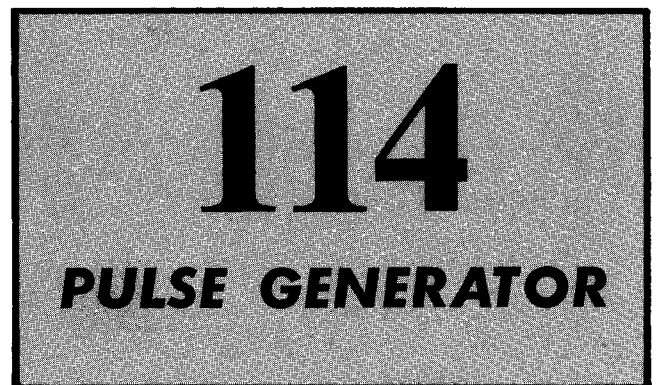


INSTRUCTION MANUAL

Serial Number _____



Tektronix, Inc.

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070-465



WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

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Type 114

Type 114 Pulse Generator



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A list of abbreviations and symbols used in this manual will be found on page 5-1. Change information, if any, is located at the rear of the manual.

SECTION 1

CHARACTERISTICS

Introduction

The Type 114 Pulse Generator is a general purpose pulse generator. Transistorized circuitry is used throughout, with most of the components being mounted on an etched circuit board.

The Type 114 Pulse Generator is versatile. The repetition rate, width, and amplitude of the output pulse are individually selectable by range and by variable control within each range. Front-panel connectors are provided for the pulse output, trigger output, and external trigger input. A single front-panel switch selects both the amplitude range and polarity of the output pulse. The trigger output pulse is set by a front-panel switch to occur on the desired edge (leading or trailing) of the output pulse. In cases where the Type 114 is set for a pulse width longer than the pulse repetition period, a built-in feature automatically counts down the repetition rate to permit the width of the output pulse to remain at the value selected (such operation is indicated by a Width > Period light). In addition, two Type 114's can be connected together so that the output pulse of the second unit is delayed by the pulse width (up to 10 ms) of the first unit.

Electrical

Pulse Period. The PERIOD switch and associated VARIABLE control provide continuously variable pulse periods from 1 μ sec to 100 msec (pulse repetition rates from one million pulses per second to 10 pulses per second). An EXTERNAL TRIGGER position on the PERIOD switch permits external control of the pulse period. With the VARIABLE control at the CAL end of its range and the WIDTH > PERIOD light unlit, the period accuracy is within $\pm 3\%$ of the indicated value. Jitter is typically less than 0.05% of pulse period $+2$ ms.

Pulse Width. The WIDTH switch and associated VARIABLE control provide continuously variable pulse widths from 100 nsec to 10 msec. With the width VARIABLE control at the CAL end of its range, the width accuracy is within $\pm 3\%$ of indicated value. Jitter is typically less than 0.05% plus $\frac{1}{2}$ nsec. An additional SQUARE WAVE position on the WIDTH switch disables the variable width feature and changes the output to a square wave whose repetition rate is determined by the PERIOD controls. Period error in the square wave mode is $\leq \pm 5\%$.

Output Polarity and Amplitude. The AMPLITUDE switch provides for either polarity output with two amplitude ranges (1 V to 3 V and 3 V to 10 V). The VARIABLE control permits the output to be varied within the voltage ranges. Aberrations (overshoot, rolloff, preshoot, or ringing) amount to less than 5% at maximum amplitude.

Output Impedance. The output impedance of the Type 114 is given in Table 1-1. The figures given are typical and are dependent upon the setting of the AMPLITUDE—VARIABLE control. Load impedance is not critical. Temporarily

short circuiting the OUTPUT connector will not damage the instrument.

WARNING

The Type 114 should never be connected to an inductive load, or any load that will produce a current which will feed back into the instrument.

TABLE 1-1

Amplitude Range	Pulse on	Pulse off
± 1 to 3 V	$\approx 20 \Omega$	19 Ω to 22 Ω
± 3 to 10 V	28 Ω to 48 Ω	30 Ω to 95 Ω

External Trigger Input. External triggering requires a positive trigger signal of 2 to 20 volts and having a risetime of 1 μ sec or less. Triggering signals up to 2 Mc may be used.

Trigger Output. The trigger output pulse into an open circuit is approximately 3 volts; into a 50 Ω termination, the trigger output pulse is approximately $\frac{1}{2}$ volt. A front-panel switch allows the output trigger pulse to be set to occur at the leading edge or the trailing edge of the main pulse.

Input Power Requirements. ≈ 15 watts; 50 to 400 cps, 94.5- to 137.5- or 189- to 275-volts, ac.

Warm-up Time at $+25^\circ\text{C} \pm 5^\circ\text{C}$. Five minutes for rated accuracies.

Environmental

Operating

Temperature	0°C to $+50^\circ\text{C}$
Altitude	15,000 feet maximum

Non-Operating

Temperature	-40°C to $+65^\circ\text{C}$
Altitude	50,000 feet maximum

Mechanical

Dimensions	Approximately 9" \times 6" \times 12 $\frac{1}{2}$ " overall
Connectors	Front-panel connectors are BNC type.

Accessories

See standard accessory lists in this manual for accessories supplied with each instrument. For optional accessories, see the current Tektronix, Inc. catalog.

GLOSSARY OF TERMS

Bistable (multivibrator)	A circuit that has two stable states and requires two input pulses to complete a cycle.	MPPS	Megapulses per second.
Calibrate	To check or correct the graduation accuracy of quantitative indicators.	Overshoot	When changing from one voltage level to another, a momentary excursion greater than the change desired.
CAL (calibrated) position	An index position to which an otherwise ungraduated control is set when a quantitative measurement must be made.	PPS	Pulses per second.
Catching or clamping diode	Establishes the + or — extremity of a voltage excursion.	Preshoot	A small negative excursion immediately preceding a positive-going pulse, or vice versa.
Count-down (of pulses) circuit	A circuit, such as a bistable, whose output consists of pulses fewer in number (usually a submultiple) than the pulses applied to the input(s).	Pulse amplitude	The amplitude of a pulse is any term indicating the magnitude of the pulse.
Delayed pulse	A pulse occurring after a preselected interval following an event used as a time reference point.	Pulse duration	The time interval between the first and last instants at which the pulse voltage (or current) reaches some specified percentage of the peak voltage (or current) of the pulse.
Delayed trigger	Generally, a narrow, delayed pulse.	Pulse period	The pulse period in a sequence of periodic pulses is the elapsed time between any given point on one of the pulse waveforms and the same point on the following pulse.
Duty factor (of pulses)	For periodic pulses, the duty factor (often called duty cycle) is equal to the duration (width) of a pulse divided by the pulse period.	Pulse Repetition Frequency	The number of periodic pulses that occur in a given unit of time. Also expressed as pulse repetition rate.
Enabling pulse	A pulse which opens a normally closed electric gate, or otherwise permits an operation for which a pulse input is a necessary condition.	Pulse width	See pulse duration.
External trigger (pulse)	An enabling pulse derived from a source external to the circuit or equipment where a particular operation requires an enabling pulse with certain characteristics (time delayed, duration, etc.).	Quiescent	At rest—specifically, the condition of a circuit when no input signal is being applied and/or no change is taking place.
Falltime	The time required by pulse waveform to fall from 90% of its maximum value to 10% of its maximum value. Not necessarily equal to risetime.	Ramp voltage	A voltage waveform that rises at a steady rate. For example, at 10 volts per second.
Jitter	Short-duration instability (of a signal); random small departures from regularity.	Ringing	High-frequency damped oscillations caused by shock excitation of high-frequency resonances, or, a damped oscillation in the output signal of a system as a result of a sudden change in the input signal.
KPPS	Kilopulses per second.	Risetime	The risetime of a pulse is taken as the time required for the leading edge of the pulse to increase from 10% of its maximum value to 90% of its maximum value.
Monostable (multivibrator)	A circuit having one stable and one semistable state. A trigger pulse drives the circuit into the semistable state, where it remains for a predetermined time before returning to the stable condition.	Sampling system	A method that takes amplitude samples from a repetitive input signal with each sample at a progressively later time, then reconstructs these samples into a replica of the original waveform at a much lower frequency.
		Trigger	A signal that starts action in another circuit.

SECTION 2

OPERATING INSTRUCTIONS

Front-Panel Controls, Indicators, and Connectors (See Fig. 2-1.)

The function of each item on the Type 114 front panel is given in the following tabulation.

POWER

Switch	This toggle switch completes the circuit to the primary of the power transformer.
Indicator	The white lamp to the right of the POWER switch lights when the Type 114 is energized.

PERIOD

Switch	This switch selects the basic range of pulse period. When the switch is set to EXTERNAL TRIGGER—INPUT, the Type 114 provides width and amplitude control for externally generated pulses applied to the INPUT connector. Note that "100 mS" does not indicate a switch position, but is instead an index for the VARIABLE control.
--------	---

VARIABLE Control	This control has a range of 10:1 or more, and provides continuous coverage between the steps of the PERIOD switch.
------------------	--

EXTERNAL TRIGGER-INPUT Connector	BNC connector to which the external trigger is applied when externally triggering.
----------------------------------	--

WIDTH

Switch	This switch selects the basic ranges of pulse width. Note that the word "10 mS" does not indicate a switch position, but is instead an index for the associated VARIABLE control.
--------	--

When the WIDTH switch is set to SQUARE WAVE, the output of the Type 114 is a square wave whose period is selected by the PERIOD controls.

VARIABLE Control	This control provides continuous coverage between the steps of the WIDTH switch and has a range of 10:1 or greater.
------------------	---

WIDTH > PERIOD Indicator light	With the flexibility provided, it is possible to set the controls so that the width of the pulse selected exceeds the period selected. When this occurs, the Type 114 counts down the repetition rate and lights the WIDTH > PERIOD light. The pulse width remains as selected, but the pulse period is no longer that selected by the PERIOD controls.
--------------------------------	---

AMPLITUDE

Switch	Selects the two basic voltage ranges and the polarity of the output signal.
--------	---

VARIABLE Control	Provides for varying the output amplitude within the range selected by the AMPLITUDE switch.
------------------	--

OUTPUT Connector

BNC connector from which the output is taken.

TRIGGER

Switch	This switch permits the operator to select the edge of the output pulse at which the trigger pulse occurs.
--------	--

Connector	BNC connector from which the trigger pulse output is taken.
-----------	---

First Time Operation

The following procedures are designed to acquaint the operator with the operation of the Type 114.

1. Set the three VARIABLE controls extreme counterclockwise. Set the PERIOD switch to 100 μ S, the WIDTH switch to SQUARE WAVE, and the AMPLITUDE switch to the "+1 TO +3 V" position.

2. Connect the OUTPUT connector of the Type 114 to the vertical input of an oscilloscope (Tektronix Type 547/1A1 or equivalent) by means of a 50 Ω coaxial cable. Terminate the coaxial cable at the oscilloscope end with a 50 Ω termination (Tektronix Part No. 011-049 or equivalent). Make sure the input voltage switch is set to match the voltage of the power source in use (115 or 230 V ac). See Fig. 2-2. Attach the power cord.

3. Apply power to the Type 114 and the oscilloscope. Set the oscilloscope TIME/DIV or TIME/CM switch to .1 mSEC and obtain a stable display.

4. Set the WIDTH switch to 10 μ S. Turn the associated VARIABLE control clockwise and note the increase in pulse width. When the control is turned so that the pulse width exceeds 100 μ S, the WIDTH > PERIOD lamp lights.

5. Operate the PERIOD, WIDTH, and AMPLITUDE switches and controls throughout their ranges and check the results with the oscilloscope.

Using the Type 114 as a Source of Delayed Trigger

The use of the Type 114 as a source of delayed trigger may be demonstrated as follows:

1. Apply a 1 Kpps signal (such as the output of the oscilloscope calibrator) through a BNC T connector and appropriate coax cables to the external trigger input connectors of

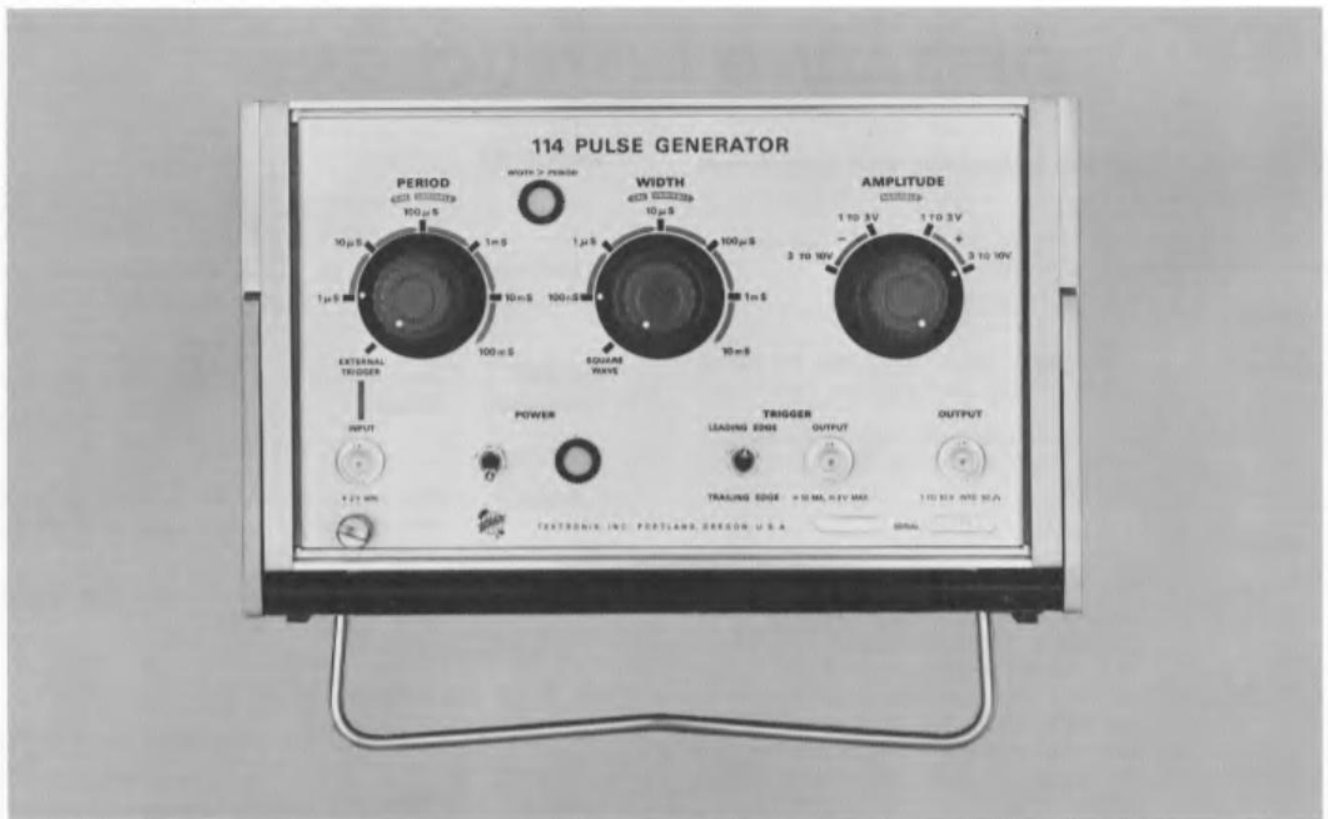


Fig. 2-1. Front panel controls.

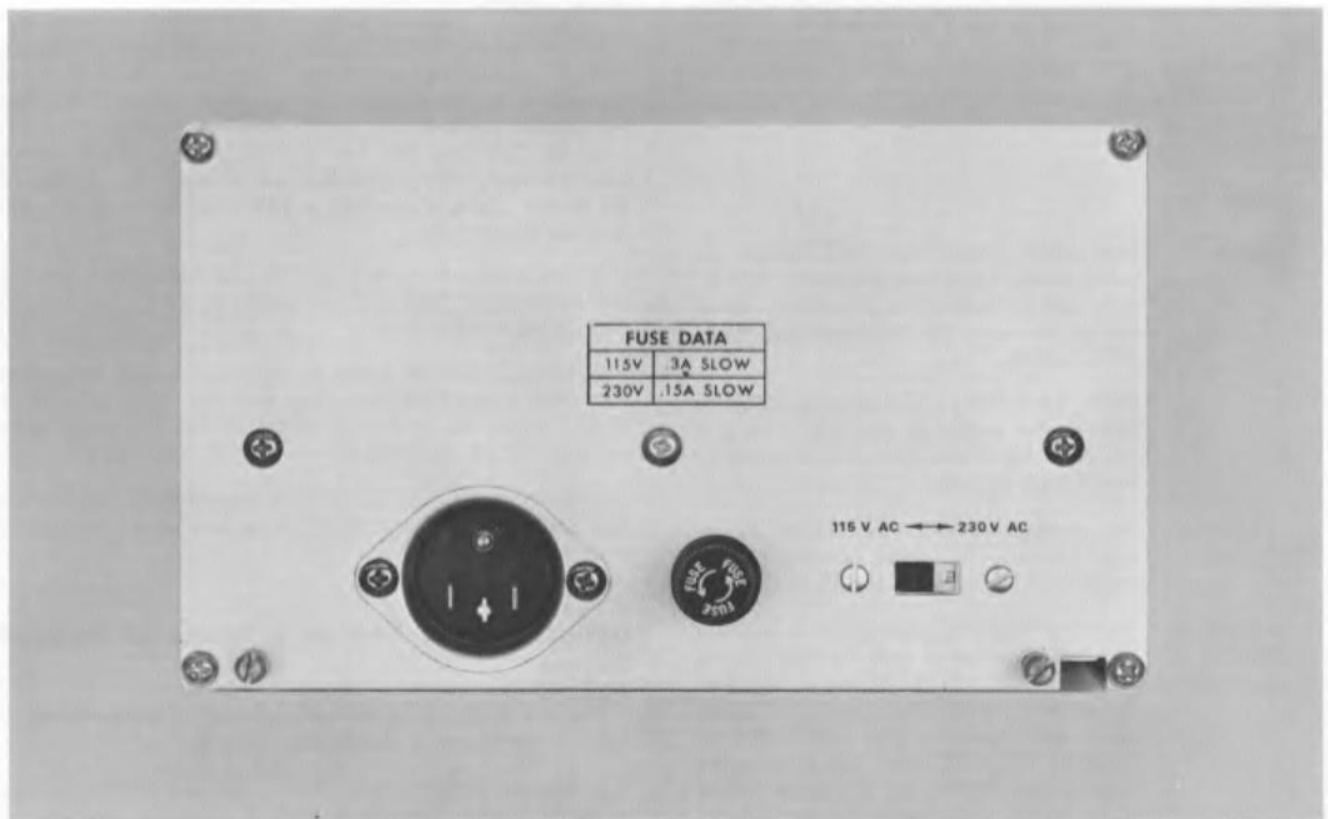


Fig. 2-2. Type 114 rear panel.

both the Type 114 and the oscilloscope (see Section 1 for external trigger characteristics required).

2. Obtain an externally triggered sweep on the oscilloscope.

3. Connect a coaxial cable between the TRIGGER OUTPUT connector of the Type 114 and the vertical input of the oscilloscope.

4. Turn the Type 114 PERIOD switch to EXTERNAL TRIGGER. Set the WIDTH switch to 100 μ S. Turn the WIDTH variable control to CAL. Set the oscilloscope VOLTS/CM switch to 1 volt. Set the TIME/CM switch to .1 mSEC.

