



# **SIMPLE AURORA MONITOR**

**~SAM-III~**

**3-AXIS GEOMAGNETOMETER**

**SOFTWARE SETUP GUIDE**



## **SAM Software Setup Guide**

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# SAM & SAM-III Software Setup Guide



## Basic software installation procedures

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### 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

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- **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 *B<sub>x</sub>*, 5,000 nT for *B<sub>y</sub>* and 43,000 nT for *B<sub>z</sub>* at 2359:59 UTC. At 0000:00 SAM\_VIEW normalizes these to 0 nT for *B<sub>x</sub>*, 0 nT for *B<sub>y</sub>* and 0 nT for *B<sub>z</sub>* 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**

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## 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.

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### 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 USB-serial adapter. Some experimentation may be needed to find the most reliable adapter. USB-serial 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.**

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### 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:

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Platform	Operating system firmware
SAM	SAM_ENG.HEX
SAM-II-X	SAM2X_ENG.HEX
SAM-IIISAM3	SAM3_ENG.HEX
SAM-IIISAM3T	SAM3T_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

- 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
- 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 (,)
- 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

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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 (,)

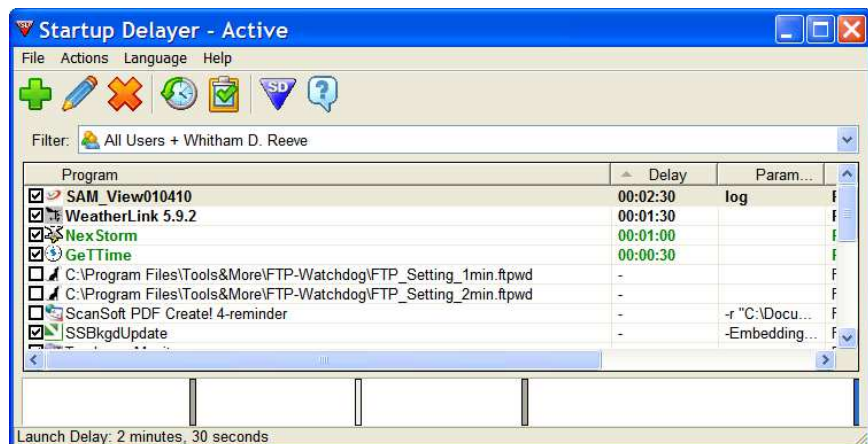
- d) SAM or SAM-III with temperature sensing firmware only: Field T.T is temperature if the optional temperature sensor is equipped. If not, the field will show 0.0. The example in B.1 shows the temperature sensor is not equipped (0.0). The SAM-III and SAM-II-X do not support optional temperature at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

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## 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.



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## D. Software Installation

The software files provided on the supplied CD are the latest appropriate versions at the time of shipment. Follow the next two steps carefully. 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.

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2. Copy all document files and folders 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.
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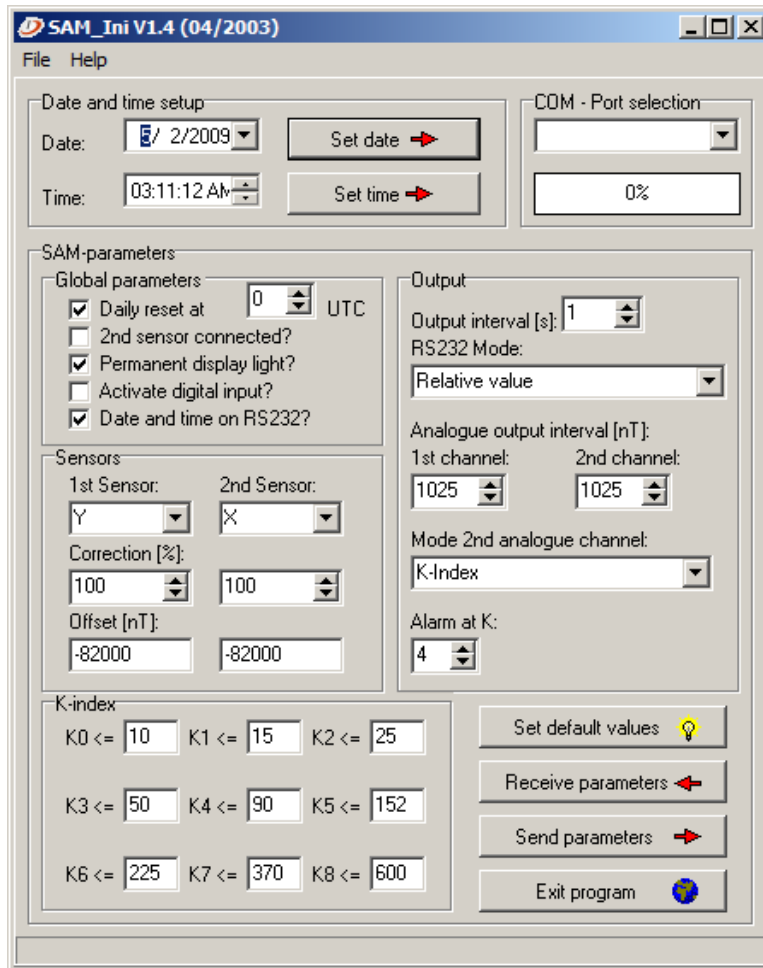


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## E. Initializing the SAM Processor

### 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: BE SURE YOU ARE USING SAM\_INI.exe AND NOT SAM\_INI.exe Version 2 or later**)



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

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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 0 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.)

Note: 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.

## Sensors

### 1st Sensor

Correction (%) 100  
Offset (nT) -82000 (see note)

### 2nd Sensor

Correction (%) 100 (see note)

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Offset (nT)      -82000 (see note)

Note: The default Correction and Offset parameter values shown above are good starting points for the FGM-3 and FG-3+ sensors. It has been found experimentally that the offset for the FG-3+ sensor is -71326 nT. This may be used as an alternative value to the default -82000 nT. You can change the values to compensate for local anomalies or variations in the sensors. 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 or FG-3+, you will need to change the Correction to 43% and Offset to [TBD] nT.

The correction and offset values may need to be adjusted 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.

## K-Index

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

Note: 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](http://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).

## Output

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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
RS232 Mode	
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

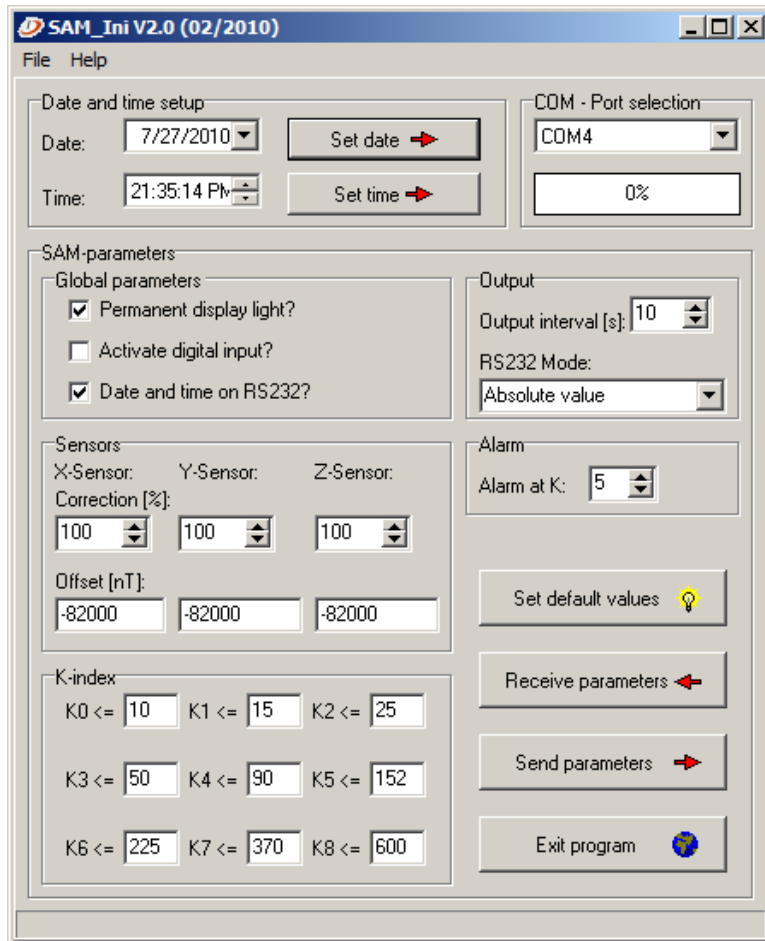
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threshold has to be reached within 20 minutes to activate the alarm. The recommended setting is  $K=4$  because a change to  $K=4$  within 20 minutes is a good indicator that a magnetic storm is starting. Also, when the threshold is reached, the keyboard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

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

Open SAM\_INI.exe Version 2.0 or later



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.

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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.)

Note: 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 a PC's real-time clock and common time synchronization protocols.

## Sensors

### X-Sensor

Correction (%) 100  
Offset (nT) -82000 (see note)

### Y-Sensor

Correction (%) 100  
Offset (nT) -82000 (see note)

### Z-Sensor

Correction (%) 100  
Offset (nT) -82000 (see note)

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Note: The default Correction and Offset parameter values shown above are good starting points for the FGM-3 and FG-3+ sensors. It has been found experimentally that the offset for the FG-3+ sensor is -71326 nT. This may be used as an alternative value to the default -82000 nT. You can change the values to compensate for local anomalies or variations in the sensors. 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 or FG-3+, you will need to change the Correction to 43% and Offset to [TBD] nT.

The correction and offset values may need to be adjusted 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.

## K-Index

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

Note: 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](http://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).

## Output

Output Interval (s)

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



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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

## RS232 Mode

### 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

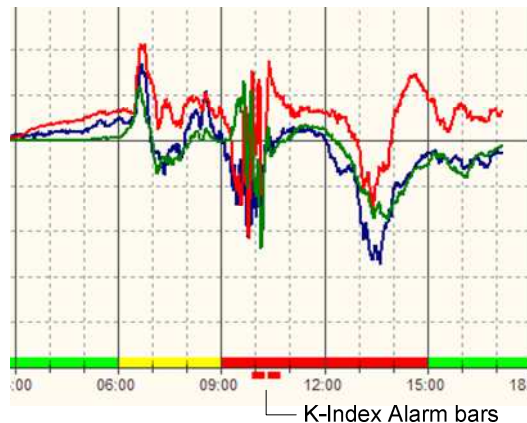
Sum of relative and absolute values

### 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 appear below the horizontal axis of the SAM\_VIEW magnetogram (illustration right)



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## F. Send INI data to the SAM

Upload the settings to the SAM as follows:

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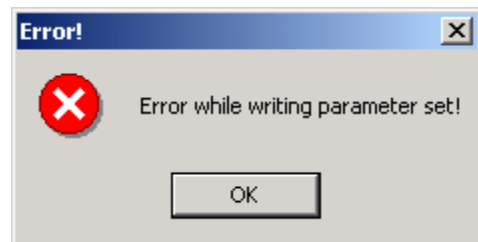
- Press the F1 function key on the SAM or SAM-III to put it into Command Mode. The keyboard LED should flash ~2 Hz rate and the display will indicate COMMAND:
- Click the Send Parameters button in SAM\_INI

The SAM display should show Parameters ← 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.

