Pulse Generator

Model 8020

INSTRUCTION MANUAL

BERKELEY NUCLEONICS CORPORATION
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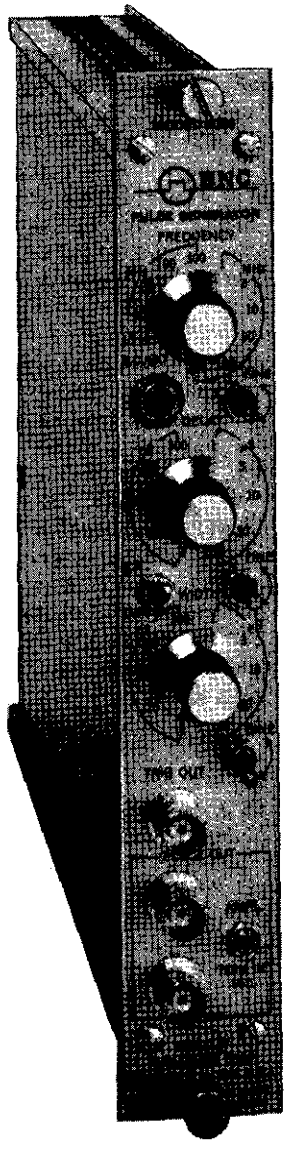
INDEX

SPECIFICATIONS



REPETITION RATE: a) 0.5 Hz-10 Hz, continuously variable, 3 kHz-125 MHz continuously variable.
b) Ext Trigger, 0-125 MHz.
c) Single Cycle.

DELAY: 0 to 100 μsec, continuously variable.

WIDTH: 3 nsec to 100 μsec, continuously variable.

JITTER: Rep rate, delay or width less than 50 psec or 0.1%, whichever is greater.

DOUBLE PULSE: 6 nsec min. separation. Pulse spacing set by delay controls.

RESOLUTION OF FINE CONTROLS: Less than 0.4%.

TEMPERATURE COEFFICIENT OF FREQUENCY, DELAY OR WIDTH: Less than 0.1%/°C.

DUTY FACTOR: Greater than 50%.

OUTPUT PULSES: Two parallel output connectors providing greater than −32 mA. When terminated in 50 Ω, there are two −0.8 V pulses. (Standard NIM fast logic level.)

RISE TIME: 1 nsec.

FALL TIME: 1.3 nsec.

AMPLITUDE ADJUSTMENT: 10:1 range (from −32 mA to −3.2 mA), continuously variable.

OUTPUT PULSE ABERRATIONS: Baseline or pulse top, less than 5%.

TRIGGER OUT: −0.8 V, 50 Ω, 1 nsec rise time. (Two outputs on front and rear panel.)

EXTERNAL TRIGGER: −0.6 V, 50 Ω. (Rear panel.)

EXT GATE: NIM logic. (−0.6 V to gate on, at rear panel.) Synchronous. Rear panel slide switch provides gated or ungated operation.

AMBIENT TEMPERATURE: 55°C max.

PROTECTION: Open and short circuit proof.

POWER REQUIREMENTS: +24 V, 120 mA, +12 V, 120 mA, −24 V, 135 mA, −12 V, 135 mA.

MECHANICAL: Single width AEC module, 1.35" wide x 8.70" high in accordance with TID-20893 (Rev. 2).

WEIGHT: 2½ lbs., net, 7 lbs. shipping.

OPERATING INSTRUCTIONS

SECTION 2

2.1 INTRODUCTION

The Model 8020 pulse generator is a one nanosecond rise time, 125 MHz pulse generator specifically designed for use with high energy physics instrumentation. However, its broad range of functions is applicable in other areas. It provides two parallel outputs of -16 mA which convert to two -0.8 V pulses terminated into 50 ohms.*

The Model 8020 conforms to the mechanical and electrical specifications for NIM (nuclear instrument modules) set up by AEC report TID-20893, Rev. 3. In order to power this instrument it is necessary to provide ±24 V and ±12 V from an external supply. Berkeley Nucleonics manufactures portable power supplies, the Model AP-1 and Model AP-2, which are designed to provide the necessary power.

2.2 FUNCTION OF CONTROLS AND CONNECTORS

FREQUENCY: A twelve-position switch and 25-turn trimming potentiometer provide the range desired. The internal repetition rate is adjustable from 3 kHz to 125 MHz. Below 3 kHz, a range of frequencies from 0.5 to 10 Hz is available by setting the FREQUENCY switch to 10 Hz. In addition a S.C. (single cycle) pushbutton and EXT (external trigger) operation is provided.

DELAY: A ten-position switch and a 25-turn trimming potentiometer provides a continuous delay between PULSE OUT and TRIG OUT from 0 - 100 μsec.

WIDTH: A ten-position switch and 25-turn trimming potentiometer provides a continuous pulse width from 3 nsec to 100 μsec.

S.P./D.P. (Single Pulse / Double Pulse): A front panel toggle provides either a single or double output pulse with each Trigger Out pulse. When this control is in the S.P. (single pulse) position, one output pulse appears with each Trigger Out pulse. When this toggle is in the D.P. (Double Pulse) position, two output pulses appear with each Trigger Out pulse. The first pulse is time coincident with the trigger out and second pulse is separated from the first by the setting of the delay controls.

AMPL. (Amplitude): A front panel mounted trimmer adjusts the output amplitudes over a 10:1 range. Normally it is set at the maximum to provide -16 mA output into each of two 50 ohms output terminations (or 0.8 V at each output when terminated in 50 ohms.)

GATE - ON / OFF: A rear panel slide switch provides gated or ungated operation. When it is in the GATE-OFF position a continuous pulse train appears at the output. When it is in the GATE-ON position a pulse burst will appear at the output connector only during the time that a -0.6 V gate signal appears at the rear panel gate connector.

TRIG OUT (Trigger Out): A connector on both the front and rear panel provides synchronizing pulses in time relation to the output pulse as set by the Delay controls. The Trigger Out pulses are a square wave train whose period is the same as the Frequency clock. THE TRIGGER OUTPUT CABLE MUST BE TERMINATED INTO 50 OHMS FOR PROPER OPERATION. The unused output need not be terminated.

PULSE OUT: Two parallel connectors on the front panel provide identical output pulses. When the AMPL (Amplitude) trimmer is set at maximum, -32 mA is available. The -32 mA divides into two -16 mA outputs when each connector is terminated in 50 ohms. If only one connector is terminated, the output amplitude will be -1.6 V across the 50 ohms termination and the rise time will be slower than 1 nanosecond. IT IS NECESSARY TO TERMINATE BOTH OUTPUT CONNECTORS IN 50 OHMS TO OBTAIN 1 NS RISE TIME AND -0.8 V PULSES.

EXT TRIG (External Trigger): A rear panel connector is provided to accept external synchronizing pulses. The FREQUENCY switch must be in the EXT position for this mode of operation. The input impedance is 50 ohms, and a -0.6 V amplitude pulse with a rise time less than 0.2 μsec is required.

GATE: A rear panel connector is provided to receive the external gate pulse. The input impedance is 50 ohms and -0.6 V is required to gate on the pulses. See GATE-ON/OFF above.

*This logic level has been adopted by the U. S. AEC committee on nuclear instrument modules. See Standard Nuclear Instrument Modules, Report TID-20893 Rev. 3, available from the U.S. Government Printing Office, Washington, D.C. 20402 for 40 cents.

2.3 OPERATIONAL CHECK POINTS

If there are any difficulties in obtaining desired operation from the Model 8020, the following check list will be useful.

NO OUTPUT PULSE:

- Is the rear panel GATE - ON/OFF in the proper position? (Set at GATE-OFF for continuous pulse train).
- Is the front panel FREQUENCY switch set correctly?

POOR OUTPUT PULSE SHAPE:

- Are both output connectors terminated in 50 ohms (even if one is not used)?
- Is the output cable 50 ohms characteristic impedance?

ERRATIC TRIGGERING OF OSCILLOSCOPE:

- Is the Trigger Out cable terminated in 50 ohms?
- Does the delay or width duty factor exceed 50%?

ERRATIC EXTERNAL TRIGGER OPERATION:

- Is the external trigger at least -0.6 V in amplitude when connected?
- Is the front panel FREQUENCY switch set at EXT?

DIFFICULTY IN EXTERNAL TRIGGERING AT 125MHz REP RATE:

- Is the Fine Frequency Control set at maximum counter-clockwise position?

DIFFICULTY IN OBTAINING 125MHz REP RATE:

- Are the Delay and Width Controls set near minimum so that 50% duty factor is not exceeded?

EXCESSIVE JITTER:

- Check power supply regulation.

INSUFFICENT AMPLITUDE:

- Check setting of AMPL. control.

This section of the manual describes the circuits used in the Model 8020. Section 3.1 describes the block diagram and reference is made to Fig. 1. Sections 3.2-3.11 describe the detailed circuits and reference is made to the schematics 8020-1, 8020-2 and 8020-3 at the back of the manual. See Sect. 3.12 for service.

3.1 BLOCK DIAGRAM

A block diagram of the Model 8020 is shown in Fig. 1. The clock pulses are generated by either the 3 kHz-125 MHz Multivibrator or the 0.5 Hz-10 Hz Multivibrator. The output of the 3 kHz-125 MHz Multivibrator triggers the Delay One-Shot and also triggers the Trigger Out circuit. The output of 0.5 Hz-10 Hz Multivibrator triggers the External Trigger circuit which in turn triggers the Delay One-Shot and Trigger Out circuit. When either the 0.5 Hz-10 Hz or 3 kHz-125 MHz Multivibrator is operating the other is inhibited.

The External Gate is connected directly to the 3 kHz-125 MHz Multivibrator. When the rear panel gate switch is in the "ON" position, the multivibrator is inhibited until a gating signal appears at the External Gate connector. The multivibrator then generates clock pulses for a period of time equal to the gate pulse width.

The External Trigger circuitry accepts external synchronizing pulses and shapes them to provide a trigger for the Delay One-Shot and the Trigger Out circuit. The 0.5 Hz-10 Hz and 3 kHz-125 MHz Multivibrators are inhibited during External Trigger operation.

The Delay One-Shot generates a pulse whose width is adjustable by the front panel Delay controls. The output of this one-shot passes into the Single/Double Pulse circuitry. If this circuit is set in the Single Pulse mode a trigger pulse is generated coincident with the trailing edge of the delay pulse. If the circuit is set in the Double Pulse mode, an additional trigger pulse appears which is coincident with the leading edge of the delay pulse.

The output of the Single/Double circuitry triggers the Width One-Shot. This one-shot generates a pulse whose width is adjustable by front panel Width controls. The Output Pulse Shaper generates the proper pulse shape to drive the output circuitry. The output circuitry is a current switch which provides a current of -36 mA into the output terminating resistances.

