ORTEC

Model 454
Timing Filter Amplifier

Operating and Service Manual

This manual applies to instruments
"Rev 01" (on rear panel)

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STANDARD WARRANTY FOR ORTEC INSTRUMENTS

ORTEC warrants its instruments other than preamplifier FET input transistors, vacuum tubes, fuses, and batteries to be free from defects in workmanship and materials for a period of twelve months from date of shipment provided that the equipment has been used in a proper manner and not subjected to abuse. Repairs or replacement, at ORTEC option, will be made on in-warranty instruments, without charge, at the ORTEC factory. Shipping expense will be to the account of the customer except in cases of defects discovered upon initial operation. Warranties of vacuum tubes and semiconductors made by their manufacturers will be extended to our customers only to the extent of the manufacturers' liability to ORTEC. Specially selected vacuum tubes or semiconductors cannot be warranted. ORTEC reserves the right to modify the design of its products without incurring responsibility for modification of previously manufactured units. Since installation conditions are beyond our control, ORTEC does not assume any risks or liabilities associated with methods of installation or with installation results.

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 you contact our Customer Services in advance of its return. ORTEC must be informed, either in writing or by telephone [(615) 482-4411], 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. Our 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 nearest ORTEC repair center. 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 will be repaired at the standard charge unless they have been grossly misused or mishandled, in which case the user will be notified prior to the repair being done. A quotation will be sent with the notification.

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 we may assist in damage claims and in providing replacement equipment if necessary.

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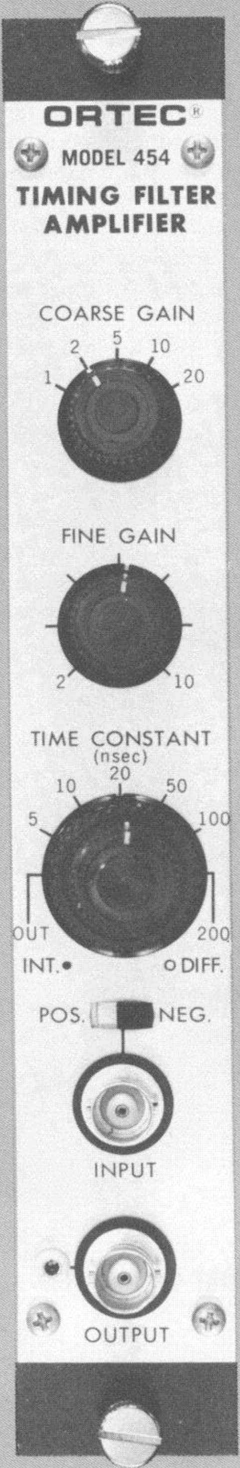
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ORTEC 454 TIMING FILTER AMPLIFIER

1. DESCRIPTION

1.1. GENERAL

The ORTEC 454 Timing Filter Amplifier is a NIM-standard module for use where a fast (wide band), variable RC filter amplifier with high drive and variable gain is needed. Features of the 454 include a wide-gain control range, separately selectable RC-integrate and RC-differentiate time constants in the nanosecond region, and drive capability sufficient for use with 50 or 100Ω systems.

1.2. INPUT SIGNALS

The input signals are ac-coupled into an impedance of approximately 1000Ω. This relatively high impedance allows multiple use of the linear input signal. The acceptable amplitude range for the linear input, to retain its linearity, is 0 to 2 V. These signals may be either positive or negative polarity, selectable with a front-panel switch. Protection is provided for input voltages of up to ±100 V at a 10% duty cycle.

1.3. GAIN

The gain for midband frequencies can be set at any value from X2 through X200, using five Coarse Gain selections and a Fine Gain control which is a single-turn potentiometer. The factors are selected to provide range overlap and to assure continuously adjustable gain control throughout the full range.

1.4. FILTERING

A 7-position concentric switch permits the separate selection of RC-integrate and RC-differentiate time constants. The positions are Out, and 5, 10, 20, 50, 100, and 200 nsec. The Out position for the RC-integrate control is equivalent to an integrate time constant of less than 2 nsec. The Out position for the RC-differentiate control implies a differentiate time constant of 5 μsec.

1.5. OUTPUT

The linear output pulses are negative for input pulses of the same polarity as selected by the front-panel polarity switch or are positive when the input has the opposite polarity. The 454 is capable of driving up to -6 V into a 50Ω impedance with no degradation of the performance specifications. Positive output signals are limited to a range from 0 to +0.5 V.

1.6. MECHANICAL

The ORTEC 454 Timing Filter Amplifier is a NIM-standard single-width (1.35 by 8.714 in.) module, designed in accordance with TID-20893 (Rev.). It is intended for installation and operation in a standard enclosure, such as the ORTEC 401A/402A Bin and Power Supply, and obtains all of its required operating power from the Power Supply.

2. SPECIFICATIONS

PERFORMANCE

AMPLITUDE RANGE +0.5 to -6.0 V (linear) onto 50Ω cable.

RISE TIME ⩽4.5 nsec with filter Out, or ~2.2 τ_i for other selections.

NOISE For maximum gain, rms noise referred to the input is ⩽10 μV for $\tau_i = \tau_d$ = 200 nsec or ⩽50 μV with filter Out.

NONLINEARITY ⩽±1%.

TEMPERATURE STABILITY ⩽0.025%/°C, 20 to 50°C; ⩽0.1%/°C, 0 to 50°C.

CONTROLS

COARSE GAIN 5-position switch for selection of X1, X2, X5, X10, or X20.

FINE GAIN Single-turn potentiometer, continuous from X2 to X10.

