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Software Manual

MA-WINAMS

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**WinAMS AMS-4  
Monitoring System  
for Windows**



**REVISIONS SHEET:**

Rev.	Rev. State	Dept. resp.	Name	Rev. page	Cat. *)	Explanation
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\*) Category C: editorial correction  
I: clearing improvement  
A: substantial amendment

Explanations must be given, at least with Category A.

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# 1. Introduction

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The AMS-4 Monitoring System for Windows allows an IBM-PC compatible computer to monitor and control a network of AMS-4 beta continuous air monitors (CAMs). The present software structure allows for the monitoring of 1 to 12 AMS-4s.

AMS-4s may be connected via RS-232, telephone modems, RF modems and RS-485. By connecting one RF modem to the central computer and one RF modem to each AMS-4, one can quickly set up a network of CAMs to monitor a job.

The AMS-4 Monitoring System runs in the multi-tasking Windows operating system allowing the operator to run other applications while simultaneously polling a CAM network. Up to five different windows are simultaneously displayed by the system to provide detailed current and historical information to the operator regarding a specific CAM. All operating parameters, including alarm setpoints, are editable through the system under three level password control; even when the CAMs are on-line monitoring.

The AMS-4 Monitoring System displays a color-coded vertical bar graph for each CAM which mimics the LED bar graph on the front cover of the AMS-4. The bar graph displays percent of slow alarm concentration. Beneath the bar graph is a digital display of fraction of derived air concentration (DAC). Frequent scanning of the information in the vertical bar graph window allows the system operator to easily monitor a CAM network for deteriorating conditions. Audible alarm acknowledgement is accomplished by simply clicking on the vertical bar graph of the alarming CAM.

A simulator mode is built-in to facilitate demonstration and training.





## 2. Software Installation

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### 2.1 Installation

The first step in configuring the system is to install the software on the personal computer hard drive. WinAMS can be operated from a floppy but this is not recommended. Windows expects the applications defined in the program groups to be available every time Windows is started. When operating from a floppy disk this is not always the case.

An install program is included on the distribution medium to make the installation nearly automatic. Execute Install.exe by double-clicking it. On some operating systems it may be necessary to set the program compatibility mode to Win 95.

To enable and configure the compatibility mode right-click on the program, open tab "compatibility" check "execute program in compatibility mode for" and select "Windows 95" from the list. Then click <Apply> and leave the properties dialogue by clicking <Ok>.

You are prompted to select a disk drive to install the software to. Normally you will choose the default drive which is C.

Next, you are asked to select a subdirectory to which the software will be installed on the selected drive. The default is *WinAMS* and you should choose this name unless you already have a subdirectory named *WinAMS*.

That's all there is to it! A new program group is automatically created and the WinAMS icon is present in that program group to allow you to start WinAM



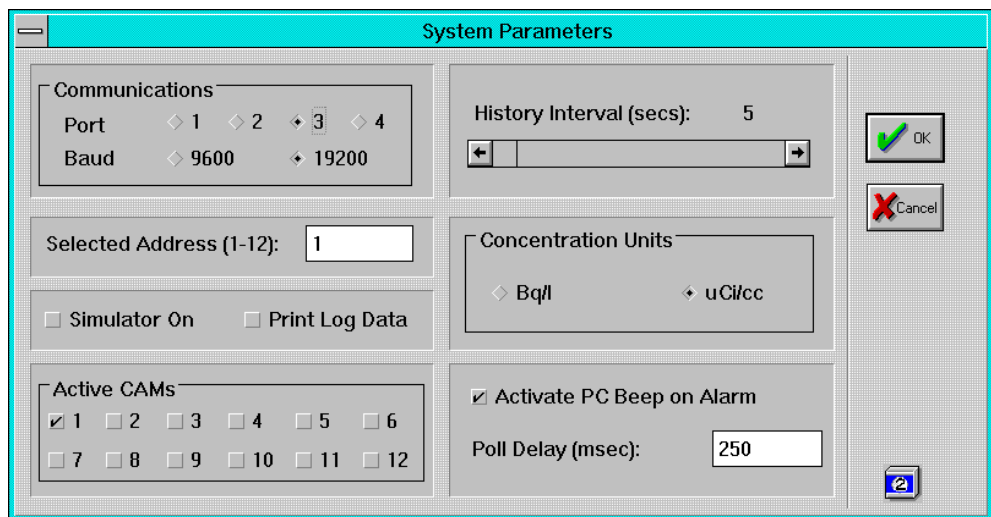
# 3. Configuration Parameters

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## 3.1 Editing System Parameters

Before the WinAMS system can be used, the operator must configure the software to use the available hardware including serial communication port, baud rate and number of active AMS-4 units in the system.

To edit the system parameters, select *Edit, System* from the main menu.



The following parameters are available for editing:

#### Communications

**Port** The serial communications port (1-4) to which the AMS-4 (or system of AMS-4s via radio or RS-485 link) is connected. Never select a serial port that does not exist in the PC.

#### Communications

**Baud Rate** The serial communications baud rate (9600 or 19,200) for the selected port. Make sure that the baud rate of each AMS-4 in the system matches this baud rate.

