

# **Model 542 Linear Gate and Stretcher Operating and Service Manual**

NOTE: A substitution for the dual diode package (MSD6100) may have been made in this unit. If so, two 1N4153 diodes were used to replace each MSD6100.

# **Advanced Measurement Technology, Inc.**

a/k/a/ ORTEC<sup>®</sup>, a subsidiary of AMETEK<sup>®</sup>, Inc.

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### **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 Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, ORTEC must be informed, either in writing, by telephone [(865) 482-4411] or by facsimile transmission [(865) 483-2133], 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. The ORTEC 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 designated ORTEC repair center. The address label and the package should include the Return Authorization Number assigned. 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 should follow the same procedure and ORTEC will provide a quotation.

### **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 assistance can be provided in making damage claims and in providing replacement equipment, if necessary.

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## SAFETY INSTRUCTIONS AND SYMBOLS

This manual contains up to three levels of safety instructions that must be observed in order to avoid personal injury and/or damage to equipment or other property. These are:

**DANGER** Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.

**WARNING** Indicates a hazard that could result in bodily harm if the safety instruction is not observed.

**CAUTION** Indicates a hazard that could result in property damage if the safety instruction is not observed.

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

In addition, the following symbol may appear on the product:



**ATTENTION – Refer to Manual**



**DANGER – High Voltage**

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

## SAFETY WARNINGS AND CLEANING INSTRUCTIONS

**DANGER** Opening the cover of this instrument is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.

**WARNING** Using this instrument in a manner not specified by the manufacturer may impair the protection provided by the instrument.

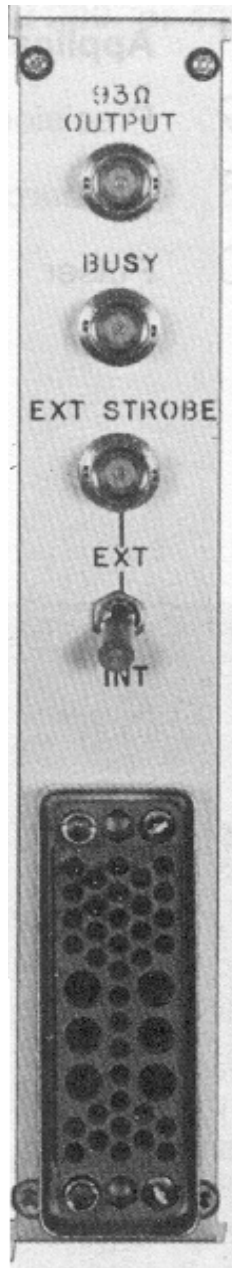
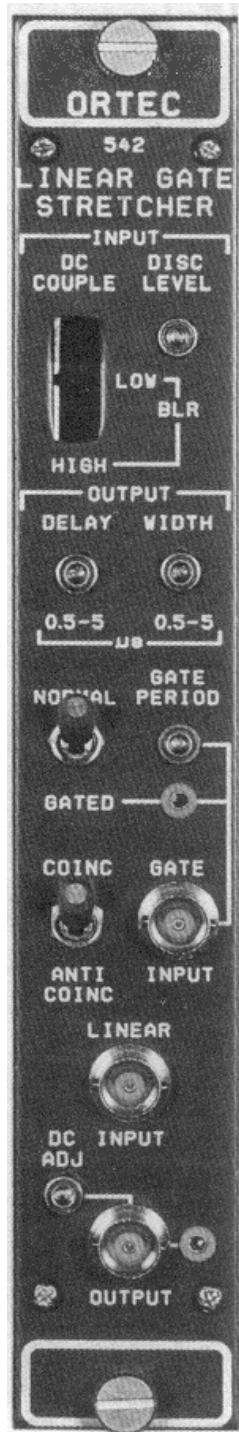
### Cleaning Instructions

To clean the instrument exterior:

- Unplug the instrument from the ac power supply.
- Remove loose dust on the outside of the instrument with a lint-free cloth.
- Remove remaining dirt with a lint-free cloth dampened in a general-purpose detergent and water solution. Do not use abrasive cleaners.

