

Model 924
Quad Discriminator
with Burst Guard
Operating and Service Manual

This manual applies instruments marked
"Rev 03" on rear panel

ORTEC
924
QUAD DISC

T W IN
A 1 C
B OUT C

T W IN
A 2 C
B OUT C

T W IN
A 3 C
B OUT C

T W IN
A 4 C
B OUT C

BURST GUARD UPDATE ONLY

The image shows a vertical control panel for an ORTEC 924 QUAD DISC. At the top, there is a logo with the letters 'ORTEC' and the number '924' above 'QUAD DISC'. Below this, there are four identical channel sections, each labeled '1', '2', '3', and '4' respectively. Each channel section contains a set of controls: a 'T W IN' section with two knobs, an 'A' knob, an 'OUT' section with two knobs, and a 'C' knob. At the bottom of the panel, there is a section labeled 'BURST GUARD UPDATE ONLY' with a small circular indicator and two knobs. The entire panel is enclosed in a rectangular frame with a semi-circular cutout at the top and bottom.

ORTEC 924 QUAD DISCRIMINATOR WITH BURST GUARD

1. DESCRIPTION

The ORTEC 924 Quad Discriminator is a single-width NIM module that includes four independent general-purpose leading edge discriminators. Each section of this module accepts NIM-standard fast negative pulses and generates a set of five negative output pulses, together with one complementary negative output, for each input pulse that exceeds the adjusted threshold. The output pulse width through all six connectors is adjusted by a front panel control, and both the threshold and width adjustments are independent for each of the four channels. The design of this instrument utilizes advanced ORTEC hybrid circuit technology to achieve high reliability in an economical high-density package.

The 924 operates in either of two basic modes, which affect all four channels. One mode is Update Only and the other mode is Burst Guard. For the Update Only mode, a zero deadtime pulse shaping circuit guarantees that a single set of output pulses will be generated to represent the most recent threshold crossing of the input in each channel independently. This feature functions regardless of the variations that random input signals and cabling techniques may produce at the input to the channel. In the Burst Guard mode, the 924 will protect against input pulses that arrive at a rate that exceeds the pulse-pair resolution of the unit (typically >110 MHz). The output duration for the Burst Guard mode is either the selected output width or the burst width, whichever is greater; the burst width is the time interval between the first leading edge crossing of the threshold and the last trailing edge recrossing of the threshold.

The input circuit has been carefully designed for 50Ω impedance matching that eliminates reflections and distortions. A protection

924-2

network is included that minimizes the risk of damage from extreme overloads.

The 924 operates in an ORTEC 401A/402D or M/400N NIMBIN^R that includes distribution of dc power at ± 24 V, ± 12 V, and ± 6 V. By using either of these recommended bins and power supplies, a full complement of 12 modules can be operated in the bin, with a total capacity of 48 discriminator channels.

2. SPECIFICATIONS

2.1. PERFORMANCE

Number of Channels Four.

Input/Output Rate 110 MHz typical, 100 MHz guaranteed.

Pulse-Pair Resolution <9 ns.

Time Slewing <1 ns for input amplitudes $\geq 110\%$ of threshold.

Transmission Delay 9.5 ns typical, input to output.

Multiple Pulsing None; one output pulse of preset duration is generated for each input threshold crossing regardless of its amplitude and duration.

Threshold Temperature Instability $\leq 0.2\%/^{\circ}$, 0 to 50°C (273 to 323 K).

Output Width Temperature Instability $\leq 0.2\%/^{\circ}$, 0 to 50°C (273 to 323 K).

Operating Temperature Range 0 to 50°C (273 to 323 K).

2.2. CONTROLS

Threshold (T) Independent 10-turn front panel screwdriver adjustment for each discriminator channel; variable from -30 mV to ~ 1000 mV; the adjusted level is measured on the adjacent test point, where a meter will indicate 10X threshold (0.3 to 10 V).

Width (W) Independent 10-turn front panel screwdriver adjustment for each discriminator to set the output pulse width; range ≤ 5 ns to > 1 μs .

Mode Front panel locking toggle switch selects mode of operation for all four discriminator channels as follows:

Burst Guard Output duration is approximately equal to the time-over-threshold for a burst of input signals or equal to the preselected width, whichever is greater. For input bursts with rates that exceed 110 MHz the 928 will produce an output of width equal to the burst duration or the preselected duration, whichever is greater.

Update Only Output pulse width determined by front panel adjustment.

Gate Rear panel On/Off toggle switch to control use of a master gate signal that can be furnished to all channels in the module.

