Model 2040
Coincidence Analyzer

9231715B

Manual Type

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The information in this document describes the product as accurately as possible, but is subject to change without notice.

Printed in the United States of America.

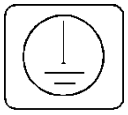
For technical assistance, call our Customer Service Hotline at 1-800-255-6370 or email techsupport@canberra.com.

Table of Contents

Important Safety Considerations
Read Carefully

Indicates warning of mains or high voltage present at output labeled HV.
Risk of electrical shock if covers are removed.

Caution – risk of danger. Refer to documentation for detailed explanation of caution symbol wherever marked.



Earth tree symbol: indicates the connection point for the primary earth (ground) supply.

Product complies with appropriate current EU directives (Low Voltage & EMC).

Product complies with appropriate current FCC /UL /CSA 61010-1 directives (Low Volatge & EMC).

Manufacturer's Address

Mirion Technologies (Canberra), Inc.
800 Research Parkway
Meriden, CT 06450 USA

1. Introduction

Coincidence Analyzer Operation

The Canberra Model 2040 Coincidence Analyzer accepts up to four input signals generated by energy analysis or time discrimination modules. In turn, it produces a logic pulse output when all of the inputs enabled by front-panel switches occur within the resolving time set by front-panel controls; that is, when the leading edges of all selected input logic pulses occur within a time period equal to the “resolving time” selected.

Two resolving time ranges are provided: 0.1 - 1.0 microsecond and 10 - 100 nanoseconds. The 0.1 to 1.0 microsecond range is typically used for energy coincidence analysis; the 10 - 100 nanosecond range is used for timing or simultaneous energy and timing coincidence experiments.

The input signals are positive NIM logic signals such as the +5 volt nominal pulses 0.5 microseconds wide from 2035A, 2036A, and 2037A Timing Single Channel Analyzers. The pulse width is not' important since only the leading edge is used by the 2040

Coincidence Analyzer to trigger the internal pulses. The positive or “slow” outputs from the 1427 ARC Timing, the 1428 Constant Fraction Discriminator, and the 2055 LogicShaper and Delay may also be used as inputs to the 2040.

The 2040 output pulse is a NIM logic pulse, and is produced when all switch-selected input conditions are met. For example, if A and B and ANTI inputs are IN, pulses must be present at A and B and not at ANTI, with the leading edges of A and B within the resolving time of the unit. A truth table for the various inputs is given in the Truth table on page 7.

Applications

The inputs to the Model 2040 can be any standard NIM logic pulse such as produced by SCAs. A coincidence set up with NaI detectors is shown in Figure 1. The unipolar output pulse from the 2012 Amplifier is processed by a Model 2036A Constant Fraction Timing SCA to produce a standard NIM logic pulse for the 2040 Coincidence

unit. In order to properly operate the system a delay curve is obtained in which coincidences are measured as a function of relative delay between the two detectors. The de- lay controls on each 2036A are used to set relative delay. In the ideal case of no time jitter in either detector, the solid curve in Figure 2 is obtained. However, real detectors will produce the dashed curve, and the minimum resolving time setting is where there is a flat region (indicating all true coincidences are collected). The proper relative de- lay is then the value for the center of the flat region.

A coincidence circuit in which the spectrum of one detector is collected in an MCA gated by coincidence pulses from the 2040 is shown in Figure 3. The timing signals are derived from Model 2037A Crossover Timing SCAs with bipolar pulses from the

2011 amplifiers. For Canberra ADCs operating in the late coincidence mode the Model 2055 Logic Shaper and Delay may be omitted since only a trigger pulse is required.

The 2040 may also be used in a slow coincidence mode in conjunction with a time-to-amplitude converter such as the Model 2043 Time Analyzer shown in Figure

4. The 2040 coincidence would be used with the RANGE switch set to 0.1 - 1 μsec. Care must be used in the arrangement shown to set the relative delays properly, which is done by adjusting 2015A amplifier time constants, 2043 output delay, and 1457 de - lay amp time constants.

2. Controls and Connectors

Front and Rear Panels

This is a brief description of the 2040's front and rear panel connectors. For more detailed information, refer to Appendix A, *Specifications*.

Input Connector

Connectors A through C are used for coincidence events. If all signals at these connectors (enabled by the corresponding input toggle switches) occur within the resolving time set by the RESOLVING TIME controls, an output signal will occur at the OUTPUT connector. The anti-coincidence input (ANTI) is used to inhibit an output, imposing a NAND condition.

Output Connector

A positive 10 volt pulse with a rise time less than 0.50 nanoseconds and a duration of one microsecond is produced when a coincidence (or anti-coincidence, depending upon the connection made) occurs among the enabled inputs to the Model 2040.

