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INSTRUCTION MANUAL

418 UNIVERSAL COINCIDENCE

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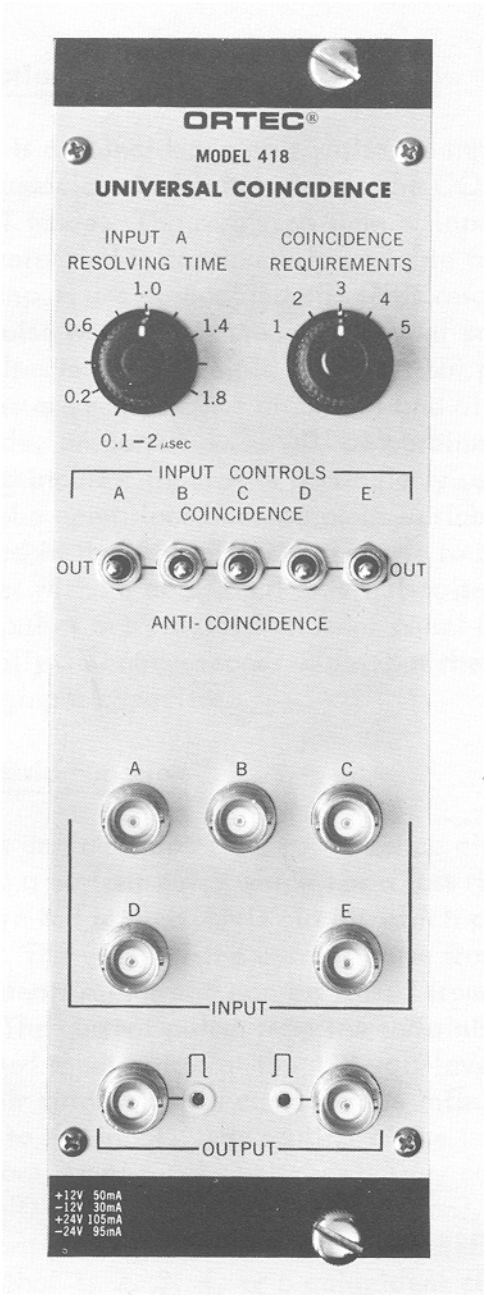
ORTEC®
MODEL 418
UNIVERSAL COINCIDENCE
INPUT A
RESOLVING TIME
1.0
0.6
1.4
0.2
1.8
0.1 – 2 μsec
COINCIDENCE
REQUIREMENTS
1
2
3
4
5
INPUT CONTROLS
A B C D E
COINCIDENCE
OUT
OUT
ANTI- COINCIDENCE
A
B
C
D
E
INPUT
OUTPUT
+12V 50mA
−12V 30mA
+24V 105mA
−24V 95mA

ORTEC 418 COINCIDENCE

1. DESCRIPTION

1.1 General Description

The ORTEC 418 is a coincidence unit with five inputs. Each input has a three-position switch associated with it to select the COINCIDENCE, ANTICOINCIDENCE, or OUT mode. The resolving time of Input A is controlled by a front panel potentiometer and is continuously variable from 100 nsec to 2 μsec. The remaining four inputs are dc coupled and their resolving times are determined by their input pulse widths. By means of a front panel switch 1, 2, 3, 4, or 5 coincident pulses may be required for an output pulse. For example, if two coincident pulses are required for an output and all five inputs are used in the coincidence mode, an output pulse will be obtained when a coincidence occurs between any two inputs. Input A is particularly useful for anticoincidence and coincidence strobe operations because of its variable resolving time; e.g., this input can be used in the anticoincidence mode to block two 500 nanosecond wide input pulses without additional external pulse shaping equipment. Two positive output pulses are provided on front panel BNC connectors. These pulses are normally 500 nanoseconds wide, but their width can be altered as desired by changing a capacitor.