**Simulator** Place a check mark in this check box to activate the WinAMS simulator. Notice that the AMS-4 icon in the main window changes from a standard icon to one with an X through it when the simulator is active.

**Print Log Data** Place a check mark in this check box to activate automatic printing of each log data point received by the central computer. Printing is to the default windows printer.

**History Interval** The history interval horizontal scroll bar specifies the time period (5 to 60 seconds) for which the DAC fraction is graphed for the selected CAM.

#### Concentration

**Units** Concentration units of either uCi/cc or Bq/l are selected by clicking on the appropriate radio button. Notice that changing the unit selection *does not* affect the units used by any AMS-4. Operating unit changes may only be implemented by editing the units selection from the AMS-4 keyboard.

#### Activate PC

**Beep On Alarm** Place a check mark in this check box to activate an audible alarm at the PC when any CAM in the system has an audible alarm active.

**Poll Delay** The delay (250 to 60,000 milliseconds) between CAM polling requests. This value is defaulted to 500 msecs (2 polls per second) but may be made longer if other systems are sharing the communications hardware or RF bus.

### 3.2 Editing Operating Parameters

Editing the operating parameters allows the operator to control the manner in which the AMS-4 operates including background compensation factors, logging intervals, slow and fast alarm concentration update intervals, weighting factors and sampling head selection.

To edit the operating parameters select *Edit, Operate Params* from the main menu.

Section	Parameter	Value
Background/Efficiency	Alpha Subtract Factor	0.0
	Gamma Subtract Factor	1.36
	Fixed Beta Bkg (cpm)	0.0
	Beta Efficiency (%)	6.37
Weight/Flow Factors	Flow WF	0.0
	Beta Count Rate WF	5.00
	Fixed Flow Rate (cc/min)	60000
	Fixed Stack Flow (cc/min)	0.0
Operating Intervals	Slow Concen. Int. (mins)	30
	Fast Concen. Int. (secs)	60
	Net Count Int. (secs)	60
	Logging Interval (mins)	30
Count/Flow Limits	Min. Beta Rate (cps)	1.00E-03
	Max. Beta Rate (cps)	1000
	Min. Flow Rate (cc/min)	20000
	Max. Flow Rate (cc/min)	60000

**CAM Identifier** A character field used to identify the CAM in the current data window. The default identifier for each CAM is CAM X where X is replaced with the address of the CAM. Select this field and replace to give the CAM a more descriptive identifier.

Sampling Head	The Sampling Head selector radio buttons allow the operator to select either a particulate/iodine sampling head or a gas sampling head. Make sure and re-edit the DAC isotope selection when a sampling head is changed. Also verify that the other operating parameters are properly set.
Alpha Subtract Factor	The Alpha Subtract Factor is the fraction of the alpha channel count rate which is subtracted from the beta channel when radon progeny background compensation is enabled. For example, if you wish to subtract 2.75 times the alpha count rate from the beta channel (the default factor indicating a 2.75 beta to alpha ratio), enter 2.75 for this factor. To disable alpha channel compensation (suggested for the gas sampling head), enter 0.0 for this factor. Notice that the derived concentration operating mode of the particulate/iodine sampling head is inherently radon progeny compensating since the previous operating interval count rate is subtracted from the current operating interval count rate during calculation of the airborne concentration which effectively removes the effect of activity on the filter which existed in the previous operating interval. For this reason there is very little effect on the CAM operation if this factor is set to 0.0.
Gamma Subtract Factor	The Gamma Subtract Factor is the fraction of the gamma background channel count rate which is subtracted from the beta channel when gamma background compensation is enabled. Typically, the ambient gamma induced count rate in both the gamma channel and the beta channel are nearly 1:1. For this reason the default factor is 1.0. To disable gamma background compensation (not typically recommended, especially for the gas sampling head) enter 0.0 for this factor.
Fixed Beta Bkg	The Fixed Beta Background is a constant count rate which is subtracted from the beta channel prior to calculating airborne concentration. This factor is typically used only when gamma background compensation is not available. When used, gamma background compensation performs the fixed beta background compensation automatically since the beta background (which is largely cosmic induced) in both the beta and gamma channels is typically about the same.
Beta Efficiency	The Beta Efficiency is the 4 pi counting efficiency of the beta channel as determined during source calibration.

## Slow Concentration

**Interval** The Slow Concentration Interval is the counting time, in minutes, used by the AMS-4 for determining the slow alarm concentration. For the particulate/iodine sampling head it actually uses two consecutive intervals of this length. For the gas sampling head, the most recent counting interval of this length is used. Notice that the slow alarm concentration is re-calculated and checked against the alarm concentration *every minute* even if the slow concentration interval is greater than one minute.

## Fast Concentration

**Interval** The Fast Concentration Interval is the counting time, in 5 second intervals, used by the AMS-4 for determining the fast alarm concentration. For the particulate/iodine sampling head it actually uses two consecutive intervals of this length. For the gas sampling head, the most recent counting interval of this length is used. Notice that the fast alarm concentration is re-calculated and checked against the alarm concentration *every five seconds* even if the fast alarm concentration interval is greater than five seconds.