2.3. INPUTS

Input Independent front panel LEMO connector for each discriminator channel. Linear range, -30 mV to -1000 mV. Z_{in} 50 Ω . Input protected to +5 V for 0.5 μ s and clamped at +1 V and -7 V. Input reflections $\leq 2\%$ for signals with rise time ≥ 2 ns. Input offset ± 1 mV.

Gate Master gate signal enabled by the rear panel Gated/Ungated locking toggle switch; connected through pin 36 in the NIM power connector to a gate line that is common to pin 36 at all other module locations in the bin. When the switch is set at Gated, a clamp to ground from +5 V inhibits operation of all four discriminator channels.

2.4. OUTPUTS

Out Six front panel LEMO connectors in each discriminator channel provide a set of negative outputs for each input pulse (or burst of pulses) that exceed the adjusted threshold. For proper operation, each of six output connectors must be terminated in 50 Ω in each active discriminator channel; there are no requirements for any channel that has no input.

A One pair of bridged negative outputs. Amplitude through each connector is 0 to -16 mA into 50 Ω ; width dependent on Mode selection and adjustable from ≤ 5 ns to > 1 μ s; rise time, 2.0 ns typical, ≤ 2.5 ns guaranteed; width instability, $\leq 0.2\%/^{\circ}\text{C}$; amplitude instability $\leq \pm 0.1\%/^{\circ}\text{C}$.

B One pair of bridged negative outputs. Characteristics identical to those listed for A above.

C One pair of timing outputs; one marked C and the other marked \bar{C} (to indicate complementary characteristics); amplitude, 0 to -16 mA on C and -16 mA to 0 on \bar{C} ; width, dependent on Mode selection and adjustable from ≤ 5 ns to 1 μ s; rise time 1.5 ns typical, ≤ 2 ns guaranteed;

width instability, $\leq \pm 0.2\%/^{\circ}\text{C}$; amplitude instability, $\leq \pm 0.01\%/^{\circ}\text{C}$.

2.5. ELECTRICAL AND MECHANICAL

Power Required +6 V, 150 mA; -6 V, 450 mA; +12 V, 20 mA; -12 V, 165 mA;
-24 V, 85 mA.

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

2.6. ACCESSORY

A small screwdriver is included with each 924 Quad Discriminator, that can be used for threshold and width adjustments.

2.7. OPTIONS

Remote Programming Permits application of dc voltages through the rear panel NIM power connector to independently control the threshold and output width for each discriminator channel.

High-Impedance Input Bridged high-impedance input for use in conjunction with amplitude digitizers. This option requires the substitution of one of the connectors normally devoted to a negative output.

3. INSTALLATION

3.1. GENERAL

The 924 operates on power that must be furnished from a nuclear-standard bin and power supply that includes the ± 6 V distribution. The ORTEC 401A/402D Bin and Power Supply provides this power distribution. The ORTEC M400/NIMBIN also provides the required power distribution and, in addition, includes wiring for the common gating line that can be used for the 924.

The bin and power supply in which the 924 will be operated is designed for relay rack mounting. If the equipment is rack mounted, be sure that there is adequate ventilation to prevent any localized heating of the components that are used in the 924. The temperature of equipment mounted in racks can easily exceed the maximum limit of 50°C (323 K) unless precautions are taken.

3.2. CONNECTION TO POWER

Turn off the Bin Power Supply before inserting or removing any modules. ORTEC modules are designed so that even a full complement of modules in the 12 bin positions will not overload an ORTEC 402D Power Supply. However, this may not be true when either a different power supply or modules other than ORTEC design are included in the bin. To be sure of proper operation, check the power supply dc voltage levels after all modules have been installed in the bin. The ORTEC bins and power supplies include convenient test points on the power supply control panel to permit monitoring these levels easily.

3.3. INPUT CONNECTIONS

Each discriminator channel includes an input connector on the front panel that is terminated internally in 50Ω . Connect the source of negative input signals to this connector with 50Ω cable and a LEMO mating connector. Any of the four channels can be used for an input signal connection, and it will operate independent from all other channels, whether they are also being used or not.

3.4. OUTPUT CONNECTIONS

There are six output connectors for each channel. Each provides a negative signal to represent an input pulse that exceeds the adjusted threshold, and the output signals are simultaneous. The width is dependent on the Mode of operation. The C and \bar{C} complementary output pair of signals are more appropriate for timing applications because they feature a shorter rise time than the other two pairs of outputs. Any one or more of these connectors can be used, as required for the applications of the information that is derived in the independent channel in the 924. Each output connection should be furnished through a mating LEMO connector and a 50Ω cable to a circuit that has a 50Ω input impedance. Always terminate the unused connectors in each active channel with a 50Ω terminator on the front panel for proper operation of the channel.