**CAUTION** To prevent moisture inside of the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.

- Allow the instrument to dry completely before reconnecting it to the power source.



## ORTEC MODEL 542 LINEAR GATE AND STRETCHER

### 1. DESCRIPTION

The ORTEC 542 Linear Gate and Stretcher accepts short duration input pulses and provides output pulses of the same amplitude, but stretched in duration, for applications which have minimum pulse width requirements. This effectively reduces the bandwidth requirements of analog-to-digital converters in multichannel pulse height analyzers and improves the resulting linearity. The linear gate included in the 542 permits selective control of the acceptance of input pulses, and is also used to prevent positive-on-positive pulse pileup.

The 542 accepts linear signals, when the input gate is qualified, from any linear source. The input signal is reshaped as required, providing a suitable waveform to a circuit which measures the peak amplitude. Any reshaping of the input pulse must retain the linear parameter of the input signal, which is its relative peak amplitude. The input pulse width is unimportant as long as the peak amplitude duration is long enough to permit accurate response and measurement.

The input gate, which can be controlled from an external source, may be operated in either a coincidence or an anticoincidence mode. The Gate Period generator is triggered on the leading edge of a gate input pulse and continues for an effective period set by a front panel adjustment. The Gate Period must overlap the linear input pulse peak for coincidence mode operation or must overlap the discriminator response for anticoincidence mode.

An External Strobe Input and switch on the rear panel provide for strobing the output after a peak detect occurs. When the Strobe switch is in external

position, an output will be generated in time coincidence with the external strobe signal. The output pulse occurs if and only if a positive logic pulse arrives at the rear panel Strobe Input during the acceptance time as set by the Delay adjustment (10 times the setting) on the front panel.

An input pulse must exceed the discriminator level to initiate a response in the 542. When the discriminator fires, it initiates the stretching action unless the gate control is in the external coincidence mode and a gate pulse is not present. The input gate remains open only until the peak of the linear pulse has been detected, and then is again closed to prevent pileup. A delayed output pulse, with selectable width, is generated following the input peak. Both the delay and width adjustments are front panel screwdriver controls on the 542. The input gate cannot be opened again until the output pulse has been completed **and** the linear input pulse has returned to baseline. This internal logic prevents pulse pileup, therefore enhancing high count rate performance.

The 542 can be used in any system to assure an adequate duration of the peak amplitude where a pulse width might otherwise have been too short or where the width variations would produce a nonlinear response or measurement. It may be used at any point in the linear system after a basic linear amplifier. The gate and strobe functions permit logical placement directly after the linear amplifier.

### 2. SPECIFICATIONS

#### 2.1. PERFORMANCE

**NOISE CONTRIBUTION** <20  $\mu$ V rms, referred to input.

**GATE FEEDTHROUGH** <0.05% of signal amplitude with gate closed.

**GATE PEDESTAL** Essentially zero, factory-calibrated.

**STRETCHER DROOP** Typically less than 0.1 mV/ $\mu$ s/V output.

**PILEUP REJECTION** After the input pulse has reached its peak, subsequent inputs are rejected until both the output pulse has terminated and the input has recovered to the baseline.

**LINEAR INPUT AMPLITUDE** +0.1 to +10V linear range;  $\pm 12$  V maximum.

**LINEAR INPUT RISE TIME** 100 ns to 10  $\mu$ s.

**LINEAR OUTPUT WIDTH** 0.5 TO 5  $\mu$ s, adjustable.

**LINEAR OUTPUT DELAY** 0.5 to 5  $\mu$ s after peak detect, adjustable.

**GAIN** Unity (nominal).

**INTEGRAL NONLINEARITY** <0.2% for pulse risetime >100 ns and pulse width >400 ns.

**TEMPERATURE INSTABILITY** Gain shift <0.01%/°C, 0 to 50°C for  $V_o = 5$  V.

**COUNTING RATE** dc-coupled throughout when DC Couple input is selected. The centroid of a pulser spectrum at 85% of full scale will shift <0.1% when modulated by  $5 \times 10^4$  counts/s of random signals from  $^{137}\text{Cs}$  source-detector combination with photopeak at 70% of full scale (DC Couple mode and amplifier shaping time  $\tau = 1$   $\mu$ s). When dc restorer modes are used, count rate is dependent on shaping amplifier time constants and pulse undershoot.

