ACE*Mate*®
Model 925-SCINT
Amplifier and Bias Supply
Operating Manual

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Manual Revision H

0505

Advanced Measurement Technology, Inc.

a/k/a/ ORTEC®, a subsidiary of AMETEK®, Inc.

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ORTEC* warrants that the items will be delivered free from defects in material or workmanship. ORTEC makes no other warranties, express or implied, and specifically NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

ORTEC's exclusive liability is limited to repairing or replacing at ORTEC's option, items found by ORTEC to be defective in workmanship or materials within one year from the date of delivery. ORTEC's liability on any claim of any kind, including negligence, loss, or damages arising out of, connected with, or from the performance or breach thereof, or from the manufacture, sale, delivery, resale, repair, or use of any item or services covered by this agreement or purchase order, shall in no case exceed the price allocable to the item or service furnished or any part thereof that gives rise to the claim. In the event ORTEC fails to manufacture or deliver items called for in this agreement or purchase order, ORTEC's exclusive liability and buyer's exclusive remedy shall be release of the buyer from the obligation to pay the purchase price. In no event shall ORTEC be liable for special or consequential damages.

Quality Control

Before being approved for shipment, each ORTEC instrument must pass a stringent set of quality control tests designed to expose any flaws in materials or workmanship. Permanent records of these tests are maintained for use in warranty repair and as a source of statistical information for design improvements.

Repair Service

If it becomes necessary to return this instrument for repair, it is essential that Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, ORTEC must be informed, either in writing, by telephone [(865) 482-4411] or by facsimile transmission [(865) 483-2133], of the nature of the fault of the instrument being returned and of the model, serial, and revision ("Rev" on rear panel) numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. The ORTEC standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped PREPAID via Air Parcel Post or United Parcel Service to the designated ORTEC repair center. The address label and the package should include the Return Authorization Number assigned. Instruments being returned that are damaged in transit due to inadequate packing will be repaired at the sender's expense, and it will be the sender's responsibility to make claim with the shipper. Instruments not in warranty should follow the same procedure and ORTEC will provide a quotation.

Damage in Transit

Shipments should be examined immediately upon receipt for evidence of external or concealed damage. The carrier making delivery should be notified immediately of any such damage, since the carrier is normally liable for damage in shipment. Packing materials, waybills, and other such documentation should be preserved in order to establish claims. After such notification to the carrier, please notify ORTEC of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment, if necessary.

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SAFETY INSTRUCTIONS AND SYMBOLS

This manual contains up to three levels of safety instructions that must be observed in order to avoid personal injury and/or damage to equipment or other property. These are:

DANGER Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.

WARNING Indicates a hazard that could result in bodily harm if the safety instruction is not observed.

CAUTION Indicates a hazard that could result in property damage if the safety instruction is not observed.

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

In addition, the following symbol may appear on the product:

ATTENTION – Refer to Manual

DANGER – High Voltage

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

SAFETY WARNINGS AND CLEANING INSTRUCTIONS

DANGER	Opening the cover of this instrument is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.

WARNING	Using this instrument in a manner not specified by the manufacturer may impair the protection provided by the instrument.

Cleaning Instructions

To clean the instrument exterior:

- Unplug the instrument from the ac power supply.
- Remove loose dust on the outside of the instrument with a lint-free cloth.
- Remove remaining dirt with a lint-free cloth dampened in a general-purpose detergent and water solution. Do not use abrasive cleaners.

CAUTION	To prevent moisture inside of the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.

- Allow the instrument to dry completely before reconnecting it to the power source.


9.25
HV ON
HV POS
HV NEG
ORTEC®
ACE Mate™ AMPLIFIER and BIAS SUPPLY
KV
LL
UL
RATE
BIAS
0-2KV
HV
ON
OFF
SCA
UL
LL
FINE GAIN
COARSE GAIN
POWER
925 SCINT


LINEAR IN
FUSE
115VAC
230VAC
EXT LL REF IN
115V/1.5A
230V/0.75A
PREAMP POWER
AMP OUT
SCA OUT
IN
HV OUT
DO NOT CHANGE POLARITY WITH AC POWER APPLIED

ACE*Mate*®
Model 925-SCINT

1. DESCRIPTION

ORTEC'S ACEMate Amplifier and Bias Supply provides the link between scintillation detectors and the ADCAM® ACE™ Multichannel Analyzer (or most other MCAs). ACEMate, a standalone instrument designed for benchtop operation, incorporates a low noise preamplifier, a spectroscopy type shaping amplifier, a single channel analyzer, count rate monitor, HV power supply, and a digital display to monitor these functions. The ACEMate module interfaces directly to ORTEC photomultiplier tube bases such as the Models 266 and 276 which in turn can be coupled with the 905 series scintillation detectors.

