ASP-2/2e Portable Radiation Monitor

Technical Manual

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Section

1

Overview

General Description

Eberline's ASP-2 is a general-purpose portable radiation meter designed to bridge the gap between older analog designs and the most advanced current generation instruments. A microprocessor is used to make the ASP-2 highly versatile, however the user interface is simple and easily understood by operators familiar with more basic instruments. Like the latest cutting-edge 'smart' instruments, an ASP-2 may be configured through the use of a host computer for a wide range of detectors and measurement units.

Two display formats are available; a traditional meter plus range multiplier and a combined analog/digital display similar to that on modern high-end poratables. This and other configuration options are set up via a host program which runs on a personal computer. Once loaded, the configuration cannot be changed either accidentally or deliberately by the operator.

The ASP-2 is available in two versions: Basic (ASP-2) and enhanced (ASP-2e). Both provide ratemeter measurements, along with alarm and overrange indications, three response time settings, and clear displays of the measurement units and the type of radiation being measured. The enhanced model also measures integrated dose and scaler counts, as well as a pulse height window for energy-proportional probes.

Non-volatile storage is available for one complete set of probe parameters. With a power supply range of 300 to 2500 Volts and detection thresholds of 0.5 to 60 millivolts, virtually any type of probe may be accomidated. Once calibration constants and operating parameters for a particular probe have been determined, they may easily be downloaded to an ASP-2 by the configuration software.

Specifications

Length:	9.1 inch	23.1 cm
Width:	4.3	10.9
Height:	5.3	13.5
Weight:	2.4 lbs	1.09 kg (With batteries)
Batteries:	3 Alkaline "C" cells, life typically 100 hours	
Operating Temperature:	-20° to +50° C (-4° to +122° F)	
Storage Temperature:	-30° to +70° C (-22° to +155° F)	
Operating Humidity:	0 to 95% non-condensing	
Probe Connector:	MHV	

Features

- Simple, user-friendly controls, ergonomically arranged.
- Choice of two display formats.
- Easy configuration via Windows®-based interface program.
- Site administrator may pre-define available operating modes.
- Basic model measures in ratemeter mode.
- Scaler and integrate modes in enhanced model.
- Wide selection of rate and dose display units.
- Analog meter provides rapid, high contrast trend indications.
- Liquid crystal display for precise digital readings.
- Pulse height energy window in enahanced version.
- Internal parameter storage for one conventional probe.
- Thresholds may be calibrated to permit rapid probe changes.
- May be configured for virtually any type of detector.
- Rugged construction.

Safety Warning

CAUTION

Shock Hazard

Depending upon the type of probe used with this instrument, potentials in excess of 2,000 Volts may be present on the probe connector. This voltage may remain for up to one minute after the probe is disconnected or the unit is turned off. Never insert fingers or metallic objects into the probe connector on the instrument or probe cable.

This instrument should never be disassembled except by a qualified technician who is experienced in servicing radiation measurement equipment and familiar with the ASP-2 design.

Battery Warning

This instrument may be powered by either alkaline or nickel-cadmium batteries, both of which contain heavy metals and other hazardous materials which must be handled and disposed of properly. Do not mix batteries of different types or charge states in the same instrument. Recharge only batteries specifically designated as rechargable, and always follow manufacturer's charging recommendations. Do not puncture, mutilate or attempt to disassemble batteries. Do not heat cells above 100^{o}C (212^{o}F). Eberline recommends that batteries be recycled at appropriate recycling centers or disposed of as required by local ordinances and regulations.

Section

2

Controls and Indicators

Dedicated Controls

Note: Configuration is accomplished by connecting the instrument to a personal computer on which the ASP-2 interface software is running. Refer to the interface program manual for detailed instructions on this procedure. Depending upon the operating modes and options enabled during instrument configuration, some of the following controls may not be active. Assuming that they are, in fact, active, the following definitions apply:

Mode Selector	In addition to turning the instrument on and off, this switch selects CHECK and RATEMETER modes. If the instrument is an ASP-2 'E' (Enhanced model), INTEGRATE and SCALER modes will also be available.
Range Up/Down	These buttons increase and decrease the full-scale range of the display by a factor of ten. If necessary, the measurements are automatically adjusted as well. When automatic ranging is enabled, these switches have no effect.
Speaker	Toggles the audible clicks for individual count events on or off. Audible alarms are not affected by this control.
Light	When this button is pressed, the mechanical meter will be illuminated for five seconds. This short interval is necessary to extend battery life; the display lights consume substantial amounts of current. The LCD display is not illuminated.
PHA	(Enhanced model only) Selects the PHA counting channel (assuming that a PHA channel has been defined in the probe parameters).

MAIN (Enhanced model only) Selects the main counting channel.

Response The operator may step through slow, medium and fast display response times. The actual time constants for each switch position are defined in probe memory to insure that each switch position represents an appropriate value for the type of probe in use.

Note that all functions controlled by pushbuttons occur after the button is released.

StarKey Functions

In computer parlance, this is termed a 'soft' key because its use is defined in software rather than by hardwired connections. Note that in some modes the definition of this key may be changed during instrument configuration to suit specific needs or preferences. It is highly recommended that the same StarKey definitions be used for all ASP-2 instruments at any one site so that users will not be confused by different function assignments.

Note: In all modes, the StarKey is used to acknowledge alarms. If a rate or dose alarm is sounding, the first StarKey stroke will be used to silence that audible alarm indication. The "ALARM" icon on the display cannot be cancelled.

Check Mode The STAR key is used to step through various display screens. Refer to the manual section on CHECK MODE for a detailed description.

Ratemeter Mode The default StarKey function in this mode is a display reset. Pressing this key will bypass the normal response time calculations and force an instantaneous display update to the current measured value.

ASP-2E offers a second configuration option. The StarKey may be used to initiate a scaler count cycle. The latter definition, with appropriately chosen parameters, is particularly useful for quantifying suspected contamination located during rapid frisking.

Integrate Mode (Enhanced model only) Depending upon the option selected during configuration, the StarKey will either reset the accumulated information to zero or provide a temporary ratemeter display without disturbing the integration process.

Scaler Mode (Enhanced model only) Pressing the StarKey resets the displayed value to zero and initiates a new scaler count cycle.

Display

Two display elements, a meter and an LCD, operate together to provide a clear readout of radiation measurements. The meter movement provides a clear, high-contrast indication which may be read easily and quickly. The LCD indicates the units of measure and shows instrument status, such as the response time selected, alarm and overrange conditions, etc. Specific display messages and icons are explained in the manual sections to which they pertain.

While the function of the analog meter is intuitive, some details of the liquid crystal display bear enumeration:

Main Digits — In the center of the LCD, this field of large digits may be configured to provide either a simultaneous digital representation of the value shown on the Mechanical meter or a more traditional range multiplier which applies to the meter reading.

In CHECK mode, the identity of the probe for which the instrument has been calibrated is continuously scrolled across the main digits. This is intended to encourage the operator to verify that the correct probe is indeed connected to the ASP-2. Pressing the StarKey in CHECK mode causes several key operating parameters to be displayed sequentially in this area of the display. Refer to the CHECK MODE section of this manual for more details.

Units — Two groups of symbols, located below and to the right of the main digital field, indicate the units in which measurements are being displayed. A complete list of available units follows in the next section.

Channel — Icons below and left of center identify the radiation being measured as (one or more of) ALPHA, BETA, GAMMA or NEUTRON. An additional icon indicates when the PHA energy window of an ASP-2E is active.

Response — Located in the lower left corner of the window. Available selections are FAST, MED(ium) and SLOW.

Status — In the upper left corner of the window: OVERRANGE, ALARM and HV FAIL. In the upper right corner: SPEAKER ACTIVE and BATTERY.

Small Digits — Located in the lower right corner, these three digits are used in SCALER and

INTEGRATE modes (available only on the ASP-2E), as well as in CHECK mode:

- In CHECK mode, battery voltage is shown as a percentage.

- During SCALER mode counts, the remaining count time or the variance of the current reading (as a percentage) is shown.

- In INTEGRATE mode, the time over which the displayed dose has been accumulated is totaled.

Units and Ranges

Each set of probe parameters specifies one unit of measure; both ratemeter and integrated measurements are expressed in the appropriate forms of that unit. If rate is displayed in counts per second, for example, integrated measurements are displayed in counts. Possible unit selections include:

Ratemeter Bq, CPS, CPM, DPS, DPM, Sv/hr, Gy/hr, R/hr, Rem/hr.

Integrate Gy, Sv, R, Rem.

Note Integration may also be performed in disintegrations or counts, however there are no display icons for these units. Numeric readings shown without explicit dimensional icons are thus implied to be total numbers of events.

Any of these units are automatically prefixed with an appropriate multiplier, such as:
μ (micro), n (nano), m (milli) or K (kilo).

If the digital readout is configured to track the analog meter, the same base units and range multipliers apply to both. As different sensitivity ranges are selected, the decimal point of the numeric display moves as appropriate. Note that the digital display continues to provide accurate information up to twice the range of the meter scale.

It is important to remember that the available multiplier prefixes are spaced three decades apart, and that the displays can also span three decimal places or zeros. It is therefore possible to represent some readings in two ways, such as 1 R or 1000 mR. The instrument will automatically select an appropriate display format, however the operator must understand the interactions between the multipliers and full-scale ranges in order to correctly interpret the displayed readings.

Note Because the meter lights do not illuminate the liquid crystal display, it may not be possible to reliably determine the range multiplier in dark environments. If auto-ranging is enabled, the 'Beep on auto range' configuration option may be

selected to alert the operator when the multiplier changes.

Audible Indications

Particle clicks may be enabled or disabled by pressing the SPEAKER key on the front panel. A speaker icon in the upper right corner of the display window will be shown when the speaker is enabled. Note that a divisor may be specified as one of the probe parameters. This feature may be used to reduce the audible click rate for detectors with high background count rates.

Caution: The maximum click rate is limited to 50 clicks per second. Do not rely entirely on audible clicks for warnings of dangerous radiation fields.

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Section

3

Probes

Probe Parameters

The ASP-2 contains an internal non-volatile memory in which may be stored one complete set of probe information. These parameters may only be entered or modified from the configuration utility program, which runs on a personal computer connected to the instrument. Several probe parameters may be examined by the operator in CHECK mode; refer to the next section of this document for details.

Caution: It is up to the operator to insure that the probe connected is indeed the one for which the ASP-2 has been calibrated. The instrument cannot verify which type of probe is in use or whether the parameters stored in its internal memory are appropriate for that probe. Connecting a different probe may result in inaccurate readings or destruction of the probe due to the application of excessive voltage. If in doubt, leave the ASP-2 in CHECK mode until the probe identity is verified; high voltage is not applied until one of the measurement modes is selected.

Changing Probes

To operate the ASP-2 with a different probe, it is first necessary to load the parameters for that probe into the instrument's non-volatile memory. This must be done via the configuration program. Refer to the manual for that software for detailed instructions.

Connecting the incorrect probe to this instrument will almost certainly result in inaccurate readings and may damage or destroy the probe.

Section

4

Check Mode

Initial Check Mode Display

Whenever the ASP-2 is placed in CHECK mode, the model and serial numbers of the probe for which the instrument has been configured are scrolled across the center of the display until the STAR key is pressed or another mode is selected. Since high voltage is not applied to the probe while in CHECK mode, this provides an opportunity to safely verify that the correct probe is connected before subjecting it to potentially damaging voltages in case of error.

When CHECK mode is first entered, whether through the power-on sequence or by switching from another mode, the first information displayed on the main digital display is battery status. The BATTERY icon is turned on to identify the display and voltage is presented as a percentage on the small numeric field in the lower right corner of the display. A reading of 100% indicates a new set of batteries; 0% means that there is little or no energy available. Note that batteries are temperature sensitive; even new cells may read less than 100% if they are very cold. Some brands of alkaline or carbon cells may produce less than 1.5 Volts, even when new. These will also indicate less than 100%.

Note Nickel-Cadmium cells have a nominal output voltage of approximately 1.2-1.3 Volts per cell during most of their useful life. For this reason, they will never give a reading of 100%, even when fully charged. Avoid operating NiCad cells after they reach 0% on the display; doing so may damage the batteries.

Mechanical Meter Zero Correction

While battery voltage and probe number are shown on the digital portion of the display, the analog meter pointer is held at zero. If the mechanical zero point of the meter has shifted due to mechanical shock, it may be adjusted slightly by

pressing the RANGE UP and RANGE DOWN keys. If these buttons do not provide adequate adjustment range to bring the pointer to zero, the meter movement has probably been severely shocked and should be re-calibrated using the ASP-2 host program.

Reviewing Instrument Parameters

Pressing the STAR key in CHECK mode sequences the display through several parameters, some of which may be changed by the operator:

Rate Alarms The alarm setpoint(s) used in RATEMETER mode are shown, along with the unit(s) in which they are defined and channel type identifiers. The initials rAL are shown in the lower right area of the display window. Note that there may be two rate alarms for an ASP-2e if a PHA channel has been defined.

If editing has been enabled during instrument setup, the operator may change the displayed value by pressing the RANGE UP and RANGE DOWN keys.

Dose Alarms These are the alarm setpoint(s) used by an ASP-2e in INTEGRATE and SCALER modes. They are identified by the initials dAL in the lower right corner of the display.

As with the rate alarm setpoints, there may be two values defined for an enhanced instrument, and editing may be enabled during instrument setup.

High Voltages The probe voltage(s) selected during instrument calibration are shown, identified by the appropriate channel type icon(s). These values may not be changed by the operator.

Scaler Times A scaler count time is defined for each channel of an ASP-2e. These values are shown, with their channel icons, and may be edited with the RANGE UP and RANGE DOWN keys. These values are displayed in seconds, minutes or hours.

Firmware Version The instrument's program revision number is displayed, along with the identifying initials ASP in the lower right corner of the window.

Net Address An address in the range of 1 to 255 may be assigned for use when the instrument is part of a data collection network. The label **Add** is show to identify this number. The RANGE UP and RANGE DOWN keys are the only way to edit this value. All instruments will always respond to address 0 (zero) for testing purposes.

If the instrument will not be used as part of a network, this value is unimportant.

Display Test All segments and icons of the liquid crystal display are turned on for inspection.

Note After editing a parameter with the RANGE UP and RANGE DOWN keys, the STAR key **MUST** be pressed once to store the new value.

Section

5

Operating Modes

Ratemeter Mode

In this mode the ASP-2 operates as a basic ratemeter. Results are displayed in the units specified as one of the channel parameters, which may be simply counts per unit time or, if the probe has been appropriately calibrated, source activity or dose rate. The rate alarm limit, which is also read from memory, is used in this mode.

If the instrument is an enhanced model (ASP-2E), a PHA energy window may also be defined for energy-proportional probes. Pressing the PHA key will select this secondary channel, while the MAIN key will return to the primary set of probe parameters. Different probe operating voltages and pulse height thresholds may be defined for normal and PHA operations. If these are substantially different, settling time may be required when switching. In this case, the HV icon will flash until the power supply stabilizes at its new setting.

During instrument configuration, the StarKey may be assigned either of two functions in ratemeter mode. The first is to immediately display the currently measured instantaneous rate, bypassing the normal time constant calculations. Alternatively, it may initiate a scaler count cycle to obtain a measurement of known precision. This option is particularly useful when the instrument is used for frisking; it provides a convenient means for accurately characterizing an area which attracts attention during a rapid scan. Pressing the StarKey a second time will return the ASP-2 to normal ratemeter operation.

As in all modes, if an alarm is sounding, the first press of the StarKey will silence the audible alarm. Thereafter, the key will revert to its normal function.

Integrate Mode (ASP-2E Only)

An integrated measurement (eg. counts, R, Sv or disintegrations) is acquired in this operating mode, starting at zero when integrate mode is first selected. If the integrate alarm limit specified in probe memory is exceeded, an alarm indication is posted. As always, the StarKey may be used to silence the audible alarm.

In this mode, the numeric field in the lower right corner of the display window is used to show the total time over which the integrated counts, disintegrations or dose have been accumulated. Units of seconds, minutes or hours will be selected as appropriate.

As in RATEMETER mode, a PHA channel (if defined) may be selected by pressing the corresponding key. When the channel selection is changed in either direction, the current value will be reset and integration will begin from zero.

As a configuration option, the StarKey may be defined to perform either of two functions in integrate mode. The first is simply to reset the integrated value and running time to zero. The second available StarKey function is to provide a temporary ratemeter readout without exiting from integrate mode. This alternate display will last only while the key is held down, and integration will continue without interruption or loss of data.

Scaler Mode (ASP-2E Only)

In this operating mode, the StarKey is used to initiate a timed count cycle. Depending upon the option selected during instrument configuration, the results of this count may be displayed either as total counts or dose, or as activity or count rate averaged over the count time. In either case, the applicable alarm limit from probe memory will be used to determine whether an alarm is posted.

As a second configuration option, the scaler mode count time may either be entered as a fixed interval, or a required measurement precision may be entered. In the latter case, the ASP-2 will count until the specified precision is attained. In fixed count time mode, the remaining count time will be displayed on the small digits in the lower right corner of the display window. If a fixed precision is specified, the current measurement precision will be displayed as counts are accumulated. The confidence level of displayed precision values is $\pm 2\sigma$.

If the probe is switched from normal to PHA channel (or the reverse) during a scaler count, the count will be restarted from zero after measurement resumes.

Note Measurements displayed without units in INTEGRATE and

SCALER modes are total events; either counts or disintegrations. If in doubt, select RATEMETER mode to determine the base units in which the probe has been calibrated.

Section

6

Troubleshooting

Low Battery

The ASP-2 is powered by three 'C' batteries, which provide a nominal 4.5 Volts when new. Operation will continue down to about 2.8 Volts. Because batteries degrade rapidly once they fall below approximately 60% of their initial voltage, it is advisable to replace them soon after the battery icon first appears. Dead batteries may also leak; remove them from the instrument to prevent corrosion.

Battery life is significantly decreased at low temperatures. Cells which give a mid-scale voltage reading in a warm building may fail rapidly if the instrument is then operated outdoors in winter.

High Voltage Failures

This message is displayed when the instrument's high voltage power supply goes out of tolerance. It is most often caused by a shorted probe which loads the supply beyond its capacity. If the same failure is indicated with no probe connected, it is probable that a component within the supply has actually failed.

When switching between the main and PHA channels of an ASP-2E, the 'HV' icon may come on briefly while the high voltage supply adjusts to a new voltage setting. This is a normal indication.

Section

7

Instrument Configuration

Purpose

The ASP-2 is entirely controlled by its microprocessor; its probe voltage and detection thresholds are directly set by output pins of the processor chip. Calibrating and configuring this instrument is accomplished from a program which runs on a host computer and communicates with the ASP-2 via a serial data link. Refer to the manual supplied with the host program for detailed information.

In addition to traditional instrument parameters such as probe voltage, response times and detection thresholds, the configuration program provides access to numerous variables such as alarm setpoints and calibration information for both the ASP-2 and the detector connected to it. This program also provides access to other useful information including calibration dates, serial numbers, etc.

This approach to instrument setup provides several advantages:

- The user interface is friendly and capable because it runs under Microsoft Windows® on a personal computer.
- The instrument hardware is greatly simplified by the absence of many switches and potentiometers.
- It is not possible for the instrument operator to accidentally or intentionally make a change which might affect the accuracy of readings.

- Adding a number of useful features, such as alarm and detector overrange settings, required no additional hardware or expense.

- Instruments built now may be upgraded to future software versions without any need for hardware modifications.

- Instrument and probe parameters may be saved to or loaded from the computer's disk. Once an ASP-2 has been calibrated with a particular probe, the instrument may be re-configured for that probe quickly and easily.

Section

8

Hardware Reference

Replacing Batteries

The ASP-2 is powered by three "C" cells, which are located in a tube running lengthwise through the instrument. When inserting new batteries, the positive terminals of all three cells must point toward the top of the instrument. Installing batteries in the wrong direction will apply reverse voltage to the circuit board which may damage or destroy components. It is recommended that the mode selector switch be placed in the OFF position before changing batteries.

DAMAGE CAUSED BY INCORRECT BATTERY INSTALLATION IS NOT COVERED BY THE WARRANTY OF THIS INSTRUMENT!

Although rechargable or low cost zinc-carbon batteries may be used in this instrument, alkaline batteries are recommended for longest battery life. All batteries in a set must be of the same type and at the same charge level; do not mix batteries of different types or new and partially discharged cells.

Disassembly and Re-Assembly

Eberline discourages unnecessary disassembly of this instrument due to the hazard presented by high voltages which may exist on the circuit board. In addition, there is seldom a real need to open the ASP-2 since there is only one manually adjustable potentiometer inside. As described above, virtually all settings are downloaded from a host computer.

Should it become necessary to re-calibrate the high voltage supply or replace a component, the first step is to insure that the unit is switched off.

DANGEROUSLY HIGH VOLTAGES ARE PRESENT ON THE CIRCUIT BOARD DURING OPERATION AND FOR UP TO A MINUTE AFTER THE MODE SWITCH IS TURNED OFF.

Remove the six screws which hold the instrument cover onto the case. Apply light downward pressure on the handle to keep the environmental sealing gasket compressed and relieve tension on the screws. The cover, with the circuit board attached, may now be lifted clear of the case. If necessary, both battery leads may be disconnected from the battery tube; this will completely free the cover and board assembly.

To detach the circuit board from the cover, first remove the 'C' clip around the serial data connector and the mode selector knob from the switch shaft. De-solder two wires from the probe connector to the circuit board, then remove the rotary switch mounting nut and four screws which secure the circuit board to the cover. Finally, unplug the pushbutton connector tail which runs through the cover casting. The board and cover may now be separated.

CAUTION The liquid crystal display panel is thin and fragile. It is tied to the circuit board by a thermally-bonded ribbon jumper and depends upon the cover for support. If the glass has adhered to the inside of the mylar panel overlay, DO NOT PULL ON THE RIBBON JUMPER; use a non-metallic tool to gently pry the glass loose. Do not permit the display glass to hang suspended from its jumper cable; secure it against the meter body with a rubber band whenever the board is not installed in the case cover.

DAMAGE TO THE LCD GLASS OR ITS RIBBON JUMPER CANNOT BE REPAIRED. THE ONLY WAY TO REPAIR THE INSTRUMENT IF THIS OCCURS MAY BE TO PURCHASE AN ENTIRE NEW BOARD ASSEMBLY.

CAUTION Do not remove the red 'O' ring located on the front surface of the mode selector switch. As well as providing an environmental seal, this ring retains two very small pins inside the switch body. If the board is inverted, these pins will fall out unless covered by the 'O' ring. After removing the board from the cover, replace the mounting nut and washer to avoid losing the stop pins.

CAUTION All of the active components on this board are CMOS and hence susceptible to damage by static electricity. All work on this board should be done at a static-free workstation.

Re-assembly is exactly the reverse of disassembly. As before, handle the LCD glass and ribbon jumper with extreme care to avoid damage. Again, apply light pressure to the carrying handle to align the screw clearance holes in the cover with the threaded inserts on the sides of the lower housing. Before re-installing the LCD glass into the cover, remove any dirt or foreign materials from both surfaces. Never force the display element into place; it is, after all, glass.

CAUTION Do not permit the display's ribbon jumper to be pinched between the circuit board and the bosses on the inside of the cover casting to which it attaches.

Circuit Description

Power for the ASP-2 is provided by three "C" batteries, which may vary from 1.5 Volts when new to below 1.0 Volts each at the end of their useful life. To obtain maximum efficiency over this voltage range, a DC-DC inverter is implemented by IC U12 and its associated components. The output of this circuit is nominally 6.0 Volts, which is then regulated down to 5.0 V by U13. A second 5-Volt output regulated by U4 powers noise-sensitive analog components. Because the main function selector switch has a grounded common terminal, the negative side of the battery stack is switched rather than the positive to turn the unit on and off.

Control logic and arithemtic functions are implemented by the microprocessor (U1) and a second large IC, U2, which contains the instrument's program in EPROM as well as RAM and additional I/O ports. As well as its digital inputs and outputs, the 80C51FA processor chip uses four pins as pulse-width modulated outputs. The square waves on these ports (pins 1, 2, 43 and 44) have software-controlled duty factors; when filtered, they produce analog levels between zero and five Volts which determine the two detection thresholds, the high voltage and the meter drive level.

Serial communications with the host during instrument setup are handled by the microprocessor's internal communications interface. U6, a CMOS to RS-232 converter chip, interfaces the low-level signals at the processor's I/O pins to the serial data connector, J2. This chip also generates the higher bipolar voltages required for RS-232 communications.

All analog functions are built into U5, a custom hybrid used in many Eberline designs. This device contains four surface mount ICs plus numerous resistors and capacitors. The first half of the hybrid is a two-stage input amplifier, each stage with its own pulse height discriminators and output conditioning one-shots. As described above, the two pulse-height reference inputs are obtained by filtering pulse-width modulated square waves produced by the microprocessor. Outputs from the pulse discriminators are routed to counter inputs on pins 10 and 11 of the processor chip.

The second half of hybrid U5 is a closed-loop regulator for the probe voltage supply. Again, a pulse-width modulated output from the 80C51FA is filtered to provide a DC reference voltage; the actual probe voltage is regulated to 1000 times this reference value. Probe voltage is generated by a ladder type multiplier network on the output of transformer T1. This, in turn, is driven by oscillator U11 and transistor Q4. Sudden changes in output voltage are coupled into the regulator circuit via capacitor C41 to reduce recovery time.

Only one adjustment, potentiometer R27, is required to calibrate the high voltage supply. This trimmer compensates for minor variations in the 1000:1 voltage divider network of the hybrid. Once this ratio is correctly set, the supply is calibrated over its entire range.

Switch inputs (eight from pushbuttons and two from the mode selector switch) feed into the ports of U2. Outputs from this chip control miscellaneous board functions such as the meter lights and sound generator.

An analog to digital converter, U7, enables the instrument to monitor its battery voltage and also a feedback point in the high voltage supply controller. The latter information is used to determine when the probe voltage has fully settled after the processor changes the voltage setting.

Two pins (40 and 41) of the microprocessor communicate with U8, a non-volatile EEPROM, and U3, the liquid crystal display controller. Instrument and probe parameters are stored in U8, which retains its contents even if the instrument's batteries are discharged or removed. U3 generates the timing signals and voltages required to drive the 80-segment display panel.

High Voltage Calibration

As described above, potentiometer R27 precisely calibrates the 1000:1 divider network through which the high voltage power supply is regulated. In theory, setting this ratio at a single voltage should calibrate the supply over its entire range. In practice, however, high-value resistors vary in value according to the voltage applied across them. The best compromise is generally obtained by calibrating the supply at approximately mid-range; about 1250 Volts for this instrument.

When performing this calibration, note that the ASP-2 displays probe voltage in 10-Volt increments, however the actual step size is about 9.766 Volts. This means that many nominal values cannot be accurately attained. 1250 Volts, however, can be set exactly. For this reason, Eberline recommends calibrating the ASP-2 power supply at 1250 Volts. The supply is regulated at capacitor C40; for best accuracy, measure directly across the leads of this component (the lead closest to the board edge is positive). Always use a high voltage probe or meter with an input resistance of at least 1000 megohms for this reading.

Schematic

The accompanying diagrams include schematics and component placement diagrams for the ASP-2 circuit board. Note that U5, the custom hybrid circuit module which contains virtually all of the analog components, is a non-repairable component and is simply shown as a block on the schematic.

Parts List

The following tables list the electronic components used in the ASP-2 and should contain sufficient information for obtaining replacement parts. Unless otherwise specified, specific manufacturers and part numbers listed may be considered examples only and not restrictions against using equivalent components with the same characteristics from other vendors. When ordering parts from Eberline, specify the model and serial numbers of the instrument and reference designator(s) and/or descriptions of the parts required. Eberline will automatically substitute equivalent parts if the original source is no longer available.