3.2 3 kHz-125 MHz MULTIVIBRATOR

Refer to Schematic 8020-1. Transistors Q11-Q18 function as a free-running multivibrator from 3 kHz-125 MHz. The feedback loop for regeneration is from the collector of Q11 through R36 and C18 to the base of Q12. The emitter of Q12 is capacitively coupled to the emitter of Q11. The value of the coupling capacitor C33-C41 sets the frequency range. The base of Q11 is coupled to the collector Q12 through C17 and R35, which completes the feedback loop.

Transistors Q14 and Q15 are constant current sources for the emitters of Q11 and Q12. Transistors Q16 inhibits the multivibrator when the Frequency switch is in the 10 Hz or External/Single Cycle position. Transistor Q13 is connected as an emitter follower to provide +9.3 V to the collectors of Q11 and Q12.

The fine frequency setting of the multivibrator is controlled by adjusting the clamping levels of the collector waveform via D12 and D13. This clamping level is set by the Fine trimmer R58 via Q17, D14, and Q18. The function of D14 and Q18 is to compensate for the temperature coefficient of Q17, D12, and D13.

The output of the multivibrator appears across R33 and R34 and is derived from the collectors of Q11 and Q12 through R45 and R46. These pulses are referred to as clock pulses and drive the bases of Q24 and Q25.

3.3 0.5 Hz-10 Hz MULTIVIBRATOR

Refer to Schematic 8020-1. The low frequency multivibrator of 0.5 Hz-10 Hz is provided by transistors Q54-Q58. The feedback loop is from the emitter of Q54 through C28 to the emitter of Q55, and from the collector of Q55 to the base of Q54. The timing capacitor is C28 which receives its charging current from the collector of Q56. The amount of charging current is set by the Fine frequency trimmer, R58, which controls the current through Q57 and Q56. The output of the multivibrator at the collector of Q54 drives the base of Q58. The collector of Q58 provides a trigger to the base of Q1, which is the input to the External Trigger circuit. The description of the operation of this circuit is given next in Section 3.4.

3.4 EXTERNAL TRIGGER

Refer to Schematic 8020-1. Transistors Q1-Q6 function to shape an external trigger to provide a clock pulse in place of the free-running multivibrators. Transistors Q1 and Q2 are in a Schmitt Trigger configuration. Transistor Q1 is normally conducting and Q2 is normally non-conducting. This state is reversed when an External Trigger pulse is connected to the base of Q1. Transistor Q3 sets the bias on the base of Q2. Transistors Q4 and Q5 function as a

current switch to increase the gain of the Schmitt Trigger. The current output of Q4 and Q5 appears across R33 and R34 to produce pulses to trigger the bases of Q24 and Q25. Transistor Q6 functions as an inhibit gate for the External Trigger circuit when the Frequency switch is in any position except External or 10 Hz. Transistor Q53 inhibits the external trigger circuit when the gating circuit is operating.

3.5 EXTERNAL GATE

Refer to Schematic 8020-1. Transistors Q7-Q10 function to gate off the 3 kHz-125 MHz multivibrator during a period of time an external gate signal is present. Transistors Q7 and Q8 function as a Schmitt Trigger. During the gated mode of operation, Q7 is normally conducting and Q8 is non-conducting. A negative gate at the base of Q7 reverses this state. Transistor Q9 operates as an emitter-follower to provide the bias for the base of Q8. The circuit functions in the following manner:

When the GATE/ON-OFF switch is in the OFF position, the voltage at the base of Q9 is +1.4 V. The voltage at the base of Q8 is +0.85 V. The collector of Q8 is +2.6 V and the emitter of Q10 is +2.0 V. Diode D7 is back-biased and the multivibrator is unaffected by a gate signal.

When the GATE/ON-OFF switch is in the ON position, the voltage at the base of Q9 is +0.2 V which produces a voltage of -0.4 V at the base of Q8. The collector of Q8 is at +6.4 V and the emitter of Q10 is at +5.8 V. This voltage, through diode D7, clamps the collector of Q14 and the multivibrator is inhibited. When a negative gate pulse appears at the base of Q7, these conditions are reversed and the emitter of Q10 shifts to +2.0 V. Diode D7 is back-biased and the multivibrator functions for a period of time equal to the gate pulse width.

3.6 DELAY LINE DRIVER & TRIGGER OUT

Refer to Schematic 8020-2. The clock pulses from the frequency multivibrators or external trigger circuit provide complementary signals which drive the bases of Q24 and Q25. Transistors Q24 and Q25 are in a current- switch configuration and their purpose is to both shape the pulses for the Trig Out (Trigger Out) circuits and to drive the Delay One-Shot.

The pulses at the collector of Q24 are delayed for 8 ns through DL-1 and then trigger the bases of Q19 and Q21. Transistors Q19, Q20, Q21, and Q22 function as current switches to provide Trigger Out pulses on both of the front and rear panels. Transistor Q23 is an emitter-follower to provide -2.7 V to the bases of Q19 and Q21.

The bases of Q20 and Q22 are at -2.5 V which is provided by the voltage drop across D19. The output pulses at the collectors of Q20 and Q22 appear at the two TRIG OUT connectors. Diodes D17 and D18 at the collector of Q20 (and diodes D20 and D21 at the collector of Q22) provide a return path to ground if the TRIG OUT connector is not terminated.

The pulses at the collector of Q25 function to trigger the Delay One-Shot. At the collector of Q25 is a shorted delay line DL-2, with a double transit time of 4 nsec. This provides a clipped pulse of approximately 3 ns width at half-height. This pulse is passed through emitter-follower Q26 and then triggers the Delay One-Shot, Q27-Q31.

3.7 DELAY ONE-SHOT

Refer to Schematic 8020-2. Transistors Q27, Q28 and Q29 form the regenerative loop for the Delay One-Shot. Before a trigger pulse arrives, the base of Q27 is at .31 V and the base of Q28 is at +.65 V. Transistor Q27 is non-conducting and Q28 is in conduction. A +0.6 V trigger pulse at the base of Q27 starts to reverse this state and the collector of Q27 goes negative. This excursion passes through emitter-follower Q29, through timing capacitors C64-C72, and then to the base of Q28. This pulse cuts off Q28 which causes Q27 to go into full conduction. A quasi-stable state now exists until the timing capacitor charges up through R87 and R82. When the base of Q28 nearly reaches 0 V, Q28 starts to conduct and Q27 starts to cut off. The transistors, by regenerative action, then switch back to their inital states. Transistor Q29 is a low impedance source to rapidly discharge the timing capacitor to its initial state.

The coarse timing period of the quasi-stable state is provided by front panel selection of one of the timing capacitors, C64-C72. The fine timing is obtained by controlling the amplitude of the voltage swing at the collector of Q27 via D25. Diode D25 obtains its clamping level via emitter-follower Q30, emitter-follower Q31, and trimmer R95. Transistor Q31 compensates for the temperature coefficient of Q30 and D25.

The bias of +.65 V at the base of Q28 is obtained from D22 and R82. The bias of +.31 V at the base of Q27 is obtained from D38, R174, and R175.

The +4.5 V collector supply voltage for Q27 and Q28 is obtained from emitter-follower Q51 (on Schematic 8020-3).

The outputs of the Delay One-Shot are two complementary pulses--one at the collector of Q27 and the other at the collector of Q28.

3.8 DOUBLE PULSE CIRCUITRY

The two output pulses from the Delay One-Shot drive current-switch Q32 and Q33. At the collectors of Q32 and Q33 are shorted clipping lines which provide bipolar, complementary pulses of about 4 ns width. The positive 4 ns pulses at the collectors of Q32 and Q33 occur at the beginning and end of the Delay One-Shot pulse, respectively. These pulses then pass to a gating circuit which permits either one or both pulses to pass.

If the SINGLE/DOUBLE PULSE toggle is in the SINGLE PULSE position the base of Q34 goes positive through R106. Transistor Q34 conducts and the collector of Q32 is held at nearly 0 V. This shorts out the pulse at the collector of Q32. However, the pulse at the collector of Q33 passes through diode D29, emitter-follower Q36 and then on to trigger the base of Q39. The function of D29 is to bias on Q36 slightly. The negative excursion of the bipolar trigger pulse is below the conduction threshold and does not appear at the emitter of Q36.

If the SINGLE/DOUBLE PULSE toggle is in the Double Pulse position, the base of Q34 is at 0 V and the transistor does not conduct. The trigger pulse at the collector of Q32 then appears at the emitter of Q35 in a similar route as described in the preceding paragraphs. The two trigger pulses then appear at the base of Q39 with a time delay set by the Delay controls to provide a double pulse operation.

3.9 WIDTH ONE-SHOT

The Width One-Shot, Q38-Q42, functions in an identical manner to the Delay One-Shot described above in Section 3.7. The output of the Width One-Shot is at the collector of Q38. This pulse is delayed from the TRIG OUT pulse as set by front panel Delay controls and has a width set by front panel Width controls. It is next shaped by the Output Pulse shaper for the output circuitry.

3.10 OUTPUT PULSE SHAPER & OUTPUT CIRCUITRY

Transistor Q43 and Q44 are a current-switch which receives the Width One-Shot pulse. The base of Q44 is biased at +3.9 V by divider R170, R159. The positive pulse at the base of Q43 causes a reversal of state and a negative pulse appears at the collector of Q43. This pulse, in turn, switches the output current-switch, Q46 and Q47. A negative pulse appears at the collector of Q47 which passes to the Output connectors. Transistor Q45 is an emitter-follower to provide -2.7 V collector supply voltage for Q43 and Q44.

Transistor Q48 is a constant current supply for the output current-switch Q46 and Q47. The output amplitude is controlled by adjusting the AMPLITUDE trimmer at the base of Q48. This trimmer controls the amount of current being switched into the output load resistance.

Transistor Q49 is an emitter-follower to provide the bias level for the base of Q47. This bias level may be adjusted internally by varying R152, the Output Drive trimmer. This adjustment is adjusted to achieve the best compromise between output rise time and pulse top aberrations.

3.11 OTHER CIRCUIT & CONSIDERATIONS

Emitter-follower, Q51 (Schematic 8020-3) provides the +4.5 V supply for the instrument. Note that 20 mA of current for the +4.5 V bus comes from the +24 V supply via R151. Another approximately 20 mA comes from Q51 whose main function is to regulate this bus.

Resistors R141, R156, and R157 (Schematic 8020-3) are provided to nearly equalize the current from all power supply buses for optimum utilization of the NIM power supply.

3.12 SERVICE

If service is required on the Model 8020 refer to the schematics for the proper waveforms and voltages. A 50 MHz oscilloscope and a 350 ps sampling oscilloscope is required to properly trouble shoot this instrument.

When circuit tracing it is particularly necessary to observe the 3-4 ns wide trigger pulse has a minimum amplitude of 0.6 V at the inputs of the Delay and Width One-shots (bases of Q27 and Q28).

There is one adjustment trimmer in the Model 8020, R152 which is at the rear of the P.C. board next to the power connector. This trimmer adjusts the bias level on the output current switch. While the output pulse is observed on a sampling oscilloscope adjust the trimmer for the best compromise between the fastest output rise time and minimum pulse top aberrations. The correct setting will provide 1 ns output pulse rise time and pulse top aberrations of less than 5%.

