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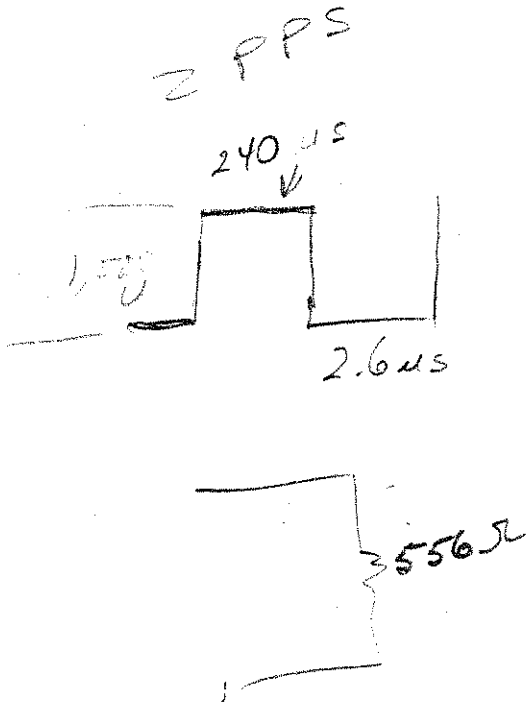
OPERATING AND SERVICING MANUAL

VELONEX MODEL 350

HIGH POWER PULSE GENERATOR

SERIAL NO._____



This Manual has been revised to apply to
Unit Serial Numbers 191 and up.

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A

CLAIM FOR DAMAGE IN SHIPMENT

This instrument should be tested as soon as possible after receipt. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number and serial number when referring to this instrument for any reason.

B

WARRANTY

The VELONEX Division of PULSE ENGINEERING, INC., warrants each instrument manufactured by us to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. Electron tubes, pilot lights, and fuses are specifically excluded from any liability. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and when upon our examination, it is disclosed to our satisfaction to be defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started.

If any fault develops, the following steps should be taken:

1. Notify us, giving full details of the difficulty and include the model number and serial number. On receipt of this information, we will give you service data or shipping instructions.

2. On receipt of shipping instructions, forward the instrument prepaid to the factory. If requested, an estimate of the charges will be made before the work begins provided the instrument is not covered by the warranty.

C

SHIPPING

All shipments of VELONEX instruments should be made via truck or Railway Express. The instrument(s) should be either re-packed in the original shipping container or packed in a strong exterior container and surrounded by at least three inches of excelsior or similar shock-absorbing material.

D

PROPRIETARY NOTICE

E

MODEL 350 SPECIFICATIONS (WITH 200 OHM RESISTIVE LOAD)

Output Pulse Voltage:	<400V - 2.0KV Peak, continuously variable.
PRF:	3pps - 100,000 pps, continuously variable in 9 steps.
Pulse Polarity:	Negative. Can be inverted by accessory plug-in units.
Pulse Width:	0.1 - 200usec, continuously variable in 7 steps.
Pulse Top Droop:	3% or 0.05% per usec max., whichever is greater.
Rise Time:	35 nanoseconds maximum
Fall Time:	50 nanoseconds maximum
Duty Factor:	0 to 1% at maximum output, up to 5% at reduced output (See Figure 6-1)
Overshoot:	5% maximum
Backswing:	5% maximum
Pulse Top Ripple:	Negligible
Pulse Width Jitter:	<(0.1% + 0.005usec)
Interpulse Jitter:	<(0.1% + 0.02usec)
Scope Trigger Output:	5V peak (into 300 ohm), positive polarity, 500 nanosec. width.
External Trigger Input*	2.5v to 25.V peak, 0.3usec width minimum, negative polarity. PRF: 1 shot to 100,000 pps. PRF should not exceed that value which results in output-pulse duty factor of 5% or more. (Z_{in} approx. 150 ohms.)

* External trigger determines PRF. Delay between trigger and output pulses is dependent upon trigger pulse characteristics.

E - (Continued)

External Drive:	Positive polarity pulse, PRF - 1 shot to 100,000 pps, 10-15V peak (Z_{in} = 50 ohms)
Input Voltage: **	105 - 125 volts.
Input Frequency:	50 - 60 HZ
Input Power:	600 watts (with 200 watt average power output).
Dimensions:	19 3/4" x 13" x 18" (cabinet model) (26" x 19¼" x 24½" shipping container).
Weight:	120 lbs. (140 lbs. approximately shipping weight.)
Accessories Available:	Plug-in output units - (See Section 2-7).
	Model V-1106 220V. External Power Convertor.**
	Model V-1208 Single Pulse External Trigger

** For operation from a 220V-240V, 50-60HZ power source, a Velonex Model V-1106 External Power Convertor may be employed.

W A R N I N G !

The Model 350 High Power Pulse Generator contains voltages which could be dangerous if contacted. All reasonable safety precautions have been taken in the design and manufacture of this instrument. DO NOT attempt to defeat the protection provided.

Power should be removed and high voltage capacitors should be discharged prior to any maintenance work.

Only recommended replacement parts should be used.

The Model 350 should be operated and maintained only by personnel qualified to work with high voltage equipment.

SECTION I - GENERAL DESCRIPTION

1-1 Introduction:

The Model 350 Generator is designed to operate in a laboratory-type environment. It will supply a 20KW pulse to a 200 ohm load without additional equipment. With accessory plug-in output units, pulses from 0.1 to 100usec in width from the Model 350 can be stepped up in voltage or current. Polarity of the output pulse can be selected by proper choice of the output unit. The Model 350 can be triggered from an external source using the front panel pulse width control to obtain the desired pulse width, or it can be utilized as a pulse amplifier by driving it with an external pulse. The Model 350, (not being a 'class A' amplifier) will tend to 'square' any input waveform.

1-2 Damage in Transit:

After unpacking this instrument, if any shipping damage is discovered, follow the procedure outlined in the 'Claim for Damage in Shipment' in Section A of this Manual.

1-3 Accessories:

Output modules are available to provide various output pulse voltages, currents, and polarities ranging from approximately 19 KV at 0.9 ampere to 40V at 400 amperes (See Data Sheet in back of manual)

1-4 Power Cable:

The three conductor power cable of this instrument is terminated in a polarized three-prong male connector recommended by the National Electrical Manufacturer's Association. The third contact is an offset round pin which grounds the instrument chassis when used with the appropriate receptacle.

To use this NEMA connector in a two-contact receptacle, a three-prong to two-prong adapter should be used. The ground connection emerges from the adapter as a short lead which should be connected to a suitable ground for the protection of operating personnel.

SECTION II - OPERATING INSTRUCTIONS

2.1 Controls and Terminals:

1. Meter:

The front panel meter contains two independent scales. One indicates the approximate pulse amplitude at 1% duty factor into 200 ohm load. This is intended primarily for reference purposes, and is not to be used for accurate adjustments. The second scale, labeled MAXIMUM DUTY FACTOR, indicates the maximum recommended duty factor for a given pulse amplitude to avoid overload conditions. The ABS MAX Meter indication should never be exceeded.

2. PRF Selector Switch:

The PRF Selector Switch allows selection of the pulse repetition range of the internal pulse generator and also is used to connect the external input to trigger the internal pulse generator (in the EXT TRIG position) or to drive the pulse amplifier (in the EXT DRIVE position).

3. PRF FINE Control:

The PRF FINE Control is a vernier control used for setting the repetition frequency of the internal pulse generator when the PRF switch is set on any position between 3 pps and 100,000 pps. It is inoperative when the PRF selector is in the EXT DRIVE and EXT TRIG positions.

4. Pulse Width Switch:

The PULSE WIDTH switch allows selection of the desired pulse width range of the internal pulse generator. It is inoperative when the PRF switch is in the EXT DRIVE position.

