



OPERATING AND SERVICE MANUAL

MODEL 5262A

SERIALS PREFIXED: 217- 229-

TIME INTERVAL UNIT

HEWLETT-PACKARD COMPANY



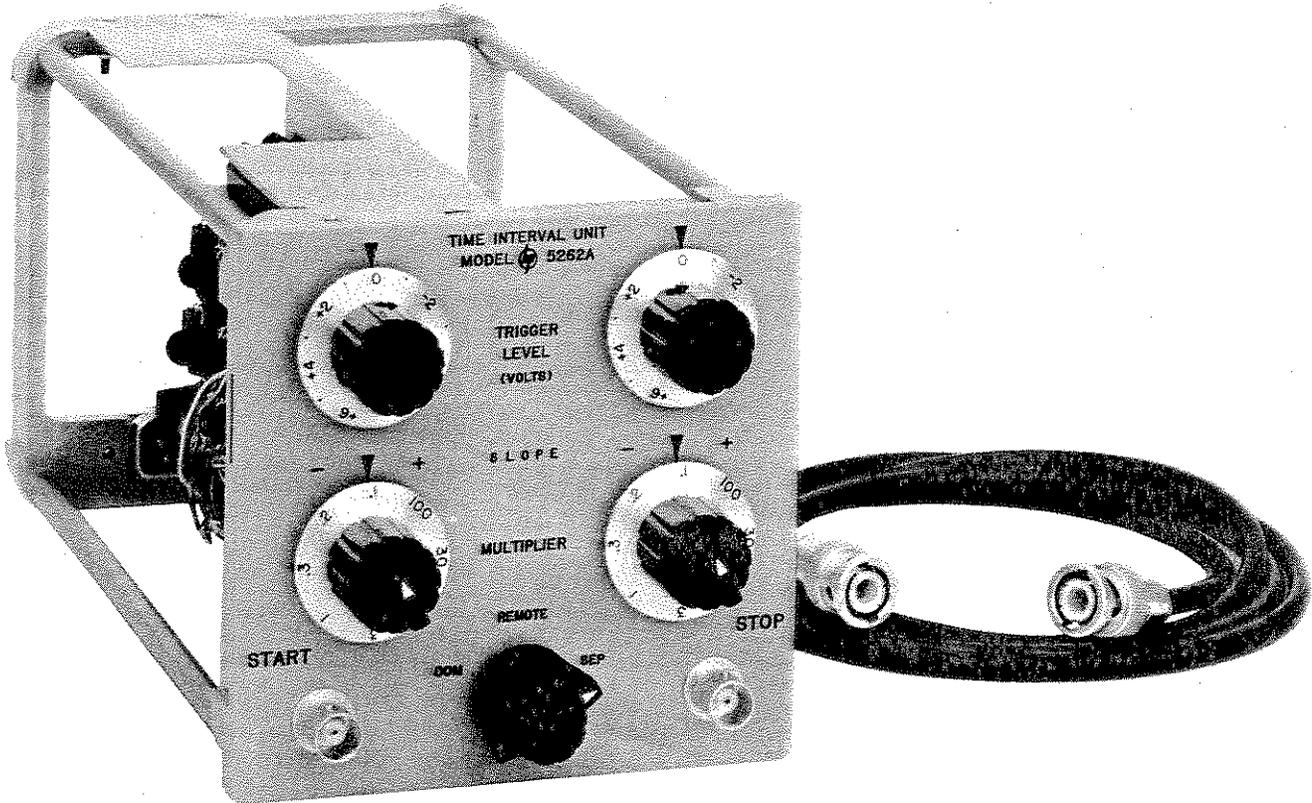


Figure 1-1. Model 5262A Time Interval Unit

SECTION I

GENERAL INFORMATION

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1-1. INTRODUCTION.

1-2. **CONTENT.** This manual provides instructions on operation and maintenance of the Φ Model 5262A Time Interval Unit.

1-3. **SERIAL PREFIX.** The Model 5262A carries a five-digit serial number with a three digit prefix (000-00000). If the prefix number on the instrument agrees with the prefix number on the title page, this manual applies to the instrument directly. If the serial prefixes do not agree, change sheets with the manual describe changes which are necessary so that the manual can be used with the instrument.

1-4. DESCRIPTION.

1-5. The Model 5262A, shown in figure 1-1, provides start and stop pulses, initiated by electrical inputs, to open and close the main gate of the Φ Model 5243L or similar electronic counter enabling it to make time

interval measurements. Time intervals from 1 microsecond to 10^8 seconds are measured with a resolution of 0.1 microsecond using frequencies available in the Model 5243L or external frequencies of 20 mc or less. When the counter counts a signal derived from its crystal oscillator, counter time base accuracy is retained. Specifications are given in table 1-1. The Model 5262A has two independent channels, each with its own controls. A function switch permits selection of three modes of operation.

1-6. APPLICATIONS.

1-7. **DIRECT ELECTRICAL MEASUREMENTS.** Basic time interval measurements can be made between pulses on isolated cables, between leading and trailing edges of a pulse, or between consecutive pulses on a single cable (figure 1-2). Start-stop signals may be initiated by inputs of either positive or negative polarity; positive or negative slope and at a predetermined voltage.

