Assembly and Operation of A E Corp
Model 22 Pulse Generator

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Introduction

The A E Corp Model 22 pulse generator is a compact, high performance solid state signal source. Most instruments tend to have two controls: one setting pulse repetition frequency, the other determining the pulse width. This leads to undesirable effects when the pulse width control is adjusted for a pulse length in conflict with the chosen repetition frequency. It is difficult indeed to fit a 500 microsecond pulse into a pulse repetition frequency of 1 MHz.

A E Corp departs from the conventional approach by permitting the operator to adjust the pulse on time independent from the pulse off time. This permits the programing of pulse trains with the maximum flexability and simplicity available. The amplitude is continuously adjustable from 0 to 15 volts with rise and fall times less than 20 nsec. This is especially advantageous when working with timing signals in todays digital computer and microprocessors. By utilizing the latest integrated circuits and fabrication technology A E Corp can provide these new features at a very low cost.

Parts List

Check each part against the following list. The designation numbers used here are the same as those found on the pictorials and schematics. Any part that is packed in an individual envelope with a part number on it should be placed back in its envelope after it is identified until it is called for in an assembly step.

Designation Number	Quantity	Description
Resistors	½ watt	5% unless otherwise specified
R1, R2	2	50K Control (T1, T2)
R3-R8	6	10K Control
R9, R10, R16	3	470 (Yel-Pur-Brn)
R11, R13	2	1K (Brn-Blk-Red)
R12	1	6.8K (Blu-Gry-Red)
R14	1	2K Control (Level)
R15	1	100 (Brn-Blk-Brn)
R17	1	150 1 watt
Capacitors		
C1, C2	2	5 uf 50 volt electrolytic
C3, C4	2	.68 uf ±5%
C5, C6	2	.068 uf ±5%
C7, C8	2	.0068 uf ±5%
C9, C10	2	560 pf ±5%
C11, C12	2	30 pf ±5% (No longer required)
C13	1	.01 uf 100v ceramic
C14	1	2200 uf 25v electrolytic
C15	1	10 uf 25v electrolytic
Diodes, Transistors and Integrated Circuits		
D1, D2, D3, D4	4	1N4002
D5	1	1N758
D6	1	1N751
D7, D8	2	1N4148
Q1	1	2N3866 or 2N4275
Q2	1	2N3904
U1	1	74123
U2	1	7426
Switches		
S1	1	S.P.S.T. PWR Switch (located on R14)
S2, S3	2	2 pole-6 position switch
Transformer		
T1	1	12.6 VAC RMS sec.

Parts List (Continued)

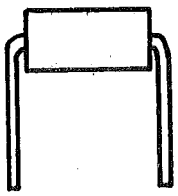
Designation Number	Quantity	Description
Misc. Components		
L1	1	Line Cord
J1	1	Red Binding Post
J2	1	Black Binding Post
J3	1	Red Banana Jack
H1, H2	2	Fuse Clips
B1	1	Power Supply P.C.
B2	1	Main Board P.C.
K1, K2, K3, K4, K5	5	Knobs
F1	1	.25 Amp fuse
LMB	1	Cabinet
G1	1	Grommet
Wires and Jumpers		Length — Function
W1	1	6.0 — 115 VAC PWR
W2, W3	2	8.0 — 5, 5R
W4, W5, W8	3	2.0 — J1, J2, TTL
W6	1	.20 — Jumpers
W7	1	.55 — "
Hardware		
HW1	2	6-32 x ½" Screw
HW2	2	6-32 Nuts
HW3	1	6-32 Internal tooth lockwashers
HW4	5	3/8" Internal tooth lockwashers
HW5	2	3/8" Flat washers
HW6	5	Control Nuts (Mixed sizes)
RF1-RF4	4	Rubber Feet and Screws
SP1, SP2	2	Phenolic Spacers

Step By Step Assembly

Before starting to assemble this kit, read this section carefully. Due to the small foil areas on the circuit boards and small areas between foils, it is necessary to exercise the utmost care to prevent solder bridges between adjacent foil areas. Use a minimum amount of solder and do not heat components excessively. The components and printed circuit board can be damaged if subjected to excessive amounts of heat. Use a soldering iron rated at 15-30 watts. This type of soldering iron will make the kit easier to assemble. Solder only the part or parts as indicated in each step.

