TECHNICAL MANUAL
*for*

# PULSE GENERATOR

# MODEL B7B

CMC

COMPUTER MEASUREMENTS COMPANY

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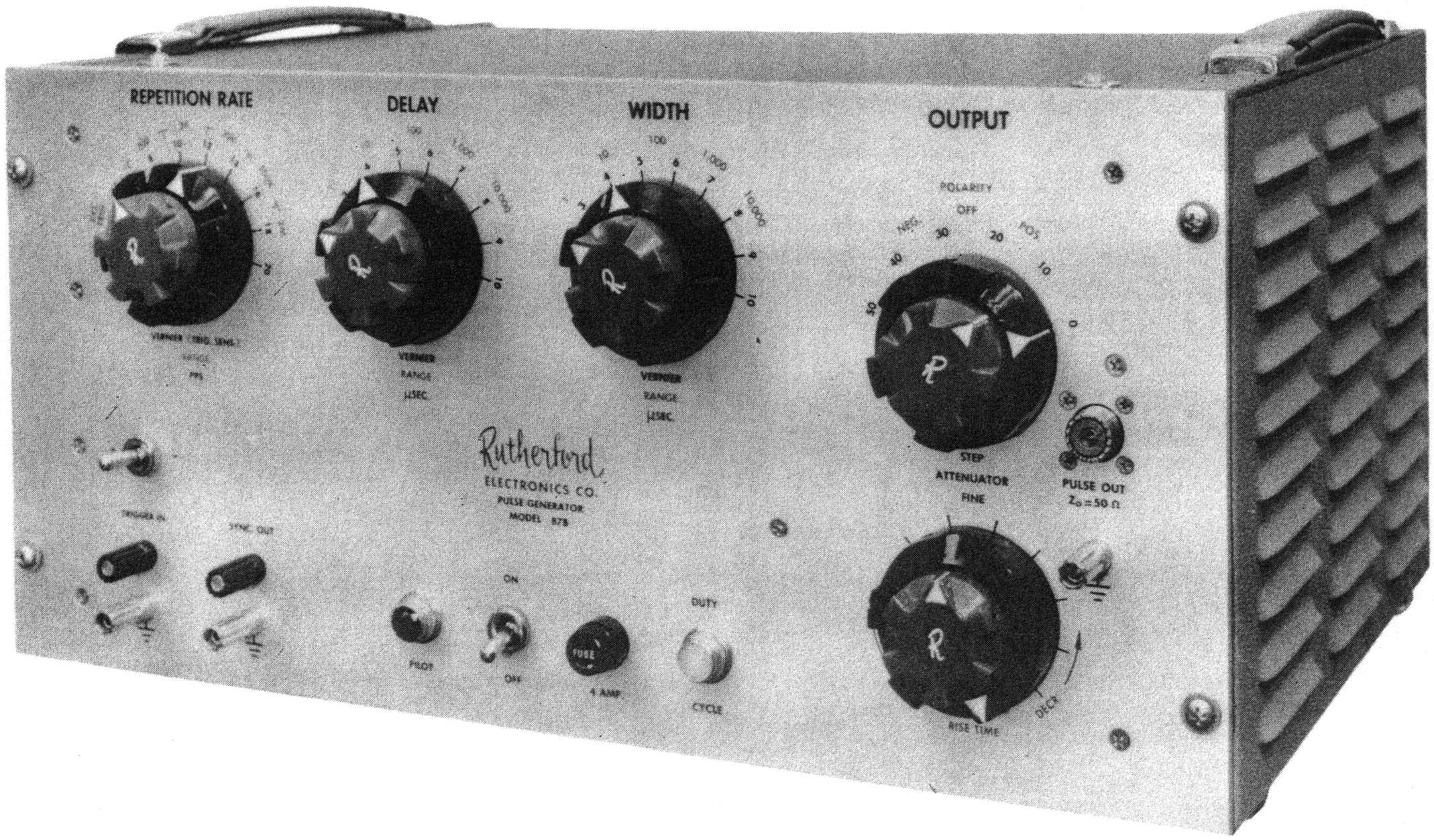


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# PULSE GENERATOR

# MODEL B7B

## GENERAL DESCRIPTION

The model B7B is a compact, lightweight, general purpose pulse generator designed to meet the rigid requirements of a great number of research and test applications. Exacting design criteria, an electron tube complement of a small number of tube types, and special duty cycle limiting circuitry to automatically protect the output tubes from life-shortening overloads insure long periods of reliable operation with a minimum of maintenance and repair problems.

The model B7B produces trains of 50 volt pulses having repetition rates to 2 megacycles, pulse delays and widths to 10,000 microseconds, rise and fall times of 15 millimicroseconds, and a permissible duty factor of up to 30% at full amplitude.

The model B7B generates these pulse trains in the following manner. (Refer to Fig. A for time relations of the various pulses.)

The oscillator section creates a continuous train of timing pulses to establish the repetition rate of the output pulse. These timing pulses are used to start delay circuitry to produce what we shall call a start pulse. The start pulse occurs at the end of a time predetermined by the pulse delay controls. The start pulse is used to form the leading edge of the output pulse and to start another delay circuit which produces a second pulse called the stop pulse. This stop pulse occurs at the end of a time predetermined by the setting of the pulse width controls and is used to form the trailing edge of the output pulse. A clamp tube, which is cut off at the time the start pulse occurs, and back on again when the stop pulse occurs, creates what is used as a fill-in pulse between the start and stop pulses. The basic output pulse is therefore created by turning the main pulse on with the start pulse, keeping it on with the fill-in pulse, and turning it off with the stop pulse.

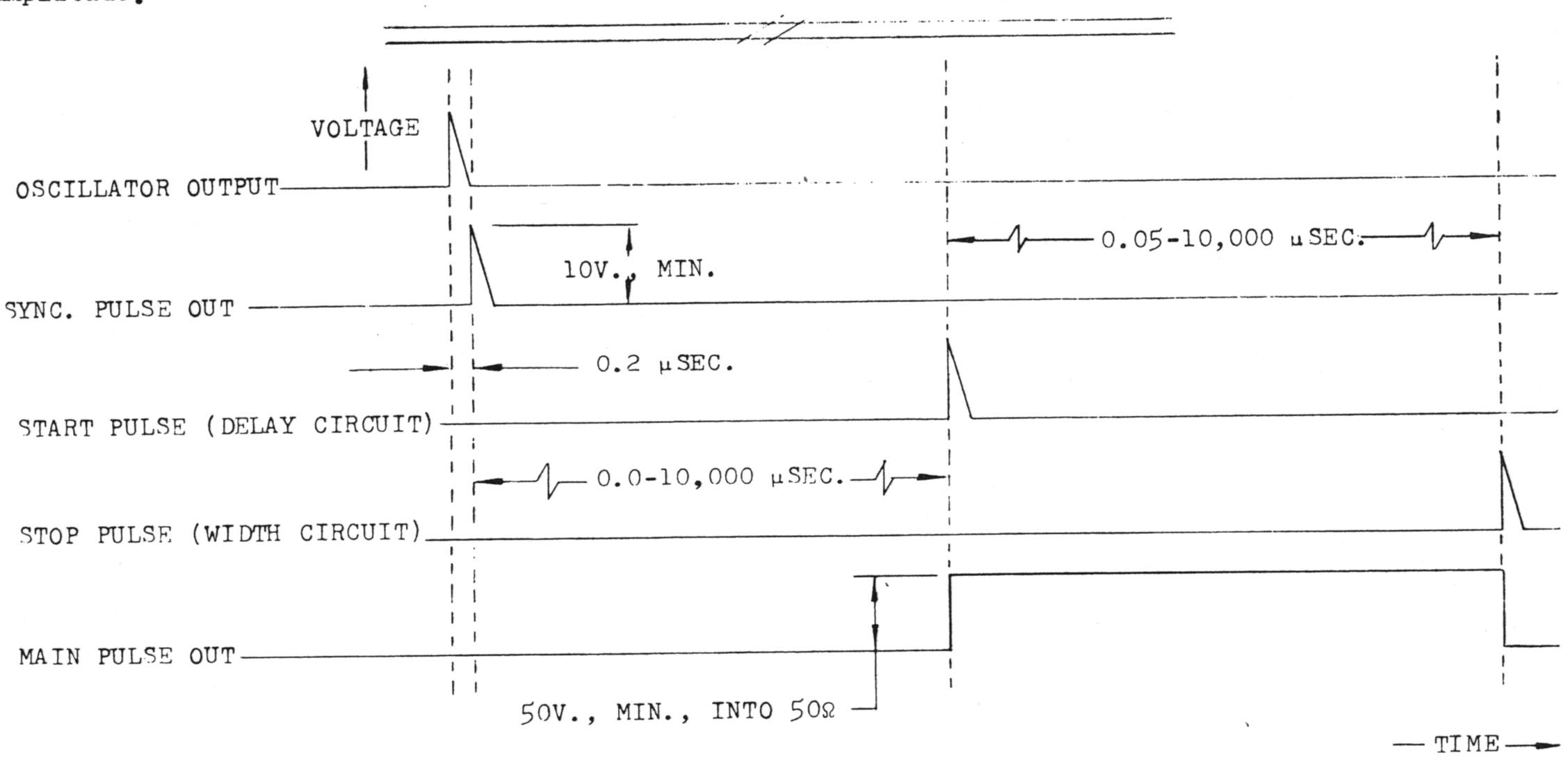



**FIG. A** TIMING DIAGRAM

The pulse forming circuitry then amplifies the power of this pulse and presents it through suitable attenuation and polarity determining circuitry as the main output pulse.

Supplementary circuitry furnishes a synchronizing pulse from the oscillator section for use in synchronizing additional instrumentation with the main output pulse of the generator, a means of triggering the generator from a external source so that it may be synchronized with other instruments, and a means of varying the rise and fall times of the output pulse for applications requiring a degraded pulse shape.

Past experience has indicated confusion concerning the definition of some of the basic terminology used in reference to pulses. Fig. B shows these terms as defined by accepted IRE standard pulse terminology. When used in this manual, these terms are meant to be as defined by this standard.

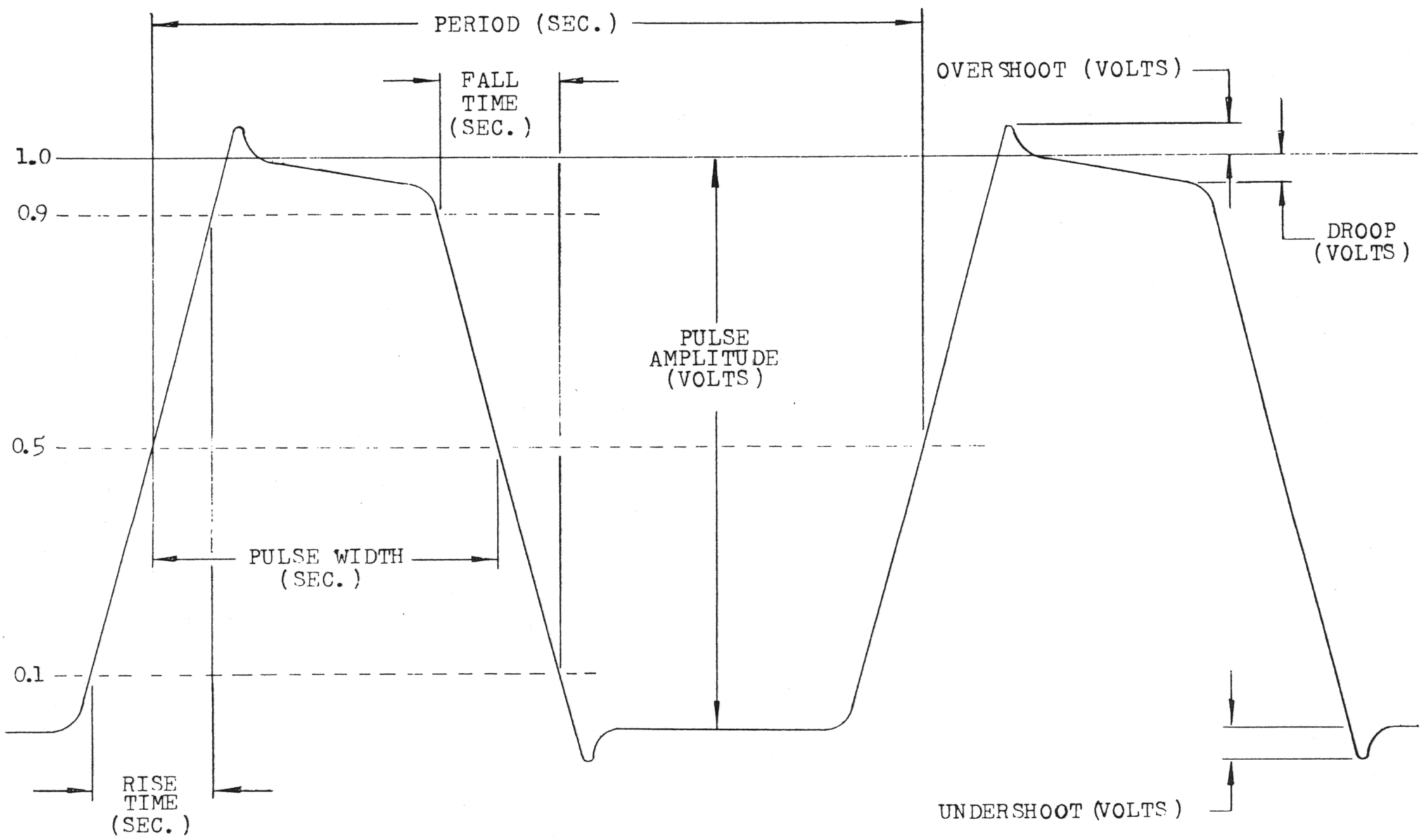
# SPECIFICATIONS

The following are the design specifications of the model B7B pulse generator. The instrument will, in most cases, exhibit properties which are superior to the specifications.

## OSCILLATOR REPETITION RATE

The internal oscillator is continuously variable from 20 cycles per second to 2 megacycles per second in five ranges.

| | | |
|---|---|---|
| 20 cps | - | 200 cps |
| 200 cps | - | 2 kc |
| 2 kc | - | 20 kc |
| 20 kc | - | 200 kc |
| 200 kc | - | 2 mc |




REPETITION RATE (PULSES/SEC.) = 1/PERIOD (SEC./PULSE)
DUTY FACTOR (%) = PULSE WIDTH (SEC.)/PERIOD (SEC.) 100
OVERSHOOT (%) = OVERSHOOT (VOLTS)/PULSE AMPLITUDE (VOLTS) 100
UNDERSHOOT (%) = UNDERSHOOT (VOLTS)/PULSE AMPLITUDE (VOLTS) 100
DROOP (%) = DROOP (VOLTS)/PULSE AMPLITUDE (VOLTS) 100

**FIG. B** DEFINITIONS OF BASIC PULSE TERMINOLOGY

## PULSE DELAY

Main pulse delay is continuously variable, with respect to the sync. pulse out, from 0.0 microseconds to 10,000 microseconds in five ranges.

| | | |
|---|---|---|
| 0.0 µsec. | - | 1.0 µsec. |
| 1.0 µsec. | - | 10 µsec. |
| 10 µsec. | - | 100 µsec. |
| 100 µsec. | - | 1,000 µsec. |
| 1,000 µsec. | - | 10,000 µsec. |

## PULSE WIDTH

Main pulse width is continuously variable from 0.05 microseconds to 10,000 microseconds in five ranges.

| | | |
|---|---|---|
| 0.05 µsec. | - | 1.0 µsec. |
| 1.0 µsec. | - | 10 µsec. |
| 10 µsec. | - | 100 µsec. |
| 100 µsec. | - | 1,000 µsec. |
| 1,000 µsec. | - | 10,000 µsec. |

## TRIGGER REQUIRED

To trigger the unit from an external source, the following trigger pulse is required.

| | |
|---|---|
| AMPLITUDE | 20V., minimum. |
| REPETITION RATE | 2 mc, maximum. |
| RISE TIME | 1.0 µsec. or less. |
| POLARITY | Positive or negative. |

NOTE: At lower repetition rates and/or faster rise times, the instrument triggers with a much lower amplitude pulse. The fast rise time quality of the sync. pulse out allows the model B7B to be triggered from the sync. pulse from another model B7B at all repetition rates.

## MAIN PULSE

The following are the specifications of the main output pulse.

| | |
|---|---|
| AMPLITUDE | 50V., minimum, into a 50Ω load. |
| POLARITY | Positive or negative, but not simultaneously. |
| RISE TIME | 0.015 microseconds. |
| FALL TIME | 0.015 microseconds. |

NOTE: Both rise and fall time may be degraded simultaneously to approximately one (1) microsecond.

| | |
|---|---|
| OVERSHOOT AND UNDERSHOOT | 5%, maximum, except when pulse is attenuated more than 30db. with the 10db. step attenuator. 30%, maximum, at 50db. down. |
| DROOP: | |
| 0-100 µsec. wide pulse | Negligible. |
| 100-1,000 µsec. wide pulse | 15%, maximum. |
| 1,000-10,000 µsec. wide pulse | 25%, maximum. |
| DUTY FACTOR | 30%, maximum, at full amplitude. |
| ATTENUATION | 0 to 60db., continuously variable. |
| OUTPUT IMPEDANCE | 50Ω. |

## SYNC PULSE OUT

The following sync. pulse is available at a front panel connector.

| | |
|---|---|
| AMPLITUDE | 10V., minimum. |
| WIDTH | 0.05 µsec., minimum. |
| RISE TIME | 0.03 µsec., maximum. |
| POLARITY | Positive. |

## MISCELLANEOUS SPECIFICATIONS

The following are miscellaneous specifications of the instrument.

| | |
|---|---|
| POWER REQUIRED | 115V., 3.26 amps., 50-60 cps, 375 watts. |
| VENTILATION | Forced air. |
| DIMENSIONS | 8 3/4" X 19 1/2" X 13". |
| WEIGHT, NET | 42 lbs. |
| WEIGHT, SHIPPING | 56 lbs. |
| ACCESSORIES INCLUDED | One instruction manual. |

# OPERATING INSTRUCTIONS

Refer to Fig. C for the location of all of the front panel controls described below.

FREQUENCY RANGE SWITCH When operated in the internal oscillator positions rotary switch S110 switches timing capacitors C110 through C119 in the grid circuits of V11 to determine the frequency range of the oscillator. In the external trigger position, the switch applies the external trigger pulse to the grid of the Schmitt trigger tube, V12.

FINE FREQUENCY AND TRIGGER SENSITIVITY CONTROL Potentiometer R115 varies the voltage at the grid of V11 to determine the repetition rate of the oscillator on any of the frequency ranges. During periods of external trigger operation this potentiometer becomes the trigger sensitivity control to determine the triggering level.

EXTERNAL TRIGGER POLARITY SWITCH In the two external trigger positions, positive or negative, depending on the polarity of the input signal, the switch selects the positive pulse from the external trigger tube, V10A, and transfers it through S110 to the input of the Schmitt trigger tube, V12.

DELAY RANGE SWITCH Rotary switch S200 switches timing capacitors C200 through C204 in the grid to ground circuit of V20A to determine the range of pulse delay.