Main PC Board (Eberline part number YP11637102)

Reference Designation	PartName	PartDescription	Eberline Part Number
[None]	Circuit board	Main PCB	ZP11637101
C3-13, 15-17, 19-24,28, 31, 46, 51	Capacitor, Ceramic	0.1 uF, 50 V Surface mount size 1206	SCPCE104P2N
C18, 26, 27, 29, 44, 47, 48	Capacitor, Tantalum	10 uF 10 V Surface mount 3.5 x 2.8 mm	SCPTA100M3D
C32, 45	Capacitor, tantalum	22 uF 10 V Surface mount 6.0 x 3.2 mm	SCPTA220M3F
C49,50	Capacitor, aluminum	33 uF 10 V Surface Mount	SCPAL330M4F
C43	Capacitor, ceramic	3300 pF 50 V Surface mount size 0805	SCPCE332P3N
C1, 2	Capacitor, ceramic	33 pF 50 V, NPO dielectric Surface mount size 0805	SCPCE330P3N
R1, 2, 11-18, 20, 21, 23, 24, 32-38, 42	Resistor, Ceramic	10 K-Ohm 0.1 Watt 5% Surface mount size 0805	SRECE103B20
R3-10, 19	Resistor, Ceramic	100 K-Ohm 0.1 Watt 5% Surface mount size 0805	SRECE104B20
XU2	Socket, IC	44-pin PLCC Surface mount	SOIC3044
XU5	Socket, IC	32-pin strip, 0.1" centers	SODS132
U1	IC	CMOS Microcoprocessor, Surface mount	SICCM8051FA

Reference Designation	PartName	PartDescription	Eberline Part Number
U3	IC	LCD Controller Surface mount	SICCMPCF8576
U7	IC	A/D, Dual 8-Bit Surface mount	SICCMLTC1098
U8	IC	EEPROM, 256 x 8 bit Surface mount	SICCM2402
U9	IC	Dual Op-Amp Surface mount	SICAO662AI
U10	IC	Hex inverter w/ hysteresis Surface mount	SICHC14
C30, 41	Capacitor,disk	220 pF 3 KV 10%	CPCE221P3Y
R43-46	Resistor, ceramic	33 Ohm 0.1 Watt 5% Surface mount size 0805	SRECE330B20
R22,49	Resistor, ceramic	220 Ohm 0.1 Watt 5% Surface mount size 0805	SRECE221B20
R28, 29	Resistor, ceramic	1M-Ohm 0.1 Watt 1% Surface mount size 0805	SRECE105B10
R31	Resistor, carbon	1 M-Ohm 0.25 Watt 5%	RECC105B22
R30	Resistor, ceramic	2.00 K-Ohm 0.1 Watt 1% Surface mount size 0805	SRECE202B10
R27	Potentiometer	100 K-Ohm, Side adjust	PTCE104B83
R41	Resistor, ceramic	39.2 K- Ohm 0.1 Watt 1% Surface mount size 0805	SRECE393B10
R40	Resistor, ceramic	100 Ohm 0.1 Watt 5% Surface mount size 0805	SRECE101B20
X1	Crystal	4.9152 MHz	CYOS22
DS2, 3	LED bar	Yellow	OPLP68
CR1-3	Diode, switching	Surface mount SMT package	SCRSIGPSW
Q1, 2	Transistor, FET	N-Channel Switching	TRMN2N7000
U4	IC	Regulator, 5V, Low-drop	ICAVA2950C

Reference Designation	PartName	PartDescription	Eberline Part Number
U5	Hybrid	[Custom]	VEBD14
SPKR1	Buzzer	Audio Alarm	ADSS6
CR8	Diode, Schottky	20 V, 1 Amp, Surface mount	SCRSC20V1A
J2	Connector Body	7-pin circular, black plastic	COMR1907
XJ2	Connector Pins	Receptacle pin, PC Tail	COHD133
J3	Connector	R/A header, 9-pin x 0.1"	COMR1309
XSW1, XDS2,3	Socket	Single pin	SOIC1001
SW1	Switch	Rotary 8-pos. Binary encoded	SWRO61
U6	IC	RS232 Interface, Surface mount	SICXXMAX242
M1	Meter	0-1 Ma Rectangular	MTPA45
U2	IC	Programmable peripheral Programmed with ASP-2 firmware	SICCZPSD312
XDS1	Ribbon jumper	Thermal bonding	WRFC6501
DS1	LCD	[Custom]	OPDS37
L1	Inductor	100 uH Choke, High current	INFI5
U11	IC	Voltage Conv., Surface mount	SICVCMAX630
U12	IC	Voltage Conv., Surface mount	SICAV1111
U13	IC	Regulator, 5V, Low-drop	ICAVAL4941
R26	Resistor, carbon	1.3 K-Ohm 0.25 Watt 5%	RECC132B22
R25	Resistor, carbon	8.2 K-Ohm 0.25 Watt 5%	RECC822B22
R39	Resistor, carbon	33 Ohm 0.25 Watt 5%	RECC330B22
R47, 48	Resistor, carbon	3 M-Ohm 0.25 Watt 5%	RECC305B22
C25	Capacitor, disk	0.01 uF 1.6 KV 20%	CPCE103PXV

Reference Designation	PartName	PartDescription	Eberline Part Number
C33, 37, 38	Capacitor, Disk	0.01 uF 3 KV 20%	CPCE103P4Y
C39, 40	Capacitor, Film	0.047 uF 4 KV 10%	CPPF503PXY
CR9	Diode	22-Volt Zener	CRZR1N0969
CR4-7	Rectifier	2500 Volt	CRSIVA0025
Q4	Transistor, PNP	Medium Power	TRSPMJE371
T1	Xformer	High-voltage	TFHV5

Miscellaneous

Reference Designation	Part Name	Part Description	Eberline Part Number
[SW1]	Knob	Finger-bar	HDKN30
[SW1]	Shaft adapter	.250" knob to .125" shaft adapter	HDKN41
None	Gasket	Silicone tube, 0.126" O.D.	MMRU112
J4	Connector	MHV bulkhead	CXMH18
None	Battery holder	Tubular, 3 C-cells	BTBH62
Keypad	Switch matrix	2x4 buttons	SWMI63
None	Panel overlay	ASP-2 (basic model)	ZP11637008
None	Panel overlay	ASP-2e (enhanced model)	ZP11637005

Section

9

Diagrams

The following schematics and assembly drawing are included for repair and troubleshooting purposes:

Main PC Board Schematic	Drawing # 11637-D100
Main PC Board Assembly	Drawing # 11637-D102

Section

10

Accessories

Probe Cables

The ASP-2 is furnished with a standard MHV coaxial connector. Select from the following cable options for probes reqiring MHV, BNC or CP-1 connectors:

MHV-MHV:	36 inch	Order # ASP2OPT8
	60 inch	Order # ASP2OPT9
MHV-BNC:	36 inch	Order # ASP2OPT10
	60 inch	Order # ASP2OPT11
MHV-CP1:	36 inch	Order # ASP2OPT12
	60 inch	Order # ASP2OPT13

Eberline can also fabricate cables of other lengths or with other probe connectors. Contact the factory for ordering information.

Probe Brackets

These bracket assemblies provide a convenient means of attaching probes to the instrument for easy carrying and to prevent damage to the probe.

For Eberline probes HP-190A, HP-270, HP-290, HP-330, HP-360, HP-370	Order # ASP2OPT4
For Eberline probes SPA-8, LEG1	Order # ASP2OPT5
For Eberline probes PG-2, SPA-3, SPA-6, SPA-9	Order # ASP2OPT6

For Eberline probe NRD-1 Order # ASP2OPT7

Other Accessories

Software: The ASP-2 Interface Program, as described in this manual. Additional documentation is provided with this software. Runs on an IBM® PC compatible computer running Microsoft Windows®. Requires an ASP-2 data cable for connection to the instrument.

Interface program	Order # ASP2OPT1
ASP-2 data cable	Order # ASP2OPT3
Carry strap w/ D-rings	Order # ASP2OPT2

Probes

HP-100 series	100 cm^2 Gas flow proportional (MHV)
HP-190A	End window GM detector (BNC)
HP-210 series	Pancake GM detectors (BNC)
HP-220A	Shielded/directional GM detector (BNC)
HP-270	Energy compensated GM detector, 0-3 R/Hr (BNC)
HP-280	Neutron sphere, 3 inch diameter (MHV)
HP-290	Energy compensated GM detector, 0-80 R/Hr (BNC)
HP-330	Sealed gas proportional (MHV)
HP-340	Alpha/Beta scintillator (MHV)
HP-350	Alpha scintillator (MHV)
HP-360	Pancake GM detector (BNC)
HP-370	Pancake low energy Gamma (MHV)
HP-380A	100 cm^2 Alpha scintillator (MHV)
HP-380AB	100 cm^2 Alpha/Beta scintillator (MHV)
NRD-1	Neutron sphere, 9 inch diameter (MHV)
AC-3-7, AC-3-8	Alpha scintillators (CP-1)
LEG-1	Low energy Gamma scintillator (CP-1) 1" diameter x 0.04" thick NaI crystal
PG-2	Low energy Gamma/X-Ray scintillator (CP-1) 2" diameter x 0.08" thick NaI crystal
SPA-1A	Alpha scintillator for particulate and swipe samples (MHV) 1" diameter zinc sulfide detector element
SPA-3	High sensitivity Gamma scintillator (CP-1) 2" diameter x 2" thick NaI crystal
SPA-3MHV	As above, with MHV connector
SPA-6	Medium sensitivity Gamma scintillator (MHV) 2" diameter x 2.4" thick plastic element
SPA-8	Gamma scintillator (MHV) 1" diameter x 1" thick NaI crystal
SPA-9	Gamma scintillator for Iodine (MHV) 2" diameter x 0.5" thick NaI crystal

Section

11

Host Program

System Requirements

This program must be installed on a personal computer running the Microsoft® Windows® operating system (either Windows® 3.1 or Windows® 95). In addition, an Eberline ASP2OPT3 (model CA-104-60 serial data cable) is needed to connect the computer's serial port to the ASP-2 instrument.

Insert the floppy diskete on which the host program is distributed into the system's 3.5'' floppy drive, then run the file **install.exe** on the diskette. Under Windows® 3.1, this may be accomplished by clicking *File* on the main menu, then *Run* from the pull-down menu which appears. Enter the file path (A:\install.exe, for floppy drive A:) or use the *Browse* option to find this file. In Windows® 95, the corresponding *Run* command is located under the **Start** button menu.

Once started, the installation program will automatically create a new directory if required, then copy the host program, **ASP2.EXE** to the computer's hard disk. If installing over an older version of the same program, it is strongly recommended that the file **ASP2.DAT** be deleted first, as it is generally best to allow the new installation to create its own data file.

In addition to copying the host program onto a hard disk, the install program also creates an icon through which it may be started. Double-click this icon to launch the program. Before attempting to use this program, click on the *Edit* option, then on *Host System Properties* in the pull-down menu which appears. Select the computer's serial port which will be used for communicating with instruments. This port must have a 9-pin 'D' conector. If your computer's serial port has a 25-pin connector, an adapter (available from computer supply stores) will be required.

Note: The *Host System Properties* window contains several other options which may be turned on or off by clicking on them with the mouse cursosr. One in particular, *Simulator Active*, should generally be left turned off. If enabled, this control connects the host program to a 'virtual' ASP-2 for training purposes. If this box is checked, the program will **not** communicate with real instruments.

Main Screen

When first launched, the host program displays a window with the title **Eberline ASP-2 Vx.xx** (where x.xx is the software version number). At the right end of the title bar are the standard Windows® buttons to minimize, maximize and close the program window. Below this is a line of headings: *File, Edit, Calibration, Utility* and *About*. Each of these words, when clicked with the mouse cursor, provides access to one or more program functions.

The next line down contains three icons:

ASP-2 glyph — Indicates whether the program is operating in simulator mode. If the simulator is active, an 'X' is drawn across the icon as a reminder that the program is not currently able to communicate with real instruments.

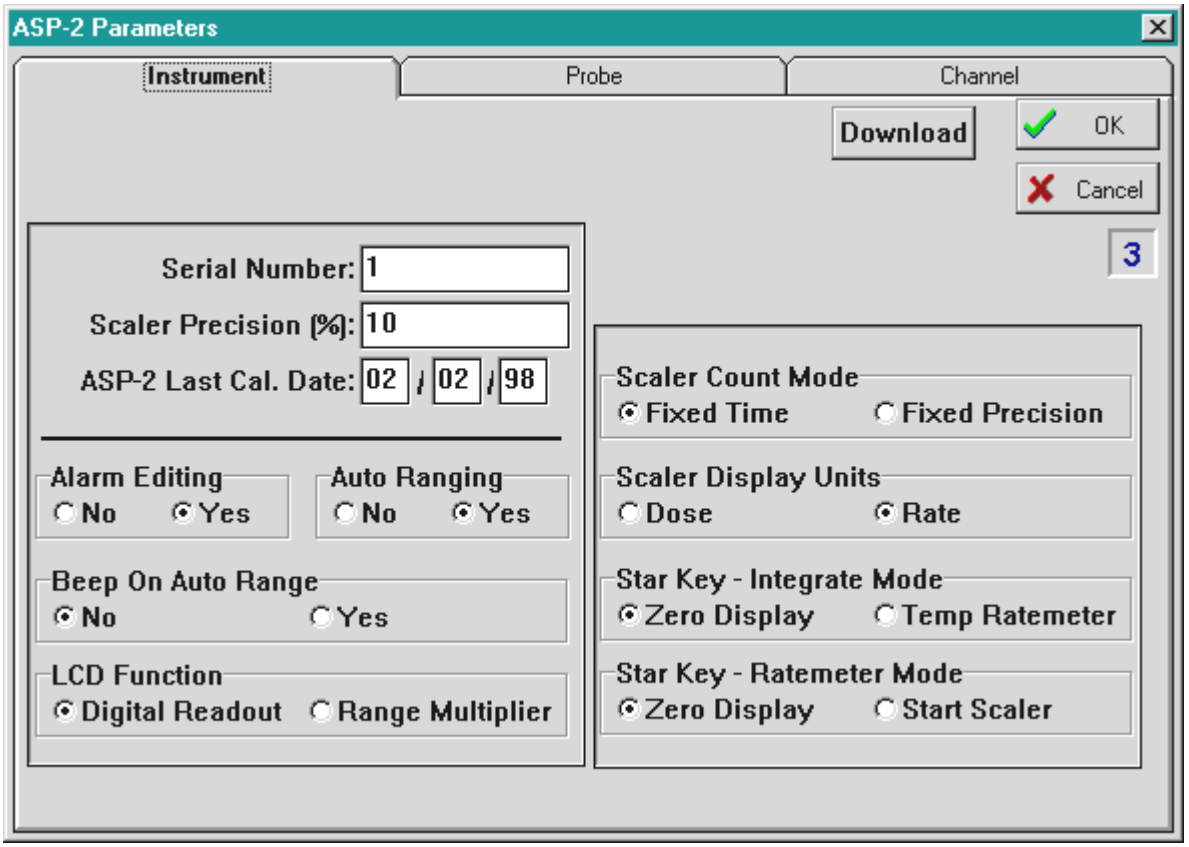
Parameters icon — Clicking on this icon provides immediate access to instrument and probe parameters (a shortcut equivavlent to selecting *Edit*, then *Instrument/Probe Parameters*).

Level Number — Shows the level (1 thru 3) of the last password entered. Refer to the *Edit* section for details on password access.

The following sections provide details of the *Edit, Calibration* and *Utility* headings and the functions which may be accessed through those labels. The two remaining menus (under *File* and *About*), contain only items common to most Windows® applications.

Edit: Instrument/Probe Parameters

This is the largest and most complex screen of information available from the host program. Three separate pages of information are contained in the Instrument/Probe Parameters window, each identified by a labeled 'tab' along the top edge. Clicking on one of these tabs will open that page of data. Three buttons in the upper-right corner are common to all three pages:



Download Sends the contents of the window (all three screens at once) to a ASP-2 connected to the host computer.

OK Downloads as above, then closes the window.

Cancel Closes the window <u>without</u> saving its contents to the ASP-2.

<u>Edit: Instrument Parameters</u>

Serial Number This is the instrument's identification number, and is initially set to the factory-assigned serial number printed on the ASP-2 case.

Scaler Precision The measurement variance, expressed as a percentage, to which the instrument will count in scaler mode when **Fixed Precision** rather than **Fixed Time** scaler counting is selected.

ASP-2 Last When calibrating an ASP-2, enter the current date in these

Cal. Date three fields. This information is not checked by either the Instrument or the host program. Enter dates in month-day-year format.

Alarm Editing Enables or disables editing of the rate and dose alarm Setpoints from the ASP-2 front panel. To use this feature, place the unit in CHECK mode and use the STAR KEY to RATE ALARM (rAL) or DOSE ALARM (dAL) screen. If editing is enabled, the RANGE UP and RANGE DOWN buttons may be used to change the alarm limits.

Auto Ranging Switches the instrument between automatic and manual ranging.

Beep On Auto Range If this feature is enabled and automatic ranging is enabled, the ASP-2 will produce audible beeps whenever a new range is selected by the instrument.

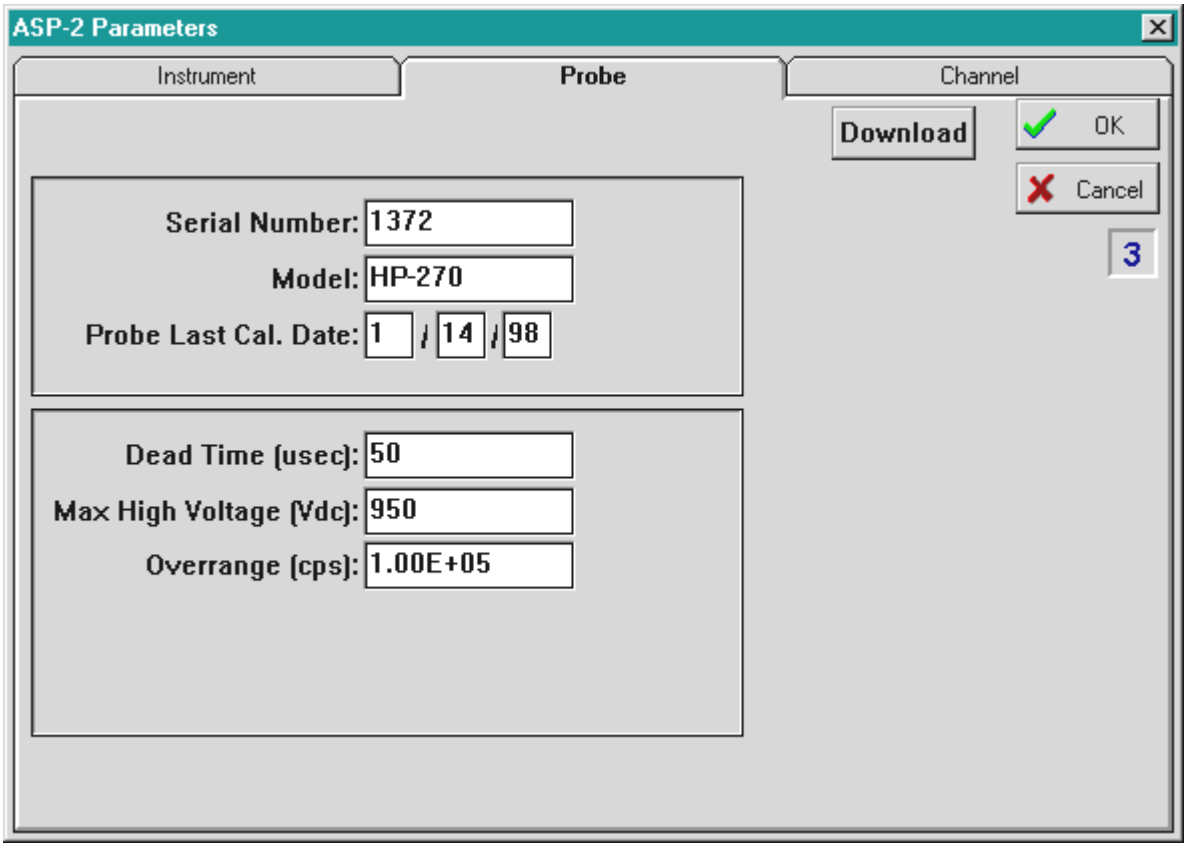
LCD Function The ASP-2 offers two display modes; a **Digital Readout** mode in which both the mechanical pointer and numeric display show the same value, and a **Range Multiplier** mode in which the pointer provides significant digits) while the lower

Scaler Count Time Mode If the ASP-2 supports scaler counts, either a **fixed time** count or a **fixed precision** may be selected. If **fixed time** is specified, the time is specified in the **Channel Parameters** window and different values may be set for each channel. In **fixed precision** mode, the desired variance is entered elsewhere in this window.

Scaler Display Units Scaler count results may be displayed as either the **dose** accumulated during the count or as a **rate** averaged over the counting interval.

Star Key Integrate Mode While operating in INTEGRATE mode, the STAR key may be assigned either of two functions while in this mode. The first is to zero the display and re-start dose integration. As an alternative, this key may be set to provide a temporary rate indication without exiting from INTEGRATE mode or stopping the accumulation of dose data.

Star Key Ratemeter Mode An ASP-2e, which includes a SCALER counting mode, may be configured to perform a scaler count cycle without switching out of RATEMETER mode. This provides a quick means for accurately characterizing ‘hot’ spots located during frisking.



NOTE: SCALER and INTEGRATE modes are not supported by the base model ASP-2.

Edit: Probe Parameters

Serial Number Numeric serial number of the probe for which this instrument has been calibrated.

Model Alphanumeric model designation of the probe.

NOTE: The probe model and serial number are continuously scrolled across the instrument'sdisplay while in CHECK mode. It is the operator's responsibility to verify rifythat the probe so identified is actually the one connected to the ASP-2 before switching into any measurement mode. Because the display is made up ofseven-segment numbers, only a subset of the alphabet can be correctly shown.

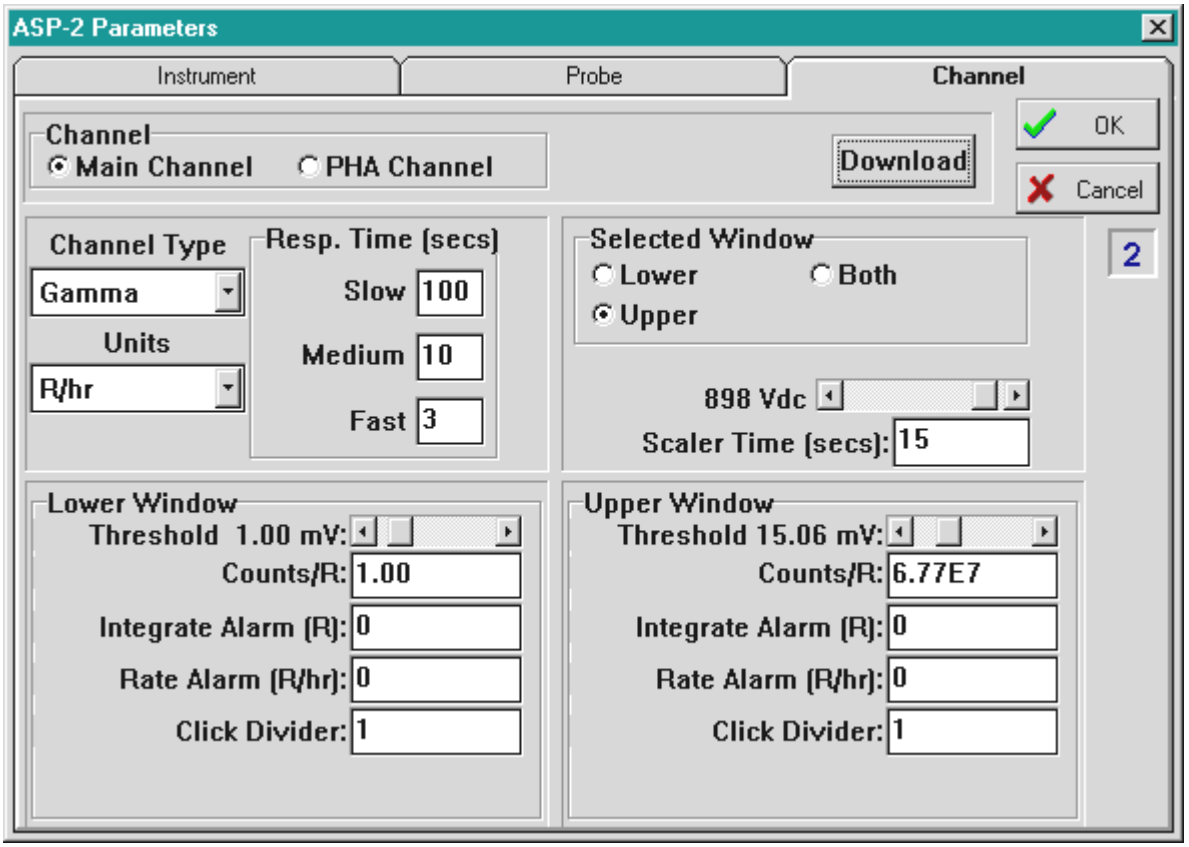
Probe Last Cal. Date When calibrating a probe with this instrument, enter the current date in these fields (in month-day-year format).

Dead Time The probe's dead time in microseconds should be entered here. Readings taken in high fields will then be corrected statistically for detector pulse collisions.

Max High Voltage Under no circumstances will the ASP-2 output a probe voltage greater than the limit entered in this field. This is a safety feature intended to protect the probe.

NOTE: This voltage limit will not be exceeded under **ANY** conditions, including during calibration or instrument test. Before attempting to calibrate the high voltage power supply, verify that this setting is at or above 1250 Volts.

Overrange Enter the detector pulse rate in counts per second at which the **overrange** alarm should be triggered. Should this happen, it is necessary to power the ASP-2 completely OFF before resuming measurements. Overrange values are in counts per second AFTER DEADTIME CORRECTION. If the overrange point for a detector is known in dose rate units, such as R/h, a deadtime alarm point may thus be calculated easily using the probe's calibration constant.



Edit: Channel Parameters

Channel Selects either the main or PHA channel parameter set for display and editing. NOTE: This control is not displayed for a single-channel base model ASP-2.

Channel Type Select the type of radiation to be measured from this list by using the up and down arrow keys on the PC keyboard, or click on the arrowhead at the right of this field to display a list of choices and select one with the mouse cursor.

All unused channels (typically the PHA channel of an ASP-2e used with a single-channel probe) should be set to type **NONE**. This will prevent the operator from accidentally selecting an undefined channel.

Units Offers a range of dose, rate and activity units in which a channel may be calibrated. The same base units are used for both rate and dose measurements; if R/h is selected for dose rate, dose will be integrated in R.

Response Times Three response times (slow, medium and fast) may be entered for each defined channel. The operator may step

through these selections by pressing the **Response** button.

Selected Window Selecting **Lower** will count only detector events which produce pulses above the lower window threshold, but below the upper window. Selecting **Upper** counts only those pulses which cross the upper window energy threshold. The **Both** option sums counts from both energy windows. Since PHA (Pulse Height Analysis) requires both lower and upper energy limits, only the **Lower** window is available for the PHA channel of an ASP-2e.

Note that when **Both** windows are selected, the ASP-2 will apply the lower window calibration constant to counts from the lower energy window and the upper cal constant to counts in the upper window, then display the sum of these two calculations.

