ORTEC®

AMETEK®

296

ScintiPack™ Photomultiplier Base with Preamplifier and HV Supply

- **For scintillation detectors employing 10-stage PMTs that fit standard 14-pin sockets**
- **Internal, adjustable, high-voltage bias supply eliminates high-voltage cables**
- **Integral spectroscopy preamplifier avoids dangling boxes**
- **Active bias network minimizes peak shifts at high countingrates**
- **Anode timing output for coincidence measurements**
- **Low power consumption (240 mW) for portable applications**
- **Convenient, single-cable connection for most applications**



The ScintiPack Photomultiplier Base (Model 296) includes everything needed for scintillation detectors in one compact package: a low-power, adjustable, high-voltage supply, an active bias network, and a spectroscopy preamplifier.

Incorporating the bias supply in the photomultiplier base eliminates high-voltage cable connections to bulky, external, HV supplies. As a result, the ScintiPack operates with extremely low power consumption (240 mW). This makes the ScintiPack attractive for portable applications, as well as for high-density detector arrays.

Because the preamplifier output signal is bundled into the power cable, only a single cable is required between the photomultiplier base and the main amplifier location. The optional Signal Break-Out Adaptor can be used with amplifiers that do not offer signal interfacing through the preamplifier power plug. The adaptor attaches to the preamplifier power plug at the amplifier, and supplies the preamplifier signal on a coaxial cable for connection to the front-panel input of the amplifier. This approach maintains a singlecable connection from the ScintiPack to the amplifier location.

The ScintiPack biases the cathode of the associated photomultiplier tube at ground potential, and the anode at a positive voltage. The voltage applied to the anode can be optimized within the range of +600 V to +1100 V via a 20-turn screwdriver adjustment. This provides a cost-effective means of adjusting and matching photomultiplier gains in large arrays of scintillation detectors. The dynode bias network applies 1/6 of the anode voltage between the cathode and first dynode, and 1/12 of the anode voltage between the remaining pairs of electrodes. To provide excellent gain stability at high counting rates, the voltages applied to dynodes 8, 9, and 10 are transistor regulated. Feedback regulation is also applied to the anode voltage to achieve optimum gain stability for the entire photomultiplier tube.

The signal from dynode 10 is integrated on a 500-pF capacitor at the preamplifier input, amplified by the preamplifier gain, and presented as a positive-polarity pulse at the PREAMP output. A jumper on the printed circuit board allows selection of a preamplifier gain of X1 or X6. The preamplifier output signal can be accessed on pin 3 of the power connector, or at the BNC connector on the rear panel of the ScintiPack.

The anode signal is available on a rear-panel BNC connector to facilitate high resolution timing in coincidence measurements. This output is intended to drive a 50-Ω coaxial cable to a timing amplifier or a timing discriminator. By moving a jumper on the printed circuit board, the anode output connector can be converted to a test input for the preamplifier. A pulser can be applied to the test input to check the operation of the entire chain of electronics, starting from the preamplifier input.

The PMT socket is a standard JEDEC B14-38 socket that fits 10-stage photomultiplier tubes with 14 pins. Figure 1 defines the pin assignments, and Figure 2 illustrates the connections. The Model 296 ScintiPack Photomultiplier Base is compatible with the photomultiplier tubes listed in Table 1.

Compatibility with tubes not listed in Table 1 can be checked by reference to Figures 1 and 2, and by comparison with the photomultipliers listed in the table.

Specifications

PERFORMANCE

PMT Bias

CATHODE-TO-ANODE VOLTAGE Adjustable from +600 V to +1100 V (grounded cathode, positive anode) with feedback regulation.

BIAS DISTRIBUTION 1/12 of the cathode-to-anode voltage is applied between: the cathode and focus electrode, the focus electrode and the first dynode, each pair of dynodes, and between the tenth dynode and the anode. Voltages on dynodes 8, 9, and 10 are transistor regulated for improved stability at high counting rates.

TEMPERATURE SENSITIVITY The cathode-to-anode voltage changes <100 ppm/°C over the operating temperature range of 0 to 50°C.

BIAS VOLTAGE DECAY TIME Nominally 3 minutes, when the HV switch is turned off.

Preamplifier

OUTPUT POLARITY Positive.

OUTPUT RISETIME <100 ns for a fast pulser at the TEST input, or for a fast scintillator.

OUTPUT DECAY TIME CONSTANT Nominally a 50-µs exponential time constant.