Table 1-1. Specifications

Range: 1 μ sec to 10^8 sec (Start and stop pulses must be separated by 1 μ sec to give useful readings.)	Trigger Amplitude: Both channels continuously adjustable from -600 volts to +600 volts
Accuracy: ± 1 period of standard frequency counted \pm time base accuracy	Frequency Range of 5262A when used as an input signal discriminator: 0 to 2 mc
Registration: On 5243L counter	Standard Frequency Counted: 10^7 to 1 cps in decades from 5243L, or externally applied frequency
Input Voltage: 0.3 volt, peak-to-peak, minimum, direct coupled input	Markers: Separate output voltage steps, 0.5 volts peak-to-peak from source impedance of approximately 7K ohms, 100 pf; available at rear panel of 5243L with negative step coincident with trigger points on input waveforms for positive slope and positive step coincident for negative slope
Input Impedance: 10K ohms, less than 80 pf, on X.1 and X.2 multiplier positions; constant up to ± 40 volts peak times multiplier position 100K ohms times multiplier position on X.3 to X100 positions, less than 40 pf on X.3, and less than 20 pf on X1 to X100; constant up to ± 40 volts times multiplier position	Reads In: μ s, ms, sec with measurement units indicated and decimal point positioned
Overload: 50 volts rms, or ± 150 volts peak on X.1, .2, and .3 multiplier positions is tolerable; 150 volts rms, or ± 250 volts peak, on X1 and X3; 250 volts rms, or ± 250 volts peak, on X10, 30 and 100	Accessories Furnished: Φ AC-16K Cable Assembly, male BNC to male BNC 48 inches long
Start Stop: Independent or common channels	Net Weight: 2 lb
Trigger Slope: Positive or negative on Start and Stop channels, independently selected	

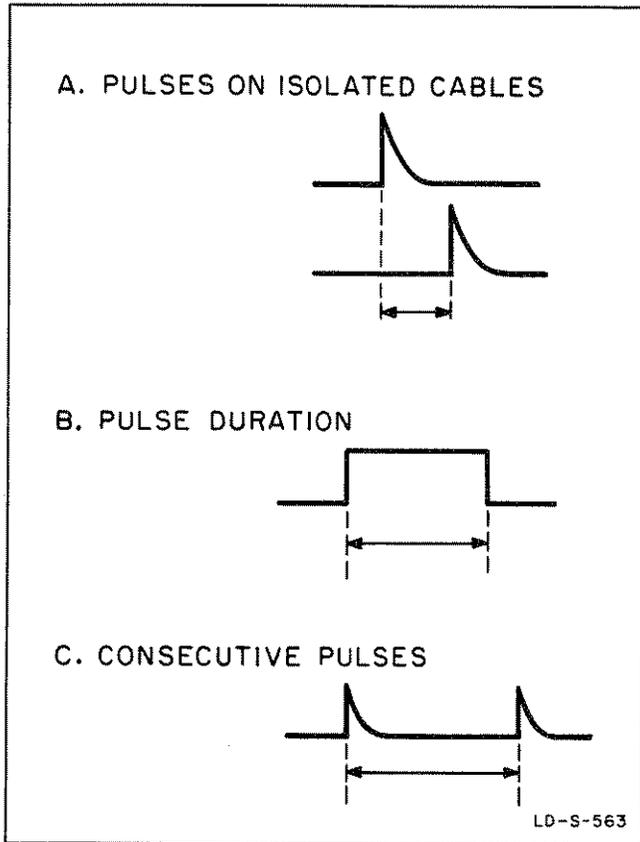


Figure 1-2. Basic Start-Stop Signals

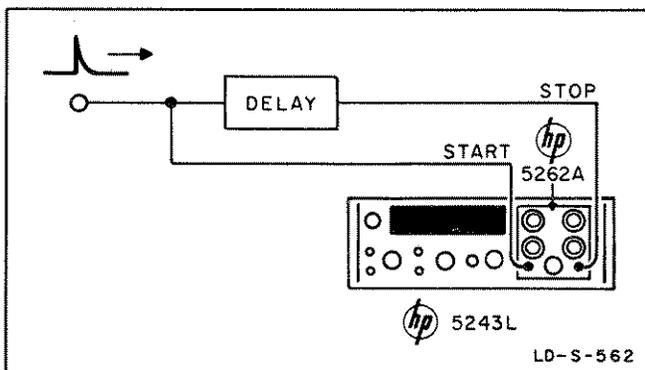


Figure 1-3. Delay Measurement

1-8. DELAY. Figure 1-3 shows a circuit arrangement of measurement of delay for a fixed delay line.

1-9. VELOCITY. Velocity of an object can be determined by measuring the time required for it to pass from one transducer to another.

1-10. ROTATIONAL SPEED. High-speed rotation can be measured using a photomultiplier pickup to scan a shaft which has been prepared with an alternately reflective and non-reflective surface. Speed determinations for slow-speed shafts can be made in a small fraction of a revolution from an optical pickup scanning a pattern of closely spaced lines.

1-11. UNPACKING AND INSPECTION.