Probe Voltage This slider control bar may be positioned anywhere between zero and the maximum high voltage defined in the **Probe Parameters** screen.

Scaler Time Sets the time, in seconds, used for fixed-time scaler counts.

Upper/Lower Window

These windows contain two identical sets of parameters which control the energy thresholds, calibration constants, alarm setpoints and speaker click dividers for the upper and lower detection windows, respectively. The

Selected Window buttons described above select which window(s) are actually used for counting.

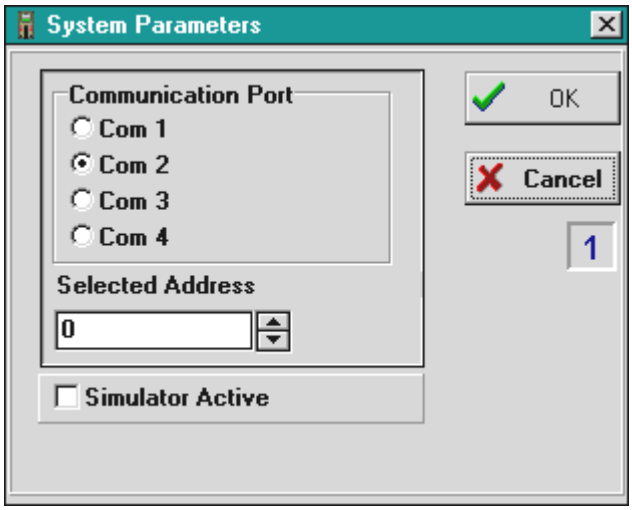
Threshold Slider controls which set the voltage threshold above which pulses are counted in each window. Always set the upper window threshold to a value greater than that for the lower window.

Counts/unit Calibration constants expressed as the number of detector pulses per display unit (ie. Counts/R, Counts/Sv, etc.).

Integrate Alarm Integrated dose at which an alarm will be posted. This value is used only by instruments which support integrating modes. Setting this alarm limit to zero disables dose alarms entirely.

Rate Alarm Instantaneous dose rate at which an alarm is posted. Set this value to zero to disable rate alarms.

Click Divider The number of detector events required to produce one click from the ASP-2's speaker. Useful for detectors with high background count rates.



EDIT: Host System Properties

The parameters in this window are used to configure the ASP-2 host program.

Communication Port Selects which of the host computer's serial data ports the program will use when communicating with an ASP-2.

Selected Address Although it is possible to assign each ASP-2 a unique address for use in local networks, all instruments will respond to a 'broadcast' address of zero. When communicating with only one instrument at a time over a serial cable, set this field to zero.

Simulator Active When this box is checked, the host program simulates an ASP-2 rather than attempting to talk to a real instrument via the serial port. This is useful for training and experimental work.

Edit: Load / Save Setup Parameters

Instrument and probe parameters may be saved from an ASP-2 to the disk drive of a computer, then reloaded into the instrument at a later time. This makes it possible to calibrate a single instrument with several different probes, then restore any of these setups when required. Typical setups may also be defined for various probe types and used as starting points for individual calibrations.

The commands which perform these functions are included under the **Edit** heading:

Load Setup Parameters and **Save Setup Parameters.**

When either of these is selected with the mouse pointer, a smaller window pops up offering the options **Instrument Parameters** and **Probe Parameters**. The first transfers the information such as the instrument serial number and configuration. The second copies general and channel parameters for the probe to or from a disk file. Once any of these actions is chosen, a directory window opens and the operator is asked to select a destination or source file. If these commands are displayed in gray (rather than black) text, a higher level password is required (see next section).

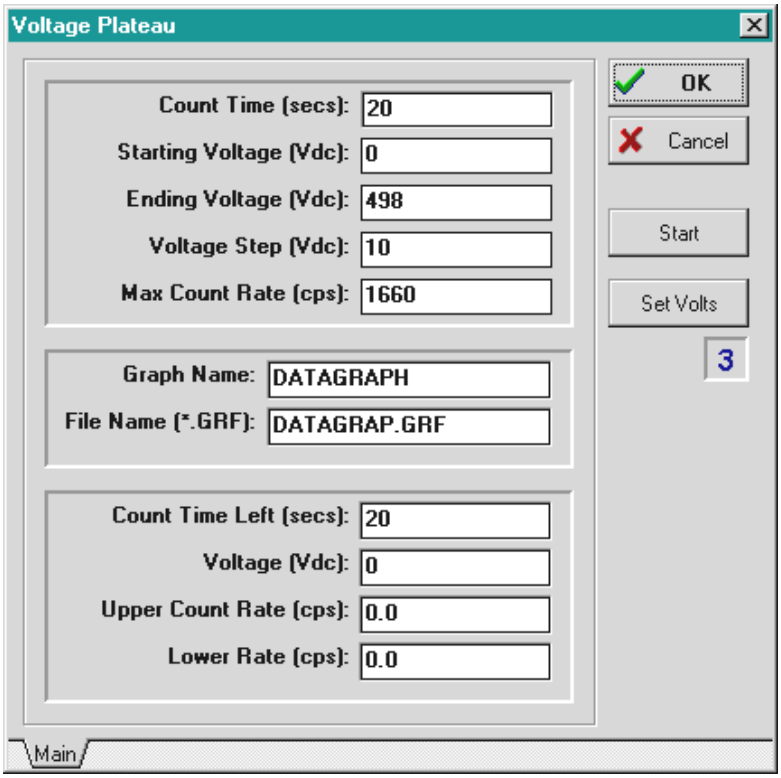
Edit: Enter / Edit Passwords

To prevent unauthorized tampering, it is possible to password protect various functions of the ASP-2 host program. Three levels of security are provided to restrict which functions are accessable to specific personnel:

Level 1	This password permits changes to the host system properties such as communications port selection and enabling/disabling the instrument simulator.
Level 2	Allows access to stored information including calibration reports and voltage plateau graphs.
Level 3	Grants full access and the ability to change parameters which affect instrument operation.

Entering the level 2 password also provides access to level 1 functions, while the level 3 password unlocks all level 1 and 2 commands. The factory default for all passwords is '**Eberline**'. Note that if the file **ASP2.DAT** is ever deleted, this default value will be restored, since all password changes are encrypted into this file.

If security is not an issue, the password may be made part of the Windows®

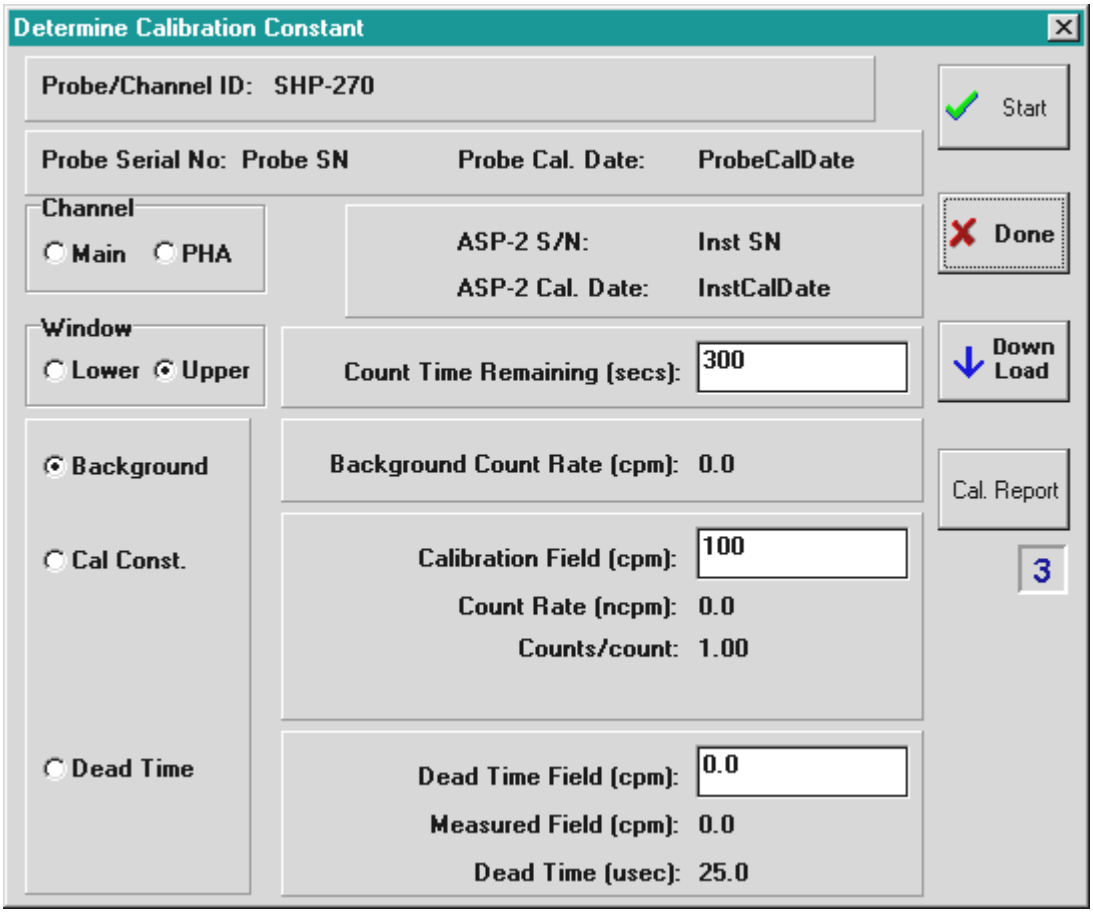


command line which launches the host program. Once this is done, no additional passwords will be required. The modified command line will typically be something like: **C:\ASP2\ASP2.EXE Eberline**.

Calibration: Run Plateau

This menu is accessed through the **Calibration** menu. It automates the process of running a plateau during probe calibration. The following information must be entered by the operator; the last four fields of data are updated by the program while the plateau is running:

Count Time	The time (in seconds) to count at each voltage step.
Starting Voltage	Initial probe voltage
Ending Voltage	Last voltage at which to take a count.
Voltage Step	Voltage step size between successive counts.
Max Count Rate	A count rate at which the detector is assumed to be breaking down internally. This will stop the plateau.
Graph name	Label (such as probe ID) to be printed on plateau graph.



File Name Disk file in which to save results (must end in **.GRF**).

After entering the necessary parameters, click **START** to begin the plateau process.

Calibration: Determine Calibration Constant

Once the basic operating parameters (probe voltage, detection thresholds, etc.) Have been entered, this window may be used to calibrate the ASP-2 and probe.

Channel If more than one channel is available, the one to be calibrated must be selected by clicking here.

Window When a channel is selected, the window specified in the Channel parameters is automatically selected.

Count Time For background counts, this value may be entered manually. The calibration and dead time functions count as long as necessary to obtain a statistically valid value. The remaining time is re-calculated periodically throughout the count cycle.

Calibration Field Enter the field to which a probe is exposed for determination of a calibration constant.

Dead Time Field Enter the field used to calculate probe dead time.

Background Select this button, then click on **Start** to begin a background count for the number of seconds shown in **Count Time**.

Cal Const. This button, followed by **Start**, calibrates the instrument and probe. The calibration field and background count rate shown will be used; count time will be calculated by the program.

Dead Time Click here, then **Start** to begin a deadtime measurement. The previously-determined background and cal constant will be used, and the program will calculate the required count time.

Done Note that any of the above count cycles may be cut short by clicking on the button. The value determined as of that time will be used. Clicking on **Done** while no count is in progress will exit to the main program window.

Clicking on **Down Load** will write the displayed calibration constant and dead time to the ASP-2.

Calibration: Calibration Report

Use this command to print a calibration report or certificate:

Cal Report Select this option to produce a full calibration report, complete with title, signature block, etc.

Certificate Omits the title and signature block. Used for printing calibration data on a certificate form which already includes these items.

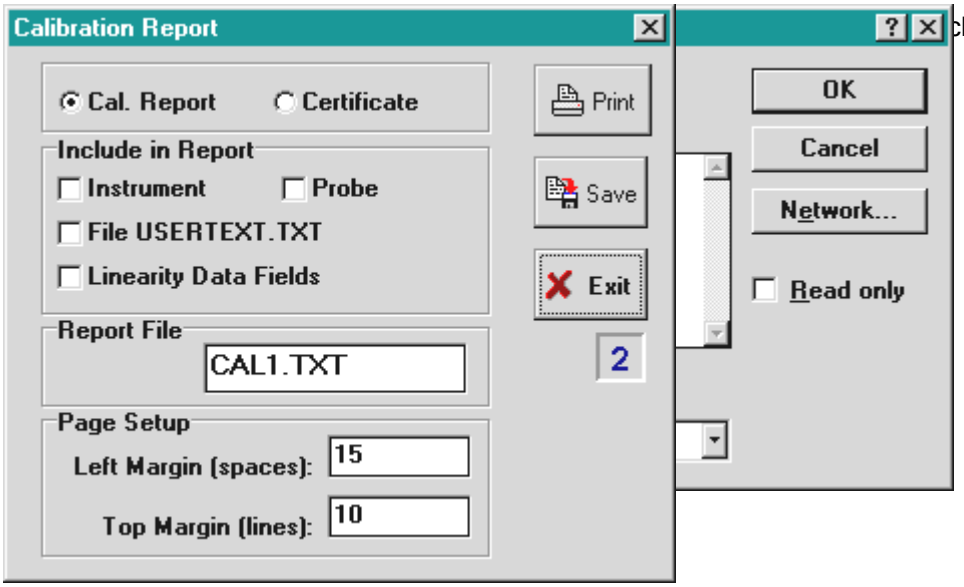
Include... Check the items which should be included in the printout. In adition to the instrument setup and probe information, a file named USERTEXT.TXT may be created with an editor such as Windows® Notepad® and added to the report. Checking the **Linearity Data Fields** button will insert three blank lines on which data may be written after the report is printed.

Report File If the **Save** button is clicked, the report will be written to this file instead of sent directly to the printer. The file may be

edited using Notepad® or another editor before printing. To avoid overwriting existing files, select unique names for each.

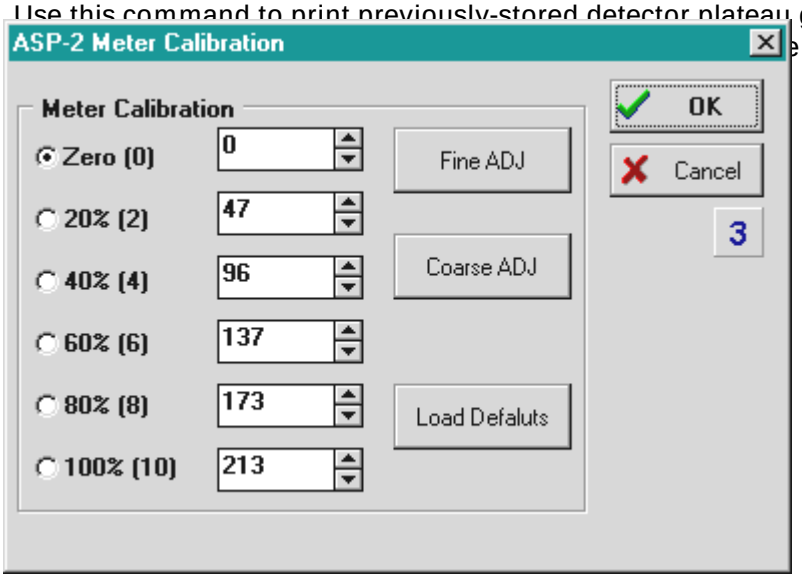
Page Setup Positions the printed information using the margins specified.

This may be necessary with some printers in order to center the report on a page.



Calibration: Display Plateau

Use this command to print previously-stored detector plateau graphs. A e may be selected.



Displays the analog meter calibration window. Clicking on any of the six points will drive the meter to that value. Use the up and down spinner controls to correct any meter error, then go to the next point and back again to overcome any friction. Once all six points are acceptable, click **OK** to save this calibration to the ASP-2. All readings are interpolated by the instrument using the two closest cal points.

Utility: Program Version

Requests the firmware version number from a connected ASP-2 and displays the value returned.

Utility: Default Parameters

Clicking on this command resets the ASP-2 to its default parameters. This ability is used mainly during instrument test; the defaults are not necessarily appropriate for any particular probe, however the instrument will be set to known and safe values.

Utility: ASP-2 Instrument Test

This is the final test used by Eberline to insure that an ASP-2 is fully functional before it is shipped. The same test may be used to determine whether an instrument requires service. Because this test requires a high voltage probe, pulse generator and other test equipment, it is intended primarily for use in service facilities.

Although completeness dictates that this item be listed here along with the other menu items, a separate chapter follows which describes the test in detail.

Section

12

Instrument Test

Overview

This test is part of the ASP-2 host program described in the previous chapter. It is included in the distribution version of the sofware to enable any facility to test instruments, either as part of a routine maintenance program or to resolve any question regarding the operational status of a unit.

This test suite is organized as six pages of tests, plus a seventh page which summarizes the results obtained. Individual tests may be run to check a specific function, or the entire suite may be run to exercise all of the hardware. There is no specific order for completion of the six pages. In any case, the seventh page will always contain all test data taken. To select one of these pages, simply click on the labeled 'tab' at the top of that page.

Before running this test suite, back up all instrument and probe setup parameters, either to disk or on paper. If a problem is encountered, the program may not be able to reliably restore this information to its previous state. After testing, inspect the parameters and verify that they have indeed been correctly restored.

Remember that during this test, the probe power supply is set to 1250 Volts. Thisvoltage is dangerous to both people and some probes. Do not run this test with a probe connected to the ASP-2. Avoid contact with the probe supply circuit.

In addition to the controls which actually run specific tests, several of the pages contain buttons which perform other functions. In particular, the seventh page (which summarizes all test results) inculdes a **RESET** button which clears all test data and allows all tests to be run again. Some pages also have **Clear Results** buttons which reset the tests on that one page. Each page also has an **EXIT** switch which is the only way to exit to the main host program screen. The ASP-2 under test should NOT be turned off while testing is in progress.

Inventory of Tests

The tests in this suite include the following:

ASP-2 Status Page

Comm Test Verifies basic communications between the instrument under test and the host computer.

Version Reads and displays version number of the ASP-2's firmware.

Test EEPROM Writes and reads back the non-volatile memory, in which instrument and probe parameters are stored.

Pwr Supp. & A/D Conv. Page

Adjust HV Forces the probe voltage to 1250. Adjust the HV calibration potentiometer in the instrument if necessary to obtain a reading of 1250 Volts at the probe connector.

Pwr Sup A/D Starts the following sequence of tests for this page:

High Voltage Asks the operator to take a voltage measurement at the probe connector. If within ±2 Volts of nominal (1250), no action is needed. If more than 5 Volts from nominal, re-calibration of the power supply is required.

A/D Channel 1 Checks the instrument's ability to measure its own probe voltage at 1250 Volts.

A/D Response Allows 60 seconds for the probe supply to bleed down to 800 V, then takes a second reading on A/D channel 1 to verify linearity.

LCD/Meter Test Page

LCD Test Displays a picture of what the liquid crystal display should look like, turns on all segments of that display, and asks the operator to verify that the picture and display match exactly.

Meter Test Opens the same meter calibration window described elsewhere. The operator must use this utility to exercise the meter, then verify for the program that it is responding accurately.

Test Switches Page

Start Test Clicking on this button begins the tests for this page. Once active, the program displays a picture of the mode selector knob and pushbutton array on the ASP-2. Turn the mode selector, press the buttons and verify that the picture on the screen depicts what is actually happening on the instrument. DO NOT turn the mode switch to the **OFF** position during this test.

Stop Test After testing all of the switches, click on this button to end this test. The program will then request verification that the test was completed successfully (or not).

Speaker/Light Test Page

Speaker Test Turns on the instrument's speaker and asks the operator to determine whether it is producing sound.

Light Test Turns on the meter scale lights. Verify that both lights (one on each side) come on.

Hybrid Functional Test Page

Start Clicking on this button begins a three-test sequence which checks the hybrid input stage and pulse-height discriminators. The program will prompt for two different MiniPulser settings which are used for these tests.

Test Results Page

Print Sends a picture of this page to the printer.

Reset As described above, clears test results for all six pages.

Section

13

Appendix 1

Factory Test Procedure

This document defines the procedure for testing fully assembled ASP-2 instruments.

Description of Test

The test performed per these instructions, using the WINASP2 program, constitutes Eberline's acceptance criteria for newly-manufactured ASP-2 instruments. The same method may be used to verify that instruments which are already in service are still functioning correctly. This test is largely automated; the test software will provide on-screen instructions to the test technician, however most of the actual evaluations are made by the software.

Required Materials

1. Personal computer running Microsoft Windows7 which has Eberline WINASP2 host program installed.

2. Instrument data cable (Eberline CA-104 or functional equivalent).

3. Eberline MP-1 or MP-2 MiniPulser, modified (output coupling capacitor must be a 0.0047 uF rated for 3KV, Eberline CPCE472P4Y or equivalent).

4. Digital voltmeter.

5. High voltage probe suitable for use with the available meter. Must have an in impedance of at least 1000 megohms.

6. Coaxial cable assembly with suitable connector for MiniPulser on one end and test clips on the other (clip end may be a commmercial coax-to-clips adapter).

Preparation

Start the PC and boot Windows7, then launch the WINASP2 host program. Connect the CA-104 data cable to the

computer's serial port for which the host program has been configured.

Note: It is assumed that the host software has been correctly installed and configured on the host computer. This process is beyond the scope of these instructions due to the wide range of PCs which may be used for this purpose.

Caution:
The power supply of this instrument produces up to 2500 Volts and may hold a dangerous charge for up to one minute after the board is powered off. Avoid contact with the probe connector. If the ASP-2 case has been opened, do not touch any components on the lower end of the circuit board.

Overview
The **ASP-2 Instrument Test** is invoked from the **Utility** menu of the WINASP2 program window. Clicking on this option will open a test window with seven page tabs across the top. Details of these pages are given in the sections which follow. Six of these pages contain buttons which initiate specific tests; the seventh is a summary of all test results and also permits the operator to print the results, save them to disk, or exit to the main WINASP2 window.

There is no preferred order in which the six pages of tests should be performed, however all of the tests on each page should generally be run as a group. The **Test Results** page should be viewed last, since it provides a complete summary of the other six pages. Note that test results may be cleared and the tests re-run if a failure is corrected. Clicking **RESET** on the **Test Results** page will clear all pages at once.

If all of the results listed on the **Test Results** page are acceptable (passed), the instrument has successfully completed this test. If any results are not acceptable (failed) the instrument is not ready for service and requires repairs.

Before Testing If this instrument has previously been calibrated for a specific probe, use the *Save Setup Parameters* function located under the *Edit* menu to store both instrument and probe parameters to the computer's disk drive. Note that separate commands must be issued to save the two sets of parameters.

ASP2 Status Tests

Comm Test Verifies basic communications between the host computer and the ASP-2 under test. If this does not work, no other tests will run. Conversely, if this test passes, the processor chip on the board under test is definitely running.

Get Version Returns the version number of the firmware in the instrument under test.

Test EEPROM Writes and reads the instrument's non-volatile memory.

Power Supply and A/D Converter Test

This page initially contains a single button which starts a series of tests when clicked. These tests verify correct operation of the high voltage power supply and the analog to digital converter. The operator will be asked to measure and type in the probe supply voltage.

NOTE: When this test is initiated, the software will offer to set the HV power supply to 1250 Volts and permit the operator to adjust it before testing. This step is completely optional.

HV supply Measure this voltage at the probe conector when prompted and type the reading obtained in when requested. Remember that this voltage is dangerous. If the output voltage is within " 2 Volts of the correct value (1250), no action is required or recommended. If an error of "2-4 Volts is reported, adjustment of the supply is recommended. If the output is below 1245 or above 1255 Volts, adjustment is required.

The high voltage supply may be adjusted as part of this procedure. This may be done at the start of this test group or later on by clicking the **Adjust HV** button. While the supply is set for 1250 Volts, adjust potentiometer R27 until the supply output is actually 1250.

A/D Chnl. 1 Verifies that the instrument is correctly sensing the output voltage of its probe power supply. No operator action is required.

A/D Resp. This test sets the probe supply to 800 Volts and waits 60 seconds for the output voltage to stabilize at that value. The internal A/D converter is again used to measure the supply output and ascertain that the voltage regulator is linear.

LCD/Meter Test

LCD Test Shows a picture of the LCD display with all segments turned on. If the display on the board shows EXACTLY the same characters and icons, and if all appear clear and sharp, click on the **YES** button to inform the program that this test has been successfully completed. If any display segments or icons are missing or do not appear correct, click the **NO** button to reject the LCD.

Analog Meter Initiating this test pops up a meter calibration window. Click on each of the six calibration points (0, 20, 40, 60, 80 and 100% of full scale) and use the appropriate set of up and down buttons to bring the meter into calibration for each value. Cycle through the six points in both directions and verify that the needle comes to rest near the appropriate scale lines. If the needle's final position is different when moving down from above than when moving up from below (for example, when changing from 60% to 40% as opposed to going from 20% to 40%), use calibration values which result in approximately equal errors.

In order to pass this test, the final calibration values must bring the needle to rest within less than one minor scale division of the desired value for all six calibration points, regardless of the direction from which these points are approached.

Test Switches

Click the **START** button to begin this test. The screen will then show a picture of the ASP-2 panel including the mode selector knob and eight pushbuttons. Rotate the knob on the board under test through all of its positions (except for OFF) and press all eight buttons. Verify that the controls on the screen follow the real controls on the board. Click the **STOP** button to terminate this test and, when requested, indicate whether the rotary mode selector and eight push button switches responded correctly..

Speaker/Light Test

Speaker Test When this button is clicked, the instrument's speaker will be turned on and the program will ask whether it is working. If the device is producing sound, click **YES**; otherwise

click **NO**.

Light Test Clicking this button will turn on the meter dial lights. If the lights on BOTH sides of the meter are working, click **YES**; otherwise click **NO**.

Hybrid Functional Check

This is a complex performance test which requires the use of a MiniPulser, voltmeter, high voltage probe, etc. Follow the on-screen instructions.

Test Results

This screen displays all of the tests from the other six pages. If all of the tests have been completed, the board may be declared good if all have been passed or otherwise should be rejected for diagnosis and repair.

Final Inspection

Perform the following checks:

1. If instrument and probe parameters were saved prior to testing, use the *Load Setup Parameters* function under the *Edit* menu to restore both sets of parameters from the disk files in which they were saved. Otherwise, use the *Default Parameters* option under *Utilities* to set both instrument and probe parameters to their default values.
2. Use the*Edit Instrument/Probe Parameters* function to view the contents of the ASP-2's memory. Verify that the serial number matches the number on the instrument label. If a probe accompanies the instrument, verify that its serial number and other parameters are reasonable for that probe type. Correct invalid information if necessary.
3. Rotate the mode selector switch through all positions. Verify that this switch rotates through all of the positions labeled on the cover overlay, but no further in either direction. If the instrument is an ASP-2e, the **INTEGRATE** and **SCALER** modes should show normal displays; if the display reads **OFF** in either of these positions, the board's configuration code must be set to 'enhanced'.

Section

14

Appendix 2

ASP-2 Probe Calibration

AC-3-7, AC-3-8, HP-350, HP-380A
Calibration in CPS, CPM, DPS, DPM, Bq
Calibration to ^{239}Pu (or ^{230}Th if necessary) in S94 type source holders when possible, except for HP-380A.

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

   a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

   b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

      Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	8
Max. High Voltage	1500 (1300 for HP-380A)
Overrange (cps)	90000

These probes are not suitable for operation with the PHA channel of an ASP-2. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Alpha	
Units	Cpm	
Selected Window	Upper	
High Voltage	700	
Window Param's	**Lower**	**Upper**
Threshold (mV)	2.00	10.00
Counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

4.