The instrument's preamplifier is noninverting and is intended for use with photomultiplier tubes. The input is ac coupled and diode protected against sudden positive or negative high voltage spikes. A printed wiring board (PWB) switch is provided to bypass the preamplifier when using external preamplifiers which allows the signal to be connected directly to the internal shaping amplifier.

The spectroscopy shaping amplifier provides a 10 volt linear output and features low input noise and a wide gain range to allow a variety of applications. Semi-Gaussian, bipolar shaping is used to eliminate baseline shift with count rate changes. Bipolar pulse shaping also eliminates the need for pole-zero adjustments, simplifying the setup of the ACEMate.

A single channel analyzer (SCA) is incorporated into the ACEMate. The input to the SCA is obtained from the amplifier output. The SCA operates in Window mode and the Lower Level and the Upper Level can be set over a 200:1 dynamic range from 50 mV to 9.99 V. The lower level reference is selected by a PWB jumper for the front panel potentiometer or an external signal.

A three digit display on the front panel allows the user to monitor either the high voltage in kV, the lower level and the upper level SCA discriminator settings in volts, or the count rate in kcps. A front panel pushbutton selects the desired function to be displayed.

The high voltage supply provides the voltage necessary for the proper operation of photomultiplier tubes. The output is continuously adjustable from 50 volts to 2000 volts dc and internal PWB jumpers select the output polarity. Front panel LEDs indicate the presence of high voltage and its polarity. The maximum load current is 1 mA (to 2000 V). A front panel ON/OFF switch controls the high voltage.

A preamp power connector provides power to tube bases, such as the ORTEC Model 276, containing internal preamplifiers.

2. SPECIFICATIONS

2.1. PREAMPLIFIER

INPUT Ac coupled input stage. Diode protected against sudden positive or negative voltage spikes.

IN/OUT PWB slide switch provides preamplifier selection. The IN position allows the internal preamplifier to function. The OUT position allows an external preamplifier to be directly connected to the amplifier via the INPUT BNC connector.

2.2. AMPLIFIER

GAIN RANGE Continuously adjustable from 5 to 1250 using a six-position front panel Coarse Gain switch and a ten-turn direct reading Fine Gain potentiometer.

PULSE SHAPE Peaking time equals 2 µs and is semigaussian bipolar.

POS/NEG PWB slide switch selects either positive or negative input pulse polarity.

INPUT Accepts either the output of the internal preamplifier or a signal from the rear panel BNC connector. External input signals can be positive or negative with rise times <1 µs and decay times >40 µs; Z_{in} = 1000 Ω); ac coupled; linear maximum input 2 V; absolute maximum 20 V.

OUTPUT Rear panel BNC connector with Z_{out} <1 Ω is short-circuit proof and positive lobe leading with a full-scale linear range of 0 to 10 V. Active filter shaping is incorporated.

PREAMP POWER Rear panel standard ORTEC preamplifier power connector (Amphenol 17-10090) mates with captive and noncaptive power cords on all ORTEC preamplifiers. Output voltages are +24 V, –24 V, +12 V, and –12 V.

2.3. SINGLE CHANNEL ANALYZER

DYNAMIC RANGE 200:1.

UL Front-panel screwdriver adjustable potentiometer determines the upper level (0.05–9.99 V). The control setting is read on the front panel digital display.

LL Front-panel screwdriver adjustable potentiometer determines the lower level (0.05–9.99 V). The control setting is read on the front panel digital display.

LOWER LEVEL REFERENCE CONTROL A PWB jumper selects either the front panel LL potentiometer or the positive voltage signal applied to the rear panel EXT LL REF BNC connector.

SCA INPUT Internally connected to the amplifier output.

SCA OUTPUT Rear panel BNC connector provides TTL compatible signal; output amplitude >3 V, pulse width approximately 0.5 µs. Output occurs as the trailing edge of the amplifier output crosses the LL threshold.

2.4. RATEMETER

INPUT Ratemeter input is internally connected to the SCA output.