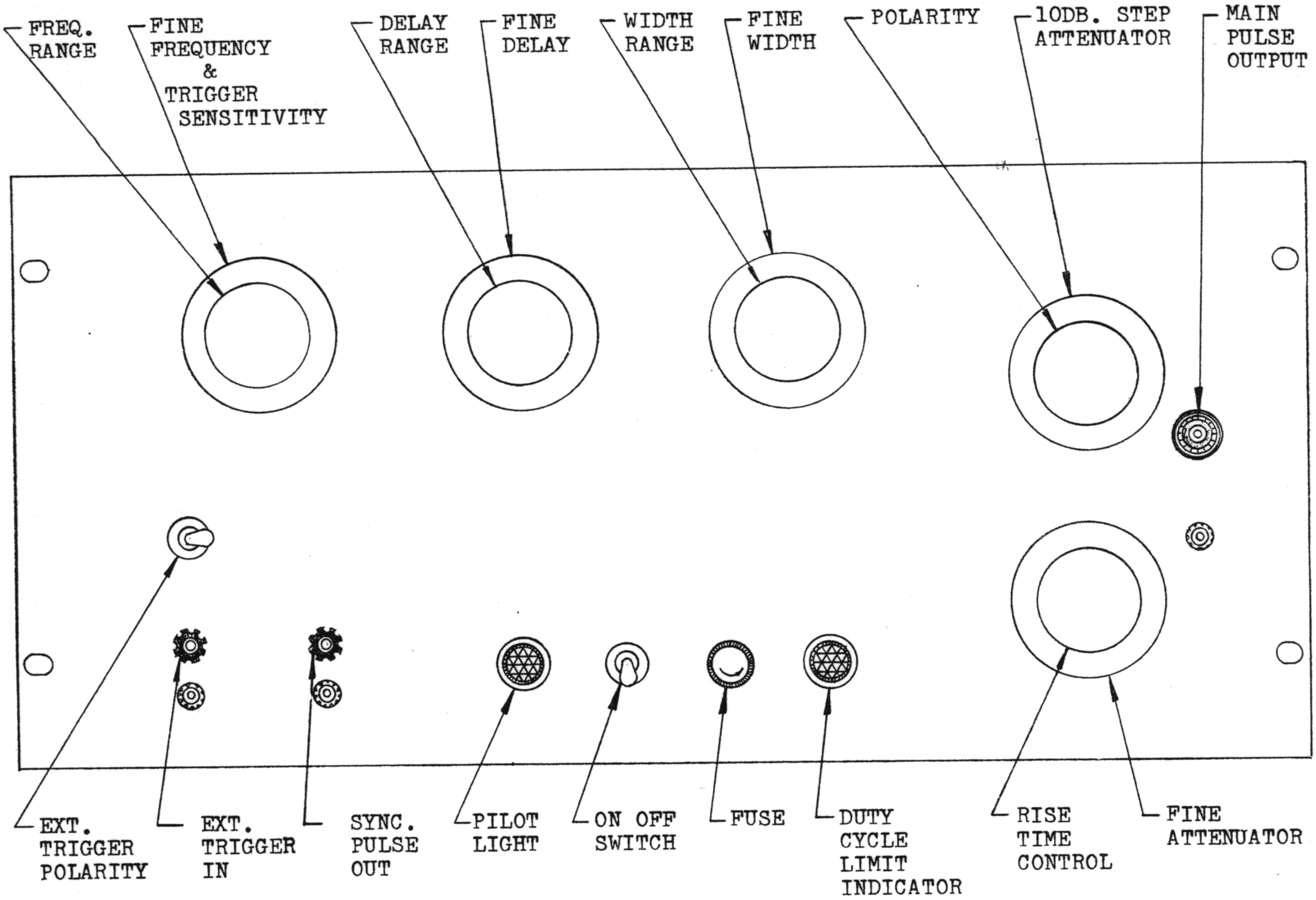



**FIG. C** FRONT PANEL CONTROLS

FINE DELAY CONTROL Potentiometer R208 varies the cathode to ground resistance of the pulse delay multivibrator, affording continuous delay settings on all delay ranges.

WIDTH RANGE SWITCH Rotary switch S300 switches timing capacitors C300 through C304 in the grid to ground circuit of V30A to determine the range of pulse width.

FINE WIDTH CONTROL Potentiometer R308 varies the cathode to ground resistance of the pulse width multivibrator, affording continuous width settings on all width ranges.

10db. STEP ATTENUATOR Rotary switch S800 controls the amplitude of the output pulse in 10db. steps.

FINE ATTENUATOR CONTROL Potentiometer R531 affords a continuously variable attenuation through each range of the 10db. step attenuator.

POLARITY SWITCH Rotary switch S450 determines the polarity of the output pulse by grounding various levels of the floating power supply and applying its voltages to the output tubes.

RISE TIME CONTROL Potentiometer R401 varies the resistance in the output tube control grid circuits, affording simultaneous degradation of rise and fall times to approximately one microsecond.

EXTERNAL TRIGGER IN J100 couples an external trigger through C100 to the control grid of the external trigger amplifier, V10A.

SYNC. PULSE OUT J101 takes the synchronizing pulse from the cathode of the sync. pulse cathode follower, V10B.

PILOT LIGHT Lamp DS500 lights when 115V. AC, 50-60 cps, single phase power is applied to the power transformer, T500.

ON-OFF SWITCH Switch S500 applies power to the primary winding of the power transformer, T500.

FUSE 4 ampere "slo-blo" fuse F500 protects the pulse generator from overloads.

DUTY CYCLE LIMITING INDICATOR Lamp DS530 lights when the 30% duty factor limitation is exceeded. This lamp, when lit, is a warning to the operator that the amplitude of the output pulse is being automatically reduced.

MAIN PULSE OUT Coaxial connector J800 takes the main pulse from the output of the 10db. step attenuator.

## PRELIMINARY INSTRUCTIONS

VENTILATION The model B7B pulse generator is cooled by forced air. It is imperative that both ends of the instrument be kept free of obstructions at all times in order to insure adequate air flow.

It is inadvisable to operate the instrument for appreciable lengths of time with the dust covers removed. These covers not only help to keep the instrument free from dust and other foreign matter, but also properly direct the flow of air through the instrument. Therefore, if the end covers are removed and the instrument mounted in a rack, the dust cover sections must be replaced before rack mounting.

DUTY FACTOR LIMITATION The dissipation limitations of the 6DQ5 power amplifier tubes limit the duty factor of the model B7B pulse generator to 30%, i.e., at full pulse amplitude, the pulse width must never equal greater than 30% of the pulse to pulse spacing. Operation up to approximately 70% duty factor is possible with reduced pulse amplitude.

The 30% duty factor limitation is automatically controlled in the model B7B. Should the duty factor limitation be exceeded, the model B7B automatically reduces the amplitude of the output pulse to such a level that the ratings of the output tubes are not exceeded. When the duty cycle limiter is in operation, the duty cycle lamp on the front panel lights, warning the operator of the reduced pulse amplitude condition.

FIRST TIME OPERATION The following procedure is recommended for putting the instrument into operation for the first time.

1. Turn the power switch to "OFF" and connect the line cord to a source of 115V., 50-60 cps power.

2. Set the instrument controls as follows:

| | | |
|---|---|---|
| a. | Frequency Range | 200 kc |
| b. | Frequency | 100 kc |
| c. | Delay Range | 1 µsec. |
| d. | Delay | 0 µsec. |
| e. | Width Range | 10 µsec. |
| f. | Width | 1 µsec. |
| g. | 10db. Step Attenuator | 0 db. |
| h. | Fine Attenuator | 0 db. |
| i. | Polarity | "+" |
| j. | Rise Time | clockwise |

3. Connect a synchroscope as follows:

| | | |
|---|---|---|
| a. | Sweep | 1 µsec./cm |
| b. | Vertical Deflection | 20 V./cm |
| c. | Trigger | External from the sync. out connector on the model B7B front panel. |

4. Connect a ground strap from one of the model B7B ground binding posts to a ground binding post on the synchroscope.

5. Connect a 50Ω resistive load between the pulse out connector and ground. The output impedance of the model B7B is 50Ω and it is imperative that it be properly terminated if the true output waveform is to be observed.

6. Connect the input probe of the synchroscope across the 50Ω external load. If the true waveform of the output pulse is to be observed, it is imperative that the synchroscope input probe be properly compensated for viewing step function waveforms by adjusting the compensating capacitor in the probe itself and that the probe ground strap be connected to the instrument ground.

7. Turn the model B7B power switch to "ON" and allow approximately one (1) minute for the instrument to reach operating temperature. Adjust the trigger sensitivity of the synchroscope for a stable trace. The model B7B controls may now be set to any desired values within the 30% duty factor limitation.

# MAINTENANCE INSTRUCTIONS

## DANGER

The power supplies in this instrument operate at voltages which are dangerous to personnel. Extreme caution must be exercised at all times. Repair or maintenance work should never be attempted unless competent personnel, thoroughly trained in the accepted methods of artificial respiration, are in attendance.

## DANGER

The following maintenance suggestions are designed to aid the maintenance technician in scheduling regular preventative as well as cor-

rective maintenance routines. It is important that maintenance routines be performed regularly to obtain maximum life and usefullness from the instrument.

FAN MOTOR The fan motor bearings require oil periodically. Use a good grade of light machine oil and apply only a drop or two every six months.

CLEANING THE INSTRUMENT At regular intervals, any dust that has settled on the interior of the instrument should be removed by means of dry compressed air. AVOID high velocity air streams which might injure the instrument or disturb adjustments. Persistent dirt may be removed with a lint-free cloth and, if necessary, carbon tetrachloride.

Under normal conditions, the silver plated contacts of the rotary switches should not require special attention. In case they become tarnished, the contacts should be cleaned by rotating the switch several times.

INSPECTION A visual inspection for loose or broken wiring, loose hardware, and discolored or deformed components is desirable while the instrument is being cleaned.

SWITCHES Turn the rotary switches while observing the contacts to check contact centering in each index position. Improperly centered contacts may be due to the switch becoming warped or twisted. AVOID pressure on the contacts as they are easily damaged.

CAPACITORS AND RESISTORS Inspect the electrolytic capacitors for leakage of electrolyte. Replace if necessary. The wax coating of the paper tubular capacitors may drip if the instrument has been overheated by operation in a restricted space. This condition usually does not indicate replacement.

Composition resistors should be checked for serious discoloration which would indicate excessive dissipation and, therefore, faulty operation. A moderate amount of discoloration is normal.

RACK MOUNTING The model B7B, as purchased, is a portable instrument. It may, however, be mounted in a rack with other instrumentation by removing the louvered end panels. To remove the end panels, first remove both sections of the dust cover. The six sheet metal screws which hold each louvered end panel to the inner end panels are now accessible. Remove these screws and the two screws which hold each end panel to the front panel. Replace both dust covers on the instrument and it is ready for rack mounting. The dust covers must be put back on the instrument before rack mounting as they not only serve to keep dust and other foreign matter out of the instrument, but also help to properly direct the flow of cooling air through the instrument.

CALIBRATION The model B7B contains several controls for the purposes of calibration, pulse shape adjustment, etc. These controls are preset at the factory and should not require readjustment except due to component aging or when electron tubes are replaced.

When readjustment of these controls becomes necessary, the instrument should be allowed to operate for one hour prior to adjustment in order that all components may reach their normal operating temperatures and the instrument has reached maximum stability.

The calibration and checkout chart shown on the following page is patterned after the checkout procedure used at the factory. The chart is intended as a calibration aid only and presupposes that the instrument is in proper working order, except for calibration. It should be noted that there is some interaction between many of the controls. Therefore, it is recommended that the complete calibration and check procedure, working from top to bottom of the chart, be performed at one time on a periodic basis rather than spot adjustments to one circuit which could conceivably have adverse effect on another. Note that an asterisk (*) in any one column indicates that it does not matter which position that control is in for that particular check.

All of the controls used for calibration and adjustment are called out by schematic symbol number on the chassis or circuit board on which they are located, with the following exceptions:

C118 is mounted on the repetition rate switch.

C204 is mounted on the delay switch.

C304 is mounted on the width switch.

R602 is adjustable through the access hole at the rear of the instrument.

TROUBLE SHOOTING It is of extreme importance that the operation, theory, and physical location of components be thoroughly understood before any repair of the instrument is undertaken. A careful study of the circuit descriptions and the schematic diagram will, in most instances, indicate the cause for a particular difficulty in a much shorter time than will a blind point to point check of the entire instrument. It is also suggested that whenever an operational difficulty is encountered, a recheck of the setting and adjustment of the operational controls will often times reveal that a control has been inadvertantly set in the wrong position and that this is the cause of the difficulty.

ELECTRON TUBE FAILURE A major cause of equipment failure is weak or inoperative electron tubes. When a system failure has been traced to a particular circuit, it will be found expedient to test the electron tubes in that circuit, replacing all weak or inoperative ones, before a more detailed examination of the circuit is un-

| TO CHECK OR CALIBRATE | | | MODEL B7B DIAL SETTINGS | | | | | | | | | | | OSCILLOSCOPE SETTINGS | | OBSERVE | ADJUST | REMARKS (*) + or - |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | REP. RATE | | DELAY | | WIDTH | | ATTENUATOR | | POLARITY | | RISE TIME | | | | | |
| | | | RANGE | VERNIER | RANGE | VERNIER | RANGE | VERNIER | STEP | VERNIER | OUTPUT | TRIGGER | CONTROL | VERTICAL | HORIZONTAL | | | |
| REP. RATE | 20℈-200℈<br>200 -2KC<br>2KC-20KC<br>20KC-200KC | HIGH END | 200℈-2KC | 20 | 1 | 1 | 10 | 5 | 0 | CW | * | * | CW | 20V/cm | 0.1millisec/cm | 0.5 millisec<br>Pulse to pulse | R111 | There is some interaction between the high and low controls. Therefore, these two adjustments should be readjusted several times until both are correct. Adjustment of this range automatically adjusts the other three ranges. |
| | | LOW END | 200℈-2KC | 2 | 1 | 1 | 100 | 5 | 0 | CW | * | * | CW | 20V/cm | 1 millisec/cm | 5 millisec<br>Pulse to pulse | R116 | |
| | 200KC-2MC | | 200KC-2MC | 20 | 1 | MIN | 1 | MIN | 0 | CW | * | * | CW | 20V/cm | 0.1μsec/cm | 0.5μsec<br>Pulse to pulse | C118 | This adjustment is to be made only after the four lower ranges have been calibrated. |
| | EXTERNAL TRIGGER | POSITIVE | EXT. TRIG. | SEE REMARKS | 1 | MIN | SEE REMARKS | | 0 | CW | * | + | CW | 20V/cm | SEE REMARKS | One output pulse for each trigger in. | NONE | Use any input trigger from 20℈ to 2MC rep. rate, 20V amplitude, and rise time less than 1μsec. Oscilloscope horizontal settings and B7B width setting will depend on rep. rate. Adjust B7B rep. rate vernier for reliable triggering. |
| | | NEGATIVE | EXT. TRIG. | SEE REMARKS | 1 | MIN | SEE REMARKS | | 0 | CW | * | - | CW | 20V/cm | SEE REMARKS | One output pulse for each trigger in. | NONE | |
| | SYNC PULSE | AMPLITUDE | 200KC-2MC | 20 | 1 | MIN | 1 | MIN | 0 | CW | * | * | CW | 10V/cm | 0.1μsec/cm | 10V, Minimum | NONE | Looking at pulse at the sync. out jack on the instrument front panel. Polarity of the sync. pulse is positive. |
| | | WIDTH | | | | | | | | | | | | | | Approx .05μsec | | |
| | | RISE TIME | | | | | | | | | | | | | | Approx .03μsec | | |
| PULSE DELAY | 1-10<br>10-100<br>100-1,000<br>1,000-10,000 | | 2KC-20KC | 2 | 10 | 10 | 1 | 10 | 0 | CW | * | * | CW | 20V/cm | 1μsec/cm | 10μsec. - leading edge of sync pulse to leading edge of output pulse. | R200 | Adjustment of this range also adjusts the three remaining longer ranges. |
| | 0 to 1 | | 20KC-200KC | 2 | 1 | 10 | 1 | MIN | 0 | CW | * | * | CW | 20V/cm | 0.1μsec/cm | 1μsec. - leading edge of sync pulse to leading edge of output pulse. | C204 | This adjustment is to be made only after the four longer ranges have been calibrated. Note that when the delay vernier is CCW the output pulse occurs coincident with or before the sync. pulse. |
| PULSE WIDTH | 1-10<br>10-100<br>100-1,000<br>1,000-10,000 | | 2KC-20KC | 2 | 1 | MIN | 10 | 10 | 0 | CW | * | * | CW | 20V/cm | 1μsec/cm | 10μsec. - leading edge to trailing edge of output pulse at 50% amplitude points. | R300 | Adjustment of this range also adjusts the three remaining longer ranges. |
| | 0.05 to 1 | | 20KC-200KC | 2 | 1 | MIN | 1 | 10 | 0 | CW | * | * | CW | 20V/cm | 0.1μsec/cm | 1μsec. - leading edge to trailing edge of output pulse at 50% amplitude points. | C304 | This adjustment to be made only after the four longer ranges have been calibrated. Note that when the width vernier is CCW the pulse width is 0.05μsec. or less. |
| OUTPUT PULSE | AMPLITUDE | POSITIVE<br>NEGATIVE | 20℈-200℈ | 2 | 1 | MIN | 10,000 | 8 | 0 | CW | + | * | CW | 20V/cm | 1 millisec/cm | SEE REMARKS | R473 | Increase the adjustment until the amplitude of the output pulse near the trailing edge stops increasing and the leading edge starts to peak. Decrease the adjustment until the peaking just disappears. |
| | PULSE SHAPE | SHORT PULSE | 20KC-200KC | 2 | 1 | MIN | 1 | 5 | 0 | CW | + | * | CW | 20V/cm | 0.1μsec/cm | SEE REMARKS | C260 C360 C472 | Set C472 for best possible overall pulse shape. Adjust C260 and C360 for improvement. Finally, slight readjustment of all three controls will optimize the pulse shape. |
| | | LONG PULSE | 2KC-20KC | 2 | 1 | MIN | 10 | 10 | 0 | CW | + | * | CW | 20V/cm | 10μsec/cm | SEE REMARKS | C350 R354 | Adjust R354 for minimum droop. Adjust C350 for optimum flatness of pulse top. Finally, slight readjustment of both controls will optimize long pulse shape. |
| | ATTENUATOR | 10db STEP | 2KC-20KC | 2 | 1 | MIN | 10 | 10 | 0 | CW | + | * | CW | SEE REMARKS | 1μsec/cm | SEE REMARKS | NONE | The step attenuator dial should be rotated to the various dial settings while noting that pulse amplitude decreases accordingly. Change the oscilloscope vertical setting as the attenuator is changed. At high attenuation settings, good grounding between instrument and oscilloscope becomes extremely important. |
| | | VERNIER | 2KC-20KC | 2 | 1 | MIN | 10 | 10 | 0 | SEE REMARKS | + | * | CW | 20V/cm | 1μsec/cm | SEE REMARKS | SEE REMARKS | Turn attenuator vernier CCW until the output pulse decreases 10db. Pulse flatness is pre-adjusted at the factory at this setting with R353. Note, however, that R353 may be adjusted for optimum flatness at any fine attenuator (0 to 10db down) or pulse width setting. Recheck the R354 setting. |
| | DUTY FACTOR | | 20KC-200KC | 10 | 1 | MIN | 10 | 3 | 0 | CW | + | * | CW | 20V/cm | 1μsec/cm | SEE REMARKS | R602 | Adjust R602 to the point that pulse amplitude just starts to decrease and the duty cycle lamp on the front panel lights. |
| | RISE TIME | FASTEST | 20KC-200KC | 2 | 1 | MIN | 1 | MIN | 0 | CW | + | * | CW | 20V/cm | 0.02μsec/cm | 0.015μsec or less | NONE | Rise and fall times will appear to be greater than 0.015μsec. when viewed on an inferior oscilloscope. The Tektronix type N sampling unit is recommended for direct viewing of actual rise and fall times. |
| | | DEGRADED | 20KC-200KC | 2 | | | 10 | 5 | | | | | CCW | | 1μsec/cm | Approx 1μsec | | |
| | FALL TIME | FASTEST | 20KC-200KC | 2 | 1 | MIN | 1 | MIN | 0 | CW | + | * | CW | 20V/cm | 0.02μsec/cm | 0.015μsec or less | NONE | |
| | | DEGRADED | 20KC-200KC | 2 | | | 10 | 5 | | | | | CCW | | 1μsec/cm | Approx 1μsec | | |
| | POLARITY | ALL OUTPUT PULSE CHARACTERISTICS SHOULD BE RECHECKED WITH THE POLARITY SWITCH IN THE "-" POSITION | | | | | | | | | | | | | | | | |

CALIBRATION AND CHECK CHART MODEL B7B

dertaken. A HICKOCK #539A Tube Checker has been found very satisfactory in detecting electron tubes with low transconductance.