5. 3. Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

6.

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	700 (500 for HP-380)
Ending Voltage	1250
Voltage Step	25
Max. Count Rate (cps)	2500*
Graph Name	AC-3, HP-380, etc.
File Name	AC3.GRF (example)

- Depends on source activity.

4. Expose the probe to a ^{239}Pu (or ^{230}Th) 40K to 200K cpm (or .80K to 400K dpm) plated source. Position the source disc with the active side facing the probe. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached extend the ending voltage as necessary to complete the plateau, but not above 1300 volts.

5. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the upper window plateau. Adjust up and down from this point noting the ratio of the upper window counts versus the lower window counts shown in the lower left corner. Select the point where the upper window (alpha) counts are highest and the lower window (beta) counts are lowest while still on the plateau. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.

6. Determine background and calibration constant next by selecting *Calibration* then *Determine Calibration Constant*. Verify that the Upper Window, and Background buttons are selected with the count time set to 300 seconds. Place the probe in a low background area and then click on the *Start* button to begin the background count. The background should be less than 10 cpm.

7. Upon completion of the background count, click on the *Cal. Const*. button. Enter the calibration field, which should be a ^{239}Pu source (or ^{230}Th), of around 50K cpm (.100K dpm). The units must be in cpm to match the probe set up. Expose the probe to the source and click on *Start* to begin the count. The actual count time will be determined by the WinASP2 program.

8. Upon completion, verify the determined cal constant (ie. 2π efficiency or counts/count parameter) for ^{239}Pu is greater than 0.28 for the AC-3-7, greater than 0.18 for the AC-3-8, and greater than 0.36 for the HP-350 and HP-380A. If within tolerance, answer Yes to the save prompt. Note the efficiency (CC H 100 = % eff.) to record later on the calibration report.

9. Unless calibration other than cpm is specified, edit the cal constant to 1.00 in both the upper and lower windows. This yields actual probe count rate, the recommended calibration for these probes. To edit the cal constant select *Edit, Instrument Parameters, Channel*. Jump to step 12.

10. If calibration is to source count rate (2π emissions), jump to step 12. Do not edit the cal constants to 1.00; the previously determined values are correct for 2π emissions.

11. If units of dps, dpm or Bq are desired, change the activity units and cal constant at this time. To edit the units and cal constant select *Edit, Instrument Parameters*, then *Channel*. Select the desired units in and divide the previously determined cal constant by two.
For example: If the previously determined cal constant was 0.28 counts/count. Change the units to dpm, then edit the cal constant to 0.14 counts/disint. (0.28) 2).

12. Calibration is now complete. Verify that the correct units of measure are set in the instrument. To print a cal report, select *Calibration*, and *Calibration Report*, while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Record the isotope and previously determined efficiency on the printed calibration report. Print the plateau for this probe by selecting *Calibration, Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the plateau is displayed in the Graph Window, select *File* then *Print Graph*.

HP-100C, HP-100CGS

Calibration in CPS, CPM, Bq, DPS, DPM

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

   a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

   b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

      Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	7.5
Max. High Voltage	1900
Overrange (cps)	80000

Note:These probes may be used to measure Alpha, Beta or total (Alpha plus Beta) radiation. Select one column from the table which follows and edit those values into the main channel parameters, along with both columns from the chart of window parameters. Change the type identifier of the PHA channel to 'NONE' since these probes are not suitable for pulse height measurements.

Main Channel Parameters			
Channel Type	Alpha	Beta	A/B
Units	cpm	cpm	cpm
Selected Window	Upper	Lower	Both
High Voltage	1360	1360	1360

Window Param's	**Lower**	**Upper**
Threshold (mV)	1.00	27.00
Counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

3. Flush the probe with P10 gas for one hour (minimum) at a flow rate of 50 cc/min. During the actual plateau and counting operations, flow must be maintained at 40 cc/min or more.

4. Select *Calibrate*, then *Run Plateau*. Edit the plateau voltage parameters as shown below. Specify a graphname (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	1360
Ending Voltage	1660
Voltage Step	20
Max. Count Rate (cps)	2500*
Graph Name	HP-100CGS
File Name	HP100.GRF

* Depends on source activity.

5. Expose the probe to a ^{99}Tc* 40K to 200K cpm (or .80K to 400K dpm) plated source. Position the source with the active side facing the probe. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached extend the ending voltage as necessary to complete the plateau.

6. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the plateau. 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. 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 for channel 1 by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.

7. Place the probe in a low background, then select *Calibration,* then *Determine Calibration Constant*. Verify that the MAIN channel is selected and that the correct window (upper, lower or both, as appropriate to the channel type in use) is checked (this should happen automatically). Click the *Background* button, enter a count time of 120 seconds, then click *Start*.

8. For a Beta channel or for total counts (Alpha plus Beta), expose the probe to a 100 cm^2 ^{137}Cs source. For an Alpha channel, use a 100 cm^2 ^{241}Am source. Enter the calibration field in CPM, check the *Cal Const*. box, verify that *Do XOver* is NOT checked, then click on *Start* to begin counting. The count time will be determined by the host program.

9. For a Beta channel or for total counts (Alpha plus Beta), expose the probe to a 100 cm^2 ^{137}Cs source. For an Alpha channel, use a 100 cm^2 ^{241}Am source. Enter the calibration field in CPM, check the *Cal Const.* box, verify that *Do XOver* is NOT checked, then click on *Start* to begin counting. The count time will be determined by the host program.

10. Verify that the cal constant obtained is greater than 0.52 for a ^{137}Cs source or greater than 0.45 for an ^{241}Am source. Calculate the detector efficiency (100 times the cal constant) to be recorded later on the calibration certificate.

    Unless calibration other than cpm is specified, edit the cal constant to 1.00 in both upper and lower windows. *Instrument Parameters*, then *Channel*. Jump to step 13.

11. If calibration to source count rate (2π emissions) is specified, then jump to step 13. Do not edit the cal constants to 1.00, the previously determined values are correct for 2π emissions.

12. If units of dpm, dps, Bq are desired, change the activity units and cal constant. To edit the units and cal constant select *Edit*, *Instrument Parameters*, then *Channel*. Select the desired units for the main channel and divide the previously determined cal constant by two.

    For example: If the previously determined cal constant was 0.54 counts/count. Change the units to dpm, then edit the cal constant to 0.27 counts/disint. (0.54) 2).

13. Calibration is complete. To print a cal report, select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. After printing the report, enter the Alpha and Beta isotope and efficiency on the cal report. Print the plateau for this probe by selecting *Calibration*, *Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the Graph Window is displayed, select *File* then *Print Graph*.

14. The gas should now be disconnected from the probe. For **Gas Seal (GS) versions** of the probe perform the following:

    a. Seal the probe by disconnecting the inlet and then the outlet.

    b. Wait 4 hours. Measure the Beta 2π efficiency. It should be less than 5% decrease from the original value from step 9. Calculate the percent decrease with the following equation. This value should be less than 5.0 (5%):

- $100cm^2$ source is preferred, but any size may be used for the plateau. If necessary, the following isotopes may also be used for the plateau: ^{137}Cs, ^{90}Sr, ^{60}Co. A $100cm^2$ ^{137}Cs source is the only type that should be used to measure beta efficiency.

HP-190A

Section 1 - Calibration in CPM

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

    a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

    b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

    Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	250
Max. High Voltage	900
Overrange (cps)	12500

This probe is not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Beta	
Units	cpm	
Selected Window	Upper	
High Voltage	900	
Window Param's	**Lower**	**Upper**
Threshold (mV)	5.00	10.0
Counts/count	1.0	1.0
Integrate Alarm	0	0
Rate Alarm	0	0
Click Divider	1	1

3. If R/h calibration is specified, then jump to step 8, otherwise calibration should be in CPM.

4. Place the probe in a low background area. Select *Calibration*, then *Determine Calibration Constant*. Verify that Upper Window and Background are selected with the count time set to 180 seconds. Click on the *Start* button to begin background count.

5. After the background has been determined, click on *Cal. Const.* Expose the probe screen on a 1 inch plated ^{90}SrY source of less than 20K cpm. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and source activity. Upon completion, verify that the determined Beta Cal. Constant (ie. 2π efficiency or counts/count parameter) is greater than 0.12. DO NOT save this calibration constant to the instrument. The calibration constants (counts/count) in both windows should remain set at 1. Note the efficiency (CC H 100 = % eff.) to record later on the calibration report.

6. Manually determine efficiencies for two ^{90}SrY sources. Sources should be 1 inch diameter plated ^{90}SrY, one of about 2K to 20K cpm and another of .75K to 100K cpm. Record the nominal and observed count rates for both sources in CPM, then compute efficiencies (100 x observed/nominal = % eff) for each. Verify that the two calculated efficiencies are within 10% of each other. Save these values for inclusion in the calibration report as linearity data.

7. When the linearity tests are complete, select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope and previously determined efficiency on the cal report.

Section 2 - R/h Calibration

8. Select *Edit, Instrument Parameters*, then *Channel*. Change the units for channel 1from cpm to R/h and the channel type to gamma.

9. Select *Calibration*, then *Determine Calibration Constant*. Verify that Upper Window and *Cal. Const.*are selected. Enter the cal constant field of 0.0075R/h. Place the probe in a 0.0075 R/h (7.5 mR/h) ^{137}Cs field, side on. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program based on field strength. When the count is complete, click on *Save* to store the new calibration constant if within 1.15E+08 to 1.95E+08.

10. Next, click on *Dead Time*. Enter the dead time field of 0.75R/h. Place the probe, in a 0.75R/h (750 mR/h) ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of 230 to 330 μsec., click on *Save* when prompted, to store the new Dead Time value in the instrument.

11. Manually perform linearity checks in three ^{137}Cs fields: 0.005 R/h (5 mR/h), 0.05 R/h (50 mR/h), and 0.25 R/h (250 mR/h). For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).

12. When the linearity tests are complete, select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.

HP-210, HP-260, HP-360

Section 1 - Calibration in CPM

1 . With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

   a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

   b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

      Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	100
Max. High Voltage	900
Overrange (cps)	58000

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Beta	
Units	cpm	
Selected Window	Upper	
High Voltage	900	
Window Param's	**Lower**	**Upper**
Threshold (mV)	5.00	10.0
Counts/count	1	1
Integrate Alarm	0	0
Rate Alarm	0	0
Click Divider	1	1

3. If R/h calibration is specified, then jump to step 8, otherwise calibration should be in CPM.

4. Place the probe in a low background area. Select *Calibration*, then *Determine Calibration Constant*. Verify that Upper Window and Background are selected with the count time set to 120 seconds. Click on the *Start* button to begin background count.

5. After the background has been determined, click on *Cal. Const.* Expose the probe screen on a 47mm plated ^{99}Tc source of less than 20K cpm. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and source activity. Upon completion, verify that the determined Beta Cal. Constant (ie. 2π efficiency or counts/count parameter) is greater than 0.25. DO NOT save this calibration constant to the instrument. The calibration constants (counts/count) in both windows should remain set at 1. Note the efficiency (CC H 100 = % eff.) to record later on the calibration report.

6. Manually determine efficiencies for two ^{99}Tc sources. Sources should be 47mm diameter plated ^{99}Tc, one of about 2K to 20K cpm and another of .75K to 100K cpm. Record the nominal and observed count rates for both sources in CPM, then compute efficiencies (100 x observed/nominal = % eff) for each. Verify that the two calculated efficiencies are within 10% of each other. Save these values for inclusion in the calibration report as linearity data.

7. When the linearity tests are complete, select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope and previously determined efficiency on the cal report.

Section 2 - R/h calibration

8. Select *Edit, Instrument Parameters*, then *Channel*. Change the units for channel 1 from cpm to R/h and the channel type to gamma.

9. Select *Calibration*, then *Determine Calibration Constant*. Verify that Upper Window and *Cal. Const.* are selected. Enter the cal constant field of 0.0075 R/h.

NOTE

Use a 1/4" plastic (plexiglas) between source and detector, placed in contact with detector, for the following readings.

10. Place the probe in a 0.0075 R/h (7.5 mR/h) ^{137}Cs field, face on. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and field strength. When the count is complete, click on *Save* to store the new calibration constant if within 1.8E+08 to 2.4E+08.

11. Next, click on *Dead Time*. Enter the dead time field of 0.75R/h. Place the probe, in a 0.75R/h (750 mR/h) ^{137}Cs field. Click on the *Start* button. The program could take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of 80 to 125 μsec., click on *Save* when prompted, to store the new Dead Time value in the instrument.

12. Manually perform linearity checks in three ^{137}Cs fields: 0.005 R/h (5 mR/h), 0.05 R/h (50 mR/h), and 0.5 R/h (500 mR/h). For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).

13. When the linearity tests are complete, select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.

HP-220A

Calibration in R/h

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

   a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

   b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

      Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	60
Max. High Voltage	600
Overrange (cps)	67000

This probe is not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Gamma	
Units	R/h	
Selected Window	Upper	
High Voltage	600	
Window Param's	**Lower**	**Upper**
Threshold (mV)	5.00	10.0
Counts/R	1	1.50E+06
Integrate Alarm	0	0
Rate Alarm	0	0
Click Divider	1	1

3. Place the probe in a low background area. Select *Calibration*, then *Determine Calibration Constant*. Verify that Upper Window and *Cal. Const.* are selected.

4. Enter the cal constant field, 0.075 R/h. Place the probe in a 75 mR/h (0.075 R/h) ^{137}Cs field. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program, based on field strength. When the count is complete, click on *Save* to store the new calibration constant if within 4.9E+07 to 9.1E+07.

5. Next, click on *Dead Time*. Enter the dead time field, 75 R/h. Place the probe in a 75 R/h ^{137}Cs field. Click on the *Start* button. The program could take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of 70 to 100 μsec., click on *Save* when prompted, to store new value in the instrument.

6. Manually perform linearity checks in three ^{137}Cs fields: 0.75 R/h (750 mR/h), 7.5 R/h, and 75 R/h. For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 85-115% of nominal (all errors <15%).

7. When the linearity tests are complete, select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.

HP-270

Calibration in R/h

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

    a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.
    b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

    Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	90
Max. High Voltage	900
Overrange (cps)	60000

This probe is not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Gamma	
Units	R/h	
Selected Window	Upper	
High Voltage	900	
Window Param's	**Lower**	**Upper**
Threshold (mV)	5.00	10.0
Counts/R	1	7.00E+07
Integrate Alarm	0	0
Rate Alarm	0	0
Click Divider	1	1

3. Select *Calibration*, then *Determine Calibration Constant*. Verify that Upper Window and Cal. Const. are selected. Enter the calibration constant field, 0.0075 R/h. Place the probe in a 7.5 mR/h (0.0075 R/h) ^{137}Cs field, side on, shield closed. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and field strength. When the count is complete, click on *Save* to store the new calibration constant if within 4.9E+07 to 9.1E+07.

4. Next, click on *Dead Time*. Enter the dead time field, 0.75 R/h. Place the probe, shield closed, in a 750 mR/h (0.75R/h) ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within a range of 60 to 120 μsec., click on *Save* when prompted, to store new value in the instrument.

5. Manually perform linearity checks in three ^{137}Cs fields: 0.005 R/h (5 mR/h), 0.5 R/h (500 mR/h), and 2.0 R/h. For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors below 10%).

6. When the linearity tests are complete, select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.

HP-290

Calibration in R/h

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

   a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

   b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

      Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	24
Max. High Voltage	550
Overrange (cps)	75000

This probe is not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Gamma	
Units	R/h	
Selected Window	Upper	
High Voltage	550	
Window Param's	**Lower**	**Upper**
Threshold (mV)	5.00	10.0
Counts/R	1	5.50E+06
Integrate Alarm	0	0
Rate Alarm	0	0
Click Divider	1	1

3. Select *Calibrate*, then *Determine Calibration Constant*. Verify that Upper Window and Cal. Const. are selected. Enter the calibration constant field, 0.75 R/h. Place the probe in a 0.75 R/h (750 mR/h) ^{137}Cs field, side on. Click on the *Start* button to begin count. Actual count time will be determined by the program and field strength. When the count is complete, click on *Save* to store the new calibration constant if within 4.50E+06 to 7.0E+06.

4. Next, click on *Dead Time*. Enter the dead time field, 25 R/h. Place the probe in a 25R/h ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of 22-35 μsec., click on *Save* when prompted to store new value in the instrument.

5. Manually perform linearity checks in three ^{137}Cs fields: 0.075 R/h (75 mR/h), 7.5 R/h, and 40 R/h. For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).

6. When the linearity tests are complete, select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.

HP-300

Calibration in R/h

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

    a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.
    b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

    Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	100
Max. High Voltage	500
Overrange (cps)	16,000

This probe is not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Gamma	
Units	R/h	
Selected Window	Upper	
High Voltage	449	
Window Param=s	**Lower**	**Upper**
Threshold (mV)	5.00	10.0
Counts/R	1	5.00E+08
Integrate Alarm	0	0
Rate Alarm	0	0
Click Divider	1	1

3. Select *Calibration*, then *Determine Calibration Constant*. Verify that Upper Window and Cal. Const. are selected. Enter the calibration constant field, 0.001 R/h. Using the free air calibrator setup, place the probe in a 1 mR/h (0.001 R/h) ^{137}Cs field, side on. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and field strength. Repeat until determined cal constant is consistent. When counting is complete, click on *Save* to store the new calibration constant if within 4.7E+08 to 7.0E+08.

4. Next, click on *Dead Time*. Enter the dead time field, 0.05 R/h. Follow the instructions for HP-300 probes located in the source room for source well s/n EI-152. Place the probe in the special holder above the well, and set up for a 50 mR/h (0.05R/h) ^{137}Cs field per the HP-300 instructions. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of 90 to 140 μsec., click on *Save* when prompted to store the new value in the instrument.

5. Manually perform linearity checks in three ^{137}Cs fields: 0.02 R/h (20 mR/h), 0.05 R/h (50 mR/h), and 0.1 R/h (100 mR/h). For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).

6. When the linearity tests are complete, select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.

HP-330

Calibration in CPM, CPS, DPM, DPS, Bq

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

   a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.
   b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

   Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	8.5
Max. High Voltage	1800
Overrange (cps)	48000

Note: These probes may be used to measure Alpha, Beta or total (Alpha plus Beta) radiation. Select one column from the table which follows and edit those values into the main channel parameters, along with both columns from the chart of window parameters. Change the type identifier of the PHA channel to 'NONE' since these probes are not suitable for pulse height measurements.

Main Channel Parameters			
Channel Type	Alpha	Beta	A/B
Units	cpm	cpm	cpm
Selected Window	Upper	Lower	Both
High Voltage	1450	1450	1450

Window Param's	**Lower**	**Upper**
Threshold (mV)	1.00	30.00
Counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	1450
Ending Voltage	1650
Voltage Step	10
Max. Count Rate (cps)	2500*
Graph Name	HP-330
File Name	HP330.GRF

*Depends on source activity.

3. Expose the probe to a ^{99}Tc 20K to 200K cpm (or .40K to 400K dpm) 47mm plated source. Position thesource disc with the active side facing the probe. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached extend the ending voltage as necessary to complete the plateau, not to exceed 1800 Volts.

4. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the plateau. Adjust up and down from this point noting the ratio of the upper window counts versus the lower window counts. Select the point where the lower window counts are highest and the upper window counts are lowest while still on the plateau. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.

5. Place the probe in a low background, then select *Calibration,* then *Determine Calibration Constant*. Verify that the MAIN channel is selected and that the correct window (upper, lower or both, as appropriate to the channel type in use) is checked (this should happen automatically). Click the *Background* button, enter a count time of 120 seconds, then click *Start*.

6. For a Beta channel or for total counts (Alpha plus Beta), expose the probe to a 47 mm diameter ^{99}Tc source with an activity of 50K to 100K cpm. For an Alpha channel, use a 47 mm ^{239}Pu source, again with an activity of 50K to 100K cpm. Enter the calibration field in cpm, check the *Cal Const*. box, verify that *Do XOver* is NOT checked, then click on *Start* to begin counting. The count time will be determined by the host program.

7. Verify that the cal constant obtained is greater than 0.18 for a ^{99}Tc source or greater than 0.20 for an ^{239}Pu source. Calculate the detector efficiency (100 times the cal constant) to be recorded later on the calibration certificate.

8. Unless calibration other than cpm is specified, edit the cal constant to 1.00 in both upper and lower windows. This yields actual probe count rate, the recommended procedure for this probe. To edit the cal constant select *Edit*, *Instrument Parameters*, then *Channel*. Jump to step 13.

9. If calibration to source count rate (2π emissions) is specified, then jump to step 13. Do not edit the cal constants to 1.00, the previously determined values are correct for 2π emissions.

10. If units of dpm, dps, Bq are desired, change the activity units and cal constant. To edit the units and cal constant select *Edit*, *Instrument Parameters*, then *Channel*. Select the desired units for the main channel and divide the previously determined cal constant by two.

    For example: If the previously determined cal constant was 0.54 counts/count. Change the units to dpm, then edit the cal constant to 0.27 counts/disint. (0.54) 2).

11. Calibration is complete. To print a cal report, Select *Calibration,* then *Calibration Report,* while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Record the isotope and previously determined efficiency on the printed cal report. Print the plateau for this probe by selecting *Calibration, Display Plateau* then select the appropriate file from the list in the dialog box. When the Graph Window is displayed, select *File* then *Print Graph*.

LEG-1

Main Channel Calibration in CPS, CPM - Gross Counting

Note: This energy-proportional probe is suitable for use with the Pulse Height Analysis (PHA) capabilities of the ASP-2. If the instrument with which it will be used is an ASP-2e (Enhanced), both a main gamma channel and a PHA channel may be defined and will be available to the user. A base model ASP-2 (Non-Enhanced) instrument may be calibrated for one channnel of either type. To create a PHA channel on an ASP-2, edit the PHA channel parameters given below into the MAIN channel of the instrument and follow the PHA calibration instructions.

Important: If the either channel of an ASP-2E is not calibrated, change the unused channel identifier to type 'NONE'. This will disable the channel and prevent accidental use.

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

   a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

3. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

   Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

Main Channel Calibration in CPS, CPM - Gross Counting

Click on *Edit, Instrument Parameters, Channel* to open the probe channel parameters window. If necessary, click on the *Main* channel radio button to display parameters for the main channel.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	8
Max. High Voltage	1500
Overrange (cps)	40000

Channel Parameters				
Channel	Main		PHA (ASP-2e only)	
Channel Type	Gamma		PHA	
Units	Cpm		CPM	
Selected Window	Upper		Lower	
High Voltage	460		460	
Window Param's	**Lower**	**Upper**	**Lower**	**Upper**
Threshold (mV)	2.00	2.00	4.00	5.00
counts/count	1.00	1.00	1.00	1.00
Integrate Alarm	0.0	0.0	0.0	0.0
Rate Alarm	0.0	0.0	0.0	0.0
Click Divider	1	1	1	1

Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	20
Starting Voltage	450
Ending Voltage	725
Voltage Step	20
Max. Count Rate (cps)	5000*
Graph Name	LEG-1
File Name	LEG1.GRF

* Depends on source activity.

4. Expose the probe to an ^{241}Am plated source, of .300k cpm (.600k dpm). Position the source disc with the active side facing the end of the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1500 Volts.

5. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the upper window plateau. The operating voltage is normally set at a point where the voltage is as high as possible with less than a 1% crossover. The black vertical bar turns red when the window 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 in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.

6. Next select *Calibration* then *Determine Calibration Constant*. Verify that Upper Window and Background buttons are selected with the count time set to 300 seconds. Place the probe in a low background area, preferably in a lead shield, then click on the *Start* button to begin the background count. Note the background reading.

7. Check the ^{241}Am 60 keV gamma efficiency. Expose the detector to an ^{241}Am source of .600k dpm, preferably s/n 6025 and place in a shield. Use the *Background* mode to acquire a count by watching the countdown in the lower right corner, note the cpm when it is below 2%. Subtract the previously determined background from this count. Use the following formula to determine efficiency. Note the calculated efficiency to record later on the calibration report.

NOTE: Gamma per minute based on 0.357 abundance of 60 keV gamma from ^{241}Am.
Ref: ICRP Publication 38, 1983.

8. If a PHA channel is to be calibrated, proceed with step 9. If only the main channel is needed, skip to step 13. **PHA Channel Calibration** (ASP-2e only)

9. Click *Edit, Instrument Parameters, Channel* to open the probe channel parameters screen. Click on the *PHA* channel radio button to switch to the Pulse Height channel parameters.

10. Select *Calibrate,* then *Run Plateau*. Click on the *Channel 1* radio button on top, then edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	20
Starting Voltage	700*
Ending Voltage	900*
Voltage Step	10
Max. Count Rate (cps)	20,000**
Graph Name`	LEG-1, PHA
File Name	LEG1.GRF

* Plateau starting and ending voltages will vary with isotope.
** Depends on source activity.

11. Place a ^{241}Am or ^{239}Pu source (or other isotope of interest) against the end of the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1500 Volts.

12. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is on the peak of the lower window plot. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the correct desired value.

13. Calibration is now complete. Verify that the correct units of measure (cps or cpm) are set in the instrument. To print a cal report, select *Calibration,* and *Calibration Report,* while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Print the plateau for this probe by selecting *Calibration, Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the Graph Window is displayed, select *File* then *Print Graph*.

NRD, HP-280

Calibration in Rem/h

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

    a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

    Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

    Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	10
Max. High Voltage	2300
Overrange (cps)	NRD: 10,000 HP280:25,000

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Neutron	
Units	Rem/h	
Selected Window	Lower	
High Voltage	1500	
Window Param=s	**Lower**	**Upper**
Threshold (mV)	2.00	60.00
Counts/rem	1.00	1.00
Integrate Alarm	0	0
Rate Alarm	0	0
Click Divider	1	1

3. Temporarily edit the units of measure to cpm in by selecting *Edit*, *Instrument Parameters*, then *Channel*. Place the detector in a 10 R/h ^{137}Cs field. Select *Edit*, *Instrument Parameters* then *Channel* and adjust the HV for approximately 50 cpm as read on the ASP-2 in Ratemeter mode. Changing the high voltage setting in the channel parameters and clicking on the *Down Load* button, will allow changes to the HV while observing the effect on count rate in Ratemeter mode. When the reading is approximately 50 cpm in a 10 R/h field, decrease the HV by 50V and verify no counts.

4. Edit the units of measure back to Rem/h, by selecting *Edit*, *Instrument Parameters* then *Channel*. Next select *Calibration*, then *Determine Calibration Constant*. Verify that Lower Window and Cal. Const. are selected. Enter the calibration constant field, 0.027 Rem/h. Place the detector in a 27 mRem/h neutron field (0.027 Rem/h) then click on the *Start* button to begin calibration constant determination. Actual count time will be determined by the program. When the count is complete, click on *Save* to store the new calibration constant.

5. Manually perform linearity checks in three neutron fields: 0.027 Rem/h (27 mRem/h), 0.1 Rem/h (100 mRem/h), and 0.2 Rem/h (200 mRem/h). For each field, record the observed reading in Rem/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).

6. When the linearity tests are complete, select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form.

PG-2

Note: This energy-proportional probe is suitable for use with the Pulse Height Analysis (PHA) capabilities of the ASP-2. If the instrument with which it will be used is an ASP-2e (Enhanced), both a main gamma channel and a PHA channel may be defined and will be available to the user. A base model ASP-2 (Non-Enhanced) instrument may be calibrated for one channnel of either type. To create a PHA channel on an ASP-2, edit the PHA channel parameters given below into the MAIN channel of the instrument and follow the PHA calibration instructions.