## Net Count Rate

**Interval** The Net Count Rate Interval is the counting time (5-255 secs), in 5 second intervals, used by the AMS-4 for determining the net count rate. For the particulate/iodine sampling head it actually uses two consecutive intervals of this length. For the gas sampling head, the most recent counting interval of this length is used. Notice that the net count rate is re-calculated and checked against the alarm *every five seconds* even if the net count rate interval is greater than five seconds.

**Logging Interval** The Logging Interval is the elapsed time in minutes (0-60 mins) which defines the frequency for slow concentration data logging. The WinAMS program automatically collects the log data as it appears in the AMS-4 log data buffer and stores it to disk. Select Log Data from the main menu to display the log data and status changes for the current day or any previous day.

## Flow Weighting

**Factor** This factor is used to dampen fluctuations in the flow readings caused by pump pulsations. Refer to the AMS-4 technical manual for a detailed explanation.

## Beta Count Rate

**Weighting Factor** This factor is used to dampen fluctuations in the beta channel count rate which might cause it to fail the count rate within limits check performed every five seconds. The weighted beta channel count rate is not currently used for any other purpose than fail limit checking.

- Fixed Flow Rate** The Fixed Flow Rate is a user defined flow rate, in  $\text{cm}^3/\text{min}$ , which must be entered if the sample flow sensor is not being used in the AMS-4. Since the flow sensor is standard equipment, this value is normally set to 0 to indicate active flow monitoring.
- Fixed Stack Flow** The Fixed Stack Flow Rate is the stack flow rate, in  $\text{cm}^3/\text{min}$ , which is used by the AMS-4 to calculate stack release rate. Since the AMS-4 does not have any capability to monitor stack flow directly, this value must always be set to the nominal stack flow rate whenever the AMS-4 is being used to monitor a stack or duct.
- Min. Beta Rate** The Minimum Beta Rate is the minimum beta channel count rate (before background subtraction is applied) allowed before a low count fail condition is flagged. Note that the Beta Count Rate Weighting Factor is used to eliminate false low count fail alarms. Set this value to zero to disable low count checking.
- Max. Beta Rate** The Maximum Beta Rate is the maximum beta channel count rate (before background subtraction is applied) allowed before a high count fail condition is flagged.
- Min. Flow Rate** The Minimum Flow Rate is the minimum sample flow rate, as measured by the built-in flow sensor, allowed before a low flow fail condition is flagged. Note that the Flow Weighting Factor is used to eliminate false low flow fail alarms. Set this value to zero to disable low flow checking.
- Max. Flow Rate** The Maximum Flow Rate is the maximum sample flow rate, as measured by the built-in flow sensor, allowed before a high flow fail condition is flagged. Note that the Flow Weighting Factor is used to eliminate false high flow fail alarms.

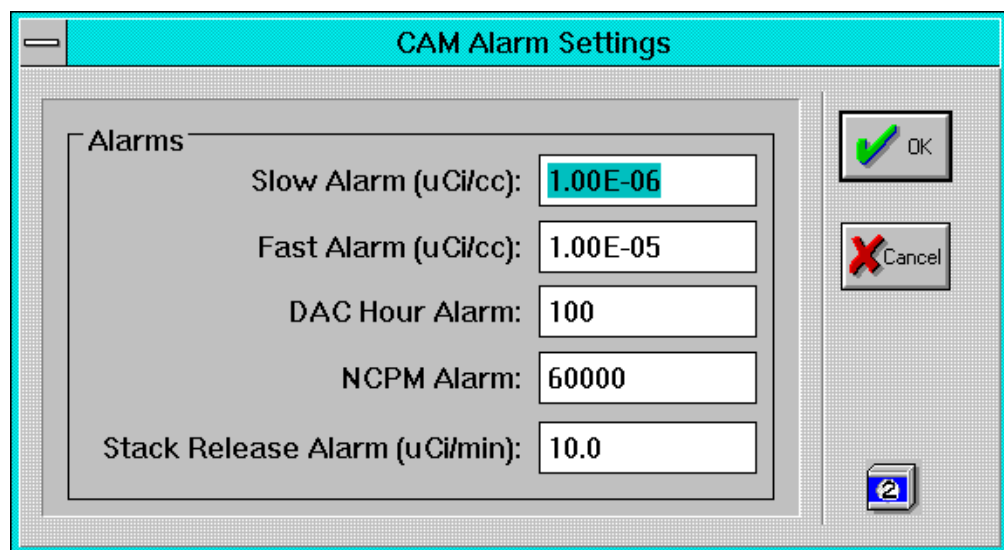


### 3.3 Editing Alarm Setpoints

The AMS-4 CAM makes four independent alarm determinations for Slow Alarm Concentration, Fast Alarm Concentration, DAC Hour, Net Count Rate and Stack Release Rate.

These alarms are shown in the concentration units selected in the System Parameters (uCi/cc or Bq/l). Editing any alarm setting to 0.0 disables the alarm.

To edit the alarm setpoints, select *Edit, Alarms* from the main menu.



### 3.4 Editing Detector Parameters

The AMS-4 has a beta detector and a gamma background detector; both of which are sealed gas proportional detectors. The gamma background detector is used to correct the reading in the beta detector when the AMS-4 is used in elevated gamma backgrounds.