5. Set the Type 114 TRIGGER switch to TRAILING EDGE. A narrow trigger pulse approximately 3 volts in amplitude

should be visible approximately 1 cm from the start of the oscilloscope trace.

6. Turn the WIDTH—VARIABLE control and note that the displayed trigger pulse can be delayed from 10 μ sec to more than 100 μ sec from the start of the trace. By using the 5 basic ranges of the WIDTH switch and by turning the associated VARIABLE control, it is possible to delay the trigger pulse over a range from approximately 150 nanoseconds to 10 milliseconds.

Switching the Power Transformer Primary Connections

A switch on the rear of the Type 114 chassis permits switching the power transformer connections for operation on either 94.5-137.5 (115 V ac nominal) or 189-275 volts ac (230 V ac nominal). Be sure the correct fuse is installed.

SECTION 3

CIRCUIT DESCRIPTION

Introduction

This section contains the theory of operation of the various circuits in the Type 114. The text is supplemented by two block diagrams inserted in the text and by schematics in Section 5. The reader should follow the circuits on the diagrams as they are presented in the text.

CAUTION

There is no fixed chassis ground for the circuit board used in the Type 114. A common negative point is used instead. This permits changing the polarity of the output by grounding the appropriate side of the power supply. For this reason, always connect probe grounds to the main chassis rather than to a point on the circuit board.

Period Generator

The Period Generator (see Fig. 3-1) supplies the trigger pulse which activates the Width Generator. The trigger pulse is generated internally, or is derived from an externally generated triggering signal, depending upon the setting of the PERIOD switch.

Internal Operation. When the Type 114 is operating in the internally triggered modes, the operation of the Period Generator is as follows:

Transistors Q115 and Q125 in conjunction with the appropriate RC timing combination form a free running oscillator. At the start of a cycle of operation, Q115 is biased off and Q125 is biased slightly on. The charge on timing capacitor C115 has been removed by the preceding cycle and now starts charging toward a common point voltage at an RC rate. As the timing capacitor charges, the voltage across it reaches a point where it turns on diode D114 and transistor Q115. At this instant the circuit becomes regenerative with Q115 turning Q125 on hard, which in turn biases Q115 into heavy conduction. The heavy conduction of Q115 removes the charge accumulated on timing capacitor C115 and ends the cycle.

At the instant Q125 is turned on hard by Q115, the steep wave-front is coupled through R131 and C131 to the base of Q134, and thence to pulse transformer T131. The pulse output of T131 is in the order of 20 nanoseconds in width.

External Trigger Operation. When the Type 114 is operating in the externally triggered mode, the Pulse Generator functions as a pulse shaper. Period switch SW120 disconnects the base of Q115 from the collector of Q125 and reconnects it to the external trigger input circuit. SW120 also connects the base of Q125 to +25 volts through R121 and disconnects the timing capacitor from the circuit. Under these conditions none of the transistors in the Period Generator are conducting. A positive pulse of 2 to 20 volts in amplitude and having a risetime of 1 microsecond or less is required at the EXTERNAL TRIGGER—INPUT connector

in order to make the transistors conduct and deliver the proper pulse to the Width Generator.

When a pulse having the proper amplitude and risetime is applied to the EXTERNAL TRIGGER—INPUT connector, Q115 is biased into conduction and in turn biases Q125 and Q134 into conduction. The resulting pulse at the primary of T131 has a risetime of about 10 nanoseconds.

Width Generator

The Width Generator receives the trigger pulses from T131 and generates pulses of the desired width. The output of the width generator is applied to the Trigger Out Circuit and to the Output Amplifier. Except when operating in the square wave mode, the Width Generator operates as a monostable multivibrator; in the square wave mode the Width Generator functions as a bistable.

Normal Operation. In normal operation transistors Q205 and Q215 form a bistable network whose output drives ramp transistor Q224, trigger output transistor Q234, and the output amplifier. Q205 is the normally "on" transistor. The arrival of a negative trigger pulse from T131 cuts off Q205. Q215 now conducts and cuts off Q224, permitting the voltage at the collector of Q224 to start charging ramp capacitor C195. When the selected ramp capacitor reaches the desired voltage, D193 is forward biased and transistor Q194 is biased into conduction. The conduction of Q194 increases the conduction of Q184 and thereby biases Q205 back into conduction. The conduction of Q205 ends the output pulse. Turning on Q205 turns off Q215 and turns on Q224. The conduction of Q224 discharges the ramp capacitor.

When the ramp capacitor is discharged down to about 0.3 volt, Q174 turns off and Q164 is turned on. Transistors Q164 and Q174, diodes D136 and D161, and pulse transformer T131 function as a pulse steering circuit. With Q164 on, the pulse from the Period Generator via T131 triggers the width monostable circuit on, generating an output pulse. As soon as the ramp capacitor reaches approximately 0.3 volt, Q174 conducts and turns Q164 off. Turning off Q164 reverse biases D161, while turning on Q174 biases D136 near zero. If the Period Generator produces a pulse while these conditions exist, that is, whenever the ramp capacitor has a charge above approximately 0.3 volt, the pulse is steered to the WIDTH > PERIOD light circuit. This monostable circuit is actuated by the pulse from T131, turning off Q145 and turning Q155 on, lighting the WIDTH > PERIOD light. Turning on Q155 causes C155 to discharge through T131 and R136. When C155 is discharged, D141 and Q145 conduct and reset the circuit, making it ready for another pulse.

Square Wave Mode. When the Type 114 is operated in the Square Wave Mode (see Fig. 3-2), the Width Generator operates as a bistable and requires two trigger pulses from the Period Generator for each cycle of operation. Consequently, the RC network in the Period Generator is

Circuit Description—Type 114

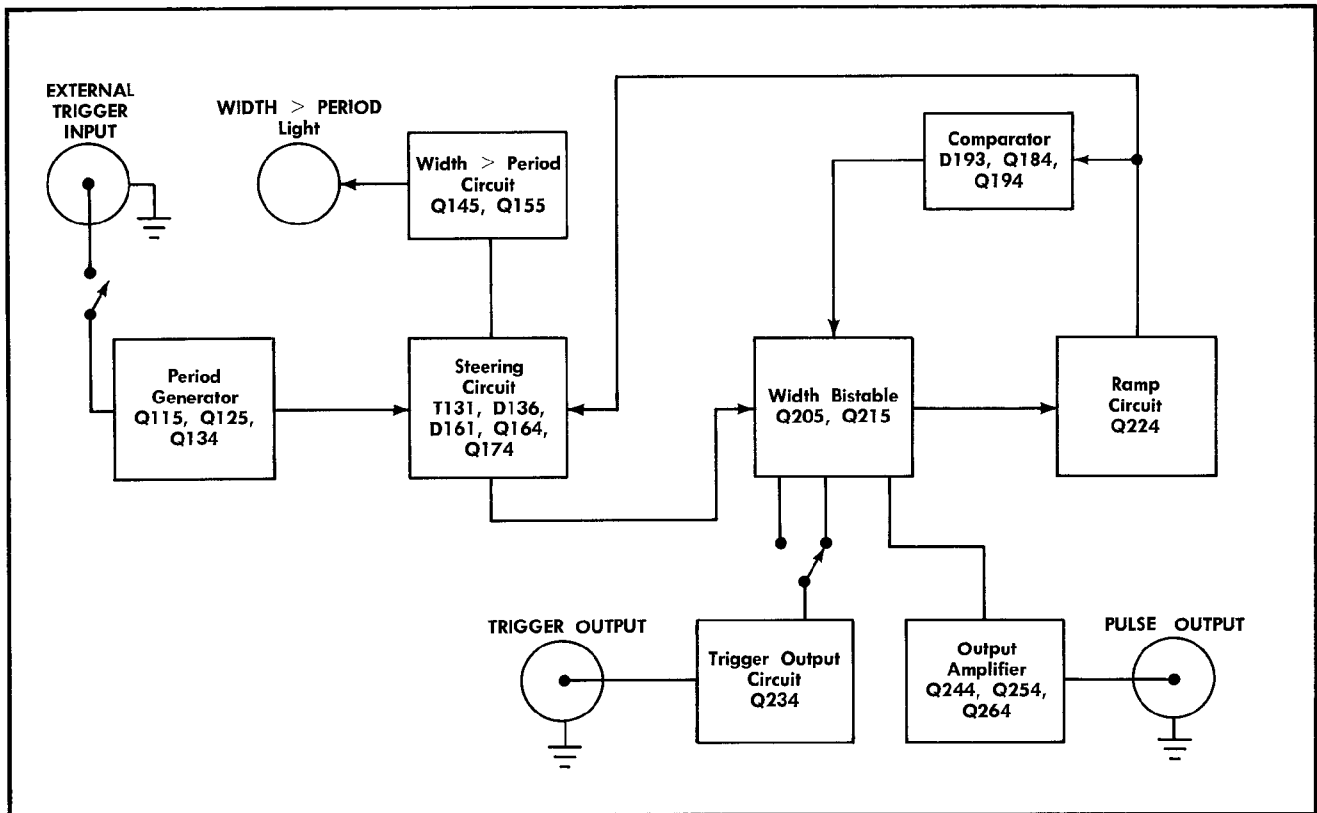


Fig. 3-1. Type 114 block configuration for pulse output.

reduced to half its normal value so that the Period Generator can deliver twice the usual number of output pulses. This procedure ensures that the period indicated by the PERIOD switch remains valid for square-wave operation. (When external triggering is used, the period of the square wave is twice that of the triggering signal, since the Width Generator is functioning as a bistable and requires two pulses for each cycle of operation.)

In the Width Generator, the ramp circuit is disabled by D196, which means that the comparator consisting of D193, Q194, and Q184 is not used. Resetting of the width bistable is accomplished by applying the output of WIDTH > PERIOD light driver transistor Q155 to the base of Q125.

At the instant of turn on when operating in the square-wave mode, D177 reverse biases and Q174 is biased on. Q174 turns off Q164 and zero biases steering diode D136. Under these conditions, the first pulse from the Period Generator forward biases D136 and turns off Q145. Turning off Q145 turns on Q155, which in turn cuts off Q215 and makes Q205 the conducting transistor in the bistable. Turning off Q215 also biases Q224 into conduction which switches the steering circuit so that D161 becomes zero biased. The second pulse from the Period Generator is steered to Q205, switching the bistable and the steering circuit. Thus the output of the bistable is a symmetrical square wave.

Trigger Output Circuit

Trigger output transistor Q234 normally operates in saturation due to the current through R232. Whenever the sig-

nal selected by the TRIGGER switch goes negative, the voltage change is coupled through C231 to the base of Q234 and momentarily takes it out of saturation. When this happens, the collector voltage of Q234 rises sharply until it reaches $\approx 3\frac{1}{2}$ volts and forward biases catcher diode D236. The resulting trigger output through C236 is about 80 nanoseconds wide and is limited to $\approx +3$ volts into an open circuit, or to 10 ma into a short circuit.

The TRIGGER switch permits selecting the edge of the output waveform at which the trigger occurs. By setting the switch to TRAILING EDGE, the Type 114 may be used as a delay generator with the WIDTH controls setting the amount of delay.

Output Amplifier

The two-stage output amplifier consists of driver transistor Q244 and the parallel-connected output transistors Q254 and Q264. When negative output pulses are desired, the output transistors are connected common emitter and the +25-volt supply is connected to chassis ground displacing the circuit board common ground 25 volts negative. When positive output pulses are desired, the output transistors are connected as an emitter follower and the common point is connected to chassis ground. Polarity switching of the output is accomplished by the AMPLITUDE switch.

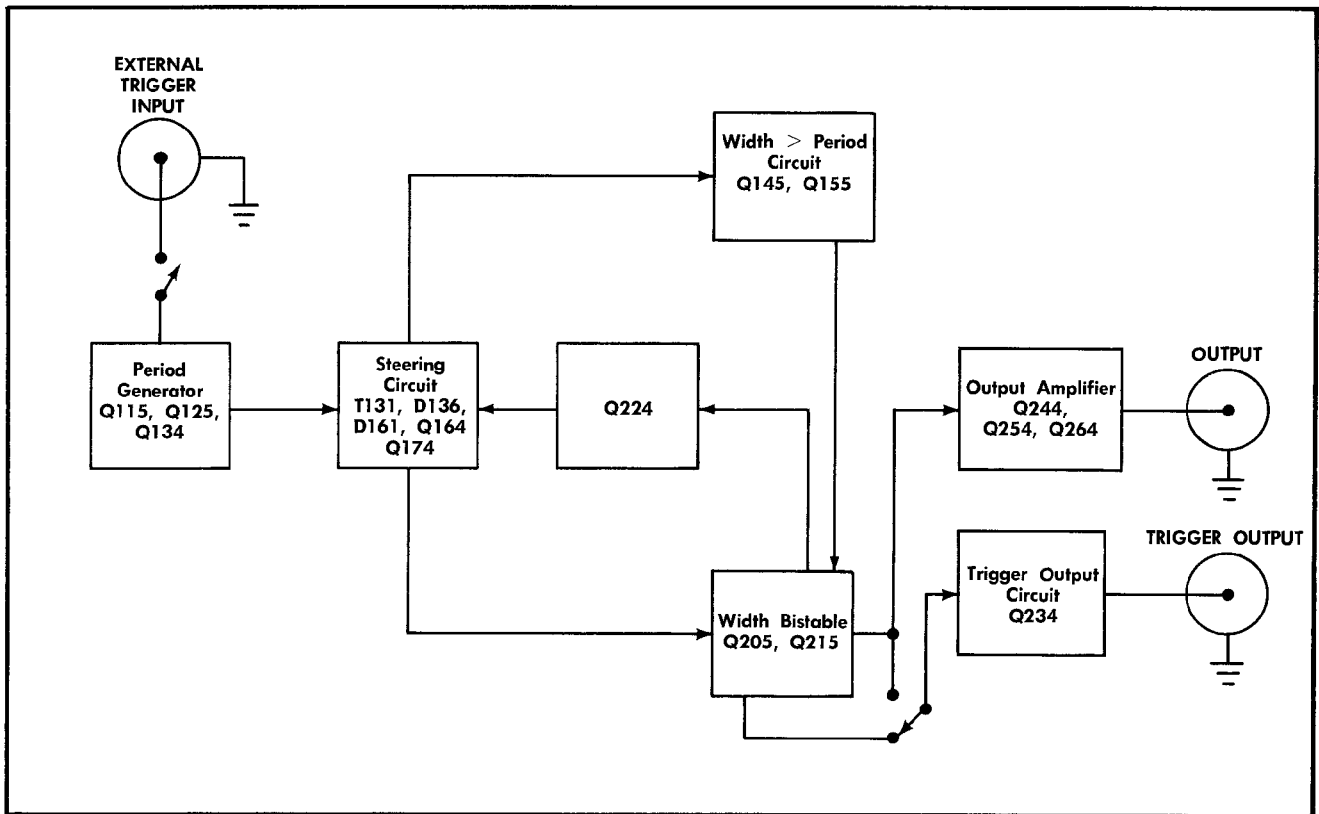


Fig. 3-2. Type 114 block configuration for square-wave output.

CAUTION

Do not connect test probe ground clips to the common point of the circuit board while the AMPLITUDE switch is in either of the negative positions. The best procedure is to always connect the test probe ground clip to the main chassis and leave the AMPLITUDE switch in the positive output positions.

The VARIABLE control associated with the AMPLITUDE

switch provides continuously variable voltage amplitude within the ranges of the AMPLITUDE switch.

Power Supply

The power supply consists of a regulated 25-volt supply and an unregulated 35-volt supply. The 25-volt supply and a 10-volt supply are stacked to obtain the 35-volt supply. A rear-panel switch is provided to change transformer primary connections when switching from 115- to 230-volt operation.

SECTION 4

MAINTENANCE AND CALIBRATION

Preventive Maintenance

Preventive maintenance consists of cleaning, visual inspection, lubrication, and if needed, recalibration. Preventive maintenance is generally more economical than corrective maintenance since preventive maintenance can usually be done during idle periods at a time convenient to the user. The preventive maintenance schedule established for the instrument should be based on the amount of use and the environment in which the instrument is used.

Cleaning. Clean the instrument often enough to prevent accumulation of dirt. Dirt on the components acts as an insulating blanket (preventing efficient heat dissipation) and may provide conducting paths.

Clean the instrument by loosening the accumulated dust with a dry, soft paint brush. Remove the loosened dust by vacuum and/or dry, low pressure compressed air (high velocity air can damage certain components). Hardened dirt and grease may be removed with a cotton-tipped swab or a soft cloth dampened with water and a mild detergent solution (such as Kelite or Spray White). Abrasive cleaners should not be used.

CAUTION

Do not permit water to get inside controls or shaft bushings.

Lubrication. The life of potentiometers and rotary switches is lengthened if these devices are kept properly lubricated. Use a cleaning type lubricant (such as Cramoline) on shaft bushings and switch contacts. Lubricate the switch detents with a heavier grease (Beacon grease No. 325 or equivalent). Do not over-lubricate. The necessary materials and instructions for proper lubrication of Tektronix instruments are contained in a component lubrication kit which may be ordered from Tektronix. Order Tektronix Part No. 003-342.

Visual Inspection. After cleaning, the instrument should be carefully inspected for such defects as poor connections, damaged parts, and improperly seated transistors. The remedy for most visible defects is obvious; however, if heat-damaged parts are discovered, determine the cause of overheating before the damaged parts are replaced. Otherwise, the damage may be repeated.

Transistor Checks. Periodic preventive maintenance checks consisting only of removing the transistors from the instrument and testing them in a tester are not recommended. The circuits within the instrument provide the most satisfactory means of checking transistor performance. Performance of the circuits is thoroughly checked during calibration so that substandard transistors will be detected at this time. Check suspect transistors by substitution. Be sure the substituted transistor is the same type as the one replaced, and that the substitute itself is good. If the original transistor is found to be good, return it to the same socket from which removed.

Recalibration. Instrument accuracy is ensured if the calibration of the Type 114 is checked after every 500 hours of operation (every six months if the instrument is used intermittently). Complete recalibration instructions are contained later in this section.

The calibration procedure is helpful in isolating major troubles in the instrument. Moreover, minor troubles not apparent during regular operation may be revealed and corrected during recalibration.

Corrective Maintenance

General Troubleshooting. If the instrument is not operating, attempt to isolate the trouble by a quick operational and visual check. Make sure that any apparent trouble is actually due to a malfunction within the Type 114 and not due to improper control settings or a fault in associated equipment.

Operate the front-panel controls to see what effect, if any, they have on the trouble symptoms. The normal or abnormal operation of each particular control helps in establishing the nature of the trouble. The normal function of each control is listed in Section 2 of this manual.

If the trouble cannot be located by means of front-panel checks, remove the instrument from its case and check voltages and waveforms against those shown on the schematics in Section 5, starting with the power supply connections. Once the trouble is isolated to a particular circuit, refer to the circuit description in Section 3 for an explanation of how the circuit normally operates.

CAUTION

Be careful when making measurements on live circuits. The small size and high density of components used in this instrument result in close spacing. An inadvertent movement of the test probes, or the use of oversized probes, may short between circuits.