Resolving Time Control

This potentiometer selects resolving times within the range set by the RANGE switch.

Range Switch

This switch determines the resolving time range within which the Model 2040 will operate. There are two positions: 10 – 100 nanoseconds and 0.1 – 1.0 microseconds.

Toggle Switch

These switches are used to select those inputs which will be considered for coincidence (or anti-coincidence) experiment; all inputs not selected by these switches are ignored; the absence of any input pulse at an input enabled by the toggle switch will inhibit any output from the Model 2040 Coincidence Analyzer.

Figure 1 2040 Front Panel Controls and Connectors

Controls

3. Operations

Since it is impossible to determine exactly how the user will operate his module in a specific experiment, explicit instructions cannot be given. However, if the following general procedures are performed, the user will become as familiar with the operation of the module as is necessary.

Setup

1. Insert the Model 2040 Coincidence Analyzer module in an AEC compatible bin such as the Canberra Model 2000.

2. For coincidence operation, connect input signals, which meet the conditions detailed in the Inputs section of Appendix A, Specifications, to BNC connectors A and B. (See also “Applications” on page X.).

3. Set toggle switches A and B to the IN position.

4. Set the toggle switches associated with input C and 'ANTI at their out positions (down).

5. Connect the OUTPUT connector to an oscilloscope or to the input of a scaler such as the Canberra Model•1772. Set the sensitivities of the oscilloscope to 5V/cm and 1 microsecond/cm, vertical and horizontal, respectively.

6. Set the RANGE switch to 0.1 – 1.0 microsecond; set the RESOLVING TIME control to 10 (max.).

Coincidence Checkout

1. Activate the input signals and observe the OUTPUT signal on the oscilloscope (or observe the scaler beginning to count). If an output cannot be seen, using the oscilloscope check that the inputs are as specified in the Inputs section of Appendix A, Specifications. An output signal will be generated when the input signals occur within one microsecond of each other.

2. Repeat step 1 with the following input signal combinations:

   a. Input A and Input C.

   b. Input B and Input Co c. Inputs A, B, and Co

   Be sure that the IN switch is set for those inputs which are to be. Enabled (and that they are off for those not enabled).

3. Keeping the set up as in Step 2, reduce the RESOLVING TIME control setting and note that the OUTPUT signal finally disappears.

4. Using two coincidence inputs (A and B, for example) delay one with respect to the other. The following diagrams show how Canberra modules can be used for this test:

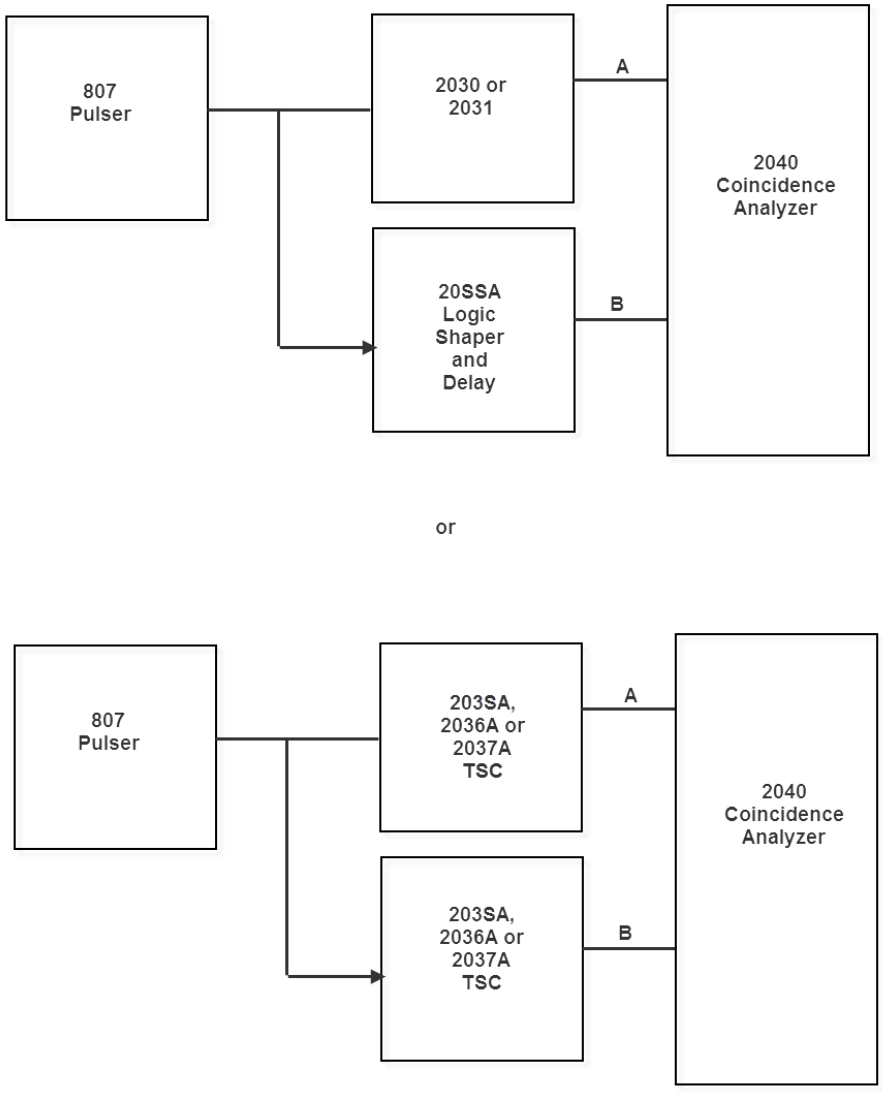


Figure 2 Use variable delay on one Model 2037A SCA

5. Check that an output is generated when the input signals occur within the RESOLVING TIME set on the RESOLVING TIME control. Vary the delay and RESOLVING TIME controls and check them at different settings. Refer to Figure 4-2 for a typical linearity/accuracy curve of actual resolving time vs. indicated time.

6. Set all IN switches at their off position (down). Note that the OUTPUT signal disappears.

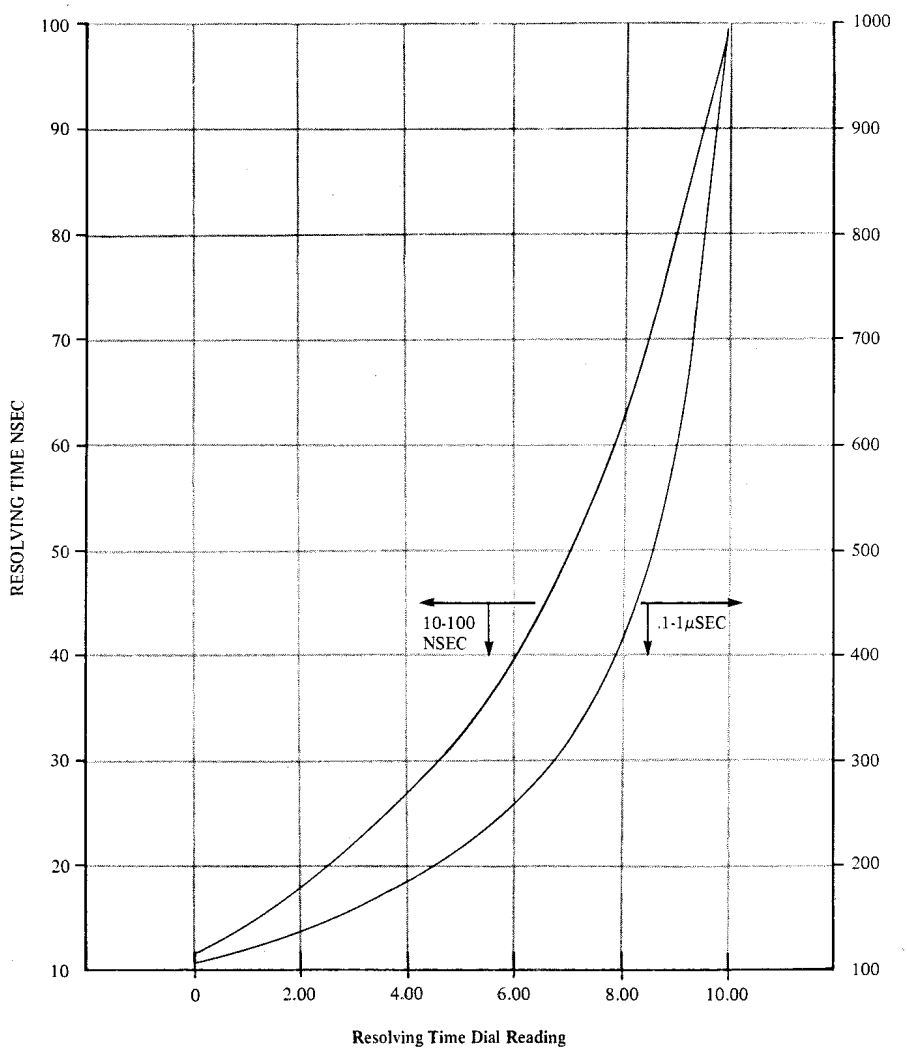


Figure 4-2 Dial Resolving Time vs. Actual Resolving Time

Anti-Coincidence

1. Supply a signal to the ANTI connector and one to the INPUT A connector.
2. Set the RESOLVING TIME control at 10.
3. Set the RANGE switch at 0.1 – 1.0 microsecond.
4. Set the A IN switch at IN.
5. Set the ANTI IN switch at IN.
6. Set all other switches at their off position (down).
7. Observe the OUTPUT. No output pulse will be generated if any input signals on connectors A, B, or C occur in coincidence with the signal at the ANTI connector.
8. Repeat Step 7 utilizing other coincidence inputs. The following truth table will be obtained when operating the Model 2040 Coincidence Analyzer:

Input Signal				
A	**B**	**C**	**ANTI**	**OUTPUT**
0	0	0	1	0
0	0	1	1	0
0	1	0	1	0
0	1	1	1	0
1	0	0	1	0
1	0	1	1	0
1	1	0	1	0
1	1	1	1	0
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	0	1
1	0	0	0	1
1	0	1	0	1
1	1	0	0	1
1	1	1	0	1

Note: It is assumed that a “0” input refers to the corresponding channel that is switched “OUT”.

4. Circuit Description

The following is a description of the circuitry used in the 2040 Coincidence Analyzer. A functional schematic and/or block diagram of the Model 2040 can be ordered from Canberra.

Each input to the Model 2040 has a differentiator and a one-shot associated with it. The differentiator detects the leading edge of the input pulse and generates a negative spike to trigger the one-shot.

The ANTI input is disabled by holding the buffer transistor (Q13) on, so that an input will not make a trigger spike. The three COINC inputs are disabled by turning off the one-shot input transistor. This also makes the output of the one-shot high so that it can be ANDed with enabled one-shots.

RESOLVING TIME is essentially the width of the one-shots. The last input must be triggered before the first input one-shot times out. (See Timing Diagrams). When the third triggered input one-shot goes high, this makes the input to the Schmitt Trigger made up of Q20, Q2 I, and Q22 go high and give a TRIG X pulse.

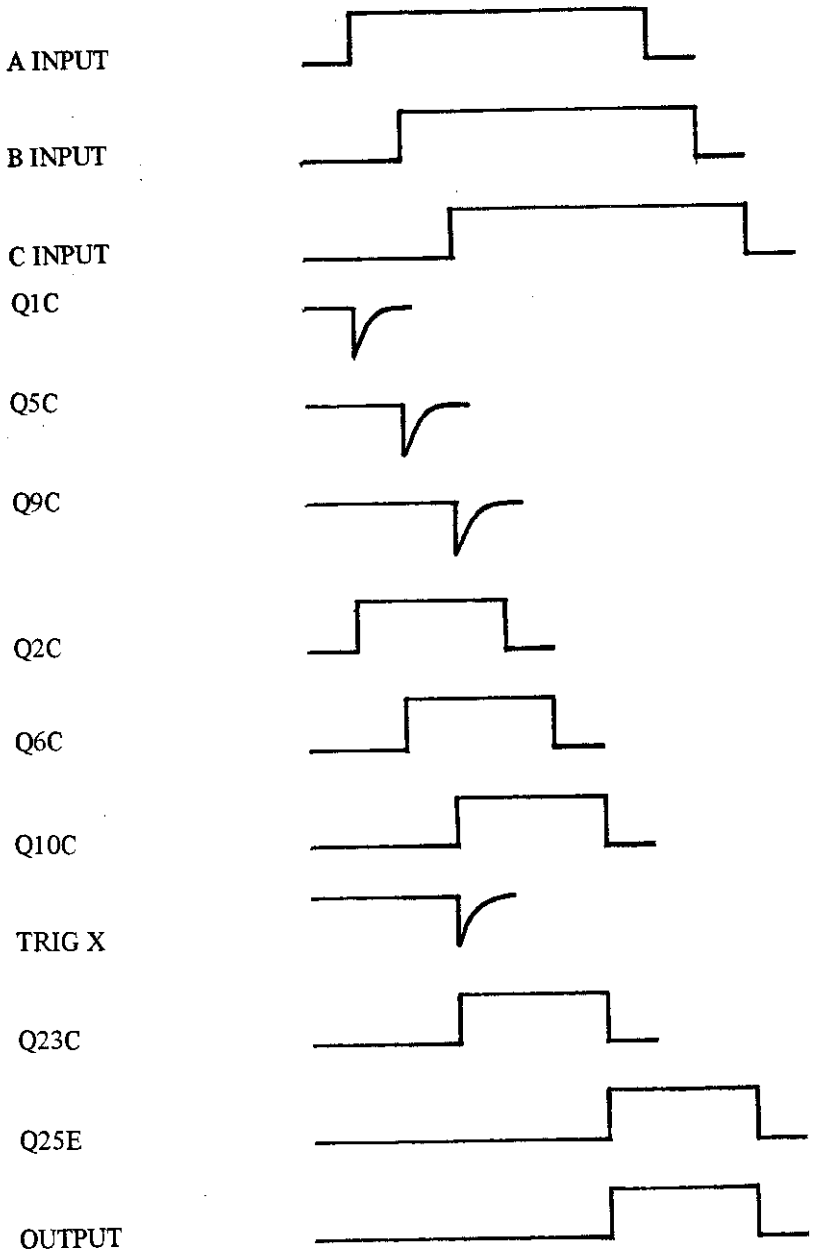
TRIG X triggers the ENABLE ONE-SHOT (Q23, Q24) which in turn triggers the OUTPUT ONE-SHOT (Q25, Q27) to generate an output.