INT 7-position switch, with RC time constants of 5, 10, 20, 50, 100, and 200 nsec and Out (equivalent to 2 nsec).

DIFF 7-position switch, with RC time constants of 5, 10, 20, 50, 100, and 200 nsec and Out (equivalent to ~5 μsec).

POS/NEG For input polarity same as selected by front-panel polarity switch, the output is negative; for oppositive input polarity, the output is positive.

INPUT

Positive or negative polarity, front-panel-switch selectable; amplitude 0 to 2 V, protected to ±20 V dc and to ±100 V at 10% duty factor; impedance ~1000Ω. Front-panel BNC connector.

OUTPUT

Polarity of the output depends both on the polarity of the input and on the setting of the Pos/Neg switch. Impedance ~1Ω. Front-panel BNC connector.

ELECTRICAL AND MECHANICAL

POWER REQUIREMENTS

+24 V, 79 mA; +12 V, 42 mA;
-24 V, 75 mA; -12 V, 39 mA.

DIMENSIONS NIM-standard single-width module (1.35 by 8.714 in.) per TID-20893 (Rev.).

WEIGHT (Shipping) 5 lb (2.3 kg).

WEIGHT (Net) 2 lb (0.9 kg).

3. INSTALLATION INSTRUCTIONS

3.1. GENERAL

Since the 454, in conjunction with the ORTEC 401A/402A Bin and Power Supply, is intended for rack mounting, vacuum tube equipment operating in the same rack must be sufficiently cooled with circulating air to prevent any localized heating of the all-transistorized circuitry used throughout the 454. The temperature of equipment mounted in racks can easily exceed the recommended maximum limit of 120°F (50°C) unless these precautions are taken.

3.2. CONNECTION TO POWER

The 454 contains no internal power supply, and must obtain the necessary dc operating power from the 401A/-402A Bin and Power Supply in which it is installed for operation. Always turn off power for the Power Supply before inserting or removing modules. The ORTEC 400 Series of modular instruments is designed so that the Power Supply cannot be overloaded when there is a full complement of modules in the Bin. Since, however, this may not be true when the Bin contains modules other than those of ORTEC design, use the convenient test points on the front panel of the 401A/402A to check each Power Supply voltage level after all modules have been inserted.

3.3. INPUT/OUTPUT CONNECTIONS

The high input impedance (~1000Ω) and low output impedance (~1Ω) of the ORTEC 454 permit it to be included in a system using either 50Ω or 93Ω cable. For proper system operation the source and load impedances on the cable system should be of matching values to eliminate reflections.

Input The high input impedance of the 454 allows the input signal to be shunt terminated at the 454 or allows subsequent reuse of the input signal. When the input signal is terminated, assure that the cable is terminated in its characteristic impedance (usually 50 or 93Ω). This requires an external terminator. Any subsequent use of the input signal in another instrument requires that the cable from the source to the 454 ultimately be terminated properly. This requires either an external terminator or the use of a signal source with an output impedance equivalent to the cable characteristic impedance.

Output The low output impedance of the ORTEC 454 requires that the output cable be terminated by the characteristic impedance of the cable at the remote cable end. This can be accomplished at the input of a high input impedance instrument or by the use of an instrument with an input impedance equal to the impedance of the cable. Both driving-end and receiving-end coaxial line termination is recommended for long cables.

4. OPERATING INSTRUCTIONS

The ORTEC 454 Timing Filter Amplifier has front-panel controls for selection of the input polarity, for adjustment of gain, and for the choice of shaping-time constants to be used. For input signals with the same polarity as selected by the Pos/Neg Input switch, the output will be negative with a driving capability of -6 V into 50Ω. For input signals with the opposite polarity the output will be positive with a driving capability of +0.5 V into 50Ω.

The amplitude of an output signal is determined by the input amplitude and frequency content to the 454 and by the pulse shaping and gain of the 454. For input signals with a frequency response unaffected by the ORTEC 454, gain settings of from X2 to X200 are correct in an absolute sense. That is, for an input of 30 mV and a gain setting of X200, the output can be expected at approximately 6 V. However, for input signals where the frequency response is affected by the 454, the gain settings are correct only in a relative manner. The choice of Integrate and Differentiate control settings is a function of the particular application. The best settings for several typical conditions are described in "Application Notes," Section 7.

5. CIRCUIT DESCRIPTION

The 454 circuit will be described with reference to schematic 454-0101-S1, included at the back of this manual.

Input protection is provided by the diodes of D1. Transistors Q1 and Q2 form the input stages, where polarity selection and Differentiate time constants are determined.

The first stage of amplification is provided by the circuit that includes transistors Q3 through Q5. This is a cascode configuration, driven by an emitter follower. Coarse Gain selection is determined partially by resistors R19 through R21.

The second stage of amplification is also a cascode circuit configuration, driven from the first stage through an emitter follower; the second stage operates as a complement of the first stage. The second stage includes transistors Q6 through Q8, and the remaining Coarse Gain selection is determined by resistors R29 through R31.

The Fine Gain control, R44, adjusts the gain in the third stage of amplification, using transistors Q9 through Q11. The RC Integrate time constant is determined by the selection of a capacitor to ground between the third stage of amplification and the final stage.

The final output stage includes transistors Q12 through Q14, and is a three-transistor voltage feedback amplifier. It has a constant gain of 4. Transistor Q14 provides the output drive capability.

6. MAINTENANCE INSTRUCTIONS

6.1. CORRECTIVE MAINTENANCE

The ORTEC 454 should require no regular maintenance other than replacement of components which have failed due to age. Always ensure that the replacement components are equivalent to the original parts, designated in schematic 454-0101-S1. No internal trimming or adjustment is necessary with the 454.