3.5. GATING

If the 924 is operated in an ORTEC M400/N NIMBIN or equal, control can be accepted simultaneously for all four discriminator channels from the common gating line that is wired through the rear panel power connectors. To accept the gating control, set the rear panel locking toggle switch at Gated; or to ignore this control for the module, set the switch at Ungated. The switch is accessible when the module is installed in the bin, and can be changed at any time.

4. OPERATING INSTRUCTIONS

Each channel that is to be used will have an input connection and requires that each of its six outputs be either cabled to a 50Ω circuit or terminated with a 50Ω terminator on the front panel. The discriminator threshold and the output width can be adjusted in each channel independently as required by the application.

To adjust a threshold, measure the voltage from the front panel monitor test point to ground for the active channel. The range of meter indications will be from -300 mV to -10 V, corresponding to the screwdriver-adjusted threshold, which is 10% of the meter indication. Use the special accessory screwdriver that is furnished with the 924 to set the threshold level as desired within this range.

To adjust the output width, provide an input pulse that exceeds the adjusted threshold at a rate less than 100 MHz and observe the width of an output pulse through any of the six output connectors; be sure that all six Out connector circuits are terminated in 50Ω . Use the special accessory screwdriver that is furnished with the 924 to adjust the width for the active channel within the limits of approximately 5 through 1000 ns.

Each channel that does not have an input connected to it can be completely ignored without affecting operation in any of the active channels.

When the input pulse rate is high enough that there is any probability of having input pulses arrive within a shorter interval than the 9-ns pulse pair resolution time, the front panel toggle switch can be set at Burst Guard to provide compatible operation. The output pulse width is extended beyond the adjusted width when a burst of input pulses maintains an input level above threshold for a longer time.

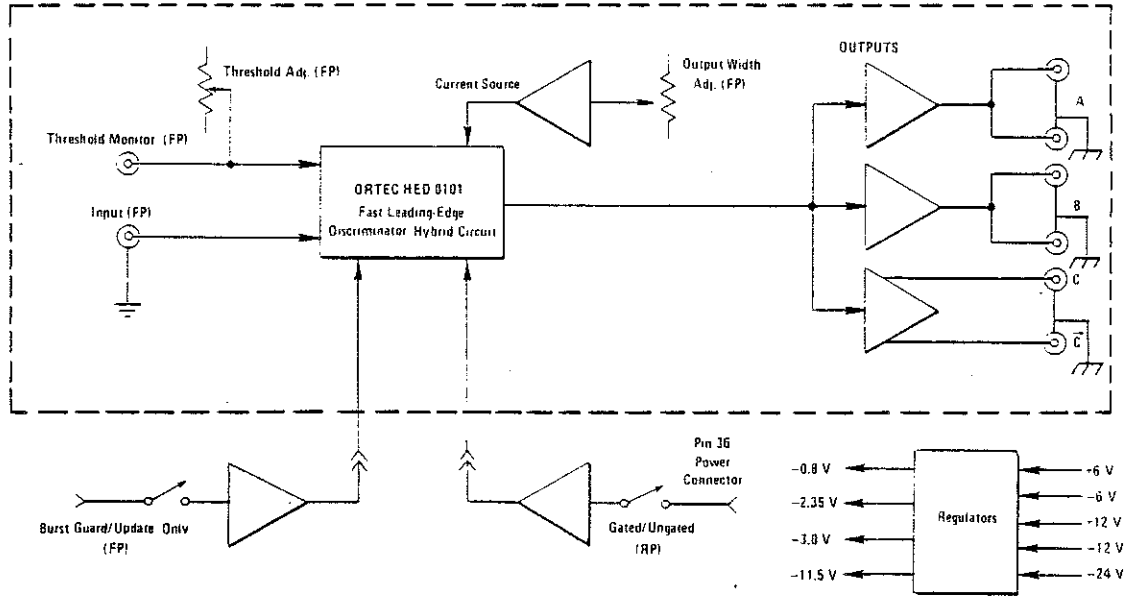
5. THEORY OF OPERATION

A complete schematic of the 924 Quad Discriminator with Burst Guard is included at the back of this manual. The block diagram in Fig. 5.1 illustrates the dc power circuits and one of the four identical discriminator channels in the instrument.