Note: 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.

Note: 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.

# SAM & SAM-III Software Setup Guide

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.**

---

# SAM Magnetometer Setup Guide

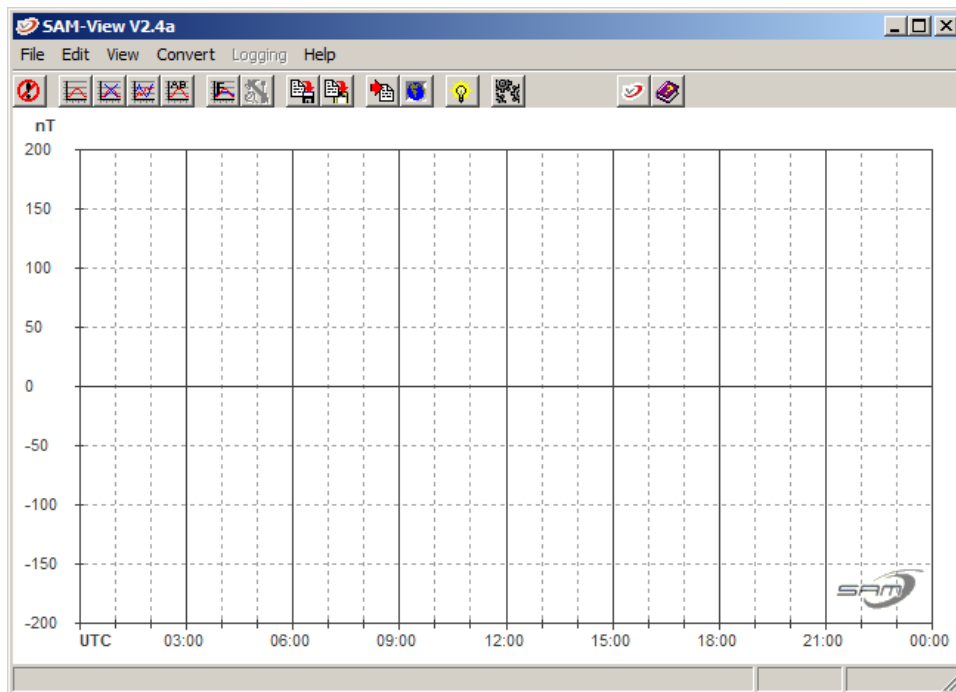
## III. Configure SAM\_VIEW

**NOTE:** 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.

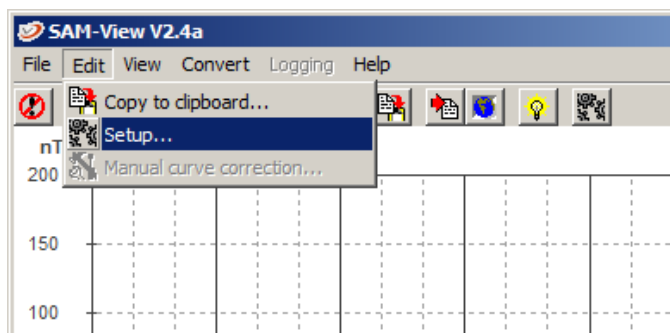
### A. Setup SAM\_VIEW.exe

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



# SAM Magnetometer Setup Guide

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

Note: 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
  - $K0 \leq 5$
  - $K1 \leq 10$
  - $K2 \leq 20$
  - $K3 \leq 40$
  - $K4 \leq 70$
  - $K5 \leq 120$
  - $K6 \leq 200$
  - $K7 \leq 330$
  - $K8 \leq 500$

Note a: 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 identify a geomagnetic storm by showing a red bar just above the chart time axis.

Note b: 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  $K \geq 4$  (adjust to meet your preference)

Note: 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.

# SAM Magnetometer Setup Guide

- 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

Note a: 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.

Note b: 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

Note c: 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.

Note d: 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.).

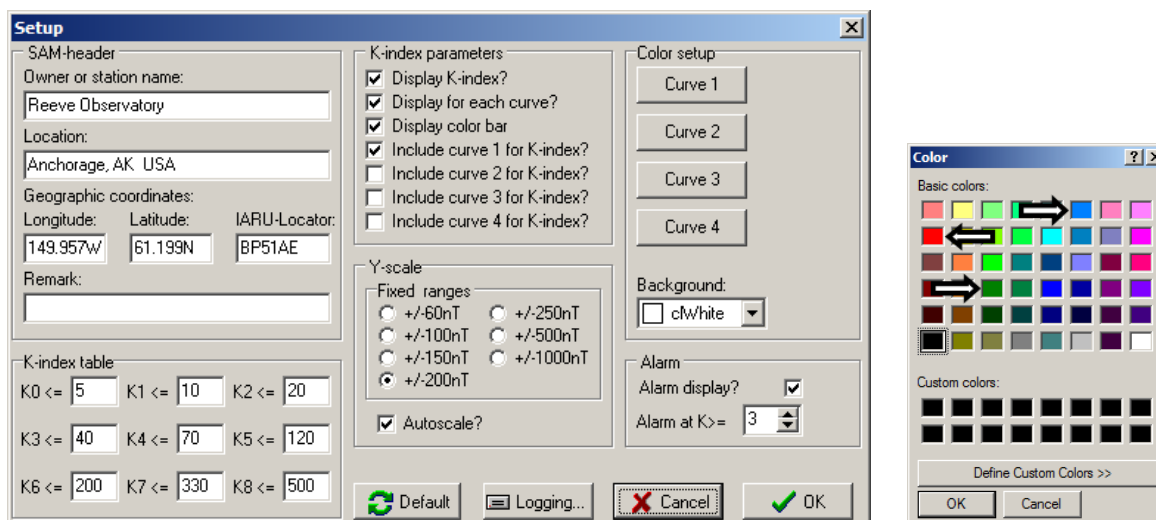
- Y-scale
  - Fixed range: +/-200 nT
  - ☒ Autoscale ON

Note a: 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.

Note b: 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

# SAM Magnetometer Setup Guide



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.

Note on sensor orientation: 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.**

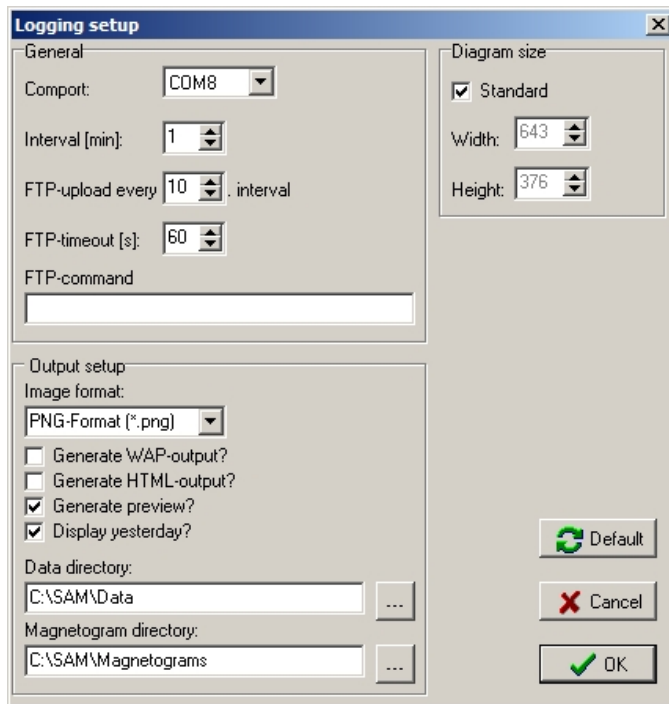
If you have a SAM-III or SAM-II-X with three sensors, the corresponding curves and colors are

- **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.

# SAM Magnetometer Setup Guide

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 [www.sam-magnetometer.net](http://www.sam-magnetometer.net))
- ☐ Display yesterday? (chart will show curves for today and yesterday; uncheck this box if you do not want to display yesterday).



# SAM Magnetometer Setup Guide

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](http://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.

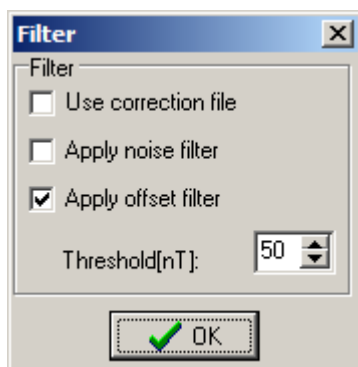
In the Diagram size area, check the Standard box and click OK to go back to the Setup menu. DO NOT click the Default button on the Setup menu. It will reset the K-Index values to defaults.

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. Refer to Sect. VII for additional information on setting and using the filters. Click OK when done setting the filters to return to the SAM\_VIEW main screen.

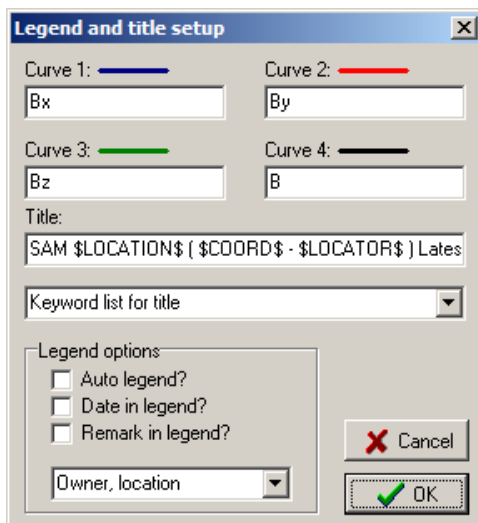
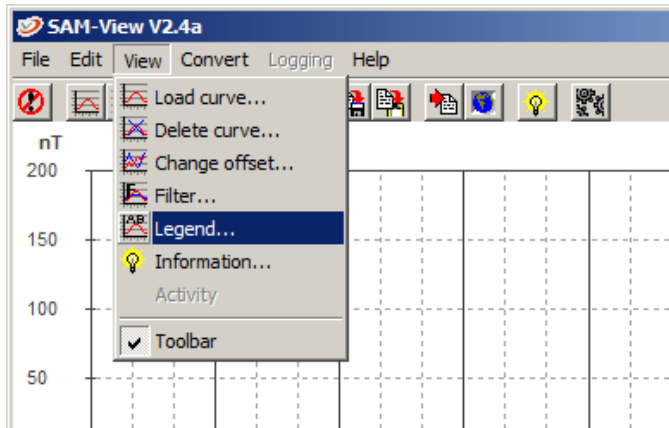


The Filter settings take effect immediately when checked; however, SAM\_VIEW does not remember them unless you click OK.

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

# SAM Magnetometer Setup Guide

Select View – Legend . . .



**Title field:** 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 drop-down 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.