OUTPUT Ratemeter output can be read on the front panel 3-digit digital display. The range is from 0 to 99.9 kcps.

2.5. HIGH VOLTAGE SUPPLY

OUTPUT PWB jumper selects either positive or negative high voltage output and is available at rear panel SHV connector.

OUTPUT RANGE 50 V to 2000 V.

OUTPUT LOAD CAPACITY 1 mA (to 2000 V).

HV CONTROL A front panel HV ON/OFF switch provides control of the high voltage supply when the main ac power switch is On.

OUTPUT ADJUST A 3-turn precision potentiometer adjusts the output from 50 V to 2000 V.

REGULATION <0.02%.

OUTPUT RIPPLE <15 mV rms at 1 kV, 1 mA load.

STABILITY <0.01%/°C.

2.6. ELECTRICAL AND MECHANICAL

POWER REQUIRED AC input of 115 Vac or 230 Vac. Separate internal tap connection for 100 Vac or 200 Vac. AC power <50 VA at 2 kV, 1 mA load.

DIMENSIONS 9.2 × 30.5 × 27.9 cm (3.6 × 12 × 11 in).

WEIGHT 9 lbs.

SHIPPING WEIGHT 11 lbs.

3. INSTALLATION

3.1. GENERAL

The ACEMate is a standalone instrument which contains its own internal power supply. Coaxial cables are needed to connect the ACEMate to the detector assembly and to MCAs such as the ADCAM ACE or the ACE MCS (multichannel scaler).

3.2. CONNECTION TO POWER

On the ACEMate front panel, turn off both the Power switch and the HV ON/OFF switch. On the rear panel set the 115/230Vac switch appropriately. Check that the fuse is the proper rating depending on the 115/230 Vac switch setting. Plug the power cord into the ac mains. Turn on the ACEMate front panel Power switch. The ac Power light will illuminate as well as the HV polarity. LED and one of the display selection LEDs: kV, LL, UL or RATE.

3.3. INPUT CONNECTIONS

Figure 1 shows a typical application of the ACEMate. The detector is a photomultiplier tube (PMT) with a NaI(TI) crystal mounted to its face. The output signal of the PMT base is connected to the LINEAR IN BNC connector an the rear panel of the ACEMate. The HV connector on the PMT base is connected to the HV OUT SHV connector on the ACEMate rear panel. Depending on the particular PMT base being used, the PREAMP POWER may be needed to provide power to a preamplifier in the PMT base. Specific requirements for individual ORTEC PMT bases are discussed in the Applications section of this manual.

The ACEMate can be operated without any other output device by using the RATE display function on the front panel. In this mode, the output rate corresponds to the number of counts that fall within the window of the SCA. This method of operation is particularly useful when only a limited range of activity is of interest.

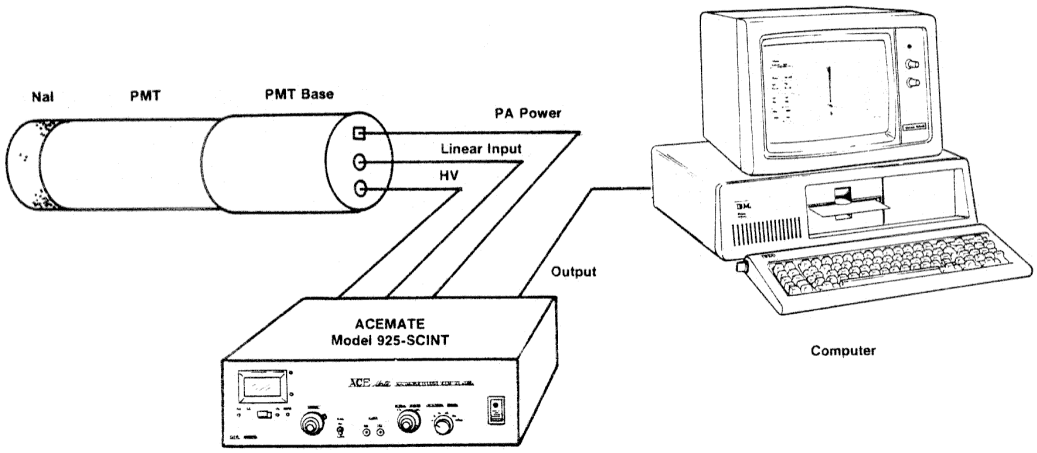

Fig. 1. Typical Application of ACEMate with NaI(TI) Detector, PMT, and ACE™ Card and a PC.