The input pulses are furnished through the LEMO connector on the front panel directly into an ORTEC HED 0101 Fast Leading Edge Discriminator circuit. The reference level is set by the front panel adjustment, and its setting can be monitored at the front panel test point; measurement at the test point is ten times the threshold level. When an input pulse amplitude exceeds the threshold level the discriminator generates an output unless it is inhibited by a gate input (common to all four discriminators).

When the discriminator is triggered, it causes the current source to control the width of the output that is generated. The output width is normally adjusted (for the Update Only mode) within the limits of about 5 to 1000 ns by the front panel W control. The output through the A connectors has been designed to furnish -16 mA through each of the pair of connectors when they are each terminated in 50 Ω . The B connectors provide a duplicate output circuit with the same characteristics. The C and \bar{C} connectors provide complementary outputs with faster rise time that can be used for timing applications.

When the front panel toggle switch is set at Burst Guard, the output pulses have a width that is either equal to the front panel adjusted width (if the threshold has been recrossed by the input prior to that time) or extended until the threshold is recrossed by the burst of input pulses.



ORTEC 924 Quad Discriminator Block Diagram (only one out of four channels shown).

Fig. 5.1

The dc power requirements are shown in both Fig. 5.1 and the schematic, 924-0201-S1. The power levels at 6, 12, and 24 V are all obtained directly from the bin power supply. The ORTEC Hybrid package also requires dc power at -0.8 V, -2.35 V, -3.0 V, and -11.5 V; each of these levels is obtained from a regulator and is adjustable on the printed circuit board. Monitor points are provided on the board for each of the four adjustable dc power levels.

6. MAINTENANCE AND CALIBRATION

6.1. DC POWER LEVELS

The 924 includes power regulators for four special dc levels that are required for the hybrid circuits. The levels are -11.5 V, -3 V, -2.35 V, and -0.8 V. Of these, the -11.5 V and -3 V levels are adjustable with calibration controls that are mounted on the printed circuit. A test point is provided for each of the four levels. Use the following procedure to check and adjust these levels if necessary.

1. Observe the -11.5 V level at TP3. Adjust R19 as necessary to obtain -11.5 V (± 115 mV) at TP3.
2. Observe the -3 V level at TP1. Adjust R4 as necessary to obtain -3 V (± 30 mV) at TP1.
3. Recheck the -11.5 V level at TP3; the adjustment for -3 V can reflect a change of loading on the -11.5 V circuit, and they must both be brought within the specified tolerances.
4. The -2.35 V and -0.8 V levels are directly dependent on the adjustment of the -11.5 V level. Check these at TP4 and TP2, respectively, to determine that they are operating properly.

6.2. TYPICAL DC VOLTAGES

Table 6.1 provides an aid for troubleshooting, if this should be necessary. The typical dc measurements in Table 6.1 were obtained with the threshold and width controls at minimum (fully counterclockwise), with the mode switch at Update Only, and with the rear panel toggle switch at Ungated; all inputs and outputs were unterminated. These dc levels should be considered as relative rather than absolute, and can vary from one unit to another and from one channel to another within the same module.

Table 6.1. Typical dc Voltages

<u>Test Point</u>	<u>Voltage</u>	<u>Test Point</u>	<u>Voltage</u>
A101-1	+6.00	Q103E	-3.00
A101-2	-5.84	Q103B	-2.40
A101-3	-1.20	Q103C	-1.20
A101-4	-2.50	Q104E	-2.86
A101-5	-2.50	Q104B	-2.40
A101-6	-2.05	Q104C	-0.935
A101-7	-5.84	Q105E	-2.86
A101-8	-11.5	Q105B	-2.06
A101-9	0	Q105C	-1.12
A101-10	-2.40		
A101-11	-2.37		
A101-12	-2.06		
A101-13	-1.94		
A101-14	-0.810		
A101-15	-0.888		
A101-16	-2.43		
A101-17	-0.810		
A101-18	0		
A101-19	-0.029		
A101-20	0		
Q101E	-2.76		
Q101B	-0.660		
Q101C	-1.93		
Q102E	-3.00		
Q102B	-2.40		
Q102C	-1.20		

Note: These voltages are listed for the components in one channel only; they are typical of the values that should be measured in each of the other three channels of the 924.

6.3. FACTORY SERVICE

This instrument can be returned to the ORTEC factory for service and repair at a nominal cost. The ORTEC standard procedure for repair ensures the same quality control and checkout that are used for a new instrument. Always contact Customer Services at ORTEC, (615) 482-4411, before sending in an instrument for repair to obtain shipping instructions and so that the required Return Authorization Number can be assigned to the unit. This number should be written on the address label and on the package to ensure prompt attention when it reaches the factory.