## 2.2. CONTROLS

The following controls are on the front panel:

**INPUT** 3-position slide switch, selects input circuit desired: BLR High, BLR Low, or DC Couple.

**DISC LEVEL** Screwdriver potentiometer; adjusts sensitivity level for input discriminator; range +0.1 to +1 V; discriminator remains triggered while input level exceeds adjusted sensitivity.

**OUTPUT DELAY** Screwdriver potentiometer; adjusts delay period from peak detect to start of output pulse; typical range 0.5 to 5  $\mu$ s. Delay ranges up to 50  $\mu$ s available on special request. In External Strobe mode, adjusts Acceptance Time; typical range 5 to 50  $\mu$ s.

**OUTPUT WIDTH** Screwdriver potentiometer adjusts width of the output pulse; typical range 0.5 to 5  $\mu$ s.

**NORMAL/GATED** Locking-toggle switch selects exclusion (Normal) or inclusion (Gated) of external gating function.

**GATE PERIOD** Screwdriver potentiometer, adjusts duration of gating control from leading edge of Gate Input pulse; range 0.5 to 5  $\mu$ s; includes test point for monitoring adjusted gate period.

**OUTPUT DC ADJ** Screwdriver potentiometer, permits adjustment of output dc level between  $\pm 1.5$  V.

**COINC/ANTICOINC** Locking-toggle switch selects effective mode for Gate Input function.

The following control is on the rear panel:

**EXT/INT** Locking-toggle switch selects External strobe operation. External Strobe Acceptance Time is adjustable from 5 to 50  $\mu$ s by the front panel Delay potentiometer.

## 2.3. INPUTS

**LINEAR INPUT** BNC connector, front panel.

**Polarity** Positive unipolar, or bipolar with positive portion leading.

**Amplitude** +0.1 to +10 V;  $\pm 12$  V maximum.

**Risetime** 100 ns to 10  $\mu$ s.

**Impedance**  $\sim 1000\Omega$ .

**GATE INPUT** BNC connector, front panel, for optional external control of switch-selectable coincidence or anticoincidence mode triggering. Standard NIM slow logic pulse, triggers selected gate function at +3 V (100 ns minimum width), protected to  $\pm 25$  V.

**STROBE INPUT** BNC connector, rear panel, for optional external control of the output pulse timing. Standard NIM slow positive logic pulse triggers the strobe functions at +3 V (100 ns minimum width), protected to  $\pm 25$  V.

## 2.4. OUTPUTS

**OUTPUT** Front panel BNC connector; furnishes linear positive output pulses through  $Z_o < 1\Omega$ ; risetime, 300 ns; includes test point.



**93Ω OUTPUT** Rear panel BNC connector furnishes the linear positive output pulses through  $Z_o=93\Omega$ .

**Polarity** Positive.

**Amplitude** +0.1 to +10 V; equal to peak amplitude of the linear input pulse.

**Delay** Adjust by front panel control; typical range 0.5 to 5  $\mu$ s after input pulse peak detect. Strobe Acceptance Time range 5 to 50  $\mu$ s.

**Width** Adjusted by front panel control; range 0.5 to 5  $\mu$ s typical.

**Impedance** <1 $\Omega$  on front panel.

**DC Offset Adjust**  $\pm 1.5$  V.

**BUSY OUTPUT** Rear panel BNC connector furnishes +5 V nominal through  $Z_o < 10\Omega$  through all periods when input pulses cannot be accepted; may

be used to control external equipment or for monitoring internally created deadtime. Busy, +5 V nominal - linear pulse cannot be accepted. Not Busy, 0 V nominal - linear pulse can be accepted.