Important: If the either channel of an ASP-2E is not calibrated, change the unused channel identifier to type 'NONE'. This will disable the channel and prevent accidental use.

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

    a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

    Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

. Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

Main Channel Calibration in CPS, CPM - Gross Counting

Click on *Edit, Instrument Parameters, Channel* to open the probe channel parameters window. If necessary, click on the *Main* channel radio button to display parameters for the main channel.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	12
Max. High Voltage	1300
Overrange (cps)	20000

Channel Parameters				
Channel	Main		PHA (ASP-2e only)	
Channel Type	Gamma		PHA	
Units	Cpm		cpm	
Selected Window	Lower		Lower	
High Voltage	560		700	
Window Param's	**Lower**	**Upper**	**Lower**	**Upper**
Threshold (mV)	3.00	45.00	4.00	5.00
counts/count	1.00	1.00	1.00	1.00
Integrate Alarm	0.0	0.0	0.0	0.0
Rate Alarm	0.0	0.0	0.0	0.0
Click Divider	1	1	1	1

Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	560
Ending Voltage	1060
Voltage Step	20
Max. Count Rate (cps)	25,000*
Graph Name	PG-2
File Name	PG2.GRF

* Depends on source activity.

3. Expose the probe to a ^{239}Pu plated source (preferably one of the Meg cpm sources). Position the source disc with the active side facing the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1300 Volts.

4. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the plateau. The operating voltage is normally set at a point where the voltage is as high as possible with less than a 1% alpha (upper window) to gamma (lower window) crossover. The black vertical bar turns red when the alpha to gamma 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 in the plateau dialog box. A prompt will appear to verify that the the HV set point is the desired value established during the plateau.

5. Determine efficiency next by selecting *Calibration* then *Determine Calibration Constant.* Verify that Lower Window and Background buttons are selected with the count time set to 300 seconds. Place the probe in a low background area, preferably in a lead shield, then click on the *Start* button to begin the background count. The background should be less than 60 cpm in a lead shield.

6. Expose the detector to a plated ^{239} Pu source, preferably s/n 1071 or s/n P1646 and place in a shield. Use the *Bacground* mode to acquire a count by watching the countdown in the lower right corner, note the cpm when it is below 2%. Subtract the previously determined background from this count. Use the following formula to determine efficiency. Note the calculated efficiency to record later on the calibration report.
   Calibration is now complete. Verify that the correct units of measure (cps or cpm) are set in the instrument.

To print a cal report, select *Calibration*, and *Calibration Report*, while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Record the isotope and previously determined gamma efficiency on the printed calibration report. Print the plateau for this probe by selecting *Calibration*, *Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the plateau is displayed in the Graph Window, select *File* then *Print Graph*.

Section 2 - PHA Calibration (ASP-2e only)

Load the PG-2 PHA probe parameters (*pg2pha.** file), by selecting *Edit*, *Load Setup From Disk*, then *Probe Parameters*. Click on the *OK* button to transfer the parameters from the disk file to the instrument. Verify that the default probe parameters in the ASP-2 are set per the table below by selecting *Edit*, *Instrument Parameters*, then the *Probe* and *Channel* parameters.

Probe Parameters	
Dead Time (μsec.)	12
Max. High Voltage	1300
Overrange (cps)	20000

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Channel Parameters	
Channel Type	PHA
Units	cpm
Selected Window	Lower
High Voltage	700

Window Param's	Lower	Upper
Threshold (mV)	4.00	5.00
Counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

7. Select *Edit*, then *Instrument Parameters*. If necessary, enter the ASP-2 serial number and calibration dates in the window that appears. Likewise, enter the probe serial number and model in the *Probe* information page.

8. Select *Calibrate*, then *Run Plateau*, then edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	20
Starting Voltage	700*
Ending Voltage	900*
Voltage Step	10
Max. Count Rate (cps)	20,000**
Graph Name	PG-2, PHA
File Name	PG2.GRF

* Plateau starting and ending voltages will vary with isotope.
** Depends on source activity.

9. Place a ^{241}Am or ^{239}Pu source (or other isotope of interest) against the end of the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1300 Volts.

10. When the plateau is complete, select the high voltage set point by clicking on the<and>symbols on the voltage plateau graph until the vertical bar is on the peak of the lower window plot. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the correct desired value.

11. Calibration is now complete. Verify that the correct units of measure (cps or cpm) are set in the instrument. To print a cal report, select *Calibration,* and *Calibration Report,* while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Print the plateau for this probe by selecting *Calibration*, *Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the Graph Window is displayed, select *File* then *Print Graph*.

HP-340, HP-380AB

Calibration in dps, dpm, cps, cpm, Bq

NOTE: The probe must have been closed up for at least 8 hours before attempting to calibrate. Exposing the scintillator or PM tube to light will cause the probe to be noisy.

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

   a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

   b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

   Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	8
Max. High Voltage	1000
Overrange (cps)	80,000

Note: When properly calibrated for energy-proportional probes of this type, the ASP-2 will register counts caused by Alpha particles in the upper energy window and those caused by Betas in the lower window. Select the window to be counted as shown in the following table, using the table column corresponding to the type(s) of radiation to be measured. If the instrument is an ASP-2e, set the PHA channel type to 'NONE' since this probe does not support PHA.

Channel Parameters			
Channel Type	Alpha	Beta	A/B
Units	cpm	cpm	cpm
Selected Window	Upper	Lower	Both
High Voltage	654	654	654

Channel Parameters	**Lower**	**Upper**
Threshold (mV)	1.50 (1.2 for HP-380AB)	30.1 (22.1 for HP-380AB)
counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

3. Select *Calibrate*, then *Run Plateau*. Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	20
Starting Voltage	684 (550 for HP-380AB)
Ending Voltage	889
Voltage Step	10
Max. Count Rate (cps)	5000*
Graph Name	HP340, HP380AB, etc.
File Name	340XXX.GRF, 380ABXXX.GRF, etc. where XXX = serial no.

*Depends on source activity.

4. Expose the probe to a ^{99}Tc 10K to 200K cpm (or .20K to 400K dpm) plated source. Position the source disc near the center of the probe face, with the active side facing the probe. Click on the *Start* button. There may be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If there are no counts in the upper window, extend the plateau ending voltage, but not above 1000 volts.

5. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the desired HV set point. The operating voltage is normally set at a point where the voltage is as high as possible with less than a 1% beta (lower THLD cts.) to alpha (upper THLD cts.) crossover. The black vertical bar turns red when the beta to alpha crossover exceeds 1%. Once it turns red, move the bar back until the alpha counts (upper window) is #0.1 cps to obtain the optimum operating voltage. Save the desired high voltage setting for channel 1 by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the the HV set point is the desired value established during the plateau.

6. Perform a quick check on the beta background. Remove the source from the probe and select channel 2 (Beta), Ratemeter mode. The beta background count rate should be between 150 and 300 cpm (250 to 450 cpm on HP-380). If not, adjust the high voltage as necessary. Note: Ensure the HV is set the same on all three channels before proceeding.

7. Place the probe in a low background, then select *Calibration*, then *Determine Calibration Constant*. Verify that the MAIN channel is selected and that the correct window (upper, lower or both, as appropriate to the channel type in use) is checked (this should happen automatically). Click the *Background* button, enter a count time of 120 seconds, then click *Start*.

8. For a Beta channel or for total counts (Alpha plus Beta), expose the probe to a 47 mm diameter ^{99}Tc source with an activity of 50K to 100K cpm. For an Alpha channel, use a 47 mm ^{239}Pu source, again with an activity of 50K to 100K cpm. Enter the calibration field in cpm, check the *Cal Const*. box, then click on *Start* to begin counting. The count time will be determined by the host program.

9. Verify that the cal constant obtained is greater than 0.10 for a ^{99}Tc source or greater than 0.36 for an ^{239}Pu source. Calculate the detector efficiency (100 times the cal constant) to be recorded later on the calibration certificate.

10. Unless calibration other than cpm is specified, edit the cal constant to 1.00 in both upper and lower windows. This yields actual probe count rate, the recommended procedure for this probe. To edit the cal constant select *Edit*, *Instrument Parameters*, then *Channel*. Jump to step 13.

11. If calibration to source count rate (2π emissions) is specified, then jump to step 13. Do not edit the cal constants to 1.00, the previously determined values are correct for 2π emissions.

12. If units of dpm, dps, Bq are desired, change the activity units and cal constant. To edit the units and cal constant select *Edit*, *Instrument Parameters*, then *Channel*. Select the desired units for the main channel and divide the previously determined cal constant by two.

    For example: If the previously determined cal constant was 0.54 counts/count. Change the units to dpm, then edit the cal constant to 0.27 counts/disint. (0.54) 2).

13. Calibration is complete. To print a cal report, Select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Record the isotope and previously determined efficiency on the printed cal report. Print the plateau for this probe by selecting *Calibration*, *Display Plateau* then select the appropriate file from the list in the dialog box. When the Graph Window is displayed, select *File* then *Print Graph*.

SPA-1A.

Calibration in CPS, CPM, DPS, DPM, Bq to ^{230}Th

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

    a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

    b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk,* then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

    Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	10
Max. High Voltage	1400
Overrange (cps)	15000

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Alpha	
Units	Cpm	
Selected Window	Upper	
High Voltage	430	
Window Param's	**Lower**	**Upper**
Threshold (mV)	2.00	10.00
counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

3. Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	30
Starting Voltage	425
Ending Voltage	725
Voltage Step	25
Max. Count Rate (cps)	2500*
Graph Name	SPA-1A
File Name	SPA1A.GRF

* Depends on source activity.

4. Expose the probe to a ^{230}Th plated source of around 10K cpm. If available ^{239}Pu may also be used. Position the source disc with the active side facing the detector. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached extend the ending voltage as necessary to complete the plateau, not to exceed 1400 Volts.

5. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the plateau. Adjust up and down from this point noting the ratio of the upper window counts versus the lower window counts shown in the lower left corner. Select the point where the upper window (alpha) counts are highest and the lower window (beta) counts are lowest while still on the plateau. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.

6. Determine background and calibration constant next by selecting *Calibration* then *Determine Calibration Constant*. Verify that Upper Window and Background buttons are selected with the count time set to 300 seconds. Place the probe in a low background area and then click on the *Start* button to begin the background count. The background should be less than 30 cpm.

7. Upon completion of the background count, click on the *Cal. Const*. button. Enter the calibration field, which should be a ^{230}Th source of around 8K cpm (.16K dpm). The units must be in cpm to match the probe set up. Expose the probe to the source and click on *Start* to begin the count. The actual count time will be determined by the WinASP2 program.

8. Upon completion, verify that the determined cal constant (ie. 2π efficiency or counts/count parameter) is greater than 0.60. DO NOT save this calibration constant to the instrument at this time; the calibration constants (counts/count) in both windows should remain set at 1. Simply note the efficiency (CC H 100 = % eff.) for later use.

9. Manually determine efficiencies for two ^{230}Th sources. Sources should be 1 inch diameter plated ^{230}Th, one of less than 2,000 cpm and the other of at least 7,000 cpm. Record the nominal and observed count rates for both sources in cpm, then compute efficiencies (100 x observed/nominal = % eff.) for each source.Verify that the two calculated efficiencies are withhin 10% of each other. Save these values for inclusion in the calibration report as liearity data.

10. If calibration in cpm is required, leave the calibration constants (counts/count) in both windows set at 1.

    If units of dps, dpm or Bq are desired, change the activity units and cal constant at this time. To edit the units and cal constant select *Edit, Instrument Parameters*, then *Channel*. Select the desired units, divide the previously determined cal constant by two, then replace the upper window cal constant with the resulting number.

    If source count rate calibration (2π emissions) is specified, edit the active (upper) window cal constant to the value obtained in step 8.

11. Select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotopes used for calibration on the printed calibration report.

Print the plateau for this probe by selecting *Calibration*, *Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the plateau is displayed in the Graph Window, select *File* then *Print Graph*.

SPA-3

Note: This energy-proportional probe is suitable for use with the Pulse Height Analysis (PHA) capabilities of the ASP-2. If the instrument with which it will be used is an ASP-2e (Enhanced), both a main gamma channel and a PHA channel may be defined and will be available to the user. A base model ASP-2 (Non-Enhanced) instrument may be calibrated for one channnel of either type. To create a PHA channel on an ASP-2, edit the PHA channel parameters given below into the MAIN channel of the instrument and follow the PHA calibration instructions.

Important: If either channel of an ASP-2e is not calibrated, change the unused channel identifier to type 'NONE'. This will disable the channel and prevent accidental use.

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

   a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

   b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

      Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

Main Channel Calibration in CPS, CPM - Gross Counting

Click on *Edit, Instrument Parameters, Channel* to open the probe channel parameters window. If necessary, click on the *Main* channel radio button to display parameters for the main channel.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	20
Max. High Voltage	1600
Overrange (cps)	48000

Channel Parameters				
Channel Type	Gamma		PHA (ASP-2e only)	
Units	R/h		cpm	
Selected Window	Upper		Lower	
High Voltage	410		400	
Window Param's	**Lower**	**Upper**	**Lower**	**Upper**
Threshold (mV)	2.00	2.00	4.00	5.00
Counts/count	1.00	1.00	1.00	1.00
Integrate Alarm	0.0	0.0	0.0	0.0
Rate Alarm	0.0	0.0	0.0	0.0
Click Divider	1	1	1	1

.

Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify graph name up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	400
Ending Voltage	840
Voltage Step	20
Max. Count Rate (cps)	20,000*
Graph Name	SPA-3
File Name	SPA3.GRF

* Depends on source activity.

3. Place a CS-7B, ^{137}Cs (.1μCi) check source against the end of the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1600 Volts.

4. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the upper window plateau. At this point the lower window counts should be at their lowest also. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.

5. Next select *Calibration*, then *Determine Calibration Constant*. Verify that Upper Window and Background buttons are selected with the count time set to 120 seconds. Calibration should be performed in an area with less than 30 μR/h background. Place the probe in a low background area, then click on the *Start* button to begin background count.

6. After the background has been determined, click on *Cal. Const.* Enter the calibration field, 0.0004 R/h. Place the probe in a 0.4 mR/h (0.0004 R/h) ^{137}Cs field, face on. Probe must be in free air, suspended on non-metallic objects at least 3 feet off the floor with no other objects within 6 feet. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and field strength. When the count is complete, click on *Save* to store the new calibration constant if within 5.0E+10 to 9.0E+10.

7. Click on *Dead Time* and enter the dead time field, 0.002 R/h. Place the probe in a 2 mR/h (0.002 R/h) ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of 16 to 26 μsec., click on *Save* when prompted, to store new value in the instrument.

8. Calibration is now complete. Verify that the correct units of measure are set in the instrument. If calibration is to **R/h**, jump to step 10. Otherwise, edit the units of measure to cpm or cps, and cal constant (counts/count parameter) to 1.00 in both the upper and lower windows of channel 1. To edit the units and cal constant, select *Edit*, *Instrument Parameters*, then *Channel*. Jump to step 11 to print calibration report.

9. Manually determine response in ^{137}Cs linearity fields of 0.0005 R/h (0.5 mR/h) and 0.001 R/h (1 mR/h). For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors below 10%).

10. Print cal report by selecting *Calibration*, and *Calibration Report*, while still connected to the ASP-2 just calibrated. If linearity data was taken, include linearity fields in the report and add the results obtained in step 11 to the report after printing. Print the plateau for this probe by selecting *Calibration*, *Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the Graph Window is displayed, select *File* then *Print Graph*.

Section 2 - PHA Calibration (ASP-2e only)

11. Load the SPA-3 PHA probe parameters, by selecting *Edit*, *Load Setup From Disk*, then *Probe Parameters*. From the list presented, select the *spa3pha.** file for the probe under calibration. Click on the *OK* button to transfer the parameters from the disk file to the instrument. Verify that the the default probe parameters in the ASP-2 are set per the table below by selecting *Edit*, *Instrument Parameters*, then *Probe* and *Channel* parameters.

Probe Parameters	
Dead Time (μsec.)	20
Max. High Voltage	1600
Overrange (cps)	48,000

Channel Parameters	
Channel Type	PHA
Units	cpm
Selected Window	Lower
High Voltage	400

Window Param's	Lower	Upper
Threshold (mV)	4.00	5.00
counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

12. Select *Edit*, then *Instrument Parameters*. If necessary, enter the ASP-2 serial number and calibration dates in the window that appears. Likewise, enter the probe serial number and model in the *Probe* information page.

13. Select *Calibrate*, then *Run Plateau*. Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	20
Starting Voltage	440*
Ending Voltage	500*
Voltage Step	10
Max. Count Rate (cps)	20,000**
Graph Name	SPA-3, PHA
File Name	SPA3.GRF

* Plateau starting and ending voltages will vary with isotope. Approximate plateau voltages are 440V to 500V for ^{137}Cs; 670V to 710V for ^{241}Am and 400V to 450V for ^{60}Co.

** Depends on source activity.

14. Place a CS-7B, ^{137}Cs (**.** 1μCi) check source or other isotope of interest, against the end of the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1600.

15. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is on the peak of the lower window. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the the HV set point is the correct desired value.

16. Calibration is now complete. Verify that the correct units of measure (cps or cpm) are set in the instrument. To print a cal report, select *Calibration*, and *Calibration Report*, while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Print the plateau for this probe by selecting *Calibration*, *Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the Graph Window is displayed, select *File* then *Print Graph*.

SPA-6
Calibration in CPS, CPM

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

    a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

    b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk,* then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

    Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

    IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	15
Max. High Voltage	1600
Overrange (cps)	50,000

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Gamma	
Units	cpm	
Selected Window	Upper	
High Voltage	750	
Window Param's	**Lower**	**Upper**
Threshold (mV)	3.00	10.00
Counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

3. Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	750
Ending Voltage	1500
Voltage Step	50
Max. Count Rate (cps)	6.70E+04
Graph Name	SPA-6
File Name	SPA6.GRF

4. Place a CS-7B, ^{137}Cs (.1μCi) check source against the end of the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1600 Volts.

5. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the upper window plateau. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.

6. Next select *Calibration* then *Determine Calibration Constant*. Verify that Upper Window and Background buttons are selected with the count time set to 60 seconds. Calibration should be performed in an area with less than 30 μR/h background. Place the probe in a low background area, then click on the *Start* button to begin the background count. Note the reading upon completion of the background count. Switch to *Background* mode on the ASP-2.

7. Place the probe in a 0.5 mR/h (0.0005 R/h) ^{137}Cs field, face on. Probe must be in free air, at least 3 feet off the ground with no large objects within 6 feet. Acquire a count in the *Background* mode by watching the countdown in the lower right corner. Note the CPM value when it is below 2%. Subtract the previously determined background from this value. Multiply the net cpm value by 8 and use this number as the dead time field.

8. Click on *Dead Time* and enter the dead time field, determined in step 8. Place the probe, in a 4 mR/h (0.004 R/h) ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of 16 to 26 μsec., click on *Save* when prompted, to store the new value.

9. Calibration is now complete. Verify that the correct units of measure (cps or cpm) are set in the instrument. To print a cal report, select *Calibration*, and *Calibration Report*, while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Print the plateau for this probe by selecting *Calibration*, *Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the Graph Window is displayed, select *File* then *Print Graph*.

SPA-8
Calibration in CPM, CPS, R/h

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

    a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

    b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

    Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

    IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	36
Max. High Voltage	1500
Overrange (cps)	45000

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Gamma	
Units	Cpm	
Selected Window	Upper	
High Voltage	525	
Window Param's	**Lower**	**Upper**
Threshold (mV)	2.00	2.00
counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

3. Select *Calibrate*, then *Run Plateau*. Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	500
Ending Voltage	1100
Voltage Step	50
Max. Count Rate (cps)	15,000*
Graph Name	SPA-8
File Name	SPA8.GRF

* Depends on source activity

4. Expose the probe to a CS-7B, ^{137}Cs (.1μCi) check source, preferably in a lead shield. Position the source disc with the active side facing the end of the probe. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1500 Volts.

5. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the upper window plateau. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau. If calibration is to **μR/h** then jump to step 11.

6. Select *Calibration* then *Determine Calibration Constant*. Verify that Upper Window and Background buttons are selected with the count time set to 300 seconds. Calibration should be performed in an area with less than 30 μR/h background. Place the probe in a low background area, then click on the *Start* button to begin the background count.

7. Place the probe in a 0.5 mR/h (0.0005 R/h) ^{137}Cs field, face on. Probe must be in free air, at least 3 feet off the ground with no large objects within 6 feet. Acquire a count in the *Background* mode by watching the countdown in the lower right corner. Note the CPM value when it is below 2%. Subtract the previously determined background from this value. Multiply the net cpm value by 15 and use this number as the dead time field.

8. Click on *Dead Time* and enter the dead time field, determined in step 8. Place the probe, in a 7.5 mR/h ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of the range of 20 to 65 μsec., click on *Save* when prompted, to store the new Dead Time parameter.

9. Calibration is now complete. To print a cal report, select *Calibration*, and *Calibration Report*, while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Print the plateau for this probe by selecting *Calibration, Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the plateau is displayed in the Graph Window, select *File* then *Print Graph*.

R/h Calibration

10. Edit the units to R/h by selecting *Edit, Instrument Parameters*, then *Channel*. Change units from cpm to R/h. Place the probe in a low background area. Calibration should be performed in an area with less than 30 μR/h background. Select *Calibration*, then *Determine Calibration Constant*. Verify that Upper Window and Background are selected with the count time set to 120 seconds. Click on the *Start* button to begin background count.

11. After the background has been determined, click on *Cal. Const.* Enter the calibration field, 0.0005 R/h. Place the probe in a 0.5 mR/h (0.0005 R/h) ^{137}Cs field, face on. Probe must be in free air, at least 3 feet off the ground with no large objects within 6 feet. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and field strength. When the count is complete, click on *Save* to store the new calibration constant if within 1.00E+10 to 2.00E+10.

12. Next, click on *Dead Time*. Enter the dead time field, 0.0075 R/h. Place the probe in a 7.5 mR/h (0.0075R/h) ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of 20 to 65 μsec., click on *Save* when prompted, to store new value in the instrument.

13. Manually perform linearity checks in three ^{137}Cs fields: 0.0005 R/h (0.5 mR/h), 0.002 R/h (2 mR/h), and 0.01 R/h (10 mR/h). For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).

14. When the linearity tests are complete, select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.

SPA-9, RD-19

Calibration in CPS, CPM

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

   a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

   b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

      Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

      IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (μsec.)	31
Max. High Voltage	1600
Overrange (cps)	50000

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Gamma	
Units	R/h	
Selected Window	Upper	
High Voltage	575	
Window Param's	**Lower**	**Upper**
Threshold (mV)	3.00	10.00
Counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

3. Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	550
Ending Voltage	1300
Voltage Step	50
Max. Count Rate (cps)	67000
Graph Name	SPA-9
File Name	SPA9.GRF

4. Place a CS-7B, ^{137}Cs (.1μCi) check source against the end of the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau.

5. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the upper window plateau. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.

6. Next select *Calibration*, then *Determine Calibration Constant*. Verify that Upper Window and Background buttons are selected with the count time set to 120 seconds. Calibration should be performed in an area with less than 30 μR/h background. Place the probe in a low background area, then click on the *Start* button to begin the background count. Upon completion of the background count, click on the *Cal. Const.* button.

7. After the background has been determined, click on *Cal. Const.* Enter the calibration field, 0.0005 R/h. Place the probe in a 0.5 mR/h (0.0005 R/h) ^{137}Cs field, face on. Probe must be in free air, suspended on non-metallic objects at least 3 feet off the floor with no other objects within 6 feet. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and field strength. When the count is complete, click on *Save* to store the new calibration constant if within 2.0E+10 to 4.0E+10.

8. Click on *Dead Time* and enter the dead time field, 0.005 R/h. Place the probe in a 5 mR/h (0.005 R/h) ^{137}Cs ield. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of 25 to 38 μsec., click on *Save* when prompted, to store new value in the instrument.

9. Calibration is now complete. Verify that the correct units of measure are set in the instrument. If calibration is to **R/h**, jump to step 11. Otherwise, edit the units of measure to cpm or cps, and cal constant (counts/count parameter) to 1.00 in both the upper and lower windows of channel 1. To edit the units and cal constant, select *Edit*, *Instrument Parameters*, then *Channel*. Jump to step 11 to print a calibration report.

10. Manually perform linearity checks in three ^{137}Cs fields: 0.0005 R/h (0.5 mR/h), 0.0025 R/h (2.5 mR/h), and 0.005 R/h (5 mR/h). For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).

12. Select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data (if taken) to the printed form. Record the isotope used for calibration on the cal report. Print the plateau for this probe by selecting *Calibration*, *Display Plateau* then select the appropriate file from the list in the dialog box. When the Graph Window is displayed, select *File* then *Print Graph*

Conversion Sv/h

Any probe which may be calibrated in R/h may also be configured for Sv/h. To calibrate an ASP-2 and probe in these units, perform the following steps:

1. Calibrate in R/h per the appropriate section.

2. While the instrument is connected to the host computer, use the ASP-2 host program to *Edit Instrument /Probe Parameters.* Select the **Channel** tab to view the previously determined calibration data.

3. Multiply the existing calibration constant by 100 and select **Sv/h** as the display units. Click *OK* to download these changes to the instrument. If a second channel (such as a PHA channel) has also been calibrated in R/h, repeat this process for the channel as well.

4. Switch the APS-2 to **Ratemeter** mode and verify that **Sv/h** icon is displayed. If two channels have been defined, switch to the second and verify that it displays in the desired units.

5. When producing a calibration report or certificate, verify that the **Rate Units** are **Sv/h** and that all linearity data is displayed in these units.

Section 14

Appendix

ASP-2 Probe Calibration

AC-3-7, AC-3-8, HP-350, HP-380A

Calibration in CPS, CPM, DPS, DPM, Bq
Calibration to ^{239}Pu (or ^{230}Th if necessary) in S94 type source holders when possible, except for HP-380A.

1. With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	8
Max. High Voltage	1500 (1300 for HP-380A)
Overrange (cps)	90000

These probes are not suitable for operation with the PHA channel of an ASP-2. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Alpha	
Units	cpm	
Selected Window	Upper	
High Voltage	700	
Window Param's	Lower	Upper
Threshold (mV)	2.00	10.00
counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

3. **Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.**

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	700 (500 for HP-380)
Ending Voltage	1250
Voltage Step	25
Max. Count Rate (cps)	2500*
Graph Name	AC-3, HP-380, etc.
File Name	AC3.GRF (example)

Depends on source activity.

4. **Expose the probe to a ^{239}Pu (or ^{230}Th) 40K to 200K cpm (or . 80K to 400K dpm) plated source. Position the source disc with the active side facing the probe. Click on the *Start***

button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached extend the ending voltage as necessary to complete the plateau, but not above 1300 volts.