To aid in the identification of a malfunctioning component, typical stage-by-stage dc voltages are shown in Table 1. Note that these are typical values, and may vary through a narrow range without indicating a fault.

6.2. FACTORY REPAIR SERVICE

The ORTEC 454 may be returned to the factory for repair service at a nominal cost. Our standard procedure requires that each repaired instrument receive the same extensive quality control as is provided for a new instrument. Please contact the Customer Service Department, (615) 482-4411, for instructions before shipping the instrument to the factory.

Table 1 Typical DC Voltages

Checkpoint	Volts	Checkpoint	Volts	Checkpoint	Volts	Checkpoint	Volts
Q1B	+ 0.55	Q4E	- 1.35	Q7C	- 7.75	Q11B	+ 8.5
Q1E	- 0.75	Q4C	+ 7.8	Q8B	- 8.45	Q11C	+ 17.25
Q1C	+ 8.5	Q5B	+ 8.5	Q8C	- 17.6	Q12B	+ 0.1
Q2B	- 11.4	Q5C	+ 17.6	Q9B	- 0.05	Q12E	+ 0.8
Q2E	- 12.0	Q6B	+ 0.065	Q9E	- 0.69	Q12C	- 12.0
Q3B	0	Q6E	+ 0.72	Q9C	+ 8.54	Q13E	- 12.6
Q3E	- 0.64	Q6C	- 8.5	Q10E	- 1.36	Q13C	- 0.1
Q3C	+ 8.5	Q7E	+ 1.45	Q10C	+ 7.8	Q14E	- 13.2

7. APPLICATIONS NOTES

7.1. TIMING WITH Ge(Li) DETECTORS

To ensure that the energy resolution is not affected by the time measurement when using Ge(Li) detectors, the time measurement of signals from these detectors is usually performed on the output from the charge-sensitive preamplifier. The noise of the detector and preamplifier and the charge collection variations in the detector create error in the time measurement. The ORTEC 454 improves the signal from the charge-sensitive preamplifier for timing determinations. Discrimination can be made in either of two ways: by leading edge, using the ORTEC 436 Fast Discriminator, or by the timing technique introduced by Chase.[1] Both methods are discussed generally in the referenced literature,[2,3] and these instructions will be concerned with the typical system setup when using an ORTEC 454 with a 436 Fast Discriminator or with a 453 Constant Fraction Timing Discriminator.

Leading-Edge Timing Figure 7.1 is a block diagram showing both a leading-edge timing system and an amplitude and risetime compensated (ARC) timing system developed by Chase.[1] The left side of the diagram is a conventional CFPHT timing system for fast scintillators.[4] Both the leading edge and the ARC timing systems are shown at the right.

[1] R.L. Chase, "Pulse Timing System for Use with Gamma Rays on Ge(Li) Detectors," *Rev. Sci. Instr.* **39**(9), 1318 (1968).

[2] T.D. Douglass and C.W. Williams, "A Comparison of Various Filter and Discriminator Techniques on Timing with Ge(Li) Detectors," *IEEE Trans. Nucl. Sci.* **NS-16**(1), 87 (1969).

[3] *Timing with Ge(Li) Detectors*, ORTEC Application Note 31 (March 1970); copies available from ORTEC on request.

[4] D.A. Gedcke and C.W. Williams, *High Resolution Time Spectroscopy: 1. Scintillation Detectors*, ORTEC Publication (August 1968); copies available from ORTEC on request.

In both leading edge and ARC timing, the preamplifier output is brought to the shaping amplifier (ORTEC 450, 451, or 452) through 93Ω cable. At the energy analysis shaping amplifier, a BNC tee accommodates a 93Ω cable to carry the signal to the 454. This cable should normally be terminated in 100Ω at the 454 input unless the preamplifier includes a reliable 93Ω series output impedance. Be careful to assure that the 454 input is situated at the receiving end of the cable and also that the BNC tee is attached directly to the energy analysis amplifier input. If the 454 is not at the end of the cable, the reflected pulse from the unterminated receiving-cable end can distort the leading edge of the signal.

The 454 output is connected directly to the ORTEC 436 Fast Discriminator through 50Ω cable. Since the input impedance of the 436 is 50Ω, no additional termination is required.

For best performance, set the 454 RC Integrate control at Out and its RC Differentiate control at the 5-, 10-, or 20-nsec position. The gain of the 454 is normally adjusted so that the discriminator level of the 436 is just above the noise level. That is, very few noise pulses should trigger the discriminator. Adjustment for a discriminator level just above noise should always be the case for large coaxial Ge(Li) detectors. For small planar Ge(Li) detectors the discriminator level should be adjusted to determine the best timing characteristics, and this level may or may not be just above the noise, depending upon the situation.

Figure 7.2 illustrates results of using leading-edge timing for a 30-cm^3 Ge(Li) coaxial detector to measure 511-keV gamma rays.