1.2 Description of Basic Function

The 418 employs an "overlap" type coincidence circuit. Each input pulse is regenerated into a current pulse which has a fast rise and fall time. These current pulses are fed into an AND circuit which produces an output when an overlap occurs. The width of the current pulse from Input A is controlled by a front panel potentiometer and can be varied from 100 nanoseconds to 2 microseconds. The current pulses from the remaining inputs are the same width as their associated input pulses at the 1.8 volt level. Since these inputs are dc coupled, their current pulses can be made infinitely long by the application of a dc voltage to the input. The routing of the individual current pulses is controlled by front panel toggle switches. They can be routed to the COINCIDENCE or AND circuit, ground (OUT position), or the ANTICOINCIDENCE circuit. The front panel COINCIDENCE REQUIREMENTS switch alters the AND circuit so that 1, 2, 3, 4, or 5 coincident current pulses are required to produce an output; therefore, the number of INPUT CONTROL toggle switches in the COINCIDENCE position must be equal to or greater than the number selected by the COINCIDENCE REQUIREMENTS switch in order for

the unit to produce an output. A current pulse routed to the anticoincidence circuit blocks all pulses routed to the coincidence circuit for the duration of the anticoincidence pulse.

When the coincidence requirements are met, a 500 nanosecond wide output pulse is generated. The width of this pulse can be changed as desired by changing the value of capacitor C9.

2. SPECIFICATIONS

2.1 General

The 418 is housed in a Nuclear Standard Module. It is two modules wide and weighs 2.5 pounds. It contains no internal power supply and therefore obtains necessary operating power from the Nuclear Standard Bin and Power Supply, ORTEC 401A/402A. All signals in and out of the module are on front panel BNC connectors, and input power is via the standard connector on the rear panel.

2.2 Coincidence

Input Polarity: Positive 2 volts minimum, 30 volts maximum

Input Pulse Width: Dc to 50 nsec

Input Impedance: >1.5K, dc coupled

Input Controls: Each input has a three-position switch associated with it which permits any input to be used in the COINCIDENCE, ANTICOINCIDENCE, or OUT mode. When the OUT mode is selected, the respective input is disabled.

Resolving Time (τ): INPUT A - 100 nsec to 2 μsec controlled by one-turn potentiometer
INPUTS B, C, D, E - controlled by input pulse width

Coincidence Requirements: Selectable by front panel switch; i.e., 1, 2, 3, 4, or 5 coincident pulses may be required to yield an output. For example, if the COINCIDENCE REQUIREMENTS switch is set to 3 and all five INPUT CONTROL switches are set to COINCIDENCE, an output will be obtained when a coincidence occurs between any three inputs.

Outputs: Two each, dc coupled, positive 5 volts, 500 nsec wide

Output Impedance: <10 ohms

Temperature Stability: Change in INPUT A resolving time (τ) is less than 0.1%/°C
Change in INPUTS B, C, D, and E resolving time (τ) is less than 0.05%/°C τ = 500 nsec

Operating Temperature: 0 to 50°C

Power Requirements:

+24V	105 mA	-24V	90 mA
+12V	50 mA	-12V	30 mA

3. INSTALLATION

3.1 General Installation Considerations

The 418, used in conjunction with a 401A/402A Bin and Power Supply, is intended for rack mounting and therefore it is necessary to ensure that vacuum tube equipment operating in the same rack have sufficient cooling air circulating to prevent any localized heating of the all-transistor circuitry used throughout the 418. The temperature of equipment mounted in racks can easily exceed the recommended maximum unless precautions are taken. The 418 should not be subjected to temperatures in excess of 120°F (50°C).

3.2 Connection to Power - Nuclear Standard Bin, ORTEC 401A/402A

The 418 contains no internal power supply and therefore must obtain operating power from the Nuclear Standard Bin and Power Supply such as ORTEC 401A/402A. It is recommended that the bin power supply be turned off when inserting or removing modules. The ORTEC 400 Series is designed so that it is not possible to overload the bin power supply with a full complement of modules in the bin; however, this may not be true when the bin contains modules other than those of ORTEC design, and in such instances power supply voltages should be checked after the insertion of modules. ORTEC 401A/402A has test points on the power supply control panel to monitor the dc voltages.