All parts will be installed from the component side and soldered on the printed circuit side of the board.

Bend all resistors as shown in the accompanying illustration. This is done by simply holding the resistor in one hand and using one finger of the other hand to make the lead flex to a right angle.



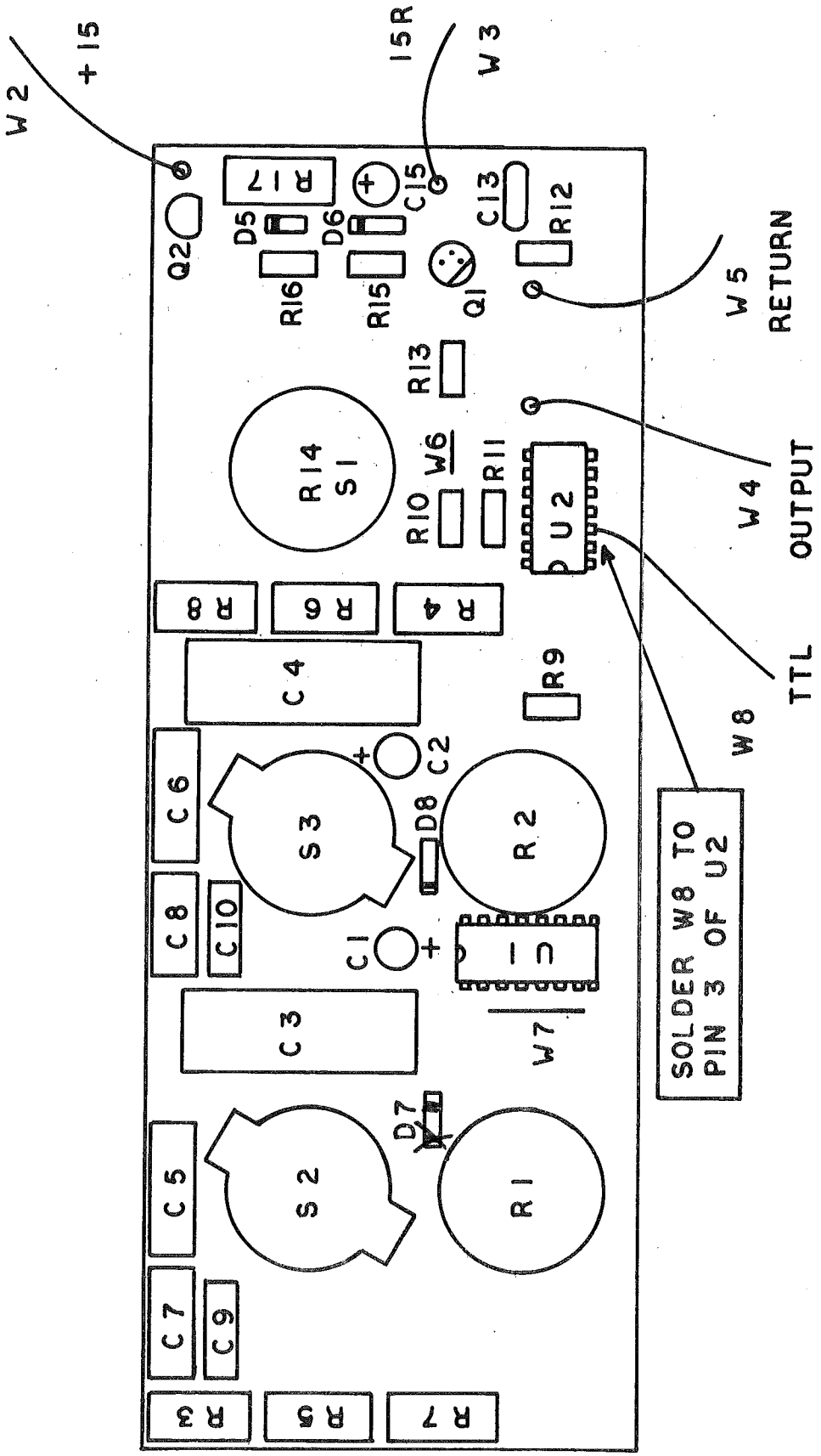

W2
+15
15R
W3
W5
RETURN
W4
OUTPUT
TTL
W8
SOLDER W8 TO
PIN 3 OF U2
Q2
D5
D6
R17
C15
C13
R12
R16
R15
Q1
R13
R14
S1
W6
R10
R11
U2
R8
R6
R4
C4
R9
C6
S3
C2
D8
R2
C8
C10
C1
U1
C3
W7
D7
C5
S2
R1
C7
C9
R3
R5
R7