Abbreviations

cer	ceramic	μH	microhenry
comp	composition carbon	μF	microfarad
EMC	electrolytic, metal case	pF	picofarad
mic	mica	pos	positions
myl	mylar	tan	tantalum
k	kilohm	V	working volts DC
meg	megohm	var	variable
m	milli	W	watts
MF	metal film	ww	wirewound

---------- NOTE ----------

The last number after each part description is the BERKELEY NUCLEONICS part number for reordering.

Capacitors

C1	.05 μF	cer	100 V		110-017	C37	.0068 μF	myl	600 V	10%	114-009
C2	.05 μF	cer	100 V		110-017	C38	.022 μF	myl	100 V	10%	114-014
C3	10 pF	cer	1 kV		110-002	C39	.068 μF	myl	100 V	10%	114-019
C4	180 pF	cer	1 kV		110-007	C40	.22 μF	tan	35 V	10%	122-007
C5	180 pF	cer	1 kV		110-007	C41	.68 μF	tan	35 V	10%	122-009
C6	180 pF	cer	1 kV		110-007	C43	.05 μF	cer	100 V		110-017
C7	180 pF	cer	1 kV		110-007	C44	10 pF	cer	1 kV		110-002
C8	5 pF	cer	1 kV		110-001	C45	180 pF	cer	1 kV		110-007
C9	180 pF	cer	1 kV		110-007	C46	180 pF	cer	1 kV		110-007
C10	5 pF	cer	1 kV		110-001	C47	180 pF	cer	1 kV		110-007
C11	.05 μF	cer	100 V		110-017	C48	180 pF	cer	1 kV		110-007
C12	180 pF	cer	1 kV		110-007	C49	180 pF	cer	1 kV		110-007
C13	180 pF	cer	1 kV		110-007	C50	10 pF	cer	1 kV		110-002
C14	180 pF	cer	1 kV		110-007	C51	180 pF	cer	1 kV		110-007
C15	5 pF	cer	1 kV		110-001	C52	180 pF	cer	1 kV		110-007
C16	180 pF	cer	1 kV		110-007	C53	5 pF	cer	1 kV		110-001
C17	100 pF	cer	1 kV		110-006	C54	180 pF	cer	1 kV		110-007
C18	100 pF	cer	1 kV		110-006	C55	180 pF	cer	1 kV		110-007
C19	2.5-10 pF	var			130-004	C56	180 pF	cer	1 kV		110-007
C20	180 pF	cer	1 kV		110-007	C57	180 pF	cer	1 kV		110-007
C21	180 pF	cer	1 kV		110-007	C58	180 pF	cer	1 kV		110-007
C22	180 pF	cer	1 kV		110-007	C59	180 pF	cer	1 kV		110-007
C23	180 pF	cer	1 kV		110-007	C60	180 pF	cer	1 kV		110-007
C24	180 pF	cer	1 kV		110-007	C61	25 pF	cer	1 kV		110-003
C25	180 pF	cer	1 kV		110-007	C62	10 pF	mic	500 V	5%	112-016
C26	180 pF	cer	1 kV		110-007	C63	180 pF	cer	1 kV		110-007
C27	180 pF	cer	1 kV		110-007	C64	.33 μF	tan	35 V	10%	122-008
C28	25 μF	elec	25 V		120-005	C65	.1 μF	myl	100 V	10%	114-020
C29	180 pF	cer	1 kV		110-007	C66	.033 μF	myl	100 V	10%	114-024
C30	180 pF	cer	1 kV		110-007	C67	.01 μF	myl	400 V	10%	114-011
C31	180 pF	cer	1 kV		110-007	C68	.0033 μF	myl	600 V	10%	114-005
C33	22 pF	mic	500 V	5%	112-001	C69	.001 μF	myl	600 V	10%	114-001
C34	100 pF	mic	500 V	5%	112-004	C70	270 pF	mic	500 V	5%	112-009
C35	430 pF	mic	100 V	5%	112-012	C71	68 pF	mic	500 V	5%	112-018
C36	.002 μF	myl	600 V	10%	114-002	C72	18 pF	mic	500 V	5%	112-017

. . . continued

CAPACITORS (continued)

C75	180 pF	cer	1 kV		110-007
C76	180 pF	cer	1 kV		110-007
C77	10 pF	cer	1 kV		110-002
C78	180 pF	cer	1 kV		110-007
C79	180 pF	cer	1 kV		110-007
C80	180 pF	cer	1 kV		110-007
C81	180 pF	cer	1 kV		110-007
C82	10 pF	cer	1 kV		110-002
C83	180 pF	cer	1 kV		110-007
C84	180 pF	cer	1 kV		110-007
C85	10 pF	mic	500 V	5%	112-016
C86	.33 µF	tan	35 V	10%	122-008
C87	.1 µF	myl	100 V	10%	114-020
C88	.033 µF	myl	100 V	10%	114-024
C89	.01 µF	myl	400 V	10%	114-011
C90	.0033 µF	myl	600 V	10%	114-005
C91	.001 µF	myl	600 V	10%	114-001
C92	270 pF	mic	500 V	5%	112-009
C93	68 pF	mic	500 V	5%	112-018
C94	10 pF	mic	500 V	5%	112-016
C96	180 pF	cer	1 kV		110-007
C99	180 pF	cer	1 kV		110-007
C100	180 pF	cer	1 kV		110-007
C101	180 pF	cer	1 kV		110-007
C102	180 pF	cer	1 kV		110-007
C103	5 pF	cer	1 kV		110-001
C104	.05 µF	cer	100 V		110-017
C105	180 pF	cer	1 kV		110-007
C106	180 pF	cer	1 kV		110-007
C107	.05 µF	cer	100 V		110-017
C108	20 pF	cer	1 kV		110-018
C109	100 µF	elec	15 V		120-007
C110	180 pF	cer	1 kV		110-007
C111	180 pF	cer	1 kV		110-007
C112	50 µF	elec	25 V		120-006
C113	50 µF	elec	25 V		120-006
C114	50 µF	elec	25 V		120-006
C115	50 µF	elec	25 V		120-006
C116	180 pF	cer	1 kV		110-007
C117	180 pF	cer	1 kV		110-007
C118	180 pF	cer	1 kV		110-007
C119	180 pF	cer	1 kV		110-007
C120	10 pF	cer	1 kV		110-002
C121	.05 µF	cer	100 V		110-017
C122	.05 µF	cer	100 V		110-017
C123	.05 µF	cer	100 V		110-017
C124	180 pF	cer	1 kV		110-007
C125	.05 µF	cer	100 V		110-017
C126	.05 µF	cer	100 V		110-017
C127	180 pF	cer	1 kV		110-007
C128	.05 µF	cer	100 V		110-017
C129	180 pF	cer	1 kV		110-007
C130	10 pF	cer	1 kV		110-002
C131	10 pF	cer	1 kV		110-002
C132	180 pF	cer	1 kV		110-007

Diodes

D1	1N4154	411-003
D2	1N4154	411-003
D3	1N4154	411-003
D4	1N4154	411-003
D5	1N4154	411-003
D6	1N4154	411-003
D7	FH1100	415-001
D8	1N4154	411-003
D9	1N4154	411-003
D10	1N4154	411-003
D11	1N4154	411-003
D12	FH1100	415-001
D13	FH1100	415-001
D14	1N4154	411-003
D15	1N4154	411-003
D16	1N4154	411-003
D17	1N4154	411-003
D18	1N4154	411-003
D19	1N4154	411-003
D20	1N4154	411-003
D21	1N4154	411-003
D22	FH1100	415-001
D23	1N4154	411-003
D24	1N4154	411-003
D25	FH1100	415-001
D26	1N4154	411-003
D28	1N4154	411-003
D29	1N4154	411-003
D30	FH1100	415-001
D31	1N4154	411-003
D32	1N4154	411-003
D33	FH1100	415-001
D34	1N4154	411-003
D35	1N4154	411-003
D37	1N4154	411-003
D40	1N5231	412-009
D41	FH1100	415-001
D42	FH1100	415-001

Inductors

L1	.33 µH	310-011
L2	.22 µH	310-013
L3	.22 µH	310-013

Resistors

R1	470 k	1/4 W	comp	5%	213-474
R2	270 k	1/4 W	comp	5%	213-274
R3	10	1/4 W	comp	5%	213-100
R4	1 k	1/4 W	comp	5%	213-102
R5	51	1/4 W	comp	5%	213-510
R6	51	1/4 W	comp	5%	213-510
R7	51	1/4 W	comp	5%	213-510
R8	1 k	1/4 W	comp	5%	213-102
R9	8.2 k	1/4 W	comp	5%	213-822
R10	56	1/4 W	comp	5%	213-560
R11	56	1/4 W	comp	5%	213-560
R12	270	1/4 W	comp	5%	213-271
R13	10 k	1/4 W	comp	5%	213-103
R14	240	1/4 W	comp	5%	213-241
R15	51	1/4 W	comp	5%	213-510

. . . continued

RESISTORS (continued)