ARC Timing Figure 7.1 includes the block diagram for an ARC timing system. The requirements for connections

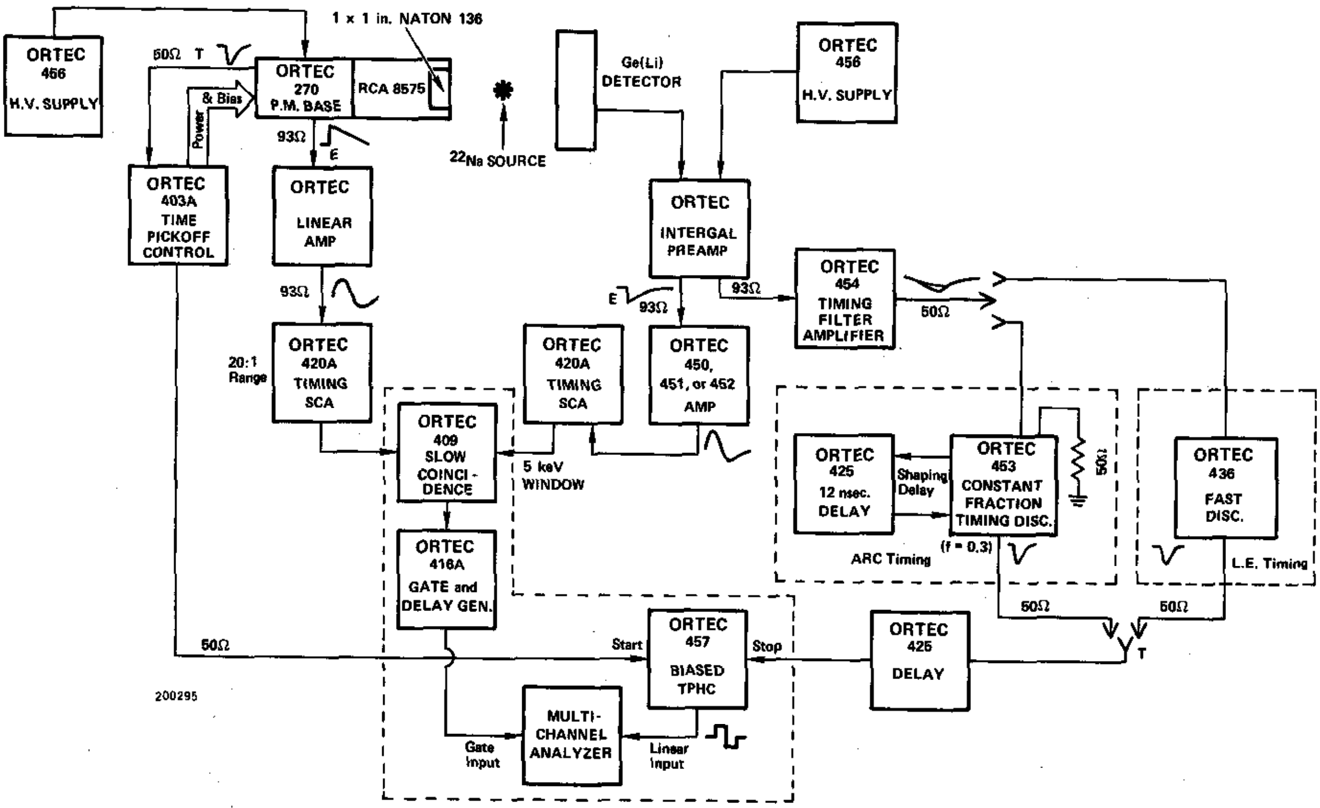


Fig. 7.1. Block Diagram Showing Leading Edge (L.E.) Timing vs Amplitude and Risetime Compensated (ARC) Timing Systems for Ge(Li) Detectors.

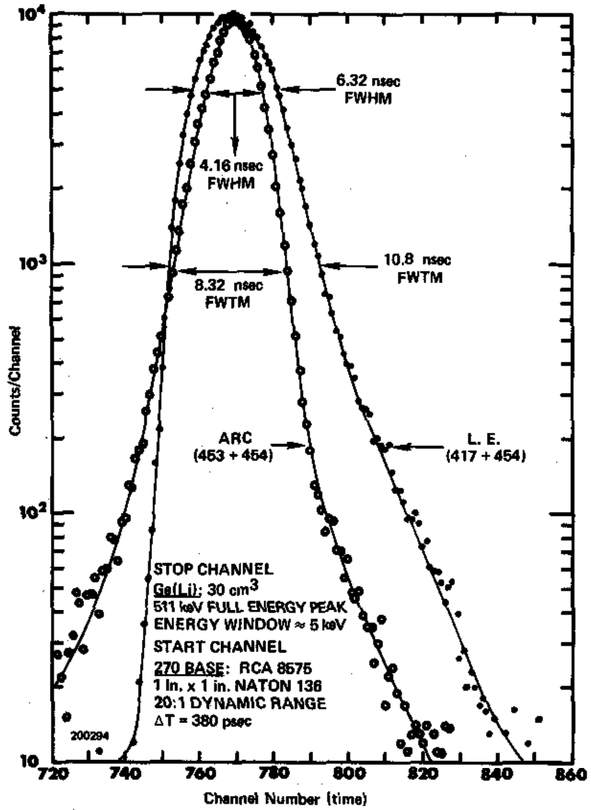


Fig. 7.2. Ge(Li) Leading Edge vs ARC Timing.

between the preamplifier and the 454 are exactly the same as those described for leading-edge timing.

- For best performance, set the filter on the 454 for the RC Integrate control at Out and the RC Differentiate control at either 100 or 200 nsec. A typical setting for the ORTEC 453 includes f = 0.3, with an external shaping delay of 14 nsec (total). The 454 gain must be adjusted to achieve the signal conditions as follows:

In Fig. 7.3(a) the well-known spectrum of charge signal shapes for planar Ge(Li) detectors is displayed.[1] For a monoenergetic event the charge collection time from the detector varies from a minimum of t_{min} to a maximum, t_{max}. Generally $t_{max} \simeq 2t_{min}$. These two extremes produce pulse shapes with an approximately linear rise. Between the two limits are families of pulses, starting with the maximum slope and followed by a break to the minimum slope. Several examples of these are included in Fig. 7.3(a). This model is, of course, an extremely simplified description of the actual process in Ge(Li) detectors. For planar detectors the model is fairly accurate. On the other hand, the effects of geometry and volume in coaxial detectors tend to wash out the shapes shown in Fig. 7.3(a). The simplified model is useful, however, in selecting the pulse amplitudes to be presented to the 453.