# SAM Magnetometer Setup Guide

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

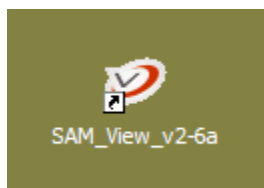
## B. Running SAM\_VIEW in Logging Mode

**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

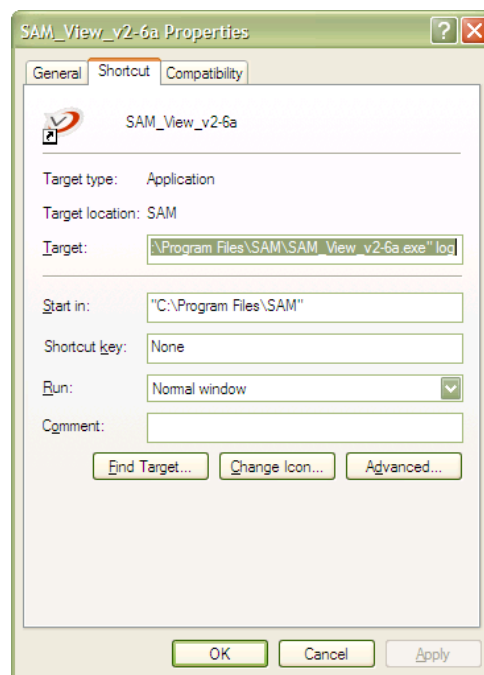
SAM\_VIEW does not actually save or log data unless it is in the logging mode. In other words, simply running SAM\_VIEW does not mean that SAM or SAM-III data is logged. **You must start SAM\_VIEW in the logging mode if you want to actually save data.**



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 **log** 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 **log** switch.

You also should setup a shortcut that does not specify the **log** 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).



# SAM Magnetometer Setup Guide

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.

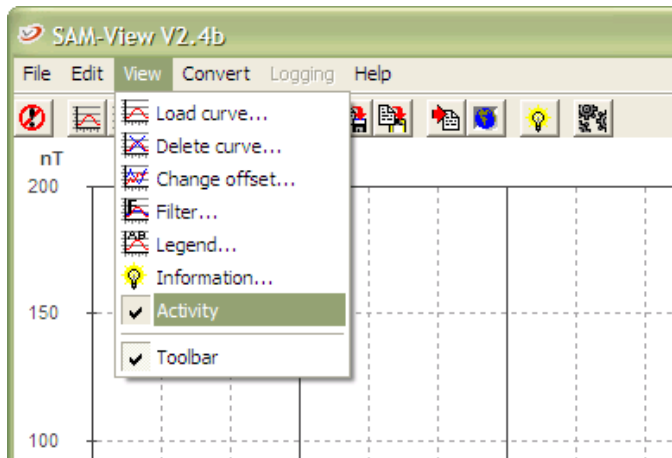
**Note:** As previously explained SAM\_VIEW normalizes the displayed data to zero at the beginning of each day or when a data file does not already exist. If the magnetic field is very quiet, zero values may be written during subsequent sampling intervals at the beginning of the day or beginning of the 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 immediately 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.

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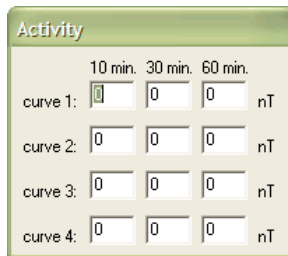
# SAM Magnetometer Setup Guide



## 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 Z, 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 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.

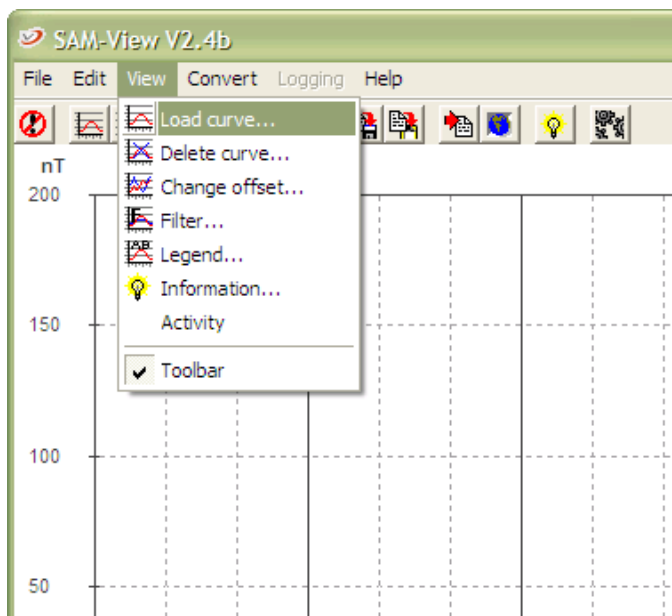


Later versions of SAM\_VIEW allow you to activate or deactivate the Activity screen from the View menu. Click on View and then select or de-select the Activity.

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## D. Viewing Offline (Archived) Data in SAM\_VIEW

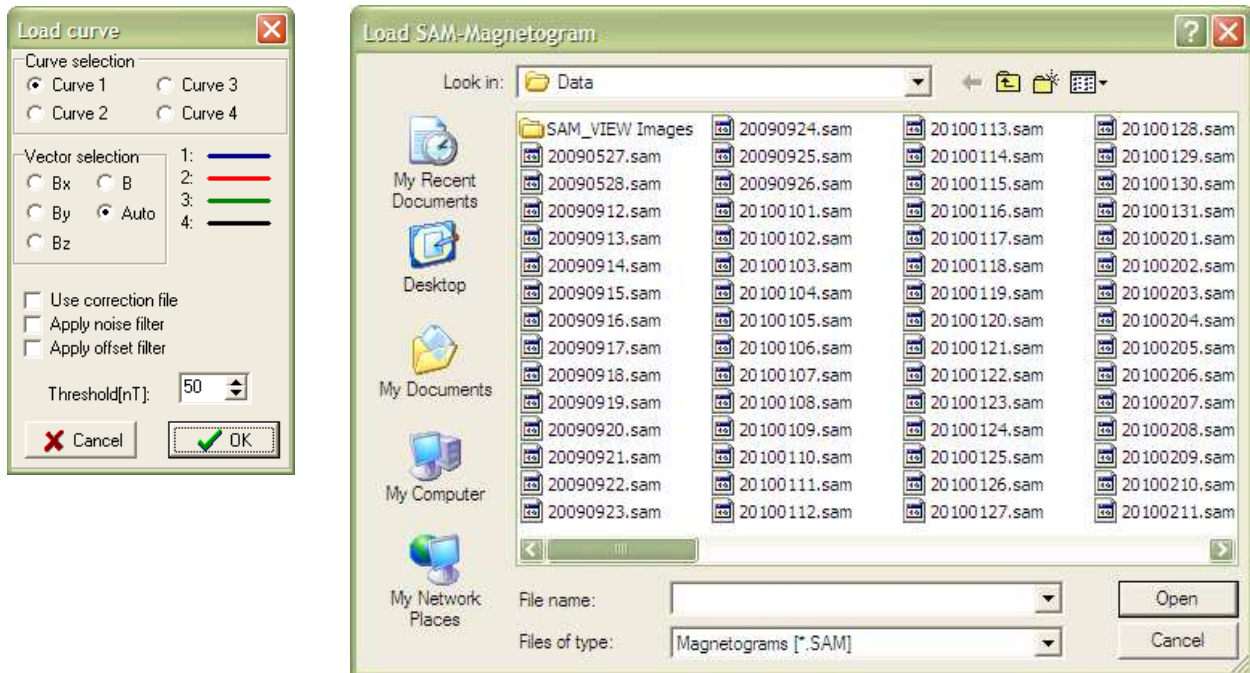
SAM\_VIEW can be used to view a magnetogram from any previous day using that day's .sam file. If you want to compare magnetograms for two days, say a quiet and active day, two consecutive days, or two specific dates, use SAM\_BROWSER (described in Sect. VIII).



To view a magnetogram in SAM\_VIEW, open SAM\_VIEW. You can use the non-logging shortcut you made in Sect. III.B. or simply double-click the SAM\_VIEW file. Select View – Load Curve . . . Note: 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.

# SAM Magnetometer Setup Guide

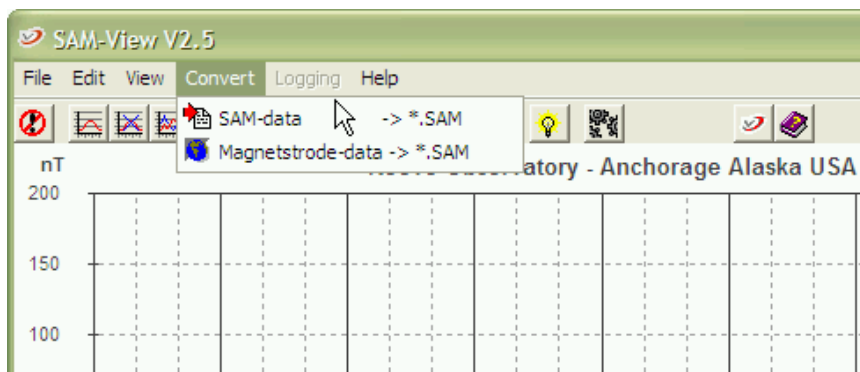
Select the curve (.sam file) you want to see and click OK. When you click OK, a file selection window will open. If necessary navigate to the folder when the .sam files are located. The filename for the .sam files includes the year-month-day. Select the desired date and click Open.



## E. Converting SAM text data files in SAM\_VIEW

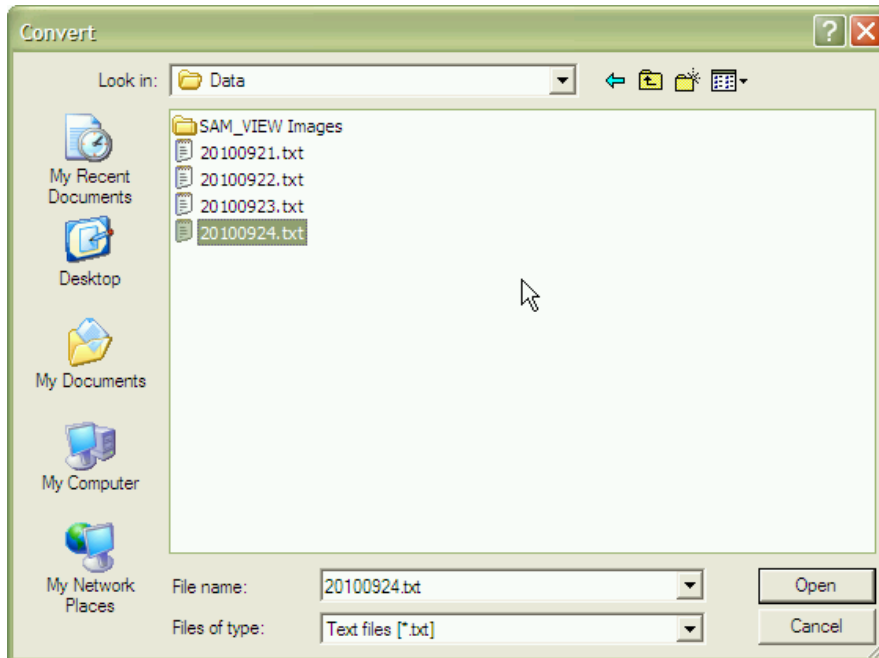
The SAM and SAM-III processors send text data to SAM\_VIEW, which produces a magnetogram image. SAM\_VIEW also can be used to convert daily yyyyymmdd.txt files to yyyyymmdd.sam files for archive viewing in SAM\_VIEW and for use in other SAM application programs (SAM\_BROWSER, SAM\_STAT).