1-12. Inspect instrument for shipping damage as soon as it is unpacked. If reshipment is expected, save all packing materials to simplify repackaging. Check for broken knobs and connectors; inspect panel surface for dents and scratches. A performance check is given in paragraphs 4-14 through 4-18. If instrument is damaged in any way or fails to operate properly, notify carrier immediately to report damage (see warranty sheet at rear of manual). Carrier will arrange for repair or replacement as necessary. Remember that your Hewlett-Packard engineering representative is ready to give assistance with any problem.

1-13. STORAGE AND RESHIPMENT.

1-14. PACKAGING. To protect valuable electronic equipment during storage or shipment always use the best packaging methods available. Your Hewlett-Packard engineering representative can provide packing material such as that used in original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. If original materials are unavailable, proceed as follows:

- Cover panel with soft wrapping paper.
- Wrap corrugated cardboard completely around instrument.
- Pack instrument securely in strong corrugated container (350 lb/square inch bursting test).
- Insert filler between wrapped instrument and container to insure a snug fit on all surfaces of the instrument.

1-15. ENVIRONMENT. Conditions during storage and shipment should normally be limited as follows:

- Maximum altitude 20,000 feet.
- Minimum temperature -40°F (-40°C).
- Maximum temperature 167°F (75°C).

SECTION II

OPERATING INSTRUCTIONS

2-1. INTRODUCTION.

2-2. The Model 5262A has two independent channels which determine the beginning and the end of a time interval. Each channel has its own TRIGGER SLOPE, TRIGGER LEVEL, and MULTIPLIER controls. Figures 2-4 and 2-5 show procedures for making a time interval measurement and a phase measurement. The following paragraphs describe installation of the Model 5262A and the function of each control.

2-3. INSTALLATION.

2-4. Installing the Model 5262A is a simple matter. Just slide it all the way into the plug-in compartment of the Model 5243L and turn the knurled knobs on either side of the compartment clockwise until tight. Power is supplied to the Model 5262A from the Model 5243L.

2-5. CONTROLS.

2-6. FUNCTION SWITCH. The function switch provides the operator with three modes of operation: common, separate, and remote.

a. With the function switch in the COMMON position START and STOP input connectors are connected together internally. Thus, if start and stop signals come from the same source, set function switch to COMMON and apply the signal to either input connector. Adjust MULTIPLIER and TRIGGER LEVEL controls for each channel separately.

b. With the function switch in the REMOTE position, the time interval function becomes one of the remote programming operations of the counter.

c. With the function switch in the SEPARATE position the start signal must be applied to START input connector and stop signal must be applied to STOP input connector.

2-7. TRIGGER SLOPE. The TRIGGER SLOPE controls determine the slope a signal must have as it crosses the voltage level set by the MULTIPLIER and TRIGGER LEVEL controls to start or stop a measurement.

2-8. MULTIPLIER AND TRIGGER LEVEL. These controls work together to determine the voltage level a signal must cross to start or stop a measurement. For example with the TRIGGER LEVEL dial set at +2 and the MULTIPLIER set at .3 the Model 5262A will trigger as the input crosses the +0.6 volt level. Suppose you have a pulse as shown in figure 2-1A, there will be little difference whether measurement begins at V_a or V_b . However, to measure interval "y" of figure 2-1B, you must be more careful. Set TRIGGER LEVEL dial reading near 0 as a preliminary