The ACEMate can also be operated with any standard MCA. The AMP OUT signal is a bipolar signal with positive lobe leading with a full-scale linear range of 0 to 10 volts. This signal is ideally suited as the linear input to an MCA. In particular, the ACEMate is intended for use with the ORTEC ADCAM ACE MCA. In this application the AMP OUT signal on the ACEMate rear panel is connected to the ADC input on the rear panel of the ACE MCA using a coaxial cable. Full MCA emulation is obtained using ORTEC MAESTRO™ software and a Personal Computer. Consult the ACE Multichannel Analyzer Operator's manual for full details.

The ACEMate can also be operated with the ORTEC ACE MCS card, which plugs into a slot in the PC. In this application, the SCA OUT signal on

the rear panel of the ACEMate is connected to the DATA IN connector on the rear panel of the ACE MCS using a coaxial cable. MCS controls are provided using emulation software and the PC. Consult the ACE MCS Multichannel Scaler Operator's Manual for full details.

4. OPERATION

4.1. GENERAL

The first task when operating the ACEMate is to connect the unit to the ac mains as described in Section 3.2 above. Next turn on the unit using the front panel POWER switch. The final task is to connect the various cables between the instrument and the detector, and between the instrument and the MCA or MCS unit. As received from the factory, the ACEMate is set for a positive input signal, positive high voltage, the preamplifier is set IN, and the LL reference is the front panel potentiometer. Refer to Section 4.3 for procedures to change these settings.

4.2. TYPICAL SYSTEM CONFIGURATIONS

The ACEMate can be used in a variety of applications and with various MCAs. Two specific systems described in this section will outline the general cabling requirements. Many other system configurations are possible.

4.2.1. Basic MCA System

Figure 1 shows a typical MCA system configuration. When the PMT base is the ORTEC Model 266, or equivalent, the PREAMP power cable is not needed since the 266 has no internal preamplifier. The ACEMate HV OUT is connected to the 266 POS HV connector, and the LINEAR IN to the 266's DYNODE connector. The ACEMate AMP OUT is connected to the ACE MCA's ADC connector. These three cables are all that are required for normal operation of this system. Please consult the individual operator's manual for specific instructions on the operation of the Model 266 and the ACE MCA units.

Once connected, expose the detector to a suitable radioactive source such as ^{60}Co or ^{137}Cs. View the AMP OUT signal either on the MCA or on an oscilloscope. With the BIAS potentiometer adjusted to 0 V, turn on the HV using the front panel HV ON/OFF switch. Next adjust the BIAS potentiometer on the ACEMate front panel to the desired value of high voltage. The BIAS control is a linear potentiometer and the bias value can be read directly from the potentiometer setting. Also, the DISPLAY pushbutton can select the kV display mode to allow direct reading of the bias value. A typical setting is 1 kV, but consult the PMT base manual for the exact value of BIAS.

Next, adjust the COARSE GAIN and FINE GAIN on the ACEMate front panel until the desired spectrum is obtained. The AMP OUT signal can be observed either on an oscilloscope or on the MCA. When using the MCA, start an acquisition to view the spectrum.

The use of the SCA is optional. The output of the amplifier is internally connected to the SCA input. The SCA output is available at the rear panel SCA OUT connector and is the input to the internal Ratemeter. The lower level of the SCA is adjusted using the LL potentiometer on the front panel of the ACEMate. The value of the LL setting is available on the front panel DISPLAY when selected by the DISPLAY pushbutton. Similarly, the upper level of the SCA is adjusted using the UL potentiometer on the ACEMate front panel, and the value of the UL setting is available on the front panel DISPLAY when it is selected by the DISPLAY pushbutton. Please note that the SCA operates in the window mode and that the value of the UL setting must be less than 10.00 volts. The lower level LL can also be set by an external reference voltage. Please refer to Section 4.3 for details.

The output of the SCA is internally connected to the Ratemeter input. The Ratemeter output is available on the front panel DISPLAY when RATE is selected by the DISPLAY pushbutton. By proper adjustment of the SCA LL and UL, the RATE output can display the count rate of the entire spectrum (LL = 0.00 V, UL = 9.99 V) or the count rate of a single peak.