If the 454 RC Differentiate switch is set at Out, the resulting signal for a selected full energy peak will appear similar

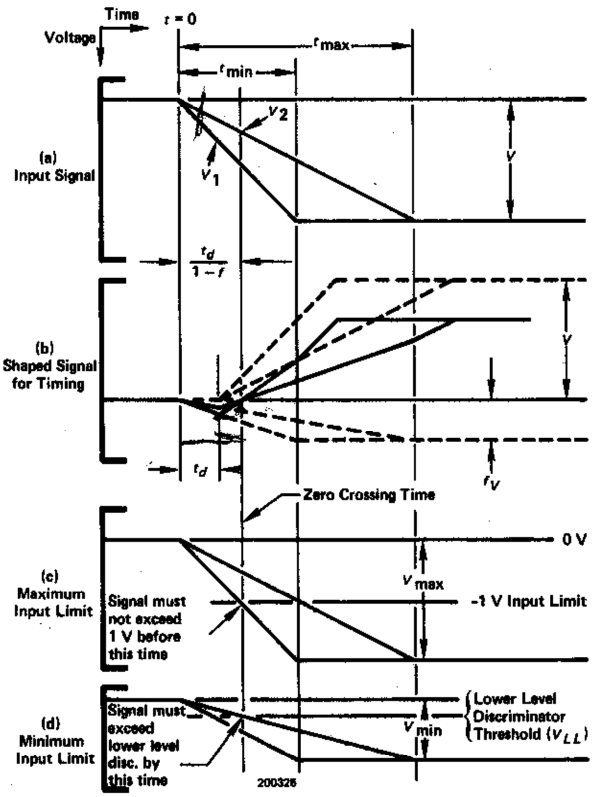


Fig. 7.3. Pulse Shape Considerations for the ARC Timing Technique.

to those depicted in Fig. 7.3(a). In Fig. 7.3(b) a fraction f and an external shaping delay of length T_d have been selected on the 453 such that the heavy lined signal is observed at the monitor output. Only the extreme rise times have been drawn in order to simplify the explanation. Note that both signals cross the zero baseline at the same time. All signals for which the slope does not change before the time $t = T_d\ (1 - f)$ will cross through zero at the same time.

Figure 7.3(c) illustrates the limitation on the maximum input pulse height to the 453. To preserve linearity for the crossover point, the 453 must not saturate before the zero-crossing time $t = T_d\ (1 - f)$. This means that the maximum signal height at the 453 input is

$$V_{max} = \frac{t_{min}}{T_d}\ (1 - f)\ V. \tag{7.1}$$

For example, with T_d = 14 nsec, t_{min} = 50 nsec, and f = 0.3,

$$V_{max} = \frac{50}{14}\ (1 - 0.3) = 2.5\ V. \tag{7.2}$$

Figure 7.3(d) illustrates the minimum input pulse height limitation for proper operation. To allow the zero-crossing discriminator to trigger on the zero-crossing point, the lower level discriminator must have been triggered before time $t = T_d\ (1 - f)$. This implies that the minimum input pulse height limitation is

$$V_{min} = \frac{t_{max}}{T_d}\ (1 - f)\ V_{LL}\,, \tag{7.3}$$

where V_{LL} is the lower level discriminator threshold.

For T_d = 14 nsec, t_{max} = 100 nsec, f = 0.3, and V_{LL} = 50 mV,

$$V_{min} = \frac{100}{14}\ (1 - 0.3) \times 50 = 250\ mV. \tag{7.4}$$

A single channel analyzer should be used on the energy pulse to restrict the accepted amplitudes in the total system to those specified in Eqs. (7.1) and (7.3).

In Fig. 7.2, an ARC timing spectrum is shown for a 30-cm^3 Ge(Li) detector and a narrow window on 511-keV gamma rays.

7.2. TIMING WITH SURFACE BARRIER DETECTORS

The ARC timing process discussed in Section 7.1 is also recommended for slow collection type (high resistivity or low electric field) of surface barrier detectors or diffused junction detectors when they are used for timing with charged particles. When fast detectors (low resistivity or overdepleted junction) are used, the processing method is the same except that the required delay in the 453 processing will vary from ~3 nsec to the rise time of the preamplifier for best results.

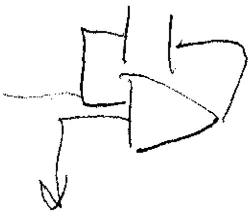
The primary advantage of using ARC timing is the reduction of the walk phenomenon, but some improvement can be expected in compensation for charge collection variations.

7.3. TIMING WITH PHOTOMULTIPLIERS

For timing with photomultipliers the primary use of the 454 is that of added wideband gain between the photomultiplier and the signal discrimination (436 or 453). This is especially important at low gains or light levels, such as either a 10-stage photomultiplier or a high gain (12- or 14-stage) photomultiplier at low light levels. The use of additional amplification is mandatory for single-photon experiments.[5] It is also highly desirable when working with NaI(Tl) scintillators, since the additional gain allows the PM tube to be operated at low gains, where it has the best gain stability versus count rate characteristics.

For applications with photomultiplier tubes the 454 Integrate switch should be set at Out and the Differentiate switch set to select a time constant for best results.

[5] ***The Single-Photon Technique for Measuring Light Intensity and Decay Characteristics,*** ORTEC Application Note 35 (February 1971); copies available from ORTEC on request.