The high voltage for either detector can be set either from the high voltage plateau routine (see the Calibration menu) or directly from the Detector Parameters dialog box shown below.

The screenshot shows a dialog box titled "Detector Parameters". It is divided into two main sections. The top section is labeled "Beta Detector" and contains three input fields: "High Voltage (Vdc)" with the value 1543, "BetaThreshold (%)" with the value 6.3, and "Alpha Threshold (%)" with the value 45.1. The bottom section is labeled "Gamma Bkg Detector" and contains two input fields: "High Voltage (Vdc)" with the value 1543 and "Threshold (%)" with the value 6.3. On the right side of the dialog, there are three buttons: "OK" (with a green checkmark icon), "Cancel" (with a red X icon), and a button with a blue "E" icon.

The beta and alpha thresholds in the case of the beta detector and the beta/gamma threshold in the case of the gamma background detector can also be set from the detector parameters dialog box. The default thresholds of 6.3% for the beta/gamma thresholds and 45.1% for the alpha threshold can be left set as they are in almost every case.

### 3.5 Editing DAC Isotope Selection List

The AMS-4 CAM maintains a Derived Air Concentration (DAC) isotope list for up to ten user defineable isotopes. The concentration of the selected isotope is used by the AMS-4 to calculate DAC fraction and DAC Hr. Only one isotope is chosen for the CAM to operate with, however, the DAC isotope may be changed as often as desired.

To edit the DAC list, select Edit, DAC List from the main menu.

CAM 1	Isotope	Concentration	
<input type="checkbox"/>	Cs-137	6.00E-08	uCi/cc
<input type="checkbox"/>	Co-60	1.00E-08	uCi/cc
<input type="checkbox"/>	Tc-99	3.00E-07	uCi/cc
<input type="checkbox"/>	Sr-90	2.00E-09	uCi/cc
<input type="checkbox"/>	C-14	1.00E-06	uCi/cc
<input type="checkbox"/>	I-125	3.00E-08	uCi/cc
<input type="checkbox"/>	I-131	2.00E-08	uCi/cc
<input checked="" type="checkbox"/>	Kr-85	1.00E-04	uCi/cc
<input type="checkbox"/>	Xe-133	1.00E-04	uCi/cc
<input type="checkbox"/>	I-123	3.00E-06	uCi/cc

The vertical column of check boxes on the left hand side of the dialog box determine the selected isotope. Simply click on the desired isotope check box to select the isotope to use.

Both the isotope name and concentration may be edited at any time. The table shown above is the default isotope table in the AMS-4.



## 4. Operating the Software

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### 4.1 Selecting a CAM

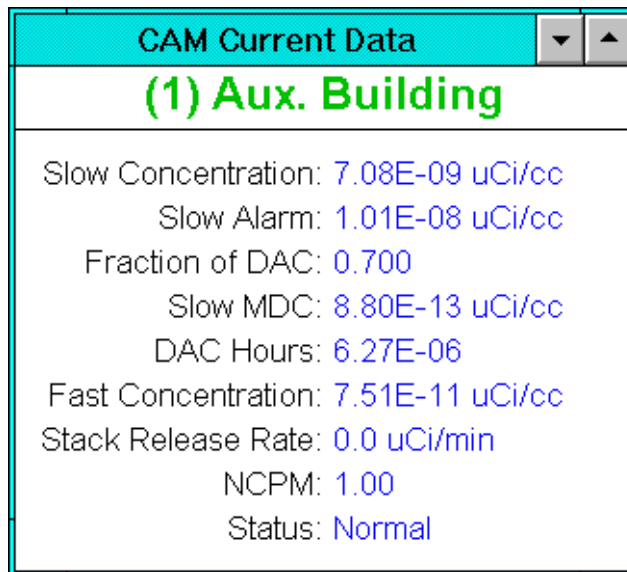
While WinAMS constantly polls from 1 to 12 CAMs and updates the vertical bar graphs in the main window, all specific data display, parameter editing and DAC fraction graphing is performed only on the selected CAM.

To select a CAM for primary information display and/or editing, move the mouse cursor to the desired CAM bar graph in the main window and click the left button anywhere on the bar graph or bar graph title. The bar graph title (e.g. CAM1, CAM2) of the selected CAM is always surrounded by a black rectangle. The CAM Current Data and CAM DAC History windows also indicate which CAM is currently selected for detailed display.

### 4.2 Current Data Window

During polling, WinAMS is constantly collecting current data and status change information from each active CAM.

The current data for the selected CAM (click on the vertical bar graph to select a CAM) is displayed in the window labeled CAM Current Data. Displayed information includes slow concentration, slow alarm setpoint, fraction of DAC, slow MDC, integrated DAC hours, fast concentration, stack release rate, net counts per minute and CAM status.



A particular CAM may have multiple statuses at any one time. WinAMS prioritizes the statuses and just presents the highest priority status in the current data window.

The CAM status priority list, listed in highest to lowest priority, is listed below.

