM_View version (v2.8) and date (17/Aug/2015) will be shown at the top of the main window. Click About. The sam.bpl version and date will be shown at the bottom of the window:



8. Report problems to the SAM-INTL Yahoo Group: https://groups.yahoo.com/neo/groups/SAM-INTL/info

IV. Connect Sensor and Check Chart

Connect the sensor to the SAM, SAM-III or SAM-II-X through the appropriate connector:

- SAM: 6-pin DIN connector X3
- SAM-III: Pluggable terminal block X2
- SAM-II-X: 6-pin DIN connector X3

The SAM processor immediately starts scanning the sensor signal.

Look in the SAM data directory specified when you setup SAM_VIEW. Within a few seconds a text file should appear:

• 20090426.txt (the number is the current date in YYYYMMDD format, so it changes daily)

After a moment the following NEW files should appear:

- sam_data.log
- sam_data.png
- sam_data.sam
- sam_data.txt

In the SAM_VIEW status bar, you also should see Logging... and the directory where the logging files are being placed (see below). If the data from the SAM-III has a valid date and time format, the Status bar has a normal background color. If the date and time formats are invalid, the Status bar background will be red. Invalid date and time formats usually are due to the SAM-III real-time clock being reset by, for example, removing the jumper block from JP2 or a bad battery.



Note: As previously explained SAM_VIEW normalizes the displayed data to zero at the beginning of each day or when a data file does not already exist. If the magnetic field is very quiet, zero values may be written during subsequent sampling intervals at the beginning of the data or beginning of the data file. SAM_VIEW does not display a trace until it detects a non-zero value in the data file. Therefore, if you do not immediate see a trace for a particular sensor, wait until there have been some changes in the field.

When sam_data.png becomes available, or is renewed, you can view the latest magnetogram with any image viewing program. If you want to view older magnetograms, you can use

SAM_BROWSER described later or plot the data using a separate application program. You also can load a sam_data.sam file into SAM_VIEW when it is not in logging mode.

You can change the directory where the data files are stored. In SAM_VIEW, go to Edit – Setup – Logging. The file directories can be changed at the bottom of the screen.

To save the current magnetogram as a bmp, jpg or png file: In SAM_VIEW select File – Store diagram . . .

	IL VIEW	Convert	Loggi	ід пер	The second second	1.1.1.1.1.1.1	
Stor	e diagram.	••			🔁 🖉	8	調査
🗶 Exit.	(i)				-		
200 -	1		1 1	1	15	1 1	T
			10 10	10	10	10 10	
20000			18 R.			6 6	

Select the file type, bmp, jpg or png, then Exit to go back to the SAM_VIEW main screen, or

Select Edit - Copy to clipboard . . . to copy the current magnetogram and then paste it into a picture viewing and editing program or any program that accepts pasted images.



<u>Note</u>: To view older magnetograms "offline", use SAM_BROWSER or SAM_STAT described later. These programs use the archived *.sam text files to generate magnetograms based on the data stored in the file.

V. Posting Real Time SAM_VIEW Chart Images on the Internet

A. Introduction:

If SAM magnetograms (sam_data.png image files) are to be viewed on the internet, they must be sent to a website by FTP. If you wish to participate in the SAM Magnetometer Project at www.sam-magnetometer.net, both sam_data.png and sam_small.png image files must be placed on a website accessible by the project (refer to the section describing how to setup SAM_VIEW for settings to produce both images files). This section describes how to setup a File Transfer Protocol program for this purpose.

Anyone who uses File Transfer Protocol (FTP) software tools knows they are not all the same. When you find one that works the way you expect it to work with your application, you stick with it.

FTP-WatchDog is such a program and it works very well with SAM_VIEW. SAM_VIEW prepares a chart image file (sam_data.png) and, optionally, a chart thumbnail image file (sam_small.png) every couple minutes and places it in the folder specified in the SAM_VIEW Logging Setup menu. FTP-WatchDog detects the new file and sends it using FTP to a web location of your choice where it can be viewed on a browser.

The FTP-WatchDog user interface is in German, so if you are unable to read it, the translations below will help you setup the program for use with SAM_VIEW.