Select Convert – SAM-data . . .

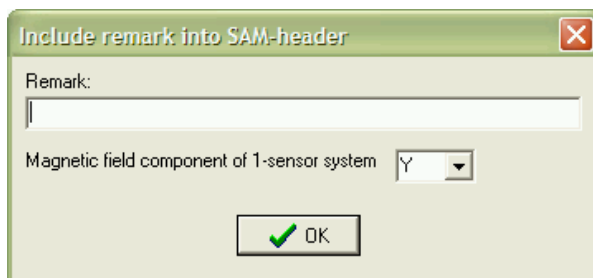


A file selection window will appear, Select the desired text file and click Open.

# SAM Magnetometer Setup Guide



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.



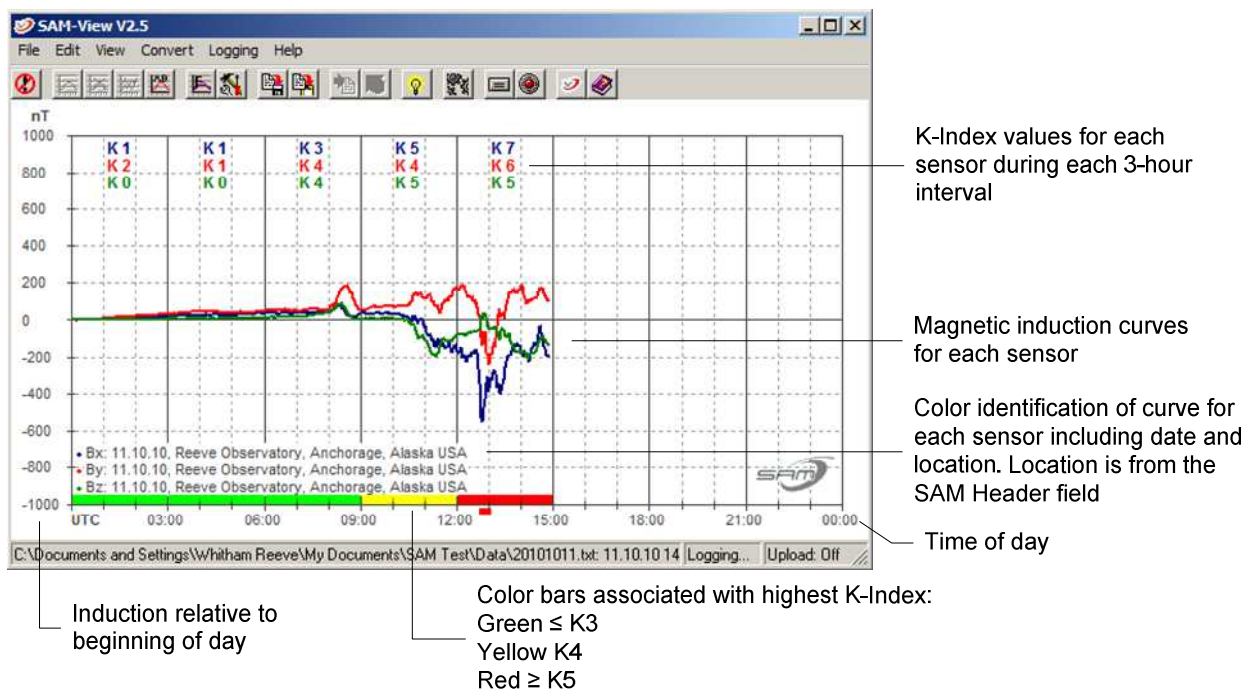
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## F. Reading a SAM\_VIEW Magnetogram

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.



# SAM Magnetometer Setup Guide



## G. SAM\_VIEW v2.8

SAM\_VIEW version 2.8 includes several new features:

1. 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.
2. 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  $\pm 12$  hours. For time zones west of the prime meridian (west of  $0^\circ$  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.

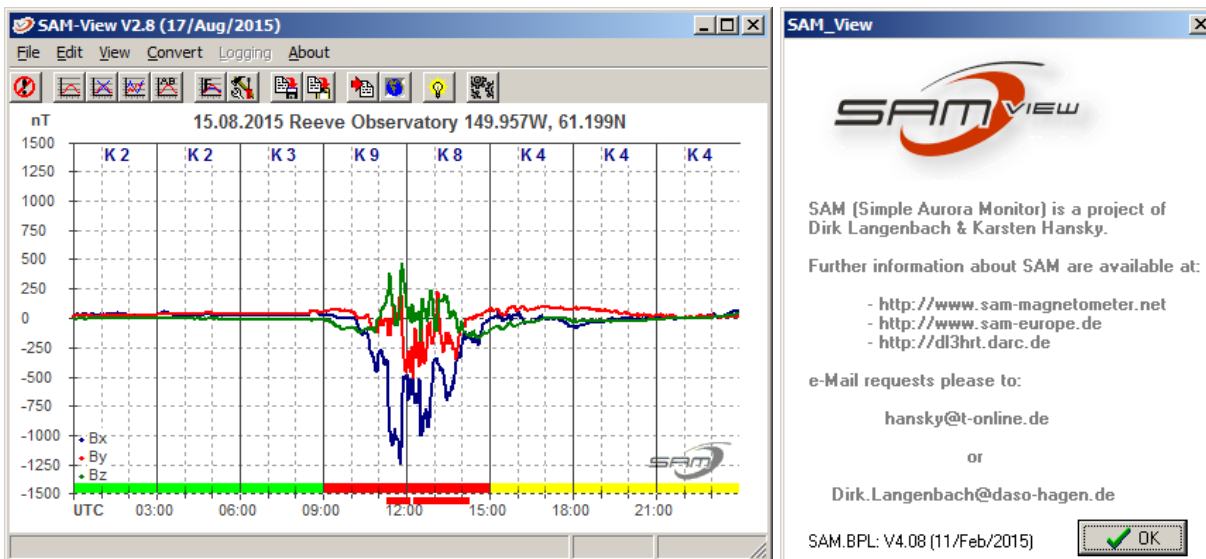


# SAM Magnetometer Setup Guide

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. To upgrade: 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:

# SAM Magnetometer Setup Guide



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

# SAM Magnetometer Setup Guide

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## 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.

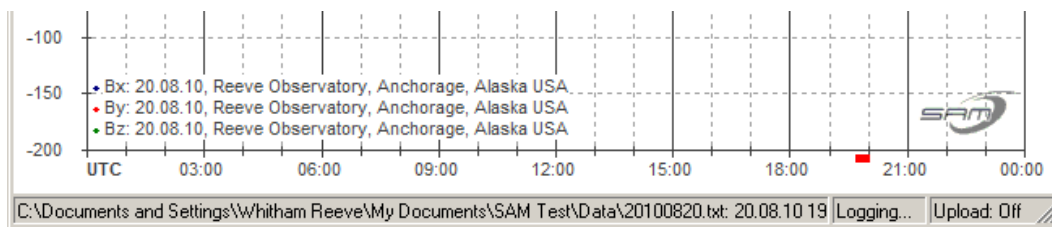
Look in the SAM data directory specified when you setup SAM\_VIEW. Within a few seconds a text file should appear:

- 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 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 immediately see a trace for a particular sensor, wait until there have been some changes in the field.

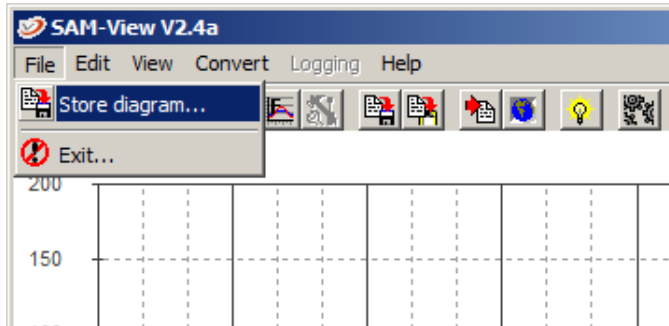
When sam\_data.png becomes available, or is renewed, you can view the latest magnetogram with any image viewing program. If you want to view older magnetograms, you can use

# SAM Magnetometer Setup Guide

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.

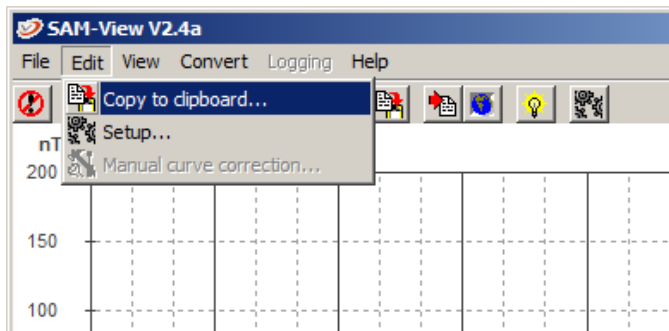
You can change the directory where the data files are stored. In SAM\_VIEW, go to Edit – Setup – Logging. The file directories can be changed at the bottom of the screen.

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



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.



**Note:** 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.

# File Transfer Protocol Tool – FTP-WatchDog

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## **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](http://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.