ISOLATION OF THE DEFECTIVE CIRCUIT The following trouble shooting procedure is designed to isolate the trouble to one particular circuit.

Complete failure of the instrument to operate indicates a power source difficulty. Check the source of power and make certain that the power cord plug is firmly in place. Check the fuse on the instrument front panel. A blown fuse indicates an overload condition within the instrument. Blown fuses should not be indiscriminately replaced without first ascertaining the cause of overload, as further damage is likely to result.

If power is applied to the instrument but it still fails to operate, a check should be made of the power supply voltages. For this and subsequent checks, it will be necessary to remove the dust covers from the instrument.

It will be necessary to use a synchroscope for further checks. It is important that a synchroscope with a wide band-pass be used as it is impossible to observe many of the fast rise times and narrow pulse widths on an inferior synchroscope. The Tektronix models 517, 541, 543, or 545 have been found satisfactory in observing the waveforms present in the instrument.

If the instrument has no output pulse, check for a sync. pulse at the sync. out jack on the instrument front panel. If there is no sync. pulse, the trouble is in the oscillator section of the instrument. If, however, a sync. pulse is present, synchronize a synchroscope with this pulse and proceed as follows.

Check for a pulse at the input of the attenuator switch, S800. A pulse here isolates the trouble to the switch or its components. If no pulse or a deformed pulse is present, check for a pulse at pins 3 and 6 of V40. If a normal pulse is present at this point, the faulty circuitry is in the output section.

If no pulse is present at the cathodes of V40, the trouble will probably be found in the delay multivibrator or blocking oscillator. If, however, a deformed pulse is present, a study of its shape will be helpful in quickly finding its cause.

If the deformed pulse shows a very slow rise time and normal fall time, the start pulse is missing. Check the start pulse channel. If there are very narrow pulses where the leading and trailing edges of the output pulse would normally be, the clamp circuit is inoperative. If the pulse rises normally and then immediately starts to decay slowly toward zero, the trouble lies in the clamp circuit or the width multivibrator circuit. Finally, if the pulse is normal except for a slow fall time, check the stop pulse channel for faulty operation.



In checking each subsection, it is advisable to start by looking for an output pulse from the section and then work back toward the start of the section. Thus, whenever a normal pulse is found, the trouble is isolated to the stage which immediately follows it.

# CIRCUIT DESCRIPTION

OSCILLATOR SECTION The oscillator section consists of the external trigger amplifier, V10A; the free-running multivibrator, V11; the Schmitt trigger, V12; the repetition rate blocking oscillator, V13; and the sync. pulse cathode follower, V10B. V10, V11, V12, and V13 are type 6DJ8 dual triode electron tubes.

The repetition rate of the free-running multivibrator is determined by the action of two front panel controls. The range of the oscillator is determined by the selection of timing capacitors C110 through C119, in the grid circuits of V11, by the oscillator range switch, S110. Fine repetition rate control of the multivibrator, through any range, is determined by varying the fine frequency potentiometer, R115, which varies the voltage to this grid circuit.

The limits of repetition rate for each range are set with the two calibration potentiometers, R111 and R116, which establish the range through which this voltage may vary.

The output, taken from the plate of the multivibrator triggers the Schmitt trigger circuit. The Schmitt trigger circuit shapes the pulse, and sends it to the repetition rate blocking oscillator.

The repetition rate blocking oscillator again shapes the pulse. The basic repetition rate timing pulse is taken from the cathode of this blocking oscillator and is used to trigger the delay multivibrator.

The external trigger amplifier provides a means of triggering the instrument from an external source. The external trigger polarity switch, in either the positive or negative position, depending on the polarity of the input signal, couples the positive pulse from V10A through the repetition rate range switch, S110, to the input grid of the Schmitt trigger. Potentiometer R115 now becomes a trigger sensitivity control to set the triggering level. It should be noted that the repetition rate switch, S110, must be placed in the external trigger position in order to trigger the model B7B from an external source.

The timing pulse taken from the cathode of the repetition rate blocking oscillator is also coupled through a 0.2 μsec. delay line to the

grid of the sync. pulse cathode follower. The pulse taken from the cathode is brought to the instrument front panel to be used as a synchronizing pulse for use with other instrumentation. Due to the fact that the sync. pulse occurs approximately 0.2 μsec. after the pulse which triggers the pulse delay circuit, we are able to overcome the inherent delay of the remaining circuitry and can thus produce output pulses which are not delayed in time with respect to the sync. pulse.

DELAY SECTION The delay section consists of the delay multivibrator, V20, and the delay blocking oscillator, V21. V20 is a type 6DJ8 dual triode electron tube and V21 is a type 6BQ7A dual triode electron tube.

The monostable multivibrator, V20, is triggered from its stable state to its quasi-stable state by positive pulses from the oscillator section which are coupled into the grid of V20B and the plate of V20A through diode CR201. The length of time which the multivibrator remains in this quasi-stable state, determined by the timing capacitor in the grid circuit of V20A and the cathode to ground resistance of V20, is the delay time of the circuit. Thus, this circuit determines the time between the oscillator section timing pulse and the start of the main pulse.

The range of delay is determined by the selection of timing capacitors C200 through C204 by the delay range switch, S200. Fine delay control throughout any range is determined by varying the cathode to ground resistance with the fine delay potentiometer, R208.

R200 sets the voltage to which the grid circuit is returned, thus providing calibration for the various ranges.

A pulse, created by the return of the multivibrator to its stable state after this predetermined delay, is coupled from the plate of V20B to trigger the delay blocking oscillator, V21.

The pulse taken from the cathode of the blocking oscillator is known as the "start pulse". This start pulse goes to the amplifiers in the start channel and to the width section where it is used to trigger the width multivibrator.

WIDTH SECTION The pulse width section consists of the width multivibrator, V30. V30 is a type 6DJ8 dual triode electron tube.

The monostable multivibrator, V30, is triggered from its stable state to its quasi-stable state by positive pulses from the delay section which are coupled into the grid of V30B and the plate of V30A through diode CR301. The length of time which the multivibrator remains in this quasi-stable state, determined by the timing capacitor in the grid circuit of V30A and the cathode to ground resistance of V30, is the delay time of this circuit. Thus, this circuit determined the time between the delay section output pulse which starts the main pulse and the width section output pulse which stops the main pulse.

The range of pulse width, is determined by the selection of timing capacitors C300 through C304 by the width range switch, S300. Fine width control throughout any range is determined by varying the cathode to ground resistance with the fine width potentiometer, R308.

R300 sets the voltage to which the grid circuit is returned, thus providing calibration for the various ranges.

Two outputs are taken from the width multivibrator. The first is the waveform taken from the plate circuit of V30B. This waveform is a negative going pulse equal in time duration to the delay time of the width multivibrator. It is coupled through C310 to the grid of the clamp tube, V35B. The second output, a pulse created by the return of the multivibrator to its stable state after the predetermined delay, is known as the "stop pulse". This stop pulse is coupled into the amplifiers in the stop channel.

START PULSE CHANNEL The start pulse channel consists of three pulse shaping amplifier stages and the leading edge forming tube. V25 and V26 are type 7119 dual triode electron tubes. V27 is a type 6BQ7A dual triode electron tube.

The start channel receives the positive start pulse from the delay section through a 0.02 microsecond delay line, DL210. This delay line delays the start pulse without delaying the stop pulse, thus allowing a minimum output pulse width of 0.05 microseconds. This pulse goes through three pulse transformer coupled amplifier stages; V25A, V25B, and V26. Pulse transformer T260 couples the amplified pulse into the grids of the leading edge forming tube, V27. This tube drives the output pulse cathode follower, in the pulse forming section, to form the leading edge of the output pulse.

STOP PULSE CHANNEL The stop pulse channel consists of three pulse shaping amplifier stages and the trailing edge forming tube. V35A is ½ of a type 6BQ7A dual triode electron tube. V36 and V37 are type 7119 dual triode electron tubes.

The stop channel receives the positive stop pulse from the width section. It is sent through three stages of transformer coupled amplification; V35A, V36A, and V36B, into the grids of the trailing edge forming tube, V37. This tube drives the output pulse cathode follower, in the pulse forming section, to form the trailing edge of the output pulse.

OUTPUT SECTION The output section consists of the clamp tube, V35B; the pulse forming cathode follower, V40; two power amplifier tubes, V45 and V46; the control grid restoration diode, V47A; and the screen grid disconnect diode,

V47B. Electron tube V35B is ½ of a type 6BQ7A dual triode, V40 is a type 7119 dual triode, V45 and V46 are type 6DQ5 power pentodes, and V47 is a type 6DJ8 dual triode.

The clamp tube receives its input from the plate circuit of V30B in the pulse width section. During the period between output pulses, it conducts fully, holding the output at the zero level. Between the start and stop pulses it is completely cut off by the signal from the width multivibrator and holds the output pulse at full amplitude.

The grids of the pulse forming cathode follower are driven positive by the leading edge forming tube, held there by the clamp tube, and driven back to their original level by the trailing edge forming tube. From the cathodes of this tube, we take the fully shaped output pulse. This pulse is coupled through the rise time control circuitry to the control grids of the power amplifiers.

The power amplifiers, connected in parallel, act as a cathode follower for a positive pulse out, and as an inverting amplifier for a negative pulse out. This is accomplished by the action of the polarity switch, S450, which switches the floating power supply voltages to the output power amplifiers as well as coupling the output pulse to the attenuator.

Triode V47A, connected as a diode, provides restoration at the control grids of the output tubes. The restoration level is adjusted by potentiometer R473. V47B, as connected, acts as the screen grid disconnect diode for the output amplifiers.

Finally, the output pulse is sent to the step attenuator, consisting of five 10db. constant impedance T-sections, and to the pulse output jack on the instrument front panel.

POWER SUPPLY SECTION The power supply section contains the power transformer, T500; V50, a type 0A2 voltage regulator tube; V51, a type 6AS7GA dual triode electron tube; V52, a type 12AX7 dual triode electron tube; V53, a type 6U8 triode-pentode electron tube, and their associated circuitry which includes two controls for varying the amplitude of the output pulse.

The power supply section furnishes five unregulated DC voltages (+250V., -4V., -8V., -18V., and -24V.), and three regulated voltages (+150V., -150V., and a positive variable voltage) from its ground reference supplies. From its floating supply it furnishes 150V. above and below a zero reference. It also furnishes filament power for all of the electron tubes in the unit.

The +150V. supply is regulated by the action of V51A and V52A. The -150V. supply is regulated by the action of the voltage regulator tube, V50.

The positive variable voltage, used in two places; as plate supply for the last stage of start pulse amplification and as plate supply for the clamp tube; furnishes a means of varying the amplitude of the output pulse. This supply is regulated by the action of V51B and V52B. Its reference, however, is set by V53B.

This reference may be varied in two ways. First, it may be varied by varying the fine attenuator, R531. Secondly, it may be varied by the action of the duty cycle limiting control consisting of the circuitry of T600 and V53A.

Transformer T600 senses the ripple voltage in the zero leg of the floating supply. This ripple voltage increases as the output power amplifiers draw more current. The bias on the control grid of V53A is set at such a level by potentiometer R602 that the ripple voltage will take control of the tube at the point where the power amplifiers are drawing rated current and change the reference to lower the variable supply voltage. Thus, the output tubes are never allowed to exceed their dissipation ratings even if the duty factor limitation is inadvertantly exceeded. At the time the variable voltage starts to decrease due to duty cycle limiting, the front panel lamp DS530, lights to warn the operator that the amplitude of the output pulse is being automatically reduced.

## CIRCUIT THEORY

This section of the manual contains explanations of several basic circuits which are used in the model B7B. Inasmuch as the technician may not be totally familiar with high repetition rate pulse handling circuitry, it is felt that the inclusion of this section in the manual will lend to a more thorough understanding of the instrument.

FREE-RUNNING MULTIVIBRATOR Fig. D is a simplified circuit of a free-running multivibrator similar to that used in the oscillator section of the model B7B.

Arbitrarily assume that at any specified instant, triode section V1 is conducting fully and triode section V2 is non-conducting because the potential at its control grid is below the cut-off potential of the tube. At this instant, the plate voltage of V1 is lowered due to the current flow through V1 and R1. C2 discharges to this voltage, holding V2 cut off.

After a time determined by the discharge time of C2 through R4, the voltage potential on the grid of V2 reaches the cut-in potential of the tube. V2 starts to conduct and its plate potential drops. This drop is immediately felt at the grid of V1 across C1, driving it to cut-off. Its plate potential rises sharply and capacitor C2 charges to the new voltage, further aiding

in the conduction of V2. After the initial change, V2 steadies to a low plate voltage and C1 discharges to the cut-in potential of V1 and the cycle starts over again.

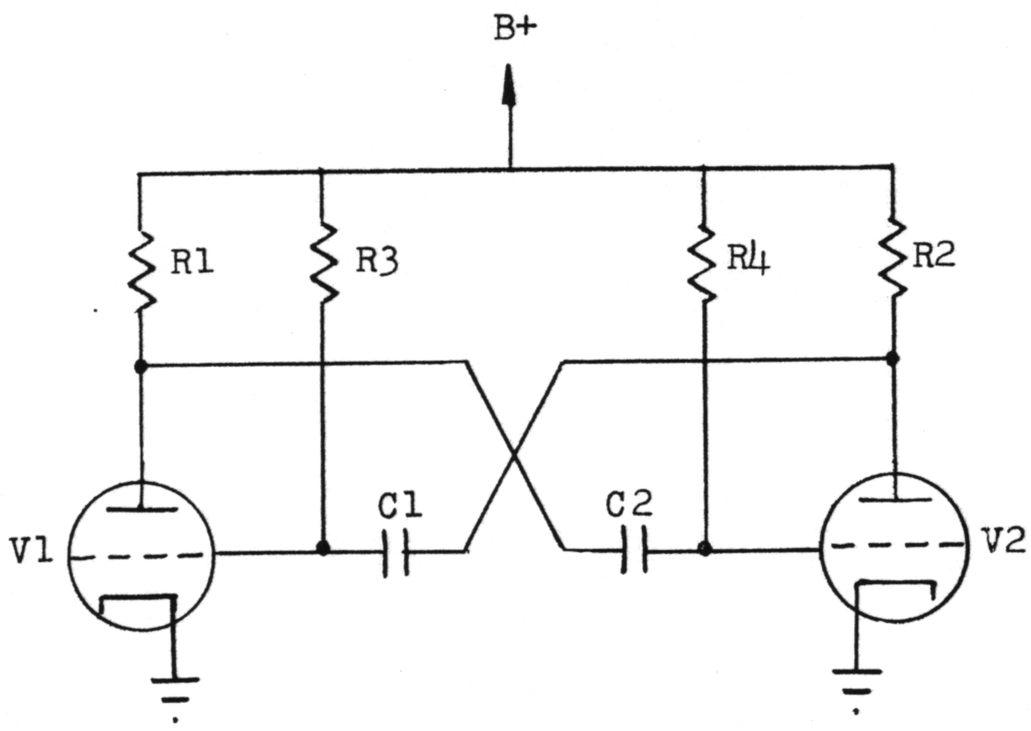



**FIG. D** FREE-RUNNING MULTIVIBRATOR

In summary, the operation of this circuit consists of periods of time when one tube conducts a high current while the other tube is cut off, followed by an extremely rapid change to the other tube conducting and the first tube cut off.

The repetition rate of the circuit is determined by the time constants of C1-R3 and C2-R4 and the voltage to which they are returned.

In the model B7B the range of the repetition rate of the oscillator is changed by changing the values of C1 and C2 in decade steps and the repetition rate is made continuously variable for each range by varying the level of the grid return voltage.

MONOSTABLE MULTIVIBRATOR Fig. E shows a simplified circuit of a monostable multivibrator similar to those used in the pulse delay and pulse width sections of the model B7B.

The multivibrator has one stable state and one quasi-stable state. That is, one tube section is capable of remaining in the conducting state indefinitely while the other does not have this capability. In this type of multivibrator it is necessary to trigger the circuit from its stable state to its quasi-stable state with trigger pulses from an external source. Then, the circuit will automatically return to its stable state after a certain length of time. Therefore, in operation, one triode section is triggered from non-conduction to conduction with an applied trigger. It remains in this condition for a predetermined length of time and then returns abruptly to the non-conducting state to await another trigger. Thus, we are able to generate a pulse, at a predetermined time after a given input pulse, by abruptly changing a tube section from conduction to non-conduction. Or, essentially, we have introduced a delay into the system.

Assume that the circuit is in its stable state. V1 is conducting, its grid clamped to its cathode. If R2 is made quite large, the full conduction current through V1 and thus through R6 is small and the grid is clamped near zero potential. The plate of V1, however, is at quite a low potential due to the current through the large R2. V2 is not conducting, its grid held below cut-off by the divider formed by R3, R4, and R7 between the low positive plate potential of V1 and -150 volts.