B. Installation:

- Download the free installation program ftp-watchdog-setup.exe from: http://toolsandmore.de/Central/Produkte/Software/Internet/Webmaster/FTP-Watchdog/
- 2. Run the program and it will install itself in the Program Files folder and then open. Refer to the screenshot below and the next section. The original program has German language text, and the screenshot shows English translations.

O Save Settin Open Settings v Settings =	gs		About	Exit program		
FTP-Wate	ndog - [Unber	nannte FTP-Einstellung	2			
	4	2 2 1		G		Passive FTP
FTP Serve	r Name	Name des FTP-Servers:	eeve.c	com		Passives FTP:
FTP Use	name	FTP-Benutzername:	reevec	om		
FTP Pas	sword	FTP-Passwort	иникки	жж		Only 1 Level
Local Dir	ectory	Lokales Verzeichnis:	c:\Prog	gram Files\SAM\Data\		Nur 1 Ebene:
FTP Dire	ectory	FTP-Verzeichnis:	/www.	reeve.com/SAM		
Text File	Types	Textdateitypen:				
Binary File	Types	Binärdateitypen:	sam_d	ata.png		
Patterns to b	e Ignored	Zu ignorierende Muster:	Con	vert Filenames 🔍	No	: Retain 🔍
Watchdog	Enabled	Watchdog aktiv:		Dateinamen wandel	n: Nein: Be	eibehalten
Ignore I	rrors	Fehler ignorieren:	ন	Upload-Interva	II: sofort -	– Immediately
Play Sc	unds	Sounds abspielen:	Г	Löschen von Dateien	auf FTP-S	erver bestätigen:
Autostart	Enabled	Autostart aktiv:	-	Upload interval 🗐 📙	- Delete Fil	es from FTP Server

C. Setup and Use FTP-WatchDog:

- 1. Refer to the screenshot, and fill in or check the following fields:
 - FTP Server Name (use the format shown)
 - FTP Username (must match the username allowed access to your FTP site)
 - FTP Password (must match the password allowed access to your FTP site)
 - Passive FTP (if the PC running FTP-Watchdog is behind a router with Network Address Translation (NAT) enabled, checking this box will make file transfers much more reliable)

Now fill in the following fields:

- Local Directory
- FTP Directory

The Local Directory is where the image file is located and is the same folder used by SAM_VIEW (be sure they match), and FTP Directory is where the image file is to be sent (typically a folder on your website). Leave the Text File Types and Patterns to be Ignored fields blank.

Fill in the following field with the SAM_VIEW image filename and extension:

• Binary File Types

The default image filename in SAM_VIEW is sam_data.png. Other filenames and extensions can be used but they must match the filename and extension specified in this field.

Do not put any path information in this field (the path is specified in the FTP Directory field). Be sure there are no other .png files in the local directory specified above except sam_data.png and, optionally, sam_small.png.

Leave the Text File Types and Patterns to be Ignored fields blank.

Check the following boxes (leave Play Sounds unchecked unless you want to be driven crazy):

- WatchDog Enabled (check to allow FTP-WatchDog to send files; uncheck if you want it to stop)
- Ignore Errors (check)
- Autostart Enabled (check to cause FTP-WatchDog to automatically start when you reboot the PC; uncheck if you do not want the program to automatically start sending on reboot)

The remaining fields on the lower-right should be setup exactly as shown:

- Change Filename uppercase/lowercase: No
- Upload Interval: Immediately
- Confirm deletion of data from FTP Server (uncheck)

After you have everything setup properly, click the Save icon on the Toolbar. The default filename is Unnamed FTP-Setting.ftpwd (in German). If desired, change to another name, such as SAM_VIEW_setup. At this time FTP-WatchDog should start sending files. The howling dog icon in the taskbar system tray should indicate that FTP-WatchDog is active (green).

- 2. You can setup different configurations and Save as many of them as you need. Ordinarily, one is sufficient. When FTP-WatchDog starts, it automatically loads the last used Settings file. You can manually load a Settings file by clicking the Open icon or setup a new file by clicking the New icon on the Toolbar.
- 3. If you have problems getting file transfers to work properly, click the Open Log File icon on the Toolbar. Although the logs are in German, it should be apparent what is causing the problem. Alternately, you can use translate.google.com to translate the logs. Copy the log entry in question and Paste it into the Google text entry box. Be sure to select German > English translation in the dropdown boxes. If you want to start fresh logs, click the Delete Log File icon.
- 4. To hide the user interface, click the Hide icon on the Toolbar. This will hide the interface window but the program will continue to run in the background. As long as you see a

howling dog icon in the taskbar, FTP-WatchDog is running. If the icon is red, it is disabled and not sending; if the icon is green, it is enabled and sending.