5. PULSE WIDTH FINE Control:

The FINE control is a vernier control for setting the pulse width in conjunction with the WIDTH selector switch. It is inoperative when the PRF switch is in the EXT DRIVE position.

6. AMPLITUDE AND HV RESET Control:

The AMPLITUDE control provides continuous adjustment of the output voltage from essentially zero to maximum output. This control also contains a zero start (HV RESET) feature which requires the control to be at zero before the high voltage can be turned on. By-passing of zero start feature may be accomplished by means of the HV RESET OVER-RIDE (lock) switch.

7. EXTERNAL INPUT:

A front panel BNC connector for external input is employed to apply either an external trigger to the internal pulse generator (when the PRF selector switch is in the EXT TRIG position), or a drive pulse to the pulse amplifier (when the PRF selector switch is in the EXT DRIVE position). The input impedance at the EXT INPUT terminal is approximately 150 ohms with the PRF switch in the EXT TRIG position and 50 ohms with the PRF switch in the EXT DRIVE position.

8. SCOPE TRIGGER:

A SCOPE TRIGGER is obtained by connecting to a front panel BNC Connector which provides the trigger pulse for scope synchronizing purposes. This trigger is of positive polarity and approximately 5 volts peak. A scope trigger is present for all settings of the PRF Selector Switch except 'EXT DRIVE'.

9. POWER Push Button:

The POWER push button is the main power switch which controls all voltages to the unit.

10. HV-ON - READY Push Button:

The READY green light becomes illuminated after the unit has reached operating temperature (approximately one minute after applying power) and remains on until the HV is turned on. The 'HV-ON' red-flashing light indicates that the power supply units are all actuated.

11. OVERLOAD RESET Push Button:

The OVERLOAD RESET yellow light indicates that the equipment has been subjected to an overload condition. High voltage is removed and may not be restored until after depressing the OVERLOAD RESET push button.

12. HV RESET OVER-RIDE Switch:

The HV RESET OVERRIDE lock switch bypasses the zero start feature of the HV supply. The key may not be removed in the IN position, but should normally be removed in the OUT position as a safety precaution.

13. MODEL 350-12 Plug-In Units:

The Plug-in units are listed and discussed on data sheet in the back of manual.

14. FUSES:

The fuses are described in Section 4-6.

2-2 Initial Turn On:

1. HV-RESET OVERRIDE switch should be in OUT position.

2. Plug the AC power cord into a 115 VAC 10 amp 50-60 cps source.

3. Connect SCOPE TRIGGER to the external trigger of an oscilloscope.

4. Connect output of the Model 350 to its load and also to the input of the scope.

5. Depress POWER push button and allow approximately 60 seconds for warm-up. (READY light will indicate when warm-up time has elapsed).

6. Set PRF and Pulse WIDTH selector switches to the approximate desired settings.

7. Depress HV ON button when ready light is lighted.

8. Turn AMPLITUDE control fully counter-clockwise so that HV RESET momentary contact switch is activated. READY light should go out and HV ON flashing light should come on. If this does not happen, repeat steps 7 and 8.

9. Increase the amplitude slightly and set PRF and WIDTH with vernier controls to the desired settings.

10. Set AMPLITUDE to desired operating level.

11. To turn the instrument to standby depress the HV ON button.

12. To turn all power off, depress the POWER button.

2-3 Set-up Procedure:

1. PRF:

Select the range of the PRF with the PRF selector switch. While monitoring the output at a low amplitude setting, vary the FINE control directly under the selector switch for the desired PRF.

2. Width:

Select the range of the pulse width with the WIDTH selector switch. While monitoring the output at a low amplitude, vary the FINE control directly under the WIDTH selector switch for the desired pulse width.

3. Amplitude:

Set the AMPLITUDE control to provide the desired output. If changes in load, duty factor (i.e., PRF and width settings), or line voltage are made, the output AMPLITUDE control should be adjusted to maintain constant output. Care must be taken not to exceed the allowable output level which is dependent upon the pulse duty factor. See Figure 6-1.

4. External Trigger:

When the PRF selector switch is in the EXT TRIG position, the generator can be triggered from an external source by means of a 2.5V peak minimum negative trigger pulse. This pulse should be at least 0.3usec in width. When using wide trigger pulses, the rise time should be 10usec or less. The external trigger rate can be from one-shot to 100,000 pps. However, the trigger rate should never exceed that value which would result in an output pulse of more than 5% duty factor. If PRF of trigger is too high, no output pulse may appear.

5. External Drive:

When the PRF selector switch is in the EXT DRIVE position, the internal pulse generator is not used to drive the pulse amplifier. In this application, an external pulse is fed to the external input which is terminated into 50 ohm (when used for external drive). The pulse amplifier is to be driven from an external positive 10V or greater pulse source. However, the pulse amplitude should not exceed 30 volts with a duty factor less than 5%. The pulse amplifier is not a Class 'A' amplifier; therefore, some shaping of the output pulse will occur. The pulse amplifier will tend to 'square' any input signal. PRF of the external drive may be any rate between zero and 100KC. Duty factor may be increased up to 5% at reduced output levels. The PRF and width controls are inactivated in this position. Other controls are unaffected.

2-4 Overload Protection

The OVERLOAD RESET switch removes high voltage when the output tube plate current is exceeded. If an overload occurs, the yellow (OVERLOAD RESET) indicator lights, and the HV-ON flasher goes off. After removing the overload, turn the AMPLITUDE control to zero, and depress the OVERLOAD RESET button. The OVERLOAD RESET light should now go off and the green READY light come on. Operation is resumed by turning the AMPLITUDE control completely counter clockwise to activate the HV RESET switch. The HV-ON red flasher should come on. Then the AMPLITUDE control should be increased slowly to the desired operating level.

2-5 High Voltage Reset Override

As a safety precaution, the Model 350 contains a feature that requires the output amplitude to be set to zero before the HV supply can be energized. If desired, this feature can be overridden by means of a key switch located on the front panel. The key is removable from the switch only in the OUT position. When this switch is in the IN position, high voltage may be turned off and on simply by depressing the HV-ON READY switch (without turning the AMPLITUDE control to zero).

2-6 Output Plug-In Module

The Model 350 is supplied with output terminals on a plug-in module which can be replaced with alternate accessories to provide higher output voltage, higher output current, and for positive pulse polarity. The module is removed by unscrewing the two front panel knobs on the plug-in unit. Interlocking is provided to remove the high voltage when the module is removed.

2-7 Standard Accessory Plug-In Units

A data sheet in the back of this manual lists the standard Plug-In Output Units available. *

*Accessory output Units, other than standard, will be quoted on request. Please advise the VELONEX Sales Office of your special requirements.

SECTION III - CIRCUIT DESCRIPTION

3-1 General

The Model 350 employs an oscillator to establish the pulse repetition frequency, a timing circuit to control the pulse width, followed by a four stage pulse amplifier. The first amplifier is AC coupled to a second stage which is DC coupled to a cathode follower which is also DC coupled to four parallel output amplifier tubes. Output amplitude is controlled by varying the DC voltage on the output stage. Figure 6-2 is a block diagram of the major elements of the Model 350. Figures 6-3, 6-4 and 6-5 are schematic diagrams of the pulse generator, pulse amplifier, and power supply and control circuits, respectively.

3-2 Control Circuits

The following control circuitry is employed in the Model 350:

(a) Warm up delay circuit - A time delay relay K1 provides heater warm up time prior to application of high voltage. When time delay relay K1 closes, it actuates relay K2, which in turn supplies AC power to the power supplies and also lights the 'Ready' panel indicator.