- Filter Door Open
- Detector Fail
- Flow Fail Low
- Flow Fail High
- Beta Fail Low
- Beta Fail High
- Filter Door Fail
- Calibrate Mode
- Fast Concentration Alarm
- Slow Concentration Alarm
- DAC Hour Alarm
- NCPM Alarm
- Release Rate Alarm
- Fast Alarm Disabled
- Net Count Alarm Disabled
- Slow Alarm Disabled
- Normal

### 4.3 Log Data Display

WinAMS is continually polling CAMs in background mode and logging status changes and log data (if enabled within the Operate Parameters) to disk file(s) named according to the address of the CAM and the date in MMDDYY.AAA format. For example, log data for CAM address 1 on January 1, 1994 is stored in a log data file named *010194.001* where the file extension is the address of the CAM from 001 to 255.

To display the current day log data for any CAM, first select the CAM by left button clicking on the bar graph of the desired CAM and then select *Log Data, Display Log Data* from the main menu. A log data window is opened (if not already open) and the current log data file is read into the window for display and/or editing.

The log data window is updated at any time with the most current data in the selected CAM's log file by re-selecting *Display Log Data* from the main menu.

To display log data from a previous day, open the log data window by selecting *Log Data* from the main menu and then select *File, Open* from the log data window menu. Double click on the desired data file to load it into the display window. Maximize the window for easy viewing of the data file.

The log data display window is a fully capable Windows text editor and may be used to annotate log data files. To do so, insert the desired text into the file and select *File, Save* from the log data window menu. Notice that caution should be exercised in saving log data files for the current day on an operating system. The disk based file may contain information which is more current than that which is in the display window. In this case, saving the log data file back to disk will cause loss of some log data and/or status changes.

#### 4.4 Rapid Log Data Collection

As stated in the previous section, WinAMS is continually polling CAMs in background mode and logging status changes and log data to the appropriate disk files.

If the WinAMS computer has been turned off for hours or days, a great deal of log data may exist in one or more CAMs which would take hours to poll out in the normal background mode polling.

To rapidly poll all stored log data and status changes from all active CAMs, select *Log Data, Collect All Log Data* from the main menu. A task complete dialog box is displayed when all data has been collected.

#### 4.5 Acknowledging an Audible Alarm

Any CAM for which the audible alarm is currently active is indicated by an alarm icon in the middle of the vertical bar graph. To silence an audible alarm, move the mouse cursor to the vertical bar graph for the alarming CAM and click the left mouse button. An alarm acknowledge message is sent to the desired CAM and the audible alarm icon is removed from the bar graph as soon as the polled CAM status indicates that the *audible* alarm is inactive.

Note that the *visual* alarm indicator (flashing strobe light) remains active until the alarm condition clears. To clear a visual alarm at a CAM, select the alarming CAM and edit the alarm setpoint which is exceeded (see the CAM Current Data Window) above the current reading to clear the alarm condition.

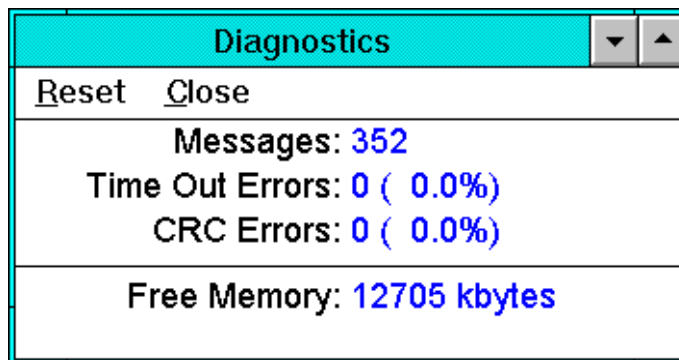


## 4.6 Diagnostic Information

A diagnostic information window is available to assess the effectiveness of the central computer to CAM communication link and to view the remaining extended memory available for Windows applications.

Select *Utility, Show Diagnostics* from the main window to display the diagnostics window. The communication diagnostics displays total communication messages to all CAMs in the system and provides the rate at which both time out and cyclic redundancy check (CRC) errors are occurring.

You may reset the communication counters by clicking on the Reset selection from the diagnostics window menu.



## 4.7 Displaying Status Changes

As previously discussed, all status changes are logged to the day log file for each CAM. In addition, a buffer containing the four most recent status changes (for the whole system) is always maintained. Each time a status change is logged by the system, an audible beep is heard.

To immediately identify the most recent status change as well as the three status changes prior to that, select *Utility, Status Changes* from the main menu. A message dialog box is displayed showing these changes.

## 4.8 Setting Time Clocks

The data and status changes in the daily log data files for each CAM are time and date stamped by clock information maintained by the CAMs.

To synchronize the time clocks in every CAM in the system with the central computer, select *Utility, Set Time* from the main menu.

## 4.9 Zero DAC Hours

Each CAM continuously integrates DAC hours during periods of continuous running. This information is displayed in the CAM Data window.

To zero the DAC hours for all CAMs in the system, select *Utility, Zero DAC Hours* from the main menu. To zero the DAC Hours for only a single CAM, disable polling on all but the desired CAM from the System Parameters dialog box and then select the zero DAC hours utility.