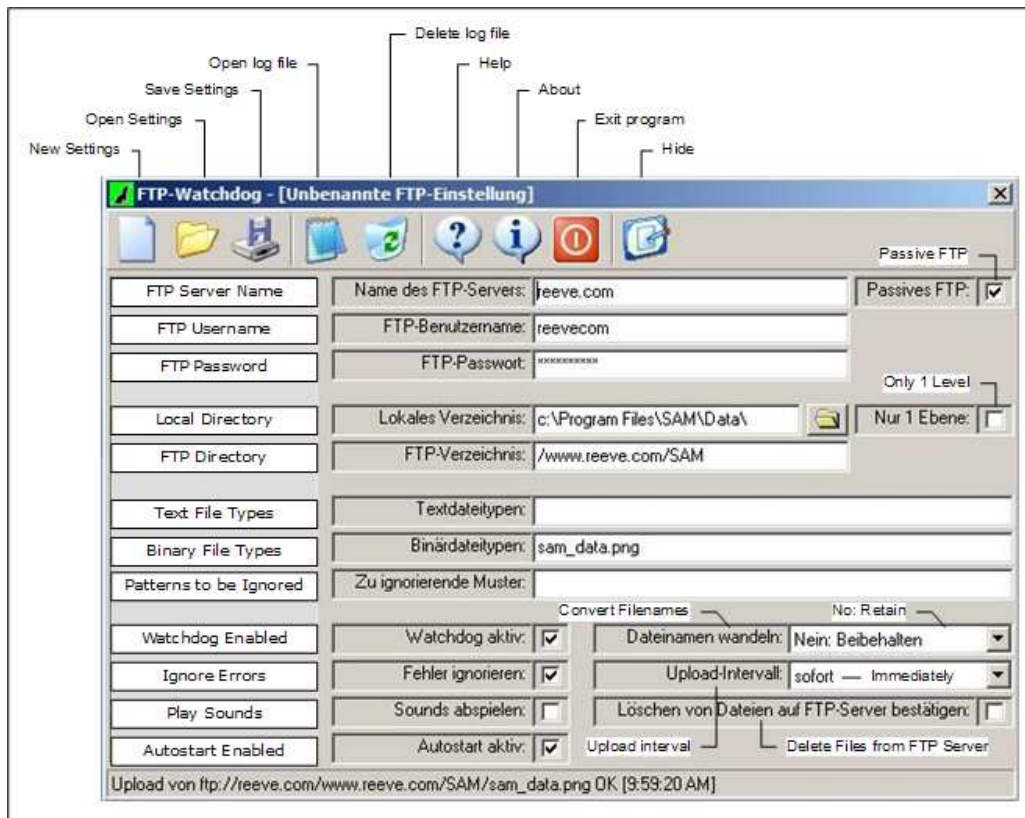
The FTP-WatchDog user interface is in German, so if you are unable to read it, the translations below will help you setup the program for use with SAM\_VIEW.

---

### **B. Installation:**

1. 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.

# File Transfer Protocol Tool – FTP-WatchDog



## 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

# File Transfer Protocol Tool – FTP-WatchDog

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](http://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

# File Transfer Protocol Tool – FTP-WatchDog

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.

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# File Transfer Protocol Tool – FTP-WatchDog

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## 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>
  </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](http://www.reeve.com/SAM/SAM_simple.html); in this case the filename for the code is SAM\_simple.html.

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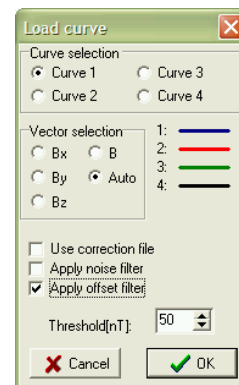
# SAM Magnetometer - Additional Setup

## 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. **Important Note:** The filters do not change the original stored SAM data values, they change only the chart display.

**Offset filter:** 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.



Offset Filter applied



No Offset Filter applied

Filter efficiency is increased by evaluating measurements before and after a particular time value. The threshold  $t$  in nT for the Offset Filter can be set in SAM\_VIEW as mentioned above. For a given minute  $i$  of the day, the filter algorithm evaluates the values  $v_{i-1}$ ,  $v_i$  and  $v_{i+1}$ . If  $\text{abs}(v_i - v_{i-1}) > t$  and  $\text{abs}(v_{i+1} - v_i) < t$  the Offset Filter corrects the displayed value.

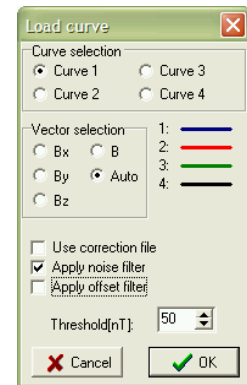
In other words, if there is a sudden change from one minute to the next that exceeds the threshold but in the following minute the change is below the threshold, then the filter

# SAM Magnetometer - Additional Setup

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.

**Noise filter:** 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.

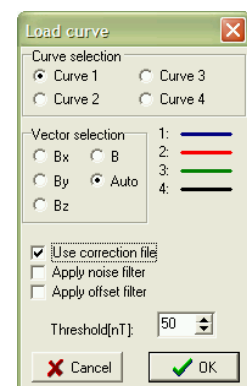


For small variations ( $\leq 20$  nT) within a 7-minute window, the filter displays the mean value and flattens the curve. For larger variations the filter uses the median value. This does not change the original values and, in case of a geomagnetic storm, the curve usually is not altered and keeps its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

Filtering is done in three steps:

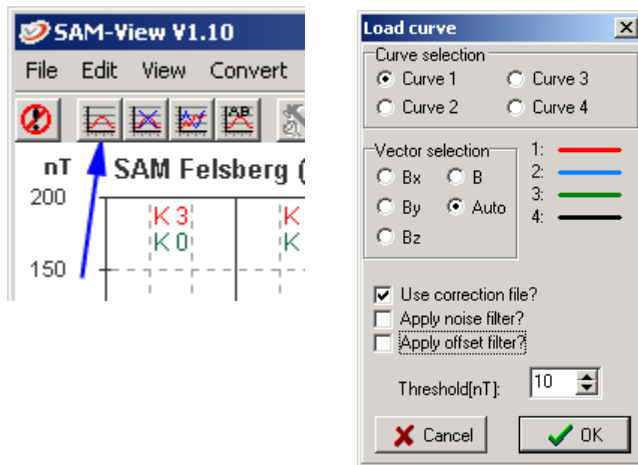
1. For each minute  $i$  of the day a list of the following values  $v$  is created:  $v_{i-3}$ ,  $v_{i-2}$ ,  $v_{i-1}$ ,  $v_i$ ,  $v_{i+1}$ ,  $v_{i+2}$  and  $v_{i+3}$
2. The maximum difference  $d_{\max}$  of the values  $v_{i-3} \dots v_{i+3}$  is computed.
3. The new value of  $v_i$  is computed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

**Correction filter:** 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.



**Using the Correction filter:** To make corrections start SAM\_VIEW, and click on the icon shown below or select View – Load Curve.

# SAM Magnetometer - Additional Setup

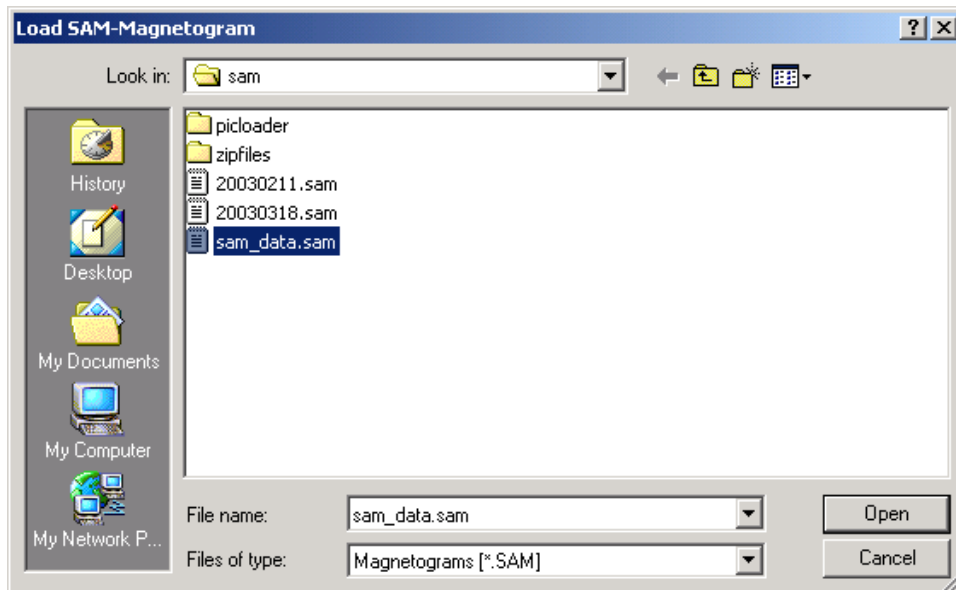


Set the following options:

- Curve 1 (ON)
- Vector selection Auto (ON)
- ☒ Use correction file
- ☐ Apply noise filter
- ☐ Apply offset filter
- Threshold [nT] (sets offset filter threshold; does not apply when offset filter not selected)

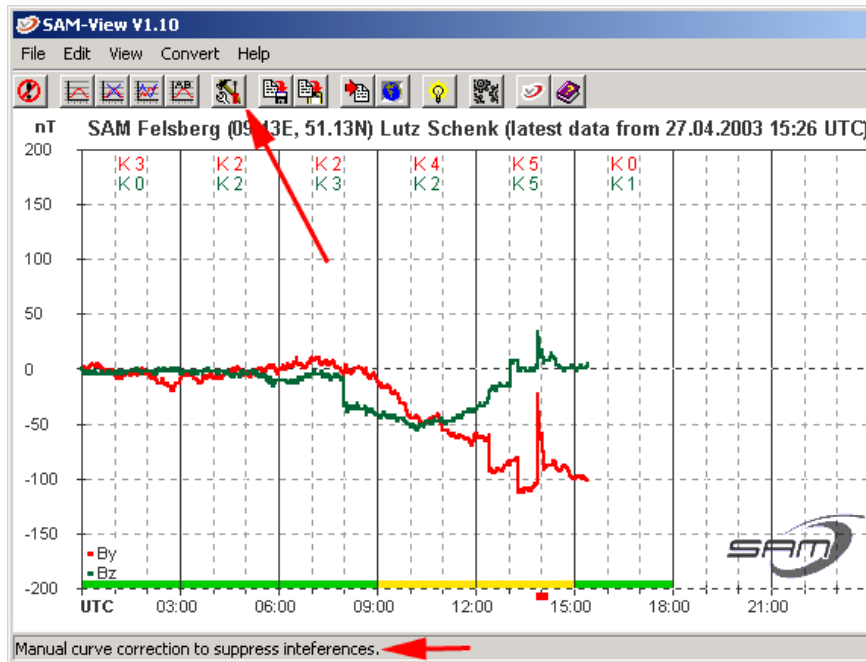
Press OK. In the next window that pops up, select sam\_data.sam and open the file.

Note: 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, then load sam\_data.sam. To prevent the crash you also can stop the logging during the correction period.



# SAM Magnetometer - Additional Setup

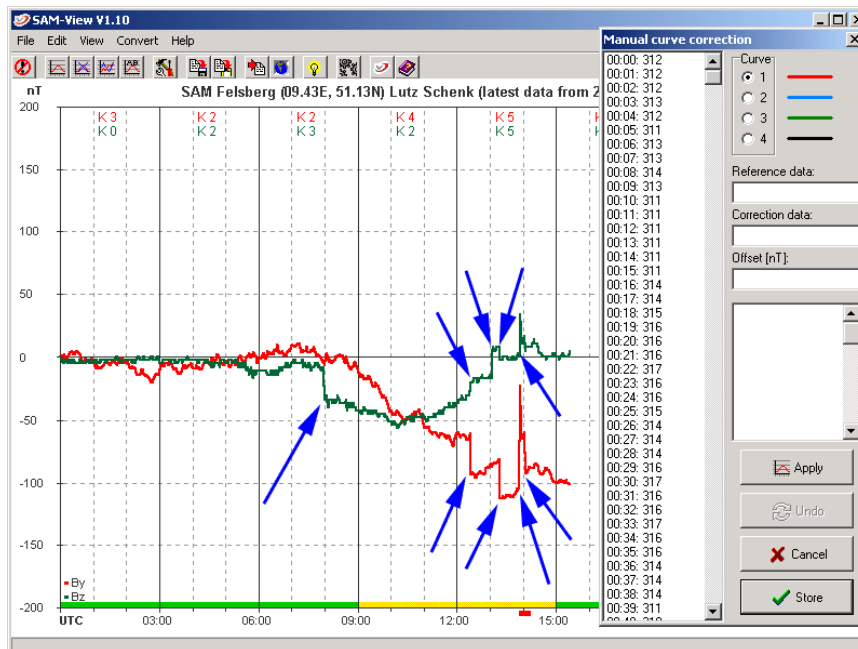
The latest chart is loaded. Open the correction menu with the Manual Curve Correction button on the menu bar. See screenshot below.