## 2.5. ELECTRICAL AND MECHANICAL

**POWER REQUIREMENTS** +24 V, 83 mA; -24 V, 80 mA; +12 V, 130 mA; -12 V, 30 mA.

### WEIGHT

**Shipping** 1.9 kg (4 lb).

**Net** 0.9 kg (2 lb).

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

## 3. INSTALLATION

The 542 contains no internal power supply but is designed for installation in a standard Bin and Power Supply, such as the ORTEC 4001/4002 or 401/402 Series, which are intended for rack mounting. If vacuum tube equipment or other heat-producing equipment is operated in the same rack, there must be adequate circulation of cooling air to prevent any localized heating of the 542 transistorized circuits. The temperature of equipment mounted in racks can easily exceed the recommended maximum unless precautions are observed. The ORTEC 542 should not be subjected to temperatures in excess of 50°C (122°F).

### 3.1. CONNECTION TO POWER

Always turn off power for the Bin and Power Supply before inserting or removing any modules. ORTEC NIM instruments are designed so that it is not possible to overload the Power Supply with 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, check the Power Supply for any overload conditions by testing the dc power levels after all modules are inserted.

The ORTEC 542 may be operated outside the Bin and Power Supply, using a power extension cable. Be sure that the cable used accounts properly for the grounding circuits recommended in AEC standards of TID-20893 (Rev). Both clean and dirty ground connections are included to ensure proper

reference voltage feedback into the Power Supply and must be preserved by the remote cable. Be careful to avoid ground loops when the module is operated outside the Bin.

### 3.2. LINEAR INPUT CONNECTION

Linear input pulses can be furnished from any ORTEC NIM linear module. These include amplifiers, delay circuits, biased amplifiers, gates, and other pulse-handling equipment. It is recommended that the 542 be used ahead of a biased amplifier when both modules are used in a system. The effective input range will be from the adjusted discriminator level (+0.1 to 1 V) up through +10 V.

When the linear input signals are furnished through a cable more than 4-ft long (approximately), the input should be terminated with the characteristic impedance of the cable. This can usually be avoided by the use of shorter cable lengths.

### 3.3. LINEAR OUTPUT CONNECTIONS

The shaped linear output pulses can be furnished into any ORTEC NIM linear module or directly into the ADC input of a multichannel analyzer. It is important to preserve the pulse shape and linear amplitude relationship of the output, as it appears at the inputs of subsequent instrument modules. Either of two standard output impedances may be selected according to the type and length of

interconnecting cable and the input impedance of the instrument to which it is connected. The output is available through a front panel connector, with an output impedance of less than  $1\Omega$ , or through a rear panel connector, with  $Z_o = 93\Omega$ . For most applications the  $1\Omega$  front panel Output connector can be used, with a short cable length, to transfer the output signal into the (normally) high input impedance of the next module.

When the output signals must be furnished through the cable lengths greater than approximately 4 ft, proper resistive termination of the cable is required in order to preserve the linear output pulses and prevent oscillations. Either of two convenient methods can be selected for the 542 outputs, when termination is required. One method uses a series-type termination, using the rear panel  $93\Omega$  Output connector and an appropriate length of  $93\Omega$  coaxial cable to transfer the signal into the next module or instrument. The total amplitude of each output pulse will be divided between the  $93\Omega$  output impedance of the 542 and the input impedance of the next module, so a high input impedance is desirable. An alternate method uses shunt termination at the remote end of the cable. For this, use the front panel  $1\Omega$  Output connector and whatever type of coaxial cable is desired. Then use a BNC Tee at the input to the next module to accept both the cable and a BNC Terminator, selected to match the characteristic impedance of the cable when connected in parallel with the instrument's input impedance. For your convenience, ORTEC stocks BNC Tee connectors and both 50 to  $100\Omega$  BNC Terminators.

### 3.4. GATE INPUT

When Gate Input signals are required, they will be furnished through the BNC connector on the front panel of the 542. When selected, a gate input pulse will trigger the 542 Linear Input gate for an adjusted Gate Period. The function may be selected as either Coinc or Anticoinc by a front panel locking-toggle switch.