However, if an ANTI input occurs within the resolving time, a TRIG Y will be generated by Schmitt Trigger QI 7, QI8 and Q19. This triggers the DISABLE ONE-SHOT (Q30, Q31) and holds the output of the ENABLE ONE-SHOT low to inhibit an output.

Resolving time is varied by the RESOLVING TIME control and the RANGE switch to control the time of each one-shot.

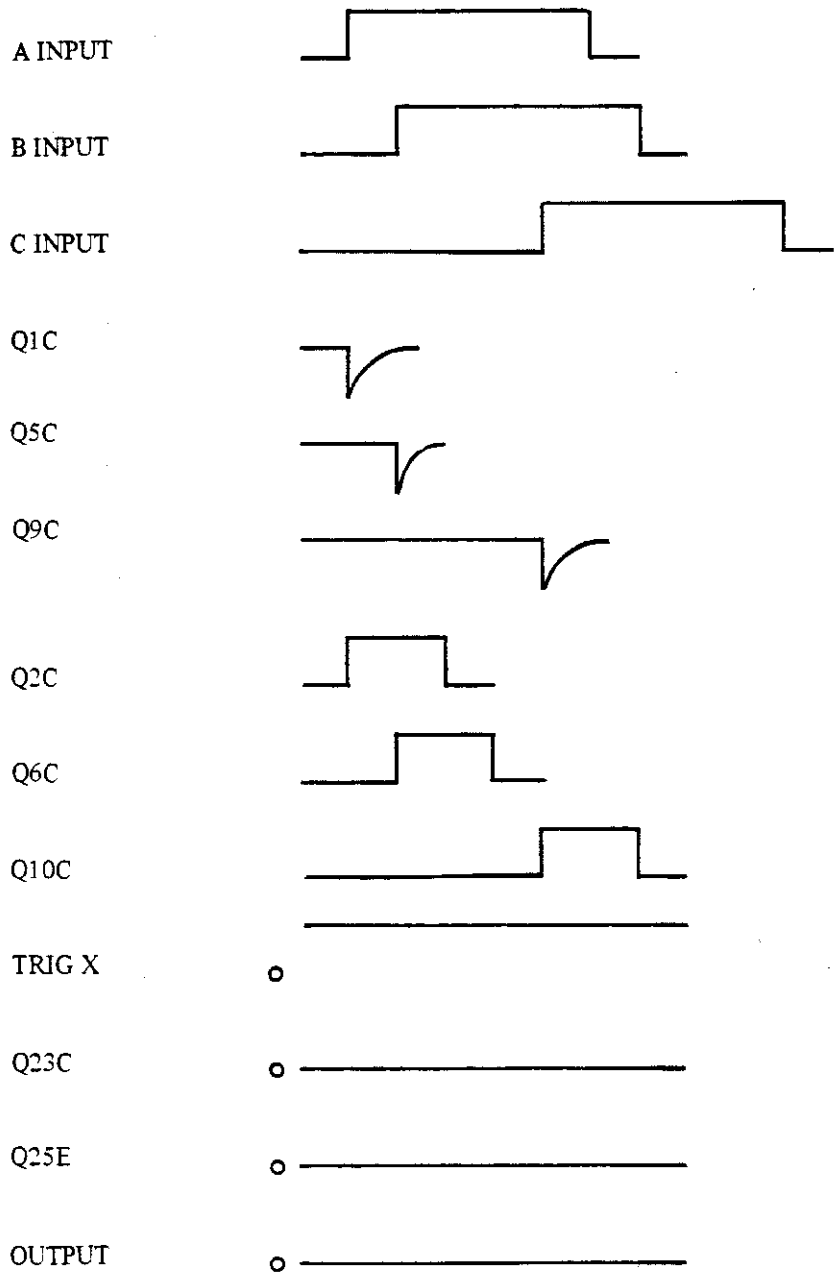
Case 1

3 COINC INPUTS WITHIN RESOLVING TIME



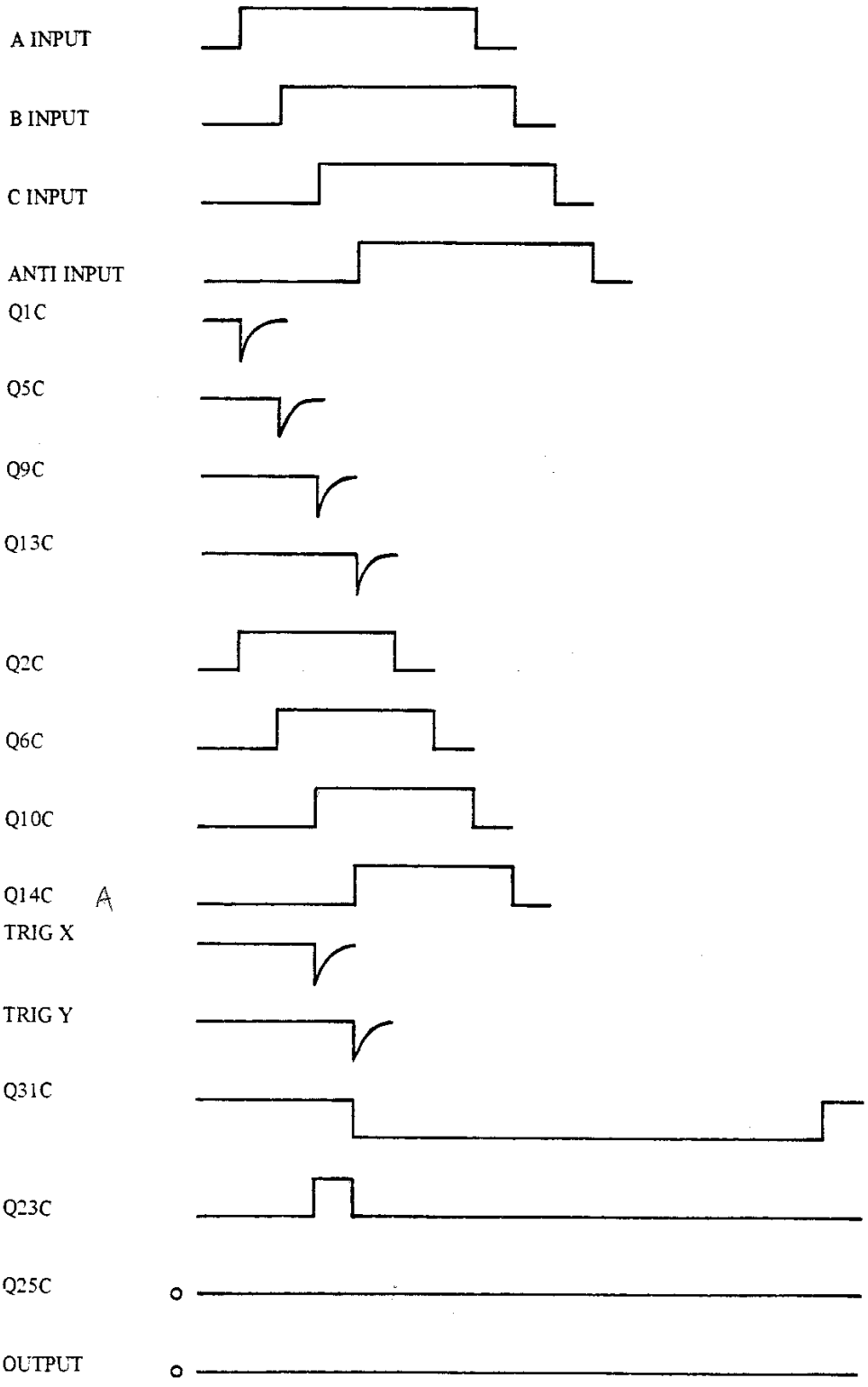
Case 2

3 COINC INPUTS - ONE OUT OF RESOLVING TIME



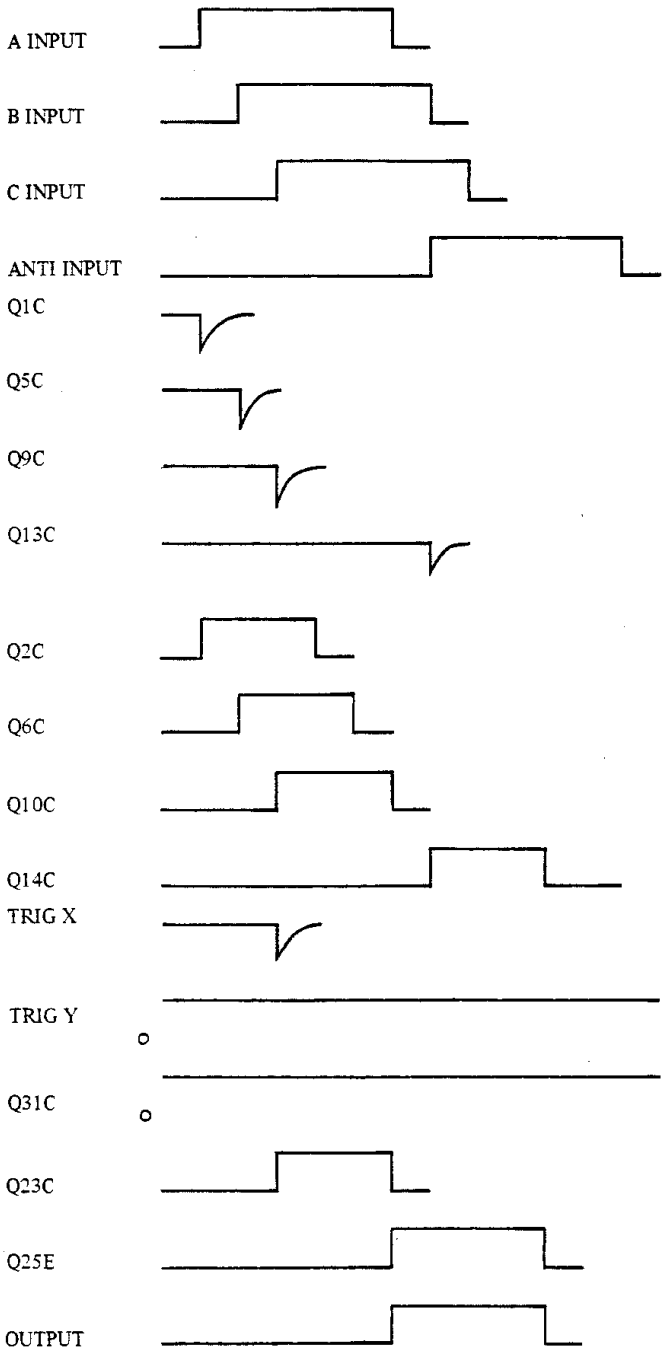
Case 3

3 COINC INPUTS AND ANTI INPUT IN RESOLVING TIME



Case 4

3 COINC INPUTS IN RESOLVING TIME ANTI OUT OF RESOLVING TIME



A. Specifications

Input

INPUTS – Accept positive 4-10 V pulses; rise time <40 ns; duration greater than 100 ns; Zin ≈ 2.2 kΩ shunted by 120 pF.

Output