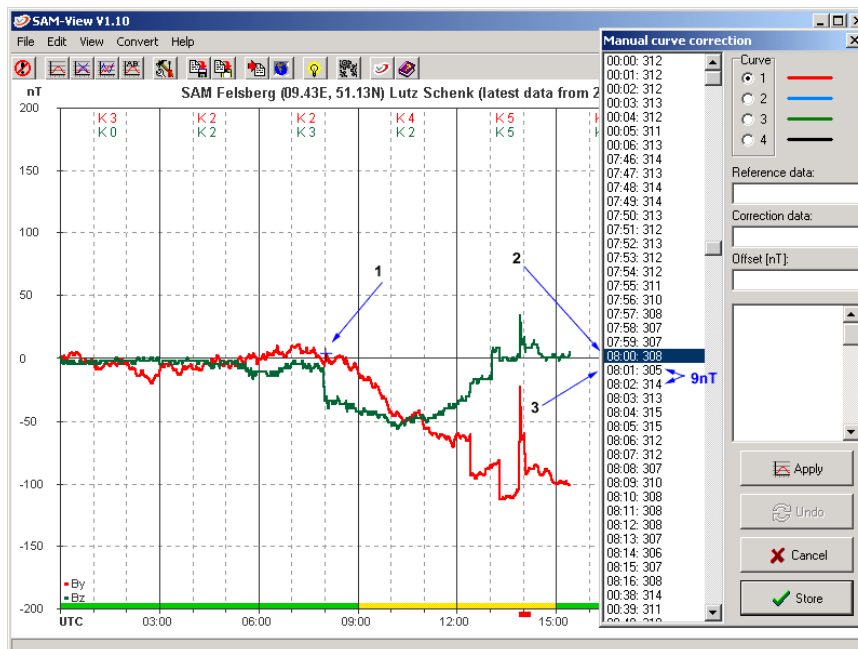
In the chart below the disturbances are marked with blue arrows. The correction menu is to the right. Maximize the window for the easiest recognition of errors.

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.

# SAM Magnetometer - Additional Setup



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.

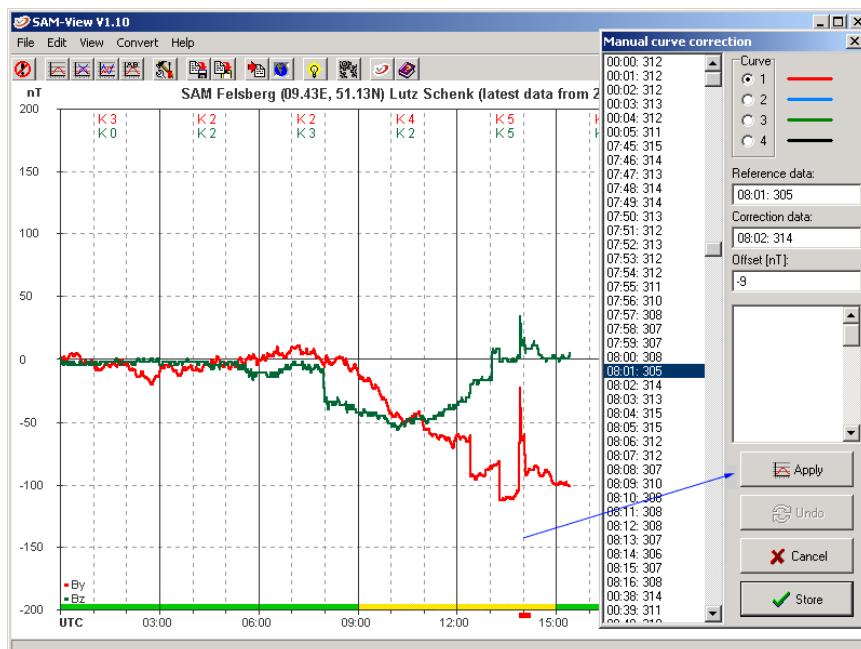


First, select the curve you want to adjust (in this case curve 1) at the top of the Manual Curve Correction menu. Move the cursor to the location on the curve where the correction is required. When the cursor is placed over the curve the cursor changes from an arrow to a cross (1).

# SAM Magnetometer - Additional Setup

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.

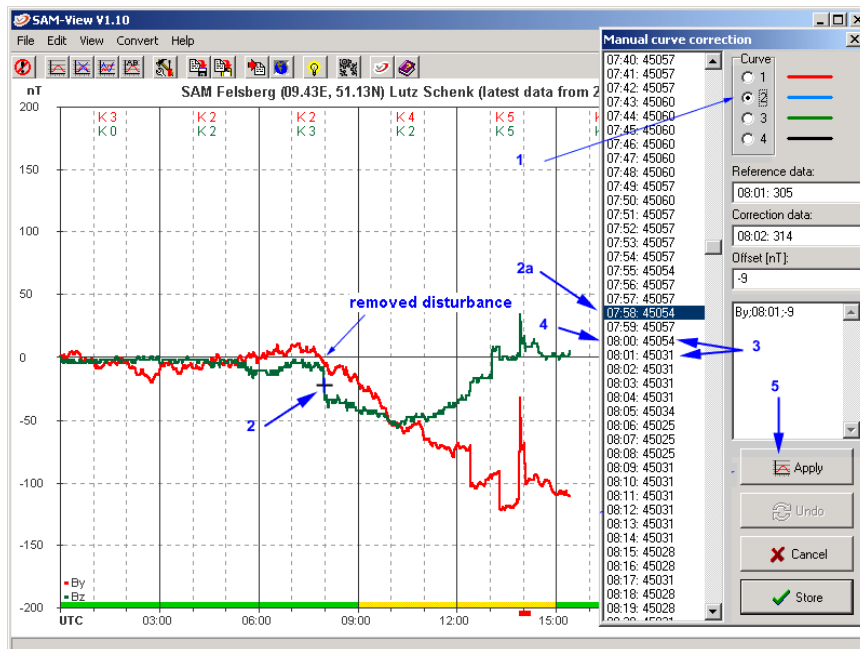
To correct the error, left-click the value before the error (in this case, 08:01: 305). The values are then set in "Reference data" and "Correction data". The program calculates the offset and sets it in the "Offset" field. Because the second value is higher than the first the correction is a negative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

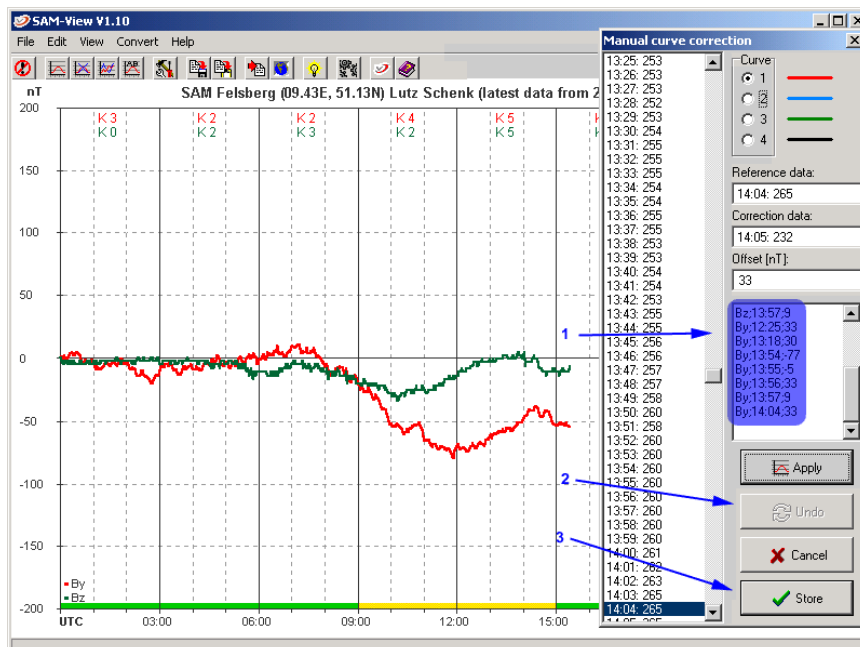
Now correct the first error in Curve 2. Select curve 2 in the Manual Curve Correction window (1) and right-click on the error in the graph (2). The numbers in parentheses correspond to the chart below.

# SAM Magnetometer - Additional Setup



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



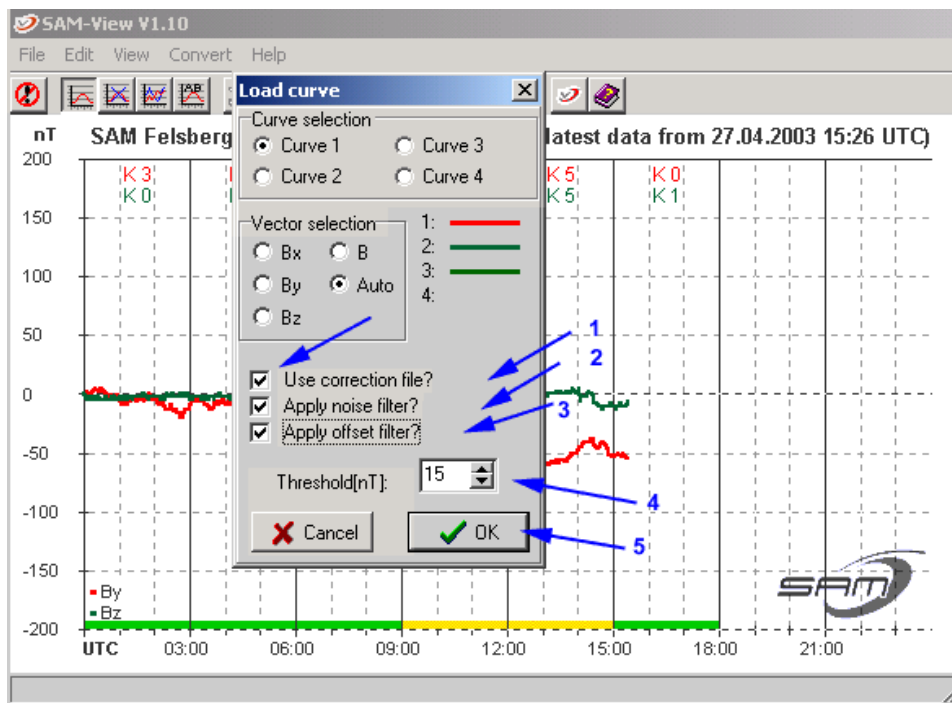
# SAM Magnetometer - Additional Setup

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:

