

# WARRANTY

## canberra nuclear instruments

*This equipment is warranted by Canberra to be free from defects in materials and workmanship for a period of twelve months from date of shipment, provided that the equipment has been used in a proper manner as detailed in this instruction manual. Repairs or replacement, at Canberra's option, will be made without charge at the Canberra plant during this warranty period. Except for the case of defects discovered upon initial operation, shipping expense to Canberra is to be paid by the customer; shipping expense to return the repaired equipment will be paid by Canberra.*

*Canberra reserves the right to modify its products without incurring the responsibility for modifying previously manufactured products.*

*Canberra does not assume any liability for the results of particular installations, as these circumstances are not in our control.*

### SHIPPING DAMAGE

*Shipments should be carefully examined when received for evidence of damage caused by shipping. If damage is found, notify Canberra and the carrier making delivery immediately, as the carrier is normally responsible for damage caused in shipment. Carefully preserve all documentation to establish your claim. Canberra will provide all possible assistance in damage claims.*

### REPAIRS

*Any Canberra instrument no longer in its warranty period may be returned, freight prepaid, to our factory for repair and realignment. All such work will be done at the least possible expense to the customer. All equipment thus repaired or realigned will pass through our normal preshipment checkout procedure and will meet or surpass its original specifications when returned. Return shipping expense will, in this case, also be charged to the customer.*



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## CONTENTS

	Page
<b>1 INTRODUCTION .....</b>	<b>1-1</b>
<b>2 SPECIFICATIONS .....</b>	<b>2-1</b>
2.1 Outputs .....	2-1
2.2 Performance .....	2-1
2.3 Controls .....	2-1
2.4 Connectors .....	2-2
2.5 Power .....	2-2
2.6 Physical .....	2-2
<b>3 CONTROLS AND CONNECTORS .....</b>	<b>3-1</b>
3.1 General .....	3-1
3.2 Controls .....	3-1
3.3 Connectors .....	3-1
<b>4 THEORY OF OPERATION .....</b>	<b>4-1</b>
4.1 General .....	4-1
4.2 Oscillator .....	4-1
4.3 Delay Trigger .....	4-1
4.4 Primary Buffer Amplifier .....	4-1
4.5 Time Delay Monostable .....	4-1
4.6 Delayed Buffer Amplifier .....	4-1
4.7 Mode Switch .....	4-2
4.8 Attenuators .....	4-2

## SECTION 2 SPECIFICATIONS

### 2.1 OUTPUTS

#### PRIMARY

Amplitude: 4mV to 250mV as selected by front panel controls.  
Rise Time: Less than 100 nanoseconds.  
Fall Time Constant: 50 microseconds.  
Pulse Type: Tail pulse.  
Output Impedance: 93 ohms.  
Coupling: DC.

#### NOTE

Pulse pairs are generated at this output connector in the Pulse Pair mode; in the Dual Pulse mode, only the leading (PRIMARY) pulse of the two pulses is obtained at this output.

#### DELAYED

Amplitude: 4mV to 250mV as selected by front panel controls.  
Rise Time: Less than 100 nanoseconds.  
Fall Time Constant: 50 microseconds.  
Pulse Type: Tail pulse.  
Output Impedance: 93 ohms.  
Coupling: DC.

#### NOTE

This output does not function in the Pulse Pair operating mode. In the Dual Pulse mode, the trailing (DELAYED) pulse *only* of the two pulses is obtained at this output.

#### TRIGGER

Leads the Primary Pulse by 200 nanoseconds.  
Pulse Width: 200 nanoseconds.  
Amplitude: 5V into 100 ohms.  
Output Impedance: 10 ohms.  
Coupling: DC.

### 2.2 PERFORMANCE

#### PULSE REPETITION RATE

From 100 Hz to 10 kHz as selected by front panel controls.

#### PULSE AMPLITUDE

Amplitude: 4mV to 250mV as selected by front panel controls.

#### SPACING

Pulse Delay Spacing: 0 to 28 microseconds as selected by front panel controls.

### 2.3 CONTROLS

#### RATE RANGE

Two position toggle switch: 0.1kHz to 1kHz and 1kHz to 10 kHz.