(b) High-Voltage on Circuit - After Relay K2 and the 'HV-ON' switch are both closed and either the 'HV-RESET OVERRIDE' (lock switch) is 'OUT' or the 'HV-RESET' momentary contact is actuated, relay K3 latches. This supplies power to the high voltage supply and actuates the 'HV-ON' flashing panel indicator. It is not apparent at the front panel whether the 'HV-ON' switch is open or closed; therefore, this switch may have to be pushed a second time if the HV-flasher does not light after the first attempt to actuate the high voltage.

(c) Overload protection - If the average current in the high-voltage power supply is exceeded, relay K6 closes and causes relay K5 to open the high voltage circuitry. This also causes the 'OVERLOAD-RESET' panel light to be energized and turns off the 'HV-ON' indicator. The solenoid of relay K6 is heavily by-passed to prevent tripping the overload relay by transients or surges.

3-3 High Voltage Power Supplies

A variable DC voltage from 0 to -3500 volts supplies potential to the cathodes of the four output tubes. Another variable DC voltage from 0 to +900 volts is also generated to operate the screen grids of the output tubes. These two power sources are designed so that their outputs vary together as the pulse amplitude control of the Model 350 is adjusted. Since several stages of the amplifier are DC coupled, the power supplies are added, (or referenced) to the high voltage power supply (as shown in Figures 6-2 and 6-5). The cathode of the cathode follower is supplied from a DC source -210 volts with respect to the high voltage, the cathode of the preceeding amplifier is supplied from a DC source -340 volts with respect to the high voltage and the plate and screen of this stage is supplied with a voltage +120 volts with respect to the high voltage. Voltage regulator tubes are employed in the -210 volt and -75 volt supplies.

3-4 PRF Oscillator and Pulse Width Circuits:

The PRF generator consists of unijunction transistor Q-202, operating essentially as a relaxation device. Switch S201D selects the capacitor value to give the desired repetition range in conjunction with R-205, which acts as the "FINE PRF" control. At the highest frequency range, the emitter fixed resistance is lowered by paralleling R-224 across R-223. In the "EXT TRIG" position, unijunction Q-202 is not used. The external input is fed through pulse-transformer, T-201 to the subsequent circuits.

The input pulse from either the unijunction or external input is amplified and shaped by switching-mode transistors Q-203 and Q-204. This pulse is then fed to the base of Q-205 which is one-half of a duration-controlled one-shot. Q-205 is normally 'on' but turned 'off' by the trigger pulse. The collector of Q-205 is coupled to the base of Q-206 through one of the ramp-timing capacitors selected by "WIDTH" range switch S-202B. The ramp-timing capacitor is charged through a constant-current source consisting of Q-201 and its associated circuitry. "FINE WIDTH" control, R-203, sets the voltage to which the ramp will rise. Internal adjustment, R-241 allows factorysetting of the fixed resistance in series with the fine width control to assure that the pulse will be present at the minimum setting of the width controls.

Because R-218 is a relatively low resistance, the signal at the base of transistor Q-206 is differentiated. Therefore the base drive drops to zero after the ramp run-up is stopped by the width control setting. The signal at the collector of Q-206 is rectangular and holds Q-205 'off' for its duration. This pulse signal is coupled from the emitter of Q-206 through transistor amplifier - shapers Q-207, Q-209, and Q-210. The output pulse is fed through capacitor C1 to the first pulse amplifier.

The 'Scope-Trigger' output is derived from the transistorized blocking oscillator Q-208 which is driven from the output signal of Q-210.

The +30 volt, +12 volt, and -12 volt power supplies are Zener regulated as shown in Figure 6-5.

3-5 Pulse Amplifier

The positive pulse output of the pulse generator is fed to the grid of V1 (6CW5) which is operated as a Class A amplifier. The plate signal is fed through a 0.25uf 4KV capacitor to the grid of V2 (6CW5). V2 is biased such that maximum plate current flows in the absence of an input signal. Negative pulses from V1 turn off V2 during the pulse interval. Shunt peaking is employed in the first two amplifier stages to enhance pulse rise and fall times. Positive pulses from the plate of V2 are coupled to the grids of the four parallel output tubes V4 through V7 (4CX350A).

All DC potentials supplied to V2 and V3 are referenced to the variable negative high-voltage power supply used for the output tubes. This allows DC coupling of tubes V2 through V7.

A fixed voltage supply between points Z and Y (on Figure 6-4), is employed to provide proper biasing of V3. Another fixed voltage supply between points Y and X (on Figure 6-4) is employed to provide cutoff bias to the output tubes between pulses. The screens of the output tubes are operated at a variable DC voltage which is approximately proportional to their plate voltage. A varistor network (RV1 through RV5) is used in the screen-grid circuit of the output tubes. The varistors, in conjunction with a 15K resistor (R47), prevent the screen voltage from rising excessively when the amplitude control is near maximum and when

little current is drawn from the output tubes (i.e. under low duty-factor conditions).

The Model 350 is designed to provide pulses at duty-factors up to 5%. However, the first amplifier and cathode-follower circuits are designed to prevent exceeding tube ratings if the duty-factor is exceeded.

A diode network (CR1 and R28 through R31) is employed in the output circuit to prevent damage to the output tubes or a transformer connected to the output due to excessive pulse 'backswing'.

If a DC potential is present in the load circuit, Velonex V-1102 plug-in should be employed. (See Data Sheet in back of manual.)

Occasional internal-flash breakdowns (or 'arc downs') are to be expected in power tubes used in pulse service. This occurance is infrequent and random; however, the probability of occurance is a function of a number of factors. Arc-downs are more likely to occur after the tube has been idle for some time, after severe vibration, under conditions of high pulse repetition rates, and when feeding highly inductive loads. Normally, the arc-down within the tube clears itself and is not destructive to the tube. In order to protect the Model 350 and the external load from damage if an arc-down should occur, a special fast-blowing fuse is employed in the Model 350. Section 4-6 describes how to replace this fuse if necessary.

SECTION IV -

MAINTENANCE

4-1 General:

Before attempting to trouble-shoot this instrument, completely study and understand the circuit description of Section III.

4-2 Cooling:

The Model 350 utilizes both convection and forced air cooling, therefore, all vents in the rear of the cabinet must be clear of obstructions. In rack mounted units it is also necessary to avoid blockage of the required airflow.

4-3 Cabinet Removal -(Not Applicable for Rack-Mounted Units)

To remove the instrument from its cabinet, remove the eight screws from the front panel, (four on each side) and slide the instrument forward clear of the cabinet.

4-4 Cleaning:

Periodically inspect the instrument for dust accumulation. If necessary, clean by use of a vacuum cleaner or by blowing out dust using air under moderate pressure.

4-5 Pilot Lights:

Incandescent panel lights are used to indicate POWER, READY, HV-ON and OVERLOAD RESET. Panel lamps for these indicators are replaceable from the front panel by snapping out the translucent cover from each switch. Six volt, number 328, lamp bulbs are used. In order to provide an additional safety measure, two lamps are connected in parallel in each indicator. Therefore, if any indicator light becomes dim (due to one lamp burnout) the burned out lamp should be replaced. This should prevent the possibility of having the high voltage on in the absence of the red flashing indicator light. Panel lamp replacement may be facilitated by the use of a lamp replacing tool (such as a Microswitch type 15PA19 tool).

4-6 Fuses

Four fuses are employed for instrument protection. Three of these are easily accessible on the back of the instrument without removing the rear panel. 8 Amp. 2 Amp. and ½ Amp Slo-Blo fuses are used to protect the entire unit. the intermediate DC power supply. and the low DC power supply. respectively. Should any of these fuses blow. after removing the cause of the failure. replace with the same type fuse as in the original equipment. The fourth fuse is used to protect the instrument (and the external load) in the event of "arc-down" in any of the output amplifier tubes (See last paragraph of Sec. 3-5). This fuse is located in the compartment housing the output plug-in module. To replace. remove the module. and unscrew the two screws holding the fuse cartridge on the back of the compartment. Use care to prevent dropping the screws into the instrument. Since the fuse (F4) employed is a specially-selected fast blowing unit. no substitution of fuse type should be made as this may defeat the protection provided. Make certain after installing a replacement fuse that the two screws are securely tightened.