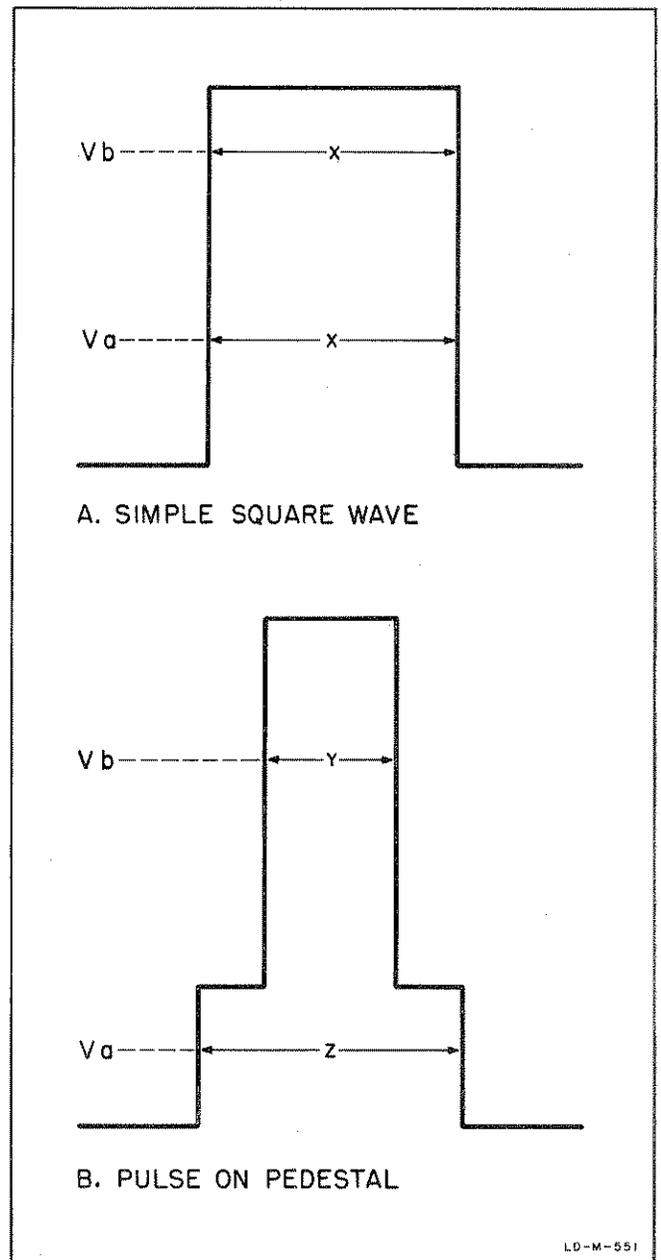


Figure 2-1. Trigger Level Settings

adjustment. Adjust the start and then the stop TRIGGER LEVEL controls. Watch for definite changes in measured time. Thus you know that start and stop voltage levels are above the step and that the indicated time interval is actually "y".

2-9. MULTIPLIER AND TRIGGER LEVEL USING OSCILLOSCOPE. This is an easier method because you can see where the pulses are occurring with respect to the signal. Connectors at the rear of the

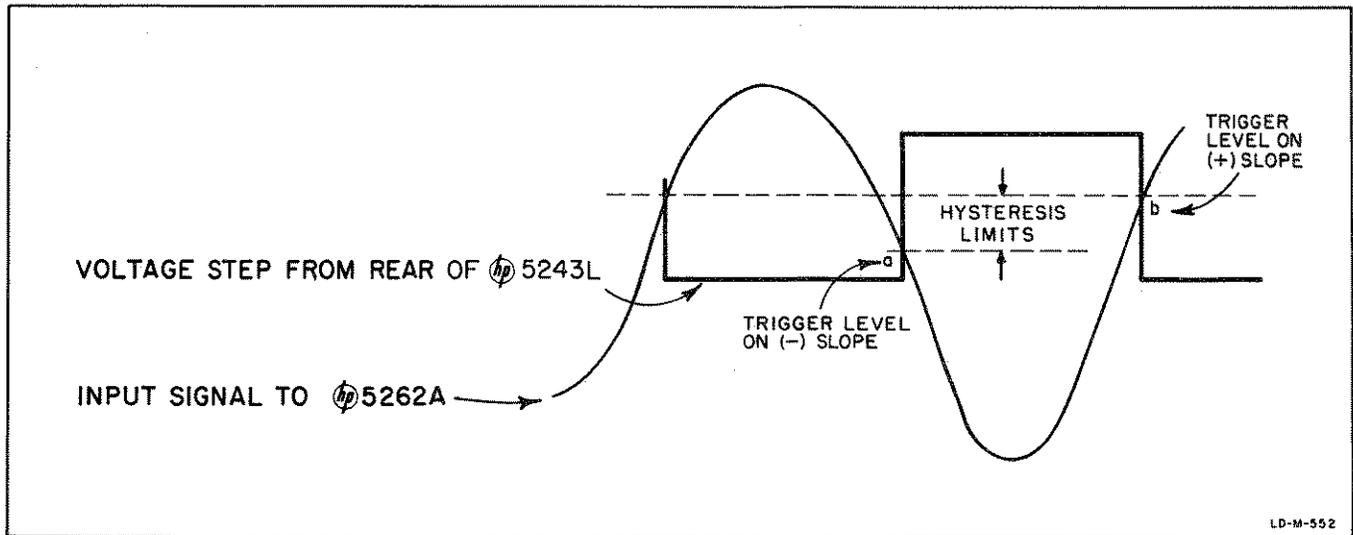


Figure 2-2. Oscilloscope Display of Trigger Levels (front panel slope control set to neg.)

Model 5243L Electronic Counter provide separate voltage steps which occur at the same time as the trigger pulses. Use the following procedure:

a. Connect BNC-to-BNC cable between START input connector on front panel of Model 5262A and EXT AC SYNC input of oscilloscope; use tee connector UG-274A/U at Model 5262A.

b. Connect the START output connector at the rear of the Model 5243L and one input channel of the oscilloscope.

c. Set Model 5262A function switch to COM.

d. Connect a cable from an oscillator to the START input connector of the Model 5262A; frequency is not important if it is a sine wave and the range is between 0 and 2 mc.

e. Connect the STOP input connector of the hp 5262A and the other channel of the oscilloscope.

f. Set VERTICAL SENSITIVITY controls to .2 volts/cm.

g. Set the VERTICAL PRESENTATION selector of the oscilloscope to CHOPPED or ALTERNATE.

h. Display on the oscilloscope will be similar to that shown in figure 2-2.