R16	22 k	1/4 W	comp	5%	213-223	R76	510	1/4 W	comp	5%	213-510
R17	15 k	1/4 W	comp	5%	213-153	R77	150	1/4 W	comp	5%	213-151
R18	33	1/4 W	comp	5%	213-330	R79	51	1/4 W	comp	5%	213-510
R19	51	1/4 W	comp	5%	213-510	R80	560	1/2 W	comp	5%	212-561
R20	51	1/4 W	comp	5%	213-510	R81	56	1/4 W	comp	5%	213-560
R21	51	1/4 W	comp	5%	213-510	R82	2.7 k	1/4 W	comp	5%	213-272
R22	1.2 k	1/4 W	comp	5%	213-122	R83	4.7 k	1/4 W	comp	5%	213-472
R23	8.2 k	1/4 W	comp	5%	213-822	R84	5.6 k	1/4 W	comp	5%	213-562
R24	27	1/4 W	comp	5%	213-270	R85	10 k	1/4 W	comp	5%	213-103
R25	360	1/4 W	comp	5%	213-361	R86	560	1/4 W	comp	5%	213-561
R26	560	1/4 W	comp	5%	213-561	R87	1.2 k	1/2 W	comp	5%	212-122
R27	8.2 k	1/4 W	comp	5%	213-822	R88	1 k	1/4 W	comp	5%	213-102
R28	1.8 k	1/4 W	comp	5%	213-182	R89	390	1/4 W	comp	5%	213-391
R29	270	1/4 W	comp	5%	213-271	R90	91	1/4 W	comp	5%	213-910
R30	110	1/4 W	comp	5%	213-111	R91	51	1/4 W	comp	5%	213-510
R31	1.5 k	1/2 W	comp	5%	212-152	R92	4.7 k	1/4 W	comp	5%	213-472
R32	6.8 k	1/4 W	comp	5%	213-682	R93	2.2 k	1/4 W	comp	5%	213-222
R33	150	1/4 W	comp	5%	213-151	R94	5.6 k	1/4 W	comp	5%	213-562
R34	150	1/4 W	comp	5%	213-151	R95	1 k	1 W	trimmer		244-017
R35	750	1/4 W	comp	5%	213-751	R96	1 k	1/4 W	comp	5%	213-102
R36	750	1/4 W	comp	5%	213-751	R98	470	1/4 W	comp	5%	213-471
R37	39	1/4 W	comp	5%	213-390	R102	470	1/4 W	comp	5%	213-471
R38	39	1/4 W	comp	5%	213-390	R103	51	1/4 W	comp	5%	213-510
R39	470	1/4 W	comp	5%	213-471	R104	91	1/4 W	comp	5%	213-910
R40	6.8 k	1/4 W	comp	5%	213-682	R105	100	1/4 W	comp	5%	213-101
R41	220	1/4 W	comp	5%	213-221	R106	10 k	1/4 W	comp	5%	213-103
R42	10 k	1/4 W	comp	5%	213-103	R107	4.7 k	1/4 W	comp	5%	213-472
R43	1 k	1/4 W	comp	5%	213-102	R108	4.7 k	1/4 W	comp	5%	213-472
R44	4.7 k	1/4 W	comp	5%	213-472	R109	51	1/4 W	comp	5%	213-510
R45	22	1/4 W	comp	5%	213-220	R110	56	1/4 W	comp	5%	213-560
R46	22	1/4 W	comp	5%	213-220	R111	100	1/4 W	comp	5%	213-101
R47	390	1/4 W	comp	5%	213-391	R112	33	1/4 W	comp	5%	213-330
R48	470	1/4 W	comp	5%	213-471	R113	560	1/2 W	comp	5%	212-561
R49	10 k	1/4 W	comp	5%	213-103	R114	56	1/4 W	comp	5%	213-560
R50	15 k	1/4 W	comp	5%	213-153	R115	2.7 k	1/4 W	comp	5%	213-272
R51	4.7 k	1/4 W	comp	5%	213-472	R116	15 k	1/4 W	comp	5%	213-153
R52	4.7 k	1/4 W	comp	5%	213-472	R117	10 k	1/4 W	comp	5%	213-103
R53	1 k	1/4 W	comp	5%	213-102	R118	560	1/4 W	comp	5%	213-561
R54	1.2 k	1/4 W	comp	5%	213-122	R119	5.6 k	1/4 W	comp	5%	213-562
R55	39 k	1/4 W	comp	5%	213-393	R120	51	1/4 W	comp	5%	213-510
R56	2.2 k	1/4 W	comp	5%	213-222	R121	1.2 k	1/2 W	comp	5%	212-122
R57	1.2 k	1/4 W	comp	5%	213-122	R122	4.7 k	1/4 W	comp	5%	213-472
R58	1 k	1 W	trimmer		244-017	R123	2.2 k	1/4 W	comp	5%	213-222
R59	820	1/4 W	comp	5%	213-821	R124	22 k	1/4 W	comp	5%	213-223
R60	1.6 k	1/4 W	comp	5%	213-162	R125	1 k	1/4 W	comp	5%	213-102
R61	10 k	1/4 W	comp	5%	213-103	R126	1 k	1 W	trimmer		244-017
R62	910	1/2 W	comp	5%	212-911	R127	5.6 k	1/4 W	comp	5%	213-562
R63	51	1/4 W	comp	5%	213-510	R132	3.3 k	1/4 W	comp	5%	213-332
R64	51	1/4 W	comp	5%	213-510	R133	7.5 k	1/4 W	comp	5%	213-752
R65	51	1/4 W	comp	5%	213-510	R134	100	1/4 W	comp	5%	213-101
R66	510	1/4 W	comp	5%	213-511	R136	33	1/4 W	comp	5%	213-330
R67	100	1/4 W	comp	5%	213-101	R137	51	1/4 W	comp	5%	213-510
R68	4.7 k	1/4 W	comp	5%	213-472	R138	51	1/4 W	comp	5%	213-510
R69	1 k	1/4 W	comp	5%	213-102	R139	330	1/2 W	comp	5%	212-331
R70	470	1/4 W	comp	5%	213-471	R141	180	2 W	comp	5%	210-181
R71	15 k	1/4 W	comp	5%	213-153	R142	680	1/4 W	comp	5%	213-681
R72	6.8 k	1/4 W	comp	5%	213-682	R143	1 k	1 W	trimmer		244-017
R73	51	1/4 W	comp	5%	213-510	R144	130	1/4 W	comp	5%	213-131
R74	51	1/4 W	comp	5%	213-510	R145	3.3 k	1/4 W	comp	5%	213-332
R75	51	1/4 W	comp	5%	213-510	R146	2.4 k	1/4 W	comp	5%	213-242

. . . continued

RESISTORS (continued)

R147	470	1 W	comp	5%	211-471
R148	39	1/4 W	comp	5%	213-390
R149	91	1/4 W	comp	5%	213-910
R150	91	1/4 W	comp	5%	213-910
R151	750	1 W	comp	5%	211-751
R152	10 k	1 W	trimmer		244-013
R153	15 k	1/4 W	comp	5%	213-153
R154	470	1/4 W	comp	5%	213-471
R155	1.8 k	1/4 W	comp	5%	213-182
R156	180	2 W	comp	5%	210-181
R157	180	2 W	comp	5%	210-181
R158	33	1/4 W	comp	5%	213-330
R159	4.7 k	1/4 W	comp	5%	213-472
R160	33	1/4 W	comp	5%	213-330
R161	1.8 k	1/4 W	comp	5%	213-182
R162	10 k	1/4 W	comp	5%	213-103
R168	51	1/4 W	comp	5%	213-510
R169	51	1/4 W	comp	5%	213-510
R170	10	1/4 W	comp	5%	213-100
R171	51	1/4 W	comp	5%	213-510
R172	10	1/4 W	comp	5%	213-100
R173	2.7 k	1/4 W	comp	5%	213-272
R174	33	1/4 W	comp	5%	213-330
R175	3.9 k	1/4 W	comp	5%	213-392
R176	3.9 k	1/4 W	comp	5%	213-392
R177	3.9 k	1/4 W	comp	5%	213-392
R178	120	1/4 W	comp	5%	213-121

Transistors

Q1	2N5179	430-025
Q2	2N5179	430-025
Q3	2N5179	430-025
Q4	2N5179	430-025
Q5	2N5179	430-025
Q6	MPS2924	430-009
Q7	2N5179	430-025
Q8	2N5179	430-025
Q9	2N5179	430-025
Q10	2N5179	430-025
Q11	2N5179	430-025
Q12	2N5179	430-025
Q13	MPS6531	430-017
Q14	2N5179	430-025
Q15	2N5179	430-025
Q16	MPS2924	430-009
Q17	MPS6531	430-017
Q18	MPS3638	430-010
Q19	2N5179	430-025
Q20	2N5179	430-025
Q21	2N5179	430-025
Q22	2N5179	430-025
Q23	MPS6534	430-018
Q24	2N4258	430-030
Q25	2N4258	430-030
Q26	2N5179	430-025
Q27	2N5179	430-025
Q28	2N5179	430-025
Q29	2N5179	430-025
Q30	MPS6531	430-017
Q31	MPS3638	430-010
Q32	2N4258	430-030
Q33	2N4258	430-030
Q34	2N5179	430-025
Q35	2N5179	430-025
Q36	2N5179	430-025
Q37	2N5179	430-025
Q38	2N5179	430-025
Q39	MPS6534	430-018
Q40	2N5179	430-025
Q41	MPS6531	430-017
Q42	MPS3638	430-010
Q43	2N4959	430-022
Q44	2N4959	430-022
Q45	MPS6534	430-018
Q46	2N5109	430-024
Q47	2N5109	430-024
Q48	2N2219	430-006
Q49	MPS6531	430-017
Q50	MPS6531	430-017
Q51	MPS6531	430-017
Q52	MPS6534	430-018
Q53	2N5179	430-025
Q54	MPS6518	430-016
Q55	MPS6518	430-016
Q56	MPS6518	430-016
Q57	MPS6518	430-016
Q58	MPS2924	430-009