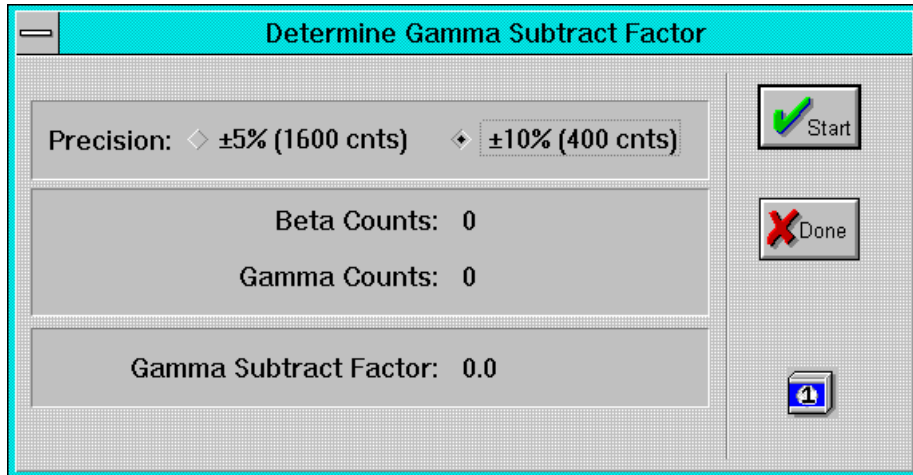
## 4.10 Determining Gamma Subtract Factor

The AMS-4 utilizes a second detector for the sole purpose of providing real-time gamma background compensation to the beta detector. For this background compensation to perform correctly, a operating parameter called the Gamma Subtract Factor must be properly set. This factor tells the AMS-4 what fraction of the gamma background count rate to subtract from the beta channel as an accurate indication of the gamma induced background in the beta channel. For example, if the gamma subtract factor is 1.2, this tells the AMS-4 that 1.2 times the count rate in the gamma channel should be subtracted from the beta channel for gamma background compensation.

Since the gamma subtract factor may change depending on the direction of the interfering gamma field, the gamma subtract factor should be re-determined each time the AMS-4 is moved. This is especially true if the AMS-4 is being operated in an elevated background.

Select *Utility, Set Gamma Subtract Factor* from the main menu to determine the gamma subtract factor.

When determining this factor, you have the choice of using either  $\pm 5\%$  fixed precision which requires the collection of 1,600 counts from each channel or  $\pm 10\%$  fixed precision which requires the collection of 400 counts from each channel. Under low background conditions always choose the default precision of  $\pm 10\%$ , otherwise the determination takes a very long time. Under elevated background conditions (several mR/h), or when you have a long time to wait, you may select the higher precision for a more accurate determination of this factor.



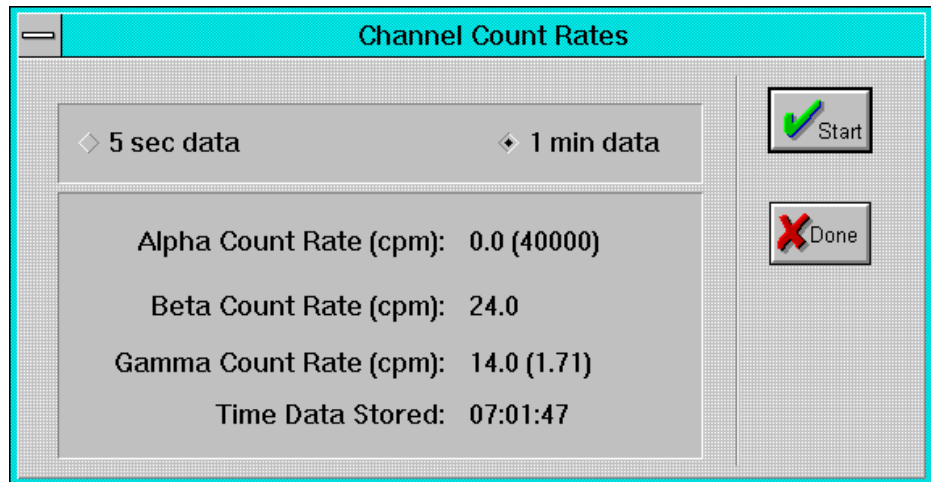
#### 4.11 Display Count Rates

The AMS-4 maintains five second and one minute log data for the alpha, beta and gamma background counting channels.

To display this information select *Utility, Display Count Rates* from the main menu.

The number in parentheses to the right of the alpha count rate is the alpha subtract factor which is needed to reduce the beta count rate reading to zero based strictly on information from the alpha channel. Monitoring this factor for the one minute data is a good way of determining the alpha subtract factor to enter into the operator parameters.