APPENDIX

REPLACEABLE PARTS

ORDERING INFORMATION

The Replaceable Parts List shown below contains information needed for ordering spare and/or replacement parts. Each listing indicates the reference designator number, the part number, a description of the component, and the part manufacturer and manufacturer's part number.

All inquiries concerning spare and/or replacement parts and all orders for same should include the model serial, and revision ("Rev" on rear panel) numbers of the instruments involved and should be addressed to the Customer Service Department at 100 Midland Road, Oak Ridge, Tennessee 37830. The Manager of Customer Services can be reached by telephone at (615) 482-4411. The minimum order for spare and/or replacement parts is $25.00.

ORDERING INFORMATION FOR PARTS NOT LISTED

In order to facilitate the ordering of a part not listed below, the following information should be submitted to the Customer Service Department:

1. the instrument model number,
2. the instrument serial number,
3. revision ("Rev" on rear panel) number,
4. a description of the part,
5. information as to the function and location of the part.

The transistor types installed in your instrument may differ from those shown in the schematic diagram and parts list. In such cases, necessary replacements can be made with either the type shown or the type actually used in the instrument.

Replaceable Parts List

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
454-0100	5004 46330			
18	9097 41339	Connector, BNC	95712	#UG1094/U DGE
20	9107 41407	Test Points	98291	#SKT0804 SEL
28	9168 42043	Hex Nut, 4-40, Cad.	73734	#8003 FSP
31	9109 41430	Knob, Dual	86797	#RB999-700 RGN
R43	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R44	9051 43763	250 Ω 1 T Cer. Pot.	71279	#550R251A CTS
R55	9015 40219	470 Ω 1/4W 5% C	01121	CB ABC
S1	9094 42677	Switch, Slide, DPDT	79727	#G-126 CWE
S2	9094 44448	Switch, Dual-Conc. DP7T	76854	#5-11831-311
S3	9094 64213	Switch, Rotary, DP5P	76854	OAK

Replaceable Parts List (continued)

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
454-0200	5007 46331			
C1	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C2	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C3	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C4	9059 40883	22 pf 2% 500V D.M.	84171	#DM15-220G ARC
C5	9059 41711	47 pf 2% 500V D.M.	84171	#DM15-470G ARC
C6	9059 41717	91 pf 2% 500V D.M.	84171	#DM15-910G ARC
C7	9059 41703	240 pf 2% 500V D.M.	84171	#DM15-241G ARC
C8	9059 40893	500 pf 2% 500V D.M.	84171	#DM15-501G ARC
C9	9059 40895	1000 pf 2% 100V D.M.	84171	#DM15-102G ARC
C10	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C11	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C12	9065 40943	2.2 uf 20% 35V Tan.	80183	#150D225X0034B2 SPR
C13	9059 40883	22 pf 2% 500V D.M.	84171	#DM15-220G ARC
C14	9059 41705	82 pf 2% 500V D.M.	84171	#DM15-820G ARC
C15	9065 40943	2.2 uf 20% 35V Tan.	80183	#150D225X0034B2 SPR
C16	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C17	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C18	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C19	9065 40943	2.2 uf 20% 35V Tan.	80183	#150D225X0034B2 SPR
C20	9059 41705	82 pf 2% 500V D.M.	84171	#DM15-820G ARC
C21	9059 40883	22 pf 2% 500V D.M.	84171	#DM15-220G ARC
C22	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C23	9059 40943	2.2 uf 20% 35V Tan.	80183	#150D225X0034B2 SPR
C24	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C25	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C26	9065 40943	2.2 uf 20% 35V Tan.	80183	#150D225X0035A2 SPR
C27	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C28	9059 40883	22 pf 2% 500V D.M.	84171	#DM15-220G ARC
C29	9065 40943	2.2 uf 20% 35V Tan.	80183	#150D225X0035A2 SPR
C30	9059 41707	820 pf 2% 500V D.M.	84171	#DM15-821G ARC
C31	9059 41706	390 pf 2% 500V D.M.	84171	#DM15-391G ARC
C32	9059 40889	200 pf 2% 500V D.M.	84171	#DM15-201G ARC
C33	9059 41702	68 pf 5% 500V D.M.	84171	#DM15-680J ARC
C34	9059 41704	27 pf 2% 500V D.M.	84171	#DM15-270G ARC
C35	9059 40881	12 pf 2% 500V D.M.	84171	#DM15-120G ARC
C36	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C37	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C38	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C39	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C40	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C41	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C42	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C43	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C44	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C45	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C46	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C47	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C48	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C49	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR

Replaceable Parts List (continued)