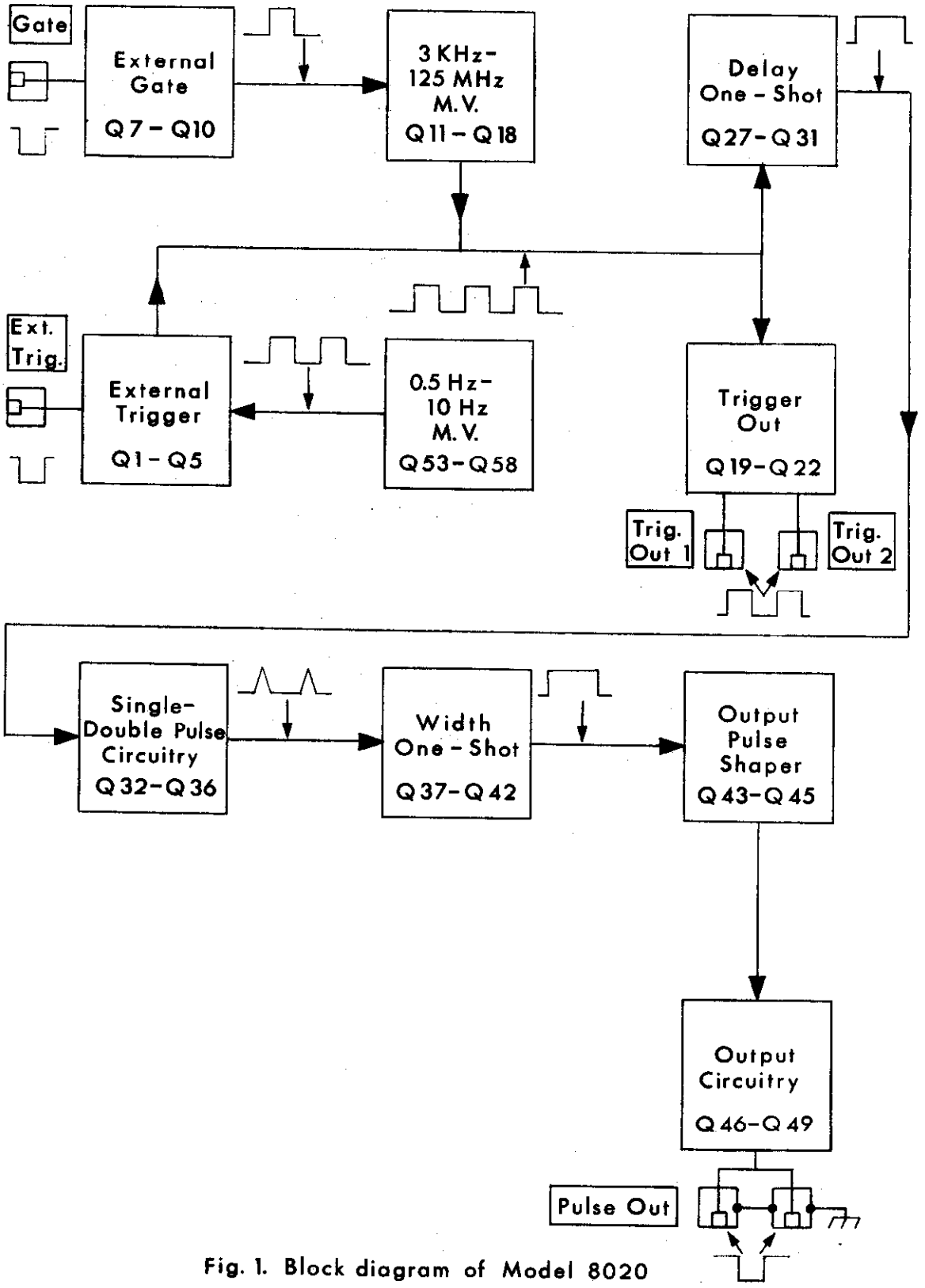
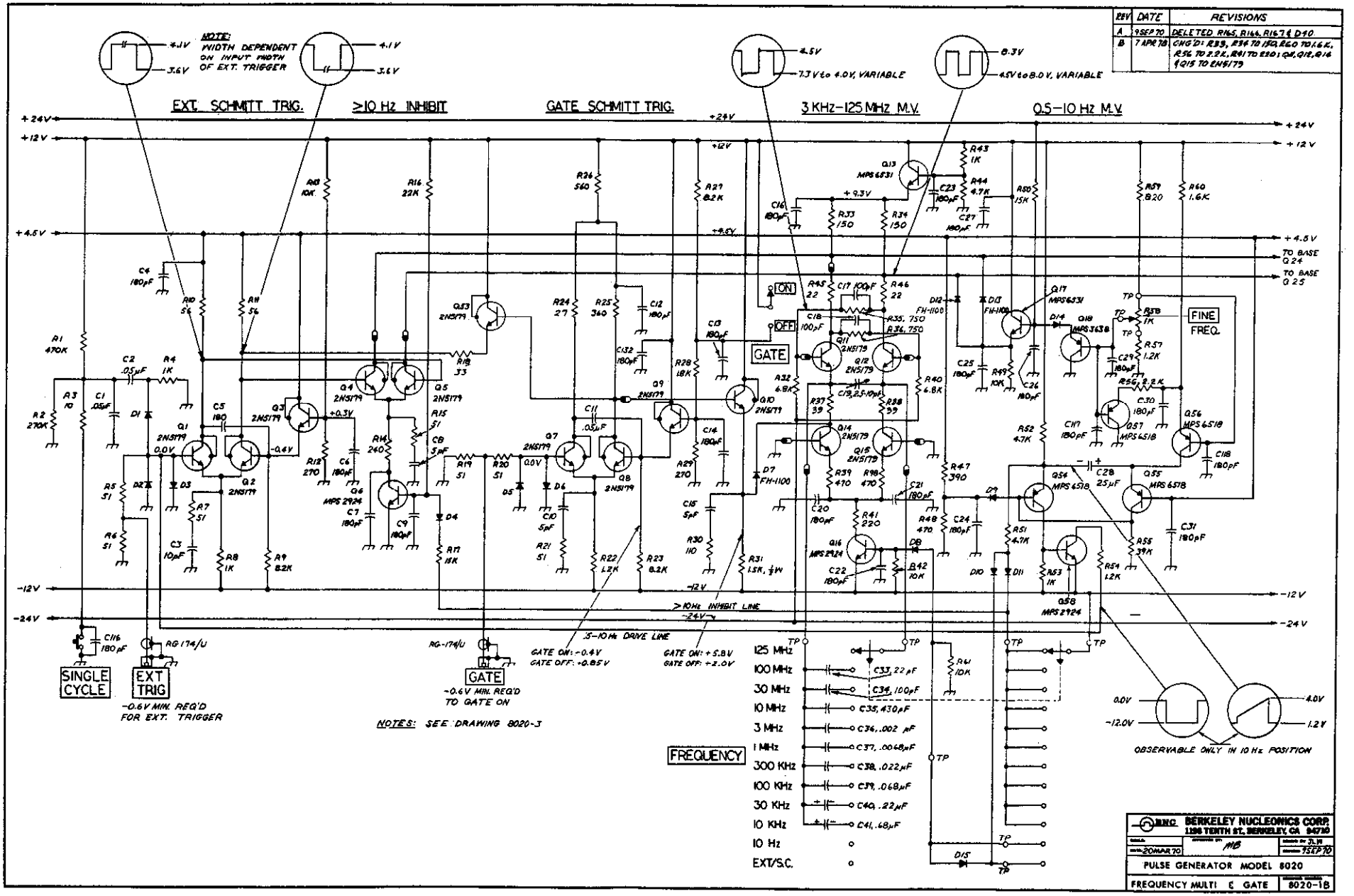


Fig. 1. Block diagram of Model 8020



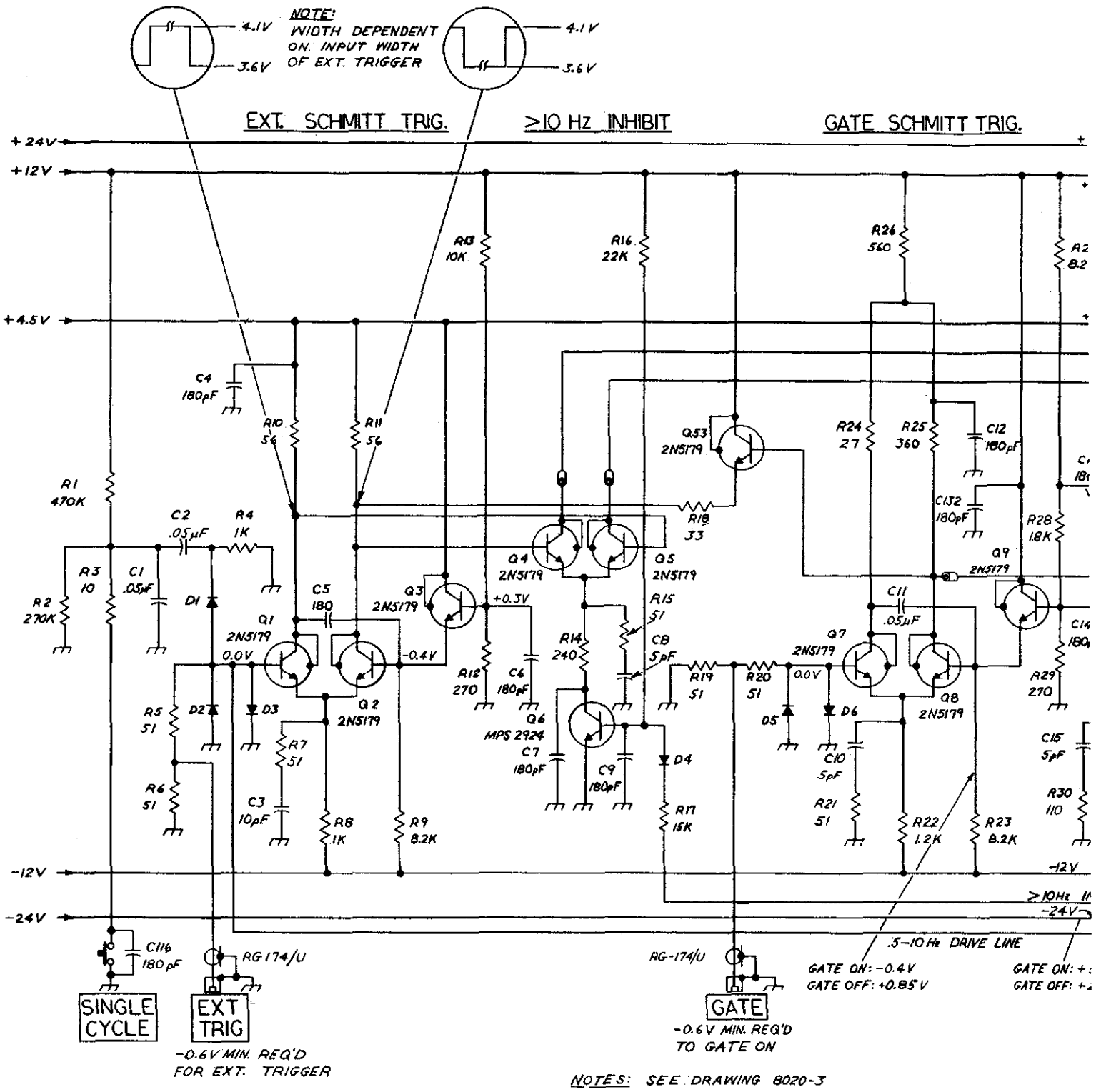
REV	DATE	REVISIONS
A	9SEP70	DELETED R165, R166, R167 & D10
B	7APR78	CHG'D: R33, R34 TO 150Ω, R60 TO 1.6K, R56 TO 2.2K, R41 TO 220Ω; Q12, Q13, & Q15 TO 2N5179