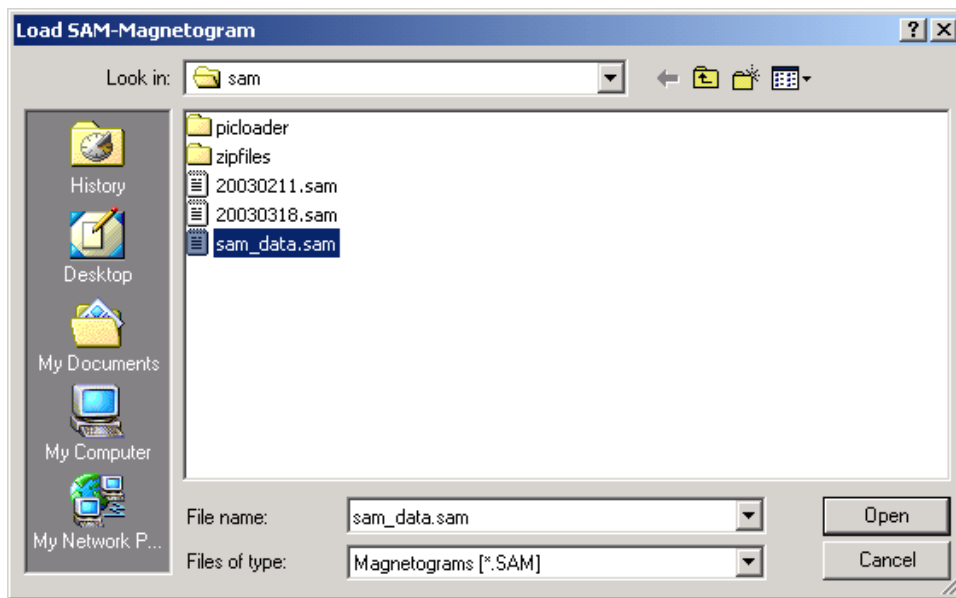
- ☒ Use correction file (1)
- ☒ Apply Noise Filter (2), to smooth the graph (see previous caution for northern latitudes)
- ☒ Apply Offset Filter (3), to limit sudden offsets larger than threshold value
- Threshold [15] (4), this sets the blocking limit for offsets. Generally, 15 should be okay but in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

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

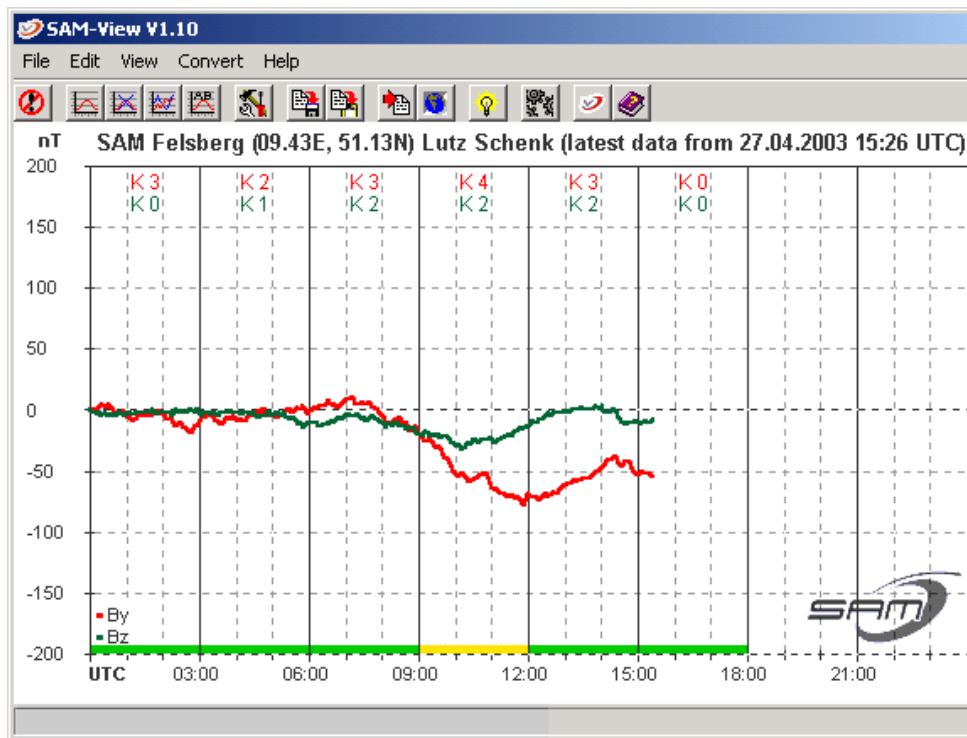


Select the sam\_data.sam file and click Open (see below).

# SAM Magnetometer - Additional Setup



The corrected magnetogram will appear (see below).



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

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

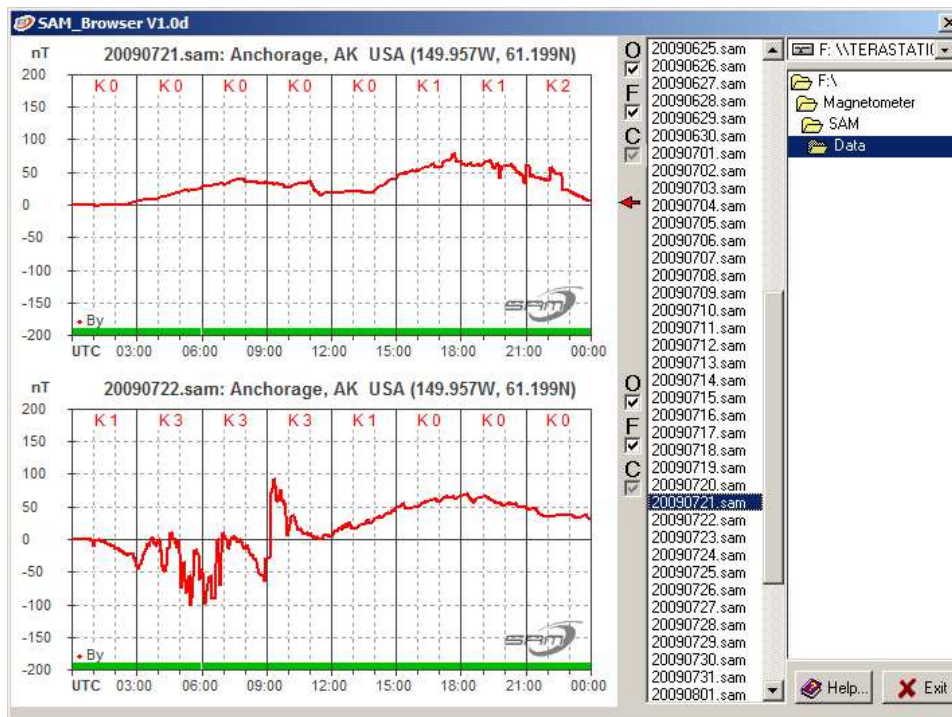
# SAM Magnetometer - Additional Setup

## 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
  - ☐ Offset filter

# SAM Magnetometer - Additional Setup

F ☐ Noise filter

C ☐ Use correction file

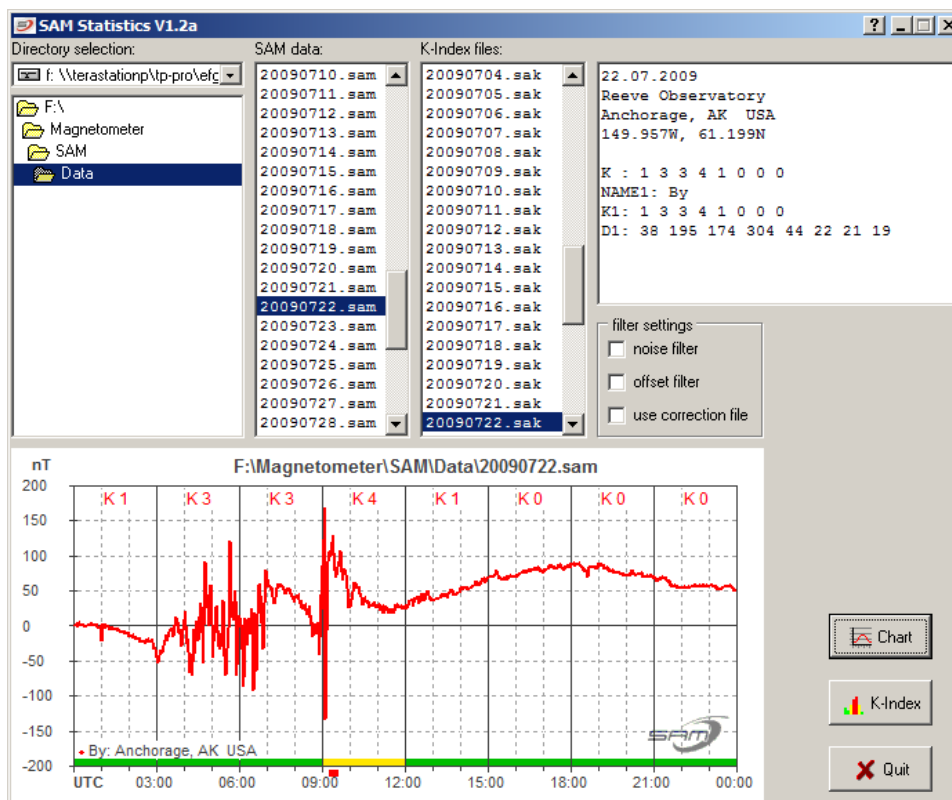
---

# SAM Magnetometer - Additional Setup

## 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.

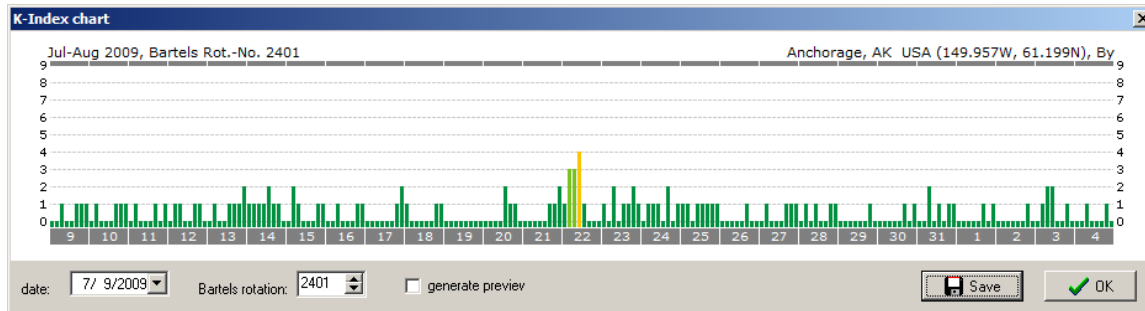
The SAM\_STAT program user interface is shown below. The data file location is specified in the left-frame, and the corresponding data files are shown in the next frame to the right. Select the filters and correction file as necessary then click on the K-Index button. The K-Index frame will then be populated 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.<sup>1</sup>

<sup>1</sup> This chart is for illustration only and may not include accurate data.