- 5. To shutdown and exit FTP-WatchDog, click the Exit icon on the taskbar. This will terminate the FTP session and shutdown the program.
- 6. To restart the program, from the main Windows screen go to Start All Programs Tools&More – FTP-Watchdog – FTP-WatchDog. FTP-WatchDog automatically loads the last saved Settings file. If WatchDog Enabled was checked, the program will start sending immediately and the taskbar icon should be green. If WatchDog Enabled was not checked, the icon will be red. Click the taskbar icon and the user interface window will appear. Check the WatchDog Enabled box and click Save. The taskbar icon should turn green, indicating that the program is sending.
- 7. If desired, you can put a Shortcut on your Desktop by right-dragging the FTP-WatchDog.exe file from the folder C:\Program Files\Tools&More\FTP-Watchdog to the Desktop and selecting Create Shortcuts here.
- 8. Test the Autostart Enabled feature by rebooting the PC. FTP-WatchDog should automatically start and you should see the howling dog icon in the taskbar. The icon should be green if WatchDog Enabled is checked in the Settings file.
- 9. To uninstall the program, from the main Windows screen go to Start All Programs Tools&More FTP-Watchdog Deinstallieren.

Now that the chart image files are being sent to an internet website, a small HTML program is required at the website to allow display in a browser. See the next section.

VI. Internet Viewing

To view your magnetograms on the internet, the magnetogram images must be sent to a web server. Setup of a web server is beyond the scope of this manual but example HTML code is given here. Save the code below as an HTML file (for example, SAM_display.html) and place on the same webpage as the sam_data.png image file.

```
<html>
<head></head>
<body style="background-color:#c0c0c0">
          <hr><center>This page reloads the latest magnetogram every 2 minutes<hr>
          <img src="sam data.png" name="myImageName"></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center></center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</center</
          <script type="text/javascript">
function reloadImage() {
    var now = new Date();
     if (document.images) { document.images.myImageName.src = 'sam data.png?' +
now.getTime(); }
    setTimeout('reloadImage()',120000);
}
setTimeout('reloadImage()',120000);
          </script>
</body>
</html>
```

When a browser goes to the webpage holding the sam_data.png image file and this HTML file, it will display the image and automatically reload a new one every 2 minutes (120,000 ms). For example, the Reeve Observatory webpage is http://www.reeve.com/SAM/SAM_simple.html; in this case the filename for the code is SAM simple.html.

VII. Filter Options in SAM_VIEW

The SAM has three filter options, Offset, Noise and Correction. Select the filtering option from the View – Load Curve . . . menu. The filters may be used in any combination as described below. <u>Important Note</u>: The filters do not change the original stored SAM data values, they change only the chart display.

<u>Offset filter</u>: The Offset filter causes SAM_VIEW to ignore step changes in the measured geomagnetic field. Step changes occur when an automobile is parked in the vicinity of the sensor, metallic tools are left near the sensor and similar reasons. Generally, the Offset filter should be selected unless you have a good reason not to use it.

Be careful using the offset filter if your observatory is located at northern latitudes (> 60 deg. geomagnetic), you probably will not use the Offset filter because the geomagnetic field naturally is more active than at mid- and low-latitudes. In this case, the Offset filter may misinterpret the onset of a geomagnetic storm. This is seen on the magnetogram as a step change in the magnetic induction that persists as shown in the left magnetogram below. If your magnetograms show step changes from natural causes then turn off the Offset filter and the magnetogram will look normal as shown in the right magnetogram below. If you use the Offset filter, you will need to set a threshold value. The threshold value should be determined experimentally, but 10 - 20 nT is a good starting point.

automatically makes the correction to the displayed curve. The filter is very reliable but may fail in case of a large geomagnetic storm with very fast fluctuations.