5. **When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the upper window plateau. Adjust up and down from this point noting the ratio of the upper window counts versus the lower window counts shown in the lower left corner. Select the point where the upper window (alpha) counts are highest and the lower window (beta) counts are lowest while still on the plateau. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.**

6. **Determine background and calibration constant next by selecting *Calibration* then *Determine Calibration Constant*. Verify that the Upper Window, and Background buttons are selected with the count time set to 300 seconds. Place the probe in a low background area and then click on the *Start* button to begin the background count. The background should be less than 10 cpm.**

7. **Upon completion of the background count, click on the *Cal. Const.* button. Enter the calibration field, which should be a ^{239}Pu source (or ^{230}Th), of around 50K cpm (. 100K dpm). The units must be in cpm to match the probe set up. Expose the probe to the source and click on *Start* to begin the count. The actual count time will be determined by the WinASP2 program.**

8. **Upon completion, verify the determined cal constant (ie. 2_ efficiency or counts/count parameter) for ^{239}Pu is greater than 0.28 for the AC-3-7, greater than 0.18 for the AC-3-8, and greater than 0.36 for the HP-350 and HP-380A. If within tolerance, answer Yes to the save prompt. Note the efficiency (CC H 100 = % eff.) to record later on the calibration report.**

9. **Unless calibration other than cpm is specified, edit the cal constant to 1.00 in both the upper and lower windows. This yields actual probe count rate, the recommended calibration for these probes. To edit the cal constant select *Edit, Instrument Parameters, Channel*. Jump to step 12.**

10. **If calibration is to source count rate (2_ emissions), jump to step 12. Do not edit the cal constants to 1.00; the previously determined values are correct for 2_ emissions.**

11. **If units of dps, dpm or Bq are desired, change the activity units and cal constant at this time. To edit the units and cal constant select *Edit, Instrument Parameters,* then *Channel*. Select the desired units in and divide the previously determined cal constant by two.**

    For example: If the previously determined cal constant was 0.28 counts/count. Change the units to dpm, then edit the cal constant to 0.14 counts/disint. (0.28) 2).

12. **Calibration is now complete. Verify that the correct units of measure are set in the instrument. To print a cal report, select *Calibration,* and *Calibration Report,* while still**

connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to

include linearity data in the report. Record the isotope and previously determined efficiency on the printed calibration report. Print the plateau for this probe by selecting *Calibration, Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the plateau is displayed in the Graph Window, select *File* then *Print Graph*.

HP-100C, HP-100CGS

Calibration in CPS, CPM, Bq, DPS, DPM

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

   a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

   b. **Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.**

   Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	7.5
Max. High Voltage	1900
Overrange (cps)	80000

Note: These probes may be used to measure Alpha, Beta or total (Alpha plus Beta) radiation. Select one column from the table which follows and edit those values into the main channel parameters, along with both columns from the chart of window parameters. Change the type identifier of the PHA channel to 'NONE' since these probes are not suitable for pulse height measurements.

Main Channel Parameters			
Channel Type	**Alpha**	**Beta**	**A/B**
Units	**cpm**	**cpm**	**cpm**
Selected Window	**Upper**	**Lower**	**Both**
High Voltage	**1360**	**1360**	**1360**

Window Param's	Lower	Upper
Threshold (mV)	**1.00**	**27.00**
counts/count	**1.00**	**1.00**
Integrate Alarm	**0.0**	**0.0**
Rate Alarm	**0.0**	**0.0**
Click Divider	**1**	**1**

3. Flush the probe with P10 gas for one hour (minimum) at a flow rate of 50 cc/min. During the actual plateau and counting operations, flow must be maintained at 40 cc/min or more.

4. Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	**10**
Starting Voltage	**1360**
Ending Voltage	**1660**
Voltage Step	**20**
Max. Count Rate (cps)	**2500***
Graph Name	**HP-100CGS**
File Name	**HP100.GRF**

*** Depends on source activity.**

5. **Expose the probe to a ^{99}Tc* 40K to 200K cpm (or . 80K to 400K dpm) plated source. Position the source with the active side facing the probe. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached extend the ending voltage as necessary to complete the plateau.**

6. **When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the plateau. 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. 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 for channel 1 by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.**

7. **Place the probe in a low background, then select *Calibration,* then *Determine Calibration Constant.* Verify that the MAIN channel is selected and that the correct window (upper, lower or both, as appropriate to the channel type in use) is checked (this should happen automatically). Click the *Background* button, enter a count time of 120 seconds, then click *Start.***

8. **For a Beta channel or for total counts (Alpha plus Beta), expose the probe to a 100 cm^2 ^{137}Cs source. For an Alpha channel, use a 100 cm^2 ^{241}Am source. Enter the calibration field in CPM, check the *Cal Const.* box, then click on *Start* to begin counting. The count time will be determined by the host program.**

9. **Verify that the cal constant obtained is greater than 0.52 for a ^{137}Cs source or greater than 0.45 for an ^{241}Am source. Calculate the detector efficiency (100 times the cal constant) to be recorded later on the calibration certificate.**

10. **Unless calibration other than cpm is specified, edit the cal constant to 1.00 in both upper and lower windows. This yields <u>actual probe count rate</u>, the recommended procedure for this probe. To edit the cal constant select *Edit, Instrument Parameters,* then *Channel*. Jump to step 13.**

11. If calibration to <u>source count rate</u> (2_ emissions) is specified, then jump to step 13. Do not edit the cal constants to 1.00, the previously determined values are correct for 2_ emissions.

12. If units of dpm, dps, Bq are desired, change the activity units and cal constant. To edit the units and cal constant select *Edit, Instrument Parameters,* then *Channel*. Select the desired units for the main channel and divide the previously determined cal constant by two.

For example: If the previously determined cal constant was 0.54 counts/count. Change the units to dpm, then edit the cal constant to 0.27 counts/disint. (0.54) 2).

13. Calibration is complete. To print a cal report, select *Calibration,* then *Calibration Report,* while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. After printing the report, enter the Alpha and Beta isotope and efficiency on the cal report. Print the plateau for this probe by selecting *Calibration, Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the Graph Window is displayed, select *File* then *Print Graph*.

14. The gas should now be disconnected from the probe. For Gas Seal (GS) versions of the probe perform the following:

a. Seal the probe by disconnecting the inlet and then the outlet.

b. Wait 4 hours. Measure the Beta 2_ efficiency. It should be less than 5% decrease from the original value from step 9. Calculate the percent decrease with the following equation. This value should be less than 5.0 (5%):

*** 100cm^2 source is preferred, but any size may be used for the plateau. If necessary, the following isotopes may also be used for the plateau: ^{137}Cs, ^{90}Sr, ^{60}Co. A 100cm^2 ^{137}Cs source is the only type that should be used to measure beta efficiency.**

Section 1 - Calibration in CPM

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

   a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

   b. **Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.**

   Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	250
Max. High Voltage	900
Overrange (cps)	12500

This probe is not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	**Beta**	
Units	**cpm**	
Selected Window	**Upper**	
High Voltage	**900**	
Window Param's	**Lower**	**Upper**
Threshold (mV)	**5.00**	**10.0**
counts/count	**1.0**	**1.0**
Integrate Alarm	**0**	**0**
Rate Alarm	**0**	**0**
Click Divider	**1**	**1**

3. **If R/h calibration is specified, then jump to step 8, otherwise <u>calibration should be in CPM.</u>**

4. **Place the probe in a low background area. Select *Calibration,* then *Determine Calibration Constant.* Verify that Upper Window and Background are selected with the count time set to 180 seconds. Click on the *Start* button to begin background count.**

5. **After the background has been determined, click on *Cal. Const.* Expose the probe screen on a 1 inch plated ^{90}SrY source of less than 20K cpm. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and source activity. Upon completion, verify that the determined Beta Cal. Constant (ie. 2_ efficiency or counts/count parameter) is greater than 0.12. <u>DO NOT</u> save this calibration constant to the instrument. The calibration constants (counts/count) in both windows should remain set at 1. Note the efficiency (CC H 100 = % eff.) to record later on the calibration report.**

6. **Manually determine efficiencies for two ^{90}SrY sources. Sources should be 1 inch diameter plated ^{90}SrY, one of about 2K to 20K cpm and another of .75K to 100K cpm. Record the nominal and observed count rates for both sources in CPM, then compute efficiencies (100 x observed/nominal = % eff) for each. Verify that the two calculated efficiencies are within 10% of each other. Save these values for inclusion in the calibration report as linearity data.**

7. **When the linearity tests are complete, select *Calibration,* then *Calibration Report,* while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope and previously determined efficiency on the cal report.**

Section 2 - R/h Calibration

8. **Select *Edit, Instrument Parameters*, then *Channel*. Change the units for channel 1from cpm to R/h and the channel type to gamma.**

9. **Select *Calibration,* then *Determine Calibration Constant.* Verify that Upper Window and *Cal. Const.*are selected. Enter the cal constant field of 0.0075R/h. Place the probe in a 0.0075 R/h (7.5 mR/h) ^{137}Cs field, side on. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program based on field strength. When the count is complete, click on *Save* to store the new calibration constant if within 1.15E+08 to 1.95E+08.**

10. **Next, click on *Dead Time*. Enter the dead time field of 0.75R/h. Place the probe, in a 0.75R/h (750 mR/h) ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of 230 to 330 _sec., click on *Save* when prompted, to store the new Dead Time value in the instrument.**

11. **Manually perform linearity checks in three ^{137}Cs fields: 0.005 R/h (5 mR/h), 0.05 R/h (50 mR/h), and 0.25 R/h (250 mR/h). For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).**

12. **When the linearity tests are complete, select *Calibration*, then *Calibration Report,* while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.**

Section 1 - Calibration in CPM

1 . With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.

2. Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:

a. Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.

b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	100
Max. High Voltage	900
Overrange (cps)	58000

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	**Beta**	
Units	**cpm**	
Selected Window	**Upper**	
High Voltage	**900**	
Window Param's	**Lower**	**Upper**
Threshold (mV)	**5.00**	**10.0**
counts/count	**1**	**1**
Integrate Alarm	**0**	**0**
Rate Alarm	**0**	**0**
Click Divider	**1**	**1**

3. **If R/h calibration is specified, then jump to step 8, otherwise <u>calibration should be in CPM.</u>**

4. **Place the probe in a low background area. Select *Calibration,* then *Determine Calibration Constant.* Verify that Upper Window and Background are selected with the count time set to 120 seconds. Click on the *Start* button to begin background count.**

5. **After the background has been determined, click on *Cal. Const.* Expose the probe screen on a 47mm plated ^{99}Tc source of less than 20K cpm. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and source activity. Upon completion, verify that the determined Beta Cal. Constant (ie. 2_ efficiency or counts/count parameter) is greater than 0.25. <u>DO NOT</u> save this calibration constant to the instrument. The calibration constants (counts/count) in both windows should remain set at 1. Note the efficiency (CC H 100 = % eff.) to record later on the calibration report.**

6. **Manually determine efficiencies for two ^{99}Tc sources. Sources should be 47mm diameter plated ^{99}Tc, one of about 2K to 20K cpm and another of .75K to 100K cpm. Record the nominal and observed count rates for both sources in CPM, then compute efficiencies (100 x observed/nominal = % eff) for each. Verify that the two calculated efficiencies are within 10% of each other. Save these values for inclusion in the calibration report as linearity data.**

7. **When the linearity tests are complete, select *Calibration,* then *Calibration Report,* while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope and previously determined efficiency on the cal report.**

Section 2 - R/h calibration

8. **Select *Edit, Instrument Parameters*, then *Channel*. Change the units for channel 1 from cpm to R/h and the channel type to gamma.**

9. **Select *Calibration,* then *Determine Calibration Constant.* Verify that Upper Window and *Cal. Const.* are selected. Enter the cal constant field of 0.0075 R/h.**

NOTE

Use a 1/4" plastic (plexiglas) between source and detector, placed in contact with detector, for the following readings.

10. **Place the probe in a 0.0075 R/h (7.5 mR/h) ^{137}Cs field, face on. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and field strength. When the count is complete, click on *Save* to store the new calibration constant if within 1.8E+08 to 2.4E+08.**

11. **Next, click on *Dead Time*. Enter the dead time field of 0.75R/h. Place the probe, in a 0.75R/h (750 mR/h) ^{137}Cs field. Click on the *Start* button. The program could take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of 80 to 125 _sec., click on *Save* when prompted, to store the new Dead Time value in the instrument.**

12. **Manually perform linearity checks in three ^{137}Cs fields: 0.005 R/h (5 mR/h), 0.05 R/h (50 mR/h), and 0.5 R/h (500 mR/h). For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).**

13. **When the linearity tests are complete, select *Calibration,* then *Calibration Report,* while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.**

HP-220A

Calibration in R/h

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

   a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

   b. **Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.**

   Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	60
Max. High Voltage	550
Overrange (cps)	67000

This probe is not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	**Gamma**	
Units	**R/h**	
Selected Window	**Upper**	
High Voltage	**550**	
Window Param's	**Lower**	**Upper**
Threshold (mV)	**5.00**	**10.0**
counts/R	**1**	**1.50E+06**
Integrate Alarm	**0**	**0**
Rate Alarm	**0**	**0**
Click Divider	**1**	**1**

3. **Select *Calibration,* then *Determine Calibration Constant.* Verify that Upper Window and *Cal. Const.* are selected.**

4. **Enter the cal constant field, 0.075 R/h. Place the probe in a 75 mR/h (0.075 R/h) ^{137}Cs field. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program, based on field strength. When the count is complete, click on *Save* to store the new calibration constant if within 4.9E+07 to 9.1E+07.**

5. **Next, click on *Dead Time*. Enter the dead time field, 50 R/h. Place the probe in a 50 R/h ^{137}Cs field. Click on the *Start* button. The program could take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of <u>70 to 100</u> _sec., click on *Save* when prompted, to store new value in the instrument.**

6. **Manually perform linearity checks in three ^{137}Cs fields: 0.75 R/h (750 mR/h), 7.5 R/h, and 50 R/h. For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 85-115% of nominal (all errors <15%).**

7. **When the linearity tests are complete, select *Calibration,* then *Calibration Report,* while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.**

HP-270

Calibration in R/h

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

   a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

   b. **Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.**

   Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	90
Max. High Voltage	900
Overrange (cps)	60000

This probe is not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Gamma	
Units	R/h	
Selected Window	Upper	
High Voltage	900	
Window Param's	Lower	Upper
Threshold (mV)	5.00	10.0
counts/R	1	7.00E+07
Integrate Alarm	0	0
Rate Alarm	0	0
Click Divider	1	1

3. **Select *Calibration,* then *Determine Calibration Constant.* Verify that Upper Window and Cal. Const. are selected. Enter the calibration constant field, 0.0075 R/h. Place the probe in a 7.5 mR/h (0.0075 R/h) ^{137}Cs field, side on, shield closed. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and field strength. When the count is complete, click on *Save* to store the new calibration constant if within 4.9E+07 to 9.1E+07.**

4. **Next, click on *Dead Time*. Enter the dead time field, 0.75 R/h. Place the probe, shield closed, in a 750 mR/h (0.75R/h) ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within a range of <u>60 to 120</u> _sec., click on *Save* when prompted, to store new value in the instrument.**

5. **Manually perform linearity checks in three ^{137}Cs fields: 0.005 R/h (5 mR/h), 0.5 R/h (500 mR/h), and 2.0 R/h. For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors below 10%).**

6. **When the linearity tests are complete, select *Calibration*, then *Calibration Report,* while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.**

HP-290

Calibration in R/h

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

   a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

   b. **Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.**

   Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	24
Max. High Voltage	550
Overrange (cps)	75000

This probe is not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	**Gamma**	
Units	**R/h**	
Selected Window	**Upper**	
High Voltage	**550**	
Window Param's	**Lower**	**Upper**
Threshold (mV)	**5.00**	**10.0**
counts/R	**1**	**5.50E+06**
Integrate Alarm	**0**	**0**
Rate Alarm	**0**	**0**
Click Divider	**1**	**1**

3. **Select *Calibrate,* then *Determine Calibration Constant.* Verify that Upper Window and Cal. Const. are selected. Enter the calibration constant field, 0.75 R/h. Place the probe in a 0.75 R/h (750 mR/h) ^{137}Cs field, side on. Click on the *Start* button to begin count. Actual count time will be determined by the program and field strength. When the count is complete, click on *Save* to store the new calibration constant if within 4.50E+06 to 7.0E+06.**

4. **Next, click on *Dead Time*. Enter the dead time field, 25 R/h. Place the probe in a 25R/h ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of 22-35 _sec., click on *Save* when prompted to store new value in the instrument.**

5. **Manually perform linearity checks in three ^{137}Cs fields: 0.075 R/h (75 mR/h), 7.5 R/h, and 40 R/h. For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).**

6. **When the linearity tests are complete, select *Calibration,* then *Calibration Report,* while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.**

HP-300

Calibration in R/h

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

   a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

   b. **Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.**

   Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	100
Max. High Voltage	500
Overrange (cps)	16,000

This probe is not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	**Gamma**	
Units	**R/h**	
Selected Window	**Upper**	
High Voltage	**449**	
Window Param=s	**Lower**	**Upper**
Threshold (mV)	**5.00**	**10.0**
counts/R	**1**	**5.00E+08**
Integrate Alarm	**0**	**0**
Rate Alarm	**0**	**0**
Click Divider	**1**	**1**

3. **Select *Calibration,* then *Determine Calibration Constant.* Verify that Upper Window and Cal. Const. are selected. Enter the calibration constant field, 0.001 R/h. Using the free air calibrator setup, place the probe in a 1 mR/h (0.001 R/h) ^{137}Cs field, side on. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and field strength. Repeat until determined cal constant is consistent. When counting is complete, click on *Save* to store the new calibration constant if within 4.7E+08 to 7.0E+08.**

4. **Next, click on *Dead Time*. Enter the dead time field, 0.05 R/h. Follow the instructions for HP-300 probes located in the source room for source well s/n EI-152. Place the probe in the special holder above the well, and set up for a 50 mR/h (0.05R/h) ^{137}Cs field per the HP-300 instructions. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of <u>90 to 140</u> _sec., click on *Save* when prompted to store the new value in the instrument.**

5. **Manually perform linearity checks in three ^{137}Cs fields: 0.02 R/h (20 mR/h), 0.05 R/h (50 mR/h), and 0.1 R/h (100 mR/h). For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).**

6. **When the linearity tests are complete, select *Calibration,* then *Calibration Report,* while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.**

HP-330

Calibration in CPM, CPS, DPM, DPS, Bq

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

   a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

   b. **Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.**

   Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	8.5
Max. High Voltage	1800
Overrange (cps)	48000

Note: **These probes may be used to measure Alpha, Beta or total (Alpha plus Beta) radiation. Select one column from the table which follows and edit those values into the main channel parameters, along with both columns from the chart of window parameters. Change the type identifier of the PHA channel to 'NONE' since these probes are not suitable for pulse height measurements.**

Main Channel Parameters			
Channel Type	**Alpha**	**Beta**	**A/B**
Units	**cpm**	**cpm**	**cpm**
Selected Window	**Upper**	**Lower**	**Both**
High Voltage	**1450**	**1450**	**1450**

Window Param's	**Lower**	**Upper**
Threshold (mV)	**1.00**	**30.00**
counts/count	**1.00**	**1.00**
Integrate Alarm	**0.0**	**0.0**
Rate Alarm	**0.0**	**0.0**
Click Divider	**1**	**1**

3. Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	1450
Ending Voltage	1650
Voltage Step	10
Max. Count Rate (cps)	2500*
Graph Name	HP-330
File Name	HP330.GRF

Depends on source activity.

4. Expose the probe to a ^{99}Tc 20K to 200K cpm (or **. 40K to 400K dpm) 47mm plated source. Position the source disc with the active side facing the probe. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A**

graph of the source plateau will appear beginning after the first count. When the

ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached extend the ending voltage as necessary to complete the plateau, not to exceed 1800 Volts.

5. **When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the plateau. Adjust up and down from this point noting the ratio of the upper window counts versus the lower window counts. Select the point where the lower window counts are highest and the upper window counts are lowest while still on the plateau. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.**

6. **Place the probe in a low background, then select *Calibration,* then *Determine Calibration Constant.* Verify that the MAIN channel is selected and that the correct window (upper, lower or both, as appropriate to the channel type in use) is checked (this should happen automatically). Click the *Background* button, enter a count time of 120 seconds, then click *Start.***

7. **For a Beta channel or for total counts (Alpha plus Beta), expose the probe to a 47 mm diameter ^{99}Tc source with an activity of 50K to 100K cpm. For an Alpha channel, use a 47 mm ^{239}Pu source, again with an activity of 50K to 100K cpm. Enter the calibration field in cpm, check the *Cal Const.* box, then click on *Start* to begin counting. The count time will be determined by the host program.**

8. **Verify that the cal constant obtained is greater than 0.18 for a ^{99}Tc source or greater than 0.20 for an ^{239}Pu source. Calculate the detector efficiency (100 times the cal constant) to be recorded later on the calibration certificate.**

9. **Unless calibration other than cpm is specified, edit the cal constant to 1.00 in both upper and lower windows. This yields <u>actual probe count rate</u>, the recommended procedure for this probe. To edit the cal constant select *Edit, Instrument Parameters,* then *Channel*. Jump to step 13.**

10. **If calibration to <u>source count rate</u> (2_ emissions) is specified, then jump to step 13. Do not edit the cal constants to 1.00, the previously determined values are correct for 2_ emissions.**

11. **If units of dpm, dps, Bq are desired, change the activity units and cal constant. To edit the units and cal constant select *Edit, Instrument Parameters,* then *Channel*. Select the desired units for the main channel and divide the previously determined cal constant by two.**

    For example: If the previously determined cal constant was 0.54 counts/count. Change the
    units to dpm, then edit the cal constant to 0.27 counts/disint. (0.54) 2).

12. Calibration is complete. To print a cal report, Select *Calibration,* then *Calibration Report,* while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Record the isotope and previously determined efficiency on the printed cal report. Print the plateau for this probe by selecting *Calibration, Display Plateau* then select the appropriate file from the list in the dialog box. When the Graph Window is displayed, select *File* then *Print Graph*.

LEG-1

Main Channel Calibration in CPS, CPM - Gross Counting

Note: This energy-proportional probe is suitable for use with the Pulse Height Analysis (PHA) capabilities of the ASP-2. If the instrument with which it will be used is an ASP-2e (Enhanced), both a main gamma channel and a PHA channel may be defined and will be available to the user. A base model ASP-2 (Non-Enhanced) instrument may be calibrated for one channnel of either type. To create a PHA channel on an ASP-2, edit the PHA channel parameters given below into the MAIN channel of the instrument and follow the PHA calibration instructions.

Important: If the either channel of an ASP-2E is not calibrated, change the unused channel identifier to type 'NONE'. This will disable the channel and prevent accidental use.

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

    a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

    b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

    Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also
    insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are
    correct, click on *OK* to download them to the ASP-2.

Main Channel Calibration in CPS, CPM - Gross Counting

Click on *Edit, Instrument Parameters, Channel* to open the probe channel parameters window. If necessary, click on the *Main* channel radio button to display parameters for the main channel.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	8
Max. High Voltage	1500
Overrange (cps)	40000

Channel Parameters				
Channel	Main		PHA (ASP-2e only)	
Channel Type	Gamma		PHA	
Units	cpm		CPM	
Selected Window	Upper		Lower	
High Voltage	460		460	
Window Param's	Lower	Upper	Lower	Upper
Threshold (mV)	2.00	2.00	4.00	5.00
counts/count	1.00	1.00	1.00	1.00
Integrate Alarm	0.0	0.0	0.0	0.0
Rate Alarm	0.0	0.0	0.0	0.0
Click Divider	1	1	1	1

3. Select *Calibrate,* then *Run Plateau.* Edit the plateau voltage parameters as shown

below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
t Time (sec.)	
ng Voltage	
g Voltage	
ge Step	
Count Rate (cps)	*
n Name	-1
Name	1.GRF

* Depends on source activity.

4. Expose the probe to an ^{241}Am plated source, of **. 300k cpm (. 600k dpm). Position the source disc with the active side facing the end of the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1500 Volts.**

5. **When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the upper window plateau. The operating voltage is normally set at a point where the voltage is as high as possible with less than a 1% crossover. The black vertical bar turns red when the window 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 in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.**

6. **Next select *Calibration* then *Determine Calibration Constant*. Verify that <u>Upper Window</u> and Background buttons are selected with the count time set to 300 seconds. Place the probe in a low background area, preferably in a lead shield, then click on the *Start* button to begin the background count. Note the background reading.**

7. **Check the ^{241}Am 60 keV gamma efficiency. Expose the detector to an ^{241}Am source of 600k dpm, preferably s/n 6025 and place in a shield. → (Note the CPM) Subtract the previously determined background from this count. Use the following formula to determine efficiency. Note the calculated efficiency to record later on the calibration report.**

NOTE: Gamma per minute based on 0.357 abundance of 60 keV

gamma from ^{241}Am. Ref: ICRP Publication 38, 1983.

8. If a PHA channel is to be calibrated, proceed with step 9. If only the main channel is needed, skip to step 13. PHA Channel Calibration (ASP-2e only)

9. Click *Edit, Instrument Parameters, Channel* to open the probe channel parameters screen. Click on the *PHA* channel radio button to switch to the Pulse Height channel parameters.

10. Select *Calibrate,* then *Run Plateau*. Click on the *Channel 1* radio button on top, then edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	20
Starting Voltage	700*
Ending Voltage	900*
Voltage Step	10
Max. Count Rate (cps)	20,000**
Graph Name	LEG-1, PHA
File Name	LEG1.GRF

*** Plateau starting and ending voltages will vary with isotope.**
**** Depends on source activity.**

11. Place a ^{241}Am or ^{239}Pu source (or other isotope of interest) against the end of the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1500 Volts.

12. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is on the peak of the lower window plot. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the correct desired value.

13. Calibration is now complete. Verify that the correct units of measure (cps or cpm) are set in the instrument. To print a cal report, select *Calibration,* and *Calibration Report,* while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Print the plateau for this probe by

selecting *Calibration, Display Plateau* then select the appropriate file from the list in the

dialog box. Verify that the printer is connected to the computer and ready to print. When the Graph Window is displayed, select *File* then *Print Graph*.

NRD, HP-280

Calibration in Rem/h

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

    a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

    b. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (**_sec.)**	**10**
Max. High Voltage	**2300**
Overrange (cps)	**NRD: 10,000 HP280:25,000**

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	**Neutron**	
Units	**Rem/h**	
Selected Window	**Lower**	
High Voltage	**1500**	
Window Param=s	**Lower**	**Upper**
Threshold (mV)	**2.00**	**60.00**
counts/rem	**1.00**	**1.00**
Integrate Alarm	**0**	**0**
Rate Alarm	**0**	**0**
Click Divider	**1**	**1**

3. **Temporarily edit the units of measure to cpm in by selecting *Edit, Instrument Parameters,* then *Channel*. Place the detector in a 10 R/h ^{137}Cs field. Select *Edit, Instrument Parameters* then *Channel* and adjust the HV for approximately 50 cpm as read on the ASP-2 in Ratemeter mode. Changing the high voltage setting in the channel parameters and clicking on the *Down Load* button, will allow changes to the HV while observing the effect on count rate in Ratemeter mode. When the reading is approximately 50 cpm in a 10 R/h field, decrease the HV by 50V and verify no counts. If H.V. is greater then 2000 VDC lower to 2000 VDC.**

4. **Edit the units of measure back to Rem/h, by selecting *Edit, Instrument Parameters* then *Channel*. Next select *Calibration,* then *Determine Calibration Constant*. Verify that Lower Window and Cal. Const. are selected. Enter the calibration constant field, 0.027 Rem/h. Place the detector in a 27 mRem/h neutron field (0.027 Rem/h) then click on the *Start* button to begin calibration constant determination. Actual count time will be determined by the program. When the count is complete, click on *Save* to store the new calibration constant.**

5. **Manually perform linearity checks in three neutron fields: 0.027 Rem/h (27 mRem/h), 0.1 Rem/h (100 mRem/h), and 0.2 Rem/h (200 mRem/h). For each field, record the observed reading in Rem/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).**

6. **When the linearity tests are complete, select *Calibration*, then *Calibration Report,* while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form.**

Note: This energy-proportional probe is suitable for use with the Pulse Height Analysis (PHA) capabilities of the ASP-2. If the instrument with which it will be used is an ASP-2e (Enhanced), both a main gamma channel and a PHA channel may be defined and will be available to the user. A base model ASP-2 (Non-Enhanced) instrument may be calibrated for one channnel of either type. To create a PHA channel on an ASP-2, edit the PHA channel parameters given below into the MAIN channel of the instrument and follow the PHA calibration instructions.