Helpful Hints:

1. Check the voltage between chassis ground and the top end of R244 (333 Ω 10 watt resistor mounted at the top-right-rear of the chassis). With normal line voltage, the voltage at the top of R244 should read 31 to 35 volts if the AMPLITUDE switch is set to +; 6 to 10 volts if the switch is set to —.

2. Set the AMPLITUDE switch to + and turn off the power. Using an ohmmeter, check the resistance from the top end of R244 to chassis ground. If there is no charge on the filter capacitors, the resistance reading should be about 800 Ω to 2 k. If it is not, reverse the meter leads and recheck.

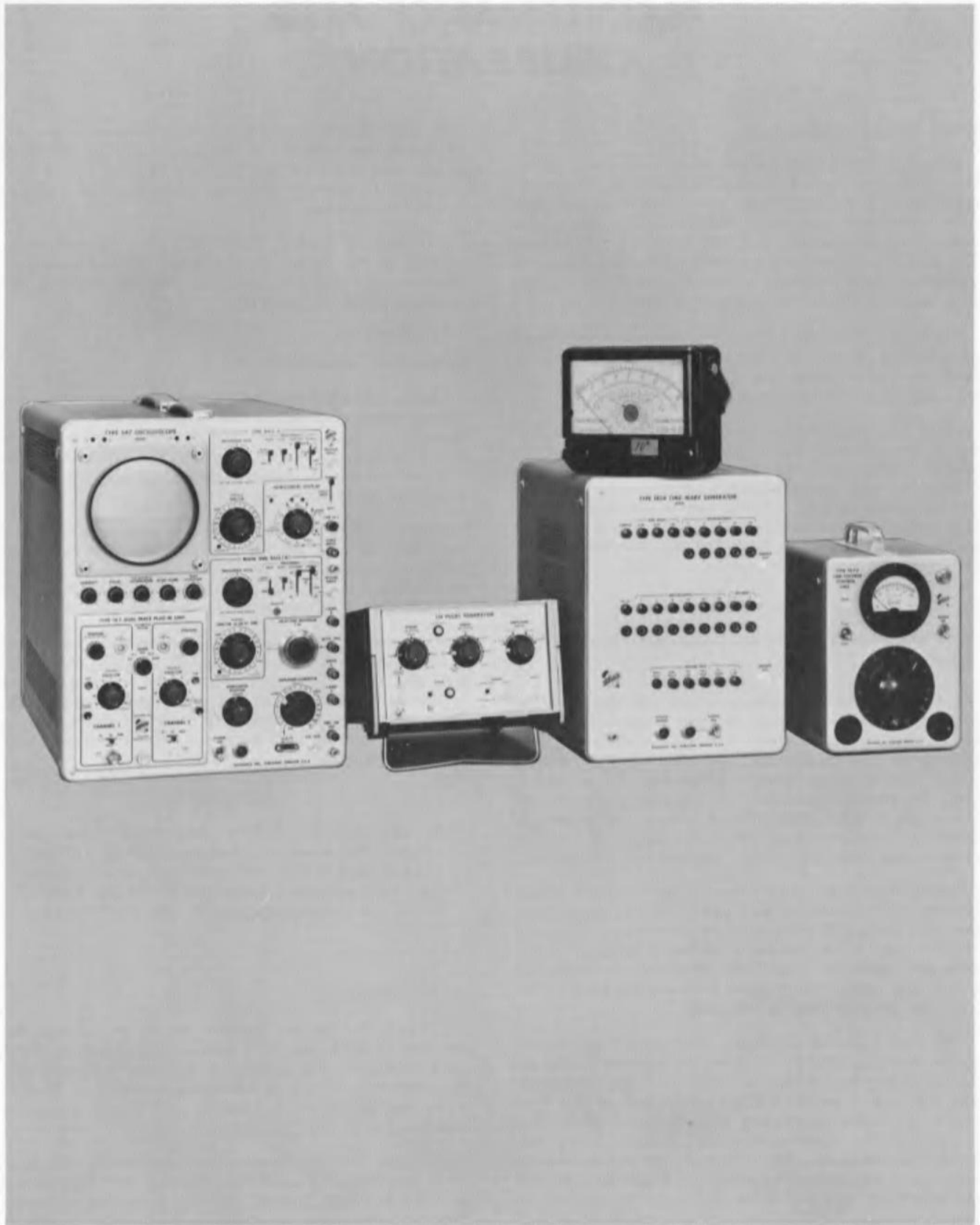


Fig. 4-1. Equipment necessary for recalibrating the Type 114.

3. If the voltage and resistance measurements taken in the preceding steps are normal, use an oscilloscope to check the waveforms at the points shown on the schematics in Section 5. Checking the waveforms will help in isolating the trouble to a particular circuit. Once the trouble is isolated to a particular circuit, take voltage and resistance measurements until the defective component is identified.

Component Identification. The circuit number of each electrical part is shown on the circuit diagrams in Section 5. Note that a functional group of circuits (such as the power supply) is assigned a particular series of numbers. Switch wafers are identified by counting from the first wafer located behind the detent section of the switch towards the last wafer. The letters F and R indicate whether the front or rear of the wafer is used to perform the particular switching function. For example, the designation 2R printed by a switch section on a schematic identifies the switch section as being on the rear side of the second wafer when counting back from the detent section.

Parts Replacement. Most of the electronic components in the Type 114 are standard items available locally. The remainder of the electronic components and most of the mechanical parts are manufactured or selected by Tektronix to satisfy particular requirements, or are manufactured for Tektronix to our specifications. However, all parts are obtainable through your Tektronix Field Engineer or Field Office. Before purchasing or ordering, consult the Parts List (Section 5) to determine the value, tolerance, and ratings required. See "Parts Ordering Information" and "Special Notes and Symbols" on the first page of Section 5.

When selecting the replacement parts, it is important to remember that the physical size and shape of a component may affect its performance in the circuit. Parts orientation and lead dress should duplicate those of the original part, since many of the components are mounted in a particular way to reduce or control stray capacitance and inductance. After repair, portions of the instrument may require recalibration.

Replacing Components on Etched-Circuit Boards. Use ordinary electronic grade 60/40 solder and a 35- to 40-watt pencil soldering iron with a $\frac{1}{8}$ " wide chisel tip. The tip of the iron should be clean and properly tinned for best heat transfer in a short time to a soldered connection. A higher wattage soldering iron, if used and applied for too long a time, ruins the bond between the etched wiring and base material by charring the glass epoxy laminate.

The step-by-step technique is as follows:

1. Remove the component by cutting the leads near the body. This frees the leads for individual unsoldering.

2. Grip the lead with needle-nose pliers. Apply the tinned tip of a 40-watt pencil soldering iron to the lead between the pliers and the board; then pull gently.

3. When the solder first begins to melt, the lead will come out, leaving a clean hole. If the hole is not clean, use the soldering iron and a toothpick or a piece of enamel wire to open the terminal hole. Do not attempt to drill the solder out since the "through-hole" plating might be destroyed.

4. Clean the leads on the new component and bend them to the correct shape. Carefully insert the leads into the holes from which the defective component was removed.

5. Apply the iron for a short time at each connection on the side of the board opposite the component to properly seat the component.

6. Apply the iron and a little solder to the connections to finish the solder joint.

Calibration and Verification

Recalibrate the Type 114 after each 500 hours of operation, or every six months if used intermittently. It may also be necessary to recalibrate certain sections of the instrument when transistors or other components are replaced. Before recalibrating the instrument, clean it as previously described.

Do not preset the internal adjustments as a preliminary to recalibration. Presetting internal adjustments makes it necessary to completely recalibrate the instrument.

The following portion of this manual presents a step-by-step calibration and verification procedure. The title of each numbered step begins either with "Adjust" or "Check", thereby identifying the step function as calibration or verification. The steps are identified in this manner because any or all groups of numbered "Checks" can be skipped without disrupting the continuity of the procedure. However, all adjustments must be completed in the order given and none should be skipped. Remember that proper overall operation is ensured only when all steps in the procedure have been completed and all adjustments have been made as accurately as possible.

NOTE

The performance standards described in this section of the manual are provided strictly as guides to calibration of the Type 114 and should not be construed as advertised performance specifications. However, if the Type 114 performs within the guide tolerances given in the calibration procedure, it will also perform as listed in the Characteristics section of this manual.

Equipment Required. (See Fig. 4-1.)

1. Oscilloscope, Tektronix Type 547/1A1 or equivalent.
2. Time mark generator, Tektronix Type 180A or equivalent.
3. Volt-Ohm-Milliammeter, 20,000 Ω per volt, Simpson Model 260 or equivalent.
4. Three 50 Ω coax cables with BNC connectors (Tektronix Part No. 012-057).
5. 50 Ω BNC termination (Tektronix Part No. 011-049).
6. Variable line voltage source such as a variable auto-transformer.

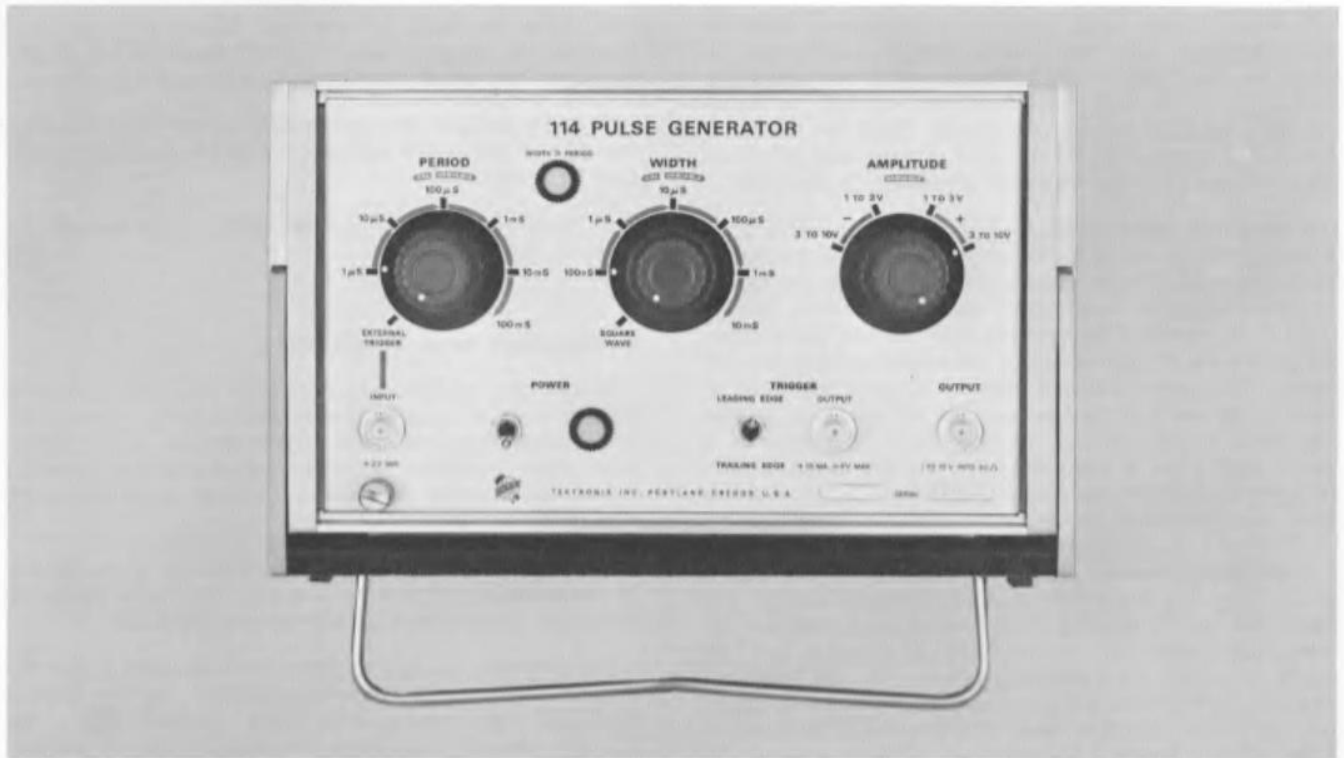


Fig. 4-2. Initial control settings for calibration.

Preliminary Procedure (no power applied)

1. Check the Type 114 front-panel controls for smooth mechanical operation, proper indexing, and knob spacing. Correct all defects found.
2. Remove the Type 114 from its cabinet and check for loose hardware.
3. Check to see that the proper fuse is installed (0.3a slo-blo for 115-volt operation, 0.15a slo-blo for 230-volt operation).
4. Set the Type 114 front-panel controls as shown in Fig. 4-2.
 - a. PERIOD 1 μs
VARIABLE CAL
 - b. WIDTH 100 nS
VARIABLE CAL
 - c. AMPLITUDE 3 to 10 V, + polarity
VARIABLE fully clockwise
 - d. POWER off
 - e. TRIGGER LEADING EDGE

5. Using the VOM, check the resistances between chassis ground and the points indicated in Table 4-1 (see Fig. 4-3).

TABLE 4-1

Circuit	Check Points	Approximate Resistance
T281 Primary	Terminals 1 thru 4	infinity
+25-volt supply	Outer shell of C298	1.5 K
+35-volt supply	C298 + terminal	2 K

Checks and Adjustments

NOTE

Control settings and test conditions for each step are the same as for the preceding step unless otherwise noted.

1. Adjust +25-volt supply

- a. Set all controls as shown in Fig. 4-2
- b. Install the 50 Ω termination (Tektronix Part No. 011-049) on the Type 1A1 Channel 1 input. Connect a 50 Ω coax cable between the Type 114 OUTPUT connector and the termination.
- c. Connect the Type 114 power cord to a variable line voltage source and set the input voltage to the Type 114 at 115 volts.
- d. Turn on the equipment and allow a 5 minute warm up before proceeding
- e. Slowly rotate the WIDTH—VARIABLE control clockwise until the WIDTH > PERIOD light is lit. Rotate the WIDTH—VARIABLE control counterclockwise to the point where the WIDTH > PERIOD light just extinguishes.
- f. Connect the VOM negative lead to chassis ground. Connect the positive lead to the outside shell of C298 (see Fig. 4-4).
- g. Adjust R290 (+25 VOLTS) until the meter reads +25 volts ±0.5 volt.

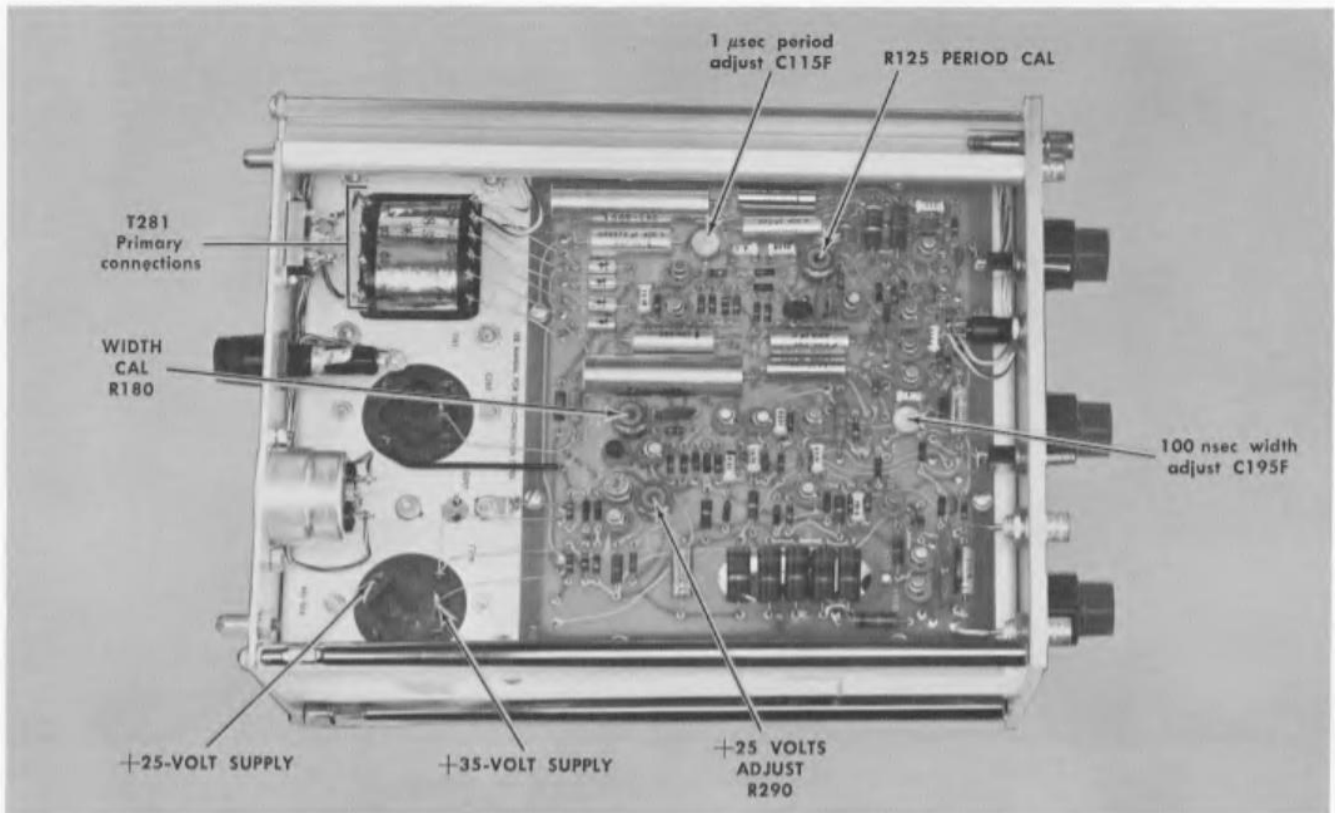


Fig. 4-3. Type 114 chassis, bottom view.

2. Check +35-volt unregulated supply

- Change the VOM positive lead to the positive terminal of C298.
- Check that the meter reads +33 volts ± 2 volts.

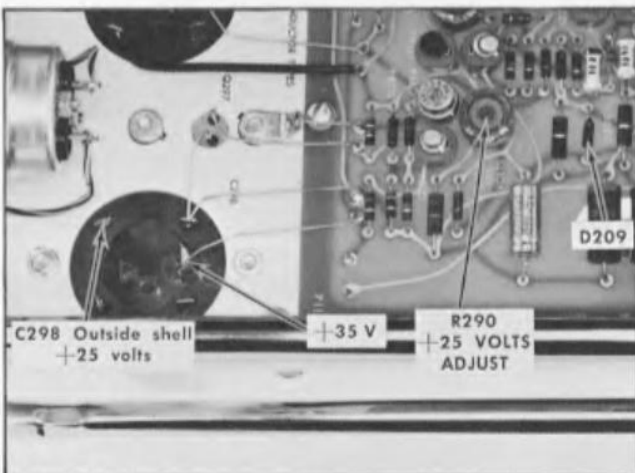


Fig. 4-4. +25 volt supply adjustment.

3. Check voltage across D209

- Change the VOM positive lead to the junction of D208, R209 and D209.

- Check that the meter reads +3 volts $\pm 1/2$ volt from the junction to chassis ground.

4. Check +25-volt supply regulation

- Change the VOM positive lead to the outside shell of C298. Check that the meter reads +25 volts ± 0.5 v.
- Using the variable line voltage source, vary the line voltage from 94.5 to 137.5 volts.
- Check that the VOM reading does not change more than 0.5 v while the line voltage is varied over the range specified.
- Return the variable line voltage source to 115 volts.