<u>Noise filter</u>: The Noise filter, described below, applies a smoothing (averaging) function that smoothes the data displayed in SAM_VIEW. Use the Noise filter if your magnetogram is noisy due to local interference. However, at northern latitudes, the Noise filter will mute some of the natural activity shown on the chart. Experiment with the Noise filter to determine if it is necessary in your installation.

SAM_VIEW holds a list of 1440 elements representing the magnetic induction for each minute of the day. The noise filter is intended suppress measurements of short magnetic deviations caused by environmental

influences. The filter algorithm determines a filtered value for every minute of the day. Filter efficiency is increased by evaluating measurements before and after a particular time value.

For small variations (\leq 20 nT) within a 7-minute window, the filter displays the mean value and flattens the cuve. For larger variations the filter uses the median value. This does not change the original values and, in case of a geomagnetic storm, the curve usually is not altered and keeps its original amplitude.

Filtering is done in three steps:

- 1. For each minute i of the day a list of the following values v is created: v_{i-3} , v_{i-2} , v_{i-1} , v_i , v_{i+1} , v_{i+2} and v_{i+3}
- 2. The maximum difference d_{max} of the values $v_{i\text{-}3} \ldots v_{i\text{+}3}$ is computed.
- 3. The new value of v_i is computed depending on d_{max}
 - If $d_{max} \le 20 \text{ nT}$ then $v_i = \text{mean}(v_{i-3} \dots v_{i+3})$ If $d_{max} > 20 \text{ nT}$ then $v_i = \text{median}(v_{i-3} \dots v_{i+3})$

<u>Correction filter</u>: The Correction filter allows you to manually correct data errors displayed in SAM_VIEW. Both the Offset and Noise filters are very effective in eliminating most disturbances in the ambient geomagnetic field (for example, automobiles or other ferromagnetic objects moving in the vicinity), and manual Correction is necessary only when these filters are not able to correct automatically. SAM data often contains errors from manmade disturbances to the ambient geomagnetic field. These manmade disturbances can be manually corrected in the dataset so that after correction a clean magnetogram reappears. SAM_VIEW can be left running while you are correcting the data, and no data will be lost during the correction process. Correcting does NOT change the original data, it simply



creates a .kor file where the corrections are stored. The procedures following show how to use the Correction filter.

<u>Using the Correction filter</u>: To make corrections start SAM_VIEW, and click on the icon shown below or select View – Load Curve.



Ø SAN	1-¥iew ¥1.10	Č.
File E	dit View Co	nvert
nT	SAM Fels	berg i
200	K 3	K
150	,K0;	K

Curve selection	
Curve1 C	Curve 3
C Curve 2 C	° Curve 4
Vector selection	1:
C Bx C B	2:
C By 💽 Auto	3.
C Bz	4.
 Use correction fi Apply noise filter Apply offset filter 	le? ? 3
Threshold[nT]:	10 🚖
	-

Set the following options:

- Curve 1 (ON)
- Vector selection Auto (ON)
- 🗹 Use correction file

- Threshold [nT] (sets offset filter threshold; does not apply when offset filter not selected)

Press OK. In the next window that pops up, select sam_data.sam and open the file.

<u>Note</u>: If SAM_VIEW is just writing the .sam file at the moment you try to open it, SAM_VIEW will crash. Wait for an update, than load sam_data.sam. To prevent the crash you also can stop the logging during the correction period.



The latest chart is loaded. Open the correction menu with the Manual Curve Correction button on the menu bar. See screenshot below.



In the chart below the disturbances are marked with blue arrows. The correction menu is to the right. Maximize the window for the easiest recognition of errors.

To recognize that smaller disturbances are not naturally occurring, you have to know your surroundings and have some experience with how the geomagnetic field is affected by everyday events. After a while you can easily see the problems and correct them. Therefore, if you just finished the kit and the sensor still is indoors, let the system run for several days or weeks so that you can learn to recognize various disturbances and correct them as much as you can.



This example will start with the error around 08:00 UTC. This one is clearly visible in Z (green line) but also weakly in Y (red line). See illustration below; the numbers and arrows in this illustration correspond to the numbers in parentheses in the text description that follows.



First, select the curve you want to adjust (in this case curve 1) at the top of the Manual Curve Correction menu. Move the cursor to the location on the curve where the correction is required. When the cursor is placed over the curve the cursor changes from an arrow to a cross (1).