Important: If the either channel of an ASP-2E is not calibrated, change the unused channel identifier to type 'NONE'. This will disable the channel and prevent accidental use.

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

    a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

    c. Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.

. Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also
insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are
correct, click on *OK* to download them to the ASP-2.

Main Channel Calibration in CPS, CPM - Gross Counting

Click on *Edit, Instrument Parameters, Channel* to open the probe channel parameters window. If necessary, click on the *Main* channel radio button to display parameters for the main channel.

IMPORTANT: Performing the following calibration procedure with

incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	12
Max. High Voltage	1300
Overrange (cps)	20000

Channel Parameters				
Channel	Main		PHA (ASP-2e only)	
Channel Type	Gamma		PHA	
Units	cpm		cpm	
Selected Window	Lower		Lower	
High Voltage	560		700	
Window Param's	Lower	Upper	Lower	Upper
Threshold (mV)	3.00	45.00	4.00	5.00
counts/count	1.00	1.00	1.00	1.00
Integrate Alarm	0.0	0.0	0.0	0.0
Rate Alarm	0.0	0.0	0.0	0.0
Click Divider	1	1	1	1

3. Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
t Time (sec.)	
ng Voltage	
g Voltage	
ge Step	

Count Rate (cps)	0*
n Name	
Name	GRF

* Depends on source activity.

4. Expose the probe to a ^{239}Pu plated source (preferably one of the Meg cpm sources). Position the source disc with the active side facing the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1300 Volts.

5. When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the plateau. The operating voltage is normally set at a point where the voltage is as high as possible with less than a 1% alpha (upper window) to gamma (lower window) crossover. The black vertical bar turns red when the alpha to gamma 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 in the plateau dialog box. A prompt will appear to verify that the the HV set point is the desired value established during the plateau.

6. Determine efficiency next by selecting *Calibration* then *Determine Calibration Constant*. Verify that Lower Window and Background buttons are selected with the count time set to 300 seconds. Place the probe in a low background area, preferably in a lead shield, then click on the *Start* button to begin the background count. The background should be less than 60 cpm in a lead shield.

7. Expose the detector to a plated ^{239}Pu source, preferably s/n 1071 or s/n P1646 and place in a shield. → (Note the CPM) Subtract the previously determined background from this count. Use the following formula to determine efficiency. Note the calculated efficiency to record later on the calibration report.

8. Calibration is now complete. Verify that the correct units of measure (cps or cpm) are

set in

the instrument. To print a cal report, select *Calibration*, and *Calibration Report*, while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Record the isotope and previously determined gamma efficiency on the printed calibration report. Print the plateau for this probe by selecting *Calibration, Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the plateau is displayed in the Graph Window, select *File* then *Print Graph*.

Section 2 - PHA Calibration (ASP-2e only)

9. Load the PG-2 PHA probe parameters (*pg2pha.** file), by selecting *Edit, Load Setup From Disk,*
then *Probe Parameters*. Click on the *OK* button to transfer the parameters from the disk file to the instrument. Verify that the default probe parameters in the ASP-2 are set per the table below by selecting *Edit, Instrument Parameters*, then the *Probe* and *Channel* parameters.

Parameters	**Probe**
Dead Time (_**sec.)**	**12**
Max. High Voltage	**1300**
Overrange (cps)	**20000**

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type
identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Channel Parameters	
Channel Type	**PHA**
Units	**cpm**
Selected Window	**Lower**
High Voltage	**700**

Window Param's	**Lower**	**Lower**
Threshold (mV)	**4.00**	**5.00**

counts/count	**1.00**	**1.00**
Integrate Alarm	**0.0**	**0.0**
Rate Alarm	**0.0**	**0.0**
Click Divider	**1**	**1**

10. Select *Edit*, then *Instrument Parameters*. If necessary, enter the ASP-2 serial number and calibration dates in the window that appears. Likewise, enter the probe serial number and model in the *Probe* information page.

11. Select *Calibrate*, then *Run Plateau*, then edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters	
Count Time (sec.)	**20**
Starting Voltage	**700***
Ending Voltage	**900***
Voltage Step	**10**
Max. Count Rate (cps)	**20,000****
Graph Name	**PG-2, PHA**
File Name	**PG2.GRF**

*** Plateau starting and ending voltages will vary with isotope.**
**** Depends on source activity.**

12. Place a ^{241}Am or ^{239}Pu source (or other isotope of interest) against the end of the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1300 Volts.

13. When the plateau is complete, select the high voltage set point by clicking onthe<and>symbols on the voltage plateau graph until the vertical bar is on the peak of the lower window plot. Save the desired voltage setting to the instrument by clicking on

the set HV button in the plateau dialog box. A prompt will appear to verify that the HV set point is the correct desired value.

14. Calibration is now complete. Verify that the correct units of measure (cps or cpm) are set in the instrument. To print a cal report, select *Calibration,* and *Calibration Report,* while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Print the plateau for this probe by selecting *Calibration,* Display Plateau then select the appropriate file from the list in the dialog box. Verify that the pinter is connected to the computer and ready to print. When the Graph Window is displayed, select *File* then *Print Graph*.

HP-340, HP-380AB

Calibration in dps, dpm, cps, cpm, Bq

NOTE: The probe must have been closed up for at least 8 hours before attempting to calibrate. Exposing the scintillator or PM tube to light will cause the probe to be noisy.

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

    a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

    b. **Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.**

Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	8
Max. High Voltage	1000
Overrange (cps)	80,000

Note: **When properly calibrated for energy-proportional probes of this type, the ASP-2 will register counts caused by Alpha particles in the upper energy window and those caused by Betas in the lower window. Select the window to be counted as shown in the following table, using the table column corresponding to the type(s) of radiation to be measured. If the instrument is an ASP-2e, set the PHA channel type to 'NONE' since this probe does not support PHA.**

Channel Parameters			
Channel Type	**Alpha**	**Beta**	**A/B**
Units	**cpm**	**cpm**	**cpm**
Selected Window	**Upper**	**Lower**	**Both**
High Voltage	**654**	**654**	**654**

Channel Parameters	**Lower**	**Upper**
Threshold (mV)	**1.50 (1.2 for HP-380AB)**	**30.1 (22.1 for HP-380AB)**
counts/count	**1.00**	**1.00**
Integrate Alarm	**0.0**	**0.0**
Rate Alarm	**0.0**	**0.0**
Click Divider	**1**	**1**

3. Select *Calibrate*, then *Run Plateau*. Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.

Plateau Parameters

t Time (sec.)	
ng Voltage	550 for HP-380AB)
g Voltage	
ge Step	
Count Rate (cps)	*
n Name	0, HP380AB, etc.
Name	XX.GRF, 380ABXXX.GRF, etc. where XXX = serial no.

Depends on source activity.

4. Expose the probe to a ^{99}Tc 10K to 200K cpm (or **. 20K to 400K dpm) plated source. Position the source disc near the center of the probe face, with the active side facing the probe. Click on the *Start* button. There may be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If there are no counts in the upper window, extend the plateau ending voltage, but not above 1000 volts.**

5. **When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the desired HV set point. The operating voltage is normally set at a point where the voltage is as high as possible with less than a 1% beta (lower THLD cts.) to alpha (upper THLD cts.) crossover. The black vertical bar turns red when the beta to alpha crossover exceeds 1%. Once it turns red, move the bar back until the alpha counts (upper window) is #0.1 cps to obtain the optimum operating voltage. Save the desired high voltage setting for channel 1 by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the the HV set point is the desired value established during the plateau.**

6. **The beta background count rate should be between 150 and 300 cpm (250 to 450 cpm on HP-380). If not, adjust the high voltage as necessary.**

7. **Place the probe in a low background, then select *Calibration,* then *Determine Calibration Constant.* Verify that the MAIN channel is selected and that the correct window (upper, lower or both, as appropriate to the channel type in use) is checked (this should happen automatically). Click the *Background* button, enter a count time of 120 seconds, then click *Start.***

8. **For a Beta channel or for total counts (Alpha plus Beta), expose the probe to a 47 mm diameter ^{99}Tc source with an activity of 50K to 100K cpm. For an Alpha channel, use a 47 mm ^{239}Pu source, again with an activity of 50K to 100K cpm. Enter the calibration field in cpm, check the *Cal Const.* box, then click on *Start* to begin counting. The count time will be determined by the host program.**

9. Verify that the cal constant obtained is greater than 0.10 for a ^{99}Tc source or greater than 0.36 for an ^{239}Pu source. Calculate the detector efficiency (100 times the cal constant) to be recorded later on the calibration certificate.

10. Unless calibration other than cpm is specified, edit the cal constant to 1.00 in both upper and lower windows. This yields actual probe count rate, the recommended procedure for this probe. To edit the cal constant select *Edit, Instrument Parameters*, then *Channel*. Jump to step 13.

11. If calibration to source count rate (2_ emissions) is specified, then jump to step 13. Do not edit the cal constants to 1.00, the previously determined values are correct for 2_ emissions.

12. If units of dpm, dps, Bq are desired, change the activity units and cal constant. To edit the units and cal constant select *Edit, Instrument Parameters*, then *Channel*. Select the desired units for the main channel and divide the previously determined cal constant by two.

For example: If the previously determined cal constant was 0.54 counts/count. Change the units to dpm, then edit the cal constant to 0.27 counts/disint. (0.54) 2).

13. Calibration is complete. To print a cal report, Select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Record the isotope and previously determined efficiency on the printed cal report. Print the plateau for this probe by selecting *Calibration*, *Display Plateau* then select the appropriate file from the list in the dialog box. When the Graph Window is displayed, select *File* then *Print Graph*.

SPA-1A.

Calibration in CPS, CPM, DPS, DPM, Bq to ^{230}Th

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

   a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

   b. **Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.**

   Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	10
Max. High Voltage	1400
Overrange (cps)	15000

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Alpha	
Units	cpm	
Selected Window	Upper	
High Voltage	430	
Window Param's	Lower	Upper
Threshold (mV)	2.00	10.00
counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

3. **Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.**

Plateau Parameters	
Count Time (sec.)	30
Starting Voltage	425
Ending Voltage	725
Voltage Step	25
Max. Count Rate (cps)	2500*
Graph Name	SPA-1A
File Name	SPA1A.GRF

*** Depends on source activity.**

4. **Expose the probe to a ^{230}Th plated source of around 10K cpm. If available ^{239}Pu may also be used. Position the source disc with the active side facing the detector. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached extend the ending voltage as necessary to complete the plateau, not to exceed 1400 Volts.**

5. **When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the plateau.**

Adjust up and down from this point noting the ratio of the upper window counts versus the

lower window counts shown in the lower left corner. Select the point where the upper window (alpha) counts are highest and the lower window (beta) counts are lowest while still on the plateau. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.

6. **Determine background and calibration constant next by selecting *Calibration* then *Determine Calibration Constant*. Verify that Upper Window and Background buttons are selected with the count time set to 300 seconds. Place the probe in a low background area and then click on the *Start* button to begin the background count. The background should be less than 30 cpm.**

7. **Upon completion of the background count, click on the *Cal. Const.* button. Enter the calibration field, which should be a ^{230}Th source of around 8K cpm (. 16K dpm). The units must be in cpm to match the probe set up. Expose the probe to the source and click on *Start* to begin the count. The actual count time will be determined by the WinASP2 program.**

8. **Upon completion, verify that the determined cal constant (ie. 2_ efficiency or counts/count parameter) is greater than 0.60. DO NOT save this calibration constant to the instrument at this time; the calibration constants (counts/count) in both windows should remain set at 1. Simply note the efficiency (CC H 100 = % eff.) for later use.**

9. **Manually determine efficiencies for two ^{230}Th sources. Sources should be 1 inch diameter plated ^{230}Th, one of less than 2,000 cpm and the other of at least 7,000 cpm. Record the nominal and observed count rates for both sources in cpm, then compute efficiencies (100 x observed/nominal = % eff.) for each source.Verify that the two calculated efficiencies are withhin 10% of each other. Save these values for inclusion in the calibration report as liearity data.**

10. **If calibration in cpm is required, leave the calibration constants (counts/count) in both windows set at 1.**

    If units of dps, dpm or Bq are desired, change the activity units and cal constant at this time. To edit the units and cal constant select *Edit, Instrument Parameters*, then *Channel*. Select the desired units, divide the previously determined cal constant by two, then replace the upper window cal constant with the resulting number.

    If source count rate calibration (2_ emissions) is specified, edit the active (upper) window cal constant to the value obtained in step 8.

11. **Select *Calibration*, then *Calibration Report,* while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotopes used for calibration on the printed calibration report.**

    Print the plateau for this probe by selecting *Calibration*, *Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the plateau is displayed in the Graph Window, select *File* then *Print Graph*.

Note: **This energy-proportional probe is suitable for use with the Pulse Height Analysis (PHA) capabilities of the ASP-2. If the instrument with which it will be used is an ASP-2e (Enhanced), both a main gamma channel and a PHA channel may be defined and will be available to the user. A base model ASP-2 (Non-Enhanced) instrument may be calibrated for one channnel of either type. To create a PHA channel on an ASP-2, edit the PHA channel parameters given below into the MAIN channel of the instrument and follow the PHA calibration instructions.**

Important: **If either channel of an ASP-2e is not calibrated, change the unused channel identifier to type 'NONE'. This will disable the channel and prevent accidental use.**

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

   a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

   b. **Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk,* then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.**

   Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

Main Channel Calibration in CPS, CPM - Gross Counting

Click on *Edit, Instrument Parameters, Channel* to open the probe channel parameters window. If necessary, click on the *Main* channel radio button to display parameters for the main channel.

IMPORTANT: **Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.**

Probe Parameters	
Dead Time (_sec.)	20
Max. High Voltage	1600
Overrange (cps)	48000

Channel Parameters				
Channel Type	Gamma		PHA (ASP-2e only)	
Units	R/h		cpm	
Selected Window	Upper		Lower	
High Voltage	410		400	
Window Param's	Lower	Upper	Lower	Upper
Threshold (mV)	2.00	2.00	4.00	5.00
counts/count	1.00	1.00	1.00	1.00
Integrate Alarm	0.0	0.0	0.0	0.0
Rate Alarm	0.0	0.0	0.0	0.0
Click Divider	1	1	1	1

3. **Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.**

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	400
Ending Voltage	840
Voltage Step	20
Max. Count Rate (cps)	20,000*
Graph Name	SPA-3
File Name	SPA3.GRF

*** Depends on source activity.**

4. **Place a CS-7B, ^{137}Cs (.1_Ci) check source against the end of the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count.**

When the ending voltage is reached a prompt will appear asking if the ending voltage should

be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1600 Volts.

5. **When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the upper window plateau. At this point the lower window counts should be at their lowest also. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.**

6. **Next select *Calibration*, then *Determine Calibration Constant*. Verify that Upper Window and Background buttons are selected with the count time set to 120 seconds. Calibration should be performed in an area with less than 30 _R/h background. Place the probe in a low background area, then click on the *Start* button to begin background count.**

7. **After the background has been determined, click on *Cal. Const.* Enter the calibration field, 0.0004 R/h. Place the probe in a 0.4 mR/h (0.0004 R/h) ^{137}Cs field, face on. Probe must be in free air, suspended on non-metallic objects at least 3 feet off the floor with no other objects within 6 feet. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and field strength. When the count is complete, click on *Save* to store the new calibration constant if within 5.0E+10 to 9.0E+10.**

8. **Click on *Dead Time* and enter the dead time field, 0.002 R/h. Place the probe in a 2 mR/h (0.002 R/h) ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of 16 to 26 _sec., click on *Save* when prompted, to store new value in the instrument.**

9. **Calibration is now complete. Verify that the correct units of measure are set in the instrument. If calibration is to R/h, jump to step 10. Otherwise, edit the units of measure to cpm or cps, and cal constant (counts/count parameter) to 1.00 in both the upper and lower windows of channel 1. To edit the units and cal constant, select *Edit*, *Instrument Parameters*, then *Channel*. Jump to step 11 to print calibration report.**

10. **Manually determine response in ^{137}Cs linearity fields of 0.0005 R/h (0.5 mR/h) and 0.001 R/h (1 mR/h). For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors below 10%).**

11. **Print cal report by selecting *Calibration*, and *Calibration Report*, while still connected to the ASP-2 just calibrated. If linearity data was taken, include linearity fields in the report and add the results obtained in step 11 to the report after printing. Print the plateau for this probe by selecting *Calibration*, *Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the Graph Window is displayed, select *File* then *Print Graph*.**

Section 2 - PHA Calibration (ASP-2e only)

12. **Load the SPA-3 PHA probe parameters, by selecting *Edit, Load Setup From Disk*, then *Probe Parameters*. From the list presented, select the *spa3pha.** file for the probe under calibration. Click on the *OK* button to transfer the parameters from the disk file to the instrument. Verify that the the default probe parameters in the ASP-2 are set per the table below by selecting *Edit, Instrument Parameters*, then *Probe* and *Channel* parameters.**

Probe Parameters	
Dead Time (_sec.)	20
Max. High Voltage	1600
Overrange (cps)	48,000

Channel Parameters	
Channel Type	PHA
Units	cpm
Selected Window	Lower
High Voltage	400

Window Param's	Lower	Upper
Threshold (mV)	4.00	5.00
counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

13. **Select *Edit*, then *Instrument Parameters*. If necessary, enter the ASP-2 serial number and calibration dates in the window that appears. Likewise, enter the probe serial number and model in the *Probe* information page.**

14. **Select *Calibrate*, then *Run Plateau*. Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note the graph file name must have a .GRF extension.**

Plateau Parameters	
ıe (sec.)	
oltage	
ltage	
ep	
ıt Rate (cps)	
me	IA
	F

*** Plateau starting and ending voltages will vary with isotope. Approximate plateau voltages are 440V to 500V for ^{137}Cs; 670V to 710V for ^{241}Am and 400V to 450V for ^{60}Co.**

**** Depends on source activity.**

15. **Place a CS-7B, ^{137}Cs (. 1_Ci) check source or other isotope of interest, against the end of the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1600.**

16. **When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is on the peak of the lower window. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the the HV set point is the correct desired value.**

17. **Calibration is now complete. Verify that the correct units of measure (cps or cpm) are set in the instrument. To print a cal report, select *Calibration,* and *Calibration Report,* while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Print the plateau for this probe by selecting *Calibration, Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the Graph Window is displayed, select *File* then *Print Graph*.**

SPA-6
Calibration in CPS, CPM

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

    a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

    b. **Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.**

Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	15
Max. High Voltage	1600
Overrange (cps)	50,000

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Gamma	
Units	cpm	
Selected Window	Upper	
High Voltage	750	
Window Param's	Lower	Upper
Threshold (mV)	3.00	10.00
counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

3. **Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.**

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	750
Ending Voltage	1500
Voltage Step	50
Max. Count Rate (cps)	6.70E+04
Graph Name	SPA-6
File Name	SPA6.GRF

4. Place a CS-7B, ^{137}Cs (**. 1_Ci) check source against the end of the probe, preferably in a lead**
shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed

1600 Volts.

5. **When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the upper window plateau. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau.**

6. **Next select *Calibration* then *Determine Calibration Constant*. Verify that <u>Upper Window</u> and Background buttons are selected with the count time set to 60 seconds. Calibration should be performed in an area with less than 30 _R/h background. Place the probe in a low background area, then click on the *Start* button to begin the background count. Note the reading upon completion of the background count. Switch to *Background* mode on the ASP-2.**

7. **Place the probe in a 0.5 mR/h (0.0005 R/h) ^{137}Cs field, face on. Probe must be in free air, at least 3 feet off the ground with no large objects within 6 feet. Acquire a count in the *Background* mode by watching the countdown in the lower right corner. Note the CPM value when it is below 2%. Subtract the previously determined background from this value. Multiply the net cpm value by 8 and use this number as the dead time field.**

8. **Click on *Dead Time* and enter the dead time field, determined in step 8. Place the probe, in a 4 mR/h (0.004 R/h) ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of <u>16 to 26</u> _sec., click on *Save* when prompted, to store the new value.**

9. **Calibration is now complete. Verify that the correct units of measure (cps or cpm) are set in the instrument. To print a cal report, select *Calibration,* and *Calibration Report,* while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Print the plateau for this probe by selecting *Calibration, Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the Graph Window is displayed, select *File* then *Print Graph*.**

SPA-8
Calibration in CPM, CPS, R/h

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

    a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

    b. **Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.**

Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	36
Max. High Voltage	1500
Overrange (cps)	45000

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Gamma	
Units	cpm	
Selected Window	Upper	
High Voltage	525	
Window Param's	**Lower**	**Upper**
Threshold (mV)	2.00	2.00
counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

3. **Select *Calibrate*, then *Run Plateau*. Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.**

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	500
Ending Voltage	1100
Voltage Step	50
Max. Count Rate (cps)	15,000*
Graph Name	SPA-8
File Name	SPA8.GRF

*** Depends on source activity**

4. **Expose the probe to a CS-7B, ^{137}Cs (. 1_Ci) check source, preferably in a lead shield. Position the source disc with the active side facing the end of the probe. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A**

graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau, not to exceed 1500 Volts.

5. **When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the upper window plateau. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in the plateau dialog box. A prompt will appear to verify that the HV set point is the desired value established during the plateau. If calibration is to _R/h then jump to step 11.**

6. **Select *Calibration* then *Determine Calibration Constant*. Verify that Upper Window and Background buttons are selected with the count time set to 300 seconds. Calibration should be performed in an area with less than 30 _R/h background. Place the probe in a low background area, then click on the *Start* button to begin the background count.**

7. **Place the probe in a 0.5 mR/h (0.0005 R/h) ^{137}Cs field, face on. Probe must be in free air, at least 3 feet off the ground with no large objects within 6 feet. Subtract the previously determined background from this value. Multiply the net cpm value by 15 and use this number as the dead time field.**

8. **Click on *Dead Time* and enter the dead time field, determined in step 8. Place the probe, in a 7.5 mR/h ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of the range of 20 to 65 _sec., click on *Save* when prompted, to store the new Dead Time parameter.**

9. **Calibration is now complete. To print a cal report, select *Calibration,* and *Calibration Report,* while still connected to the ASP-2 just calibrated. Since no linearity points were taken, do not elect to include linearity data in the report. Print the plateau for this probe by selecting *Calibration, Display Plateau* then select the appropriate file from the list in the dialog box. Verify that the printer is connected to the computer and ready to print. When the plateau is displayed in the Graph Window, select *File* then *Print Graph*.**

R/h Calibration

10. **Edit the units to R/h by selecting *Edit, Instrument Parameters,* then *Channel*. Change units from cpm to R/h. Place the probe in a low background area. Calibration should be performed in an area with less than 30 _R/h background. Select *Calibration,* then *Determine Calibration Constant*. Verify that Upper Window and Background are selected with the count time set to 120 seconds. Click on the *Start* button to begin background count.**

11. **After the background has been determined, click on *Cal. Const.* Enter the calibration field, 0.0005 R/h. Place the probe in a 0.5 mR/h (0.0005 R/h) ^{137}Cs field, face on. Probe must be in free air, at least 3 feet off the ground with no large objects within 6 feet. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and field strength. When the count is complete, click on**

***Save* to store the new calibration constant if within 1.00E+10 to 2.00E+10.**

12. **Next, click on *Dead Time*. Enter the dead time field, 0.0075 R/h. Place the probe in a 7.5 mR/h (0.0075R/h) ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of <u>20 to 65</u> _sec., click on *Save* when prompted, to store new value in the instrument.**

13. **Manually perform linearity checks in three ^{137}Cs fields: 0.0005 R/h (0.5 mR/h), 0.002 R/h (2 mR/h), and 0.01 R/h (10 mR/h). For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).**

When the linearity tests are complete, select *Calibration,* then *Calibration Report,* while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data to the printed form. Record the isotope used for calibration on the cal report.

SPA-9, RD-19

Calibration in CPS, CPM

1. **With the ASP-2 OFF, connect the computer and detector cables to the instrument. Launch the WinASP2 program, then turn the ASP-2 mode selector to the CHECK position.**

2. **Click *Edit, Instrument Parameters* to display the information currently in memory. If the ASP-2 is currently set up for the probe being calibrated, its memory will already contain appropriate parameters. Otherwise, parameters for this probe type must be loaded into the instrument. This may be accomplished in either of two ways:**

   a. **Edit all parameters on the 'Probe' and 'Channel' display pages to match those given in the tables below, then click *OK* to download to the ASP-2. If desired, changes may also be made to options on the 'Instrument' page.**

   b. **Close the parameters window by clicking *Cancel*. Click on *Edit, Load Setup From Disk*, then select a parameter file for the type of probe being calibrated and click *Load*. Note that this file may contain either default parameters for this probe model or the results of a previous calibration for this specific probe.**

   Click on *Edit, Instrument Parameters* to view and verify the probe serial number. Also insert the current date as the 'Last Cal. Date' for the probe. After verifying that all entries are correct, click on *OK* to download them to the ASP-2.

   IMPORTANT: Performing the following calibration procedure with incorrect voltage settings in the instrument's memory may damage or destroy the detector. Whatever the source of the values in use, verify that the probe voltage and maximum high voltage settings match those stated below.

Probe Parameters	
Dead Time (_sec.)	31
Max. High Voltage	1600
Overrange (cps)	50000

These probes are not suitable for operation with the PHA channel of an ASP-2e. Set the channel type identifier of the PHA channel to 'NONE' and set up the main channel as follows:

Main Channel Parameters		
Channel Type	Gamma	
Units	R/h	
Selected Window	Upper	
High Voltage	575	
Window Param's	Lower	Upper
Threshold (mV)	3.00	10.00
counts/count	1.00	1.00
Integrate Alarm	0.0	0.0
Rate Alarm	0.0	0.0
Click Divider	1	1

3. **Select *Calibrate*, then *Run Plateau.* Edit the plateau voltage parameters as shown below. Specify a graph name (up to 30 characters) and a graph file name. Note that the graph file name must have a .GRF extension.**

Plateau Parameters	
Count Time (sec.)	10
Starting Voltage	550
Ending Voltage	1300
Voltage Step	50
Max. Count Rate (cps)	67000
Graph Name	SPA-9
File Name	SPA9.GRF

4. **Place a CS-7B, ^{137}Cs (. 1_Ci) check source against the end of the probe, preferably in a lead shield. Click on the *Start* button. There will be a delay before the first count begins as the high voltage settles. A graph of the source plateau will appear beginning after the first count. When the ending voltage is reached a prompt will appear asking if the ending voltage should be extended. If the noise region of the plateau has not been reached, extend the ending voltage as necessary to complete the plateau.**

5. **When the plateau is complete, select the high voltage set point by clicking on the < and > symbols on the voltage plateau graph until the vertical bar is at the center of the upper window plateau. Save the desired voltage setting to the instrument by clicking on the *Set HV* button in**

the plateau dialog box. A prompt will appear to verify that the HV set point is the desired

value established during the plateau.