4.2.2. Basic MCS System

Figure 1 shows a typical system configuration. When the PMT base is the ORTEC Model 276, or equivalent, the PREAMP power cable is needed since the 276 has an internal preamplifier. The preamplifier IN/OUT switch internal to the ACEMate must be set to OUT. Refer to Section 4.3.1 for this switch setting. The ACEMate HV OUT is connected to the 276 POS HV connector, and the LINEAR IN is connected to the 276 PREAMP connector. The ACEMate AMP OUT is connected to the MCS DATA IN connector. These four cables are all that are required for normal operation of this system. Consult the individual operator's manual for specific instructions on the operation of the 276 and ACE MCS units.

Once the system is properly cabled, the operation of the ACEMate is identical to that of its operation in the MCA system described in Section 4.2.1. However, the operation of the MCS card is different from the operation of the MCA card. In particular, the MCS card does not provide a PHA histogram useful for adjustment of the ACEMate COARSE GAIN and FINE GAIN. Use an oscilloscope to view the ACEMate AMP OUT signal when adjusting the gain. Also, the input signal to the MCS can be either the SCA OUT from the ACEMate connected to the DATA INPUT connector of the MCS CARD, or the AMP OUT from the ACEMate connected to the LINEAR INPUT connector of the MCS card. In the latter case, the SCA in the MCS card must be adjusted to select the signal range of interest.

DANGER

AC LINE VOLTAGE AND HIGH VOLTAGE ARE EXPOSED INSIDE THE ACEMate. DISCONNECT THE POWER CORD FROM THE ACEMate TO THE AC LINE PRIOR TO REMOVING THE TOP COVER TO MAKE ANY INTERNAL ADJUSTMENTS.

4.3. ACEMate INTERNAL ADJUSTMENTS

In many applications, the ACEMate is ready for immediate use upon arrival. However, several internal switches and jumpers are available to increase the flexibility. A component assembly drawing of the ACEMate is shown in Fig. 2 indicating the location of these various controls. To change any of these internal controls, first remove the top cover of the unit.

4.3.1. Preamplifier In/out Switch

The ACEMate is shipped with the preamplifier IN/OUT switch in the IN position. To change this setting, first disconnect the ac power line and remove the top cover. Locate the IN/OUT switch, S1, using Fig. 2. Switch S1 is in the IN position when the slide is moved toward the rear panel and is in the OUT position when the slide is moved toward the front panel.

4.3.2. Amplifier Polarity Switch

The ACEMate is shipped with the amplifier polarity switch set to positive. To change this setting, first disconnect the ac power line and remove the top cover. Locate the polarity switch, S3, using Fig. 2 Switch S3 is in the POSITIVE position when the slide is moved toward the rear panel and is in the NEGATIVE position when the slide is moved toward the front panel.

4.3.3. LL Reference Jumper

The ACEMate is shipped with the LL reference selected for the front panel potentiometer. An external positive voltage level can be applied to the rear panel EXT LL REF IN connector to allow remote setting of the LL reference level. To change this setting, first disconnect the ac power line and remove the top cover. Locate the LL reference jumper, Jl, using Fig. 2. Jumper Jl is in the front panel potentiometer position when connecting the two stake pins away from the front panel display, and jumper Jl is in the rear panel connector position when the connecting the two stake pins closest to the front panel display.

4.3.4. HV Polarity Jumpers

The ACEMate is shipped with the BIAS or HV set to positive polarity. The BIAS can also be set to negative polarity. To change BIAS polarity, first disconnect the ac power line and remove the top cover. Also, remove the high voltage shield connected to the PWB. Locate jumpers W1, W2, W3 and W4 using Fig. 2. For positive BIAS, jumpers W1 and W2, located near the rear panel, are plugged into the sockets closest to the HV OUT connector. For negative BIAS, jumpers W1 and W2 are plugged into the sockets away from the HV OUT connector. For positive BIAS, jumpers W3 and W4 are plugged into the sockets closest to the rear panel, and for negative BIAS, jumpers are plugged

into the sockets closest to the front panel. **CAUTION: ALL FOUR JUMPERS MUST BE IN EITHER THE POSITIVE POSITION OR IN THE NEGATIVE POSITION FOR PROPER AND SAFE OPERATION OF THE ACEMate.**