Right-click on the curve at the correction location. The time and value for this location is highlighted in blue (2) in the Manual Curve Correction menu. This selection method is not exact so the disturbance may actually be a few lines earlier or later than the highlighted value. In this example the marker jumped to 08:00 UTC, but the real error is at 08:02 UTC. The difference between the actual error location at 08:02 and the previous time interval (08:01) is (305 – 314 =) –9 nT. At this point, the fields for "Reference data", "Correction data" and "Offset" are empty.

To correct the error, left-click the value before the error (in this case, 08:01: 305). The values are then set in "Reference data" and "Correction data". The program calculates the offset and sets it in the "Offset" field. Because the second value is higher than the first the correction is a negative value. Now click Apply to confirm the correction.



The correction is now made and the error is no longer visible (the disturbance or error was removed). If you made a mistake simply press Undo. This only works for the last correction you made; you cannot undo changes before the last one. The only option if you made several mistakes is to press Cancel and load the curve again. Continue correcting this curve as indicated in the first example.

Now correct the first error in Curve 2. Select curve 2 in the Manual Curve Correction window (1) and right-click on the error in the graph (2). The numbers in parentheses correspond to the chart below.



Check the highlighted line to make sure it contains the error (2a). In this case, the error is two lines later (3) than the selected value. Left-click on the correct line (4) and click Apply (5). Continue correcting all errors in a similar manner. A list of corrections will appear in the correction field (center right).

Refer to the following chart. The correction list (1) and curves should now look like this.



When all corrections are done they must be saved by pressing Store (3). All corrections are

saved in a ".kor" file. This file can be opened with a text editor, such as Notepad, and mistakes can be removed or fixed.

SAM_VIEW must be told to use the correction file. Select View – Load Curve . . . and select Use correction file and the other filters as necessary:

- 🗹 Use correction file (1)
- Apply Noise Filter (2), to smooth the graph (see previous caution for northern latitudes)
- Apply Offset Filter (3), to limit sudden offsets larger than threshold value
- Threshold [15] (4), this sets the blocking limit for offsets. Generally, 15 should be okay but in a busy town 10 may be needed



Click OK (5) and the Load SAM-Magnetogram window will pop up.

Select the sam_data.sam file and click Open (see below).

Load SAM-Magne	togram			<u>? ×</u>
Look in:	🔁 sam	•	+ 🗈 💣 🎫	
History History Desktop My Documents My Computer	Dicloader zipfiles 20030211.sam 20030318.sam sam_data.sam			
	File name:	sam_data.sam	•	Open
My Network P	Files of type:	Magnetograms [*.SAM]	_	Cancel

The corrected magnetogram will appear (see below).



After a while new errors may become apparent and can be corrected. However, <u>do not forget</u> to deactivate the filters before correcting the data.

<u>Note</u>: The original .sam data file is not altered in any way by the corrections.

VIII. Additional Application Programs

A. SAM_BROWSER

SAM_BROWSER can be used to view archived SAM data files (yyyymmdd.sam) as magnetograms. If necessary, first use SAM_VIEW or SAM_CONVERT to convert daily text data files (yyyymmdd.txt) to SAM data files (yyyymmdd.sam).

Run SAM_BROWSER.exe. SAM_BROWSER can display two charts in the left frame as shown below.



The location of the data files to be used by SAM_BROWSER is selected in the right-hand frame. To view a particular day in the upper chart, click on the upper chart (a red arrow will appear to the right of the chart) and then select the date in the middle frame (in the above example, July 21, 2009). Similarly, to view another day on the lower chart, click on the lower chart and select the date in the middle frame. All dates and times are in UTC.

Additional functions:

- Double-click on a chart to open it in a larger window
- Right-click at a certain nT value on the chart changes the chart offset
- Activating filter checkboxes adjacent to each chart immediately applies the selected filter
 A Offset filter

O à Offset filter

F à Noise filter C à Use correction file

B. SAM_STAT

SAM_STAT is used to build statistics from the SAM data files in the form of a Bartels Diagram, named after its inventor Julius Bartels. Bartels defined a calendar based on observations of daily geomagnetic activity, which over long periods recurs at a rate very close to 27 days. [Bartels] The equatorial rotation rate of the Sun also is close to 27 days, so there is no question the two are related. In 1934, Bartels assigned Day 1 of Rotation 1 to 08 February, 1832. Day 1 of Rotation 1001 was 17 January, 1906 and Day 1 of Rotation 2400 was 12 June, 2009.