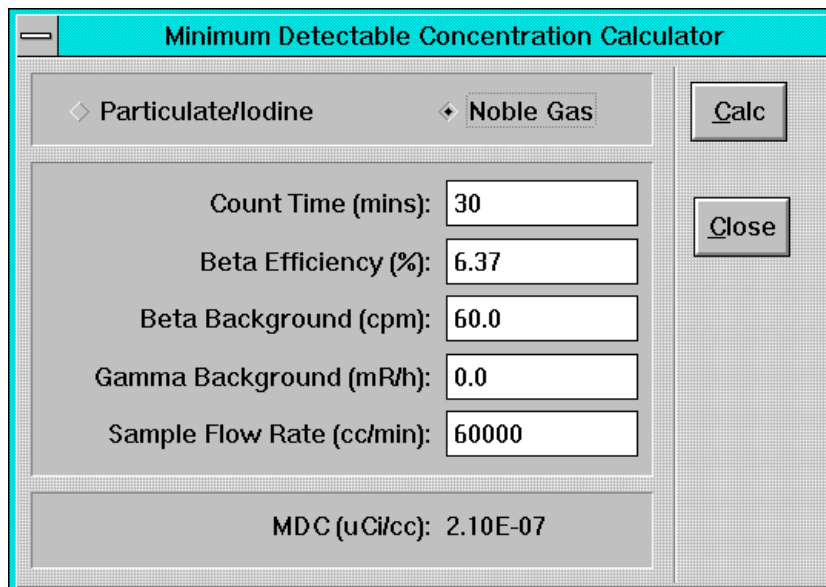
The number in parentheses to the right of the gamma count rate is the gamma subtract factor which is needed to reduce the beta count rate reading to zero based strictly on information from the gamma channel. Monitoring this factor for the one minute data is a good way of determining the gamma subtract factor to enter into the operator parameters.



#### 4.12 MDC Calculator

A calculator built into the WinAMS program supports calculations of minimum detectable concentration (MDC) based on a user alterable set of variables.

To utilize the MDC Calculator, select *Utility, MDC Calculator* from the main menu.



Notice that the Calculate button must be clicked each time the parameters are changed to recalculate the MDC.

## 5. Calibration

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### 5.1 Step 1 – Running a Voltage Plateau

Performing a full calibration on an AMS-4 normally begins with running a voltage plateau curve on both the beta and gamma channels to determine the best operating voltage.

Begin by making sure that both the beta and gamma channel thresholds are set at 6.3% and the alpha threshold is set at 45.1%. It is unlikely you will need to adjust the thresholds from their default setting. Select *Calibrate, Run Plateau* from the main menu. Notice that running the plateau takes the CAM out of normal operation.

Assuming you have entered the Level 3 password, you are presented with a dialog box which allows you to define how the voltage plateau is operated.

Select a counting time which results in at least 1,000 counts in the counting interval at a typical operating voltage. This is not at all critical, however, your voltage plateau graph will have the desired precision if you acquire  $\geq 1,000$  counts at the operating voltage. There is no point going beyond 10,000 counts in the counting interval. If this is the case, select a smaller source or a shorter counting time to get the job done quicker.

As an example, assume that you have around 7%  $4\pi$  efficiency. To obtain 1,000 counts in a 10 second counting interval requires a counting rate of 100 cps. To get this counting rate requires the following source:

$$SourceSize = \frac{100cps}{0.07} = 1,400dps(85,700dpm)$$

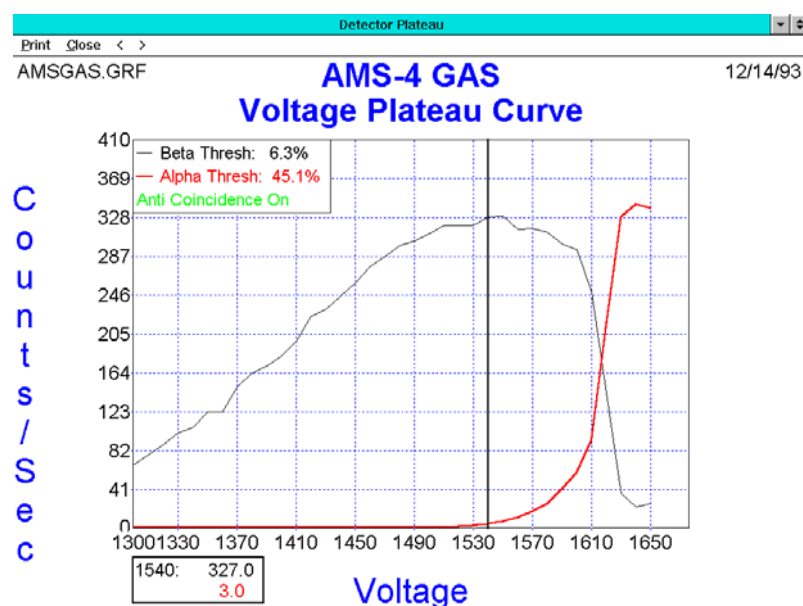
To get the same counting rate in 20 seconds requires only a 43,000 dpm source.

A starting voltage of 1,300 Vdc is usually sufficient. The ending voltage is somewhat tube dependent, however, 1700 Vdc is a good starting point. When running the beta plateau, you may select the check box *Stop When Alpha > Beta?* to have the plateau routine automatically terminate the plateau when the alpha curve rises above the beta curve. In this case, you may need to set the ending voltage a little higher to make sure it is not the controlling factor in determining the ending plateau voltage. The *Stop When Alpha > Beta?* check box has no function when running the Bkg Channel plateau.

Specify a graph name to place in the main graph title and a graph file name. Notice that the graph file name must have an extension of .GRF.

Insert the source and click on the Start button. Data gathering continues until completion or the Done button is pressed. If the Done button is pressed before the end of the plateau, the operator is allowed to save the data collected up to this point.