BNC BERKELEY NUCLEONICS CORP. 1198 TENTH ST., BERKELEY, CA 94710

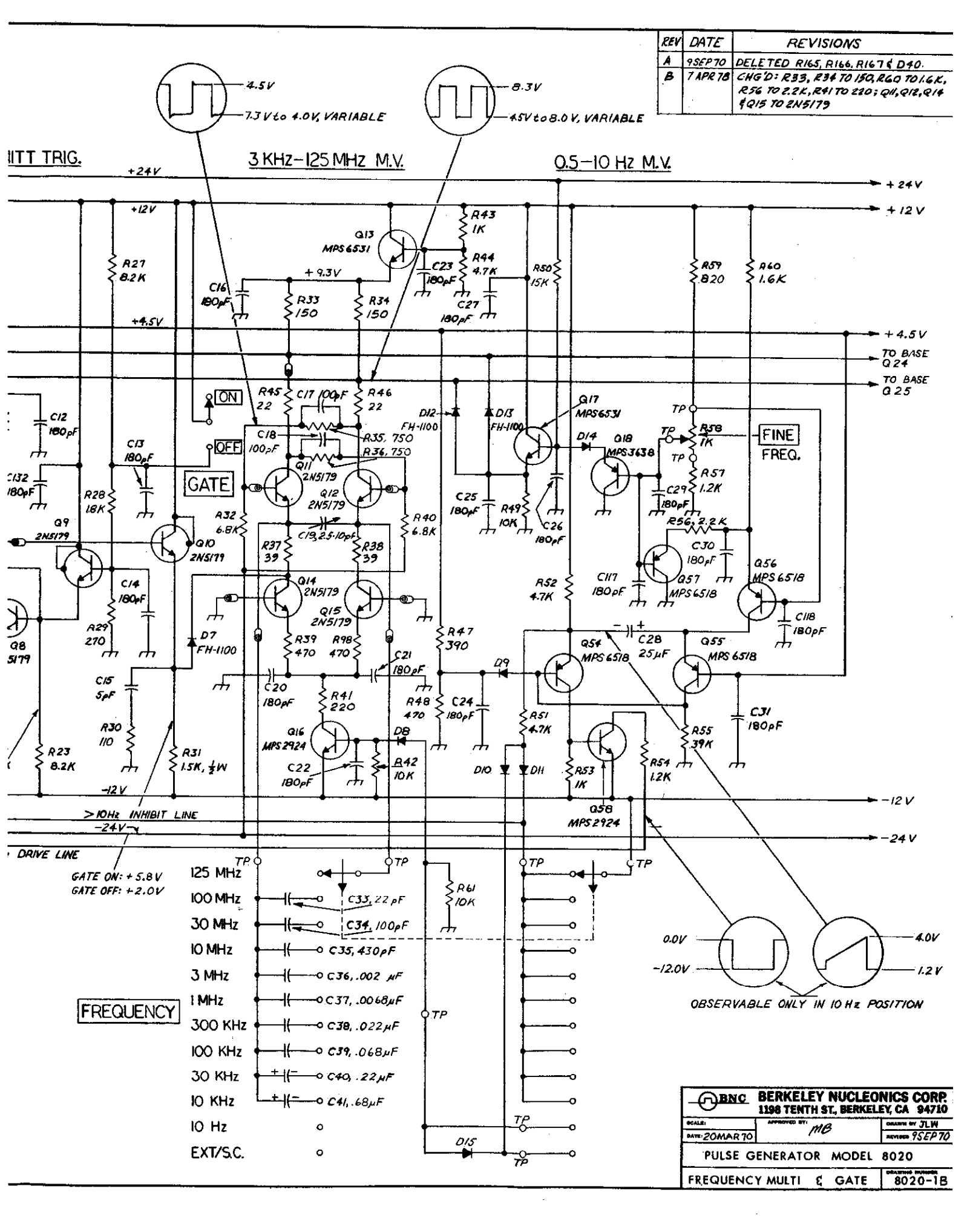
20MAR70	MB	9SEP70

PULSE GENERATOR MODEL 8020

FREQUENCY MULTI & GATE — 8020-18


NOTE:
WIDTH DEPENDENT ON INPUT WIDTH OF EXT. TRIGGER
4.1V
3.6V
EXT. SCHMITT TRIG.
>10 Hz INHIBIT
GATE SCHMITT TRIG.
+24V
+12V
+4.5V
-12V
-24V
R1 470K
R2 270K
R3 10
C1 .05μF
C2 .05μF
R4 1K
D1
Q1 2N5179
0.0V
Q2 2N5179
-0.4V
C4 180pF
R10 56
R11 56
C5 180
Q3 2N5179
+0.3V
R12 270
C6 180pF
R13 10K
R14 240
R15 51
C8 5pF
Q4 2N5179
Q5 2N5179
Q6 MPS 2924
C7 180pF
C9 180pF
D4
R11 15K
R16 22K
Q53 2N5179
R18 33
R19 51
R20 51
D5
Q7 2N5179
0.0V
D6
C10 5pF
R21 51
R22 1.2K
R23 8.2K
R24 27
R25 360
C12 180pF
C132 180pF
R26 560
Q8 2N5179
Q9 2N5179
C11 .05μF
R28 18K
R29 270
C15 5pF
R30 110
R5 51
D2
D3
R7 51
C3 10pF
R8 1K
R9 8.2K
R6 51
C116 180pF
RG 174/U
SINGLE CYCLE
EXT TRIG
-0.6V MIN. REQ'D FOR EXT. TRIGGER
RG-174/U
GATE
-0.6V MIN. REQ'D TO GATE ON
.5-10 Hz DRIVE LINE
GATE ON: -0.4V
GATE OFF: +0.85V
NOTES: SEE DRAWING 8020-3

REV	DATE	REVISIONS
A	9SEP70	DELETED R165, R166, R167 & D40.
B	7 APR 78	CHG'D: R33, R34 TO 150, R60 TO 1.6K, R56 TO 2.2K, R41 TO 220; Q11, Q12, Q14 & Q15 TO 2N5179

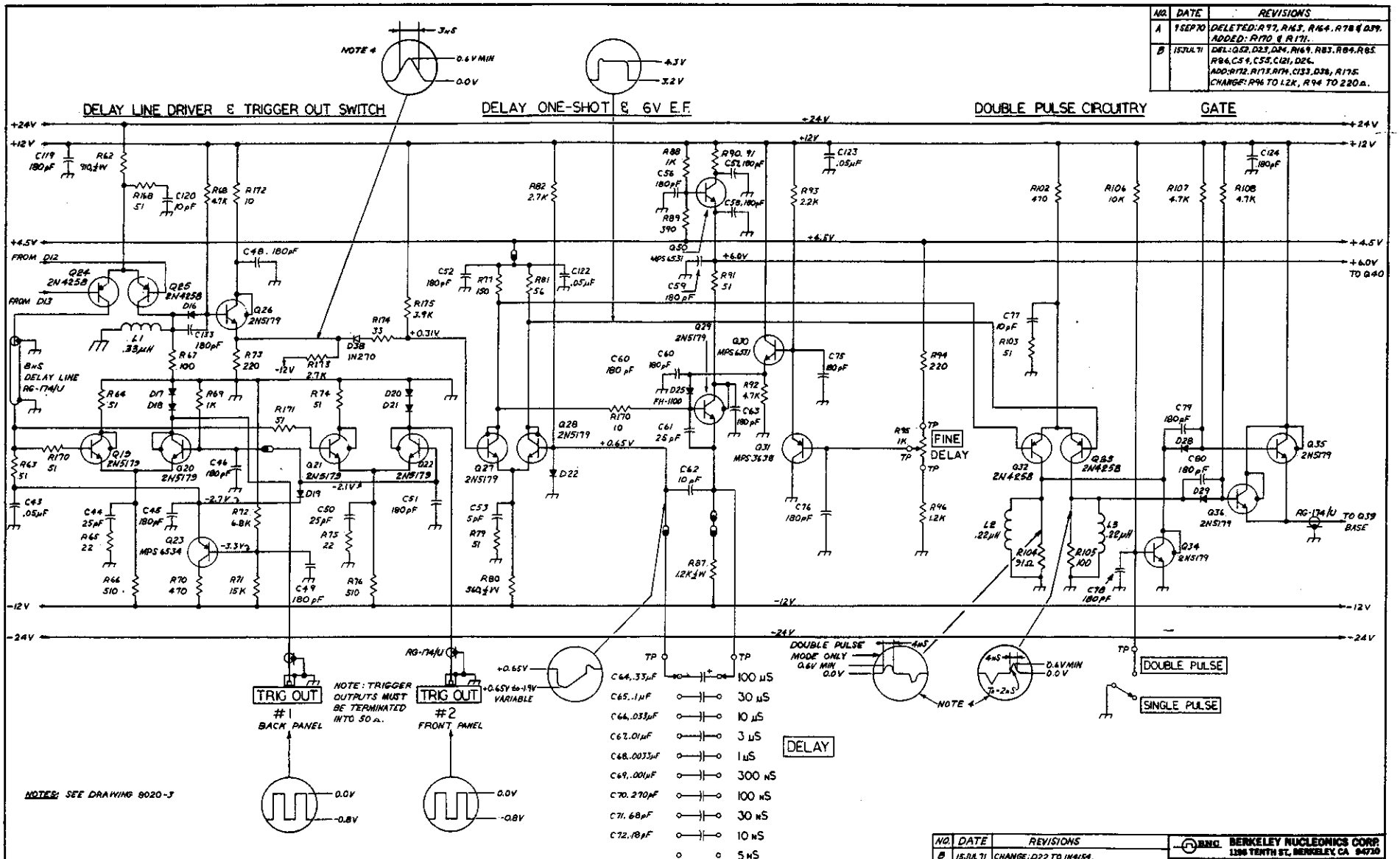


BNC BERKELEY NUCLEONICS CORP.
1198 TENTH ST., BERKELEY, CA 94710

SCALE:	APPROVED BY: MB	DRAWN BY JLW
DATE: 20MAR70		REVISED 9SEP70

PULSE GENERATOR MODEL 8020

FREQUENCY MULTI & GATE — DRAWING NUMBER 8020-1B



NO.	DATE	REVISIONS
A	9SEP70	DELETED: R97, R163, R164, R178 & D39. ADDED: R170 & R171.
B	15JUL71	DEL: Q52, D23, D24, R169, R83, R84, R85, R86, C54, C55, C121, D24. ADD: R172, R173, R174, C133, D38, R175. CHANGE: R96 TO 1.2K, R94 TO 220Ω.

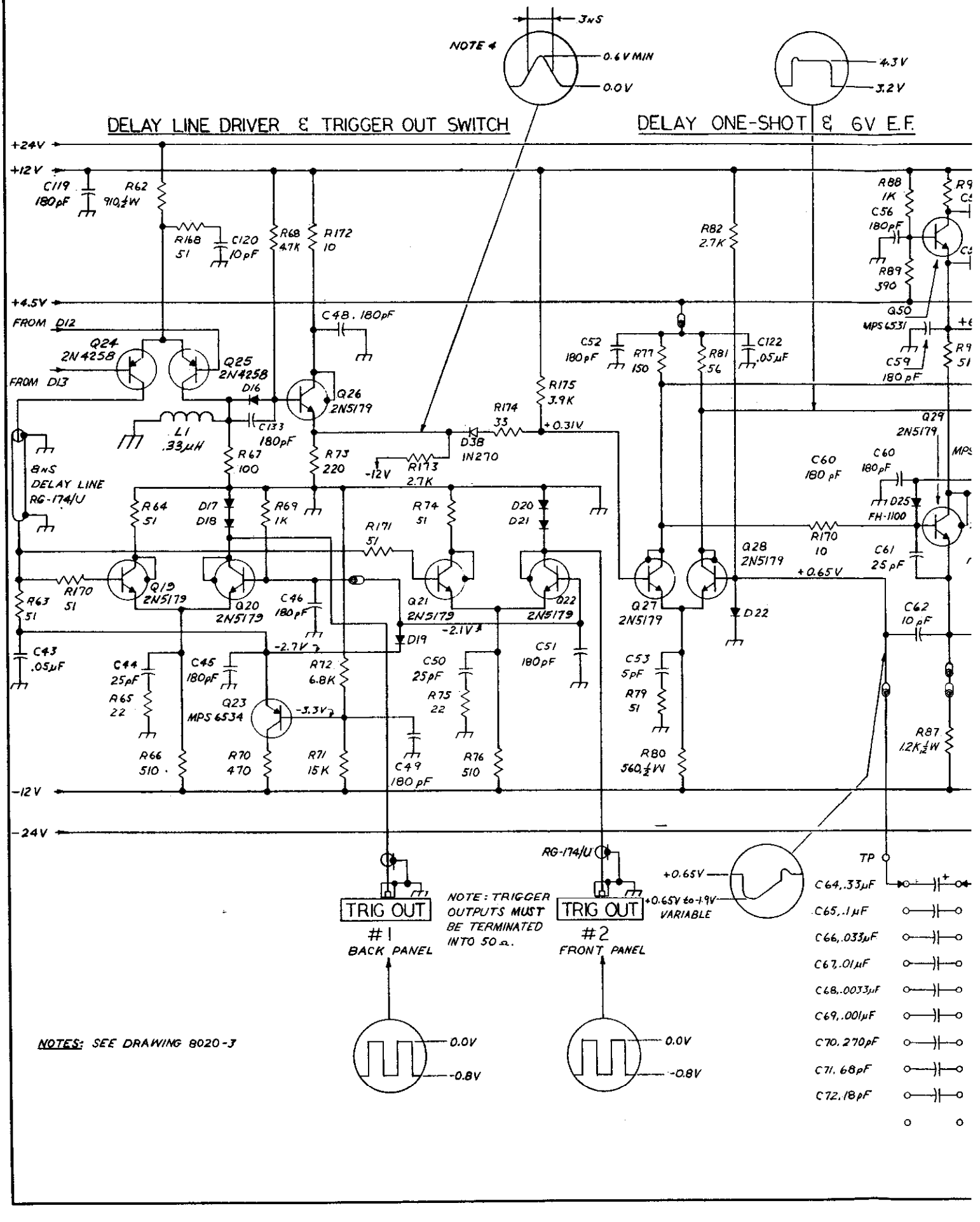
NO.	DATE	REVISIONS
B	15JUL71	CHANGE: D22 TO 1N4154.
C	12OCT71	CHANGE: DELAY SWITCH TO 2-POLE 10-POSITION.
D	7APR78	CHGD: D1-2 TO L1, .33μH, D3-5 / D14 TO L2 L3, .22μH; R104 TO 91Ω, R105 TO 15K.