3.3 Logic Inputs to the Coincidence Unit

The input pulses to the 418 may come from any source of logic pulses. The input impedance is approximately 2000 ohms, and some care must be given to ensure that reflections do not occur in the driving transmission cable. This probably can best be avoided by terminating the driving cable at the inputs with the characteristic impedance of the driving cable. The amplitude and width of the input signals are specified in Section 2.2.

4. OPERATING INSTRUCTIONS

4.1 Front Panel Controls

4.1.1 INPUT A RESOLVING TIME Control

Each input pulse is regenerated into a current pulse with fast rise and fall times. The width of the current pulse from INPUT A is continuously variable from 100 nanoseconds to 2 microseconds. The current pulses from the remaining inputs are the same width as their associated input pulses at the 1.8 volt level. The width of these current pulses determine the resolving time of the unit. INPUT A RESOLVING TIME Control is especially useful when INPUT A is used in the anticoincidence mode, e.g., this input can be used to block two 500 nanosecond pulses without additional external pulse shaping equipment.

4.1.2 COINCIDENCE REQUIREMENTS

The position of this switch determines the number of coincident pulses required to produce an output pulse; e.g., if this switch is in the 2 position and all INPUT CONTROL switches are in the COINCIDENCE position, an output pulse will be produced when any two input pulses are in coincidence. In order to obtain an output pulse, the number of INPUT CONTROL switches in the COINCIDENCE position must always be equal to or greater than the number selected by the COINCIDENCE REQUIREMENTS switch.

4.1.3 INPUT CONTROLS

These are three position toggle switches which determine the routing of the signal applied to their associated input connectors. The three positions of these switches and their function are :

1. COINCIDENCE - Input signal is routed to the coincidence portion of the circuit.
2. OUT - Input signal is routed to ground; therefore, it does not affect the coincidence or anticoincidence portion of the circuit and is completely out of the system.
3. ANTICOINCIDENCE - Input signal is routed to the anticoincidence portion of the circuit and will block all coincidence signals for the duration of the anticoincidence signal.

Any combination of switch positions may be used; however, an output pulse can be obtained only when the number of INPUT CONTROLS in the COINCIDENCE positions is equal to or exceeds the number selected by the COINCIDENCE REQUIREMENTS switch.

4.2 Connector Data

INPUT A - INPUT A is a front panel BNC connector dc coupled to the internal circuitry and has an impedance to ground greater than 1.5K ohms. To minimize reflections when driving from a low impedance source into this connector, a terminator equal to the characteristic impedance of the driving cable should be shunted to ground. A positive 2 volt signal with a minimum width of 50 nsec is required to trigger the input circuit. The resolving time of INPUT A can be varied from 100 nanoseconds to 2 microseconds by the INPUT A RESOLVING TIME control.

INPUT B - Same as INPUT A, except the resolving time is set by the input pulse width.

INPUT C - Same as INPUT B

INPUT D - Same as INPUT B

INPUT E - Same as INPUT B

OUTPUT - Two separate, buffered, dc coupled coincidence outputs are provided on front panel BNC connectors. The output pulses are 5 volts in amplitude and 500 nanoseconds wide. The output pulse width can be altered as desired by changing capacitor C9. The amplitude can be increased by increasing the value of R75.

TEST POINTS - Oscilloscope test points are provided for monitoring the output signals. Each test point has a 470 ohm resistor connecting it to the associated BNC connector.

4.3 Initial Testing and Observation of Pulse Waveforms

Refer to Section 6 for information on testing performance and observing waveforms.

4.4 Typical Operating Considerations

Careful attention should be given the 418 front panel controls when using it. The INPUT CONTROL toggle switches determine the routing of each input pulse. The COINCIDENCE REQUIREMENTS switch determines the number of

coincident pulses required to yield an output pulse. This means that the number of INPUT CONTROL switches in the COINCIDENCE position must be equal to or greater than the number selected by the COINCIDENCE REQUIREMENTS switch (See Fig. 4-5).

The coincidence circuit is an overlap type or it can be described as an AND circuit. The 2 τ resolving time of INPUT A is determined by the INPUT A RESOLVING TIME CONTROL. See timing diagrams in Figures 4-1 through 4-5.