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
454-0200	5007 46331			
cont'd.				
C50	9065 40948	6.8 uf 20% 35V Tan.	80183	#150D685X0035B2 SPR
C51	9055 40842	0.005 pf 2% 1KV Disc.	80183	#CO23K102H502M SPR
C52	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C53	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C54	9059 40882	15 pf 5% 500V D.M.	84171	#DM15-150J ARC
C55	9059 41704	27 pf 2% 500V D.M.	84171	#DM15-270G ARC
C56	9065 40942	1 uf 20% 35V Tan.	80183	#150D105X0035A2 SPR
C57	9057 40865	4.7 pf NPO Disc.	80183	#CO30K102E4R7 SPR
D1	9080 41100	Diode - MSD-6100	80211	MOT
DL-1	9147 41884	Coax, 100 Ω	98278	#293-3913 MDT
L1	9092 41237	Deciductor - 220 μh	72259	#DD-220.0 NTC
L2	9092 41237	Deciductor - 220 μh	72259	#DD-220.0 NTC
L3	9092 41237	Deciductor - 220 μh	72259	#DD-220.0 NTC
L4	9092 41237	Deciductor - 220 μh	72259	#DD-220.0 NTC
Q1	9078 43649	Transistor - MPS6520	80211	MOT
Q2	9078 43659	Transistor - 2N5179	80211	(304840) MOT
Q3	9078 43649	Transistor - MPS6520	80211	MOT
Q4	9078 43659	Transistor - 2N5179	80211	(304840) MOT
Q5	9078 43659	Transistor - 2N5179	80211	(304840) MOT
Q6	9078 43654	Transistor - MPS6522	80211	MOT
Q7	9078 43644	Transistor - 2N4260	80211	(EG&G AB0329-4) MOT
Q8	9078 43644	Transistor - 2N4260	80211	(EG&G AB-0329-4) MOT
Q9	9078 43649	Transistor - MPS6520	80211	MOT
Q10	9078 43659	Transistor - 2N5179	80211	(304840) MOT
Q11	9078 43659	Transistor - 2N5179	80211	(304840) MOT
Q12	9078 43644	Transistor - 2N4260	80211	(EG&G AB-0329-4) MOT
Q13	9078 43649	Transistor - MPS6520	80211	MOT
Q14	9078 43668	Transistor - 2N3866	80211	MOT
Q15	9078 41086	Transistor - 2N3646	13715	FSC
R1	9027 40591	4.02 K 1/8W 1% MF	IRC	CEA
R2	9027 40591	4.02 K 1/8W 1% MF	IRC	CEA
R3	9027 40522	2 K 1/8W 1% MF	IRC	CEA
R4	9015 40202	10 Ω 1/4W 5% C	01121	CB ABC
R5	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R6	9027 40489	100 Ω 1/8W 1% MF	IRC	CEA
R7	9015 40271	51 Ω 1/4W 5% C	01121	CB ABC
R8	9015 40223	750 Ω 1/4W 5% C	01121	CB ABC
R9	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R10	9027 40489	100 Ω 1/8W 1% MF	IRC	CEA

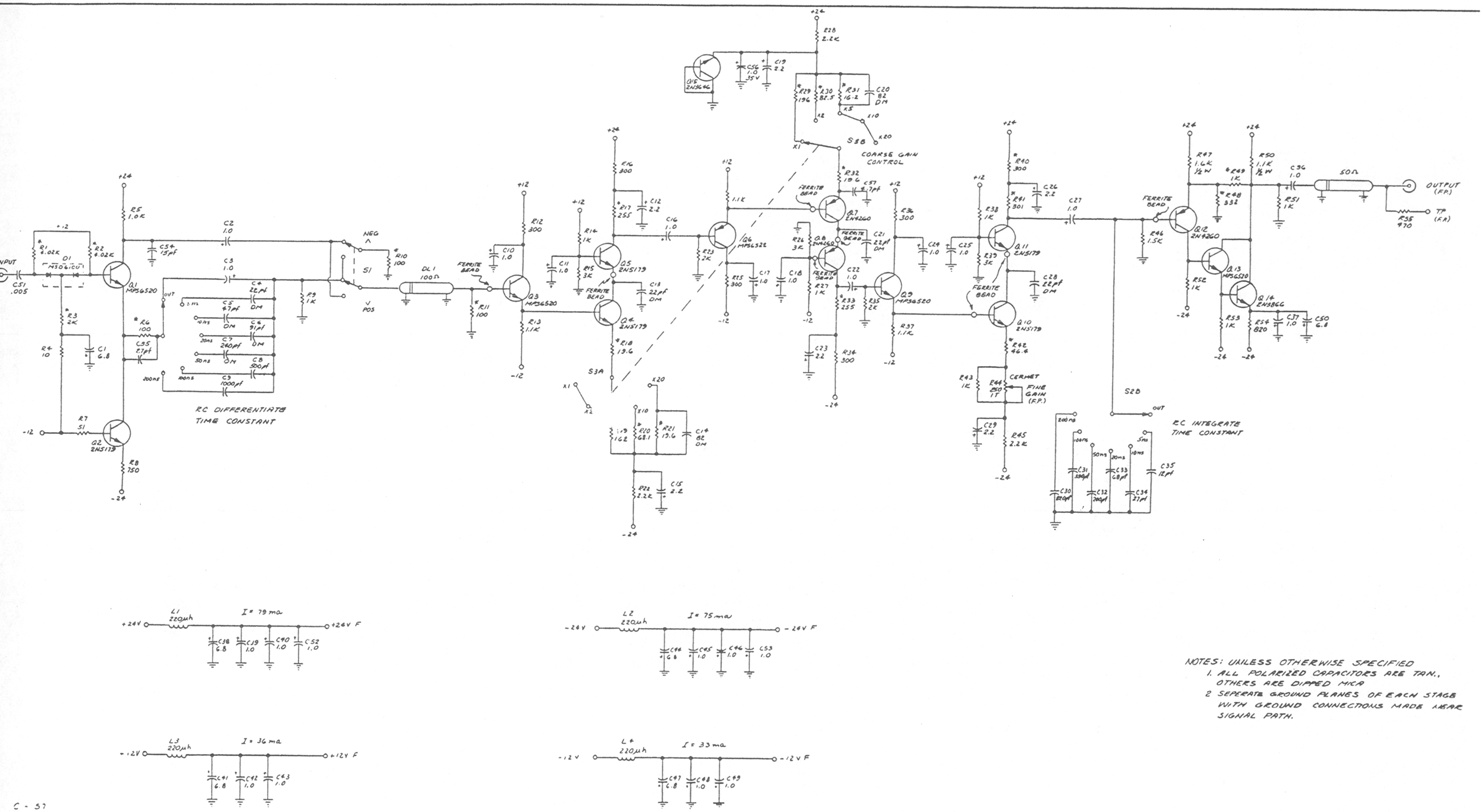
Replaceable Parts List (continued)