Once the plateau is complete, you may select a high voltage by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is placed at the desired voltage. For the beta channel, the operating voltage is normally set at a point where the voltage is as high as possible with less than a 1% beta to alpha crossover. Notice that on the beta channel voltage plateau the bar is automatically advanced to this position as the data is gathered. The black vertical bar turns red when the beta to alpha crossover exceeds 1%. Move the bar back one position when it turns red to obtain the optimum operating voltage. Save the desired voltage setting to the instrument by clicking on the Set HV button.



To plateau the gamma background channel, place one or more small (10  $\mu\text{Ci}$ )  $^{137}\text{Cs}$  sources (e.g. Eberline CS-7A source) on the sampling head housing as close to the gamma detector as possible. In all sampling head types, the gamma detector is mounted immediately behind the beta detector. On the gas sampling head, remove the outer can to support placement of the sources close to the detector.

Run the gamma channel plateau by first clicking on the *Bkg Channel* radio button and clicking on the Start button.

For the gamma channel, where there is no beta to alpha crossover to consider, you must visually select the optimum HV. While the gamma plateau is not always flat, there is always a definite point on the voltage plateau where the count rate rises sharply from the gentle slope of the plateau. Since the voltage plateau on these detectors is approximately 100 Vdc in length, choose an operating point 70-80 Vdc below the point on the plateau where the count rate rises sharply. For example, assume your plateau curve rises sharply at 1,610 Vdc. Click on the < and > selectors on

the graph until the vertical bar is on (1,610-80) or 1,530 Vdc and click on the Set HV button in the main dialog box.

## 5.2 Step 2 – Determining Beta Efficiency

Determining the beta efficiency is a two step process. The first step is to determine the beta channel background count rate.

Select a background counting time of at least 300 seconds.

Determine Background/Efficiency	
Count Time Remaining (secs):	300
<input checked="" type="radio"/> Background	Background Count Rate (cpm): 75.0
<input type="radio"/> Efficiency	Cal. Source Activity (dpm): 30000
	Cal. Source Isotope: Tc-99
	Cal. Source Serial Number: 123456
	Beta Count Rate (ncpm): 0.0
	Beta Efficiency (%): 10.0%

After setting the counting time, click on the Background radio button and then click on the Start button to take the background count.

Next, determine the efficiency by placing the calibration source into position and entering the source activity into the Cal. Source Activity edit box. (see AMS-4 manual for determination of source activity for particulate/iodine head) Click on the Efficiency radio button and click on the Start button to determine the efficiency. When determining the efficiency you should select a counting time which results in at least 2,000 counts integrated over the count period.

At the conclusion of the beta efficiency determination, you are questioned whether or not you wish to replace the existing efficiency with the new efficiency. Click the Yes button to save the new beta efficiency to the CAM.



### 5.2.1 Gas Sampling Head Calibration

Since it is impractical to perform radioactive gas calibrations on the AMS-4 Gas Sampling Head every time calibration is required, Thermo Scientific has performed a primary gas calibration with  $^{85}\text{Kr}$  and  $^{133}\text{Xe}$  and transferred the primary calibration to a  $^{99}\text{Tc}$  solid source so that AMS-4s can be easily field calibrated. This primary calibration is documented in Thermo Scientific Engineering Document 12000-A67.

AMS4 OPT10 consists of an approximately 400K dpm  $^{99}\text{Tc}$  source plated onto a rod which is mounted in a fixture which guarantees a consistent geometry when inserted through the hose barb at the end of the gas chamber. Before using the source make sure that the source end cap is resting against the rear of the chamber.

Determine the detector efficiency with this source in position (as described above) and then adjust the efficiency to establish the desired noble gas efficiency. For a  $^{85}\text{Kr}$  calibration, multiply the  $^{99}\text{Tc}$  source efficiency by 1.338 and enter the new efficiency manually into the AMS-4. For a  $^{133}\text{Xe}$  calibration, multiply the  $^{99}\text{Tc}$  source efficiency by 0.917 and enter the new efficiency manually into the AMS-4.

The correction factor for  $^{85}\text{Kr}$  is greater than the  $^{133}\text{Xe}$  correction factor since  $^{85}\text{Kr}$  (250 keV, 100%) is a stronger beta emitter than  $^{133}\text{Xe}$  (Eavg = 100 keV, 100%). The relationship between the solid source efficiency and the gas efficiency has no direct bearing (other than as a transfer standard) since the counting geometries are very dissimilar between the solid fixed position source and the homogeneously distributed gas.

Note that using the transfer standard correction factors provides a calibration referenced to standard temperature (22°C) and pressure (760 mm Hg).

### 5.3 Step 3 – Printing a Calibration Report

At the conclusion of the calibration (or at any other time the CAM is connected) you may print a calibration report.

Select *Calibration, Step 3* from the main menu and enter the serial number of the AMS-4 when prompted. The currently selected Windows printer is used for the report.

If a text file named USERTEXT.TXT exists in the WinAMS directory, the contents of this file are included in the calibration report just before the signature block at the bottom of the report. Creating/editing the USERTEXT.TXT file allows the user to define information which should be included in the printed calibration report including the model number and calibration date of the flow calibrator. Windows Notepad is an acceptable ASCII text editor to create/edit this file.



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