If the coincidence requirements are met by the input pulses, two standard output pulses 500 nanoseconds wide and 5 volts in amplitude are produced regardless of the overlap time of the coincident pulses. The width of the output pulses may be changed by changing the value of C9.

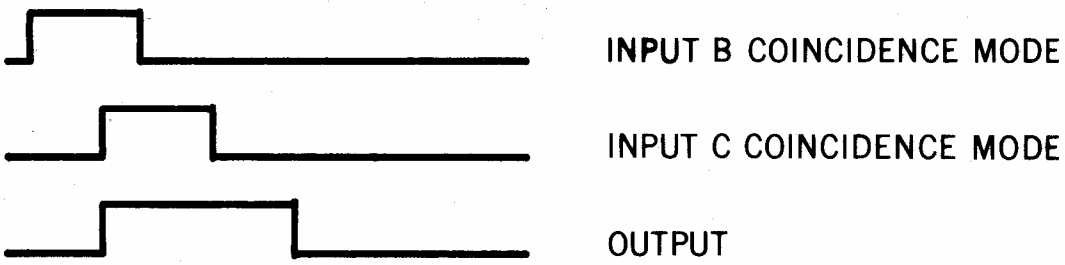

FIG. 4.1 COINCIDENCE REQUIREMENTS SWITCH SETTING—2

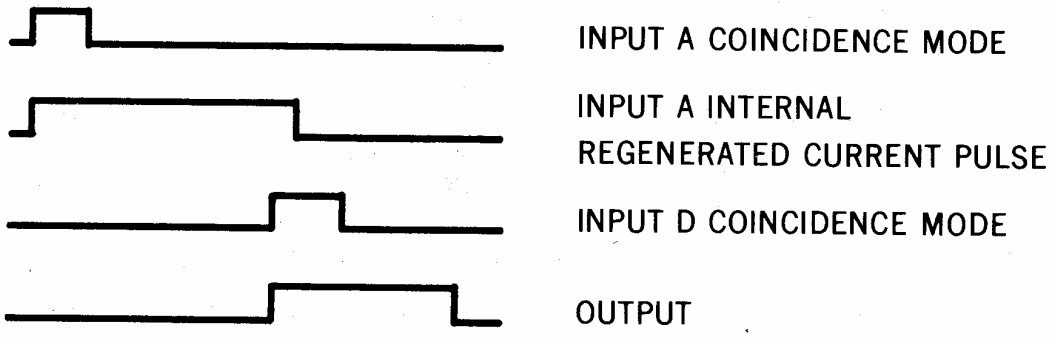

FIG. 4.2 COINCIDENCE REQUIREMENTS SWITCH SETTING—2

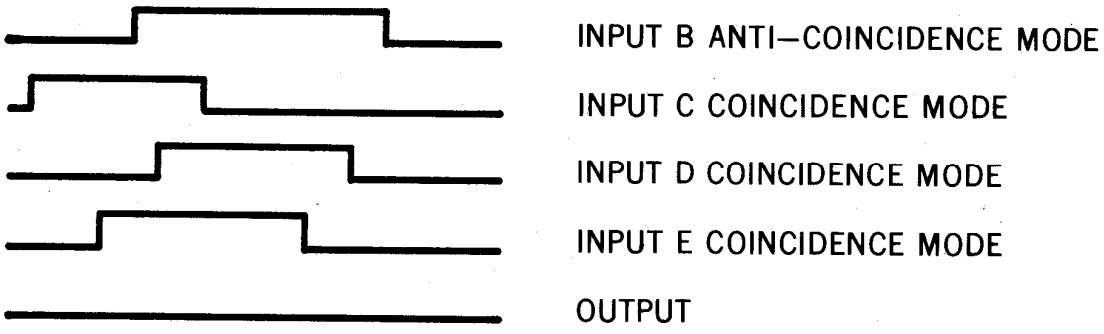

FIG. 4.3 COINCIDENCE REQUIREMENTS SWITCH SETTING—3

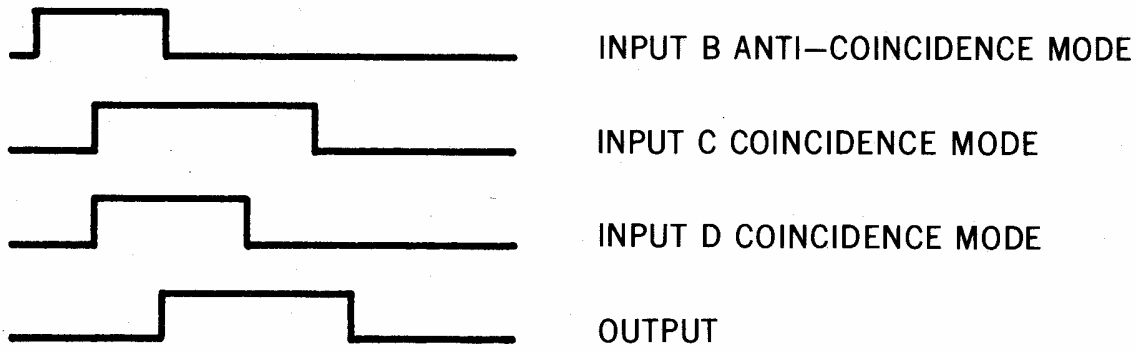

FIG. 4.4 COINCIDENCE REQUIREMENTS SWITCH SETTING—2

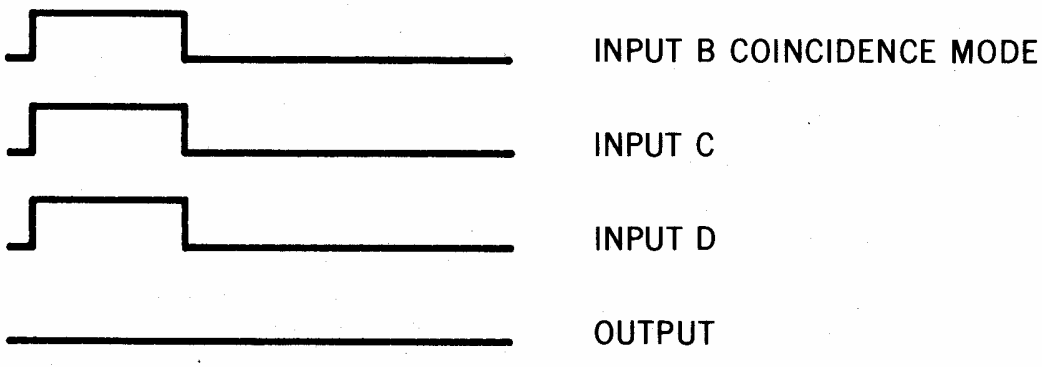

FIG. 4.5 COINCIDENCE REQUIREMENTS SWITCH SETTING—4

5. CIRCUIT DESCRIPTION

The 418 has five dc coupled inputs which may be used in the coincidence or anti-coincidence mode. (See Drawings 418-0101-S1 and 418-0201-B1.) Each input is protected by a diode limiter. INPUT A has a variable resolving time, while INPUTS B through E have a resolving time determined by their input pulse widths. The INPUT CONTROLS route the signals from these inputs to the coincidence (D29) or anticoincidence (Q25) stage. The number of coincident pulses required to trigger the coincidence stage (tunnel diode D29) is determined by the amount of reverse current flowing in D29. The quiescent current flowing in D29 is controlled by the COINCIDENCE REQUIREMENTS switch and Q26. If D29 is triggered to its high state, a one shot (Q27-Q29) is triggered which produces a 5-volt, 500 nanosecond wide pulse. This pulse is passed through two emitter followers to the output connectors.