Gate Input pulses are valid when they exceed +3 V for a period of at least 100 ns. A standard NIM slow logic pulse may be used. The Gate Input circuit is protected to  $\pm 25$  V; so a wide variety of alternate sources can also be used to initiate this control. When operating in the Coinc mode, the Gate Period must be triggered before the peak of the linear input pulse and must be continued until after the peak. When operating in the Anticoinc mode, the Gate Period must be triggered prior to a discriminator response to the linear input and must be continued until the discriminator has been reset.

No Gate Input is required if the front panel Normal/Gated switch is set at Normal. Likewise, if the front panel switches are set at Gated and Anticoinc, a Gate Input pulse is not required except when a linear input signal is to be rejected. When these switches are set for Gated and Coinc, respectively, a linear input pulse will be accepted only if it is accompanied by a time coincident Gate Input pulse.

### 3.5. EXTERNAL STROBE INPUT

The External Strobe Input is a rear panel BNC connector. When the rear panel Strobe switch is set for Ext, an output will be generated only if a standard NIM slow positive logic pulse arrives at the connector during the Strobe Acceptance Time, as set by the front panel Delay potentiometer. The Strobe Acceptance Time is approximately 10 times the Delay setting at a given potentiometer setting. Therefore the Strobe Acceptance Time may be set within a typical range of 5 to 50  $\mu$ s.

### 3.6. CONNECTION FOR BUSY OUTPUT

The duration of each busy output signal is from the time that an input pulse peak is detected until the resulting output pulse has been furnished and the input discriminator has been reset. This identifies each period during which a new input pulse cannot be accepted in the 542. This output can be integrated externally to indicate relative dead time.

## 4. OPERATION

### 4.1. SELECTION OF INPUT CIRCUIT

Any of three circuit connections can be selected with the slide switch at the top of the front panel: DC Couple, BLR (Base Line Restorer) Low, or BLR

High. The proper selection will depend on the type of output circuit in the module from which the linear input pulses are furnished to the 542 and on the relative counting rate.

The DC Couple switch position provides an optimum signal transfer circuit with  $1000\Omega$  input impedance if the pulses are furnished from an amplifier with a dc-coupled output and properly adjusted zero baseline. If the source does not include baseline restoration, use a capacitive coupling into the 542 and select either Low or High BLR at the 542.

For an ac-coupled signal input, select one of the baseline restorer input circuits in the 542. There is no precise method of input circuit selection because of the various shaping time constants which may be affecting the pulse shape furnished to the 542. For  $1\text{-}\mu\text{s}$  pulses the division is approximately 15,000 counts/s. If bipolar pulses are applied to the input, the DC Couple or BLR Low configurations must be selected. The most practical method of selecting between High and Low is observation of the output on an oscilloscope and using the setting that provides the better results.

#### **4.2. DISCRIMINATOR LEVEL ADJUSTMENT**

The Disc Level adjustment is for the purpose of preventing response to all noise pulses. This threshold voltage should be adjusted high enough in its  $+0.1$  to  $1$  V range to ensure discrimination against the maximum noise amplitude that may exist at the input to the 542 in the system. The logic in the 542 prevents response to a new input pulse until the Disc Level has been recrossed and the output pulse has been completed. Too high a setting of the Disc Level can permit a small amount of pileup to occur if the input pulse has a very long time constant decay. Although this interference is possible, it is unlikely in most applications. Still an unnecessarily high adjustment is not recommended.

#### **4.3. OUTPUT DELAY AND STROBE ACCEPTANCE TIME ADJUSTMENT**

The adjustment of the Output Delay permits a control for normalizing timing in the system in which the 542 is included. The delay period is measured from the time that the internal stretch amplifier senses a peak amplitude in the accepted linear input pulse and is typically adjustable through the range of  $0.5$  to  $5\ \mu\text{s}$ . At the end of the delay period the Output Gate is opened and an output pulse is furnished to the next instrument in the system.

For Strobed operation, the Delay adjustment becomes a Strobe Acceptance Time adjustment, providing a period of from  $5$  to  $50\ \mu\text{s}$  after linear input peak, during which the strobe signal will cause an output to be generated.