4-7 Interlocks:

Two interlocks are provided for safety. One interlock shuts off the high voltage when the output plug-in module is removed. The other interlock opens the main power line when the instrument is removed from its cabinet or when the rear panel is removed.

4-8 Instrument Failure:

By carefully observing the symptoms. and by referring to the block diagram (Figure 6-2) and the schematic diagrams (Figures 6-3. 6-4. and 6-5), most troubles can be pinpointed quickly to a particular circuit. As an aid to trouble-shooting procedures. a trouble locating chart (Figure 6-6) is provided. Significant voltages and waveforms are shown in Figures 6-3. 6-4. and 6-5. Voltage readings are given for the conditions described on the diagrams.

4-9 Power Output Tube Replacement:

In order to prevent unseating of the power output tubes (4CX350A's during shipping or moving of the Model 350. a special hold-down fixture is used. To replace any power output tube proceed as follows:

1. Remove the four cross-recessed 10-32 screws attaching the hold-down fixture to the heat dissipators on each output tube.

2. Remove the one cross-recessed 6-32 screw near the front edge of the fixture attaching it to the metal conductor which runs to the terminal on the plug-in housing. DO NOT remove the two 4-40 screws behind the 6-32 screw.

3. Remove the two cross-recessed 8-32 screws connecting the fixture to the bracket on the side wall of the model 350.

4. Lift the fixture off. DO NOT unsolder any component.

5. Remove the output tube(s) with their heat dissipator(s).

6. Separate the tube(s) and dissipator(s).

7. Replace by reversing the above process.

All screws required to be removed engage threaded mating parts. No loose nuts are involved. Care should be taken to reseat and securely tighten all tubes and components in re-assembly.

4-10 Overload Protection:

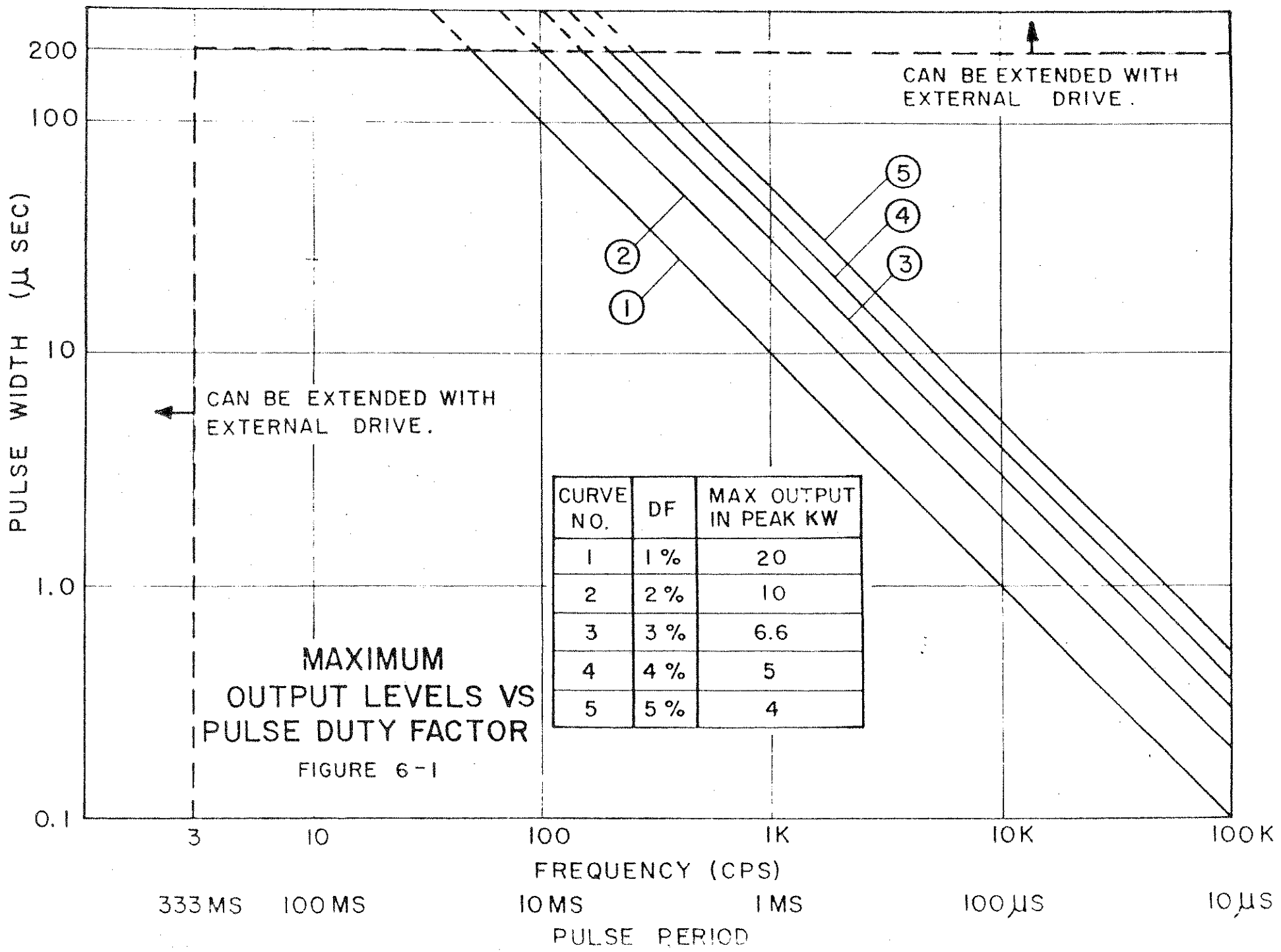
The value of R46 is approximately 75 ohms. The exact value has been selected at the factory to match the overload relay K6. In the event that a replacement of ither overload relay K6 or resistor R46 becomes necessary; after replacement of K6 or R46, check the output power level at which the protective circuitry becomes operative. This is best done by operating the Model 350 Generator into a 200 ohm ± 1% resistive load (300W minimum).* Set the pulse width to approximately 10us, PRF to 1000 pps, and the amplitude to 2KV. Hold the amplitude constant by re-adjusting the Amplitude Control on the front panel, while increasing the pulse width slowly to the point where the yellow overload indicator just lights. The overload indicator should light when the pulse width is increased to between 13us and 16us. If the indicator lights for too narrow a pulse, R46 should be reduced by approximately 10%. If lighting the indicator requires a wider pulse R46 should be increased by approximately 10%. The above test should then be repeated and R46 re-adjusted if required.

If preferred, K6 and R46 replacements may be obtained from the VELONEX factory in matched pairs.

*A V-1121 plug-in unit may be used for this purpose. (See Data Sheet in back of manual).

SECTION V

VELONEX REPLACEABLE PARTS LIST



CURVE NO.	DF	MAX OUTPUT IN PEAK KW
1	1 %	20
2	2 %	10
3	3 %	6.6
4	4 %	5
5	5 %	4

MAXIMUM OUTPUT LEVELS VS PULSE DUTY FACTOR

FIGURE 6-1

STANDARD* ACCESSORY PLUG-IN UNITS FOR VELONEX MODELS 350 AND 570

Table I lists the standard Plug-In Output Units available. "Positive" units are polarity inverting (i.e. positive pulse output results when used in the Model 350 or 570). "Negative" units are non-inverting.

V-1102 allows insertion of any DC voltage between +1.5 KV and —2.5 KV in series with the external load and the Model 350 or 570 output pulse. It also may be used for DC blocking.