OUTPUT – Positive 10 V pulse; rise time <50 ns; width; Zout = 50Ω; dc coupled.

Controls

RANGE – 10 to 100 ns or 0.1 to 1.0 μs, front panel switch selected.

RESOLVING TIME – 1 to 10 within selected RANGE; front panel ten-turn potentiometer control.

CHANNEL SELECTION – Each channel can be enabled (IN) or disabled (OUT) for coincidence evaluation using front panel switches. Input within selected RESOLVING TIME must be present at each enabled channel for an output to be generated.

Performance

RESOLVING TIME STABILITY – ≤5% of setting or 3 ns, whichever is larger.

Connectors

All signal connectors are front panel BNC type. POWER REQUIREMENTS

+24 V dc .-35 mA +12 V dc -170 mA

.24 V dc .-80 mA -12 V dc -12 mA

Physical

SIZE – Standard single-width NIM module 3.43 cm x 22.12 cm (1.35 x 8.71 in.) per

DOE/ER-0457T.

NET WEIGHT – 0.9 kg (2.0 lb). SHIPPING WEIGHT – 1.8 kg (4.0 lb).

Environmental

OPERATING TEMPERATURE – 0 to 50 °C.

OPERATING HUMIDITY – 0 to 80% relative, non-condensing.

Meets the environmental conditions specified by EN 61010, Installation Category I, Pollution Degree 2.

B. Installation Considerations

This unit complies with all applicable requirements. Compliance testing was performed with application configurations commonly used for this device.

During design and assembly of the device, precautions were taken by the manufacturer to minimize the effects of RFI and EMC on the system. However, care should be taken to maintain full compliance. These considerations include:

- A rack or tabletop enclosure fully closed on all sides with rear door access.
- Single point external cable access.
- Blank panels to cover open front panel Bin area.
- Compliant grounding and safety precautions for any internal power distribution.
- The use of NRTL/CE compliant accessories such as fans, UPS, etc.