Now, at some time, a positive timing pulse arrives at the junction of the C2-R3, C3-R4 combination through diode CR1. This pulse is felt sharply across C2 and C3 at the plate of V1 and the grid of V2. V1 starts to cut off. V2 starts conducting. If R5 is small compared to R2, V2 will conduct much more heavily than V1

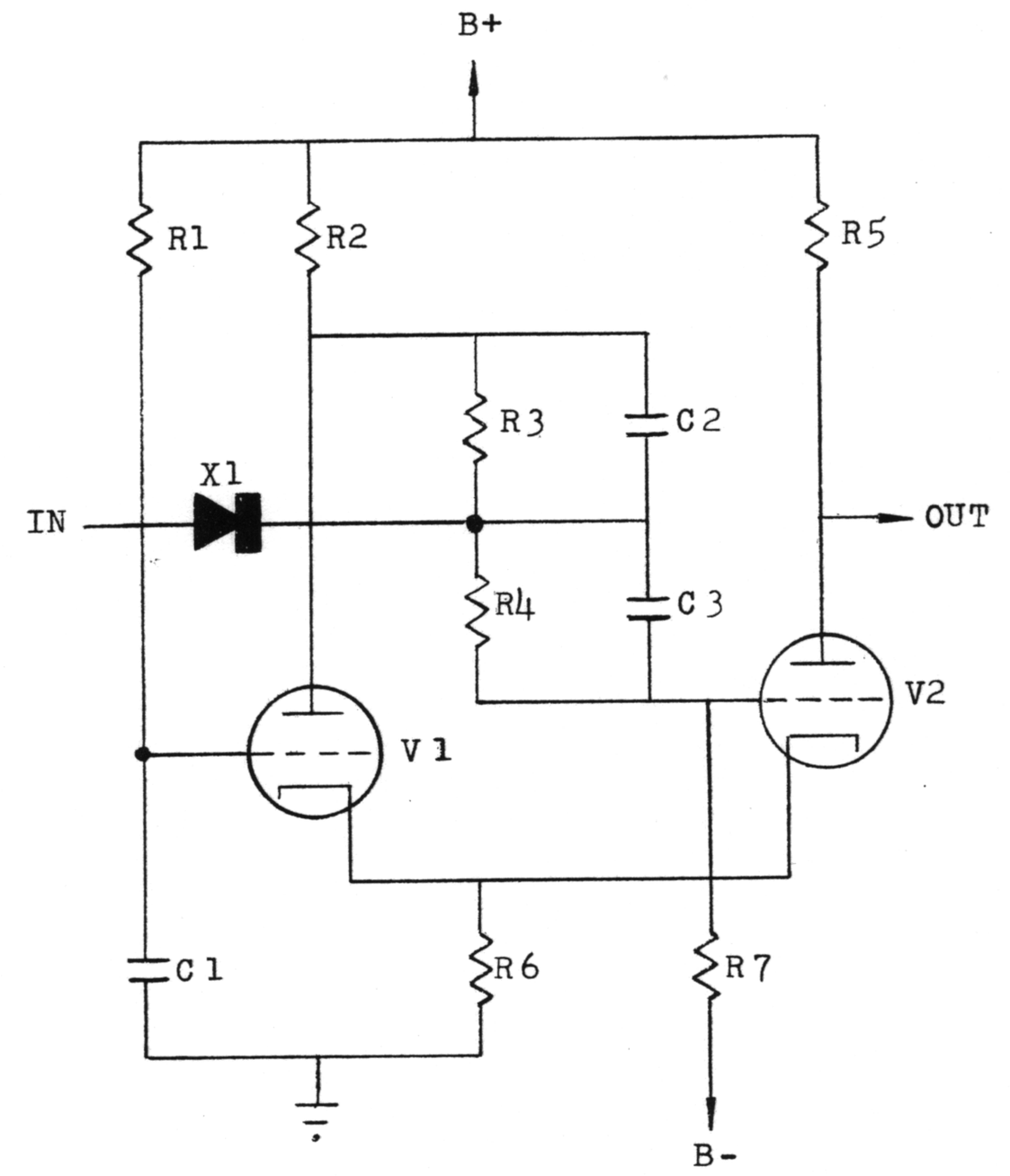



**FIG. E** MONOSTABLE MULTIVIBRATOR

was conducting. The drop across R6 becomes greater due to this higher current through V2, thus the cathodes raise to a higher potential. This holds V1 off completely. The plate of V1,

now at a higher potential, keeps the grid of V2 above its cut-off potential by the same divider network mentioned above. Thus, in a very short time, a trigger pulse has changed the state of the multivibrator from that of V1 conducting a small amount and V2 cut off, to one of V1 cut off and V2 conducting quite heavily.

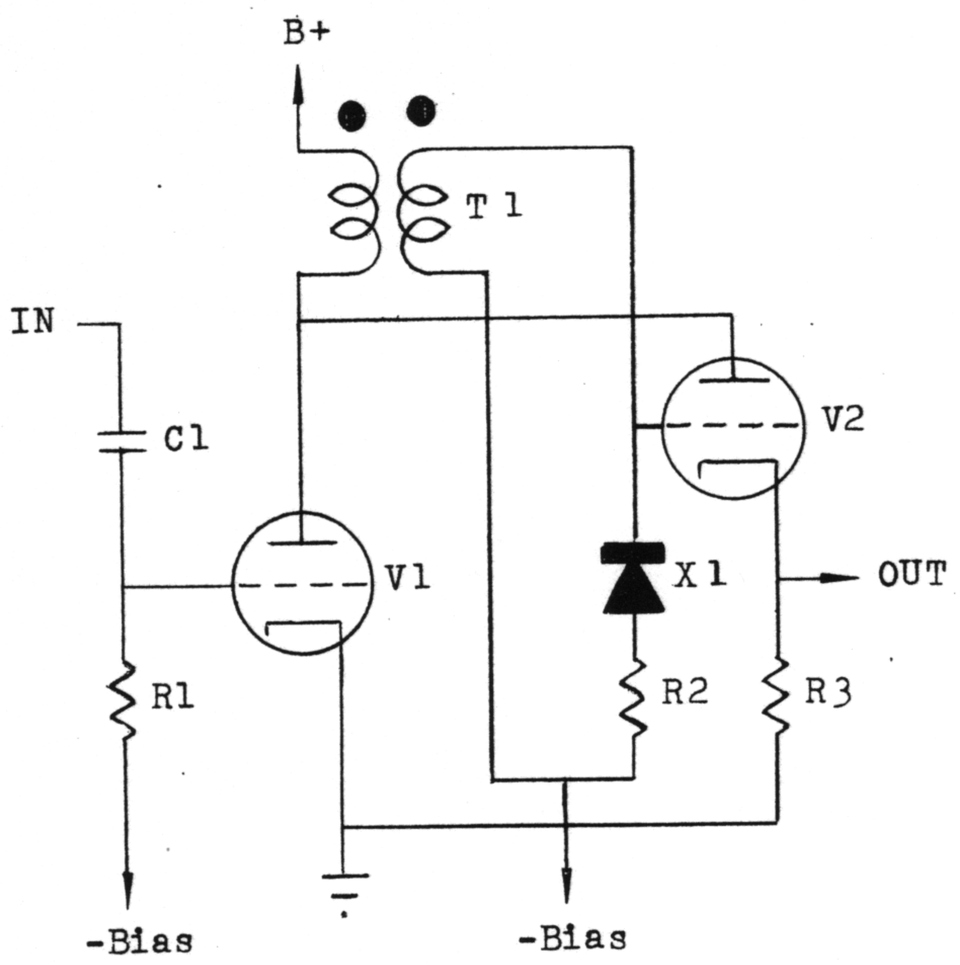



**FIG. F** MONOSTABLE BLOCKING OSCILLATOR

As soon as V1 is cut off by raising its cathode potential several volts with respect to its grid potential, C1 starts to charge through R1 toward the B+ potential. After a time, predetermined by the R1-C1 combination, the grid of V1 will reach cut-in potential and V1 will again start to conduct. The plate of V1 drops. This drop is felt at the grid of V2 through C2 and C3, immediately cutting off V2. The drop which cuts V2 off also drops the cathode potentials, which aids the conduction of V1. C1 discharges rapidly through the low grid to cathode resistance of V1, and the circuit has returned to its original stable state. At the transition point of V2 conducting to non-conducting, the plate waveform of V2 goes sharply positive. This waveform is taken as the output. Thus, we have produced a pulse, delayed from the original trigger pulse, by a time predetermined by R1-C1.

In the model B7B the range of delay of the pulse delay and pulse width multivibrators is changed by changing the value of C1 in decade steps. Delay and width are made continuously variable through any range by varying R6, which varies the cathode potential in the quasi-stable state, thus determining the potential which the grid must reach to cut V1 on and return the multivibrator to its stable state.

BLOCKING OSCILLATOR Fig. F shows a typical blocking oscillator circuit such as is used in the model B7B oscillator and pulse delay sections.

This blocking oscillator is a so-called monostable or driven type. That is, it is not free-running, but requires a trigger from an external source to excite it. It produces a high powered, extremely sharp, narrow pulse which is essentially independent of the shape or degradation of the pulse which triggers it.

V1 serves to amplify the input trigger and to eliminate the possibility of a reaction by the blocking oscillator back on the trigger pulse source.

In the quiescent condition, both sections of the tube are biased below cut-off. A positive trigger is coupled through C1 to the amplifier tube, V1, which inverts and amplifies it. Pulse transformer T1 inverts and applies this waveform to the grid of V2, the blocking oscillator tube. V2 conducts causing a drop in its plate voltage. The drop in plate voltage in turn causes an increase in grid voltage, which results in a further decrease in plate voltage. Due to the AC loop gain of the circuit being greater than unity, regeneration occurs. The plate drives abruptly downward and the grid abruptly upward. This action continues until such time as the loop gain drops below unity, due to the nonlinearity of the tube.

The plate and grid cannot remain at the values attained by the regenerative action described above because of the low frequency characteristics of the transformer. The grid starts to drop due to its finite magnetizing inductance. When the grid voltage has dropped far enough that the loop gain once again equals unity,. a regenerative action once again occurs in the direction to turn the tube off.

An overshoot occurs at the plate and grid of the tube. At the conclusion of the pulse there is still a current flowing in the magnetizing inductance of the transformer. Since this current cannot change instantaneously, it continues to flow through the effective capacitance of the transformer after the tube current has dropped to zero, causing this overshoot.

The pulse width and rise time are dependent almost entirely ,on the design of the transformer. The pulse transformers used in the model B7B blocking oscillators are specifically designed to produce extremely narrow, fast rise time pulses.

In the oscillator and pulse widht sections of the model B7B, blocking oscillators such as described above are used. In both of these cases, a positive pulse is taken from the cathode as the output pulse.

SCHMITT TRIGGER Figure "G" shows a typical Schmitt Trigger circuit such as is used in the Model B7B Oscillator section.

The Schmitt Trigger is a mono-stable circuit, that is, it is not free running but requires a trigger from an external source to excite it. This circuit produces an extremely sharp pulse which is essentially independent of the amplitude and waveform of the pulse which triggers it.

In the quiescent condition, V-2 is conducting, V-1 is not conducting, its grid held below cut-off by the divider network formed by R-4 and R-5 between the cathodes of V-1 and V-2 and ground. A positive trigger is coupled through C-1 to the grid of V-1 causing the tube to conduct. For an instant, the voltage across the cathode resistors increases driving the grid of V-2 towards cut-off. This, in addition with the drop-in plate voltage of V-1, causes a rapid change in V-2 from conducting to a cut-off condition. V-2 will remain cut-off until the input signal has decreased to the cut-off value of V-1. As soon as V-1 is cut off by the changing input signal, the plate voltage of V-1 will rise, causing the voltage on the grid of V-2 to rise, and V-2 conducts.

Thus, in a short time the circuit has been triggered between its two stable states by a trigger pulse whose amplitude exceeds a definite positive value and changes to a definite less positive value.

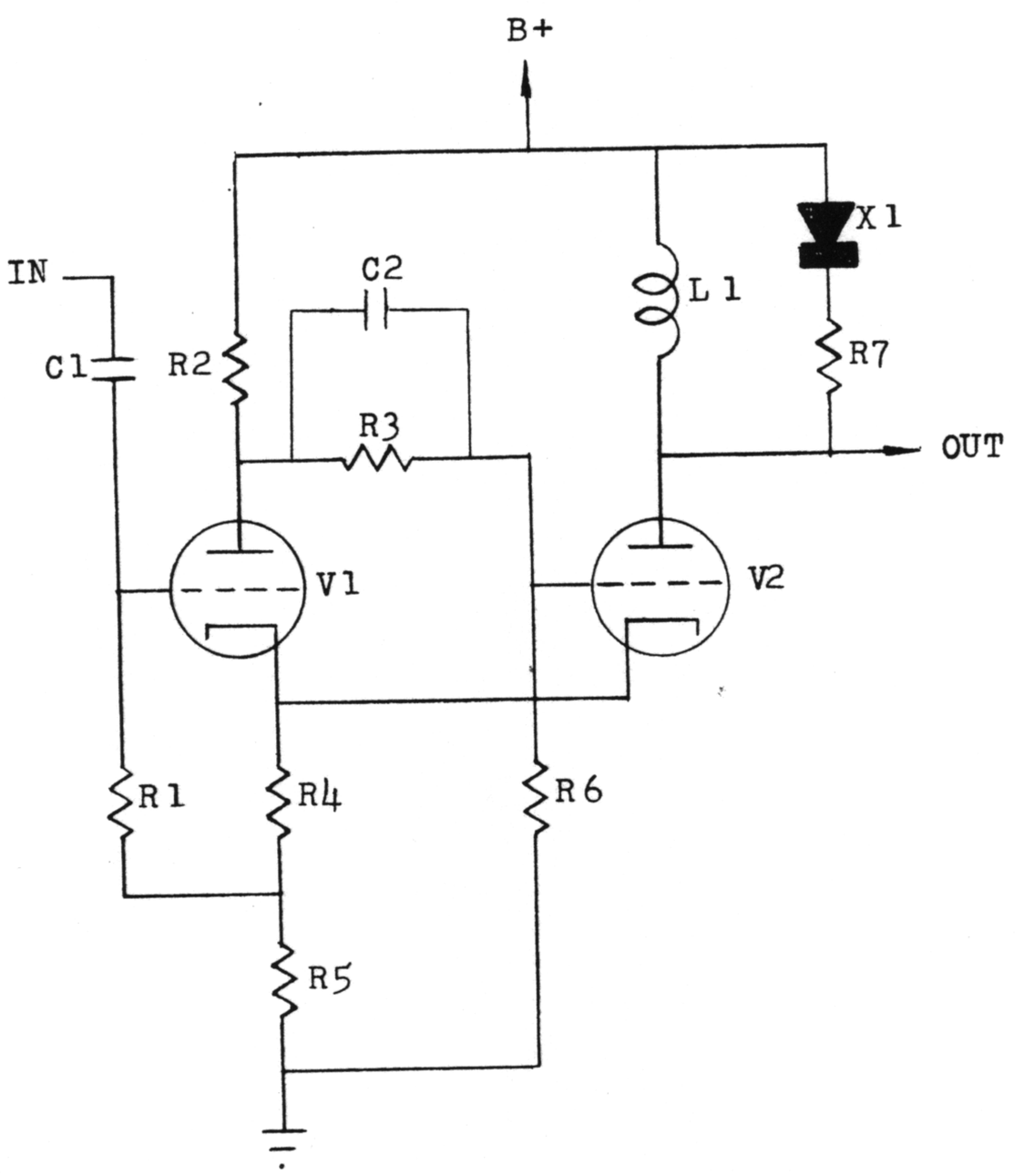



FIG. G SCHMITT TRIGGER

# PARTS LIST

This parts list contains identifying information on all of the replaceable parts contained in the Model B7B. These parts are listed in alpha-numerical order by schematic symbol number. All items with or without circuit reference numbers are considered replaceable parts.

The column headed "NUMBER" is the component identifying number assigned by CMC.

The column headed "CIRCUIT REFERENCE #" designates the component as it is found on the schematic diagram, Dwg. # 0010005, 0010006, and 0010007.

The column headed "DESCRIPTION" is, in general, a full electrical description of the component.

When ordering a complete or partial set of spares, specify by listing all of the information contained in this list for that particular part.

# ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| cer | ceramic | m | milli or $10^3$ | PT | paper tubular |
| comp | composition | meg | megohm or $10^6$ ohms | SET | solid electrolytic tantalum |
| EMC | electrolytic, metal cased | MF | metal film | SM | silvered mica |
| EMT | electrolytic, metal tubular | μ | micro or $10^6$ | V | working volts, DC |
| f | farad | μμ | micromicro or $10^{12}$ | var | variable |
| GMV | guaranteed minimum value | Ω | ohm | W | watt |
| h | henry | prec | precision | WW | wire wound |
| k | kilohm or $10^3$ ohms | MM | metalized mylar | DM | dipped mica |

# REC – CMC STOCK NUMBER CROSS-REFERENCE

Some of the Rutherford Electronics Co. (REC) stock numbers for parts listed in the parts list have been changed to CMC numbers listed below. These parts should be ordered by the CMC numbers.

| REC NO. | CMC NO. |
|---|---|
| 1420002 | 4410027 |
| 1420005 | 4108200 |
| 1518001 | 4008605 |
| 1518003 | 4008624 |
| 1518004 | 4008608 |
| 1518009 | 4008611 |
| 1518010 | 4008623 |
| 1518013 | 4008615 |
| 1518022 | 4001103 |
| 1518025 | 4008622 |
| 1518027 | 4045253 |
| 1518033 | 4001102 |
| 1520001 | 4030033 |
| 1520014 | 4030034 |
| 1520022 | 4031028 |
| 1520027 | 4031026 |
| 1520030 | 4030035 |
| 1520034 | 4031025 |
| 1520036 | 4033039 |
| 1520038 | 4033057 |
| 1520043 | 4031027 |
| 1520046 | 4033038 |
| 1528001 | 4053824 |
| 1528007 | 4053826 |
| 1528010 | 4053822 |
| 1528012 | 4053025 |
| 1528025 | 4054221 |
| 1528030 | 4066335 |
| 1528062 | 4053827 |
| 1528064 | 4052101 |
| 1528065 | 4052151 |
| 1528066 | 4052181 |
| 1528067 | 4054331 |
| 1528068 | 4066335 |
| 1528069 | 4053829 |
| 1528071 | 4052220 |
| 1528072 | 4055330 or 4066338 |
| 1528073 | 4054241 |
| 1534004 | 4066336 |
| 1534009 | 4058103 |
| 1534011 | 4058107 |
| 1534012 | 4058105 |
| 1534016 | 4066333 |
| 1534017 | 4058104 |
| 1542001 | 4011106 |
| 1574001 | 4040123 |
| 1574002 | 4040124 |
| 1574003 | 4040125 |
| 1574004 | 4040119 |
| 1574005 | 4040126 |
| 1574006 | 4040129 |
| 1580012 | 4102053 |
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| 1816006 | 5101324 |
| 1816008 | 5101325 |
| 1816014 | 5101326 |