6. **Next select *Calibration*, then *Determine Calibration Constant*. Verify that <u>Upper Window</u> and Background buttons are selected with the count time set to 120 seconds. Calibration should be performed in an area with less than 30 _R/h background. Place the probe in a low background area, then click on the *Start* button to begin the background count. Upon completion of the background count, click on the *Cal. Const*. button.**

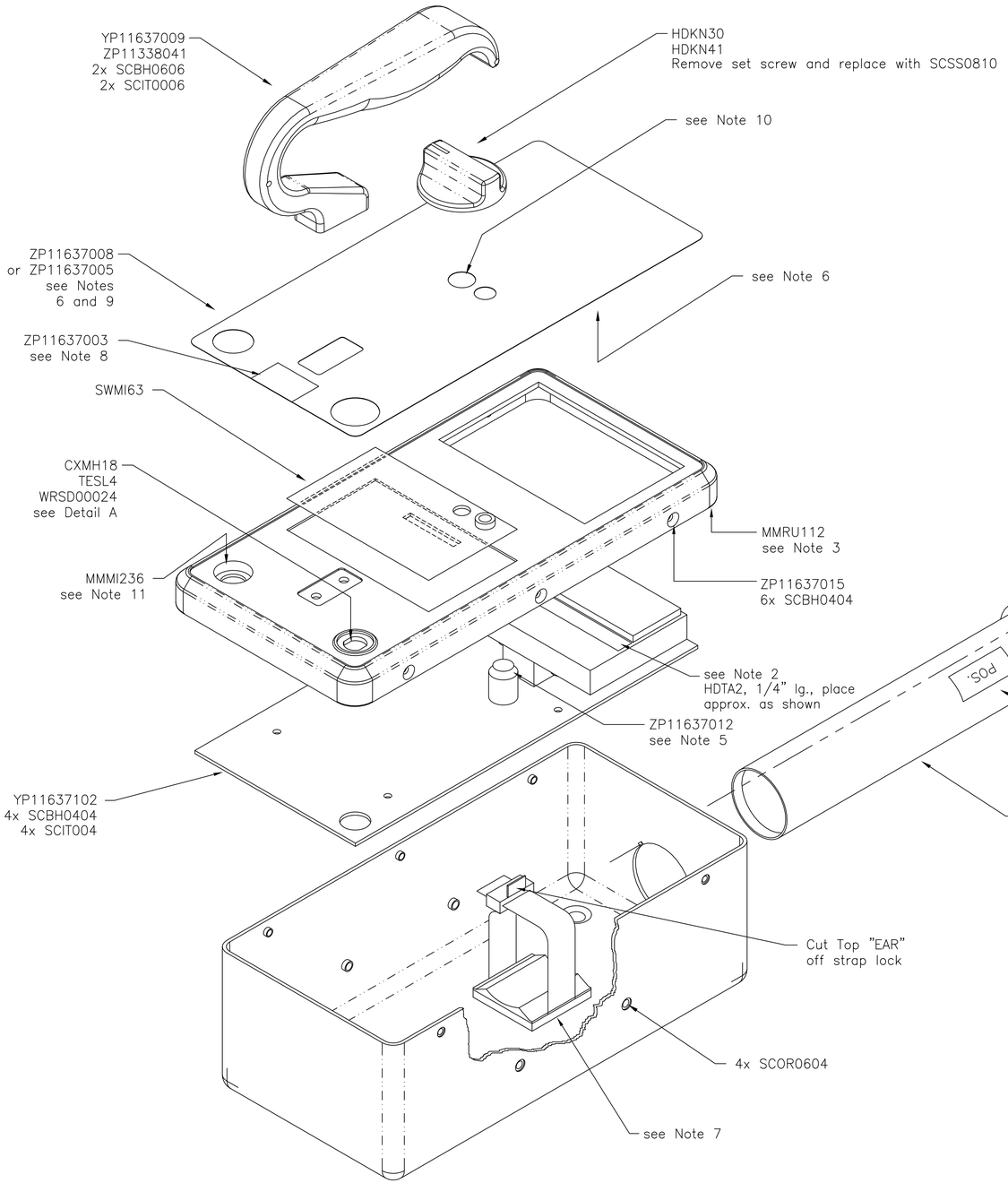
7. **After the background has been determined, click on *Cal. Const.* Enter the calibration field, 0.0005 R/h. Place the probe in a 0.5 mR/h (0.0005 R/h) ^{137}Cs field, face on. Probe must be in free air, suspended on non-metallic objects at least 3 feet off the floor with no other objects within 6 feet. Click on the *Start* button to begin determining cal constant. Actual count time will be determined by the program and field strength. When the count is complete, click on *Save* to store the new calibration constant if within 2.0E+10 to 4.0E+10.**

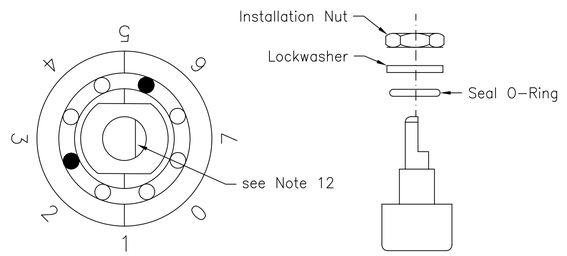
8. **Click on *Dead Time* and enter the dead time field, 0.005 R/h. Place the probe in a 5 mR/h (0.005 R/h) ^{137}Cs field. Click on the *Start* button. The program may take several count cycles to determine an accurate dead time. If the dead time value obtained falls within the range of <u>25 to 38</u> _sec., click on *Save* when prompted, to store new value in the instrument.**

9. **Calibration is now complete. Verify that the correct units of measure are set in the instrument. If calibration is to R/h, jump to step 11. Otherwise, edit the units of measure to cpm or cps, and cal constant (counts/count parameter) to 1.00 in both the upper and lower windows of channel 1. To edit the units and cal constant, select *Edit, Instrument Parameters*, then *Channel*. Jump to step 11 to print a calibration report.**

10. **Manually perform linearity checks in three ^{137}Cs fields: 0.0005 R/h (0.5 mR/h), 0.0025 R/h (2.5 mR/h), and 0.005 R/h (5 mR/h). For each field, record the observed reading in R/h and calculate the response as a percentage (100 x observed/nominal). Subtract 100% from these values to find the measurement error in percent. Responses in all fields must be within 90-110% of nominal (all errors less than 10%).**

11. **Select *Calibration*, then *Calibration Report*, while still connected to the ASP-2 just calibrated. Print the report, then manually add the linearity data (if taken) to the printed form. Record the isotope used for calibration on the cal report. Print the plateau for this probe by selecting *Calibration*, *Display Plateau* then select the appropriate file from the list in the dialog box. When the Graph Window is displayed, select *File* then *Print Graph*.**

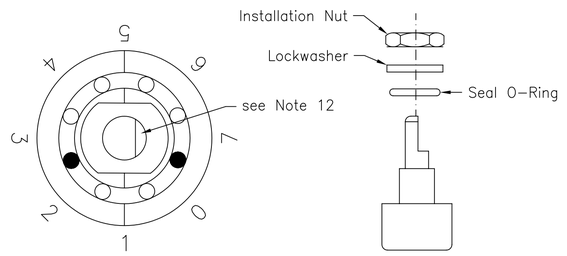




Pin Installation Details: ASP2

Scale: 5x
see Notes 12 and 13

Scale: 2x
see Note 13



Pin Installation Details: ASP2E

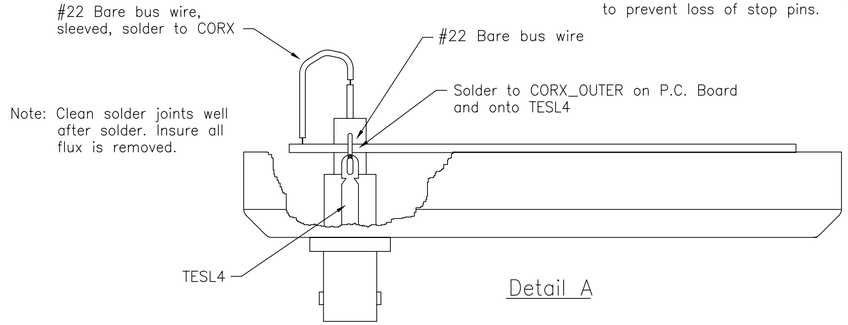
Scale: 5x
see Notes 12 and 13

Scale: 2x
see Note 13

NO.	QUAN	PER	DESCRIPTION

NOTES:

1. Refer to B.O.M. ASP2-Kit.
2. When assembling the main PCB for the ASP2E the Digital Display Board should be cleaned with anti-static cleaner after the the protective plastic covering is removed. Once unit is assembled, double check to ensure display is lint free.
3. Press tubular gasket MMRU112 into groove around cover's interior underside. Then apply a drop of adhesive glue to the 4 corners.
4. Mark positive end of battery holder as "POS," "+," or with Red tape band.
5. Apply Gasket ZP11637012, centered on speaker on PCBA.
6. Remove protective film from inside of overlay windows. Insure that there is no adhesive below overlay window.
7. Secure free end of battery holder tube BTBH62 to bottom of Can 11637003 with Cable Clamp MMMI223 centered in can using double sided adhesive foam tape HDTA22. Install the tube before sticking the clamp to the can.
8. Center Serial Number Label ZP11637003 below installed cover rim.
9. Verify that mode slector switch can be rotated through all valid positions identified on overlay, but to NO other unmarked positions.
10. Hold rotary switch bushings with pliers to prevent twisting while tightening hex nut.
11. Secure circular connector into cover with retaining ring, supplied with connector, and install MMMI236 on connector.
12. Align switch shaft such that the flat surface is facing the 7 as shown, before installing stop pins.
13. The switch stop pins are very small, easy to lose, and are not available as replacement parts. Always handle these parts over a container to catch accidentally dropped pins. Install switch seal O-ring, lockwasher, and installation nut as soon as pins are in place to prevent loss of stop pins.



Note: Clean solder joints well after solder. Insure all flux is removed.

Detail A

CHG.	Q.A.	APP.	DATE	DESCRIPTION	DATE	BY	CH'K
G		MRT	11.03.04	Added note to cut Top "Ear" off strap lock ECN 13034	04.30.04	RQ	MRT
F				Revised in accordance with DRR 12965	11.25.03	RQ	

DIMENSIONS IN INCHES

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED

Fractional	Decimal	Angular
±1/64	X.XX ±.015 X.XXX ±.005	±1/2°

MACHINED HOLE TOLERANCES

Diameter	Tolerance
0.0000–0.0625	+.0020/–.0010
0.0626–0.125	+.0045/–.0010
0.126 –0.250	+.0065/–.0010
0.251 –0.750	+.0080/–.0010
0.751 –1.000	+.0090/–.0010

Thermo
ELECTRON CORPORATION
505.471.3232 VOICE
505.428.3517 FAX

AutoCAD GENERATED DRAWING

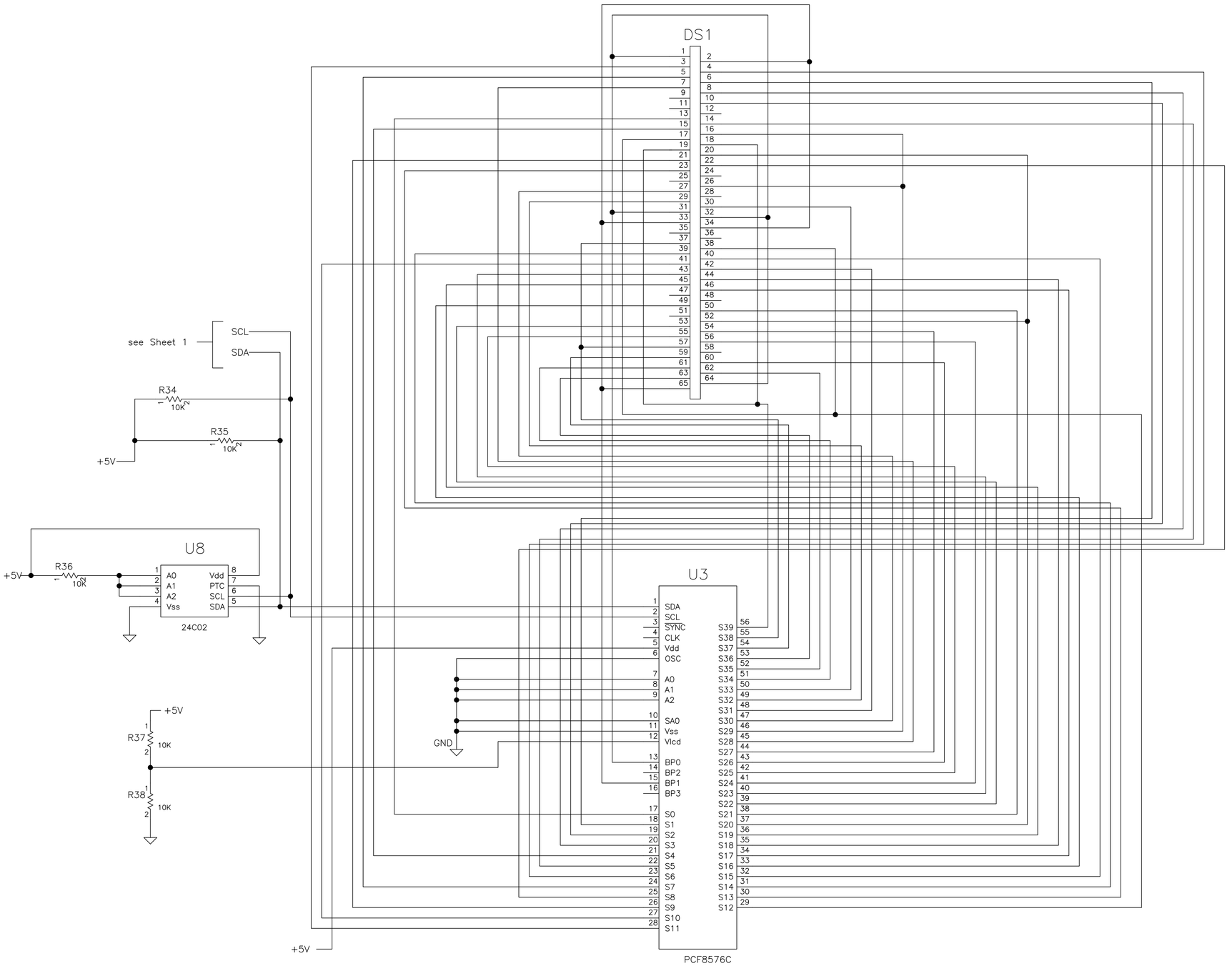
DR.	Guy Racuya	01.28.98
CH'K	W. Hart	02.25.98
ENG.	W. Brown	02.25.98
APP.	J.G. Stanke	02.25.98
Q.A.	L. Schilling	02.25.98

Overall Assembly
ASP-2/2e

SCALE 7/16

11637 001 G

NO.	QUAN.	PER	DESCRIPTION



APPROVED FOR PRODUCTION

JOB NO. _____

DATE _____

TOTAL QTY. _____

△ Signed original is on file in Document Control.

CHG.	Q.A.	APP.	DATE	DESCRIPTION	DATE	BY	CH'K
D	LS	WJH	10-15-97	REDRAWN: Populated R37.	10.15.97	GR	III
C	△	△	△	REDRAWN: Changes on Sheets 1 and 3.	5.15.97	GR	△
B	△	△	△	REDRAWN: R37 was unpopulated; U8 used to be a PCF8582 device.	3.6.97	GR	△
A	△	△	△	REDRAWN: R37 was 100K, R38 was 1K, U3 pin 29 was wired only to DS1 pin 38. U3 pin 37 was wired only to DS1 pin 52. U3 pin 48 was wired only to DS1 pin 26, and U3 pin 56 was wired only to DS1 pin 19. DRR 7240	10.1.96	GR	△

Eberline Santa Fe, New Mexico

AutoCAD GENERATED DRAWING

DR.	Guy Racuya	8.27.97
CH'K	Wm. Brown	27Aug96
PROJ. ENG.	Wm. Brown	27Aug96
APP.	J.K. Hesch	8-30-96
Q.A.	L. Schilling	8-30-96

SCHEMATIC: MAIN BOARD ASP-2

MACHINED HOLE TOLERANCES	
Diameter	Tolerance
0.0000-0.0625	+.0020/-.0010
0.0626-0.125	+.0045/-.0010
0.126 -0.250	+.0065/-.0010
0.251 -0.750	+.0080/-.0010
0.751 -1.000	+.0090/-.0010

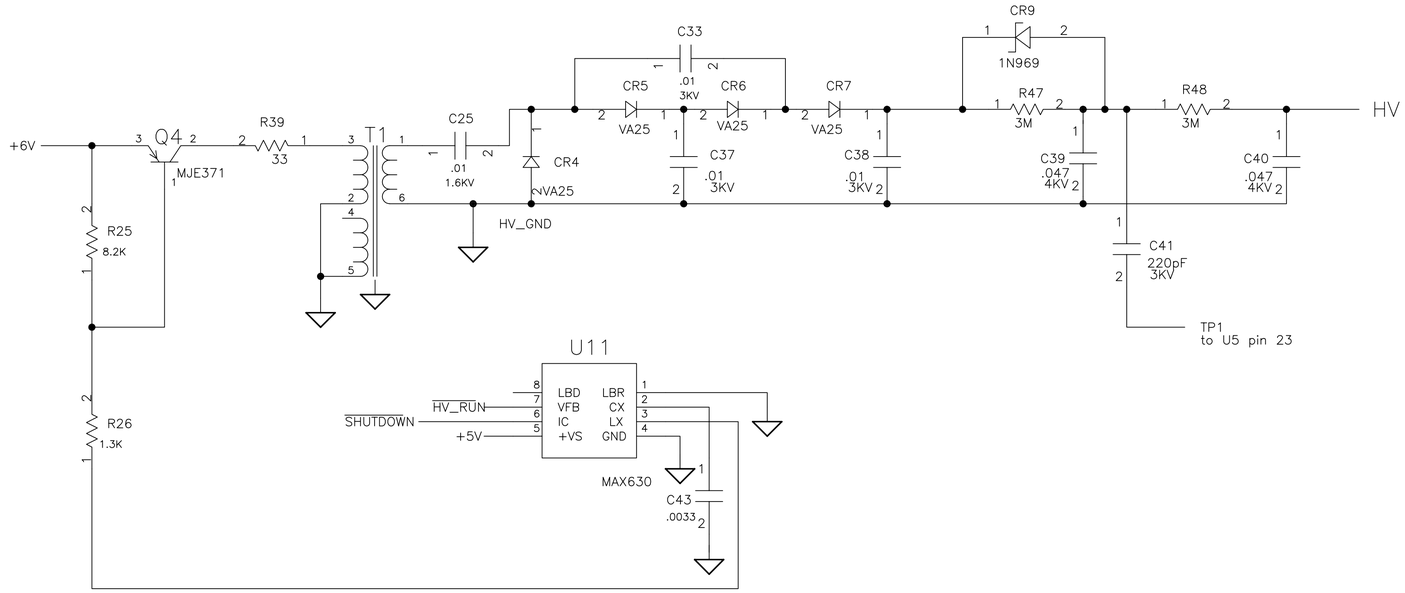
DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED

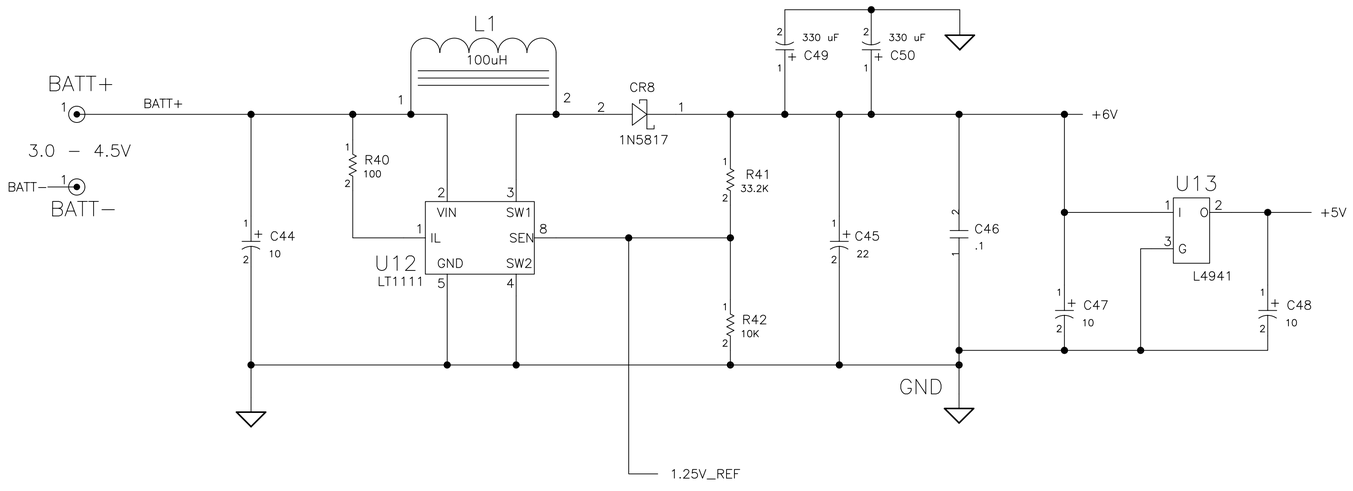
FRAC.	DEC.	ANG.
±1/64	XXX ± .015 XXXX ± .005	±1/2°

SCALE n/a

11637 – D100 D Sheet 2 of 3

NO.	QUAN.	PER	DESCRIPTION





APPROVED FOR PRODUCTION

JOB NO. _____

DATE _____

TOTAL QTY. _____

△ Signed original is on file in Document Control.

CHG.	Q.A.	APP.	DATE	DESCRIPTION	DATE	BY	CH'K
D	LS	WJH	10-15-97	REDRAWN: Changes on Sheets 1 and 2.	10.15.97	GR	III
C	△	△	△	REDRAWN: Added CR9, C49, AND C50.	5.15.97	GR	△
B	△	△	△	REDRAWN: Added this sheet.	3.6.97	GR	△

Eberline — Santa Fe, New Mexico — AutoCAD GENERATED DRAWING

DR.	Guy Racuya	8.27.97
CH'K	Wm. Brown	27Aug96
PROJ. ENG.	Wm. Brown	27Aug96
APP.	J.K. Hesch	8-30-96
Q.A.	L. Schilling	8-30-96

SCHEMATIC: MAIN BOARD
ASP-2

MACHINED HOLE TOLERANCES	
Diameter	Tolerance
0.0000–0.0625	+.0020/–.0010
0.0626–0.125	+.0045/–.0010
0.126 –0.250	+.0065/–.0010
0.251 –0.750	+.0080/–.0010
0.751 –1.000	+.0090/–.0010

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED

FRAC.	DEC.	ANG.
±1/64	X.XX ± .015 X.XXX ± .005	±1/2°

SCALE n/a

11637 – D100 D Sheet 3 of 3

NO.	QUAN.	PER	DESCRIPTION

+6V
U4
LP2950C
C27 10uF
C26 10uF
COAX_OUTER
COAX_INNER
R31 1M
C30 220pF
HV
HV_GND
CW 100K
R27
HV_DRIVE
U5
VEBD14A
POTA
GND
+V
TP1
ANALOG_GND
TP3
TP6
TP5
INPUT
SIGNAL_GND
+V
HV_GND
HV
POTB
ANALOG_GND
HVR
−HVL
−HVH
+V
THA
−B
THB
+V
A
−A
C
B
GND
+5V
TP1
HV_GND
HV_ENABLE
CR1
CR3
C29 10uF
U10 HC14
R29 1M 1%
C28 .1
R28 1M 1%
R30 2.00K 1%
M1
M1P
M2P
U9
LPC662
C51 .1
U10 HC14
SCL
SDA
see Sheet 2
SW1
BATT−
R33 10K
R32 10K
+5V
1.25V_REF
R1 10K
U9
LPC662
HV_RUN
HV_DRIVE
SHUTDOWN
U10 HC14
R19 100K
CR2
C18 10uF
GND
R21 10K
R20 10K
U10 HC14
DS2
DS3
R22 220
R49 220
+6V
SPKR1
Q1 2N7000
Q2 2N7000
DRAIN
GATE
SOURCE
U10 HC14
R11 10K
R12 10K
R13 10K
R14 10K
R15 10K
R16 10K
R17 10K
R18 10K
+5V
R24 10K
BATT+
R23 10K
U7
LTC1098
C/S
in0
in1
GND
Vcc
CLK
Dout
Din
C31 .1
C23 .1
C24 .1
C22 .1
+5V
U6
MAX242
VCC
EN
SHDN
T2_OUT
T2_IN
R2_IN
R2_OUT
T1_OUT
T1_IN
R1_IN
R1_OUT
C1+
C1−
C2+
C2−
V−
V+
GND
C19 .1
C20 .1
C21 .1
J2
GND 1
RxD 2
TxD 3
DTR 4
GND 5
DSR 6
+5V 7
R43 33
R44 33
R45 33
R46 33
U1
S80C51FA
P1.5/CEX2
P1.6/CEX3
P1.7/CEX4
RST
P3.0/RxD
NC
P3.1/TxD
P3.2/Int0
P3.3/Int1
P3.4/T0
P3.5/T1
P3.6/WR
P3.7/RD
XTAL1
XTAL2
Vss
NC
P2.0/A8
P2.1/A9
P2.2/A10
P2.3/A11
P2.4/A12
P0.4/AD4
P0.5/AD5
P0.6/AD6
P0.7/AD7
EA/Vpp
NC
ALE/PROG
PSEN
P2.7/A15
P2.6/A14
P2.5/A13
X1
4.9152_MHz
C1 33pF
C2 33pF
U2
ZPSD312
AD0/A0
AD1/A1
AD2/A2
AD3/A3
AD4/A4
AD5/A5
AD6/A6
AD7/A7
AD8/A8
AD9/A9
AD10/A10
AD11/A11
AD12/A12
AD13/A13
AD14/A14
AD15/A15
RD
WR/Vpp
BHE/PSEN
ALE
Vcc
RESET
PA0
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
PC0
PC1
PC2
A19/CSI
_GND
GND
R2 10K
R3 100K
R4 100K
R5 100K
R6 100K
R7 100K
R8 100K
R9 100K
R10 100K
C3 .1uF
C4 .1uF
C5 .1uF
C6 .1uF
C7 .1uF
C8 .1uF
C9 .1uF
C10 .1uF
J3
KEYPAD
GND
+5V
C32 22uF
C11 .1
C12 .1
C13 .1
C15 .1
C16 .1
C17 .1
GND

APPROVED FOR PRODUCTION

JOB NO. _____
DATE _____
TOTAL QTY. _____

△ Signed original is on file in Document Control.

D	LS	WJH	10-15-97	REDRAWN: Added C51 (near M1); DS2 and DS3 used to be light bulbs.	10.15.97	GR	III
C	△	△	△	REDRAWN: R30 value was 2.32K.	5.15.97	GR	△
B	△	△	△	REDRAWN: Deleted C14, rewired potentiometer R27.	3.6.97	GR	△
A	△	△	△	REDRAWN: R22 was 27 ohms, R31 was 1M. DRR 7240	10.1.96	GR	△
CHG.	Q.A.	APP.	DATE	DESCRIPTION	DATE	BY	CH'K

Eberline Santa Fe, New Mexico

AutoCAD GENERATED DRAWING

DR.	Guy Racuya	8.27.97
CH'K	Wm. Brown	27Aug96
PROJ. ENG.	Wm. Brown	27Aug96
APP.	J.K. Hesch	8-30-96
Q.A.	L. Schilling	8-30-96

SCHEMATIC: MAIN BOARD ASP−2

MACHINED HOLE TOLERANCES	
Diameter	Tolerance
0.0000−0.0625	+.0020/−.0010
0.0626−0.125	+.0045/−.0010
0.126 −0.250	+.0065/−.0010
0.251 −0.750	+.0080/−.0010
0.751 −1.000	+.0090/−.0010

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED

FRAC.	DEC.	ANG.
±1/64	XXX ± .015 XXXX ± .005	±1/2°

SCALE n/a

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