Preventive Maintenance

This unit does not require any periodic cleaning maintenance.

Any maintenance should be performed by a qualified Mirion Technologies (Canberra) service representative.

Operating Protection Impairment

Mirion Technologies (Canberra) is not liable for any operational malfunctions or personal injuries due to mishandling or unauthorized repair and maintenance not detailed in this manual.

Cleaning/Decontamination

When needed, the unit may be cleaned. Remove power from the unit before cleaning. Use only a soft cloth dampened with warm water and do not allow water to enter the unit. Make sure unit is fully dry before restoring power. Because of the ventilation holes in the NIM wrap, do not use any liquids to clean the wrap, side, or rear panels.

C. FCC Notice

The following paragraphs are notices required by Federal Communications Commission (FCC) rules, Part 15, Subpart A.

"The user is cautioned that any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment."

This equipment has been tested and found to comply with the limits for a class A digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Request for Circuit Information

The Schematics and Block Diagrams may be available for this unit directly from Mirion Technologies (Canberra). Request can be made by calling, faxing, or emailing:

Training and Technical Services Department
Mirion Technologies (Canberra), Inc
800 Research Parkway, Meriden, CT 06450
Telephone: (800) 255-6370FAX: (203) 639-2067
Email: **techsupport@canberra.com**

If you would like schematics, if available, for this unit, please provide us with the following information.

Your Name _____

Your Address _____

_____

_____

_____

_____

Unit's model number _____

Unit's serial number _____

Note: Schematics, block diagrams, and circuit descriptions are provided for information only; if you service or repair or try to service or repair this unit without Mirion Technologies (Canberra)'s written permission you may void your warranty.

Notes

CANBERRA

Warranty

Mirion Technologies (Canberra) Inc. (we, us, our) warrants to the customer (you, your) that for a period of ninety (90) days from the date of shipment, software provided by us in connection with equipment manufactured by us shall operate in accordance with applicable specifications when used with equipment manufactured by us and that the media on which the software is provided shall be free from defects. We also warrant that (A) equipment manufactured by us shall be free from defects in materials and workmanship for a period of one (1) year from the date of shipment of such equipment, and (B) services performed by us in connection with such equipment, such as site supervision and installation services relating to the equipment, shall be free from defects for a period of one (1) year from the date of performance of such services.

If defects in materials or workmanship are discovered within the applicable warranty period as set forth above, we shall, at our option and cost (A) in the case of defective software or equipment, either repair on a return to factory basis or replace the software or equipment, or (B) in the case of defective services, reperform such services.

LIMITATIONS

EXCEPT AS SET FORTH HEREIN, NO OTHER WARRANTIES OR REMEDIES, WHETHER STATUTORY, WRITTEN, ORAL, EXPRESSED, IMPLIED (INCLUDING WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE) OR OTHERWISE, SHALL APPLY. IN NO EVENT SHALL WE HAVE ANY LIABILITY FOR ANY SPECIAL, EXEMPLARY, PUNITIVE, INDIRECT OR CONSEQUENTIAL LOSSES OR DAMAGES OF ANY NATURE WHATSOEVER, WHETHER AS A RESULT OF BREACH OF CONTRACT, TORT LIABILITY (INCLUDING NEGLIGENCE), STRICT LIABILITY OR OTHERWISE. REPAIR OR REPLACEMENT OF THE SOFTWARE OR EQUIPMENT DURING THE APPLICABLE WARRANTY PERIOD AT OUR COST, OR, IN THE CASE OF DEFECTIVE SERVICES, REPERFORMANCE AT OUR COST, IS YOUR SOLE AND EXCLUSIVE REMEDY UNDER THIS WARRANTY.

EXCLUSIONS

Our warranty does not cover damage to equipment which has been altered or modified without our written permission or damage which has been caused by abuse, misuse, accident, neglect or unusual physical or electrical stress, as determined by our Service Personnel.

We are under no obligation to provide warranty service if adjustment or repair is required because of damage caused by other than ordinary use or if the equipment is serviced or repaired, or if an attempt is made to service or repair the equipment, by other than our Service Personnel without our prior approval.

Our warranty does not cover detector damage due to neutrons or heavy charged particles. Failure of beryllium, carbon composite, or polymer windows or of windowless detectors caused by physical or chemical damage from the environment is not covered by warranty.

We are not responsible for damage sustained in transit. You should examine shipments upon receipt for evidence of damage caused in transit. If damage is found, notify us and the carrier immediately. Keep all packages, materials and documents, including the freight bill, invoice and packing list.

Revised 04 Nov 16