BNC BERKELEY NUCLEONICS CORP. 1196 TENTH ST, BERKELEY, CA 94710

SCALE: 20 MAR70	APPROVED BY: MB	DRAWN BY: JLW 12 OCT71

PULSE GENERATOR MODEL 8020

DELAY & DOUBLE PULSE 8020-2D


DELAY LINE DRIVER & TRIGGER OUT SWITCH
DELAY ONE-SHOT & 6V E.F.
NOTE 4
3nS
0.6V MIN
0.0V
4.3V
3.2V
+24V
+12V
+4.5V
-12V
-24V
C119 180pF
R62 910 1/2W
R168 51
C120 10pF
R68 4.7K
R172 10
R82 2.7K
R88 1K
C56 180pF
R89 390
Q50 MPS6531
FROM D12
FROM D13
Q24 2N4258
Q25 2N4258
Q26 2N5179
D16
C48. 180pF
C133 180pF
L1 .33µH
8nS DELAY LINE RG-174/U
R67 100
R73 220
R174 33
R175 3.9K
+0.31V
D38 IN270
R173 2.7K
C52 180pF
R77 150
R81 56
C122 .05µF
C59 180pF
Q29 2N5179
C60 180pF
D25 FH-1100
R64 51
D17
D18
R69 1K
R74 51
D20
D21
R171 51
R170 10
+0.65V
C61 25pF
Q28 2N5179
Q27 2N5179
D22
R63 51
R170 51
Q19 2N5179
Q20 2N5179
Q21 2N5179
Q22 2N5179
C46 180pF
-2.1V
D19
-2.7V
C62 10pF
C43 .05µF
C44 25pF
R65 22
C45 180pF
Q23 MPS6534
-3.3V
R72 6.8K
C50 25pF
R75 22
C51 180pF
C53 5pF
R79 51
R87 1.2K 1/2W
R66 510
R70 470
R71 15K
C49 180pF
R76 510
R80 560 1/2W
RG-174/U
+0.65V
+0.65V to -1.9V VARIABLE
TRIG OUT #1 BACK PANEL
TRIG OUT #2 FRONT PANEL
NOTE: TRIGGER OUTPUTS MUST BE TERMINATED INTO 50Ω.
0.0V
-0.8V
TP
C64, .33µF
C65, .1µF
C66, .033µF
C67, .01µF
C68, .0033µF
C69, .001µF
C70, 270pF
C71, 68pF
C72, 18pF
NOTES: SEE DRAWING 8020-3

NO.	DATE	REVISIONS
A	9SEP70	DELETED: R97, R163, R164, R78 & D39. ADDED: R170 & R171.
B	15JUL71	DEL.: Q52, D23, D24, R169, R83, R84, R85, R86, C54, C55, C121, D26. ADD: R172, R173, R174, C133, D38, R175. CHANGE: R96 TO 1.2K, R94 TO 220Ω.

4.3 V

7.2 V

E.F.

DOUBLE PULSE CIRCUITRY GATE

+24 V

+12 V

+4.5 V

+6.0 V TO Q40

R88 1K
56 OpF
R89 590
Q50 6531
C59 180 pF
R90, 91 C57, 180pF
C58, 180pF
+6.0V
R91 51
C123 .05μF
R93 2.2K
C124 180pF
R102 470
R106 10K
R107 4.7K
R108 4.7K
C77 10pF
R103 51
Q29 2N5179
60 pF
D25 1-1100
61 5 pF
Q30 MPS6531
C75 180pF
R92 4.7K
C63 180pF
Q31 MPS3638
R94 220
R95 1K
TP
FINE DELAY
TP
TP
R96 1.2K
C76 180pF
C42 10pF
R87 1.2K, ½W
Q32 2N4258
Q33 2N4258
C79 180pF
D28
C80 180pF
D29
Q35 2N5179
Q36 2N5179
RG-174/U TO Q39 BASE
L2 .22μH
R104 91Ω
L3 .22μH
R105 100
Q34 2N5179
C78 180pF

-12 V

-24 V

TP
100 μS
30 μS
10 μS
3 μS
1 μS
300 NS
100 NS
30 NS
10 NS
5 NS
DELAY

DOUBLE PULSE
MODE ONLY
0.6V MIN
0.0 V
4NS
NOTE 4

4NS
0.6V MIN
0.0 V
T_R = 2NS

TP
DOUBLE PULSE
SINGLE PULSE

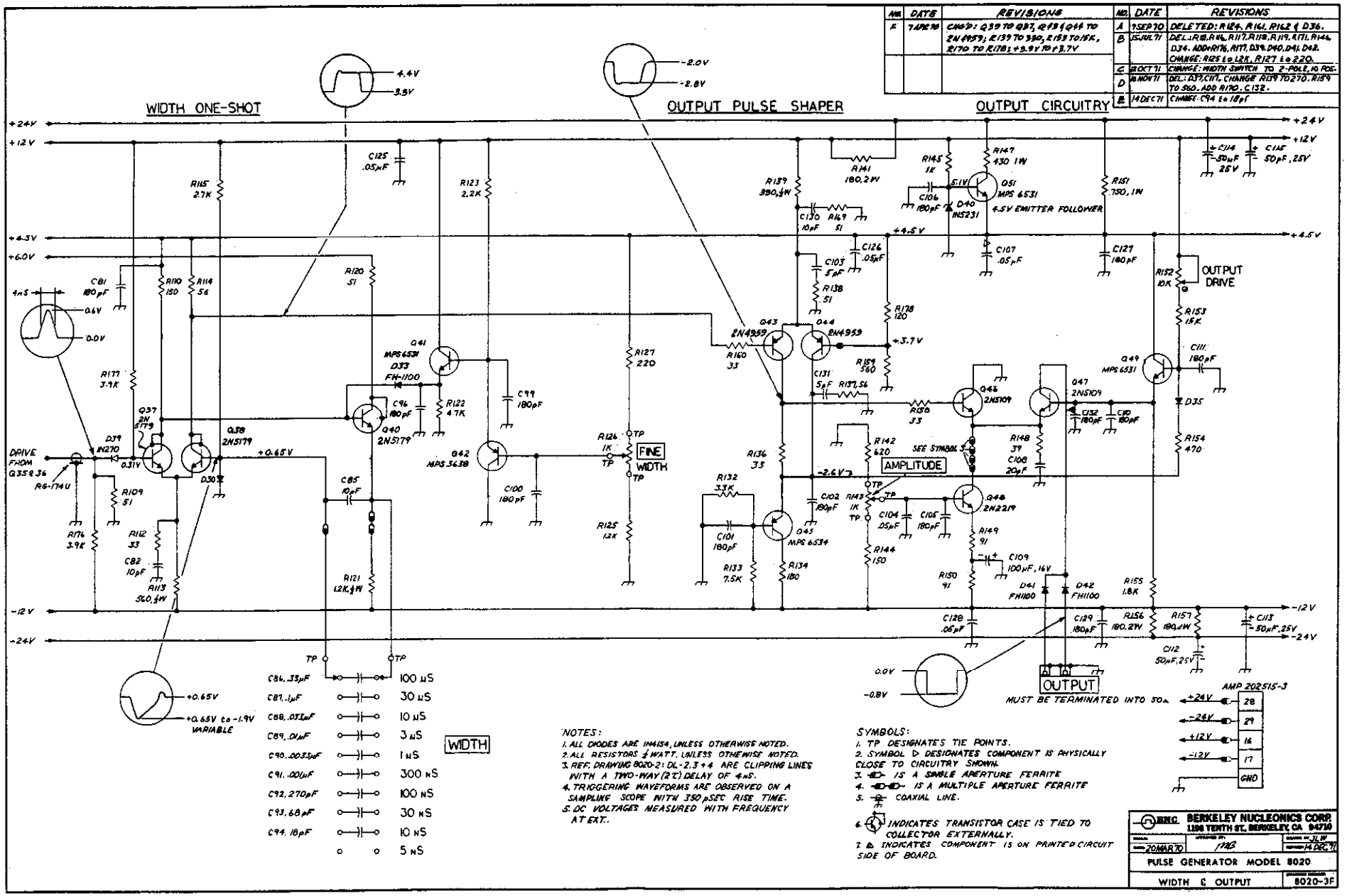
NO.	DATE	REVISIONS
B	15JUL71	CHANGE: D22 TO IN4154.
C	12OCT71	CHANGE: DELAY SWITCH TO 2-POLE 10-POSITION.
D	7 APR 72	CHG'D: DL-2 TO L1, .33μH, DL-3 & DL-4 TO L2 & L3, .22μH; R104 TO 91Ω, R153 TO 15K.