5. Check +25-volt supply for ripple

- Remove the VOM leads. Remove the 50 Ω termination from the Type 1A1 input but leave it connected to the coax cable.
- Connect a 1X probe to the Type 1A1 Channel 1 input.
- Set the test oscilloscope for line triggering. Using the 1X probe, check that the ripple on the outside shell of C298 does not exceed 10 millivolts. Check only for 60- or 120-cycle ripple; disregard the various transients noted.
- Set the variable line voltage for 94.5 volts and again check that the ripple does not exceed 10 millivolts.
- Return the variable line voltage source to 115 volts and remove the 1X probe from C298 and from the Type 1A1 Channel 1 input.

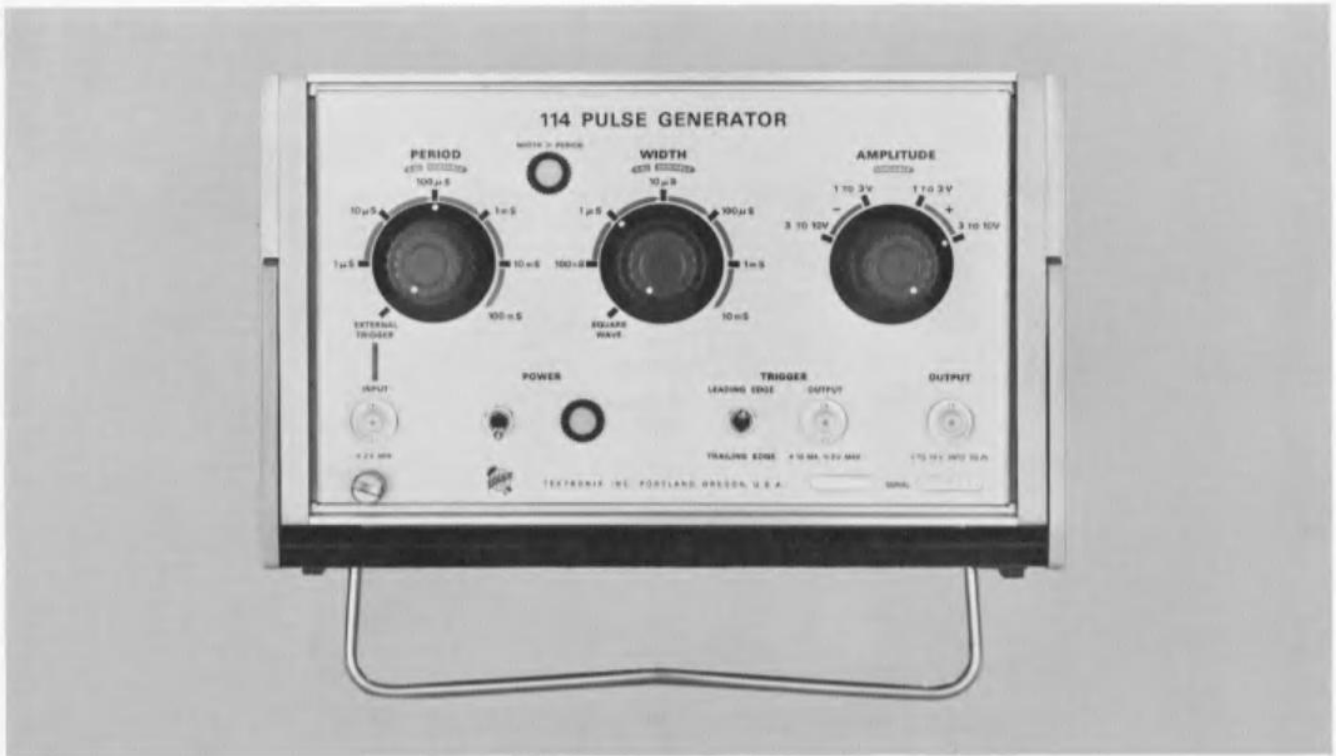


Fig. 4-5. Control settings for PERIOD CAL adjustment.

6. Adjust PERIOD CAL control R125

a. Set the Type 114 WIDTH — VARIABLE control to CAL. Turn the WIDTH control to $1 \mu\text{s}$ and the PERIOD control to $100 \mu\text{s}$ (see Fig. 4-5).

b. Reconnect the Type 114 OUTPUT to the Type 1A1 Channel 1 input through the 50Ω coax and the 50Ω termination.

c. Connect a 50Ω coax cable from the Type 180A MARKER OUT connector to the Type 1A1 Channel 2 input. Set the Type 180A for 100 microsecond markers.

d. Set the Type 1A1 Channel 2 VOLTS/CM switch to 2. Turn the MODE switch to CH 2. Pull out the Channel 2 PULL TO INVERT switch.

e. Set the Type 547 HORIZONTAL DISPLAY switch to B. Set the TIME/CM (B) switch to .1 mSEC. Set the TRIGGERING-SOURCE switch to INT-NORM, the SLOPE switch to —, and the MODE switch to TRIG. Adjust the TRIGGERING LEVEL control for a stable display of the 100 microsecond markers from the Type 180A.

f. Change the Type 1A1 MODE switch to ALT and the Channel 1 VOLTS/CM switch to 5. Using the Type 1A1 POSITION controls, position the display so that the peaks of the pulses from the Type 114 are vertically displaced about 1 mm below the peaks of the inverted pulses from the Type 180A on the other trace.

g. Adjust the PERIOD CAL control R125 (see Fig. 4-6) so that the corresponding pulses in the two traces are aligned horizontally to within $\frac{1}{2}\%$ (see Fig. 4-7).

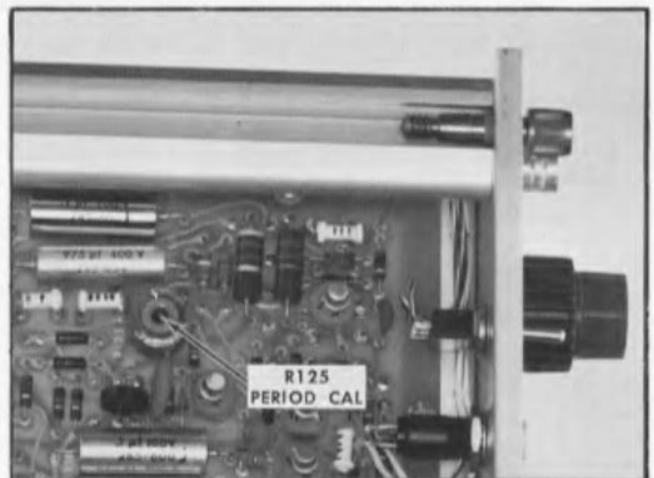


Fig. 4-6. Location of PERIOD CAL control R125.

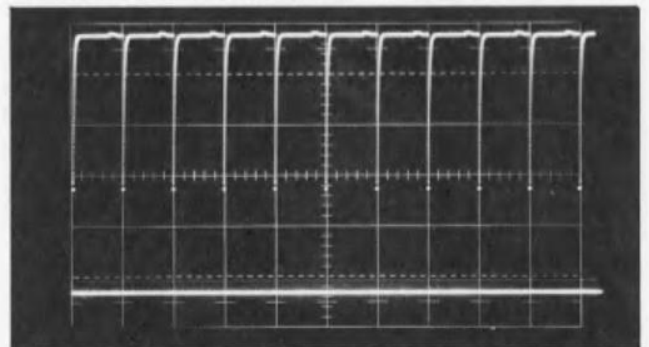


Fig. 4-7. Crt display showing correct adjustment of PERIOD CAL control.

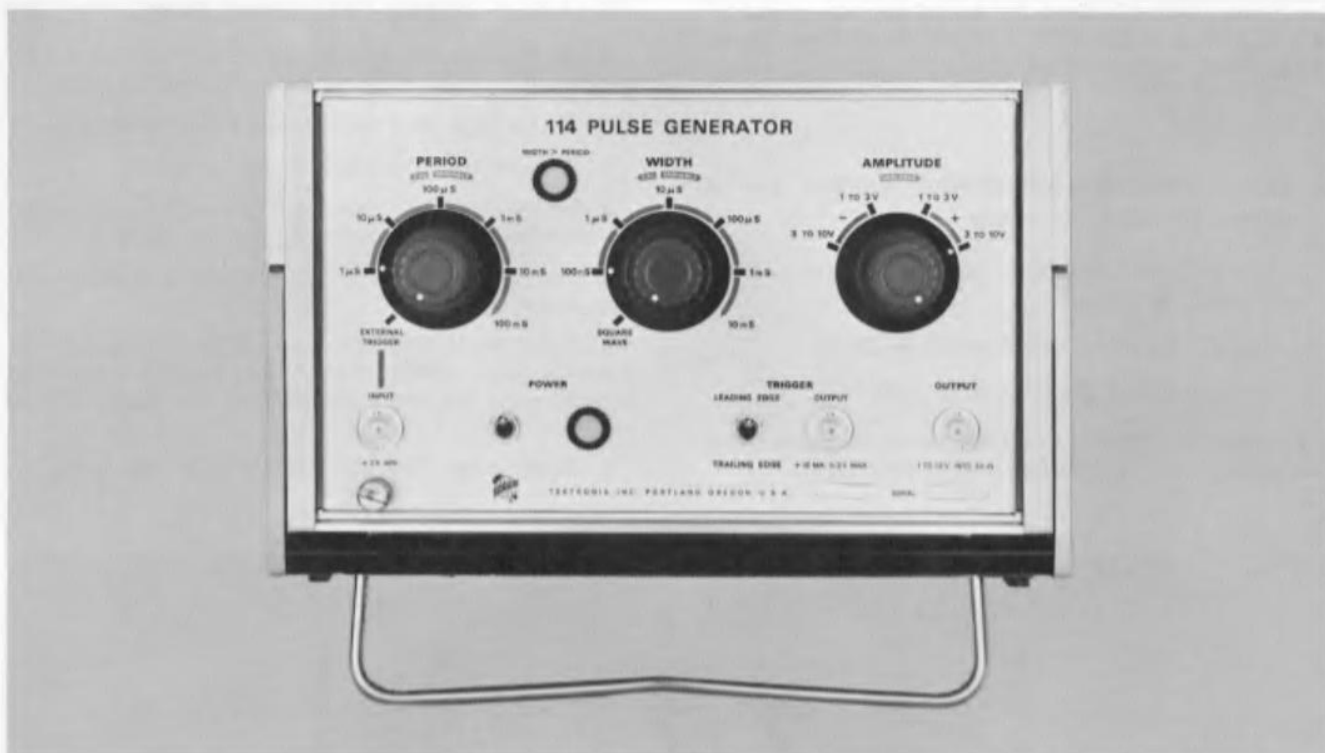


Fig. 4-8. Control settings for adjusting the 1 microsecond period capacitor.

7. Adjust 1 microsecond period capacitor C115F

a. Set the Type 114 PERIOD control to 1 μ S, the WIDTH control to 100 nS, and both PERIOD — and WIDTH — VARIABLE controls to CAL (see Fig. 4-8).

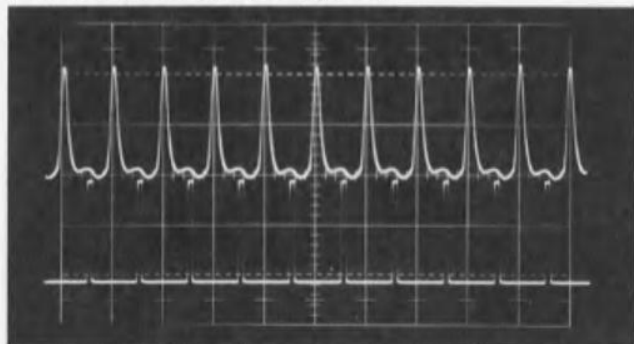


Fig. 4-9. Crt display showing correct adjustment of fast period capacitor C115F.

b. Set the Type 547 TIME/CM (B) switch to 1 μ SEC. Push in the PULL TO INVERT switch on Channel 2 of the Type 1A1.

c. Set the Type 180A to deliver 1 microsecond markers.

d. Using the Type 1A1 POSITION controls, put the peak of the first pulse from the Type 114 to some reference point on the first pulse from the Type 180A (see Fig. 4-9).

e. Adjust capacitor C115F (see Fig. 4-10) so that the peaks of the pulses from the Type 114 occur at the same point on each succeeding pulse from the Type 180A as shown in Fig. 4-9. Allowable error is 3%, but it is possible to adjust much closer than this.

8. Check period accuracy, 10 mS to 1 μ S

a. Set the Type 114 PERIOD control to 10 mS and the WIDTH control to 10 μ S.



Fig. 4-10. Location of 1 microsecond period capacitor C115F.

b. Turn the Type 1A1 MODE switch to ALT and pull out the Channel 2 PULL TO INVERT switch.

c. Set the Type 180A to deliver 10 millisecond markers.

d. Set the Type 547 TIME/CM (B) switch to 10 mSEC and adjust the TRIGGERING LEVEL control for a stable display.

e. Check for horizontal alignment between the two sets of markers (see Fig. 4-7). Horizontal alignment should be within 3%.

Maintenance and Calibration—Type 114

f. Using Table 4-2, check the period accuracy of the remaining settings of the PERIOD switch. In all cases the accuracy should be as specified.

9. Check PERIOD — VARIABLE control for a range of 10:1 or more

- Set the Type 114 PERIOD control to 10 mS and the WIDTH control to 100 μ S.
- Turn the Type 1A1 MODE switch to CH 1.
- Set the Type 547 TIME/CM (B) to .1 SEC.
- Rotate the PERIOD—VARIABLE control clockwise. Check that a display of 1 marker/cm is obtainable (10:1).

10. Adjust WIDTH CAL control R180

- Set the Type 114 PERIOD and WIDTH controls to 1 mS and turn both VARIABLE controls to CAL (see Fig. 4-11).
- Set the Type 180A for 100 microsecond markers.
- Turn the Type 1A1 MODE switch to ALT.
- Set the Type 547 TIME/CM (B) to .2 mSEC and adjust the TRIGGERING LEVEL control for a stable display.
- Use the Type 1A1 POSITION controls to obtain the display shown in Fig. 4-12.
- Adjust the WIDTH CAL control R180 (see Fig. 4-13) for a positive pulse width of 1 millisecond (ten 100 microsecond periods) using the time markers from the Type 180A as reference.
- Check to see that WIDTH > PERIOD light is on.

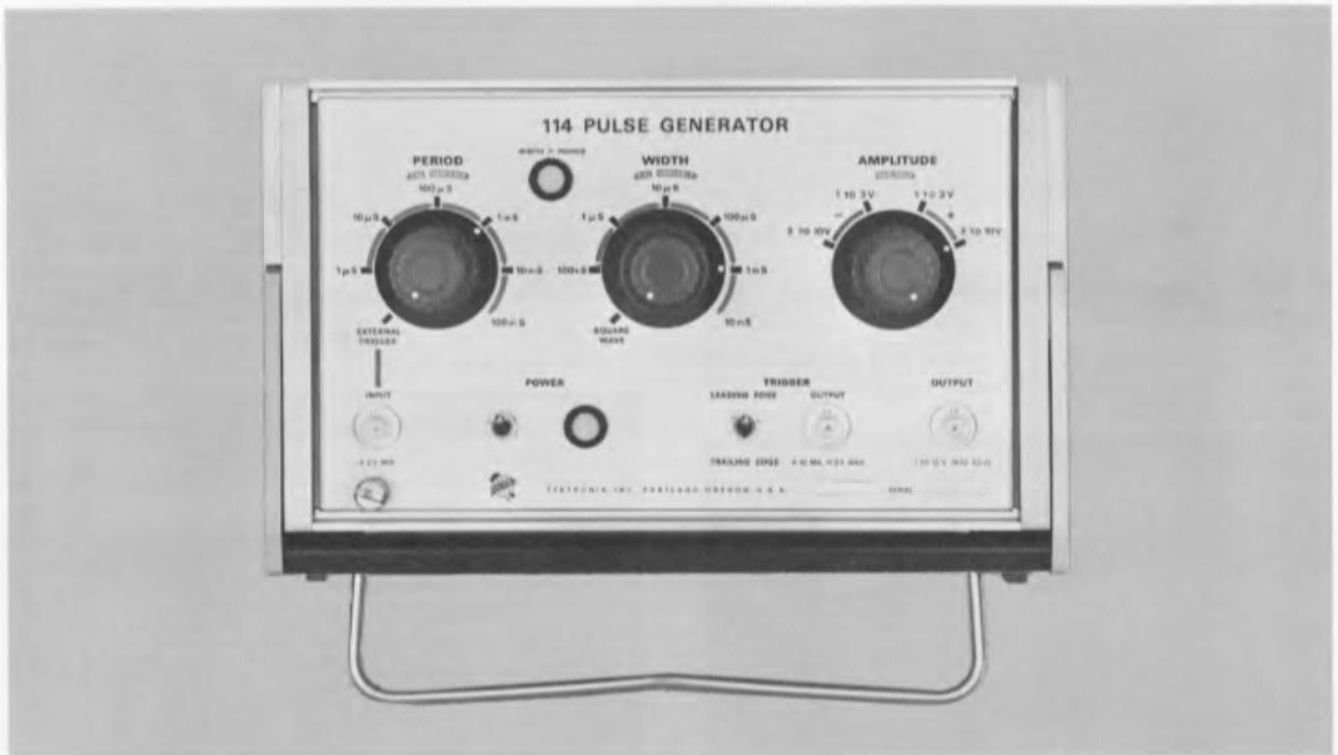


Fig. 4-11. Control settings for adjusting WIDTH CAL control R180.

TABLE 4-2

Type 114 PERIOD	Type 114 WIDTH	Type 547 TIME/CM (B)	Type 180A Markers	Error
10 mS	10 μ S	10 mSEC	10 milliseconds	$\pm 3\%$
1 mS	10 μ S	1 mSEC	1 millisecond	$\pm 3\%$
100 μ S	1 μ S	.1 mSEC	100 microseconds	Adjusted to $< 1/2\%$
10 μ S	100 nS	10 μ SEC	10 microseconds	$\pm 3\%$
1 μ S	100 nS	1 μ SEC	1 microsecond	Adjusted to $< 3\%$

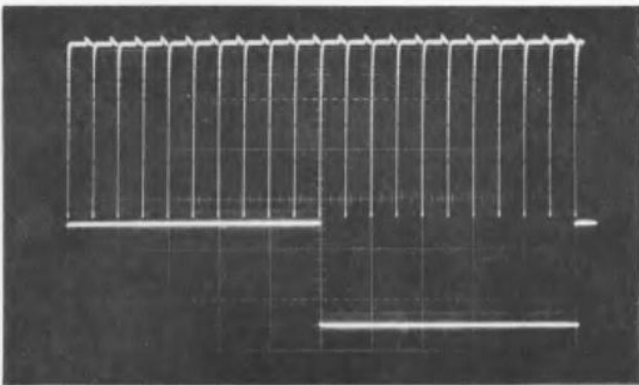


Fig. 4-12. Crt display showing correct adjustment of WIDTH CAL control R180.

11. Adjust 100 nS Pulse Width capacitor C195F

- Set the Type 114 WIDTH switch to 100 nS, set the PERIOD switch to 1 μ S (see Fig. 4-14).
- Set the Type 547 TIME/CM (B) to .1 μ SEC.
- Set the Type 1A1 Channel 1 VOLTS/CM switch to 2. Rotate the Type 114 AMPLITUDE—VARIABLE and the Type 1A1 Channel 1 POSITION controls for 5 cm of pulse amplitude. Center the pulse vertically on the graticule. Set the Type 547 TRIGGERING LEVEL control for stable triggering.
- Set the Type 180A to deliver 10 mc sine-wave output.
- Use the Type 1A1 Channel 2 POSITION control to position the top of the sine waves from the Type 180A to the graticule centerline.