REFERENCE DESIGNATOR	ORTEC PART NO.	DESCRIPTION	MFR.	MFR. PART NO.
454-0200	5007 41884			
cont'd.				
R11	9027 40489	100 Ω 1/8W 1% MF	IRC	CEA
R12	9015 40215	300 Ω 1/4W 5% C	01121	CB ABC
R13	9015 40227	1.1 K 1/4W 5% C	01121	CB ABC
R14	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R15	9015 40235	3 K 1/4W 5% C	01121	CB ABC
R16	9015 40215	300 Ω 1/4W 5% C	01121	CB ABC
R17	9027 40571	255 Ω 1/8W 1% MF	IRC	CEA
R18	9027 40588	19.6 Ω 1/8W 1% MF	IRC	CEA
R19	9027 40493	162 Ω 1/8W 1% MF	IRC	CEA
R20	9027 40574	68.1 Ω 1/8W 1% MF	IRC	CEA
R21	9027 40588	19.6 Ω 1/8W 1% MF	IRC	CEA
R22	9015 40232	2.2 K 1/4W 5% C	01121	CB ABC
R23	9015 40231	2 K 1/4W 5% C	01121	CB ABC
R24	9015 40227	1.1 K 1/4W 5% C	01121	CB ABC
R25	9015 40215	300 Ω 1/4W 5% C	01121	CB ABC
R26	9015 40235	3 K 1/4W 5% C	01121	CB ABC
R27	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R28	9015 40232	2.2 K 1/4W 5% C	01121	CB ABC
R29	9027 40496	196 Ω 1/8W 1% MF	IRC	CEA
R30	9027 40486	82.5 Ω 1/8W 1% MF	IRC	CEA
R31	9027 40581	16.2 Ω 1/8W 1% MF	IRC	CEA
R32	9027 40588	19.6 Ω 1/8W 1% MF	IRC	CEA
R33	9027 40571	255 Ω 1/8W 1% MF	IRC	CEA
R34	9015 40215	300 Ω 1/4W 5% C	01121	CB ABC
R35	9015 40231	2 K 1/4W 5% C	01121	CB ABC
R36	9015 40215	300 Ω 1/4W 5% C	01121	CB ABC
R37	9015 40227	1.1 K 1/4W 5% C	01121	CB ABC
R38	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R39	9015 40235	3 K 1/4W 5% C	01121	CB ABC
R40	9015 40215	300 Ω 1/4W 5% C	01121	CB ABC
R41	9027 43697	301 Ω 1/8W 1% MF	IRC	CEA
R42	9027 40483	46.4 Ω 1/8W 1% MF	IRC	CEA
R45	9015 40232	2.2 K 1/4W 5% C	01121	CB ABC
R46	9015 40229	1.5 K 1/4W 5% C	01121	CB ABC
R47	9017 44347	1.6 K 1/2W 5% C	01121	EB ABC
R48	9027 40503	332 Ω 1/8W 1% MF	IRC	CEA
R49	9027 40515	1 K 1/8W 1% MF	IRC	CEA
R50	9017 40311	1.1 K 1/2W 5% C	01121	EB ABC
R51	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R52	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R53	9015 40226	1 K 1/4W 5% C	01121	CB ABC
R54	9015 40224	820 Ω 1/4W 5% C	01121	CB ABC
4	9090 41223	Ferrite Beads	02114	#56-590-65/4B FEX

BIN/MODULE CONNECTOR PIN ASSIGNMENTS
FOR AEC STANDARD NUCLEAR INSTRUMENT MODULES
PER TID-20893

Pin	Function	Pin	Function
1	+3 volts	23	Reserved
2	−3 volts	24	Reserved
3	Spare Bus	25	Reserved
4	Reserved Bus	26	Spare
5	Coaxial	27	Spare
6	Coaxial	*28	+24 volts
7	Coaxial	*29	−24 volts
8	200 volts dc	30	Spare Bus
9	Spare	31	Spare
*10	+6 volts	32	Spare
*11	−6 volts	*33	115 volts ac (Hot)
12	Reserved Bus	*34	Power Return Ground
13	Spare	**35	Reset (Scaler)
14	Spare	**36	Gate
15	Reserved	**37	Reset (Auxiliary)
*16	+12 volts	38	Coaxial
*17	−12 volts	39	Coaxial
18	Spare Bus	40	Coaxial
19	Reserved Bus	*41	115 volts ac (Neut.)
20	Spare	*42	High Quality Ground
21	Spare	G	Ground Guide Pin
22	Reserved		

Pins marked (*) are installed and wired in ORTEC 401A and 401B Modular System Bins.
Pins marked (*) and (**) are installed and wired in EG&G/ORTEC–HEP M250/N and M350/N NIMBINS.



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL POLARIZED CAPACITORS ARE TAN., OTHERS ARE DIPPED MICA
2. SEPERATE GROUND PLANES OF EACH STAGE WITH GROUND CONNECTIONS MADE NEAR SIGNAL PATH.

C - 57
R - 55
D - 1
Q - 15
L - 4

UNLESS OTHERWISE SPECIFIED
DIMENSIONS IN INCHES
TOLERANCES

ORTEC
OAK RIDGE TECHNICAL ENTERPRISES CORPORATION
OAK RIDGE TENNESSEE

MODEL 454
TIMING FILTER AMPLIFIER

J.D.W. 2-20-69

454-0101-S1