The SAM_STAT program user interface is shown below. The data file location is specified in the left-frame, and the corresponding data files are shown in the next frame to the right. Select the filters and correction file as necessary then click on the K-Index button. The K-Index frame will then be populated with the K-index data extracted from the SAM data files, and the K-index data automatically will be saved as a .sak file. Once the K-index data has been extracted, it is not necessary to do it again unless the underlying files change or you need to change a filter setting.



Press the Chart button and the Bartels Diagram will pop up as shown below.¹

¹ This chart is for illustration only and may not include accurate data.



The rotation start date or rotation number can be selected at the lower-left of the window. Click the Save button to save a .png image file to the data directory. If the Generate preview selection box is checked, the saved image will include a smaller version.

Remarks:

- The K-Index button generates .sak-files for all SAM data files in the current directory. In this way the Filters settings apply to all data files when generating the Bartels Diagrams. Therefore after changing Filter settings, press the K-Index button to update the .sak files with the new Filter settings.
- When using SAM_STAT, remember that the charts are only as good as the K-index settings for the geomagnetometer station.

Additional functions:

- Main Window: Left-click on a particular data file (.sam) or K-index file (.sak) or use the up/down keys to load the corresponding magnetogram chart in the main window
- Chart (Diagram) Window: Left-click on a particular date to load the corresponding magnetogram chart in the main window
- In a system with more than one sensor, SAM_STAT uses the sensor with the highest K-Index value

References:

[Bartels] J. Bartels, Twenty-Seven Day Recurrences in Terrestrial Magnetic and Solar Activity, 1923-33, Terrestrial Magnetism and Atmospheric Electricity, Vol. 39, No. 3, Pg 201– 202a, 1934

C. SAM_CONVERT

SAM_CONVERT can be used to convert data files produced by SAM_VIEW (yyyymmdd.txt) to the SAM format (yyyymmdd.sam). Unlike SAM_VIEW, which converts one file at a time, SAM_CONVERT converts all data files in the selected directory at the same time.

Run SAM_CONVERT.exe. Use the left frame to navigate to the directory where the text data files are located. Text files that do not have a corresponding SAM file are shown in the middle frame with the "No Sam" icon as shown below.

To produce SAM files, click on the Convert button at top-right of the window. As each file is converted, its corresponding icon will change to "All ok" as shown below. SAM_CONVERT also

SAM_Convert V2.0a				×
SAM-logfiles: OpenOffice.orc Outlook Expres PC-Doctor Picasa2 Picasa2 Picasa2 Picasa2 Picasa3	20101012.txt 20101015.txt 20101018.txt	 20101013 kM 20101016 kM 20101019 kM 	20101014.txt 20101017.txt	Convert

produces .log files. The .sam files are now ready for use in other SAM application programs.



IX. SAM Magnetogram Image Size

The following sections are incomplete and have not been edited to include areas outside of Europe and Scandinavia. Users should feel free to experiment and report their results to the SAM-International Yahoo Group.

A. Introduction

The size of the magnetogram picture can be adjusted, but it must meet certain requirements:

- It has to look good
- It has to be readable
- The most common magnetic conditions and variations have to fit in the picture
- The diagram must have equal distances for equal variations, both for time and field scales
- The diagram has to fit on all screen resolutions
- The picture size in bytes should not be too large, this would only cause upload and download delays

To meet these requirements, refer to the following tables.

B. The Time axis:

To get a proper time axis we first have to determine what time resolution we want to use. The total width of the picture is: 45 (left margin) + (24x pix/hour) + 2 (extra) +20 (right margin) pixels. Below you'll find a table in which for each resolution the total width of the picture is calculated.

Magnetogram time axis formats (min/pix)		
Resolution (min/pix)	Picture width (pix)	
1	1503	
2	786	
2.5	642	
3	546	
5	354	

The best compromise is the 2.5 minute per pixel resolution.

C. The Magnetic axis

For the resolution of the magnetic axis you should first decide what scale you would like to use.