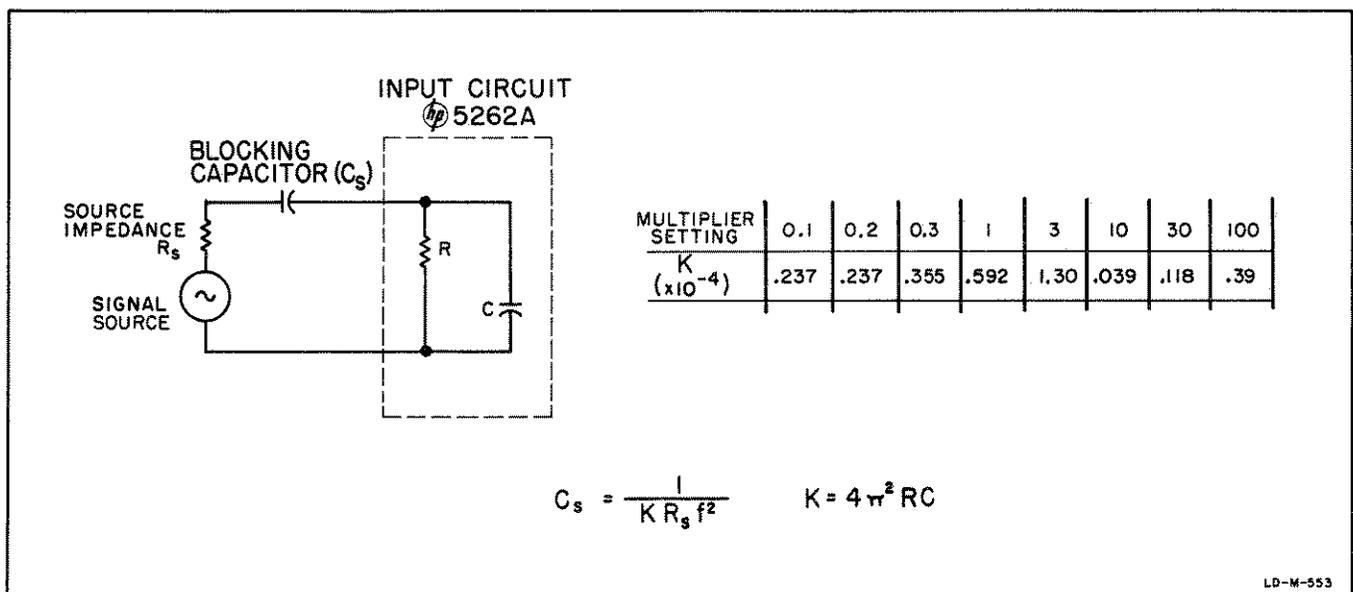
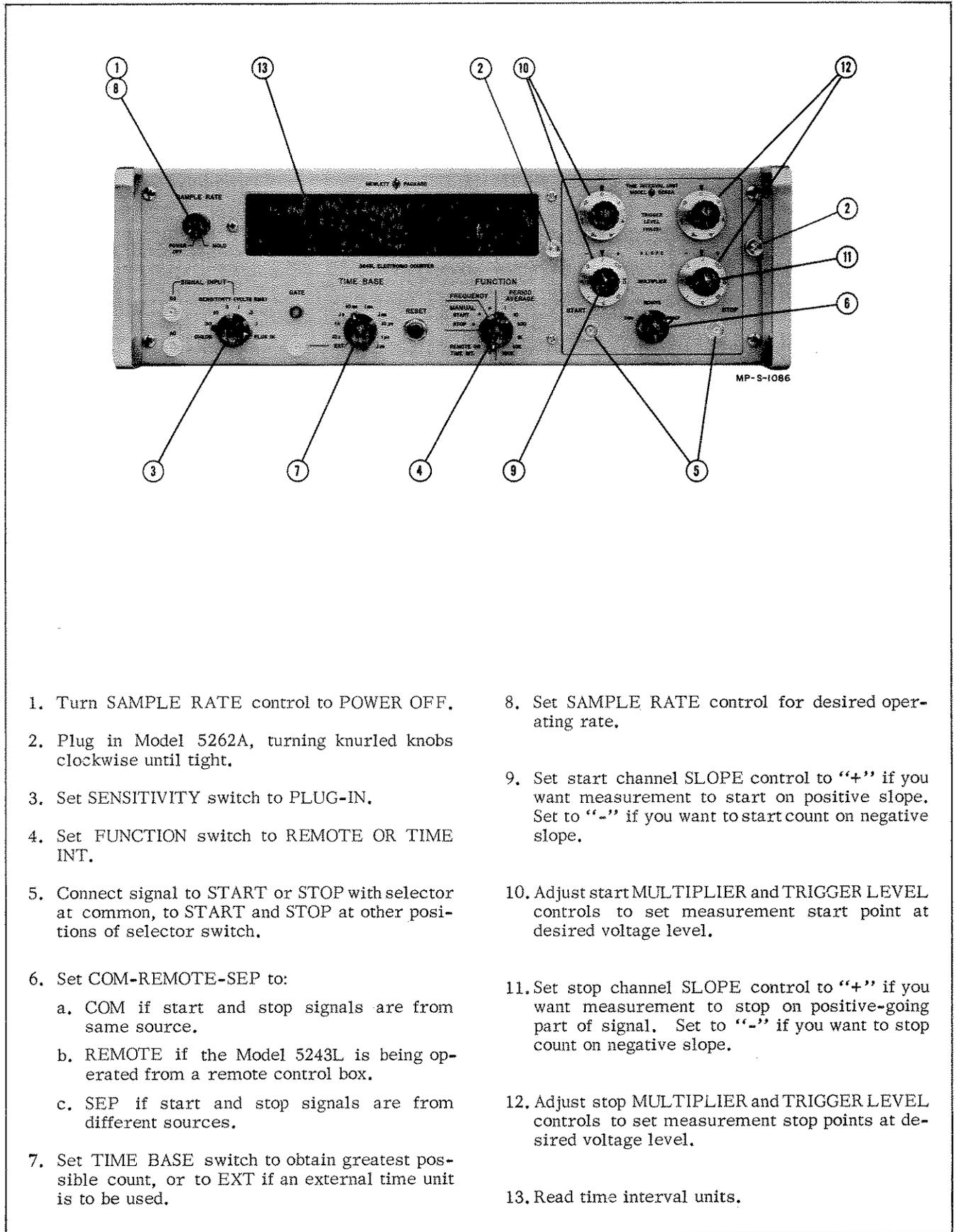
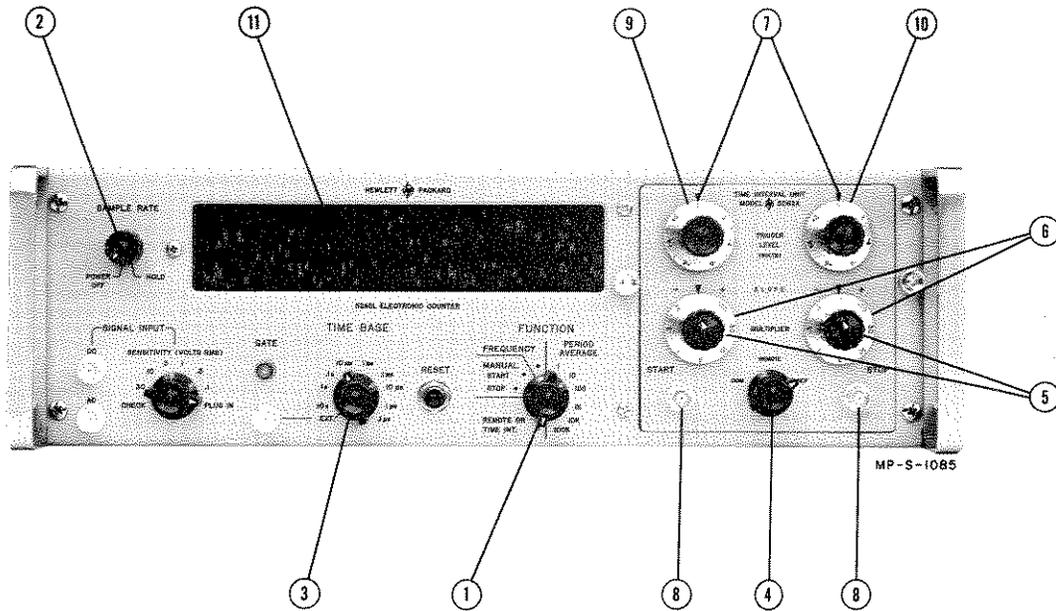