V-1121 consists of a 200 ohm internal load and a 1000:1 attenuator. Two output terminals are provided; one of these connects to the full output signal (0-2KV), the second provides a 1000 times ($\pm 2\%$) attenuated signal (0-2v) of the same wave-shape. This allows low-level monitoring of the generator output without the need for high voltage probes. Since the unit is internally loaded, the output from the high voltage terminal should be connected only to a high impedance ($>2K\Omega$). The output impedance of the attenuated output is 25 ohms. (If this signal is fed to a low impedance termination, a correction factor for the attenuation ratio should be made).

When using output modules, some power loss occurs; therefore, the maximum power output of the Model 350 or 570 Generator may not be available to the load.

Moderate waveform degradation occurs and varies over the range of plug-ins depending upon actual generator control settings and loads used.

Typical average characteristics when using either the Model 350 or 570 in the Non-Burst Mode, are:

Pulse Top Droop: On units marked for Pulse width range "1-10μsec", typical droop is up to 5% at 10μs; proportionately less for shorter pulses.
On units marked for Pulse width range "10-100 μsec", typical droop is up to 15% at 100μs; proportionately less for shorter pulses.

Rise and Fall Times: 80ns for output units with nominal pulse widths $\leq$ 1 μsec.
0.4μsec for output units with nominal pulse widths $<$ 10μsec except V-1005 and V-1098, which have rise and fall times of approximately 2μsec.
3μsec for output units with nominal pulse widths $<$ 100 μsec, except V-1077 and V-1124, which have rise and fall times of approximately 4μsec.

Overshoot: 5%

Backswing: 25%

When using the Model 570 in the Burst Mode, the maximum gate width for 10 percent droop at 50 percent duty factor, is twice the maximum nominal pulse width in the Non-Burst Mode, except for V-1077, which has a 10 percent droop at 120μsec gate width.

Within the Burst (when using the Model 570), the maximum post-pulse swing of the polarity opposite to the pulse varies between 10 and 50 percent, depending upon the plug-in type; the maximum post-pulse swing of the same polarity as the pulse is 15 percent, except for V-1088 which is approximately 25 percent.

Price for Std. Plug-in Units: $295.00 each FOB Santa Clara except V-1140 which is $395.00 FOB Santa Clara. Shipping Weight: ~ 15 lbs. ea.

*Accessory output units, other than standard, will be quoted on request to the VELONEX Sales Office.

Data and Prices shown subject to change without notice. 10/66.

velonex division of pulse engineering, inc., 560 robert ave., santa clara, california 95050 (408)244 7370 twx 910 338 0114

velonex
division of Pulse Engineering, inc.

TABLE I

STANDARD PLUG-IN OUTPUT UNITS FOR VELONEX MODELS 350 AND 570

VELONEX MODEL NUMBER NEGATIVE	VELONEX MODEL NUMBER POSITIVE	TURNS RATIO	NOMINAL PULSE WIDTH	NOMINAL LOAD	TYPICAL PEAK OUTPUT VOLTAGE WITH NOMINAL LOAD	TYPICAL PEAK OUTPUT CURRENT WITH NOMINAL LOAD	APPLICABLE TO MODEL 570 ONLY: MAX RATED PULSE PRF WITHIN BURST FOR POSITIVE OUTPUT	APPLICABLE TO MODEL 570 ONLY: MAX RATED DUTY FACTOR WITHIN BURST FOR POS. OUTPUT AT MAX PRF****
V-1140†	V-1110†	45:1	1.0-10 μsec	0.1 Ω	40 V	400 Amp	0.4 MC	40%
V-1010†	V-1010†	20:1	0.1-1.0 μsec	0.5 Ω	85 V	170 Amp	2 MC	35%
V-1014†	V-1014†	20:1	1.0-10 μsec	0.5 Ω	85 V	170 Amp	1.3 MC	25%
V-1058†	V-1058†	10:1	0.1-1.0 μsec	2.0 Ω	190 V	95 Amp	2 MC	35%
V-1009†	V-1009†	10:1	1.0-10 μsec	2.0 Ω	190 V	95 Amp	2 MC	25%
V-1115	V-1027	3:1	0.1-1.0 μsec	20 Ω	550 V	28 Amp	2 MC	35%
V-1116	V-1028	3:1	1.0-10 μsec	20 Ω	550 V	28 Amp	1.3 MC	25%
V-1092	V-1089	3:1	10-100 μsec	20 Ω	500 V	25 Amp	0.2 MC	50%
V-1117*	V-1094*	2:1	0.1-1.0 μsec	50 Ω	950 V	19 Amp	2 MC	50%
V-1118*	V-1095*	2:1	1.0-10 μsec	50 Ω	950 V	19 Amp	2 MC	50%
V-1119*	V-1096*	2:1	10-100 μsec	50 Ω	900 V	18 Amp	0.2 MC	35%
**	V-1013	1:1	0.1-1.0 μsec	200 Ω	1.9 KV	9.5 Amp	2 MC	50%
**	V-1006	1:1	1.0-10 μsec	200 Ω	1.8 KV	9.0 Amp	2 MC	50%
**	V-1071	1:1	10-100 μsec	200 Ω	1.7 KV	8.5 Amp	0.05 MC	50%
V-1102**	—	—	0.1-200 μsec	200 Ω	1.9 KV	9.5 Amp	2 MC	50%
V-1121***	—	—	0.1-200 μsec	***	2.0 KV 2.0 V	— —	2 MC	50%
V-1100	V-1088	1:3	0.1-1.0 μsec	2 KΩ	5.0 KV	2.5 Amp	1.5 MC	25%
V-1123	V-1078	1:3	1.0-10 μsec	2 KΩ	5.0 KV	2.5 Amp	0.6 MC	50%
V-1091	V-1083	1:3	10-100 μsec	2 KΩ	5.0 KV	2.5 Amp	0.2 MC	50%
V-1098	V-1005	1:10	3.0-10 μsec	20 KΩ	19 KV	0.95 Amp	0.1 MC	35%
V-1124	V-1077	1:10	10-100 μsec	20 KΩ	15 KV	0.75 Amp	0.03 MC	15%