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| 1816019 | 5101327 |
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| 2114002 | 4404327 |
| 2118003 | 4104017 |
| 2128003 | 4103193 |
| 2128006 | 4103193 |
| 2128020 | 4103177 |
| 2154005 | 4103188 |
| 2154009 | 4103189 |
| 2154013 | 4103192 |
| 2154018 | 4103191 |
| 2354001 | 5101313 |
| 2354002 | 5101316 |
| 2354003 | 5101317 |
| 2354005 | 5101323 |
| 2410001 | 4405026 |
| 2420009 | 4401141 |
| 2420019 | 4401144 |
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| 2422026 | 4402079 |
| 2422027 | 4402086 |
| 2422028 | 4402084 |
| 2422033 | 4402083 |
| 2500001 | 4401145 |
| 2514009 | 4106033 and 4106034 |
| 2514011 | 4404190 |
| 2514012 | 4409059 |
| 2520003 | 4108171 |
| 2520004 | 5101328 |
| 2612002 | 4501062 |
| 2810004 | 4104007 |
| 2814002 | 4104021 |
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| 2828018 | 5306312 |
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| 3130003 | 4108124 |
| 3130008 | 4108525 |
| 3130014 | 4108236 |
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| 4700067 | 5002512 |
| 4705008 | 5002532 |
| 4705009 | 5002527 |
| 4705010 | 5002531 |
| 4717018 | 4680204 |
| 4720017 | 4901062 |
| 4725094 | 4630682 |
| 4725095 | 4630723 |
| 4725099 | 4630104 |
| 4735003 | 4629400 |
| 4735004 | 4629409 |
| 4735007 | 4629403 |
| 4735010 | 4629003 |
| 4735011 | 4629408 |
| 4735015 | 4629407 |
| 4735019 | 4629406 |
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| 4753753 | 4609753 |
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| 4758104 | 4610104 |
| 4758105 | 4610105 |
| 4758121 | 4610121 |
| 4758122 | 4610122 |
| 4758123 | 4610123 |
| 4758124 | 4610124 |
| 4758151 | 4610151 |
| 4758152 | 4610152 |
| 4758153 | 4610153 |
| 4758154 | 4610154 |
| 4758181 | 4686181 |
| 4758220 | 4610220 |
| 4758221 | 4610221 |

| REC NO. | CMC NO. |
|---|---|
| 4758222 | 4610222 |
| 4758224 | 4610224 |
| 4758271 | 4610271 |
| 4758273 | 4610273 |
| 4758330 | 4610330 |
| 4758331 | 4610331 |
| 4758332 | 4610332 |
| 4758335 | 4610335 |
| 4758393 | 4610393 |
| 4758470 | 4610470 |
| 4758471 | 4610471 |
| 4758472 | 4610472 |
| 4758474 | 4610474 |
| 4758560 | 4610560 |
| 4758561 | 4610561 |
| 4758680 | 4610680 |
| 4758681 | 4610681 |
| 4758682 | 4610682 |
| 4758683 | 4610683 |
| 4758684 | 4610684 |
| 4758821 | 4610821 |
| 4758823 | 4610823 |
| 4759027 | 4614027 |
| 4759102 | 4614102 |
| 4759154 | 4614154 |
| 4759270 | 4614270 |
| 4759390 | 4614390 |
| 4759561 | 4614561 |
| 4760101 | 4617101 |
| 4760102 | 4617102 |

| REC NO. | CMC NO. |
|---|---|
| 4760121 | 4617121 |
| 4760151 | 4617151 |
| 4760221 | 4617221 |
| 4760223 | 4617223 |
| 4760271 | 4617271 |
| 4760332 | 4617332 |
| 4760390 | 4617390 |
| 4760470 | 4617470 |
| 4760471 | 4617471 |
| 4760472 | 4617472 |
| 4760682 | 4617682 |
| 4760683 | 4617683 |
| 4760822 | 4617822 |
| 4774002 | 4651174 |
| 4774030 | 4664152 |
| 4774033 | 4654302 |
| 4800001 | 4300250 |
| 4800007 | 4300248 |
| 4800016 | 4300260 |
| 4800020 | 4300247 |
| 4800021 | 4300184 |
| 4800023 | 4300249 |
| 4802015 | 4300257 |
| 4802016 | 4300246 |
| 4804008 | 4300256 |
| 4804013 | 4300259 |
| 4804021 | 4300223 |
| 4812006 | 4300258 |
| 4830007 | 4906173 |
| 4834010 | 4906049 |

| REC NO. | CMC NO. |
|---|---|
| 4837003 | 4906123 |
| 4838006 | 4906041 |
| 4838012 | 4906175 |
| 4838015 | 4906094 |
| 4839001 | 4906172 |
| 4839005 | 4906174 |
| 4839007 | 4906171 |
| 4839012 | 4906171 |
| 4850002 | 4404349 |
| 5110001 | 4701221 |
| 5110008 | 4701222 |
| 5110011 | 4701219 |
| 5110012 | 4701235 |
| 5110017 | 4701220 |
| 5110021 | 4701236 |
| 5110022 | 4701237 |
| 5110045 | 4701233 |
| 5110046 | 4701232 |
| 5110047 | 4701234 |
| 5110048 | 4701231 |
| 5120001 | 4702230 |
| 5120003 | 4702231 |
| 5120005 | 4702234 |
| 5120006 | 4702235 |
| 5120007 | 4702220 |
| 5140001 | 4704281 |
| 5180012 | 4102053 |
| 5180018 | 4102004 |
| 5610002 | 5100272 |
| 5640005 | 5100270 |

| REC NO. | CMC NO. |
|---|---|
| 5640018 | 5100271 |
| 5640021 | 5100266 |
| 5650001 | 5100267 |
| 5650002 | 5100268 |
| 5650004 | 5100269 |
| 5650010 | 5100273 |
| 5650011 | 5101329 |
| 5650012 | 5100274 |
| 5720001 | 4901014 |
| 5720008 | 4901065 |
| 5720010 | 4901048 or 4901064 |
| 5720011 | 4901066 |
| 5720013 | 4901013 |
| 5720014 | 4901024 |
| 5720017 | 4901062 |
| 5720029 | 4901063 |
| 6012002 | 6200018 |
| 6014034 | 6004905 |
| 6014071 | 6001111 |
| 6025001 | 6600011 |
| 6025002 | 6600021 |
| 6030003 | 4104119 |
| 6030004 | 4104041 |
| 8700015 | 4106033 |
| 8700016 | 4106037 |
| 8700017 | 4106036 |
| 8700018 | 4106035 |
| 8700019 | 4106034 |

| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION |
|---|---|---|
| C100 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C101 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C102 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C103 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C104 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C105 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C110 | 1534011 | CAPACITOR, fixed, mylar, 0.47µf, 200V, ± 1% |
| C111 | 1534011 | CAPACITOR, fixed, mylar, 0.47µf, 200V, ± 1% |
| C112 | 1534004 | CAPACITOR, fixed, mylar, 0.047µf, 200V, ± 1% |
| C113 | 1534004 | CAPACITOR, fixed, mylar, 0.047µf, 200V, ± 1% |
| C114 | 1528069 | CAPACITOR, fixed, DM, 4700µµf, 500V, ± 1% |
| C115 | 1528069 | CAPACITOR, fixed, DM, 4700µµf, 500V, ± 1% |
| C116 | 1528068 | CAPACITOR, fixed, DM, 470µµf, 500V, ± 1% |
| C117 | 1528068 | CAPACITOR, fixed, DM, 470µµf, 500V, ± 1% |
| C118 | 1574003 | CAPACITOR, var, mica, 5-80µµf, 175V |
| C119 | 1528062 | CAPACITOR, fixed, DM, 47µµf, 500V, ± 5% |
| C120 | 1518009 | CAPACITOR, fixed, cer, 100µµf, 500V, ±10% |
| C121 | 1528001 | CAPACITOR, fixed, SM, 5µµf, 500V, ± 5% |
| C122 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C123 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C130 | 1518009 | CAPACITOR, fixed, cer, 100µµf, 500V, ±10% |
| C131 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C132 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C200 | 1534011 | CAPACITOR, fixed, mylar, 0.47µf, 200V, ± 1% |
| C201 | 1534004 | CAPACITOR, fixed, mylar, 0.047µf, 200V, ± 1% |
| C202 | 1528069 | CAPACITOR, fixed, DM, 4700µµf, 500V, ± 1% |
| C203 | 1528068 | CAPACITOR, fixed, DM, 470µµf, 500V, ± 1% |
| C204 | 1574003 | CAPACITOR, var, mica, 5-80µµf, 175V |
| C205 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C206 | 1528064 | CAPACITOR, fixed, DM, 100µµf, 500V, ± 5% |
| C207 | 1528064 | CAPACITOR, fixed, DM, 100µµf, 500V, ± 5% |
| C208 | 1518009 | CAPACITOR, fixed, cer, 100µµf, 500V, ±10% |
| C209 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C210 | 1518009 | CAPACITOR, fixed, cer, 100µµf, 500V, ±10% |
| C211 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C212 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C213 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C250 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C260 | 1574001 | CAPACITOR, var, mica, 1.5-15µµf, 175V |
| C261 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |

| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION |
|---|---|---|
| C300 | 1534011 | CAPACITOR, fixed, mylar, 0.47µf, 200V, ± 1% |
| C301 | 1534004 | CAPACITOR, fixed, mylar, 0.047µf, 200V, ± 1% |
| C302 | 1528069 | CAPACITOR, fixed, DM, 4700µµf, 500V, ± 1% |
| C303 | 1528068 | CAPACITOR, fixed, DM, 470µµf, 500V, ± 1% |
| C304 | 1574003 | CAPACITOR, var, mica, 5-80µµf, 175V |
| C306 | 1528064 | CAPACITOR, fixed, DM, 100µµf, 500V, ± 5% |
| C307 | 1528064 | CAPACITOR, fixed, DM, 100µµf, 500V, ± 5% |
| C308 | 1518009 | CAPACITOR, fixed, cer, 100µµf, 500V, ±10% |
| C309 | 1520001 | CAPACITOR, fixed, EMT, 2µf, 450V, -10+50% |
| C310 | 1534009 | CAPACITOR, fixed, MM, 0.25µf, 400V, ±20% |
| C311 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C350 | 1574002 | CAPACITOR, var, mica, 2.7-30µµf, 175V |
| C351 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C352 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C360 | 1574002 | CAPACITOR, var, mica, 2.7-30µµf, 175V |
| C361 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C362 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C363 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C400 | 1534012 | CAPACITOR, fixed, MM, 0.5µf, 600V, ±20% |
| C401 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C404 | 1518025 | CAPACITOR, fixed, cer, 0.03µf, 500V, ±20% |
| C405 | 1520001 | CAPACITOR, fixed, EMT, 2µf, 450V, -10+50% |
| C450 | 1520014 | CAPACITOR, fixed, EMT, 20µf, 250V, -10+50% |
| C451 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C452 | 1528010 | CAPACITOR, fixed, SM, 33µµf, 500V, ± 5% |
| C453 | 1528007 | CAPACITOR, fixed, SM, 22µµf, 500V, ± 5% |
| C460 | 1520014 | CAPACITOR, fixed, EMT, 20µf, 250V, -10+50% |
| C461 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C462 | 1528010 | CAPACITOR, fixed, SM, 33µµf, 500V, ± 5% |
| C470 | 1534009 | CAPACITOR, fixed, MM, 0.25µf, 400V, ±20% |
| C471 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C472 | 1574005 | CAPACITOR, var, mica, 9-180µµf, 175V |
| C473 | 1518022 | CAPACITOR, fixed, cer, 0.01µf, 500V, GMV |
| C474 | 1534009 | CAPACITOR, fixed, MM, 0.25µf, 400V, ±20% |
| C500 | 1520027 | CAPACITOR, fixed, EMC, 80-80µf, 350V, -10+50% |
| C501 | 1520027 | CAPACITOR, fixed, EMC, 80-80µf, 350V, -10+50% |

| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION |
|---|---|---|
| C502 | 1520027 | CAPACITOR, fixed, EMC, 80-80µf, 350V, -10+50% |
| C503 | 1542001 | CAPACITOR, fixed, PT, 0.1µf, 400V, ±20% |
| C520 | 1542001 | CAPACITOR, fixed, PT, 0.1µf, 400V, ±20% |
| C521 | 1520001 | CAPACITOR, fixed, EMT, 2µf, 450V, -10+50% |
| C522 | 1542001 | CAPACITOR, fixed, PT, 0.1µf, 400V, ±20% |
| C523 | 1520001 | CAPACITOR, fixed, EMT, 2µf, 450V, -10+50% |
| C530 | 1542001 | CAPACITOR, fixed, PT, 0.1µf, 400V, ±20% |
| C531 | 1542001 | CAPACITOR, fixed, PT, 0.1µf, 400V, ±20% |
| C600 | 1520022 | CAPACITOR, fixed, EMT, 50µf, 25V, -10+100% |
| C601 | 1520034 | CAPACITOR, fixed, EMC, 200-200µf, 250V, -10+50% |
| C602 | 1520034 | CAPACITOR, fixed, EMC, 200-200µf, 250V, -10+50% |
| C603 | 1520034 | CAPACITOR, fixed, EMC, 200-200µf, 250V, -10+50% |
| C604 | 1520034 | CAPACITOR, fixed, EMC, 200-200µf, 250V, -10+50% |
| C700 | 1520043 | CAPACITOR, fixed, EMC, 1500µf, 50V, -10+50% |
| C801 | 1534017 | CAPACITOR, fixed, MM, 2µf, 400V, ±20% |
| C804 | 1534017 | CAPACITOR, fixed, MM, 2µf, 400V, ±20% |
| C805 | 1518003 | CAPACITOR, fixed, cer, 22µµf, 500V, ±10% |
| CR120 | 4800023 | DIODE, silicon, HMN 9008A |
| CR130 | 4800001 | DIODE, germanium, 1N34A |
| CR200 | 4800001 | DIODE, germanium, 1N34A |
| CR201 | 4800023 | DIODE, silicon, HMN 9008A |
| CR210 | 4800001 | DIODE, germanium, 1N34A |
| CR250 | 4800020 | DIODE, germanium, 1N774 |
| CR251 | 4800020 | DIODE, germanium, 1N774 |
| CR300 | 4800001 | DIODE, germanium, 1N34A |
| CR301 | 4800023 | DIODE, silicon, HMN 9008A |
| CR350 | 4800020 | DIODE, germanium, 1N774 |
| CR360 | 4800020 | DIODE, germanium, 1N774 |
| CR361 | 4800020 | DIODE, germanium, 1N774 |

| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION |
|---|---|---|
| CR500 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| CR501 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| CR502 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| CR503 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| CR504 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| CR505 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| CR530 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| CR600 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| CR601 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| CR602 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| CR603 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| CR604 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| CR700 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| CR701 | 4802016 | DIODE, silicon, SC4, 1A, 400 PIV |
| DL100 | 2354003 | DELAY LINE, fixed, 0.2 µsec. |
| DL210 | 2354001 | DELAY LINE, fixed, 0.02 µsec. |
| F500 | 5180018 | FUSE, slo-blo, 4 AMP |
| FB400 | 2520003 | FERRITE BEAD |
| FB450 | 2520003 | FERRITE BEAD |
| FB460 | 2520003 | FERRITE BEAD |
| DS500 | 3912001 | LAMP, indicator |
| DS530 | 3912002 | LAMP, indicator |
| J100 | 2824002 | CONNECTOR, nylon binding post |
| J101 | 2824002 | CONNECTOR, nylon binding post |
| J800 | 2128003 | CONNECTOR, coax |
| L120 | 1816030 | COIL, fixed, 75µh, ±10% |
| L200 | 1816023 | COIL, fixed, 25µh, ±10% |
| L300 | 1816023 | COIL, fixed, 25µh, ±10% |

| CIRCUIT REFERENCE | NUMBER | DESCRIPTION |
|---|---|---|
| P500 | 6025001 | CORD, power, w/plug, 3 wire |
| R100 | 4758154 | RESISTOR, fixed, comp, 150K, ½W, ±10% |
| R101 | 4758102 | RESISTOR, fixed, comp, 1K, ½W, ±10% |
| R102 | 4758103 | RESISTOR, fixed, comp, 10K, ½W, ±10% |
| R103 | 4758102 | RESISTOR, fixed, comp, 1K, ½W, ±10% |
| R104 | 4758102 | RESISTOR, fixed, comp, 1K, ½W, ±10% |
| R105 | 4758681 | RESISTOR, fixed, comp, 680Ω, ½W, ±10% |
| R110 | 4759102 | RESISTOR, fixed, comp, 1K, 1W, ±10% |
| R111 | 4700023 | RESISTOR, var, comp, 10K, 2W, ±20% |
| R112 | 4759102 | RESISTOR, fixed, comp, 1K, 1W, ±10% |
| R113 | 4753753 | RESISTOR, fixed, comp, 75K, ½W, ± 5% |
| R114 | 4753753 | RESISTOR, fixed, comp, 75K, ½W, ± 5% |
| R115 | 4700021 | RESISTOR, var, comp, 10K, 2W, ±20% |
| R116 | 4700009 | RESISTOR, var, comp, 5K, 1W, ±20% |
| R117 | 4760822 | RESISTOR, fixed, comp, 8.2K, 2W, ±10% |
| R118 | 4759472 | RESISTOR, fixed, comp, 4.7K, 1W, ±10% |
| R120 | 4758332 | RESISTOR, fixed, comp, 3.3K, ½W, ±10% |
| R121 | 4758471 | RESISTOR, fixed, comp, 470Ω, ½W, ±10% |
| R122 | 4758154 | RESISTOR, fixed, comp, 150K, ½W, ±10% |
| R123 | 4758105 | RESISTOR, fixed, comp, 1meg, ½W, ±10% |
| R124 | 4758102 | RESISTOR, fixed, comp, 1K, ½W, ±10% |
| R125 | 4758682 | RESISTOR, fixed, comp, 6.8K, ½W, ±10% |
| R126 | 4758683 | RESISTOR, fixed, comp, 68K, ½W, ±10% |
| R127 | 4758393 | RESISTOR, fixed, comp, 39K, ½W, ±10% |
| R128 | 4758335 | RESISTOR, fixed, comp, 3.3meg, ½W, ±10% |
| R130 | 4758471 | RESISTOR, fixed, comp, 470Ω, ½W, ±10% |
| R131 | 4759102 | RESISTOR, fixed, comp, 1K, 1W, ±10% |
| R132 | 4758102 | RESISTOR, fixed, comp, 1K, ½W, ±10% |
| R200 | 4700013 | RESISTOR, var, comp, 100K, 1W, ±20% |
| R201 | 4758104 | RESISTOR, fixed, comp, 100K, ½W, ±10% |
| R202 | 4758470 | RESISTOR, fixed, comp, 47Ω, ½W, ±10% |
| R203 | 4758471 | RESISTOR, fixed, comp, 470Ω, ½W, ±10% |
| R204 | 4630104 | RESISTOR, fixed, prec, 100K, ½W, ± 1% |
| R205 | 4758273 | RESISTOR, fixed, comp, 27K, ½W, ±10% |
| R206 | 4758123 | RESISTOR, fixed, comp, 12K, ½W, ±10% |
| R207 | 4760221 | RESISTOR, fixed, comp, 220Ω, 2W, ±10% |
| R208 | 4700015 | RESISTOR, var, comp, 500Ω, 2W, ±20% |
| R209 | 4753304 | RESISTOR, fixed, comp, 300K, ½W, ± 5% |
| R210 | 4758471 | RESISTOR, fixed, comp, 470Ω, ½W, ±10% |

| CIRCUIT REFERENCE | NUMBER | DESCRIPTION |
|---|---|---|
| R211 | 4758332 | RESISTOR, fixed, comp, 3.3K, ½W, ±10% |
| R212 | 4760471 | RESISTOR, fixed, comp, 470Ω, 2W, ±10% |
| R250 | 4758102 | RESISTOR, fixed, comp, 1K, ½W, ±10% |
| R251 | 4758151 | RESISTOR, fixed, comp, 150Ω, ½W, ±10% |
| R252 | 4758331 | RESISTOR, fixed, comp, 330Ω, ½W, ±10% |
| R260 | 4760102 | RESISTOR, fixed, comp, 1K, 2W, ±10% |
| R261 | 4760102 | RESISTOR, fixed, comp, 1K, 2W, ±10% |
| R300 | 4700013 | RESISTOR, var, comp, 100K, 1W, ±20% |
| R301 | 4758104 | RESISTOR, fixed, comp, 100K, ½W, ±10% |
| R302 | 4758470 | RESISTOR, fixed, comp, 47Ω, ½W, ±10% |
| R303 | 4758471 | RESISTOR, fixed, comp, 470Ω, ½W, ±10% |
| R304 | 4630104 | RESISTOR, fixed, prec, 100K, ½W, ± 1% |
| R305 | 4758273 | RESISTOR, fixed, comp, 27K, ½W, ±10% |
| R306 | 4758123 | RESISTOR, fixed, comp, 12K, ½W, ±10% |
| R307 | 4760471 | RESISTOR, fixed, comp, 470Ω, 2W, ±10% |
| R308 | 4700015 | RESISTOR, var, comp, 500Ω, 2W, ±20% |
| R309 | 4753304 | RESISTOR, fixed, comp, 300K, ½W, ± 5% |
| R350 | 4758474 | RESISTOR, fixed, comp, 470K, ½W, ±10% |
| R351 | 4758332 | RESISTOR, fixed, comp, 3.3K, ½W, ±10% |
| R352 | 4758331 | RESISTOR, fixed, comp, 330Ω, ½W, ±10% |
| R353 | 4700032 | RESISTOR, var, comp, 250K, 2W, ±30% |
| R354 | 4700028 | RESISTOR, var, comp, 50K, 2W, ±30% |
| R355 | 4758154 | RESISTOR, fixed, comp, 150K, ½W, ±10% |
| R356 | 4760683 | RESISTOR, fixed, comp, 68K, 2W, ±10% |
| R357 | 4758273 | RESISTOR, fixed, comp, 27K, ½W, ±10% |
| R360 | 4758331 | RESISTOR, fixed, comp, 330Ω, ½W, ±10% |
| R361 | 4758331 | RESISTOR, fixed, comp, 330Ω, ½W, ±10% |
| R400 | 4760223 | RESISTOR, fixed, comp, 22K, 2W, ±10% |
| R401 | 4700024 | RESISTOR, var, comp, 10K, 2W, ±30% |
| R402 | 4760332 | RESISTOR, fixed, comp, 3.3K, 2W, ±10% |
| R450 | 4760100 | RESISTOR, fixed, comp, 10Ω, 2W, ±10% |
| R452 | 4758470 | RESISTOR, fixed, comp, 47Ω, ½W, ±10% |
| R453 | 4758101 | RESISTOR, fixed, comp, 100Ω, ½W, ±10% |
| R460 | 4760100 | RESISTOR, fixed, comp, 10Ω, 2W, ±10% |
| R462 | 4758470 | RESISTOR, fixed, comp, 47Ω, ½W, ±10% |

| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION |
|---|---|---|
| R470 | 4758105 | RESISTOR, fixed, comp, 1meg, ½W, ±10% |
| R471 | 4758152 | RESISTOR, fixed, comp, 1.5K, ½W, ±10% |
| R472 | 4760472 | RESISTOR, fixed, comp, 4.7K, 2W, ±10% |
| R473 | 4700067 | RESISTOR, var, comp, 5K, 2W, ±30% |
| R474 | 4760332 | RESISTOR, fixed, comp, 3.3K, 2W, ±10% |
| R475 | 4758101 | RESISTOR, fixed, comp, 100Ω, ½W, ±10% |
| R500 | 4758104 | RESISTOR, fixed, comp, 100K, ½W, ±10% |
| R501 | 4774033 | RESISTOR, fixed, WW, 3K, 10W, ±10% |
| R502 | 4759154 | RESISTOR, fixed, comp, 150K, 1W, ±10% |
| R510 | 4758100 | RESISTOR, fixed, comp, 10Ω, ½W, ±10% |
| R511 | 4725095 | RESISTOR, fixed, prec, 73.2K, ½W, ± 1% |
| R512 | 4725094 | RESISTOR, fixed, prec, 68.1K, ½W, ± 1% |
| R513 | 4758100 | RESISTOR, fixed, comp, 10Ω, ½W, ±10% |
| R514 | 4753224 | RESISTOR, fixed, comp, 220K, ½W, ± 5% |
| R515 | 4753154 | RESISTOR, fixed, comp, 150K, ½W, ± 5% |
| R516 | 4774030 | RESISTOR, fixed, WW, 1.5K, 25W, ±10% |
| R520 | 4758224 | RESISTOR, fixed, comp, 220K, ½W, ±10% |
| R521 | 4758474 | RESISTOR, fixed, comp, 470K, ½W, ±10% |
| R522 | 4760223 | RESISTOR, fixed, comp, 22K, 2W, ±10% |
| R530 | 4753274 | RESISTOR, fixed, comp, 270K, ½W, ± 5% |
| R531 | 4700030 | RESISTOR, var, comp, 250K, 2W, ±20% |
| R532 | 4758684 | RESISTOR, fixed, comp, 680K, ½W, ±10% |
| R533 | 4758124 | RESISTOR, fixed, comp, 120K, ½W, ±10% |
| R534 | 4758104 | RESISTOR, fixed, comp, 100K, ½W, ±10% |
| R535 | 4760682 | RESISTOR, fixed, comp, 6.8K, 2W, ±10% |
| R536 | 4760682 | RESISTOR, fixed, comp, 6.8K, 2W, ±10% |
| R600 | 4774002 | RESISTOR, fixed, WW, 0.75Ω, 5W, ± 5% |
| R601 | 4758335 | RESISTOR, fixed, comp, 3.3meg, ½W, ±10% |
| R602 | 4700012 | RESISTOR, var, comp, 50K, 1W, ±30% |
| R603 | 4758153 | RESISTOR, fixed, comp, 15K, ½W, ±10% |
| R604 | 4758104 | RESISTOR, fixed, comp, 100K, ½W, ±10% |
| R605 | 4758104 | RESISTOR, fixed, comp, 100K, ½W, ±10% |
| R700 | 4755470 | RESISTOR, fixed, comp, 47Ω, 2W, ± 5% |
| R701 | 4755161 | RESISTOR, fixed, comp, 160Ω, 2W, ± 5% |
| R702 | 4754330 | RESISTOR, fixed, comp, 33Ω, 1W, ± 5% |
| R703 | 4754330 | RESISTOR, fixed, comp, 33Ω, 1W, ± 5% |
| R704 | 4754330 | RESISTOR, fixed, comp, 33Ω, 1W, ± 5% |
| R705 | 4755161 | RESISTOR, fixed, comp, 160Ω, 2W, ± 5% |

| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION |
|---|---|---|
| R800 | 4735037 | RESISTOR, fixed, MF, 270Ω, 8W, ± 5% |
| R801 | 4735037 | RESISTOR, fixed, MF, 270Ω, 8W, ± 5% |
| R802 | 4735037 | RESISTOR, fixed, MF, 270Ω, 8W, ± 5% |
| R803 | 4735019 | RESISTOR, fixed, MF, 75Ω, 6W, ± 5% |
| R804 | 4735019 | RESISTOR, fixed, MF, 75Ω, 6W, ± 5% |
| R805 | 4735019 | RESISTOR, fixed, MF, 75Ω, 6W, ± 5% |
| R806 | 4758823 | RESISTOR, fixed, comp, 82K, ½W, ±10% |
| R807 | 4758823 | RESISTOR, fixed, comp, 82K, ½W, ±10% |
| R810 | 4735011 | RESISTOR, 2 each fixed, MF, 52Ω, 6W, ± 5% |
| R811 | 4735004 | RESISTOR, fixed, MF, 26Ω, 6W, ± 5% |
| R812 | 4735015 | RESISTOR, 2 each fixed, MF, 70Ω, 6W, ± 5% |
| R820 | 4735003 | RESISTOR, fixed, MF, 26Ω, 4W, ± 5% |
| R821 | 4735003 | RESISTOR, fixed, MF, 26Ω, 4W, ± 5% |
| R822 | 4735007 | RESISTOR, fixed, MF, 35Ω, 4W, ± 5% |
| R830 | 4753270 | RESISTOR, fixed, comp, 27Ω, ½W, ± 5% |
| R831 | 4753270 | RESISTOR, fixed, comp, 27Ω, ½W, ± 5% |
| R832 | 4753360 | RESISTOR, fixed, comp, 36Ω, ½W, ± 5% |
| R840 | 4753270 | RESISTOR, fixed, comp, 27Ω, ½W, ± 5% |
| R841 | 4753270 | RESISTOR, fixed, comp, 27Ω, ½W, ± 5% |
| R842 | 4753360 | RESISTOR, fixed, comp, 36Ω, ½W, ± 5% |
| R850 | 4753270 | RESISTOR, fixed, comp, 27Ω, ½W, ± 5% |
| R851 | 4753270 | RESISTOR, fixed, comp, 27Ω, ½W, ± 5% |
| R852 | 4753360 | RESISTOR, fixed, comp, 36Ω, ½W, ± 5% |
| RT500 | 4717001 | THERMISTOR, 5Ω, 10W, ±20% |
| S100 | 5120003 | SWITCH, toggle, SPDT, ext, trig. pol. |
| S110 | 5110012 | SWITCH, rotary, rep. rate range |
| S200 | 5110011 | SWITCH, rotary, delay range |
| S300 | 5110011 | SWITCH, rotary, width range |
| S450 | 5110008 | SWITCH, rotary, polarity (unassembled) |
| S500 | 5120001 | SWITCH, toggle, SPST, on-off |

| CIRCUIT REFERENCE | R.E.C. STOCK NUMBER | DESCRIPTION |
|---|---|---|
| S800 | 5110001 | SWITCH, rotary, step attenuator (unassembled) |
| T130 | 5650001 | TRANSFORMER, pulse |
| T210 | 5650001 | TRANSFORMER, pulse |
| T250 | 5650002 | TRANSFORMER, pulse |
| T251 | 5650004 | TRANSFORMER, pulse |
| T260 | 5650004 | TRANSFORMER, pulse |
| T350 | 5650002 | TRANSFORMER, pulse |
| T360 | 5650002 | TRANSFORMER, pulse |
| T361 | 5650004 | TRANSFORMER, pulse |
| T500 | 5640021 | TRANSFORMER, power |
| T600 | 5610002 | TRANSFORMER, audio |
| V10 | 5720010 | ELECTRON TUBE, 6DJ8 |
| V11 | 5720010 | ELECTRON TUBE, 6DJ8 |
| V12 | 5720010 | ELECTRON TUBE, 6DJ8 |
| V13 | 5720010 | ELECTRON TUBE, 6DJ8 |
| V20 | 5720010 | ELECTRON TUBE, 6DJ8 |
| V21 | 5720008 | ELECTRON TUBE, 6BQ7A |
| V25 | 5720029 | ELECTRON TUBE, 7119 |
| V26 | 5720029 | ELECTRON TUBE, 7119 |
| V27 | 5720008 | ELECTRON TUBE, 6BQ7A |
| V30 | 5720010 | ELECTRON TUBE, 6DJ8 |
| V35 | 5720008 | ELECTRON TUBE, 6BQ7A |
| V36 | 5720029 | ELECTRON TUBE, 7119 |
| V37 | 5720029 | ELECTRON TUBE, 7119 |
| V40 | 5720029 | ELECTRON TUBE, 7119 |
| V45 | 5720011 | ELECTRON TUBE, 6DQ5 |
| V46 | 5720011 | ELECTRON TUBE, 6DQ5 |
| V47 | 5720010 | ELECTRON TUBE, 6DJ8 |
| V50 | 5720001 | ELECTRON TUBE, OA2 |
| V51 | 5720006 | ELECTRON TUBE, 6AS7GA |
| V52 | 5720017 | ELECTRON TUBE, 12AX7 |
| V53 | 5720013 | ELECTRON TUBE, 6U8A |
| | 2120001 | ADAPTER, power cord, 3 wire to 2 wire |
| | 8501001 | ASSY, switch, rep. rate, w/comps, assembled |
| | 8501002 | ASSY, switch, delay w/comps, assembled |
| | 8501002 | ASSY, switch, width w/comps, assembled |
| | 8501003 | ASSY, switch, attenuator or polarity, w/comps, assembled |
| | 8700003 | ASSY, cover, top |
| | 8700002 | ASSY, cover, bottom |
| | 8700001 | ASSY, cover, end two (2) per unit |
| | 2824004 | POST, binding (no spacer) |
| | 2118003 | HOLDER, fuse, req. for fuse F500 |
| | 8700019 | PILOT LAMP ASSY (green) |
| | 8700015 | PILOT LAMP ASSY (clear) |
| | 2422026 | KNOB, instrument, fine rep. rate, delay or width, fine attenuator |
| | 2422028 | KNOB, instrument, coarse rep. rate, delay or width, rise time control |
| | 2422025 | KNOB, instrument, 10 db step attenuator |
| | 2422027 | KNOB, instrument, polarity |
| | 3512001 | MOTOR, fan |
| | 2612002 | BLADE, fan |
| | 9207023 | MANUAL, instruction |
| | 1445006 | PANEL, front, w/silk screen 0070010 |
| | 2830024 | SPACER, binding post |
| | 6030003 | STRAIN RELIEF, req. for power cord P500 |

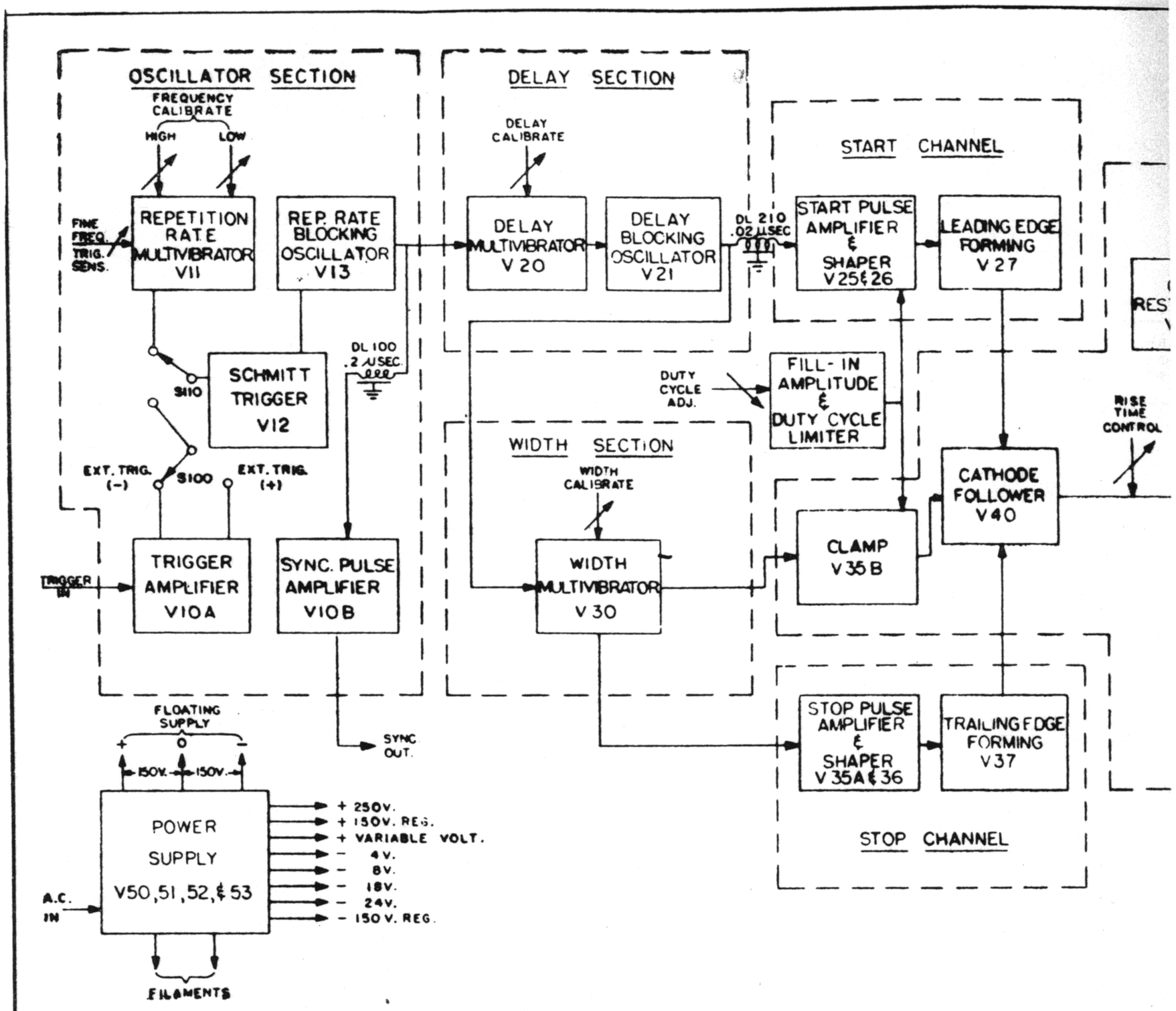
# WARRANTY

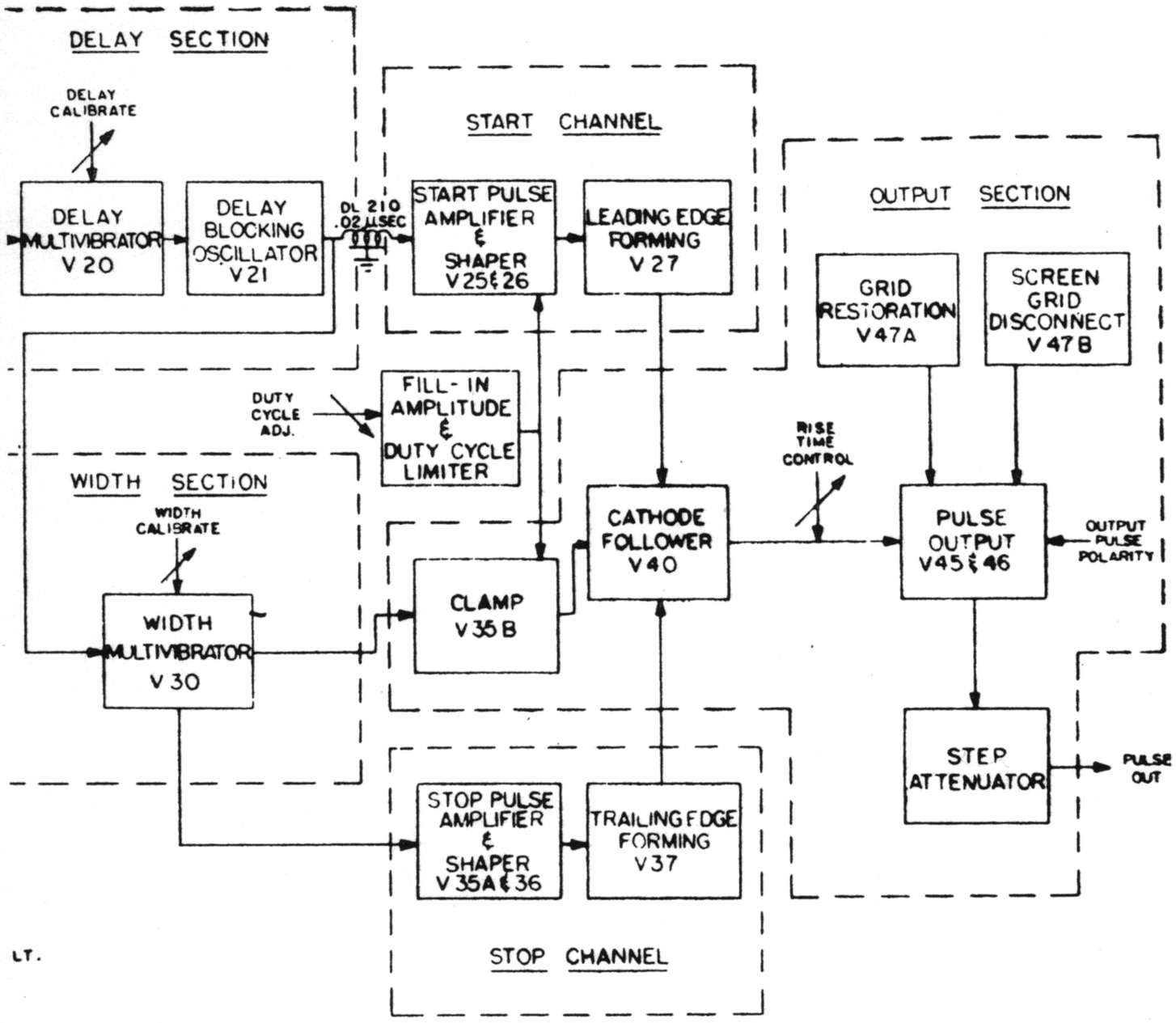
The Company warrants its equipment and materials, with exception of evacuated devices, glassware, and batteries to be free from defects in material and workmanship under normal use and service for a period of twelve months from the original date of shipment. The Company's obligation is limited to repairing or replacing any defective part or parts of such products that are returned to it.