5.1 INPUT A

INPUT A is fed to a current switch (Q1 and Q3) through a diode limiter consisting of D1, D2, R1, R2, R3, and R4. The limiting action is accomplished when a positive voltage, large enough to switch the constant current that normally flows through D1 and R1 to the limiter load, R3 and R4, is applied to the input. This causes Q1 base voltage to exceed ground potential and turn Q1 on. Emitter follower Q2 drives the base of Q6 negative through the timing capacitor, C2, with the pulse from the collector of Q1. The amplitude of this pulse can be varied by adjusting trimpot R83. The resolving time of INPUT A, τ_a, is determined by the length of time Q6 is off. The constant current generator, Q4, controls the off time of Q6, τ_a, by discharging capacitor C2 back from its negative value toward ground. When the voltage at the base of Q6 exceeds ground potential, Q6 is turned on again. Q8 converts the voltage pulse at Q6 collector to a current pulse to drive the coincidence stage. R83 should be adjusted so that the width of this current pulse is 2 μsec when INPUT A RESOLVING TIME control is set at maximum. Q5 is used as a feedback element to ensure that the pulse from the input current switch, Q1 collector, has a minimum duration of τ_a regardless of the input pulse width.

5.2 INPUTS B, C, D, and E

These four inputs are identical so only INPUT B will be explained. A diode limiter similar to that of INPUT A is provided. This limiter is followed by a dc Schmitt trigger circuit, Q9, Q10, Q11. In the quiescent state, the base of Q9 is at ground potential and the base of Q10 is 1.8 volts. Q10 base potential is maintained by the current from Q11 and R25. When a pulse is applied to the input and raises the base of Q9 above the potential at the base of Q10, Q9 turns on and Q10 and Q11 turn off. Due to the loss of the current

supplied by Q11, the base of Q10 is now set at 0.9 volt. The circuit will be reset to its quiescent state when the input voltage drops below 0.9 volt. The hysteresis and threshold of the circuit can be altered by changing the value of R22 and R25. Q12 converts the voltage pulse at the collector of Q10 to a current pulse.

The current pulse from each input circuit is connected to a three position toggle switch (INPUT CONTROLS) which routes the pulse to the coincidence stage, ground (OUT position), or the anticoincidence stage.

The anticoincidence stage is composed of Q25, which is biased off in the quiescent condition. An anticoincidence pulse saturates Q25 for the duration of the pulse. When Q25 saturates, it short circuits the coincidence line to ground, thereby preventing coincidence signals from reaching the coincidence stage for the duration of the anticoincidence pulse.

The coincidence stage is composed of D29 and Q26. When tunnel diode D29 is set to its high state by the coincidence current pulses, the 418 produces an output pulse. The number of coincident current pulses required to set D29 to its high state is determined by its quiescent current. The bias current in D29 is equal to the collection current of Q26. This current is controlled by Q26 emitter resistor which is selected by the COINCIDENCE REQUIREMENTS switch. The voltage pulse produced when D29 is set to its high state turns Q27 on and Q29 off. The period of time that Q29 stays off is equal to the output pulse width and is controlled by C9 and R74. If a different output pulse width is desired, the value of C9 should be changed. The pulse at the collector of Q29 is dc coupled to the output connectors through two emitter followers (Q30 and Q31). In the quiescent condition, the bases of these transistors are at zero volts and they do not conduct. The amplitude of the output pulses is determined by the ratio of R72 and R75. R75 should be increased in value to increase the output pulse amplitude. An output pulse amplitude of approximately 10 volts can be obtained by removing R75 from the circuit.

3. INSTALLATION

3.1 General Installation Considerations

The 418, used in conjunction with a 401A/402A Bin and Power Supply, is intended for rack mounting and therefore it is necessary to ensure that vacuum tube equipment operating in the same rack have sufficient cooling air circulating to prevent any localized heating of the all-transistor circuitry used throughout the 418. The temperature of equipment mounted in racks can easily exceed the recommended maximum unless precautions are taken. The 418 should not be subjected to temperatures in excess of 120°F (50°C).

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3.3 Logic Inputs to the Coincidence Unit

The input pulses to the 418 may come from any source of logic pulses. The input impedance is approximately 2000 ohms, and some care must be given to ensure that reflections do not occur in the driving transmission cable. This probably can best be avoided by terminating the driving cable at the inputs with the characteristic impedance of the driving cable. The amplitude and width of the input signals are specified in Section 2.2.

Mechanical: Two modules wide and designed to meet the recommended interchangeability standards set forth in USAEC Report TID-20893 (Rev.); 2.70 inches wide, 8.75 inches high, and 9.75 inches long.