#### **4.4. OUTPUT WIDTH ADJUSTMENT**

The stretch circuit provides an output pulse of a fixed and known width. The range of the control is typically  $0.5$  to  $5\ \mu\text{s}$ , and its proper setting will be determined by the input requirements of subsequent instruments in the system. Each output pulse will have the adjusted width, regardless of the width of linear pulses furnished to the 542 input.

#### **4.5. OUTPUT DC ADJUSTMENT**

In normal usage the quiescent level for the output, through both the front and rear panel connectors, should be at ground potential. Use the test point for the front panel Output, and adjust the screwdriver control as necessary to set the level at ground potential when there are no output signals. When the dc input is used on some analyzers it is necessary that the signal source have a quiescent dc level other than zero. When the 542 is used in such applications adjust the output dc level as required.

#### **4.6. GATED OPERATION**

No Gate Input pulse is required if the front panel slide switch is set at Normal. Likewise, if the slide switch is set at Gated and the mode selector on the front panel is set for Anticoinc, linear input pulses will be accepted when there is no signal through the Gate Input connector. Whenever a signal is furnished through the Gate Input with Gated Anticoinc effective, all linear input signals are inhibited throughout the Gate Period. To be effective, the Gate Period must be adjusted to overlap the period of discriminator response to any pulse that is to be inhibited by the Anticoinc signal; if the linear input triggers the discriminator before the Gate Input or if the Gate Period terminates prior to discriminator recovery, there will be an output, but the amplitude will probably not duplicate the peak input amplitude.

When the 542 is set for gated coincidence operation, a linear input signal is accepted for stretching if and only if there is a time-coincident Gate Input. The Gate Input signal must occur before the peak amplitude of the linear input pulse,

and the Gate Period must be long enough to continue the control beyond the internal detection of the peak amplitude.

Refer to Section 5.2 for linear gate pedestal adjustment procedures.

#### 4.7. STROBED OPERATION

When the 542 is to be used in Externally Strobed mode, the rear panel INT/EXT locking-toggle switch is placed in EXT position. The strobing device is connected via the External Strobe BNC connector on the rear panel. In Externally Strobed Mode, an output will be generated only if a standard NIM slow positive logic pulse arrives at the External Strobe connector within the Strobe Acceptance Time (range 5 - 50  $\mu$ s) as set by the front panel potentiometer labeled Output Delay.

#### 4.8. OVERALL LOGIC

When the amplitude of an input pulse exceeds the discriminator threshold, the discriminator may be fired or it may still be set because of not having recovered from a previous input pulse. The linear input pulse will not be accepted unless the discriminator has recovered prior to the new pulse; it will also be rejected if (1) an output pulse has not been completed for a previously accepted input; (2) the operating mode is gated coincidence and no

Gate Input has been furnished; (3) the operating mode is gated anticoincidence, a Gate Input signal has been furnished, and the Gate Period is in effect; or (4) in the External Strobe mode and no strobe signal is present during the Strobe Acceptance Time. When the discriminator recovers, it will permit the input to be gated on unless (1) the output pulse has not been completed or (2) External Gate Input logic has closed the linear input circuit. When the output pulse has been completed, the linear input is qualified unless (1) the discriminator is not reset or (2) External Gate Input logic has closed the linear input circuit.

When the discriminator is triggered prior to a Coincidence Gate Input but the linear input is otherwise qualified, the linear input signal is not applied to the stretch circuit until the Gate Input signal is furnished. Under these conditions, the linear input signal is applied to the stretch circuit at the Gate Input time; an output signal will result, which has an amplitude equal to (1) the peak input amplitude or (2) the input amplitude at the end of the adjusted Gate Period (whichever occurs first). Thus, it is important that the gate be triggered during the risetime of the linear input pulse and that it remain effective until after the peak amplitude has been sensed.

## 5. MAINTENANCE

### 5.1. TESTING PERFORMANCE OF PULSE STRETCHER

The following paragraphs are intended as an aid in the installation and checkout of the 542. These instructions present information on waveforms at test points and output connectors.