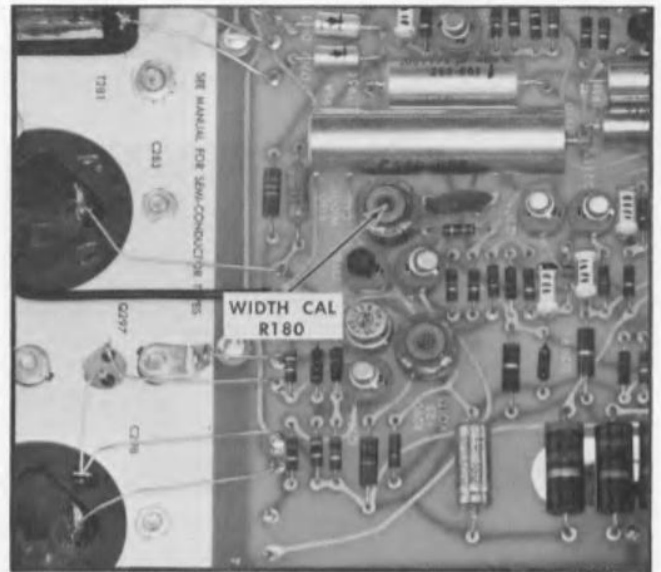


Fig. 4-13. Location of WIDTH CAL control R180.

- Set the SWEEP MAGNIFIER control to X5. Use the HORIZONTAL POSITION and TRIGGERING LEVEL controls to obtain the display shown in Fig. 4-15.

NOTE

At 100 nanosecond pulse widths, the risetime and falltime of the pulse becomes a significant portion of the pulse width, therefore the pulse width measurement is made at the 50% amplitude points.

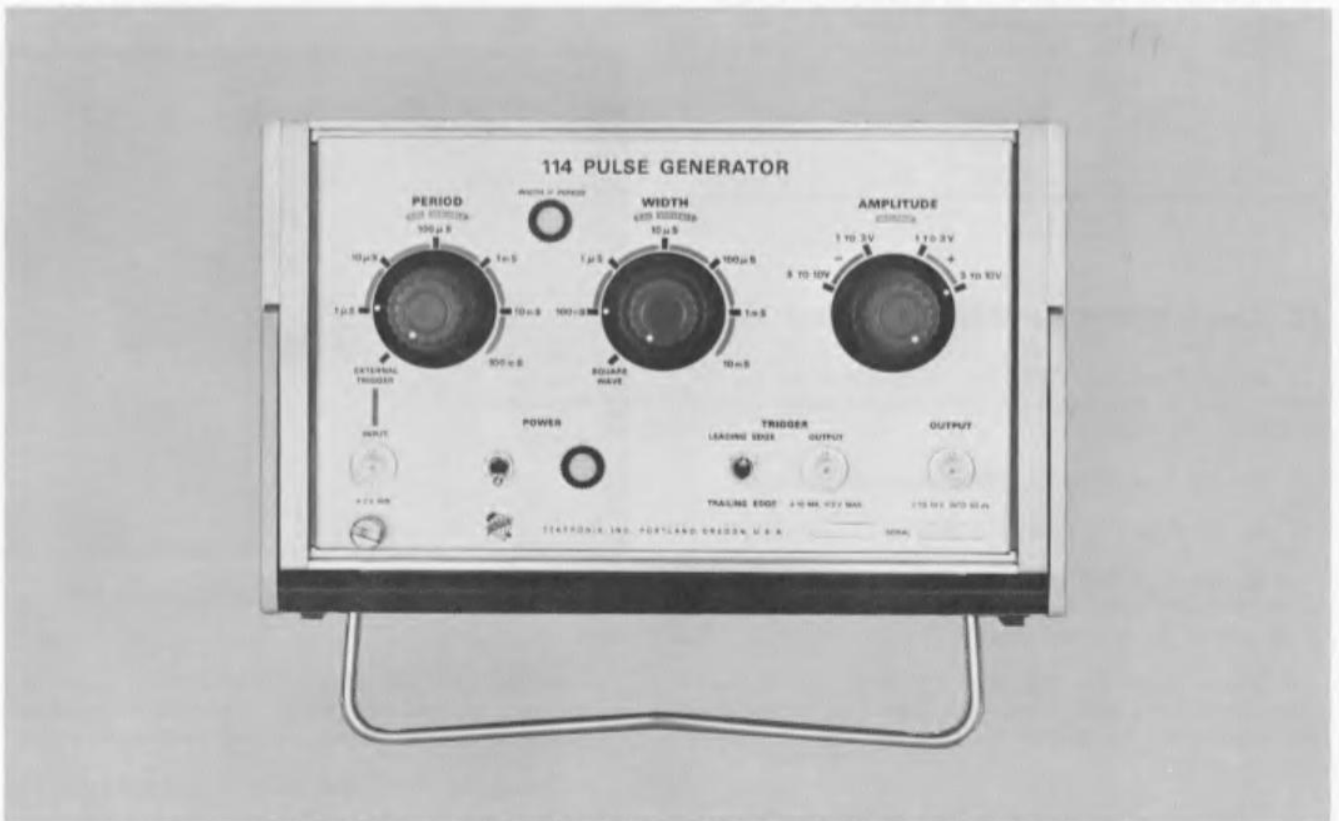


Fig. 4-14. Control settings for adjusting 100 nS Pulse Width capacitor C195F.

Maintenance and Calibration—Type 114

g. Adjust C195F (see Fig. 4-16) for 100 nanoseconds pulse width. Allowable error is $\pm 3\%$, however, it is possible to adjust more closely than this.

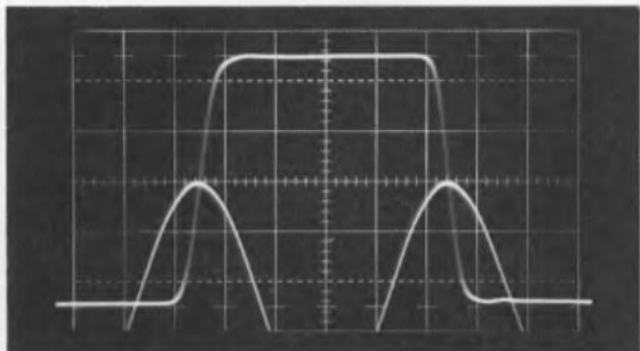


Fig. 4-15. Crt display for proper setting of 100 nS Pulse Width capacitor C195F.

12. Check pulse width accuracy

Using the settings given in Table 4-3, check the pulse width accuracy in the other settings of the WIDTH control.

TABLE 4-3

Type 114 PERIOD	Type 114 WIDTH	Type 547 TIME/CM	Type 180A Time Markers	Number of Markers
1 mS	1 mS	.2 mSEC	100 μ SEC	10
1 mS	100 μ S	20 μ SEC	10 μ SEC	10
100 μ S	10 μ S	2 μ SEC	1 μ SEC	10
10 μ S	1 μ S	.2 μ SEC	10 mc	10 cycles

13. Check WIDTH — VARIABLE control range

a. Set the Type 114 WIDTH control to 100 μ S, set the PERIOD control to 10 mS and the PERIOD — VARIABLE control to CAL.

b. Set the Type 180A for 100 microsecond markers.

c. Set the Type 1A1 Channel 1 VOLTS/CM switch to 5.

d. Set the Type 547 TIME/CM (B) to .2 mSEC, the TRIGGERING SLOPE switch to +, and adjust the TRIGGERING LEVEL control for a stable display.

e. Slowly rotate the WIDTH — VARIABLE control clockwise. Check for a pulse width of at least 1 millisecond (ten 100 microsecond markers) at the clockwise end of rotation (see Fig. 4-12).

f. Return the WIDTH — VARIABLE control to the CAL position.

14. Check operation in square-wave mode

a. Set the Type 114 WIDTH control to SQUARE WAVE.

b. Using Table 4-4 check square-wave operation for all positions of the PERIOD control. Allowable period error is 4 mm within the center 8 cm of the trace.

TABLE 4-4

Type 114 PERIOD	Type 547 TIME/CM (B)	Cycles/8 cm
10 mS	10 mSEC	8
1 mS	1 mSEC	8
100 μ S	.1 mSEC	8
10 μ S	10 μ SEC	8
1 μ S	1 μ SEC	8

15. Check output amplitude (into the 50 Ω termination)

a. Turn the Type 114 AMPLITUDE — VARIABLE control slowly counterclockwise, checking for smooth mechanical and electrical operation.

b. Set the Type 1A1 Channel 1 VOLTS/CM switch to 1 and check for 3 cm or less of vertical deflection when the AMPLITUDE — VARIABLE control is fully counterclockwise.

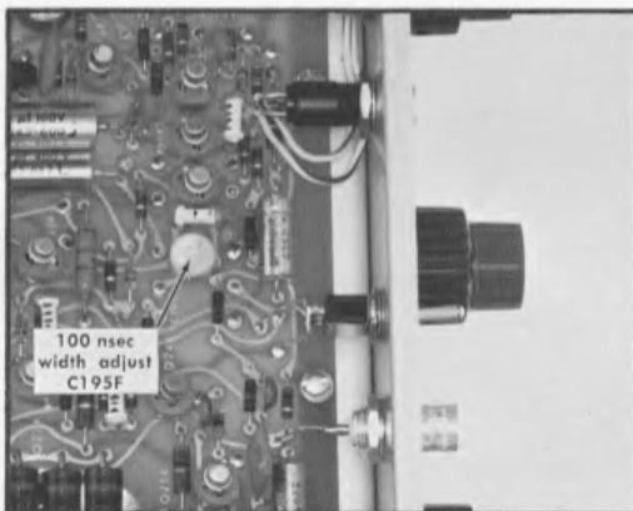


Fig. 4-16. Location of 100 nS Pulse Width capacitor C195F.

c. Set the Type 1A1 Channel 1 VOLTS/CM switch to 2. Rotate the Type 114 AMPLITUDE — VARIABLE control fully clockwise. Check for 5 cm or more of vertical deflection.

d. Change the AMPLITUDE switch to -3 to 10 V and repeat the amplitude check. Check both the + and - 1 V to 3 V positions of the AMPLITUDE switch.

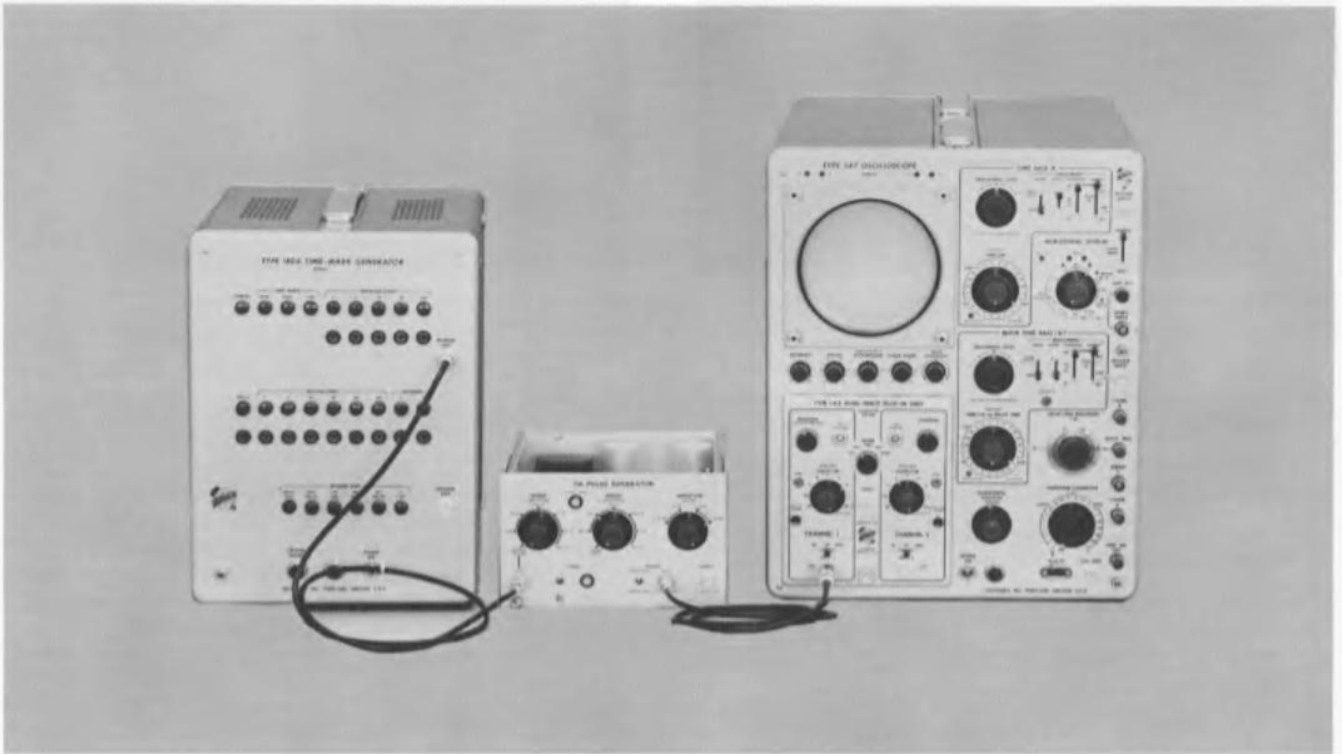


Fig. 4-17. Test setup for checking external triggering.

16. Check external triggering and trigger output operation

a. Set the Type 114 PERIOD control to $1 \mu\text{S}$, set the WIDTH control to 100 nS and set the VARIABLE controls to CAL.

b. Connect a 50Ω coax from the Type 180A MARKER OUT connector to the Type 114 EXTERNAL TRIGGER — INPUT connector. Set the Type 180A for 1 microsecond markers.

c. Connect a 50Ω coax from the Type 114 TRIGGER OUTPUT connector to the Type 1A1 Channel 1 input (see Fig. 4-17). Set the Type 1A1 MODE switch to CH 1. Set the Type 1A1 Channel 1 VOLTS/CM switch to 1.

d. Set the Type 547 TIME/CM (B) switch to $1 \mu\text{SEC}$ and adjust the TRIGGER LEVEL control for a stable display. Check for 1 pulse/cm of 3 volts amplitude ± 1 volt.

e. Insert the 50Ω termination between the coax and the Type 1A1 Channel 1 input connector. Change the Channel 1 VOLTS/CM switch to .2. The amplitude of the trigger pulse from the Type 114 should now be between 0.4 and 0.7 volt as measured on the crt.

f. Switch the Type 114 TRIGGER switch back and forth between LEADING EDGE and TRAILING EDGE. The display on the crt should flicker slightly and show minor differences between the leading edge and trailing edge trigger pulses.

g. Turn the Type 114 PERIOD control to EXTERNAL TRIG-

GER and note that the display remains the same. Return the PERIOD control to $1 \mu\text{S}$.

17. Check pulse risetime, falltime, and aberrations

a. Set the Type 547 TIME/CM (B) switch to $.2 \mu\text{SEC}$. Set the Type 1A1 VOLTS/CM switch to 2.

b. Remove the 50Ω coax from the Type 114 TRIGGER OUTPUT connector and connect it to the OUTPUT connector. Check to see that the 50Ω termination is between the 50Ω coax and the Type 1A1 Channel 1 input connector. Set the Type 114 AMPLITUDE control for maximum positive output.

c. Obtain stable triggering and adjust the AMPLITUDE — VARIABLE control for 5 cm of vertical deflection.

d. Rotate the Type 114 WIDTH — VARIABLE control for 2 complete cycles in the 10 cm of the graticule (see Fig. 4-18).

e. Check that the aberrations, such as those shown in Fig. 4-18 do not exceed 5% peak-to-peak ($2\frac{1}{2} \text{ mm}$ or $1\frac{1}{4}$ minor graticule division).

f. Change the AMPLITUDE switch to -3 to 10 V and repeat the aberration check.

g. Change the AMPLITUDE switch back to $+3$ to 10 V . Change the Type 547 TIME/CM (B) switch to $.1 \mu\text{SEC}$ and obtain a stable display.

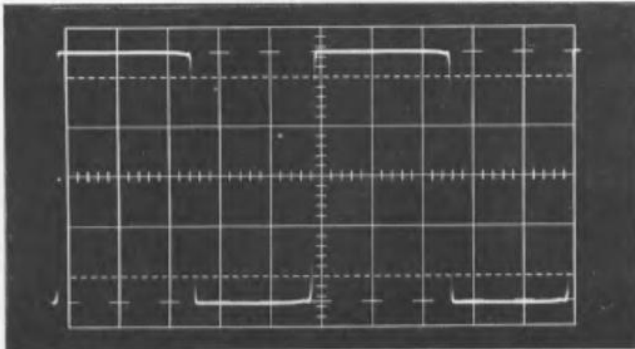


Fig. 4-18. Crt display of pulse aberrations.

h. Using the HORIZONTAL POSITION and VERNIER controls, position the leading edge of the pulse to the center of the graticule.

i. Turn the SWEEP MAGNIFIER to X10. This gives an equivalent time/cm of 10 nanoseconds.

j. Measure the risetime between the 10% and 90% points on the waveform (see Fig. 4-19).

k. Using the HORIZONTAL POSITION and VERNIER controls, position the trailing edge of the pulse to the center of the graticule and measure the falltime.

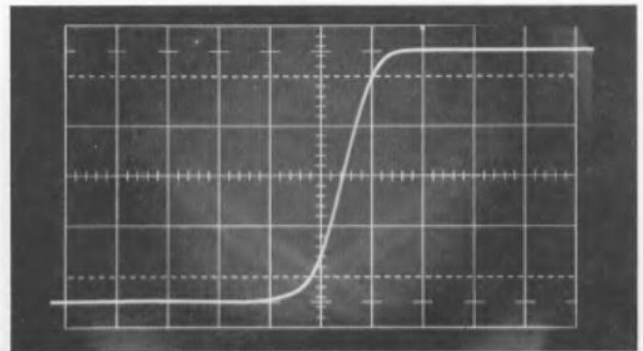


Fig. 4-19. Crt display for risetime measurement.

l. Set the AMPLITUDE switch to -3 to 10 V and repeat h, i, j, and k.

NOTE

The risetime or falltime of the Type 114 as read on the crt of the Type 547 will be less than 13 nanoseconds. The 50 megacycle bandpass of the Type 547/1A1 adds about 25% to the actual rise and fall times of the Type 114. For this reason, risetime and falltime should be checked with a sampling oscilloscope system if one is available.

CALIBRATION RECORD

Serial _____

Date _____

1. Voltage on outside shell of C298 (+25-volt supply) _____.
2. Voltage on positive terminal of C298 (+35-volt supply) _____.
3. Voltage across D209 _____.
4. Regulation of +25-volt supply _____ %.
5. Ripple on outside shell of C298 _____ millivolts.
6. Period accuracy, all settings of PERIOD control,

1 μ S	_____ %
10 μ S	_____ %
100 μ S	_____ %
1 mS	_____ %
10 mS	_____ %
7. PERIOD — VARIABLE control range _____:1.
8. Width accuracy, all settings of WIDTH control,

100 nS	_____ %
1 μ S	_____ %
10 μ S	_____ %
100 μ S	_____ %
1 mS	_____ %
9. WIDTH — VARIABLE control range _____:1.
10. Square wave period accuracy _____ %.
11. Output amplitude into a 50 Ω load, all settings of AMPLITUDE switch,

+3 to 10 V	_____.
+1 to 3 V	_____.
-1 to 3 V	_____.
-3 to 10 V	_____.
12. External trigger operation, meets specification — (yes) _____ (no) _____.
13. Trigger output amplitude, 50 Ω load _____, no load, _____.
14. Pulse risetime, _____ nanoseconds.
15. Pulse falltime, _____ nanoseconds.