4.3.5. Operation Using 100 or 200 Vac

The ACEMate is normally operated from ac line voltage of either 115 or 230 Vac. Operation is also possible from either 100 or 200 Vac. To change the ac input voltage range, first disconnect the ac power line and remove the top cover. Locate plug PLG1 using Fig. 2. For 115/230 Vac operation, wires are connected to pins 3 and 6 in PLG1. To convert to 100/200 Vac operation, move the wire from pin 3 to pin 2, and move the wire from pin 6 to pin 7. **CAUTION: BOTH WIRES MUST BE IN THE PROPER POSITION FOR 115/230 VAC OR FOR 100/200 VAC FOR PROPER AND SAFE OPERATION OF THE ACEMate.**

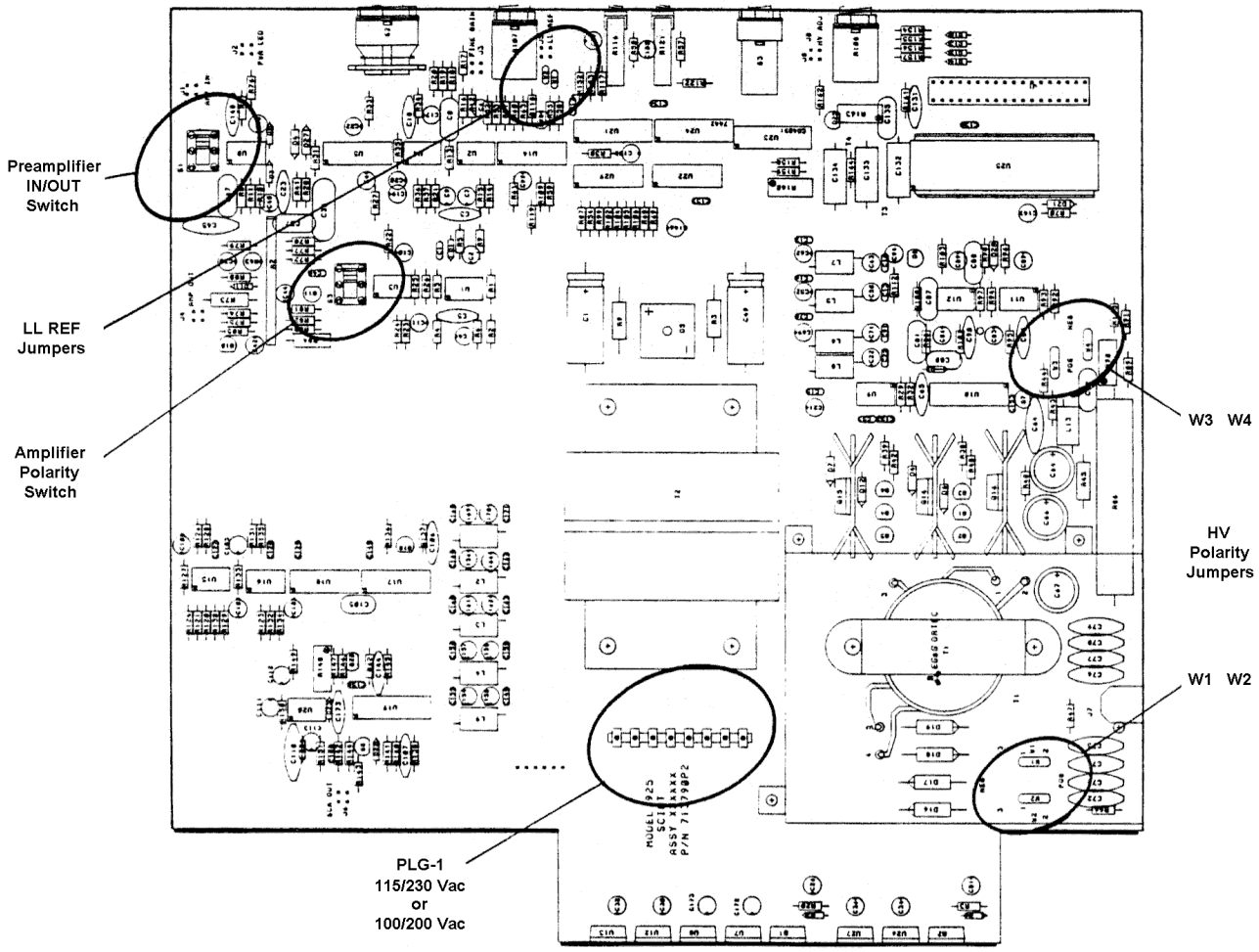

Fig. 2. Component Assembly Drawing of the 925-SCINT ACEMate Module Showing Internal Controls.