* — Supplied with Type UG-61D/U Connector

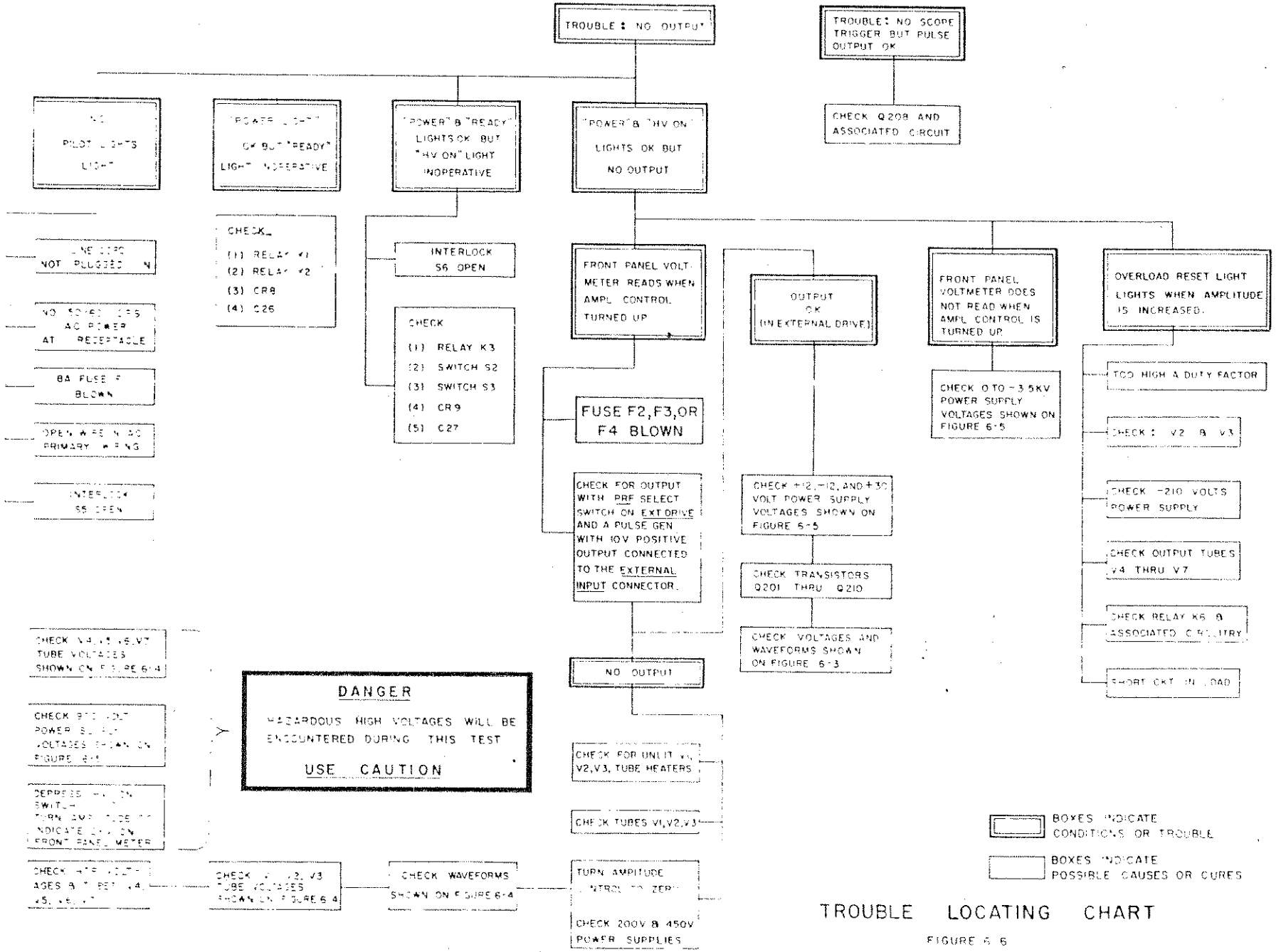
** — See second paragraph of adjoining text

*** — See third paragraph of adjoining text

**** — At reduced PRF, interpulse duty factor may be increased to a maximum of 50 percent.

† — These units may be used for either polarity by reversing ground connection on output. They employ stripline output configuration.