## **PULSE PAIR GENERATOR**

### **SECTION 1 INTRODUCTION**

The Canberra Model 1407P Pulse Pair Generator permits the nuclear experimenter to simulate two situations: first, it may be used to provide a pair of pulses from a single output to test the pulse pair response of linear amplifiers, discriminators, single and multichannel analyzers, and scalars. Second, the Model 1407P provides a pair of pulses from two separate outputs to aid in the aligning and testing of a coincidence system.

In the Pulse Pair mode, successive pulse pairs are emitted from a single BNC connector. Front panel controls allow selection of the spacing or delay between the two pulses of each pair, selection of the average repetition rate, and independent selection of the amplitude of each pulse in the pair.

The pulse pair output looks exactly like the output from a preamplifier which is processing a pair of pulses from a radiation detector. Each pulse of the pair has a rise time of less than 100 nanoseconds and a fall time constant of 50 microseconds. The pulses may be brought as close to each other as desired; as the delay is always below 50 microseconds, the second pulse rides upon the tail of the first (as would be the case from a preamplifier output). In this mode, the output is fed to a main amplifier and then to the unit whose pulse pair resolving capability is under test.

In the Dual Pulse mode, the two pulses are obtained from separate front panel BNC connectors. As in the Pulse Pair mode, the delay between the two pulses is adjustable from 0 to 28 microseconds. The average repetition rate is also selectable up to 10 kHz, and the amplitude of each pulse may be selected independently between 4mV and 250mV.

**RATE** Single-turn potentiometer to select rate within the range selected by the Rate Range control.

**DELAY RANGE** Three position rotary switch; 0 to 1 microsecond, 1 to 7 microsecond, and 7 to 28 microsecond positions.

**DELAY VERNIER** Ten-turn potentiometer control to select delay between Primary and Secondary pulses within the range selected by the Delay Range control.

**PRIMARY AMPLITUDE** Single-turn potentiometer control to select the amplitude of the primary pulse between 40mV and 250mV.

**DELAYED AMPLITUDE** Single-turn potentiometer control to select the amplitude of the Delayed Pulse between 40mV and 250mV.

**MODE** Two position toggle switch to select either the Pulse Pair or the Dual Pulse operating modes.

**ATTENUATOR** Two front panel two position toggle switches; one selects X2 attenuation for both Primary and Delayed pulses, the other selects a X5 attenuation; total attenuation available X10.

**2.4 CONNECTORS**

**PRIMARY PULSE, DELAYED PULSE TRIGGER OUTPUT**

Front panel BNC, UG-1094/U.

**2.5 POWER**

+24V	-	70mA	+12V	-	55mA
-24V	-	25mA	-12V	-	15mA

**2.6 PHYSICAL**

**SIZE**

Standard dual-width module (2.70 inches wide) per TID-20893.

**WEIGHT**

2.3 pounds.

## SECTION 3 CONTROLS AND CONNECTORS

### 3.1 GENERAL

The purpose of this section is to familiarize the user with the controls of the Model 1407P Pulse Pair Generator. Since it is difficult to determine the exact system configuration in which the module will be used, explicit operating instructions cannot be given. Therefore, only the following capsule descriptions of the controls and connectors are provided.

### 3.2 CONTROLS

#### 3.2.1 RATE: VARIABLE and RANGE Controls

These controls are used to vary the output pulse rate. The pulse repetition rate can be varied from 100 Hz to 10 kHz, the limits being determined by the RANGE switch.

#### 3.2.2 DELAY: VARIABLE and RANGE Controls

The delay between the two pulses of each pair is variable from 0 to 28 microseconds. The positions on the RANGE switch indicate the maximum delay for that setting.

#### 3.2.3 AMPLITUDE: PRIMARY and DELAYED Controls

Independently adjusts the amplitudes of the pulses in the pulse pair.

#### 3.2.4 MODE Switch

**PULSE PAIR:** With the switch set at PULSE PAIR, successive pulse pairs are emitted from the PRIMARY PULSE BNC connector. The front panel RATE, DELAY, and AMPLITUDE controls are used to vary the respective parameters of the pulses.