**Test Equipment** The following, or equivalent, test equipment is needed.

ORTEC 419 Pulse Generator  
50-MHZ Bandwidth Oscilloscope  
100 $\Omega$  BNC Terminators  
Digital Voltmeter  
ORTEC Pulse Shaping Amplifier

**Preliminary Procedures** Visually check the module for possible damage due to shipment and then perform the following steps:

1. Connect ac power to NIM standard Bin and Power Supply, ORTEC 4001/4002 or 401/402.
2. Plug module into Bin and check for proper mechanical alignment.
3. Switch ac power on and check the dc Power Supply voltages at the test points on the Bin Power Supply control panel.

**Pulse Stretcher** The following procedure will check the performance of the Pulse Stretcher:

1. Feed the output of the 419 Pulse Generator into the input of the Amplifier.

2. Set the Amplifier controls for a gain of approximately 200 with equal integration and differentiation time constants.
3. Set the 542 Input switch to DC Couple, the Gate switch to Normal, and the Strobe switch to Int.
4. Adjust the 419 Pulse Generator for a 100-mV pulse from the unipolar output of the Amplifier.
5. Feed the 100-mV unipolar output of the Amplifier into the input of the 542. Load the 542 output with a 100 $\Omega$  terminator.
6. Adjust the discriminator time potentiometer on the front panel until triggering of the stretcher circuit just occurs, as evidenced by an output pulse from the 542.
7. Increase the input signal to the 542 (by adjusting the 419 Pulse Generator) to 500 mV.
8. The output of the 542 should have a peak amplitude of  $500 \pm 25$  mV (see "Linear Gate Pedestal Adjustment" Procedure in Section 6.2 if these limits are exceeded); the top of the pulse should exhibit a smooth slope of less than 0.5 mV/ $\mu$ s.
9. Increase the input signal to the 542 to 10 V; the output should be essentially 10 V.
10. The time at which the output occurs should be adjustable from approximately 0.5 to 5  $\mu$ s after peak detect. The duration of the output waveform should be adjustable over the range of approximately 0.5 to 5  $\mu$ s.
11. Select the Gated and Coinc positions on the front panel switches. The 542 output should disappear.
12. Select the Anticoinc position and the 542 output should reappear. (A more complete check of the 542 Gate can be made if a logic pulse in time coincidence with the linear input pulse is available.)
13. Increase the input to the 542 to the saturation level of the amplifier, approximately 12 V; the output of the 542 should be greater than 10.5 V.
14. Connect the amplifier output to the 542 Gate Input and monitor the Gate Period pulse with an oscilloscope. The Gate Period should be adjustable from approximately 0.5 to 5  $\mu$ s.

**Pulse Pileup Test** A dual or variable high-frequency pulser is needed to check the operation of the 542 pileup circuit.

1. Connect a dual or variable high-frequency pulser to the 542 input.

2. Monitor the 542 input and output simultaneously with an oscilloscope.
3. Adjust the output delay and width controls to full clockwise positions.
4. Gradually decrease the time interval between the input pulses.
5. The second pulse should be blocked by the 542 when the time interval between the peaks of two consecutive pulses is short enough to cause pileup greater than the discriminator threshold.

## 5.2. CALIBRATION PROCEDURES

**Linear Gate Pedestal Adjustment** The input and output gates are shunt-type gates which clamp the signal line to ground. If the signal line is not at ground potential in the quiescent condition, then a pedestal is introduced by the gating action. This can be avoided by adjusting the output of the Buffer Amplifier (TP1) to zero volts and then adjusting the output of the Stretch Amplifier (TP2) to zero volts. Use the following procedure when making this adjustment:

1. Set the input gate switch to Normal and the strobe switch to Int.
2. Set the Input switch to the mode desired. If the DC Couple position is used, ensure that the dc level of the amplifier driving the 542 is set to zero volts.
3. Monitor TP1 with a digital voltmeter and adjust R7, on the front of the printed circuit board, to obtain zero volts at TP1.
4. When the Input switch is moved to either of the other two positions, the voltage at TP1 should remain at  $0 \text{ V} \pm 20 \text{ mV}$ .
5. Monitor TP2 with the voltmeter and adjust R18 to obtain zero volts at TP2. The 542 is now adjusted for a zero pedestal. These adjustments must be made regardless of whether or not the linear gating function of the 542 is being used.