BNC BERKELEY NUCLEONICS CORP.
1198 TENTH ST., BERKELEY, CA 94710

SCALE: | APPROVED BY: MB | DRAWN BY JLW
DATE: 20 MAR 70 | REVISED 12 OCT 71

PULSE GENERATOR MODEL 8020

DELAY & DOUBLE PULSE | DRAWING NUMBER 8020-2D



NO.	DATE	REVISIONS
E	7APR70	CHG'D: Q39 TO Q37, Q38 & Q44 TO 2N4959; R139 TO 390, R159 TO 15K, R170 TO R178; +5.9V TO +3.7V

NO.	DATE	REVISIONS
A	9SEP70	DELETED: R124, R161, R162 & D36.
B	15JUL71	DEL.: R118, R116, R117, R118, R119, R171, R146, D34. ADD: R176, R177, D39, D40, D41, D42. CHANGE: R125 to L2K, R127 to 220.
C	8OCT71	CHANGE: WIDTH SWITCH TO 2-POLE, 10 POS.
D	16NOV71	DEL.: D37, C117. CHANGE R139 TO 270, R159 TO 560. ADD R170, C132.
E	14DEC71	CHANGE: C94 to 18pF

BERKELEY NUCLEONICS CORP.
1196 TENTH ST., BERKELEY, CA 94710

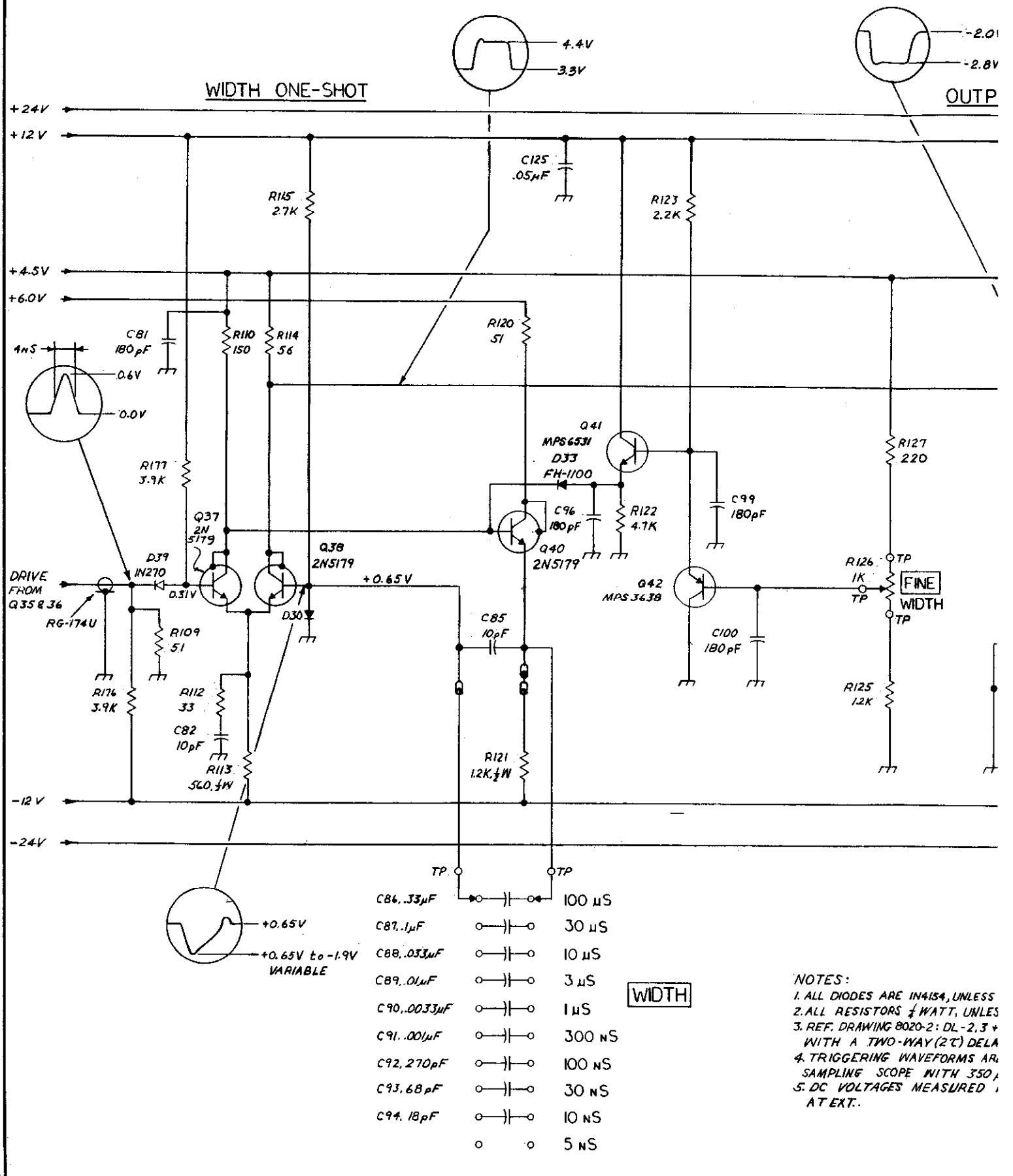
20MAR70	1/1/3	JL W	14 DEC 71

PULSE GENERATOR MODEL 8020

WIDTH & OUTPUT — 8020-3F

NOTES:
1. ALL DIODES ARE 1N4154, UNLESS OTHERWISE NOTED.
2. ALL RESISTORS ¼ WATT, UNLESS OTHERWISE NOTED.
3. REF. DRAWING 8020-2: DL-2, 3 + 4 ARE CLIPPING LINES WITH A TWO-WAY (2T) DELAY OF 4nS.
4. TRIGGERING WAVEFORMS ARE OBSERVED ON A SAMPLING SCOPE WITH 350 pSEC RISE TIME.
5. DC VOLTAGES MEASURED WITH FREQUENCY AT EXT.

SYMBOLS:
1. TP DESIGNATES TIE POINTS.
2. SYMBOL ▷ DESIGNATES COMPONENT IS PHYSICALLY CLOSE TO CIRCUITRY SHOWN.
3. IS A SINGLE APERTURE FERRITE
4. IS A MULTIPLE APERTURE FERRITE
5. COAXIAL LINE.
6. INDICATES TRANSISTOR CASE IS TIED TO COLLECTOR EXTERNALLY.
7. Δ INDICATES COMPONENT IS ON PRINTED CIRCUIT SIDE OF BOARD.


WIDTH ONE-SHOT
OUTP
4.4V
3.3V
-2.0
-2.8V
+24V
+12V
+4.5V
+6.0V
C125 .05μF
R115 2.7K
R123 2.2K
R120 51
C81 180pF
R110 150
R114 56
4nS
0.6V
0.0V
R177 3.9K
Q41 MPS6531 D33 FH-1100
R127 220
C96 180pF
R122 4.7K
C99 180pF
Q37 2N 5179
Q38 2N5179
Q40 2N5179
D39 IN270
DRIVE FROM Q35 & 36
RG-174U
0.31V
+0.65V
D30
Q42 MPS 3638
R126 1K
TP
FINE
WIDTH
C85 10pF
R109 5.1
C100 180pF
R176 3.9K
R112 33
C82 10pF
R113 560, ½W
R121 1.2K, ½W
R125 1.2K
-12V
-24V
+0.65V
+0.65V to -1.9V VARIABLE
C86, .33μF 100 μS
C87, .1μF 30 μS
C88, .033μF 10 μS
C89, .01μF 3 μS
C90, .0033μF 1 μS
C91, .001μF 300 nS
C92, 270pF 100 nS
C93, 68 pF 30 nS
C94, 18pF 10 nS
5 nS
WIDTH
NOTES:
1. ALL DIODES ARE IN4154, UNLESS
2. ALL RESISTORS ¼ WATT, UNLES
3. REF. DRAWING 8020-2: DL-2,3 +
WITH A TWO-WAY (2℃) DELA
4. TRIGGERING WAVEFORMS AR
SAMPLING SCOPE WITH 350
5. DC VOLTAGES MEASURED
AT EXT.

NO.	DATE	REVISIONS
F	7APR 78	CHG'D: Q39 TO Q37, Q43 & Q44 TO 2N4959; R139 TO 330, R153 TO 15K, R170 TO R178; +3.9V TO +3.7V

NO.	DATE	REVISIONS
A	9SEP 70	DELETED: R124, R161, R162 & D36.
B	15JUL 71	DEL.: R111, R116, R117, R118, R119, R171, R146, D34. ADD: R176, R177, D39, D40, D41, D42. CHANGE: R125 to 1.2K, R127 to 220.
C	12OCT 71	CHANGE: WIDTH SWITCH TO 2-POLE, 10 POS.
D	16 NOV 71	DEL.: D37, C117. CHANGE R139 TO 270, R159 TO 560. ADD R170, C132.
E	14DEC 71	CHANGE C94 to 18pF

-2.0V

-2.8V

OUTPUT PULSE SHAPER

OUTPUT CIRCUITRY

+24V

+12V

+4.5V

+4.5V

+3.7V

-2.6V

-12V

-24V

R139 330, ¼W

R141 180, 2W

R145 1K

R147 430 1W

5.1V

Q51 MPS 6531

4.5V EMITTER FOLLOWER

C106 180pF

D40 IN5231

R151 750, 1W

+C114 50μF 25V

+C115 50μF, 25V

C130 10pF

R169 51

C126 .05μF

C107 .05μF

C127 180pF

C103 5pF

R138 51

R152 10K

OUTPUT DRIVE

R153 15K

R178 120

Q43 2N4959

Q44 2N4959

R160 33

C131 5pF

R137, 56

R159 560

Q46 2N5109

Q47 2N5109

Q49 MPS 6531

C111 180pF

D35

R158 33

C132 180pF

C110 180pF

R154 470

R136 33

R142 620

SEE SYMBOL 3

AMPLITUDE

R148 39

C108 20pF

R132 3.3K

TP

R143 1K

TP

TP

C102 180pF

Q48 2N2219

C104 .05μF

C105 180pF

C101 180pF

Q45 MPS 6534

R149 91

R144 150

C109 100μF, 16V

R133 7.5K

R134 180

R150 91

D41 FH1100

D42 FH1100

R155 1.8K

C128 .05μF

C129 180pF

R156 180, 2W

R157 180, 2W

+C113 50μF, 25V

C112 50μF, 25V

0.0V

-0.8V

OUTPUT

MUST BE TERMINATED INTO 50Ω

AMP 202515-3

+24V	28
-24V	29
+12V	16
-12V	17
GND	

IN4154, UNLESS OTHERWISE NOTED.

¼ WATT, UNLESS OTHEWISE NOTED.

20-2: DL-2, 3 + 4 ARE CLIPPING LINES WAY (2τ) DELAY OF 4 nS.

'AVEFORMS ARE OBSERVED ON A E WITH 350 pSEC RISE TIME. MEASURED WITH FREQUENCY

SYMBOLS:

1. TP DESIGNATES TIE POINTS.
2. SYMBOL ▷ DESIGNATES COMPONENT IS PHYSICALLY CLOSE TO CIRCUITRY SHOWN.
3. IS A SINGLE APERTURE FERRITE
4. IS A MULTIPLE APERTURE FERRITE
5. COAXIAL LINE.
6. INDICATES TRANSISTOR CASE IS TIED TO COLLECTOR EXTERNALLY.
7. ▲ INDICATES COMPONENT IS ON PRINTED CIRCUIT SIDE OF BOARD.

BNC BERKELEY NUCLEONICS CORP. 1198 TENTH ST., BERKELEY, CA 94710

SCALE:	APPROVED BY: MB	DRAWN BY: JLW
DATE: 20MAR70		REVISED 14 DEC 71

PULSE GENERATOR MODEL 8020

WIDTH & OUTPUT — DRAWING NUMBER 8020-3F