# SAM Magnetometer - Additional Setup



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

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## 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

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## 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.

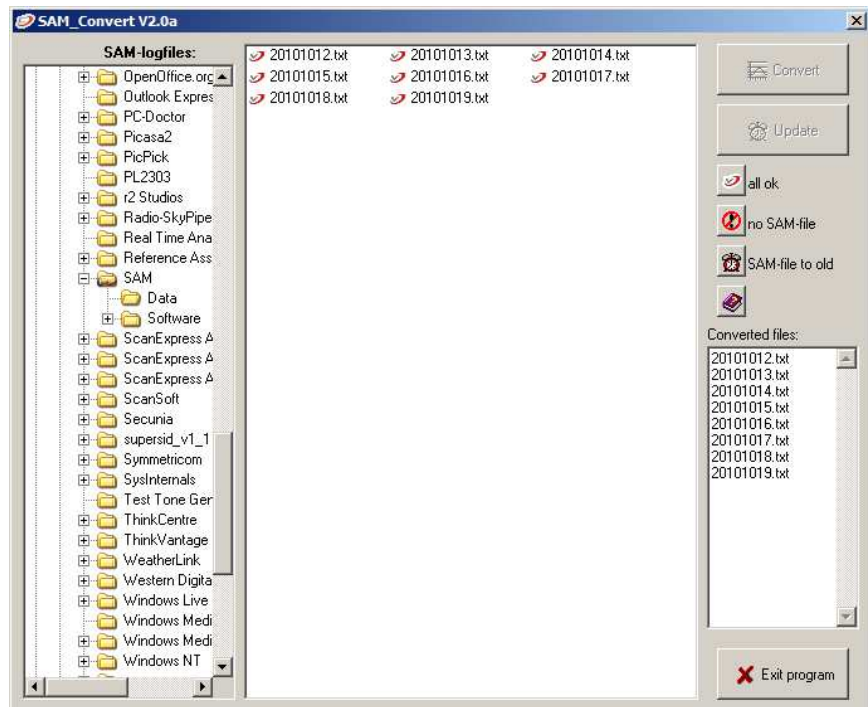
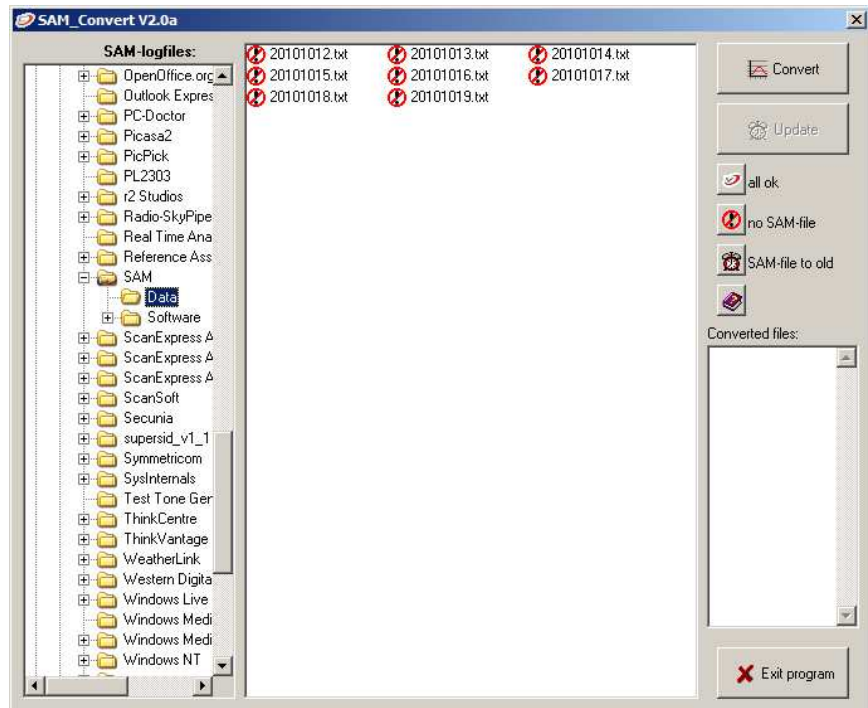
# SAM Magnetometer - Additional Setup

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



# SAM Magnetometer - Additional Setup

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## 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.



# SAM Magnetometer - Additional Setup

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.

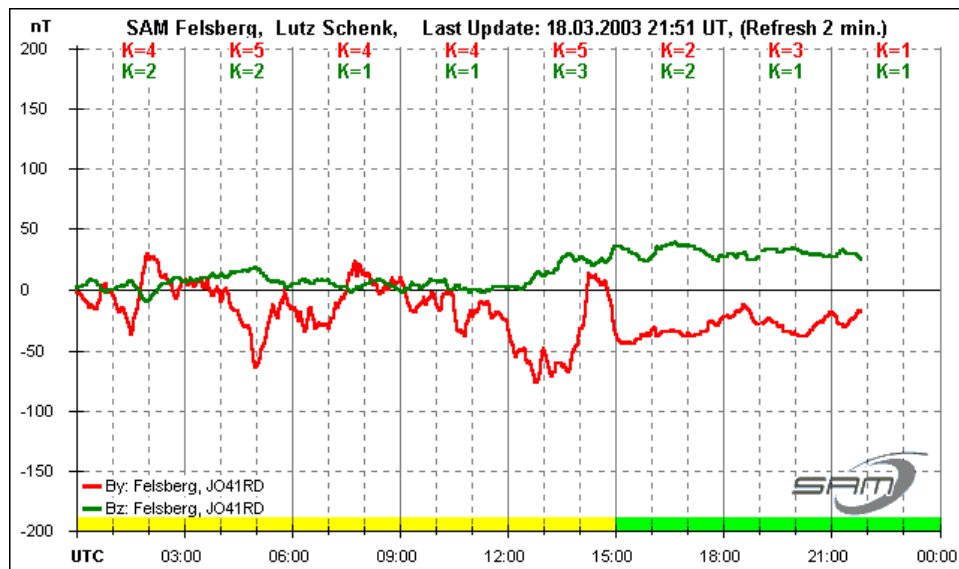
<b>Magnetogram Magnetic axis formats</b>	
<b>Resolution (min/pix)</b>	<b>Picture height (pix)</b>
0.5	296 (60 nT), 456 (100 nT)
(Southern Europe) 1	256 (100 nT), 356 (150 nT), 456 (200 nT)
(Central Europe) 1.25	296 (150 nT), 376 (200 nT)
2	256 (200 nT), 306 (250 nT)
2.5	216 (200 nT), 256 (250 nT), 456 (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).

<b>Location</b>	<b>Magnetic Scale (SAM_VIEW setting)</b>	<b>Image size (width x height)</b>
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 - Additional Setup



# 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
<b>[Diagram]</b>	<b>[Chart]</b>
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
Kurve1-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 >= 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
	<b>]Legend and title setup]</b>
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

<b>[Verzeichnisse]</b>	<b>[Directories]</b>
Bilder=C:\Program Files\SAM\Data	Magnetogram directory =
Datenverzeichnis=C:\Program Files\SAM\Data	Data directory =
<b>[Batch]</b>	<b>[Logging]</b>
Bildformat=2	<b>[Output setup]</b>
Vorschau=0	Image format = 2
Vortag=1	Generate preview = 0
WAP=0	Display yesterday = 1
HTML=0	Generate WAP-output
	Generate HTML-output
	<b>[General]</b>
Intervall=1	Interval (min) = 1
FTP-Timeout=75	FTP-timeout(s) = 75
FTP-Intervall=10	FTP-upload every 10 (interval)
FTP-Kommando=	FTP command =
<b>[Diagram size]</b>	
Standard=1	Standard = 1
Breite=643	Width = 643
Hoehe=376	Height = 376
FTP=0	
<b>[COM-Port]</b>	<b>[COM-Port]</b>
Port=COM3	Comm port = COM3
<b>[SAM-Header]</b>	<b>[SAM-Header]</b>
Autor=Reeve Observatory	Station name =
Ort=Anchorage, AK USA	Location =
Länge=149.957W	Longitude =
Breite=61.199N	Latitude =
Locator=BP51AE	IARU locator =
Remarks=	Remarks =
<b>[K-Wert]</b>	<b>[K-Index Table]</b>
K0=12	
K1=24	
K2=48	
K3=96	
K4=168	
K5=288	
K6=480	
K7=792	
K8=1200	
<b>[SAM_Browser]</b>	<b>[SAM_Browser]</b>
Datenverzeichnis=C:\Program Files\SAM\Data	Data directory =
Filter1=1	
Filter2=1	
Offset-Filter1=1	

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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
<u>Copyright:</u>	© 2009, 2010, 2011, 2012, 2013, 2014 W.D. Reeve
<u>Revision history:</u>	<p>Iss. 0.0 (Initial draft started, May 1, 2009)</p> <p>Iss. 0.1 (Substantial edits, August 1, 2009)</p> <p>Iss. 0.2 (Incorporated K. Hansky comments, August 6, 2009)</p> <p>Iss. 0.3 (Add'l edits, August 11, 2009)</p> <p>Iss. 0.4 (Add'l edits per K. Hansky comments, August 13, 2009)</p> <p>Iss. 1.0 (Issued for publication as Preliminary, August 13, 2009)</p> <p>Iss. 1.1 (Edit filters section, August 14, 2009)</p> <p>Iss. 1.2 (Edit SAM_VIEW section, December 18, 2009)</p> <p>Iss. 1.3 (Add sam.ini translation and Activity window, January 3, 2010)</p> <p>Iss. 1.4 (Add Sam-Magnetometer.net and numbered, January 24, 2010)</p> <p>Iss. 1.5 (Add SAM_INI problems discussion, TOC, April 16, 2010)</p> <p>Iss. 1.6 (Add information on filters, June 11, 2010)</p> <p>Iss. 2.0 (Add SAM-III information, July 27, 2010)</p> <p>Iss. 2.1 (Minor edits, September 20, 2010)</p> <p>Iss. 2.2 (Edits for file conversion and some cleanup, October 29, 2010)</p> <p>Iss. 2.3 (Minor edits, January 29, 2010)</p> <p>Iss. 2.4 (Noise filters, alarm, minor edits, June 30, 2011)</p> <p>Iss. 2.5 (Minor edits, 18 March 2012)</p> <p>Iss. 2.6 (Updated K-index explanation, 19 December 2012)</p> <p>Iss. 2.7 (Added info on SAM_VIEW shortcut, 11 Sep 2014)</p> <p>Iss. 2.8 (Reformatted, 11 Jun 2016)</p> <p>Iss. 2.9 (Incorporated SAM_VIEW v2.8 details, 24 Apr 2021)</p> <p>Iss. 3.0 (Added FG-3+ sensor offset, 20 Apr 2023)</p>

Note: 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](mailto:SAMinfo@reeve.com) with "SAM Kit" in the subject line (or else your email may be caught by our spam filters).

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