Figure 2-3. Remove DC Component from Sine Wave Input



1. Turn SAMPLE RATE control to POWER OFF.
2. Plug in Model 5262A, turning knurled knobs clockwise until tight.
3. Set SENSITIVITY switch to PLUG-IN.
4. Set FUNCTION switch to REMOTE OR TIME INT.
5. Connect signal to START or STOP with selector at common, to START and STOP at other positions of selector switch.
6. Set COM-REMOTE-SEP to:
 - a. COM if start and stop signals are from same source.
 - b. REMOTE if the Model 5243L is being operated from a remote control box.
 - c. SEP if start and stop signals are from different sources.
7. Set TIME BASE switch to obtain greatest possible count, or to EXT if an external time unit is to be used.
8. Set SAMPLE RATE control for desired operating rate.
9. Set start channel SLOPE control to "+" if you want measurement to start on positive slope. Set to "-" if you want to start count on negative slope.
10. Adjust start MULTIPLIER and TRIGGER LEVEL controls to set measurement start point at desired voltage level.
11. Set stop channel SLOPE control to "+" if you want measurement to stop on positive-going part of signal. Set to "-" if you want to stop count on negative slope.
12. Adjust stop MULTIPLIER and TRIGGER LEVEL controls to set measurement stop points at desired voltage level.
13. Read time interval units.