CONVERSION GAIN Typically 1 µV/eV or 6 µV/eV (jumper selectable) for a 3-in. x 3-in. NaI(Tl) crystal and a PMT gain of 10^6.

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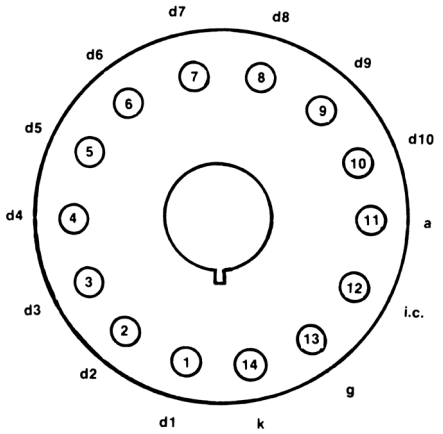


Fig. 1. JEDEC B14-38 PMT Pin Base, with Pin Assignments:

d1 – d10	dynodes 1 to 10
a	anode
i.c.	internal connection
g	grid
k	cathode

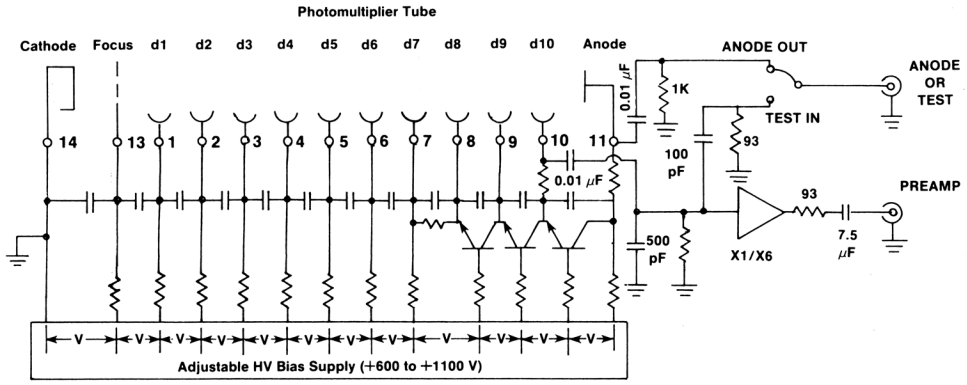


Fig. 2. Simplified Schematic Diagram of the ORTEC Model 296 Photomultiplier Base.

Table 1. Compatible Photomultiplier Tubes.

ADIT	Burle (formerly RCA)	Hamamatsu	Phillips	Electron
B51B01	4900	PM55	XP2202	9266K
L51B01	5819	R208	XP2203B	9272K
V51B01	6342A	R550	XP2412B	9250K
B51D01	6655A	R594		9256K
B51C01	S83006E	R877		9305K
B76B01	S83013F	R878		9265K
V76B01	S83019F	R1507		9269K
B76C01	S83020F	R1512		9273K
B89B01	S83021E	R1513		9274K
B89C01	S83022F	R1612		9306K
B89D01	S83025F	R1791		9390K
B133D01		R1836		9275K
B133C01		R1847-07		
V133B01		R1848-07 7696		

OUTPUT NOISE <300 μV rms. Measured using an ORTEC Model 671 Amplifier under the following conditions: HV on, no PMT installed, X6 preamplifier gain, and a 1-μs amplifier shaping time constant.

INTEGRAL NONLINEARITY <±0.1% from 0 to +6.5 V into a 1-kΩ load; measured via the TEST input. Maximum output is +7 V into an open circuit, or +3 V into a 93-Ω load. Overall linearity depends on the nonlinearity of the scintillator/photomultiplier combination.

TEMPERATURE SENSITIVITY Gain changes <±50 ppm/°C from 0 to 50°C, measured via the TEST input. Overall temperature sensitivity depends on the scintillator/photomultiplier combination and the bias supply.

SPECTRUM SHIFT Limited by the photomultiplier. Typically <±2% shift of the 662-keV peak position from a ^{137}Cs source for a change in counting rate from 0 to 100,000 counts/s in the entire spectrum. Measured using an ORTEC Model 671 Amplifier set to a 0.5-μs shaping time constant, and an ORTEC TRUMP-2k Multichannel Analyzer.

SPECTRUM BROADENING Limited by the scintillator/photomultiplier combination. Typically <10% broadening of the FWHM of the 662-keV peak from a ^{137}Cs source for a change in counting rate from 0 to 100,000 counts/s. Measured under the same conditions as SPECTRUM SHIFT.