**CAUTION:** If the Input switch is set to DC Couple and the output dc level of the Amplifier driving the 542 is not set at zero volts, the 542 will appear to have a pedestal since the 542 gate circuit will be gating a dc voltage.

**Discriminator Adjustment** The 542 Disc Level should be set well above the system noise because each pulse that exceeds the discriminator level will be stretched, whether it be noise or a legitimate signal. If the Disc Level is set far below the

system's noise, the 542 pileup rejection circuit may completely block the input and prevent any outputs from occurring. Normally a discriminator level of 100 mV is adequate. A precise discriminator setting can be made by the following procedure:

1. Apply a 0.5- $\mu$ s shaped; signal to the 542 input with amplitude equal to the desired Disc Level setting.
2. Monitor the 542 input and output signals with an oscilloscope.
3. Adjust the 542 discriminator control (front panel) until the number of output pulses is approximately equal to one-half the number of input pulses.

The discriminator is now properly adjusted.

### 5.3. SUGGESTIONS FOR TROUBLESHOOTING

In situations where the 542 is suspected of malfunction, it is essential to verify such malfunction in terms of simple pulse generator impulses at the input. In consideration of this, the 542 must be disconnected from its position in any system and routine diagnostic analysis be performed with a test pulse generator and oscilloscope. It is important that testing not be performed with a source and detector until the amplifier-pulse stretcher system performs satisfactorily with the test pulse detector.

The testing instructions in Section 5.1 of this manual should provide assistance in locating the region of trouble and repairing the malfunction. The two side plates can be completely removed from

the module to enable oscilloscope and voltmeter observations with a minimal chance of accidentally short-circuiting portions of the etched board.

If the problem involves an inability to get an output pulse, there are several solutions:

1. If Input switch is in the DC Couple position, switch to low or high positions. If output appears, a dc level is probably being applied to the 542 input and locking up the pulse pileup circuit. Adjust the output dc level of the amplifier during the 542 to zero volts.
2. Adjust the Disc Level fully clockwise. If an output occurs, the discriminator was probably set below the system noise level, locking up the pileup circuit.
3. If operating in the Gated mode, switch to the Normal mode. If an output occurs, the gating logic is probably not in time coincidence with the linear pulse.
4. If operated in Gated or Normal mode, check that Strobe switch is in Int position.

### 5.4. FACTORY REPAIR SERVICE

The 542 may be returned to ORTEC for repair service at nominal cost. Our standard procedure requires that each repaired instrument receive the same extensive quality control tests that a new instrument receives. Contact our Customer Service Department, (865) 482-4411, for shipping instructions before returning the instrument. The unit will be assigned a Return Authorization Number which must accompany the returned instrument.

**Bin/Module Connector Pin Assignments  
For Standard Nuclear Instrument Modules  
per DOE/ER-0457T.**

<b>Pin</b>	<b>Function</b>	<b>Pin</b>	<b>Function</b>
1	+3 V	23	Reserved
2	- 3 V	24	Reserved
3	Spare bus	25	Reserved
4	Reserved bus	26	Spare
5	Coaxial	27	Spare
6	Coaxial	*28	+24 V
7	Coaxial	*29	- 24 V
8	200 V dc	30	Spare bus
9	Spare	31	Spare
*10	+6 V	32	Spare
*11	- 6 V	*33	117 V 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 V	38	Coaxial
*17	- 12 V	39	Coaxial
18	Spare bus	40	Coaxial
19	Reserved bus	*41	117 V ac (neutral)
20	Spare	*42	High-quality ground
21	Spare	G	Ground guide pin
22	Reserved		

Pins marked (\*) are installed and wired in ORTEC's 4001A and 4001C Modular System Bins.