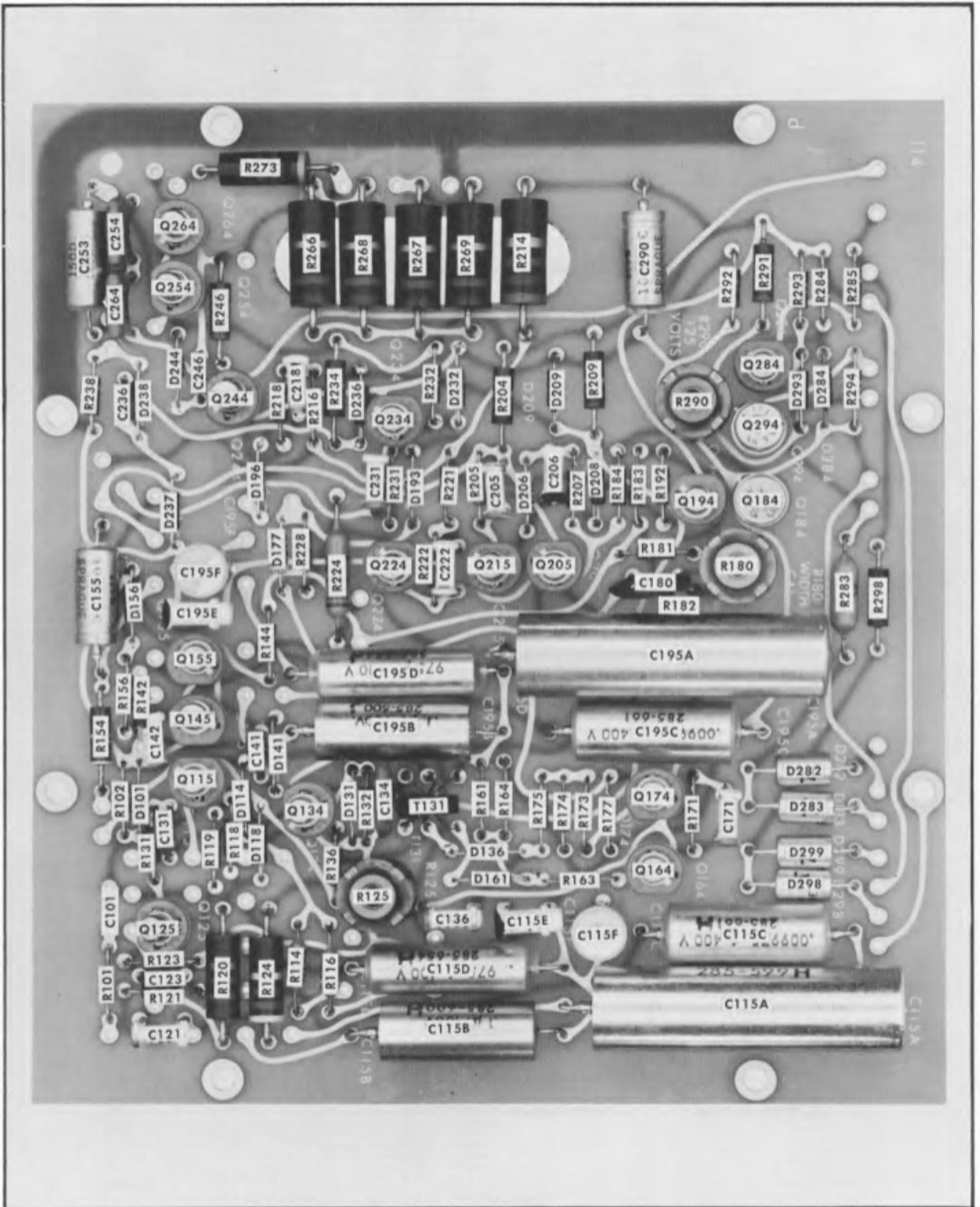


Fig. 4-20. Locations of electrical components.

SECTION 5

PARTS LIST AND DIAGRAMS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix Field Office.


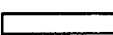
Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number including any suffix, instrument type, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix Field Office will contact you concerning any change in part number.

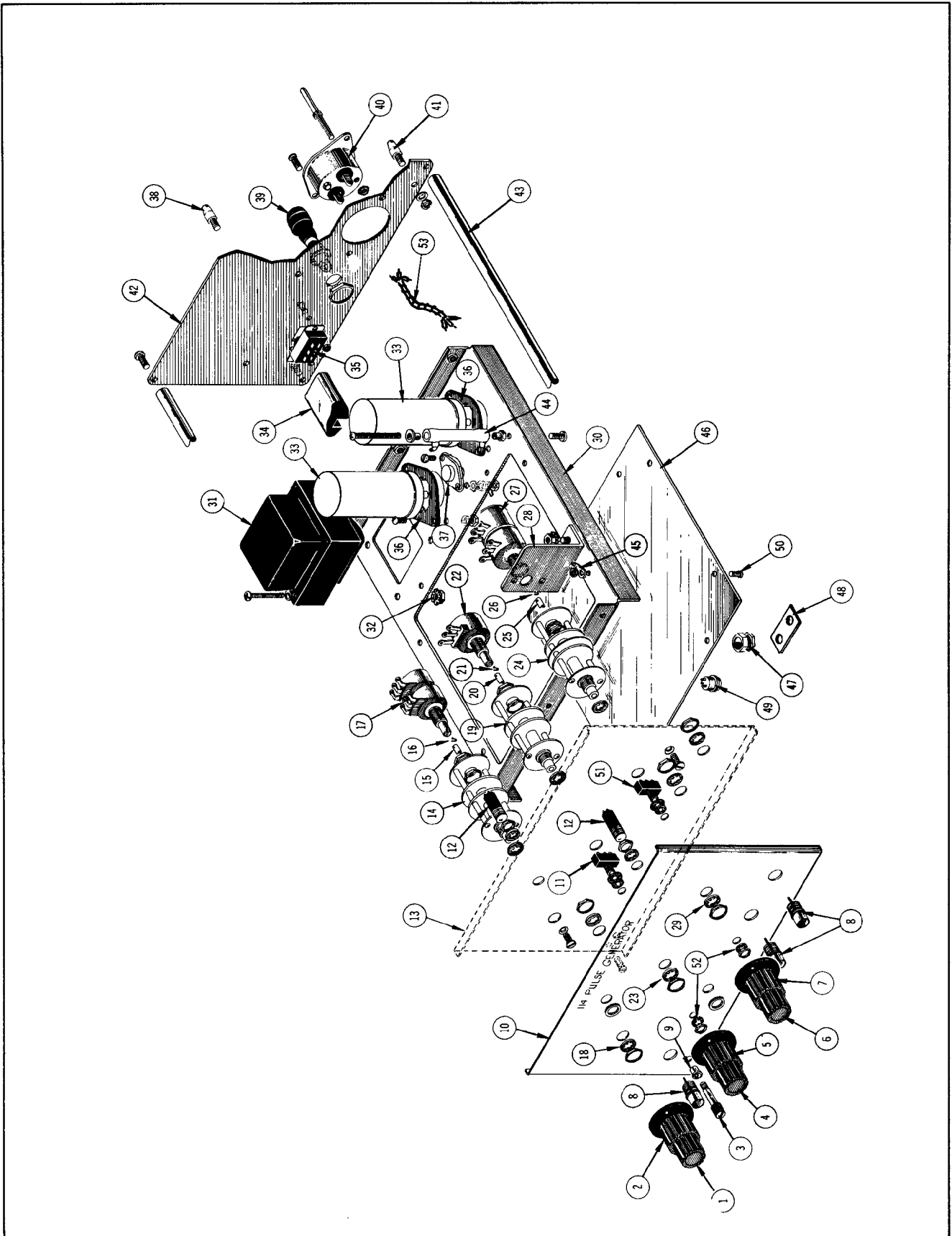
ABBREVIATIONS AND SYMBOLS

a or amp	amperes	mm	millimeter
BHS	binding head steel	meg or M	megohms or mega (10 ⁶)
C	carbon	met.	metal
cer	ceramic	μ	micro, or 10 ⁻⁶
cm	centimeter	n	nano, or 10 ⁻⁹
comp	composition	Ω	ohm
cps	cycles per second	OD	outside diameter
crt	cathode-ray tube	OHS	oval head steel
CSK	counter sunk	p	pico, or 10 ⁻¹²
dia	diameter	PHS	pan head steel
div	division	piv	peak inverse voltage
EMC	electrolytic, metal cased	plstc	plastic
EMT	electrolytic, metal tubular	PMC	paper, metal cased
ext	external	poly	polystyrene
f	farad	Prec	precision
F & I	focus and intensity	PT	paper tubular
FHS	flat head steel	PTM	paper or plastic, tubular, molded
Fil HS	fillister head steel	RHS	round head steel
g or G	giga, or 10 ⁹	rms	root mean square
Ge	germanium	sec	second
GMV	guaranteed minimum value	Si	silicon
h	henry	S/N	serial number
hex	hexagonal	t or T	tera, or 10 ¹²
HHS	hex head steel	TD	toroid
HSS	hex socket steel	THS	truss head steel
HV	high voltage	tub.	tubular
ID	inside diameter	v or V	volt
incd	incandescent	Var	variable
int	internal	w	watt
k or K	kilohms or kilo (10 ³)	w/	with
kc	kilocycle	w/o	without
m	milli, or 10 ⁻³	WW	wire-wound
mc	megacycle		

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

EXPLODED VIEW



EXPLODED VIEW

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	366-0038-00			1	KNOB, small red—CAL VARIABLE
	-----			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
2	366-0160-00			1	KNOB, charcoal—PERIOD
	-----			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
3	214-0553-00			1	LATCH, screw
4	366-0038-00			1	KNOB, small red—CAL VARIABLE
	-----			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
5	366-0160-00			1	KNOB, charcoal—WIDTH
	-----			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
6	366-0038-00			1	KNOB, small red—VARIABLE
	-----			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
7	366-0160-00			1	KNOB, charcoal—AMPLITUDE
	-----			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
8	131-0352-00			3	CONNECTOR, BNC, female (w/mounting hardware)
9	358-0255-00			1	BUSHING, latch
10	333-0887-00			1	PANEL, front
11	260-0613-00			1	SWITCH—POWER (w/mounting hardware)
12	136-0164-00			2	SOCKET, lamp (w/mounting hardware)
13	386-0122-00	100	939	1	PLATE, sub-panel
	386-0122-01	940		1	PLATE, sub-panel
14	262-0696-00			1	SWITCH, wired—PERIOD
	-----			-	switch includes:
	260-0671-00			1	SWITCH, unwired—PERIOD
15	384-0299-00			1	ROD, switch
16	376-0014-00			1	COUPLING, pot
17	-----			1	RESISTOR, variable
	-----			-	mounting hardware: (not included w/resistor)
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0413-00			2	NUT, hex., 3/8-32 x 1/2 inch
18	-----			-	mounting hardware: (not included w/switch)
	210-0840-00			1	WASHER, .390 ID x 3/16 inch OD
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch
19	262-0697-00			1	SWITCH, wired—WIDTH
	-----			-	switch includes:
	260-0671-00			1	SWITCH, unwired—WIDTH
20	384-0299-00			1	ROD, switch
21	376-0014-00			1	COUPLING, pot
22	-----			1	RESISTOR, variable
	-----			-	mounting hardware: (not included w/resistor)
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0413-00			2	NUT, hex., 3/8-32 x 1/2 inch
23	-----			-	mounting hardware: (not included w/switch)
	210-0840-00			1	WASHER, .390 ID x 3/16 inch OD
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0413-00			1	NUT, hex., 3/8-32 x 1/2 inch

Parts List—Type 114

EXPLODED VIEW (Cont'd)

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
24	262-0698-00			1	SWITCH, wired—AMPLITUDE
	- - - - -			-	switch includes:
	260-0672-00			1	SWITCH, unwired—AMPLITUDE
25	384-0299-00			1	ROD, switch
26	376-0014-00			1	COUPLING, pot
27	- - - - -			1	RESISTOR, variable
	- - - - -			-	mounting hardware: (not included w/resistor)
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0413-00			2	NUT, hex, 3/8-32 x 1/2 inch
28	407-0122-00			1	BRACKET
	- - - - -			-	mounting hardware: (not included w/bracket alone)
	210-0458-00			1	NUT, keps, 8-32 x 1 1/32 inch
29	- - - - -			-	mounting hardware: (not included w/switch)
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
30	441-0604-00			1	CHASSIS
	- - - - -			-	mounting hardware: (not included w/chassis)
	211-0542-00			3	SCREW, 6-32 x 5/16 inch, THS phillips
	211-0538-00			3	SCREW, 6-32 x 5/16 inch, FHS phillips
31	- - - - -			1	TRANSFORMER
	- - - - -			-	transformer includes:
	211-0530-00			4	SCREW, 6-32 x 1 3/4 inches, PHS
	210-0823-00			4	WASHER, fiber, 1/8 ID x 1/4 inch OD
	- - - - -			-	mounting hardware: (not included w/transformer)
32	210-0457-00			4	NUT, keps, 6-32 x 5/16 inch
33	200-0293-00			2	COVER, capacitor, polyethylene
34	351-0089-00	100	939	1	GUIDE, corner rail
	351-0089-02	940		1	GUIDE, corner rail
	- - - - -			-	mounting hardware: (not included w/quide)
	211-0538-00			2	SCREW, 6-32 x 5/16 inch, FHS phillips
35	260-0675-00			1	SWITCH, slide
	- - - - -			-	mounting hardware: (not included w/switch)
	211-0008-00			2	SCREW, 4-40 x 1/4 inch, BHS
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
36	386-0254-00			2	PLATE, fiber, large
	- - - - -			-	mounting hardware for each: (not included w/plate)
	211-0543-00			2	SCREW, 6-32 x 5/16 inch, RHS
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch

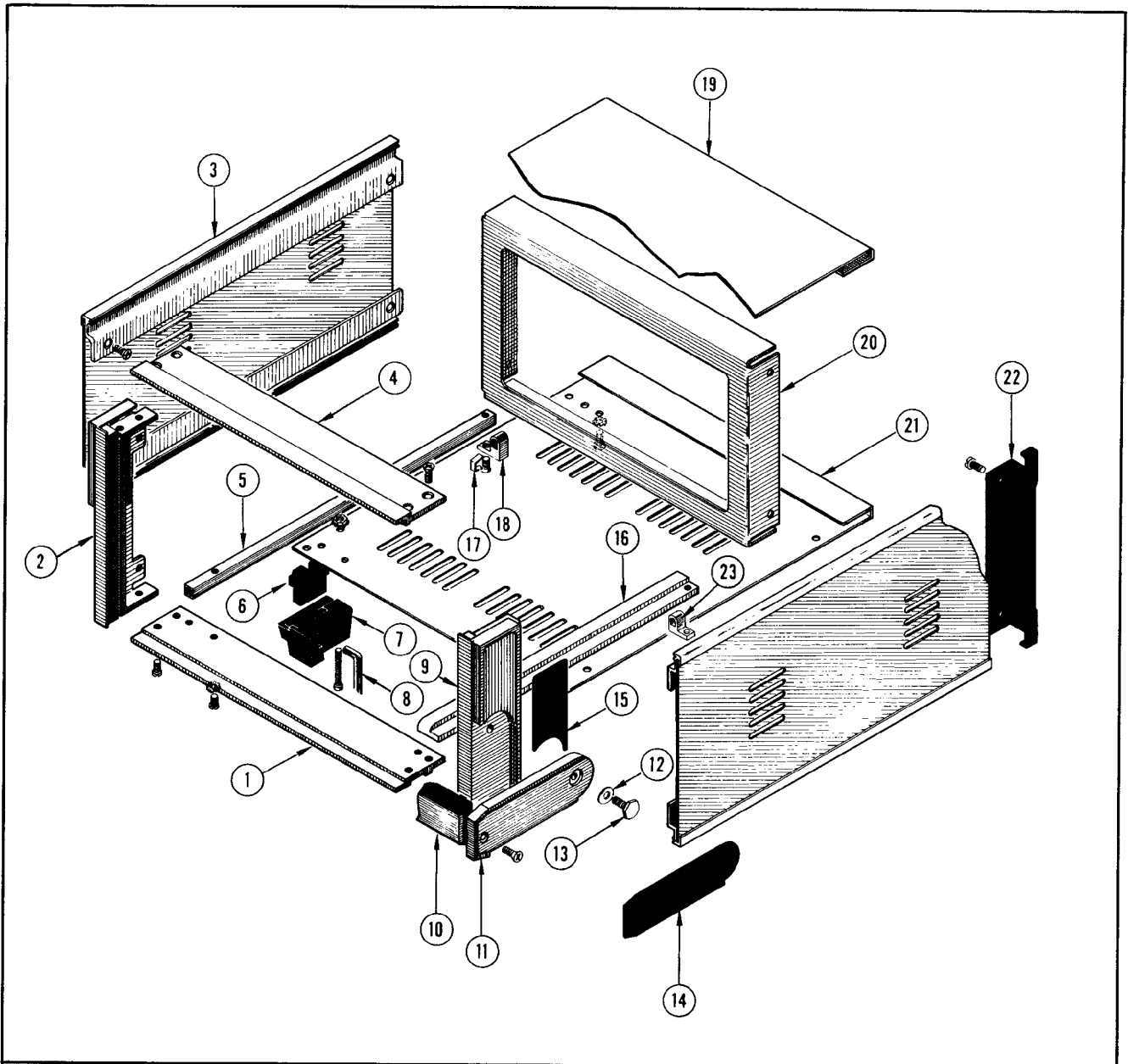
EXPLODED VIEW (Cont'd)

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
37	- - - - -			1	TRANSISTOR
	- - - - -			-	mounting hardware: (not included w/transistor)
	386-0143-00			1	PLATE, mica
	210-0202-00			1	LUG, solder, SE #6
	210-0983-00	100	1139	2	WASHER, shouldered, black anodized
	210-0811-00	1140		2	WASHER, fiber, #6
	210-0802-00			2	WASHER, 6S x 5/16 inch
	210-0006-00			1	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch
211-0507-00			2	SCREW, 6-32 x 5/16 inch, BHS	
38	214-0561-00	100	939	1	PIN, locating, w/8-32 threads
	214-0680-00	940		1	PIN, locating, w/8-32 threads
39	352-0002-00			1	ASSEMBLY, fuse holder
	- - - - -			-	assembly includes:
	200-0582-00			1	CAP, fuse
	352-0010-00			1	HOLDER, fuse
	210-0873-00			1	WASHER, rubber
40	- - - - -			1	NUT
	131-0150-00			1	CONNECTOR, motor base
	- - - - -			-	connector includes:
	129-0041-00			1	POST, ground
	200-0185-00			1	COVER
	205-0014-00			1	SHELL
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0551-00			2	NUT, hex, 4-40 x 1/4 inch
	211-0015-00			1	SCREW, 4-40 x 1/2 inch, RHS
	214-0078-00			2	PIN, connecting
	377-0041-00			1	INSERT
- - - - -			-	mounting hardware: (not included w/connector)	
213-0104-00			2	SCREW, thread forming, #6 x 3/8 inch, THS phillips	
41	214-0561-00	100	939	1	PIN, locating, w/8-32 threads
	214-0680-00	940		1	PIN, locating, w/8-32 threads
	- - - - -			-	mounting hardware: (not included w/pin)
	210-0008-00			1	LOCKWASHER, internal, #8
210-0409-00			1	NUT, hex, 8-32 x 5/16 inch	
42	386-0121-00	100	939	1	PLATE, rear
	386-0121-01	940		1	PLATE, rear
	- - - - -			-	mounting hardware: (not included w/plate)
212-0044-00			4	SCREW, 8-32 x 1/2 inch, RHS phillips	