Currently there are a few options available. Fixed scales of 100 nT (from +100 to -100 nT), 150, 200, 250, 500 and 1000 nT and a variable scale that starts at 60 nT but will rescale as soon as the limits are reached.

After determining the scale, choose a resolution (nT / pix). Given the accuracy of the SAM sensor a resolution of 2 nT/pix is justifiable. The total height of the image is as follows: 27 (top margin) + 1 (end of scale) + (scale/resolution) + 1 (the 0-line) + (scale/resolution) + 1 (end of scale) + 26 (bottom margin) pixels. Below you will find a table in which the total height of the image is calculated for each resolution and scale.

Magnetogram Magnetic axis formats		
Resolution (min/pix)	Picture height (pix)	
0.5	296 (60 nT), 456 (100 nT)	
(Southern Europe) 1	256 (100 nT), 356 (150 nT), 456 (200 nT)	
(Central Europe) 1.25	296 (150 nT), 376 (200 nT)	
2	256 (200 nT), 306 (250 nT)	
2.5	216 (200 nT), 256 (250 nT), 456 (500 nT)	
(Northern Europe) 4	306 (500 nT)	
5	256 (500 nT), 456 (1000 nT)	
(Northern Scandinavia + Iceland) 8	306 (1000 nT)	

D. Setting the image size in SAM_VIEW

For your local settings in SAM_VIEW look at the table below (the end result for central Europe can be seen below the table).

Location	Magnetic Scale (SAM_VIEW setting)	Image size (width x height)
Northern Scandinavia	1000 nT	642 x 306 pix
Northern Europe	500 nT	642 x 306 pix
Central Europe	200 nT	642 x 376 pix
Southern Europe	100 nT	642 x 256 pix



SAM Magnetometer - Appendix

X. Configuration File sam.ini

The configuration parameters for SAM_VIEW and other SAM application programs are saved in sam.ini in the C:\Windows directory. Most parameters are in German, and the table below provides a translation to English. Generally, a parameter value of 1 indicates the field is checked or activated in the application program setup, and a value of 0 indicates the field is not checked or deactivated. Note: A given sam.ini file may not have all the parameters listed below or they may be in a different order depending on the SAM_VIEW version and how SAM_VIEW was setup. The sam.ini file may be opened in a text editor, such as Notepad. However, it is recommended that sam.ini be changed only through the application programs, such as SAM_VIEW, and not through manual editing of the sam.ini file.

German	English
[Diagram]	[Chart]
Left=362	Left = 362
Top=64	Top = 64
Width=650	Width = 650
Height=479	Height = 479
K-Wert=1	Display K-index
K-Summe=1	Display for each curve
K-Farbbalken=1	Display ccolor bars
Kurvel-K-Wert=1	Include curve 1 for K-index = 1
Kurve2-K-Wert=0	Include curve 2 for K-index = 0
Kurve3-K-Wert=0	Include curve 3 for K-index = 0
Kurve4-K-Wert=0	Include curve 4 for K-index = 0
Skalierung=3	Scale = 3
Auto-Skalierung=1	Autoscale = 1
Alarm=1	Alarm display = 1
Alarmschwelle=4	Alarm threshold at K \geq = 4
Color1=8388608	Color for curve 1 =
Color2=255	Color for curve 2 =
Color3=32768	Color for curve 3 =
Color4=0	Color for curve 4 =
bkColor=16777215	Background color =
Korrektur=0	Correction = 0
Filter=0	Filter on/off =
Offset-Filter=1	Offset filter =
Offset-Filter-Limit=50	Offset filter step =
Label1=Bx	Label for curve 1
Label2=By	Label for curve 2
Label3=Bz	Label for curve 3
Label4=B	Label for curve 4
	[Legend and title setup]
Titel=\$LOCATION\$ (\$COORD\$ - \$LOCATOR\$) Data Starts at \$DATE1\$ / \$TIME1\$ UTC	Chart Title =
Autolegende=1	Auto-legend =
Datum in Legende=1	Date in legend =
Bemerkung in Legende=0	Remark in legend =
Legende-Stil=1	Legend style = 1
Aktivitaet=1	Activity window = 1