All repairs and replacements made under this warranty are f. o. b. Company's factory shipping point or Company designated service depot. This warranty is made on condition that prompt notice of defect is given to the Company, in writing, within the warranty period, and that the Company shall have the sole right to determine whether in fact a defect exists.

This warranty does not apply to any used equipment or material, or any equipment or material which shall have been repaired or altered by other than the Company's own service engineers so as, in the Company's judgment, to adversely affect it, nor which has been subject to misuse, negligence or accident or which has been used or operated contrary to sound practice or operating instructions. Components not of Company's manufacture shall be subject to the manufacturer's warranty in lieu of this warranty.

COMPUTER MEASUREMENTS COMPANY/A DIVISION OF PACIFIC INDUSTRIES, INC.
SAN FERNANDO, CALIFORNIA 91342


OSCILLATOR SECTION
FREQUENCY CALIBRATE
HIGH
LOW
FINE FREQ. TRIG. SENS.
REPETITION RATE MULTIVIBRATOR V11
REP. RATE BLOCKING OSCILLATOR V13
S110
SCHMITT TRIGGER V12
DL 100 .2 μSEC.
EXT. TRIG. (-)
S100
EXT. TRIG. (+)
TRIGGER IN
TRIGGER AMPLIFIER V10A
SYNC. PULSE AMPLIFIER V10B
SYNC OUT.
DELAY SECTION
DELAY CALIBRATE
DELAY MULTIVIBRATOR V20
DELAY BLOCKING OSCILLATOR V21
DL 210 .02 μSEC
WIDTH SECTION
WIDTH CALIBRATE
WIDTH MULTIVIBRATOR V30
START CHANNEL
START PULSE AMPLIFIER & SHAPER V25&26
LEADING EDGE FORMING V27
DUTY CYCLE ADJ.
FILL-IN AMPLITUDE & DUTY CYCLE LIMITER
RISE TIME CONTROL
CATHODE FOLLOWER V40
CLAMP V35B
STOP PULSE AMPLIFIER & SHAPER V35A&36
TRAILING EDGE FORMING V37
STOP CHANNEL
FLOATING SUPPLY
+
0
-
150V.
150V.
POWER SUPPLY V50,51,52,&53
A.C. IN
+ 250V.
+ 150V. REG.
+ VARIABLE VOLT.
- 4V.
- 8V.
- 18V.
- 24V.
- 150V. REG.
FILAMENTS




BLOCK DIAGRAM

0010008

230V OPERATION OPTIONAL

RT500 5Ω 10W ± 20%

T

FAN

F500 2 AMP SLO BLO

MAIN POWER FUSE (FRONT PANEL)

MAIN POWER SWITCH (FRONT PANEL)

S500

WHITE GREEN BLACK

P500

T500

CR500 SC4 CR501 SC4 CR502 SC4 CR503 SC4 CR504 SC4 CR505 SC4

C500 80-80 MF

R500 100K

R501 3K 10W

C503 0.1

−150 VOLT REGULATOR

C501 80-80 MF

C502 80-80 MF

R502 150K 1W

+250 VOLT SUPPLY

CR600 SC4

CR601 SC4

R600 0.75Ω 5W, ±5%

C600 50MF

CR602 SC4 CR603 SC4

C601 200-200 MF

C603 200-200 MF

C604 200-200 MF

C602 200-200 MF

R605 100K

R604 100K

150V

REF.

150V

TO OUTPUT AMPLIFIERS DWG.# 0010007

FLOATING POWER SUPPLY

RT500 5Ω 10W ± 20%

T

FAN

F500 4 AMP SLO-BLO

MAIN POWER FUSE (FRONT PANEL)

MAIN POWER SWITCH (FRONT PANEL)

S500

WHITE GREEN BLACK

P500

T600

CR604 SC4

R601 3.3M

R602 50K, 1W ±30%

DUTY CYCLE LIMIT ADJUSTMENT (REAR PANEL)

R603 15K

−150V

C531 0.1

V53A 1/2 6U8

+150V

R535 6.8K 2W

R536 6.8K 2W

CR530 SC4

R534 100K

R533 120K

R532 680K

DS530 NE-51

DUTY CYCLE LIMIT INDICATOR (FRONT PANEL)

FINE ATTENUATION (FRONT PANEL)

R531 250K 2W, ±20%

R530 270K ±5%

C530 0.1

−150V

TO OUTPUT AMPLIFIERS DWG.# 0010007

DUTY CYCLE LIMITING & FINE ATTENUATION CONTROL

CR700 SC4

CR701 SC4

C700 1500 MF

R704 33Ω 1W ± 5%

R705, 160Ω 2W ±5%

R700 47 Ω 2W, ±5%

R701 160Ω 2W, ±5%

R702 33Ω 1W, ± 5%

R703 33 Ω 1W, ± 5%

−24V −18V −8V −4V

TO MAIN CIRCUIT SECTIONS D D

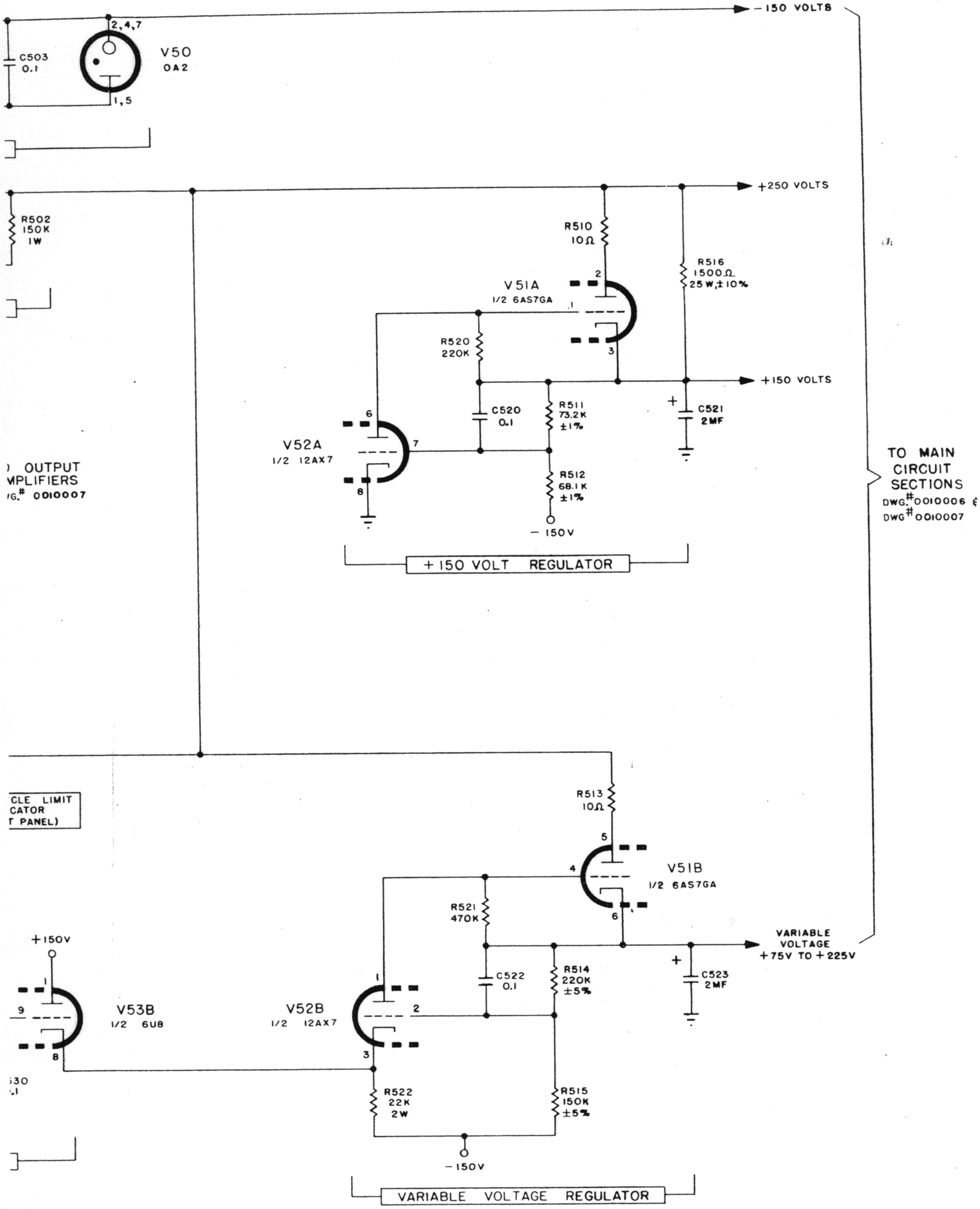
BIAS SUPPLY

V53 V52 V51

DS500 # 47

POWER APPLIED INDICATOR (FRONT PANEL)

TO MAIN CIRCUIT SECTIONS DWG.# 00100068 DWG.# 0010007




NOTES: Unless otherwise specified,

1. All fixed resistors are 1/2 watt, ±10%.
2. All capacitor values one (1) or less are in microfarads; those greater than one (1) are in micromicrofarads.

POWER SUPPLY

MODEL B7B PULSE GENERATOR

1/7/60 0010005

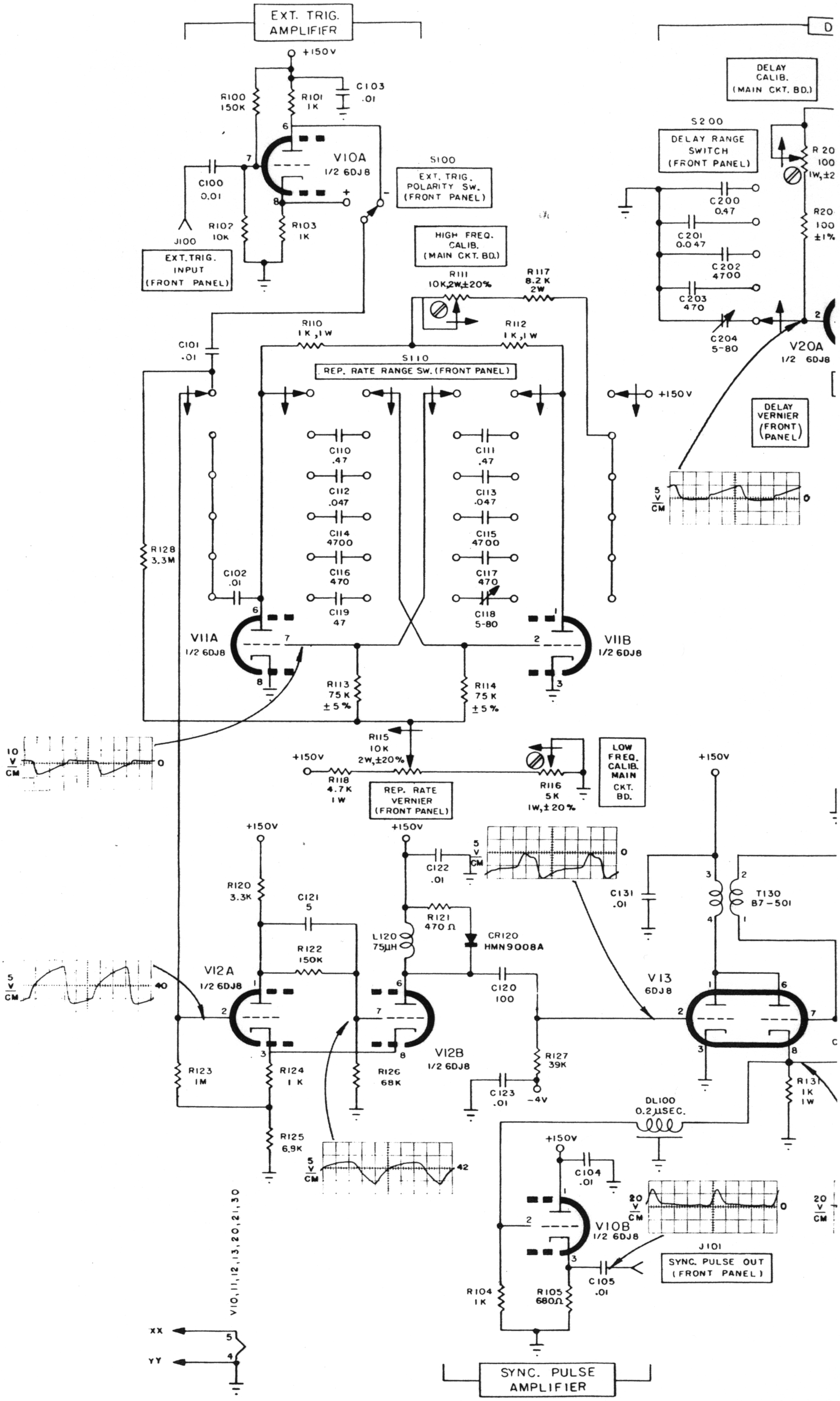
Model No. B7B

Drawing No. 0010005

# CHANGE SHEET

Following is a list of circuit changes referenced to the schematic diagram.

| | Description of Change |
|---|---|
| | On later units C600 is changed to 60 MF, 50 V (CMC No. 4033054). |


EXT. TRIG. AMPLIFIER
+150V
R100 150K
R101 1K
C103 .01
V10A 1/2 6DJ8
S100
EXT. TRIG. POLARITY SW. (FRONT PANEL)
C100 0.01
J100
EXT. TRIG. INPUT (FRONT PANEL)
R102 10K
R103 1K
HIGH FREQ. CALIB. (MAIN CKT. BD.)
R111 10K,2W,±20%
R117 8.2K 2W
R110 1K,1W
R112 1K,1W
C101 .01
S110
REP. RATE RANGE SW. (FRONT PANEL)
C110 .47
C112 .047
C114 4700
C116 470
C119 47
C111 .47
C113 .047
C115 4700
C117 470
C118 5-80
R128 3.3M
C102 .01
V11A 1/2 6DJ8
V11B 1/2 6DJ8
R113 75K ±5%
R114 75K ±5%
R115 10K 2W,±20%
R118 4.7K 1W
REP. RATE VERNIER (FRONT PANEL)
R116 5K 1W,±20%
LOW FREQ. CALIB. MAIN CKT. BD.
10 V/CM
D
DELAY CALIB. (MAIN CKT. BD.)
S200
DELAY RANGE SWITCH (FRONT PANEL)
C200 0.47
C201 0.047
C202 4700
C203 470
C204 5-80
R20 100 1W,±2
R20 100 ±1%
V20A 1/2 6DJ8
+150V
DELAY VERNIER (FRONT) PANEL
5 V/CM
C122 .01
C131 .01
T130 B7-501
R120 3.3K
C121 5
R121 470Ω
L120 75µH
CR120 HMN9008A
R122 150K
V12A 1/2 6DJ8
V12B 1/2 6DJ8
C120 100
R127 39K
C123 .01
-4V
R123 1M
R124 1K
R126 68K
R125 6.9K
V13 6DJ8
R131 1K 1W
DL100 0.2µSEC.
C104 .01
V10B 1/2 6DJ8
J101
SYNC. PULSE OUT (FRONT PANEL)
C105 .01
R104 1K
R105 680Ω
V10,11,12,13,20,21,30
XX
YY
SYNC. PULSE AMPLIFIER

DELAY MULTIVIBRATOR

DELAY BLOCKING OSCILLATOR

DELAY CALIB. (MAIN CKT. BD.)

S200 DELAY RANGE SWITCH (FRONT PANEL)

R200 100K 1W, ±20%

R201 100K

R202 47Ω

+150V

L200 25μH

R203 470Ω

CR200 1N34A

C209 .01

C200 0.47

C201 0.047

C202 4700

C203 470

C204 5-80

R204 100K ±1%

R205 27K

R206 12K

C206 100

C207 100

R207 220Ω 2W

C208 100

V20A 1/2 6DJ8

CR201 HMN9008A

V20B 1/2 6DJ8

R208 500Ω 2W, ±20%

R209 300K ±5%

C205 .01

-150V

R211 3.3K

C213 .01

-8V

DELAY VERNIER (FRONT PANEL)

+150V

-18V

C212 .01

T210 B7-501

R210 470Ω

C211 .01

CR210 1N34A

V21 6BQ7A

C210 100

R212 470Ω 2W

DL 210 0.02 μSEC.

TO DW

5 V/CM

10 V/CM

20 V/CM

20 V/CM

V11B 1/2 6DJ8

LOW FREQ. CALIB. MAIN CKT. BD.

C132 .01

C131 .01

T130 B7-501

R130 470Ω

CR130 1N34A

V13 6DJ8

C130 100

R131 1K 1W

R132 1K

DL100 0.2μSEC.

C104 .01

V10B 1/2 6DJ8

C105 .01

J101 SYNC. PULSE OUT (FRONT PANEL)

20 V/CM

20 V/CM

ULSE IER

C309 2μF

+150V

WIDTH CALIB. (MAIN CKT. BD.)

R302 47Ω

R307 470Ω, 2W

C310 0.25

TO DW

R300 100K 1W±20%

R301 100K

CR301 HMN 9008A

L300 25μH

R303 470Ω

CR300 1N34A

C300 0.47

C301 0.047

C302 4700

C303 470

C304 5-80

R304 100K ±1%

R305 27K

R306 12K

C306 100

C307 100

C308 100

R351 3.3K

C311 .01

-8V

S300 WIDTH RANGE SWITCH (FRONT PANEL)

V30A 1/2 6DJ8

V30B 1/2 6DJ8

WIDTH VERNIER (FRONT PANEL)

R308 500Ω 2W, ±20%

R309 300K ±5%

-150V

20 V/CM

WIDTH MULTIVIBRATOR

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL FIXED RESISTORS ARE 1/2 WATT
2. ALL CAPACITOR VALUES ONE (1) OR GREATER THAN ONE (1) ARE IN MI

# WAVEFORMS

**PULSE GENERATOR**

**OSCILLOSCOPE SET**
**ITEKTRONIX TYPE 5**

REP. RATE, DELAY

MODEL B7B PULSE

6/22/60

MULTIVIBRATOR

DELAY BLOCKING OSCILLATOR

R202 47Ω +150V

+150V

-18V

TO V 25A P.7 DWG.# 0010007

L200 25μH

R203 470Ω

C209 .01

CR200 IN34A

C212 .01

T210 B7-501

R210 470Ω

C211 .01

DL 210 0.02 μSEC.

CR210 IN34A

R205 27K

R206 12K

R207 220Ω 2W

C206 100

C207 100

C208 100

V21 6BQ7A

CR201 HMN9008A

V20B 1/2 6DJ8

R211 3.3K

C210 100

R208 500Ω W,±20%

R209 300K ±5%

C205 .01

C213 .01

R212 470Ω 2W

-150V

-8V

10 V/CM

20 V/CM

20 V/CM

NOTES: UNLESS OTHERWISE SPECIFIED,

1. ALL FIXED RESISTORS ARE 1/2 WATT ±10%
2. ALL CAPACITOR VALUES ONE (1) OR LESS ARE IN MICROFARADS, THOSE GREATER THAN ONE (1) ARE IN MICROMICROFARADS.

8V

C309 2μF

+150 V

WIDTH CALIB. (MAIN CKT. BD.)