EXPLODED VIEW (cont)

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
43	385-0181-00			3	ROD, spacer
44	-----			1	RESISTOR
	-----			-	mounting hardware: (not included w/resistor)
	211-0553-00			1	SCREW, 6-32 x 1 1/2 inches, RHS phillips
	211-0601-00			1	EYELET
	210-0478-00			1	NUT, resistor mounting
	211-0507-00			1	SCREW, 6-32 x 5/16 inch, BHS
45	210-0201-00			1	LUG, solder, SE #4
	-----			-	mounting hardware: (not included w/lug)
	211-0008-00	100	439	1	SCREW, 4-40 x 1/4 inch, BHS
	211-0116-00	440		1	SCREW, sems, 4-40 x 5/16 inch, PHB, phillips
	210-0406-00			1	NUT, hex, 4-40 x 3/16 inch
46	670-0203-00			1	ASSEMBLY, wired circuit board
	-----			-	assembly includes:
	388-0621-00	100	1109	1	BOARD, circuit
	388-0621-01	1110		1	BOARD, circuit
47	214-0653-00	X500		2	SINK, heat
48	386-1101-00	X500		1	PLATE, heat sink
	-----			-	mounting hardware: (not included w/plate)
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
49	136-0183-00			18	SOCKET, transistor
	-----			-	mounting hardware: (not included w/board)
50	211-0008-00	100	439	7	SCREW, 4-40 x 1/4 inch, BHS
	211-0116-00	440		7	SCREW, sems, 4-40 x 5/16 inch, PHB, phillips
	210-0004-00			7	LOCKWASHER, internal, #4
	210-0406-00			7	NUT, hex, 4-40 x 3/16 inch
51	260-0613-00			1	SWITCH—TRIGGER (w/mounting hardware)
52	210-0940-00			2	WASHER, 1/4 ID x 3/8 inch OD
53	179-0964-00			1	CABLE HARNESS, AC

CABINET



REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	437-0077-00	100	939	1	CABINET, assembly
	437-0077-01	940		1	CABINET, assembly
	- - - - -			-	cabinet includes:
	426-0254-00			1	FRAME, front, bottom
	212-0004-00			2	SCREW, 8-32 x 5/16 inch, BHS
	212-0002-00		2	SCREW, 8-32 x 1/4 inch, 100° CSK FHS phillips	
2	426-0253-00			1	FRAME, front, left
3	386-0148-00			2	PLATE, side
	- - - - -			-	mounting hardware for each: (not included w/plate)
	212-0002-00			2	SCREW, 8-32 x 1/4 inch, 100° CSK FHS phillips

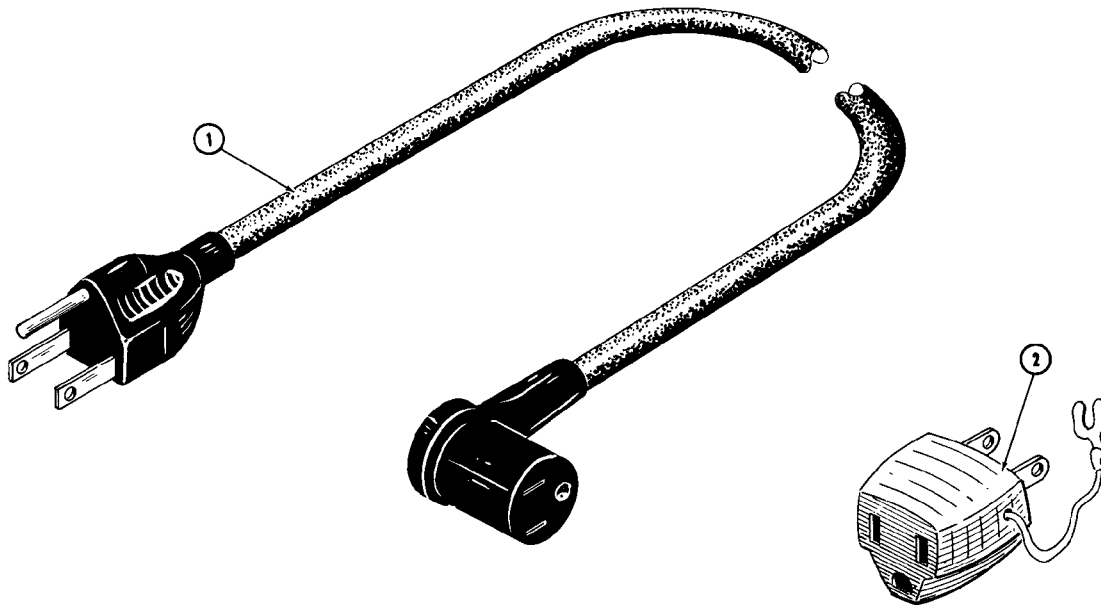
CABINET (Cont'd)

REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
4	426-0255-00 ----- 212-0002-00			1 - 4	FRAME, front, top mounting hardware: (not included w/frame) SCREW, 8-32 x 1/4 inch, 100° CSK FHS phillips
5	351-0095-00 ----- 212-0023-00 210-0007-00			1 - 1 1	GUIDE, left mounting hardware: (not included w/guide) SCREW, 8-32 x 3/8 inch, BHS LOCKWASHER, external, #8
6	377-0119-00			4	INSERT, foot
7	348-0073-00 ----- 211-0532-00 210-0457-00			1 - 2 1	FOOT, bail limiting, left front—right rear (pair) mounting hardware for left front: (not included w/foot) SCREW, 6-32 x 3/4 inch, Fil HS NUT, keps, 6-32 x 5/16 inch
	348-0074-00 ----- 211-0532-00			1 - 2	FOOT, bail limiting, right front—left rear (pair) mounting hardware for right front: (not included w/foot) SCREW, 6-32 x 3/4 inch, Fil HS
	348-0073-00 ----- 211-0532-00 210-0457-00			1 - 2 1	FOOT, bail limiting, right rear—left front (pair) mounting hardware for left rear: (not included w/foot) SCREW, 6-32 x 3/4 inch, Fil HS NUT, keps, 6-32 x 5/16 inch
	348-0074-00 ----- 211-0532-00			1 - 2	FOOT, bail limiting, left rear—right front (pair) mounting hardware for right rear: (not included w/foot) SCREW, 6-32 x 3/4 inch, Fil HS
8	348-0072-00			1	FOOT, flip-stand bail
9	426-0252-00			1	FRAME, front, right
10	367-0052-00 ----- 212-0040-00			1 - 2	HANDLE mounting hardware: (not included w/handle) SCREW, 8-32 x 3/8 inch, 100° CSK FHS phillips
11	367-0050-00			1	HANDLE, pivot, right
	367-0051-00			1	HANDLE, pivot, left
12	214-0558-00			2	WASHER, thrust
13	214-0554-00			2	BOLT, hinge
14	377-0122-00			1	INSERT, pivot, right
	377-0123-00			1	INSERT, pivot, left
15	377-0121-00			1	INSERT, frame, left
	377-0120-00			1	INSERT, frame, right
16	351-0094-00			1	GUIDE, right

CABINET (cont)

REF. NO.	PART NO.	SERIAL/ MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
17	214-0567-00	100	939X	2	SPRING, grounding
18	358-0260-00	100	939	1	BUSHING, plug-in securing
	358-0293-01	940		1	BUSHING, plug-in securing, left
	- - - - -			-	mounting hardware: (not included w/bushing)
	211-0541-00	100	939	1	SCREW, 6-32 x 1/4 inch, 100° CSK FHS phillips
	211-0510-00	940		1	SCREW, 6-32 x 3/8 inch, PHS
	210-0005-00	X940		1	LOCKWASHER, external, #6
	210-0457-00	X940		1	NUT, keps, 6-32 x 5/16 inch
	212-0001-00			1	SCREW, 8-32 x 1/4 inch, BHS
	210-0007-00			1	LOCKWASHER, external, #8
	19	386-0149-00			1
20	386-0139-00			1	PLATE, rear
21	386-0147-00	100	939	1	PLATE, bottom cover
	386-0147-01	940		1	PLATE, bottom cover
22	348-0075-00			2	FOOT, rear guard, left and right
	- - - - -			-	mounting hardware for each: (not included w/foot)
	212-0004-00			2	SCREW, 8-32 x 5/16 inch, BHS
23	358-0260-00	100	939	1	BUSHING, plug-in securing
	358-0294-01	940		1	BUSHING, plug-in securing, right
	- - - - -			-	mounting hardware: (not included w/bushing)
	211-0541-00	100	939	1	SCREW, 6-32 x 1/4 inch, 100° CSK FHS phillips
	211-0510-00	940		1	SCREW, 6-32 x 3/8 inch, PHS
	210-0005-00	X940		1	LOCKWASHER, external, #6
	212-0001-00			1	SCREW, 8-32 x 1/4 inch, BHS
	210-0007-00			1	LOCKWASHER, external, #8

STANDARD ACCESSORIES



REF. NO.	PART NO.	SERIAL/MODEL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	161-0024-00	100	1319	1	CORD, power, 3 conductor 8 feet
	161-0024-01	1320		1	CORD, power, 3 conductor, 8 feet
2	103-0013-00			1	ADAPTER, power cord
--	070-0465-00			2	MANUAL, instruction (not shown)

ELECTRICAL PARTS

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description	S/N Range
Bulbs			
B154	150-043	Ass'y, Incandescent	WIDTH-PERIOD
B298	150-043	Ass'y, Incandescent	POWER
Capacitors			
Tolerance $\pm 20\%$ unless otherwise indicated.			
C101	Use 283-0000-00	0.001 μf	Cer 500 v
C115A } C115B } C115C } C115D }	*295-076	1.0 μf 0.1 μf 0.009975 μf 975 pf	Timing Capacitor (PERIOD)
C115E	281-603	39 pf	Cer 500 v 5%
C115F	281-093	5.5-18 pf	Cer Var
C121	281-543	270 pf	Cer 500 v 10%
C123	283-067	0.001 μf	Cer 200 v 10%
C131	283-076	27 pf	Cer 500 v 10%
C134	283-010	0.05 μf	Cer 50 v
C136	281-523	100 pf	Cer 350 v
C141	283-076	27 pf	Cer 500 v 10%
C142	281-523	100 pf	Cer 350 v
C155	290-175	10 μf	EMT 35 v
C171	281-523	100 pf	Cer 350 v
C180	283-002	0.01 μf	Cer 500 v
C195A } C195B } C195C } C195D }	*295-086	1.0 μf 0.1 μf 0.009975 μf 935 pf	Timing Capacitor (WIDTH)
C195E	281-622	47 pf	Cer 500 v 1%
C195F	281-093	5.5-18 pf	Cer Var
C205	281-523	100 pf	Cer 350 v
C205	283-0032-00	470 pf	Cer 500 v 5%
C206	281-510	22 pf	Cer 500 v
C218	281-524	150 pf	Cer 500 v
C222	281-523	100 pf	Cer 350 v
C231	281-523	100 pf	Cer 350 v
C236	283-067	0.001 μf	Cer 200 v 10%
C246	283-067	0.001 μf	Cer 200 v 10%
C253	290-162	22 μf	EMT 35 v
C254	283-059	1 μf	Cer 25 v
C264	283-059	1 μf	Cer 25 v
C283	290-122	1000 μf	EMC 50 v
C284	283-0059-00	1 μf	Cer 25 v
C290	290-175	10 μf	EMT 35 v
C298	290-086	2000 μf	EMC 30 v

Parts List—Type 114

Diodes

Ckt. No.	Tektronix Part No.	Description	S/N Range
D101	*152-075	Germanium	Tek Spec
D114	*152-185	Signal	Replaceable by 1N3605
D115	152-0071-00	Germanium	ED-2007
D118	*152-185	Signal	Replaceable by 1N3605
D131	*152-075	Germanium	Tek Spec
D136	*152-185	Signal	Replaceable by 1N3605
D141	*152-075	Germanium	Tek Spec
D156	*152-185	Signal	Replaceable by 1N3605
D161	*152-185	Signal	Replaceable by 1N3605
D177	*152-075	Germanium	Tek Spec
D193	*152-075	Germanium	Tek Spec
D196	*152-185	Signal	Replaceable by 1N3605
D206	*152-075	Germanium	Tek Spec
D208	*152-185	Signal	Replaceable by 1N3605
D209	152-076	Zener	1N4372 3 v, .4 w, 10%
D232	*152-185	Signal	Replaceable by 1N3605
D236	*152-185	Signal	Replaceable by 1N3605
D237	*152-185	Signal	Replaceable by 1N3605
D238	*152-185	Signal	Replaceable by 1N3605
D244	152-141	Silicon	1N3605
D282	152-066	Silicon	1N3194
D283	152-066	Silicon	1N3194
D284	152-055	Zener	1N962A 11 v, .4 w, 5%
D293	*152-185	Signal	Replaceable by 1N3605
D298	152-066	Silicon	1N3194
D299	152-066	Silicon	1N3194

Fuse

F281	159-029	0.3 Amp 3AG Slo-Blo
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Connectors

J101	131-352	BNC Coax, female
J239	131-352	BNC Coax, female
J279	131-352	BNC Coax, female
P281	131-150	3 wire motor base, male, chassis mounted

Transistors

Q115	*151-108	Replaceable by 2N2501
Q125	*151-133	Selected from 2N3251
Q134	*151-108	Replaceable by 2N2501
Q145	*151-108	Replaceable by 2N2501
Q155	*151-108	Replaceable by 2N2501
Q164	*151-108	Replaceable by 2N2501
Q174	*151-108	Replaceable by 2N2501
Q184	151-107	2N967
Q194	*151-108	Replaceable by 2N2501
Q205	*151-108	Replaceable by 2N2501

Transistors (Cont'd)

Ckt. No.	Tektronix Part No.	Description	S/N Range
Q215	*151-108	Replaceable by 2N2501	
Q224	*151-108	Replaceable by 2N2501	
Q234	*151-108	Replaceable by 2N2501	
Q244	*151-127	Selected from 2N2369	
Q254	Use *153-0543-00	Selected 2N2501	
Q264	Use *153-0543-00	Selected 2N2501	
Q284	*151-108	Replaceable by 2N2501	
Q294	*151-136	Replaceable by 2N3053	
Q297	*151-148	Selected (RCA 40250)	

Resistors

Resistors are fixed, composition, $\pm 10\%$ unless otherwise indicated.

R101	316-102	1 k	$\frac{1}{4}$ w			
R102	316-473	47 k	$\frac{1}{4}$ w			
R114	321-321	21.5 k	$\frac{1}{8}$ w			
R115A,B	311-114	2 x 250 k		Var	Prec	1%
R116	321-317	19.6 k	$\frac{1}{8}$ w		Prec	VARIABLE (PERIOD) 1%
R118	316-222	2.2 k	$\frac{1}{4}$ w			
R119	316-271	270 Ω	$\frac{1}{4}$ w			
R120	303-511	510 Ω	1 w			5%
R121	316-222	2.2 k	$\frac{1}{4}$ w			
R123	315-161	160 Ω	$\frac{1}{4}$ w			5%
R124	304-471	470 Ω	1 w			
R125	311-442	250 Ω		Var		PERIOD CAL
R131	316-181	180 Ω	$\frac{1}{4}$ w			
R132	316-471	470 Ω	$\frac{1}{4}$ w			
R136	Use 316-0223-00	22 k	$\frac{1}{4}$ w			
R142	316-472	4.7 k	$\frac{1}{4}$ w			
R144	316-472	4.7 k	$\frac{1}{4}$ w			
R154	302-471	470 Ω	$\frac{1}{2}$ w			
R156	316-103	10 k	$\frac{1}{4}$ w			
R161	316-103	10 k	$\frac{1}{4}$ w			
R163	316-101	100 Ω	$\frac{1}{4}$ w			
R164	316-223	22 k	$\frac{1}{4}$ w			
R171	316-102	1 k	$\frac{1}{4}$ w			
R173	316-101	100 Ω	$\frac{1}{4}$ w			
R174	316-392	3.9 k	$\frac{1}{4}$ w			
R175	316-181	180 Ω	$\frac{1}{4}$ w			
R177	316-103	10 k	$\frac{1}{4}$ w			
R180	311-462	1 k		Var		WIDTH CAL
R181	316-332	3.3 k	$\frac{1}{4}$ w			
R182	316-222	2.2 k	$\frac{1}{4}$ w			
R183	316-103	10 k	$\frac{1}{4}$ w			
R184	316-221	220 Ω	$\frac{1}{4}$ w			
R192	316-103	10 k	$\frac{1}{4}$ w			
R204	302-222	2.2 k	$\frac{1}{2}$ w			
R205	315-301	300 Ω	$\frac{1}{4}$ w			5%
R205	315-0471-00	470 Ω	$\frac{1}{4}$ w			5%

Parts List—Type 114

Resistors (Con'd)

Ckt. No.	Tektronix Part No.		Description		S/N Range
R207	316-220	22 Ω	1/4 w		
R209	302-152	1.5 k	1/2 w		
R214	305-621	620 Ω	2 w		5%
R216	316-270	27 Ω	1/4 w		
R218	316-271	270 Ω	1/4 w		
R221	316-101	100 Ω	1/4 w		
R222	316-271	270 Ω	1/4 w		
R224	323-213	1.62 k	1/2 w		1% Prec
R225	311-018	20 k		Var	VARIABLE (WIDTH)
R228	316-100	10 Ω	1/4 w		
R231	316-101	100 Ω	1/4 w		
R232	316-103	10 k	1/4 w		
R234	302-222	2.2 k	1/2 w		
R238	316-102	1 k	1/4 w		
R244	308-049	330 Ω	10 w		WW 5%
R246	301-620	62 Ω	1/2 w		5%
R266	305-510	51 Ω	2 w		5%
R267	305-510	51 Ω	2 w		5%
R268	305-510	51 Ω	2 w		5%
R269	305-510	51 Ω	2 w		5%
R270A,B	311-513	2 x 150 Ω		Var	VARIABLE (AMPLITUDE)
R271	305-101	100 Ω	2 w		5%
R272	305-101	100 Ω	2 w		5%
R273	303-301	300 Ω	1 w		5%
R274	303-360	36 Ω	1 w		5%
R276	305-360	36 Ω	2 w		5%
R278	303-270	27 Ω	1 w		5%
R283	308-240	2 Ω	3 w		WW 5%
R284	316-392	3.9 k	1/4 w		
R285	316-562	5.6 k	1/4 w		
R290	311-442	250 Ω		Var	+25 VOLTS
R291	301-112	1.1 k	1/2 w		5%
R292	315-751	750 Ω	1/4 w		5%
R293	316-103	10 k	1/4 w		
R294	316-393	39 k	1/4 w		
R298	307-051	2.7 Ω	1/2 w		5%