SAM Magnetometer - Appendix

[Verzeichnisse]	[Directories]
Bilder=C:\Program_Files\SAM\Data	Magnetogram directory =
Datenverzeichnis=C:\Program Files\SAM\Data	Data directory =
[Batch]	[Logging]
	[Output setup]
Bildformat=2	Image format = 2
Vorschau=0	Generate preview = 0
Vortag=1	Display vesterday = 1
WAP=0	Generate WAP-output
HTML=0	Generate HTML-output
	[General]
Intervall=1	Interval (min) = 1
	FTP-timeout(s) = 75
	FTD-unload every 10 (interval)
	FTP command =
[bitgitam size] Standard-1	Standard - 1
Braita-6/3	Width = $6/3$
	Height = 376
	neight - 370
[COM_Dowt]	[COM-Boxt]
	[COM-FOIC]
FOLCOMS	
[SN_Worder]	[ChM_Hondon]
[Junt Header]	Station name -
	Location -
Of Children of the SA	Location -
Lange-143.557W	
	IACICULE -
	Pemarka -
Nental KS-	Nemarks -
IV Needl	[K Index Mehle]
	[K-Index Table]
N3-100 V5-208	
KJ-200 V(2,400	
NO-400 NO-400	
K/=/32 K2=1200	
N0-1200	
[SAM Browson]	[SAM Prover]
[Date_blowset]	Data directory =
Datemverzeichnits-C; (riogram files SAM Data	Data utrectory -
Offort_Filtor1=1	
VIISEL_LIICELL_T	

SAM Magnetometer - Appendix

Offset-Filter2=1	
Korrektur1=1	Correction 1 =
Korrektur2=1	Correction 2 =
Left1=0	
Top1=0	
Width1=800	
Height1=600	
Left2=0	
Top2=0	
Width2=800	
Height2=600	
[MMC]	
MMC_Drive=c	

SAM Magnetometer – Revision history

Document History

<u>Author</u> :	Whitham D. Reeve, Anchorage, Alaska USA
Copyright:	© 2009, 2010, 2011, 2012, 2013, 2014 W.D. Reeve
Revision history:	Iss. 0.0 (Initial draft started, May 1, 2009)
	Iss. 0.1 (Substantial edits, August 1, 2009)
	Iss. 0.2 (Incorporated K. Hansky comments, August 6, 2009)
	Iss. 0.3 (Add'l edits, August 11, 2009)
	Iss. 0.4 (Add'l edits per K. Hansky comments, August 13, 2009)
	Iss. 1.0 (Issued for publication as Preliminary, August 13, 2009)
	Iss. 1.1 (Edit filters section, August 14, 2009)
	Iss. 1.2 (Edit SAM_VIEW section, December 18, 2009)
	Iss. 1.3 (Add sam.ini translation and Activity window, January 3, 2010)
	Iss. 1.4 (Add Sam-Magnetometer.net and numbered, January 24, 2010)
	Iss. 1.5 (Add SAM_INI problems discussion, TOC, April 16, 2010)
	Iss. 1.6 (Add information on filters, June 11, 2010)
	Iss. 2.0 (Add SAM-III information, July 27, 2010)
	Iss. 2.1 (Minor edits, September 20, 2010)
	Iss. 2.2 (Edits for file conversion and some cleanup, October 29, 2010)
	Iss. 2.3 (Minor edits, January 29, 2010)
	Iss. 2.4 (Noise filters, alarm, minor edits, June 30, 2011)
	Iss. 2.5 (Minor edits, 18 March 2012)
	Iss. 2.6 (Updated K-index explanation, 19 December 2012)
	Iss. 2.7 (Added info on SAM_VIEW shortcut, 11 Sep 2014)
	Iss. 2.8 (Reformatted, 11 Jun 2016)
	Iss. 2.9 (Incorporated SAM_VIEW v2.8 details, 24 Apr 2021)
<u>Note</u> :	The basic contents of this manual, including SAM logos, were taken from the
	original designer's website with their permission. The manual was then revised
	to reflect the current SAM software configuration and to translate some of the
	details that originally were in German. Please let us know if you find errors –
	send an email to SAMinfo@reeve.com with "SAM Kit" in the subject line (or else
	your email may be caught by our spam filters).

Total word count: 13824 File size: 4173824B