Figure 2-4. Operating the Model 5262A



1. Set FUNCTION to REMOTE OR TIME INT.
2. Set SAMPLE RATE to position just before POWER OFF. (MAX SAMPLE RATE)
3. Set TIME BASE switch to obtain greatest possible count, or to EXT if an External Freq is counted to give an answer in degrees.
4. Set COM-REMOTE-SEP to SEP.
5. Set start and stop TRIGGER SLOPE to same polarity.
6. Set both START and STOP MULTIPLIER controls to 0.1 position.
7. Set both start and stop TRIGGER LEVEL controls to 0 position.
8. Connect signals whose phase difference is to be measured to START and STOP inputs. (Note: For specified accuracy, do not exceed ± 40 volts peak times multiplier setting.)
9. Set start TRIGGER LEVEL control for no difference in counter reading as start MULTIPLIER is switched between the 0.1 and 0.2 positions. Procedure:
 - a. Note counter reading with MULTIPLIER set to 0.1 position.
 - b. Note counter reading with MULTIPLIER set to 0.2 position.
 - c. Subtract the smaller reading from the larger reading.
 - d. If reading in step b is less than reading in step a, add result of step c to reading of step a and adjust TRIGGER LEVEL for result.
 - e. If reading in step b is greater than reading in step a, subtract result of step c from reading of step a and adjust TRIGGER LEVEL for result.
10. Repeat step 9 for stop TRIGGER LEVEL control.
11. Read phase difference in units selected by TIME BASE switch.

Note

The procedure may have to be repeated to obtain exact zero crossing.

Figure 2-5. Procedure for Phase Measurement

2-10. ELIMINATING DC COMPONENT FROM SINE WAVE INPUT.

2-11. As the input circuits of the Model 5262A are dc coupled it is sometimes easier to set the MULTIPLIER and TRIGGER LEVEL controls when any dc component from the start and/or stop sine wave input signals is eliminated with blocking capacitors. With the aid of figure 2-3 you can select the proper value of blocking capacitor for no readout error. For example, on the .1 MULTIPLIER range, at 400 cps and with a source impedance of 10,000 ohms the proper value of blocking capacitor is 25 μ f.

2-12. However, if the right value of capacitor is not available, use the following approximate formula to determine what the error per channel in seconds will be (for phase shifts less than 10^0 and signals less than ± 40 volts peak times multiplier position):

$$\text{Error in seconds} = \frac{-1}{C_s(R_s + R)(2\pi f)^2} + \frac{R_s(RC)}{R_s + R}$$

C_s = Blocking capacitor

R_s = Signal source impedance

RC = 6×10^{-7} for 0.1 and 0.2 MULTIPLIER settings,
 9×10^{-7} for 0.3, 1.5×10^{-6} for 1,
 3.3×10^{-6} for 3, 1×10^{-5} for 10,
 3×10^{-5} for 30, 1×10^{-4} for 100.

2-13. For example, on the .1 MULTIPLIER range, the use of a 10 μ f blocking capacitor at 400 cps and with a source impedance of 600 ohms results in an error of 1.5 microseconds.

2-14. PHASE MEASUREMENT.

2-15. Phase measurement is a special application of time interval measurement. You measure the time interval between like points on two similar waveforms and relate the reading to phase angle. The measurement is made between the points where the signals cross 0 volt going in the same direction. The zero-crossing is the reference point for two reasons: first, it is the easiest point to determine accurately on the counter; and second, for sinewaves it is in the region of maximum slope, allowing maximum resolution.

2-16. Phase difference is measured in time units if one of the internal standard frequencies is counted. The following formula converts time interval (t) to phase (ϕ) in degrees:

$$\phi = \frac{360t}{\text{period of either signal}}$$

2-17. If the two signals are not equal in amplitude, use the larger for the period measurement. You can measure phase directly in degrees if you apply the appropriate external frequency ($360 \times$ frequency of signals whose phase you are measuring) to the counters in place of an internal standard frequency. However, the external frequency cannot exceed the maximum counting rate of the instrument. Procedure for phase measurement is given in figure 2-5.