**DUAL PULSE:** In this mode, the two pulses are obtained from separate front panel BNC connectors: PRIMARY and DELAYED.

#### 3.2.5 ATTENUATION Switches

These two switches provide a total output amplitude attenuation of X10. With both switches set at the OUT position and the PRIMARY and DELAYED AMPLITUDE controls fully clockwise, the maximum output amplitude is 250mV. With the control fully counterclockwise, the minimum amplitude is 40mV (with the switch at OUT). The output can be varied by factors of 1/2, 1/5, and 1/10, depending upon the settings of the ATTENUATION switches.

### 3.3 CONNECTORS

#### 3.3.1 PRIMARY

The pulse pairs are available at this connector when the MODE switch is set at PULSE PAIR. When the system is operated in the DUAL PULSE mode, only the leading pulse of the two pulses is available at this output.

### 3.3.2 DELAYED

This output does not function with the system in the PULSE PAIR mode. When the system is operated in the DUAL PULSE mode, only the trailing pulse of the two pulses is available at this output.

### 3.3.3 TRIGGER

This is a logic pulse used to trigger external devices. it precedes the PRIMARY output by 200 nanoseconds; it has a pulse width of 200 nanoseconds; output impedance is 10 ohms; DC coupled; amplitude, 5V into 100 ohms.

## SECTION 4 THEORY OF OPERATION

### 4.1 GENERAL

The following discussion utilizes Schematic Drawing D-11767, which can be found at the end of this manual.

### 4.2 OSCILLATOR

The Model 1407P derives its own internal repetition rate, variable from 0.1 to 10 kHz, by means of a unijunction transistor oscillator circuit (Q1 and Q2). Q1 is a constant current source; this current can be varied by means of the VARIABLE RATE front panel potentiometer.

The variable rate circuit is designed to make the change in rate linear with respect to the change in rotation of the VARIABLE RATE control.

### 4.3 DELAY TRIGGER

The unijunction oscillator excites a monostable (Q3 and Q4). The positive-going pulse (Q4C) performs three functions: 1) it excites a second monostable (Q15 through Q18), 2) when the pulse ends, the trailing edge is differentiated and shaped and provides an output to the BNC marked TRIGGER output, 3) it excites a third monostable (the Time Delay Monostable, Q7 through Q10).

The output of the Monostable Primary Drive (Q15 through Q18) is derived from Q18 collector. This negative-going pulse is used to gate on a constant current source (Q19 and associated circuitry). This current source charges C17 at a linear rate for as long as the signal on Q18 is negative. When the signal on Q18 returns to its normal (positive) state, the charge on C17 is bled off through R23, forming a decay time constant of 50 usec.

### 4.4 PRIMARY BUFFER AMPLIFIER

The tail pulse is fed to the buffer amplifier (Q21 through Q26); this amplifier provides a high input impedance to capacitor C17 and resistor R23; it also provides a low output impedance to drive the constant impedance attenuators. The output impedance at the PRIMARY OUTPUT BNC is 93 ohms.

### 4.5 TIME DELAY MONOSTABLE

The Time Delay Monostable (Q7 through Q10) is used to delay the start of the Delayed Drive Monostable (Q11 through Q14). The output of the Delayed Drive Monostable (Q14C) is a negative-going pulse. This pulse is used to gate on a constant current source (Q20 and associated circuitry). The current source charges C38 at a linear rate for as long as the signal on Q14 is negative. When Q14 returns to its normal (positive) state, the charge on C38 is bled off through R82, forming a decay time constant of 50 usec.

### 4.6 DELAYED BUFFER AMPLIFIER

The tail pulse is fed to the Buffer Amplifier (Q27 through Q32). The purpose of the amplifier is to provide a high input impedance to capacitor C38 and resistor R82; it also provides a low output impedance to drive the constant impedance attenuators. The output impedance at the DELAYED OUTPUT BNC is 93 ohms.



#### 4.7 MODE SWITCH

The two outputs are delivered to their respective BNC connectors (PRIMARY and DELAYED) when the MODE switch is in the DUAL PULSE position. When the switch is in the PULSE PAIR position, the pulse normally delivered to the DELAYED OUTPUT is now routed to the PRIMARY OUTPUT and algebraically added to the primary pulse (at Q19C). There is no output at the DELAYED OUTPUT connector.

#### 4.8 ATTENUATORS

The attenuators follow the buffer amplifiers and attenuate the output signal by factors of 1/2 and 1/5, respectively. These attenuators affect both channels.