R302 47Ω

R307 470Ω,2W

C310 0.25

TO V 35B P.7 DWG. # 0010007

R300 100K 1W±20%

R301 100K

CR301 HMN 9008A

L300 25μH

R303 470Ω

CR300 IN34A

C300 0.47

R304 100K ±1%

R305 27K

R306 12K

C301 0.047

C302 4700

C303 470

C306 100

C307 100

C308 100

TO V35A P. 2 DWG. # 0010007

CR130 IN34A

C304 5-80

S300 WIDTH RANGE SWITCH (FRONT PANEL)

V30A 1/2 6DJ8

V30B 1/2 6DJ8

R351 3.3K

C311 .01

R132 1K

WIDTH VERNIER (FRONT PANEL)

R308 500Ω 2W,±20%

R309 300K ±5%

-8V

-150V

20 V/CM

WIDTH MULTIVIBRATOR

## WAVEFORMS

PULSE GENERATOR SETTING: REP. RATE 2 MC
DELAY 0.1 μSEC
WIDTH 0.15 μSEC

OSCILLOSCOPE SETTING: TIME/CM 0.1 μSEC
(TEKTRONIX TYPE 541A) VOLTS/CM AS SPECIFIED

# REP. RATE, DELAY & WIDTH SECT.

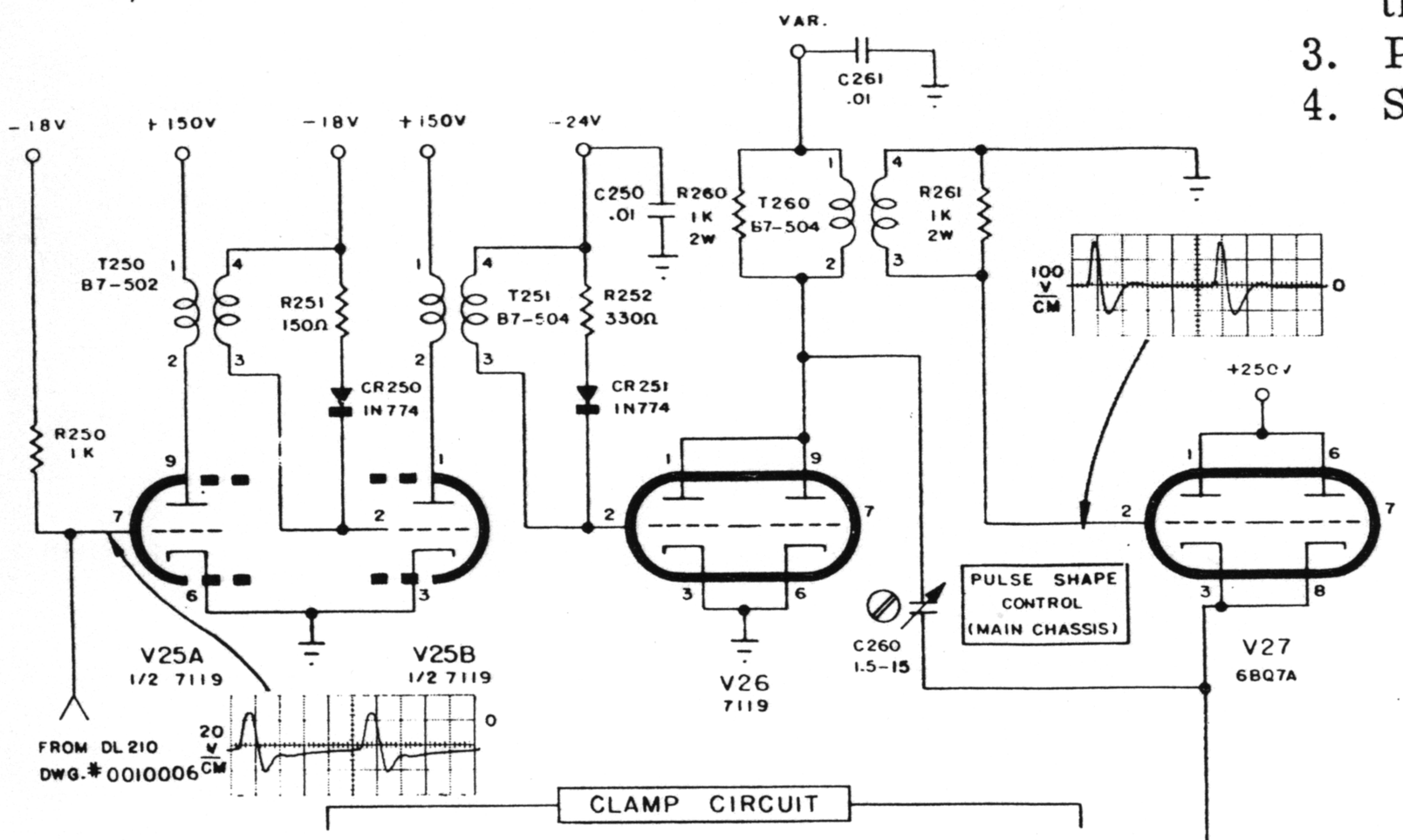
MODEL B7B PULSE GENERATOR

6/22/60 0010006

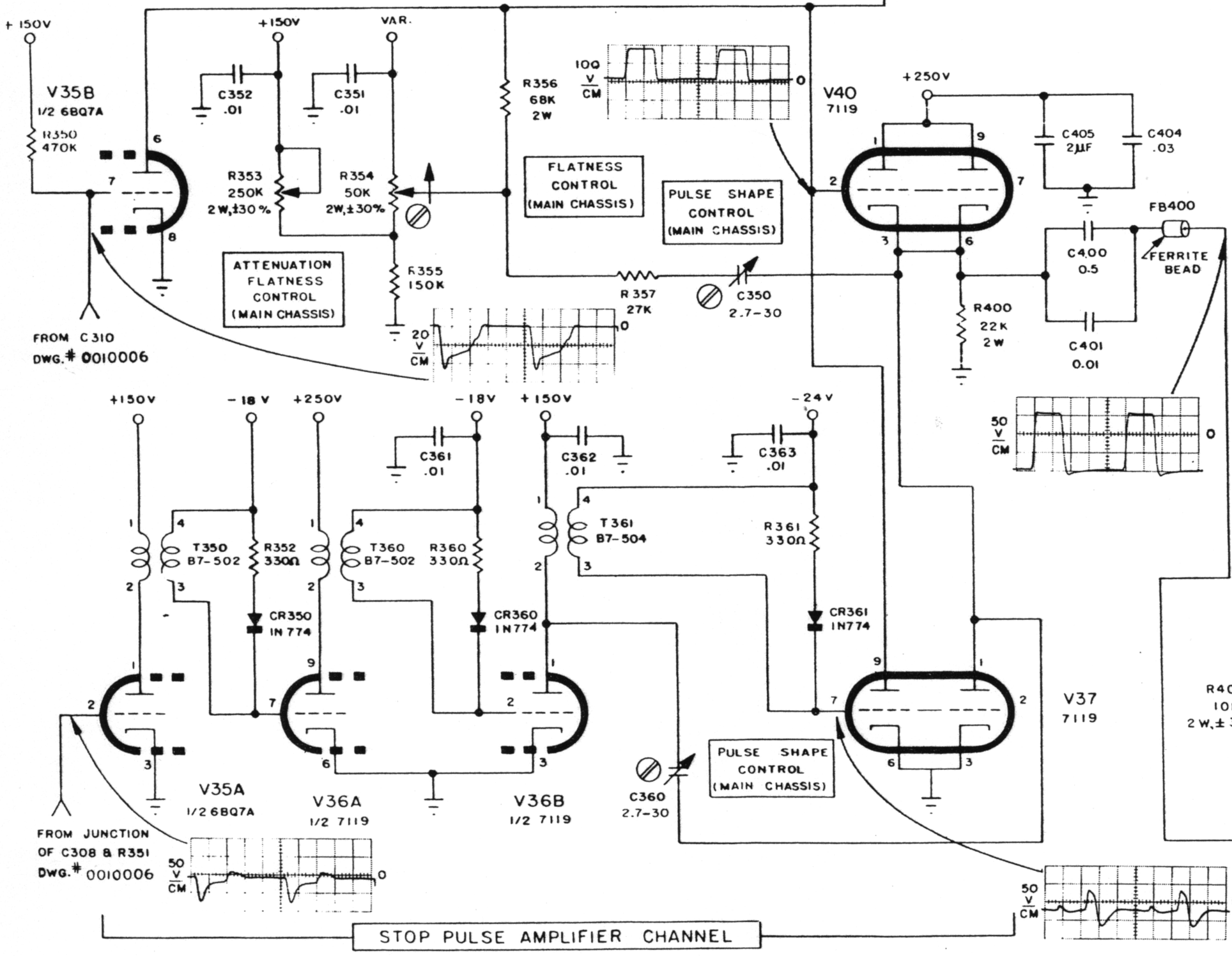
NOTES: Unless otherwise specified,

1. All fixed resistors are 1/2 watt,
2. All capacitor values one (1) or le than one (1) are in micromicrofa
3. Polarity switch, S450, shown in t
4. Step attenuator switch, S800, sho

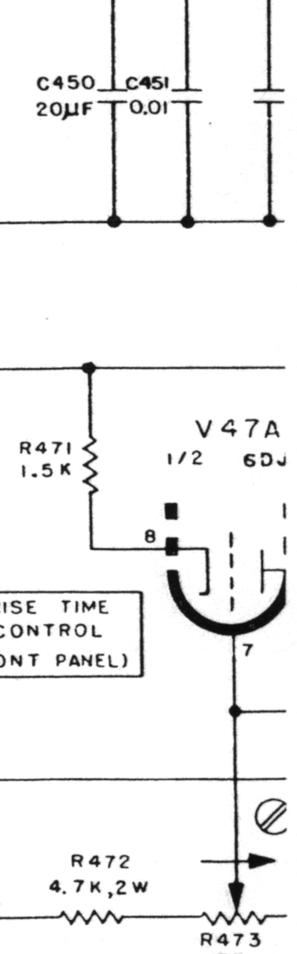
START PULSE AMPLIFIER CHANNEL



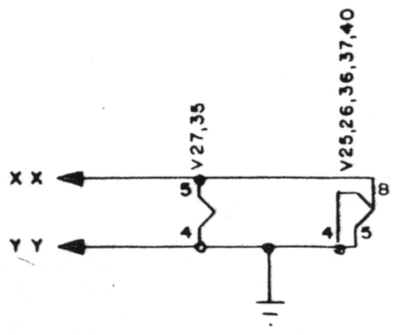

CLAMP CIRCUIT

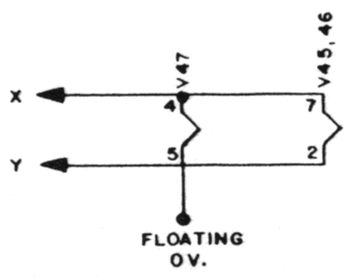



STOP PULSE AMPLIFIER CHANNEL




OUTPUT AMPL



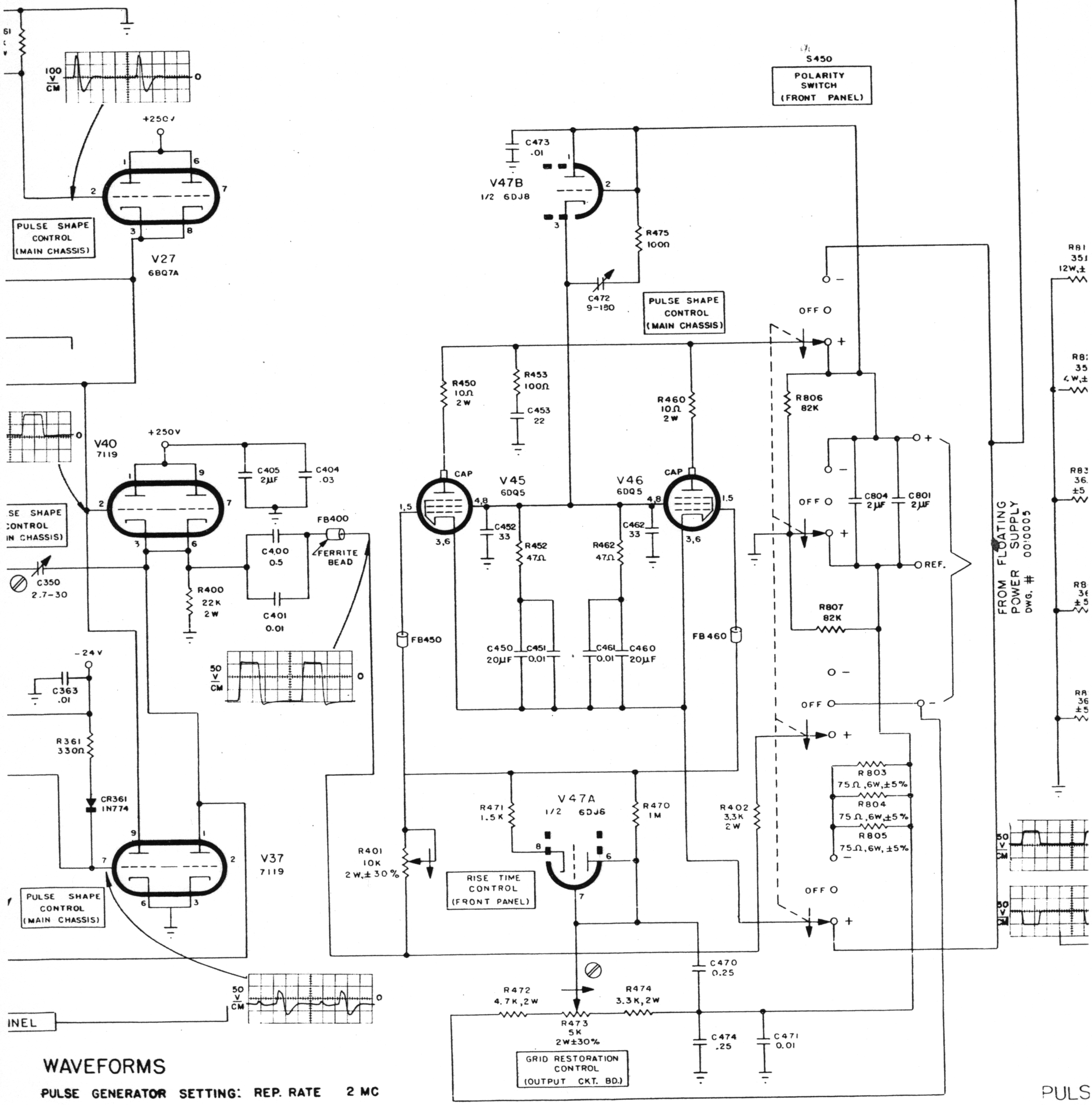




## WAVEFORMS

| | | |
|---|---|---|
| PULSE GENERATOR SETTING: | REP. RATE | 2 MC |
| | DELAY | 0.1 µSEC |
| | WIDTH | 0.15 µSEC |
| OSCILLOSCOPE SETTING: | TIME/CM | 0.1 µSEC |
| (TEKTRONIX TYPE 541A) | VOLTS/CM | AS SPECIFIED |

NOTES: Unless otherwise specified,

1. All fixed resistors are 1/2 watt, ±10%.
2. All capacitor values one (1) or less are in microfarads; those greater than one (1) are in micromicrofarads.
3. Polarity switch, S450, shown in the positive (+) output pulse position.
4. Step attenuator switch, S800, shown in the (0) db attenuation position.

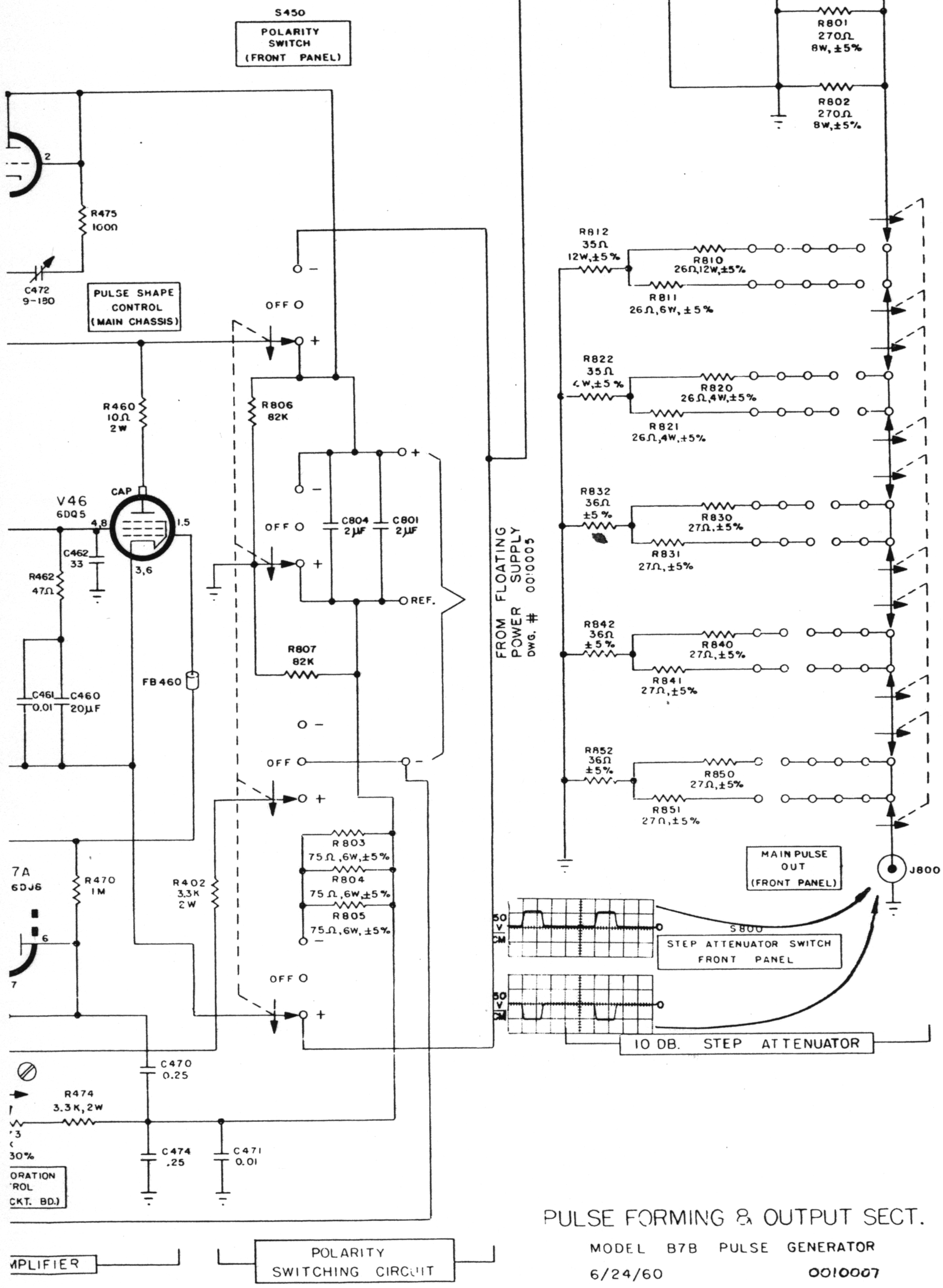



## WAVEFORMS

**PULSE GENERATOR SETTING:** REP. RATE 2 MC
DELAY 0.1 μSEC
WIDTH 0.15 μSEC

**OSCILLOSCOPE SETTING:** TIME/CM 0.1 μSEC
(TEKTRONIX TYPE 541A) VOLTS/CM AS SPECIFIED

, ±10%.
less are in microfarads; those greater
arads.
ı the positive (+) output pulse position.
hown in the (0) db attenuation position.




PULSE FORMING & OUTPUT SECT.

MODEL B7B PULSE GENERATOR

6/24/60 0010007

CMC