CONTROLS AND INDICATORS

HV Rear-panel, 22-turn potentiometer provides adjustment of the HV bias voltage from +600 V to +1100 V. The adjacent test point permits monitoring of the actual bias voltage with a digital voltmeter. A digital voltmeter reading of 1.000 V corresponds to an actual bias voltage of 1000 V. The output impedance of the test point is <14 kΩ.

ON Rear-panel push-button switch turns on the preamplifier and HV bias power when depressed. Pushing a second time releases the button and turns the power off.

X1/X6 A two-position jumper, located on the preamplifier printed circuit board, selects the preamplifier gain to be X1 or X6. Shipped set to X1.

ANODE OUT/TEST IN A two-position jumper, located on the preamplifier printed circuit board, selects the function of the rear-panel, ANODE OR TEST connector. With the jumper in the ANODE OUT position, the anode signal is routed to the BNC connector for timing applications. Testing of the preamplifier function can be accomplished by moving the jumper to the TEST IN position and applying an external pulser to the rear-panel connector. Shipped in the ANODE OUT position.

INPUTS AND OUTPUTS

ANODE OR TEST Rear-panel, BNC connector functions as either the anode output for timing applications, or as a test input for inserting test pulses into the preamplifier input. (See ANODE OUT/TEST IN jumper description.)

Anode Output With the internal jumper set to ANODE OUT, the negative-polarity anode signal is ac-coupled to the rear-panel BNC output, with an output impedance of 1 kΩ. Intended for driving a 50-Ω coaxial cable terminated in 50 Ω.

Test Input With the internal jumper set to TEST IN, the rear-panel BNC connector is connected to the preamplifier test input. Input impedance is nominally 93 Ω in parallel with 83 pF.

PREAMP A rear-panel, BNC connector delivers the preamplifier output signal for applications where a separate signal cable is desired. The same signal is also available on pin 3 of the power cable connector for systems that accommodate a single-cable connection to the spectroscopy amplifier. Both outputs have a common, ac-coupled, 93-Ω, output impedance, and are short-circuit protected. The signal from dynode 10 is integrated on a 500-pF capacitor at the preamplifier input, amplified by the preamplifier gain, and presented as a positive-polarity pulse at the PREAMP output.

PMT SOCKET TRW 3B14. Fits the standard JEDEC B14-38 photomultiplier tube pin base for 14-pin, 10-stage PMTS. See Figures 1 and 2 for pin assignments.

ELECTRICAL AND MECHANICAL

POWER REQUIRED +12 V at 20 mA. Supplied via a captive power cord terminated in a standard preamplifier power plug (9-pin, D connector). Power cord length is nominally 3 m. The preamplifier power plug is compatible with the standard preamplifier power-connector provided on most nuclear spectroscopy amplifiers. An optional Signal Break-Out Adaptor is available for extracting the preamplifier signal at the power connector.

WEIGHT
Net 0.5 kg (1.1 lb).
Shipping 1.2 kg (2.6 lb).

DIMENSIONS 5.6 cm (2.2 in.) diameter X 17 cm (6.7 in.) length.

Optional Accessories

296-ADAPT SIGNAL BREAK-OUT ADAPTOR Connects to the end of the power cable from the Model 296 and separates the preamplifier signal cable from the power cable. The 9-pin D connector on the adaptor plugs into the standard preamplifier power connector on the rear of most spectroscopy amplifiers. The 60-cm long preamplifier signal cable from the adaptor terminates in a BNC connector for connection to the input of a spectroscopy amplifier.

C-24-12 93-Ω, coaxial cable for connecting the PREAMP output to an amplifier input. (Not necessary when the 296-ADAPT is employed.) RG-62A/U 93-Ω cable (3.7-m length) with two BNC connectors.

C-25-12 50-Ω, coaxial cable for connecting the ANODE output to timing instruments. RG-58A/U 50-Ω cable (3.7-m length) with two BNC connectors.

Ordering Information

Model	Description
296	ScintiPack™ PMT Base (with Preamplifier and HV Supply)
296-ADAPT	Signal Break-Out Adaptor
C-24-12	RG-62A/U 93-Ω Cable with two BNC male plugs; 12-ft length
C-25-12	RG-58A/U 50-Ω Cable with two BNC male plugs; 12-ft length

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Specifications subject to change
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