5. CIRCUIT DESCRIPTION

A block diagram of the ACEMate is shown in Fig. 3. The ACEMate contains all the functions needed to perform spectroscopy using a NaI(Tl) detector and a MCA. The LINEAR IN signal is connected either to a charge sensitive preamplifier or directly to the amplifier input. Internal switch S1 is factory set to the IN position.

The amplifier uses active filter stages to produce a bipolar positive lobe leading signal with a peaking time of 2 µs. The amplifier is factory set for POSITIVE input signals, but the polarity can be changed by internal switch S3. The amplifier output is available on the rear panel AMP OUT connector, and is also internally connected to the SCA input.

The SCA output is available at the rear panel SCA OUT connector, and is also internally connected to the RATEMETER input. The lower level of the SCA is factory set to the front panel LL potentiometer, but can be changed to the rear panel EXT LL REF IN connector by jumper J1. The output of the SCA is generated when the linear signal recrosses the lower level.

The RATEMETER is a charge-pump type with a linear range of 0–99.9 kcps. The output of the RATEMETER is available on the front panel DISPLAY.

A 50 V to 2 kV high voltage BIAS supply is available to provide dynode voltages for the PMT. The maximum current available is 1 mA. The BIAS setting can be read on the front panel 3-turn potentiometer or on the front panel DISPLAY.

The front panel DISPLAY is a 3-digit voltmeter to allow reading of the BIAS in kV, the LL and UL in Volts, and the RATEMETER in kcps. The various readings are selected using the front panel DISPLAY pushbutton.

The required power for the ACEMate is taken from the ac line. Input voltage can be either 115 Vac or 230 Vac and is switch selectable on the rear panel. The proper fuse must be used for the selected line voltage to insure safe operation. The ac is converted into 6 dc voltages: +24 V for the high voltage, +24 V for the linear circuits, +12 V for the linear circuits, +5 V for the logic circuits, –12 V for the linear circuits, and –24 V for the linear circuits.

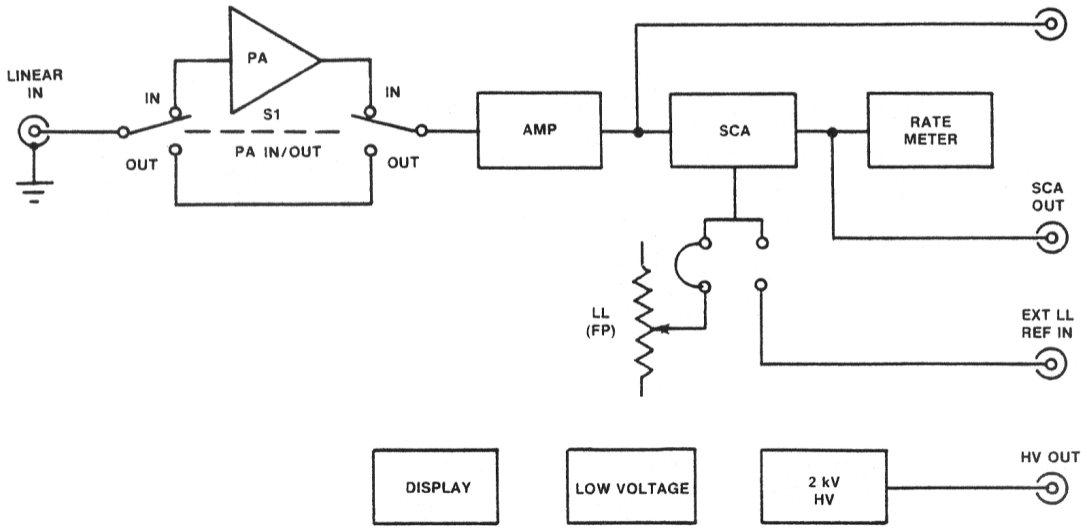

Fig. 3. Block Diagram of the 925-SCINT ACEMate.

6. FACTORY SERVICE

This instrument may be returned to the ORTEC factory for service and repair at a nominal cost. The ORTEC standard procedure for repair uses the same quality control and checkout that are used for a new instrument. Always contact the ORTEC Global Service Center, (865) 482-4411, before sending in an instrument for repair to obtain shipping instructions and so that the required Return Authorization Number can be assigned to the unit. This number should be written on the address label and on the package.