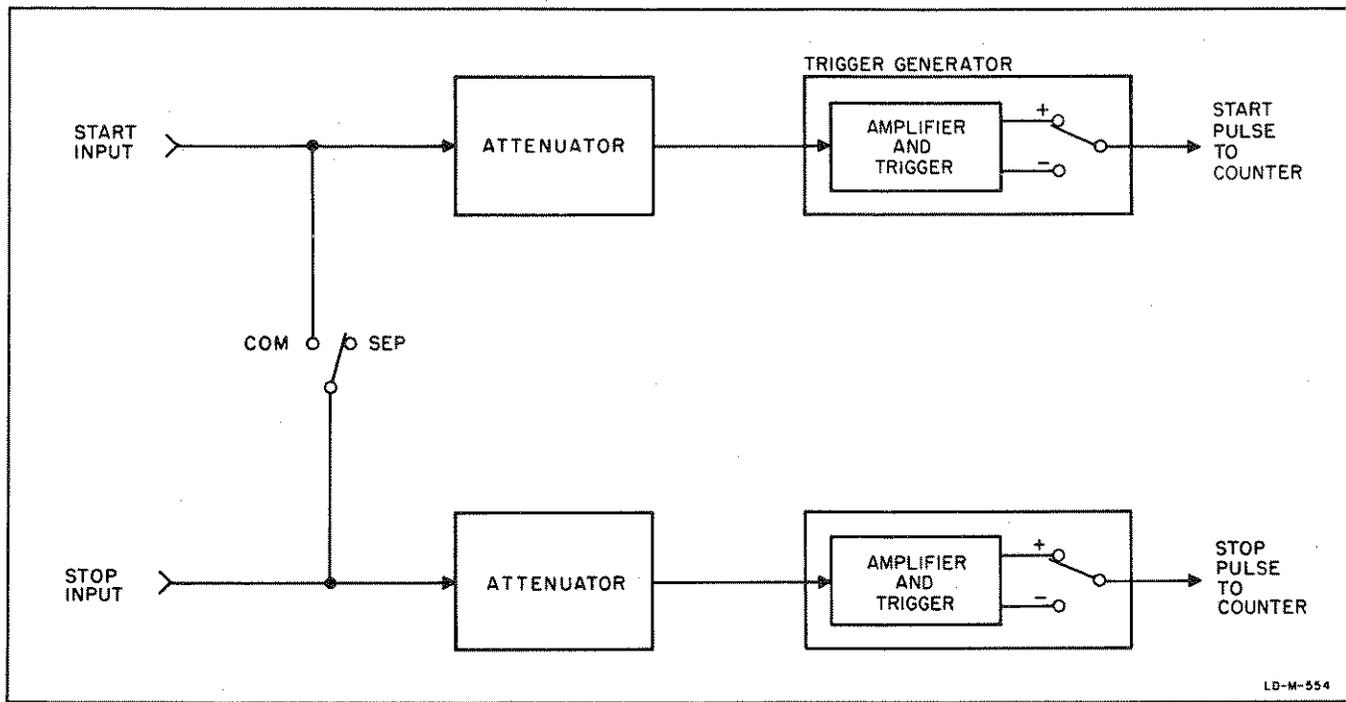


Figure 3-1. Overall Block Diagram of Model 5262A

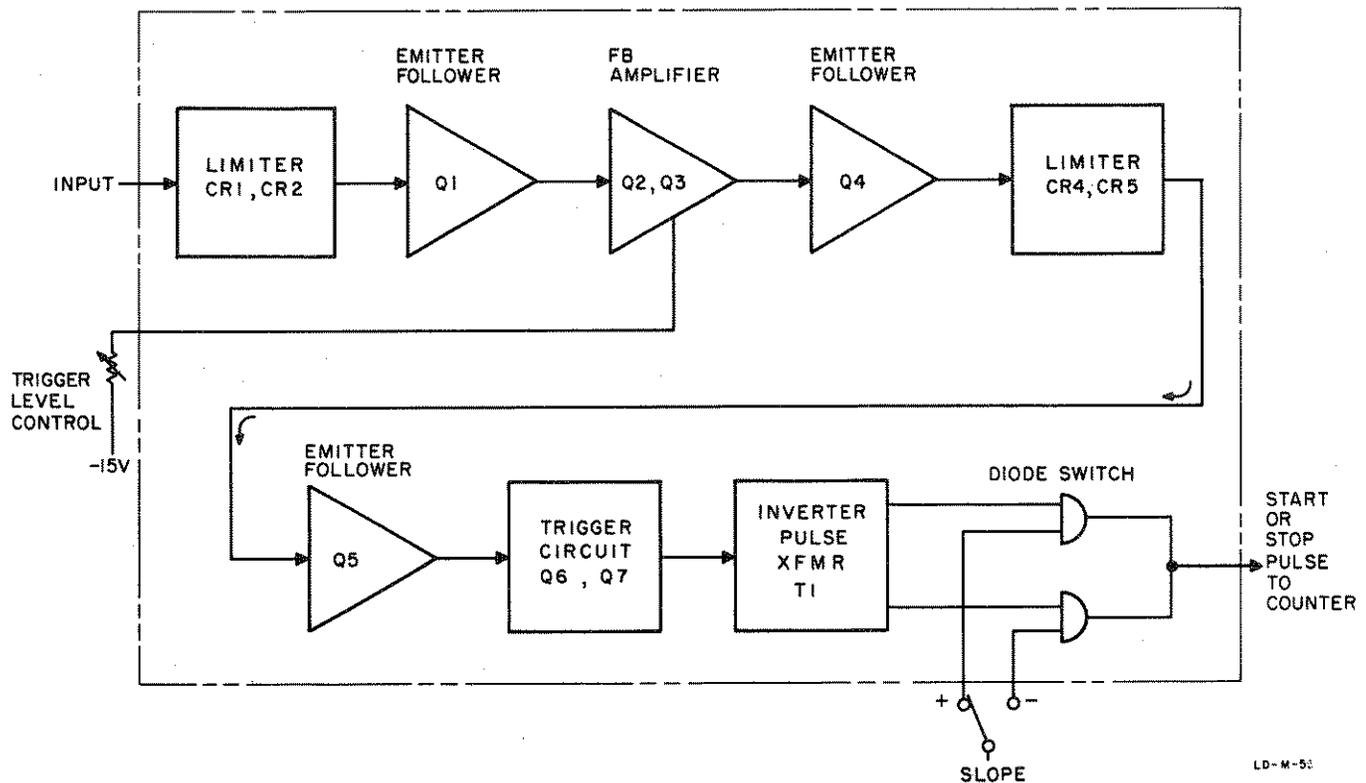


Figure 3-2. Block Diagram of 5262A-65A Trigger Generator Assembly