Switches

	Unwired	Wired		
SW120	260-671	*262-696	Rotary	PERIOD
SW190	260-671	*262-697	Rotary	WIDTH
SW230	260-613		Toggle	TRAILING EDGE-LEADING EDGE
SW260	260-672	*262-698	Rotary	AMPLITUDE
SW281	260-613		Toggle	POWER
SW282	260-675		Slide	115 V AC-230 V AC

Transformers

Ckt. No.	Tektronix Part No.	Description	S/N Range
T131 T281	*120-370 *120-369	Toroid, 3 windings Power	

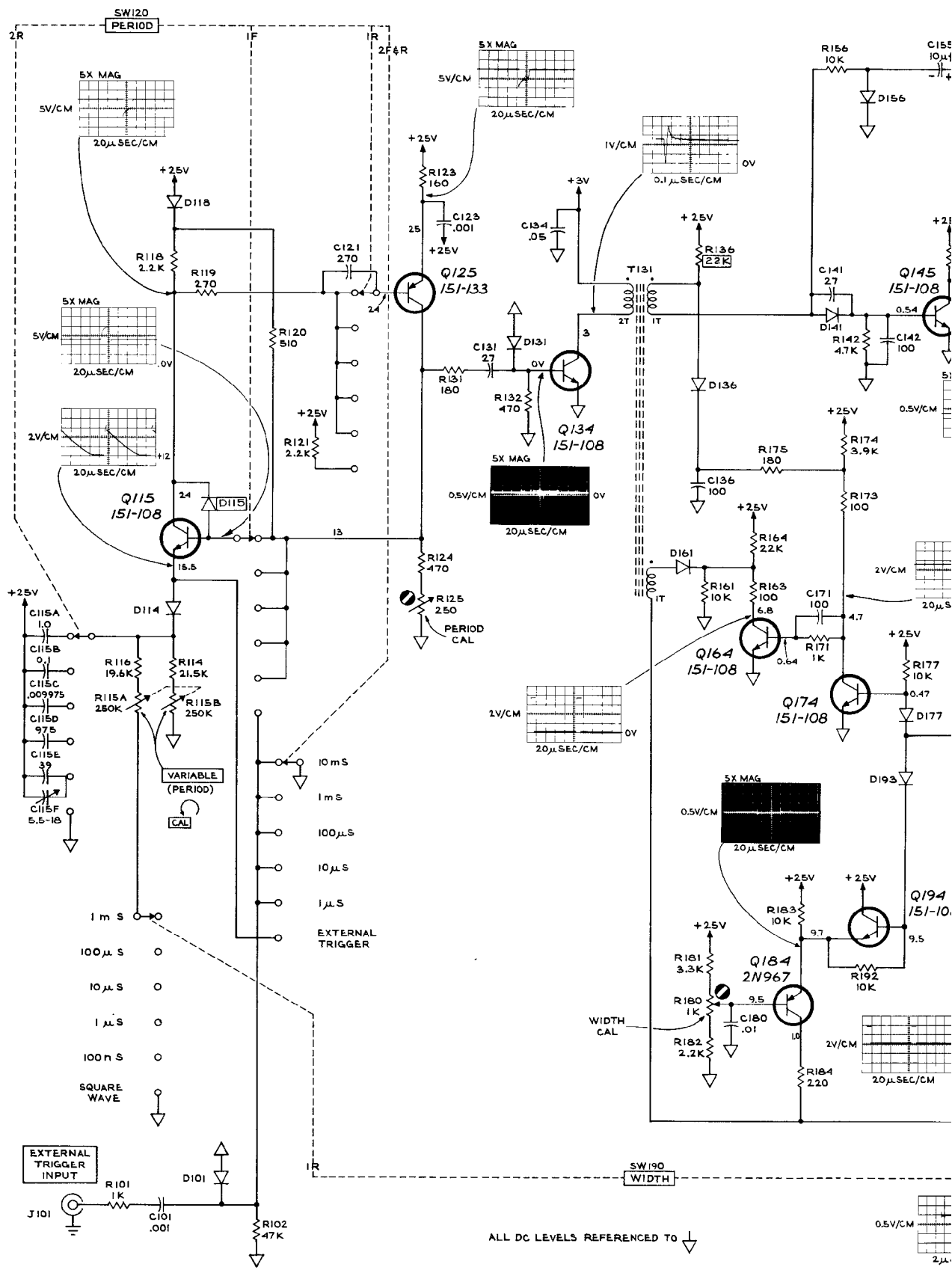
TEST CONDITIONS

All Voltage Readings were obtained under the following conditions unless otherwise noted on the specific diagrams:

Line Voltage	117 volts
Dc Voltmeter Impedance	20,000 Ω /volt
Control Settings:	
All VARIABLE controls	counterclockwise (CAL)
PERIOD	100 μ S
WIDTH	10 μ S
AMPLITUDE	+3 to 10 V
TRIGGER switch	LEADING EDGE

Voltage readings shown in blue on the schematics were obtained with a 20,000 Ω /volt meter and in some cases show meter loading. All voltages measured with respect to the outside shell of C283 unless otherwise (*) indicated.

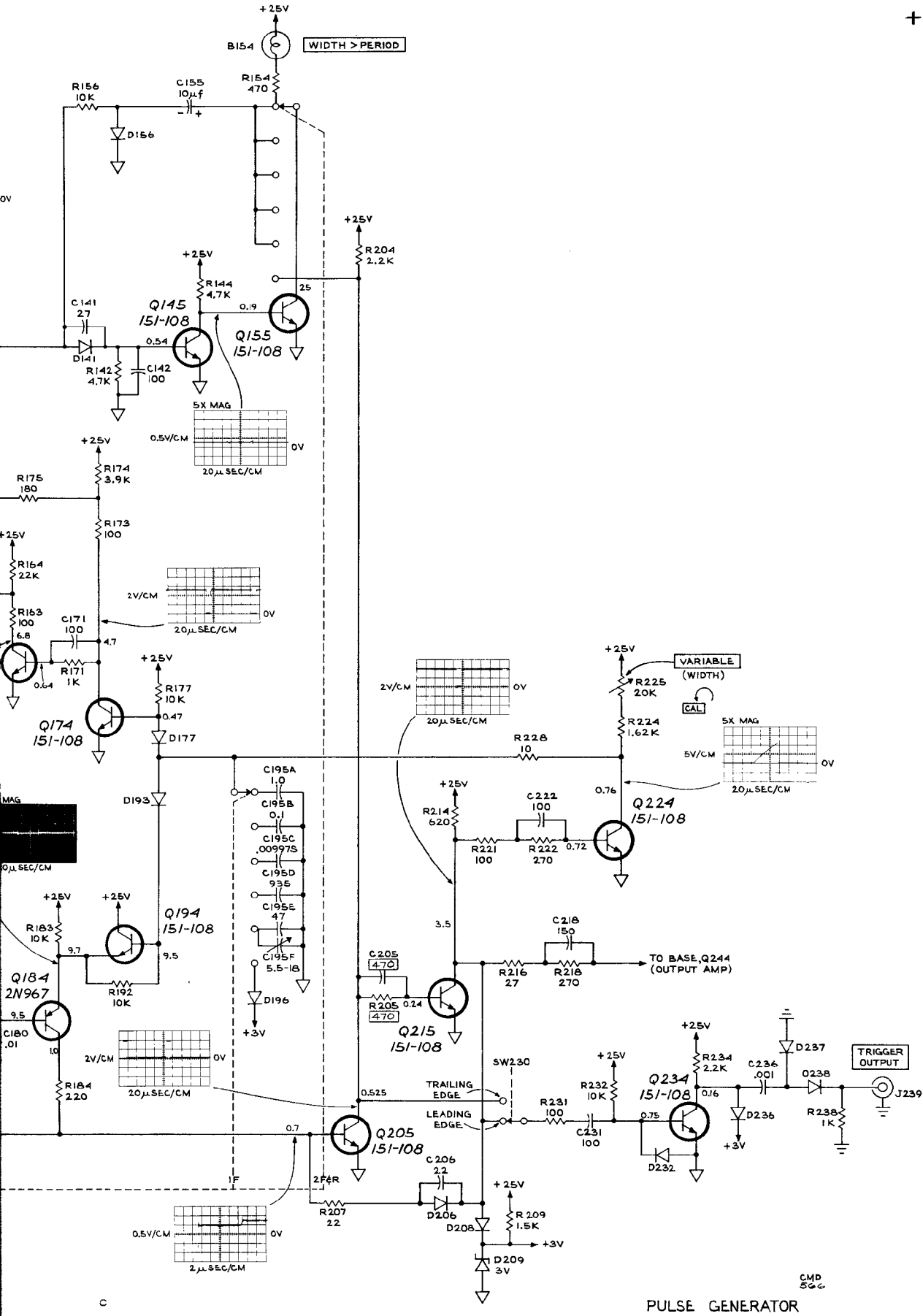
Voltage readings may vary somewhat between instruments due to normal manufacturing tolerances and component characteristics. Waveforms shown on the schematics were obtained from the crt of a Tektronix Type 547/1A1 Oscilloscope.



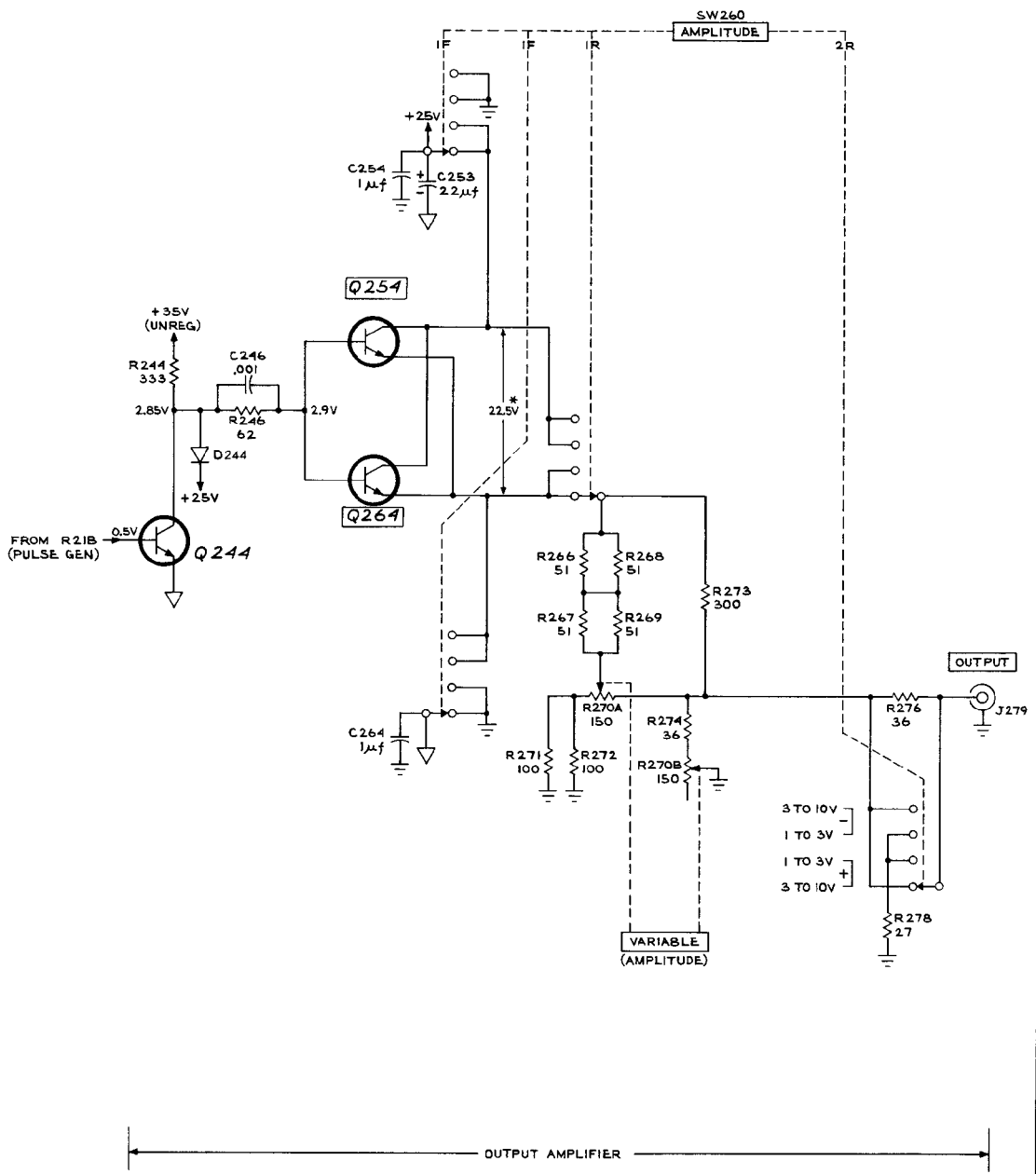
TYPE 114 PULSE GENERATOR

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C



PULSE GENERATOR



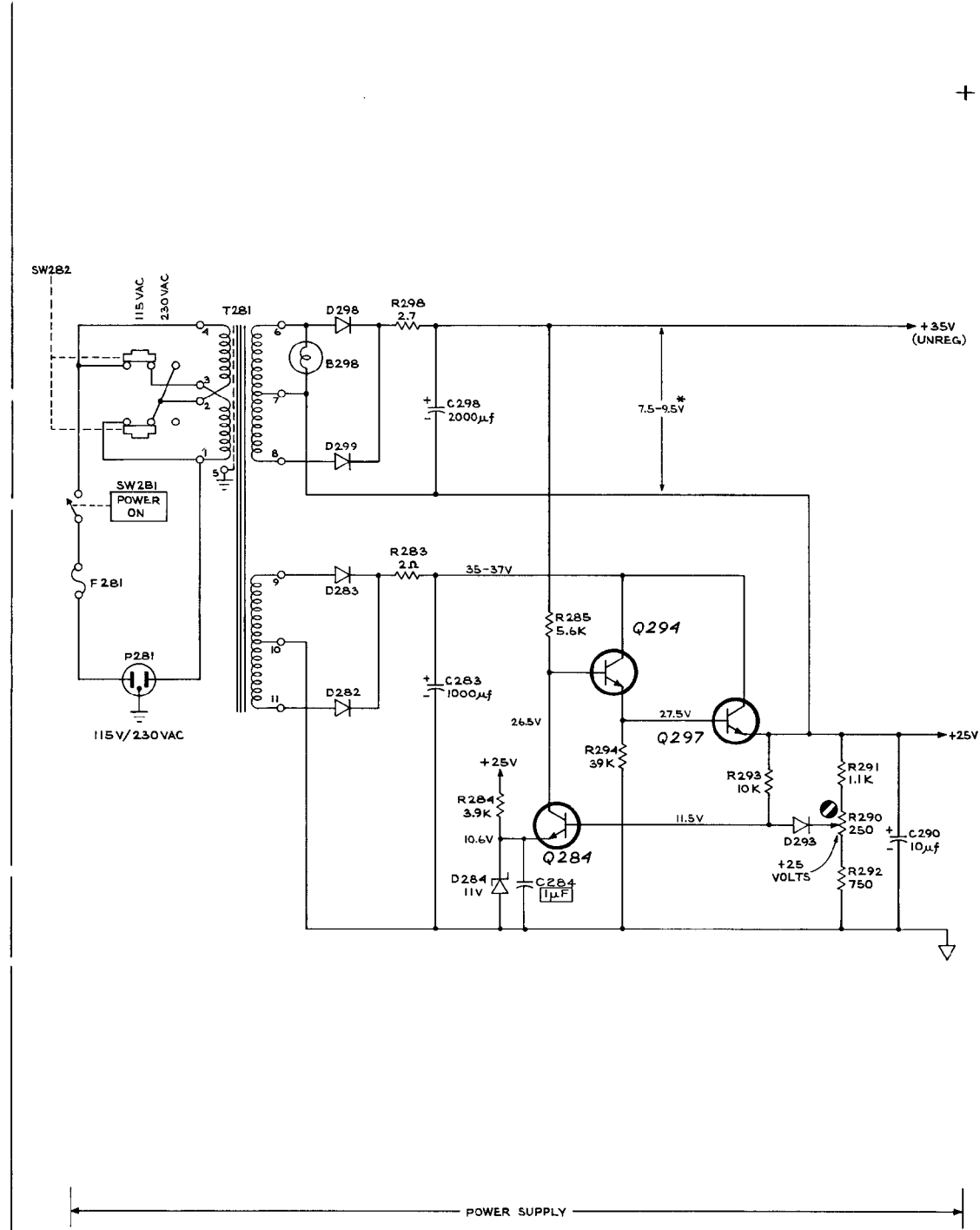
NOTE: ALL VOLTAGES REFERENCED TO COMMON POINT ∇ EXCEPT AS INDICATED *.

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

TYPE 114 PULSE GENERATOR



FOR
TYPES



CMD
566

OUTPUT AMPLIFIER & POWER SUPPLY

c

TYPE 114

TEXT CORRECTION

Section 1 Characteristics

Page 1-1, 1st column, Pulse Width

CHANGE: 2nd sentence to read:

With the width VARIABLE control at the CAL end of its range, the width accuracy is within $\pm 3\%$ (+10 ns on negative pulse) of indicated value at 10 ms through 1 μ s positions. At the 100 ns position, accuracy is within $\pm 5\%$ (+10 ns on negative pulse).

G2/767

TYPE 114

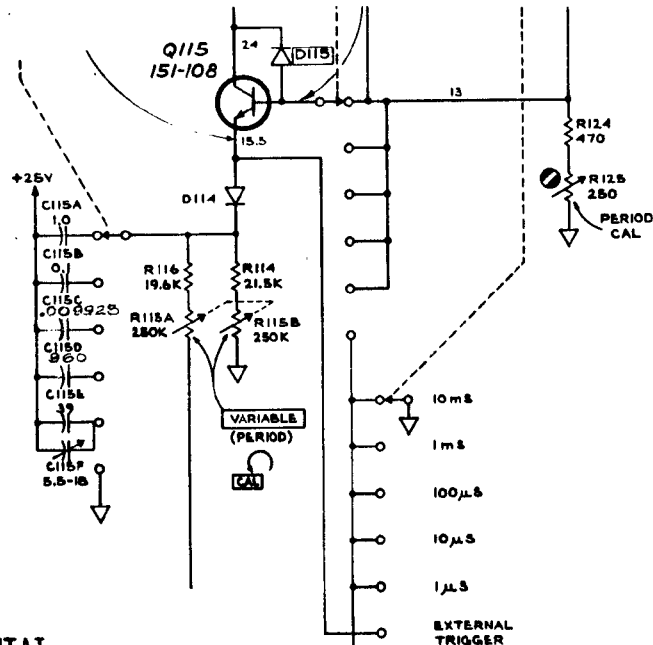
PARTS LIST CORRECTION

CHANGE TO:

C115A	} *295-0108-00	1.0 μ F	Timing Capacitor (PERIOD)
C115B		0.1 μ F	
C115C		0.009925 μ F	
C115D		960 pF	

* Checked assembly

SCHEMATIC CORRECTION



PARTIAL
PULSE GENERATOR