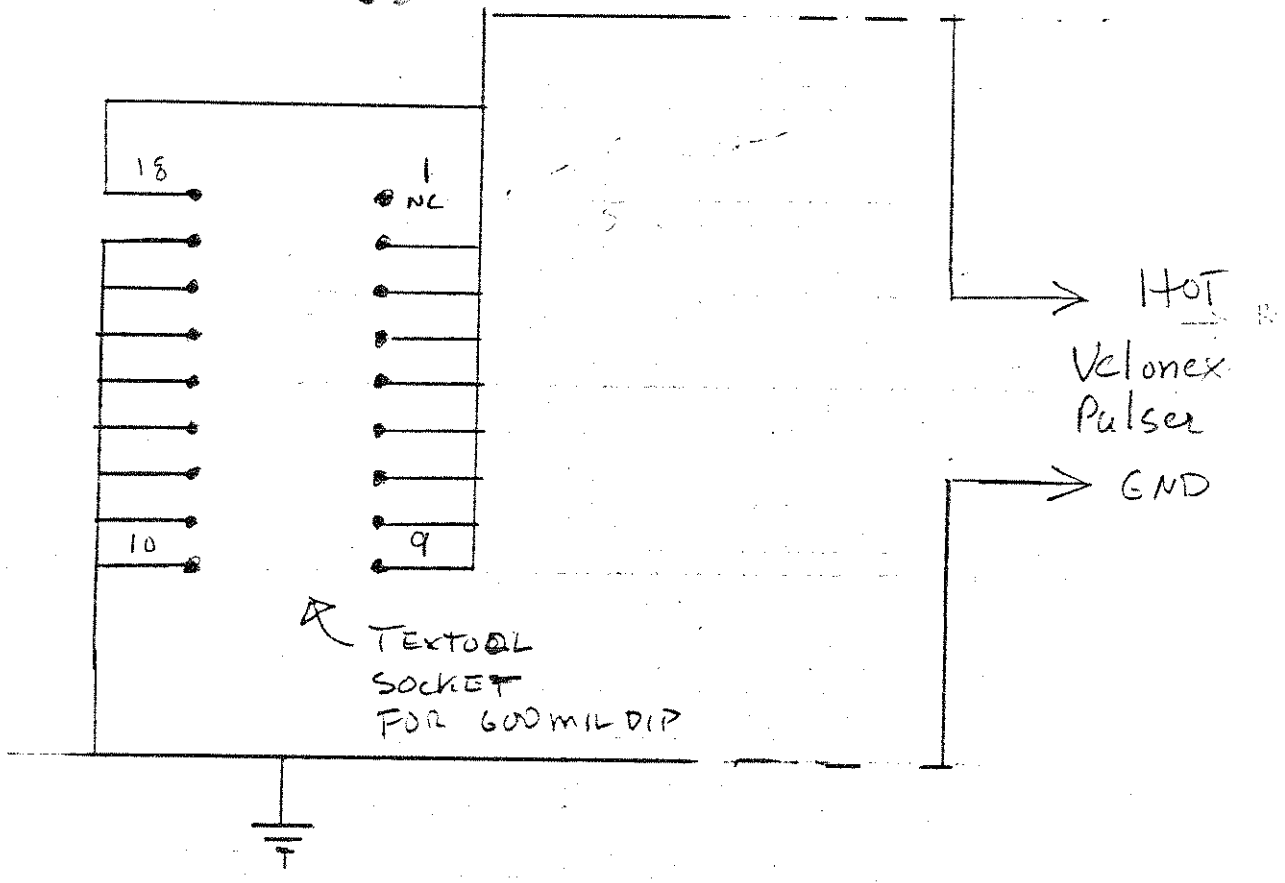
049



TROUBLE LOCATING CHART

FIGURE 6-6

NOTE. FIVE SOCKETS WIRED IN PARALLEL IN THIS MANNER PRESENT A LOAD OF 750 Ω TO THE PULSE GENERATOR.
555

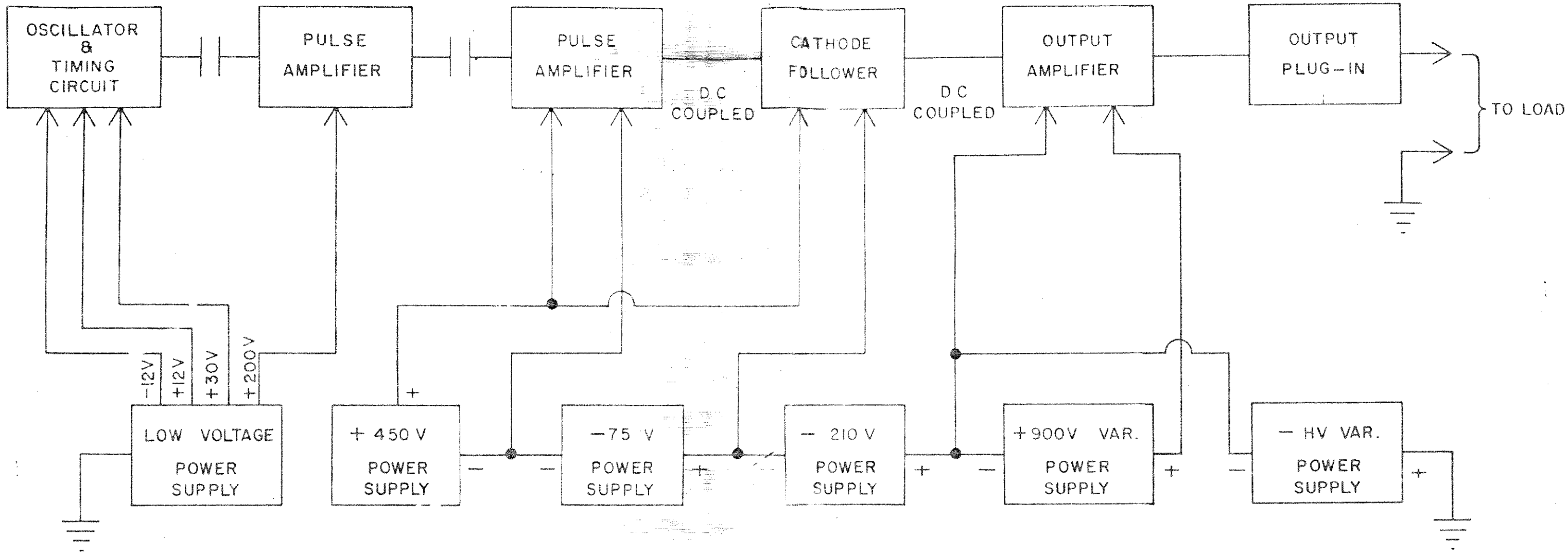


1000 V
2.4 μSec

VIEWED FROM BOTTOM OF SOCKET

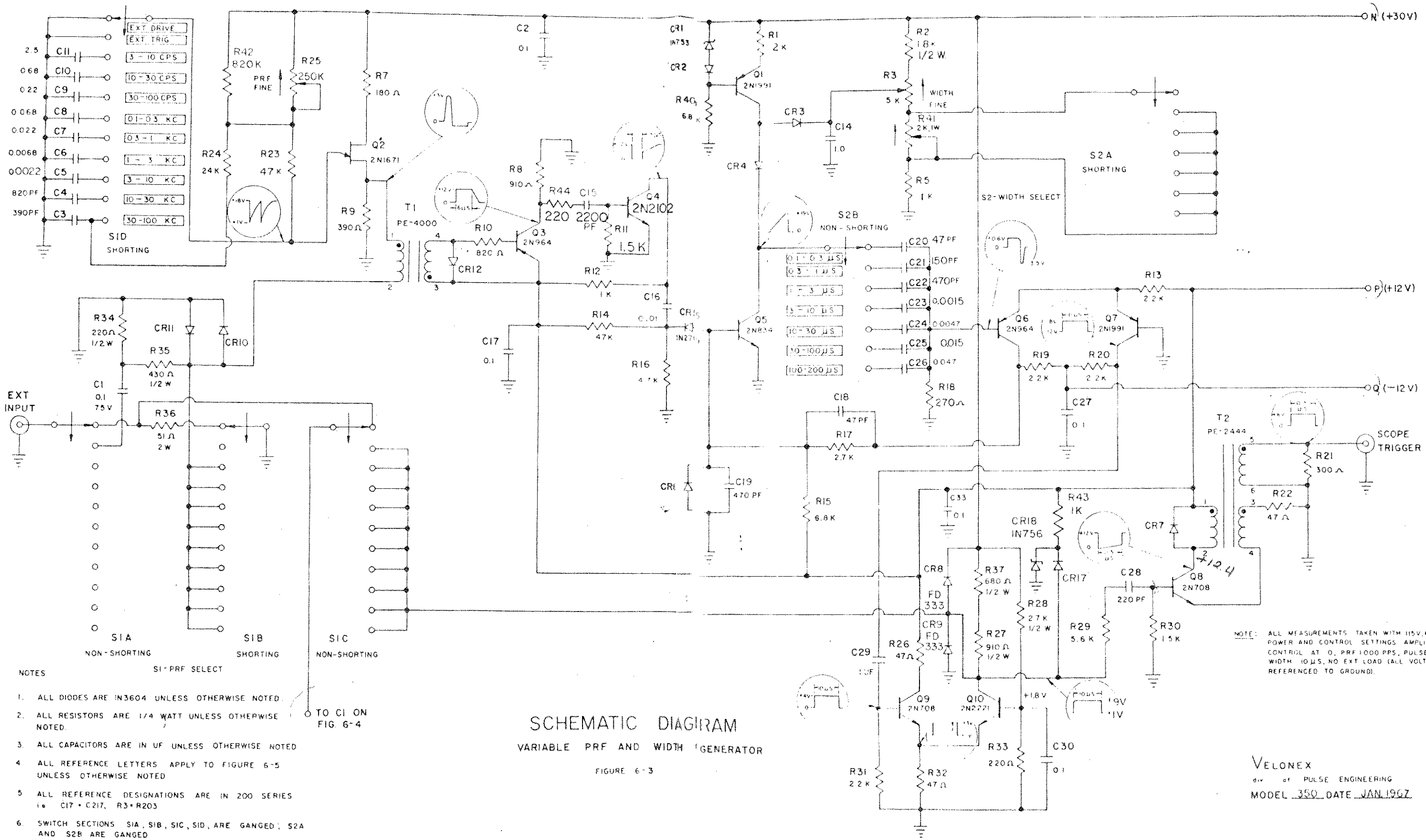
ISSUE	ENGR JMC	TITLE 239A High Voltage Surge Fixture	BELL LABORATORIES
	DRAWN		SHEET

PRINTED IN U.S.A.
832-A3 (10-71)



BLOCK DIAGRAM OF MODEL 350 HIGH POWER PULSE GENERATOR

FIGURE 6-2



NOTES

1. ALL DIODES ARE IN3604 UNLESS OTHERWISE NOTED.
2. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE NOTED.
3. ALL CAPACITORS ARE IN UF UNLESS OTHERWISE NOTED
4. ALL REFERENCE LETTERS APPLY TO FIGURE 6-5 UNLESS OTHERWISE NOTED
5. ALL REFERENCE DESIGNATIONS ARE IN 200 SERIES i.e. C17 + C217, R3 + R203
6. SWITCH SECTIONS S1A, S1B, S1C, S1D, ARE GANGED; S2A AND S2B ARE GANGED

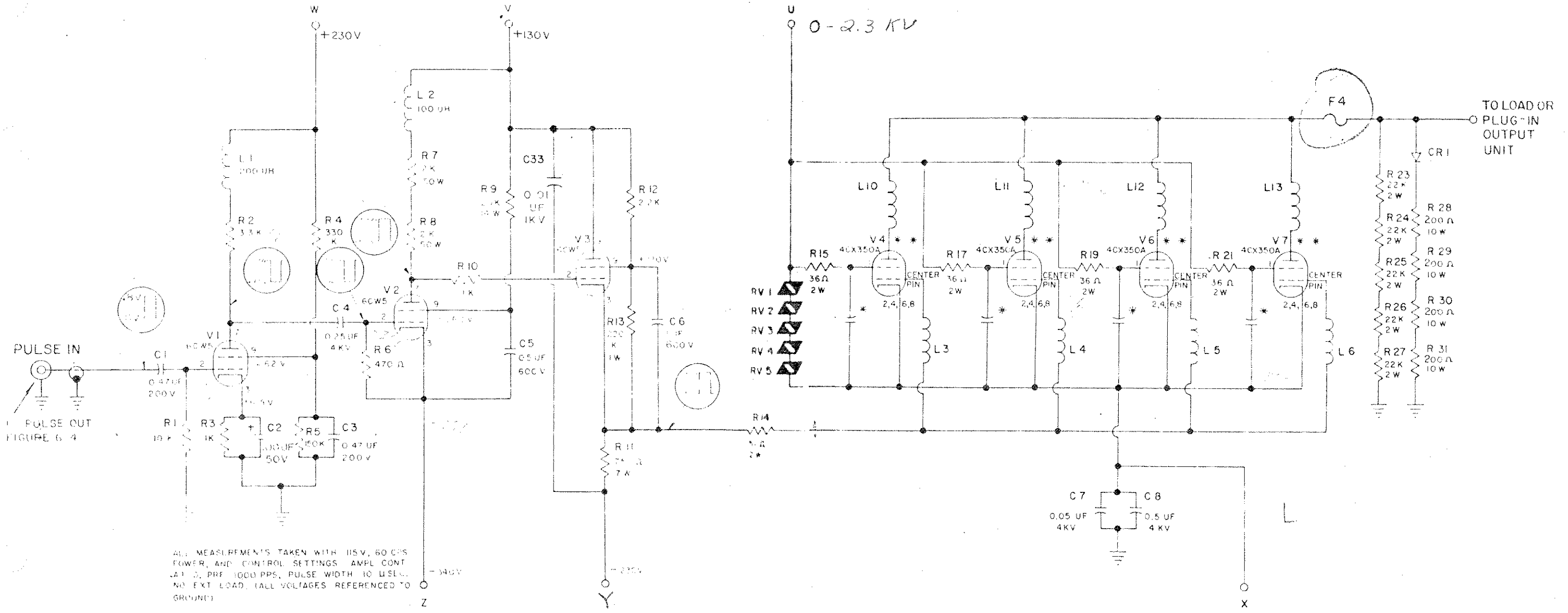
NOTE: ALL MEASUREMENTS TAKEN WITH 115V, 60CPS POWER AND CONTROL SETTINGS AMPLITUDE CONTROL AT 0, PRF 1000 PPS, PULSE WIDTH 10 µS, NO EXT LOAD (ALL VOLTAGES REFERENCED TO GROUND).

SCHEMATIC DIAGRAM

VARIABLE PRF AND WIDTH GENERATOR

FIGURE 6-3

VELONEX
div of PULSE ENGINEERING
MODEL 350 DATE JAN 1962



ALL MEASUREMENTS TAKEN WITH 115 V, 60 CPS POWER, AND CONTROL SETTINGS AMPL CONT AT 5, PRF 1000 PPS, PULSE WIDTH 10 μSEC., NO EXT LOAD. (ALL VOLTAGES REFERENCED TO GROUND)

ALL RESISTORS ARE ± 5% AND 1/2 W UNLESS OTHERWISE NOTED.

* PART OF SOCKET SK 630 (1000 UUF, 1KV EACH)

* * CONNECTS TO ANODE RADIATOR CAP

SCHEMATIC DIAGRAM

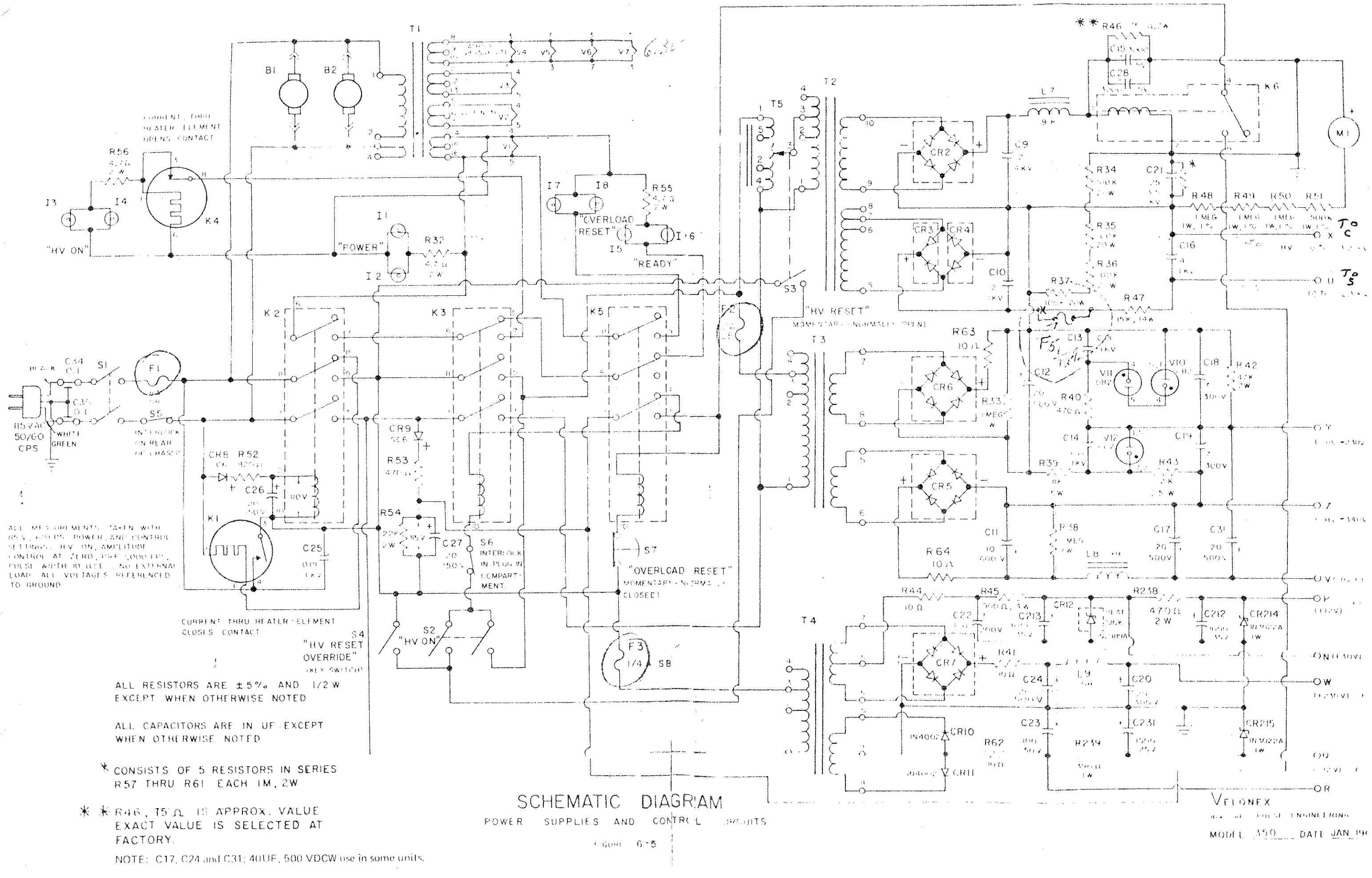
PULSE AMPLIFIER

FIGURE 6-4

VELONEX

[illegible] OF PULSE ENGINEERING

MODEL 350 DATE JAN. 1966



ALL MEASUREMENTS TAKEN WITH 115 V, 60 CPS POWER, AND CONTROL SETTINGS: H.V. ON, AMPLITUDE CONTROL AT ZERO, PRF 1000 CPS, PULSE WIDTH TO TEST, NO EXTERNAL LOAD. ALL VOLTAGES REFERENCED TO GROUND

ALL RESISTORS ARE ±5% AND 1/2 W EXCEPT WHEN OTHERWISE NOTED

ALL CAPACITORS ARE IN UF EXCEPT WHEN OTHERWISE NOTED

* CONSISTS OF 5 RESISTORS IN SERIES R57 THRU R61 EACH 1M, 2W

** R46, 75 Ω IS APPROX. VALUE EXACT VALUE IS SELECTED AT FACTORY.

NOTE: C17, C24 and C31; 40UF, 500 VDCW use in some units.

SCHEMATIC DIAGRAM

POWER SUPPLIES AND CONTROL CIRCUITS

FIGURE 6-5

VELONEX

DIV. OF PULSE ENGINEERING

MODEL 350 DATE JAN 19