FIGURE 1

Main Board Assembly

1.0 In the following 8 steps do not solder the components into place. (Use component pictorial figure 1).

1.1	Insert	Capacitor	C11, C12	as indicated	30 pF	5%	( )
1.2	"	"	C9, C10	" "	560 pF	5%	( )
1.3	"	"	C7, C8	" "	6800 pf	5%	( )
1.4	"	"	C5, C6	" "	.068 uf	5%	( )
1.5	"	"	C3, C4	" "	.68 uf	5%	( )
1.6	"	"	C1, C2	" "	5 uf	20%	( )
1.7	"	"	C13	" "	.01 uf	20%	( )
1.8	"	"	C15	" "	10 uf	20%	( )

1.9 *Note, before soldering, make sure the correct polarity is observed for C1,C2 & C15. Turn the board over and solder the components into place. Cut the remaining leads off. ( )

2.0 Install U1 and U2 into the printed circuit board, making sure that the orientation is exactly identical to that shown in figure 1. ( )

2.1 Turn the board over and solder the components into place. Care must be exercised or a short will result. Cut the remaining leads off. ( )

3.0 In the following steps do not solder the components into place.

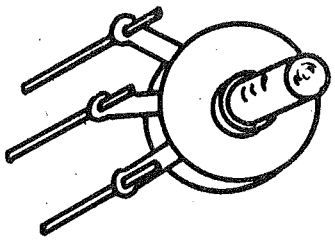
3.1	Insert	Control	R3, R4	as indicated	(10K Trim Pot)	( )
3.2	"	"	R5, R6	" "	(10K Trim Pot)	( )
3.3	"	"	R7, R8	" "	(10K Trim Pot)	( )
3.4	"	Jumper	W6	" "	(Solid wire)	( )
3.5	"	"	W7	" "	(Solid wire)	( )
3.6	"	Diodes	D7, D8	" "	1N4148 (Observe Polarity Band)	( )
3.7	" R16,	R9, R10	as indicated		470 (Yel-Pur-Brn)	( )
3.8	"	R11, R13	" "		1K (Brn-Blk-Red)	( )
3.9	"	R12	" "		6.8K (Blu-Gry-Red)	( )
3.10	"	R15	" "		100 (Brn-Blk-Brn)	( )
3.11	"	R17	" "		150 (Brn-Grn-Brn)	( )
3.12	"	D5	" "		1N758 (Observe polarity)	( )
3.13	"	D6	" "		1N751 (Observe polarity)	( )
3.14	"	Q2	" "		2N3904	( )
3.15	"	Q1	" "		2N3688 or 2N4275	( )

3.16 Now turn the board over and solder these components into place. Cut the remaining leads off. ( )

4.0 Install S2 and S3 as shown in figure 1. Note: this is accomplished by first pushing the switches completely through the P.C. board. Then slightly bend back two switch terminals located directly opposite each other. Now pull the switches back so that approximately 1/32 of an inch of the terminals still extends through the board. (Make sure all the switch terminals extend the same amount through the board.) Solder the switches by holding the iron on the terminals and feeding solder until the whole area is filled. ( )

Main Board Assembly (Continued)

5.0 Prepare R1, R2, and R14 for placement into the printed circuit board as follows: Install nine wires left over from the fixed capacitors into R1, R2, and R14 (see below).( )



6.0 Insert wire W2 as indicated in figure 1. ( )

6.1 " " W3 " " " " " ( )

6.2 " " W4 " " " " " ( )

6.3 " " W5 " " " " " ( )

6.4 " " W8 " " " " " ( )

6.5 Solder those wires and cut the extra length off. ( )

The main board is now completed.

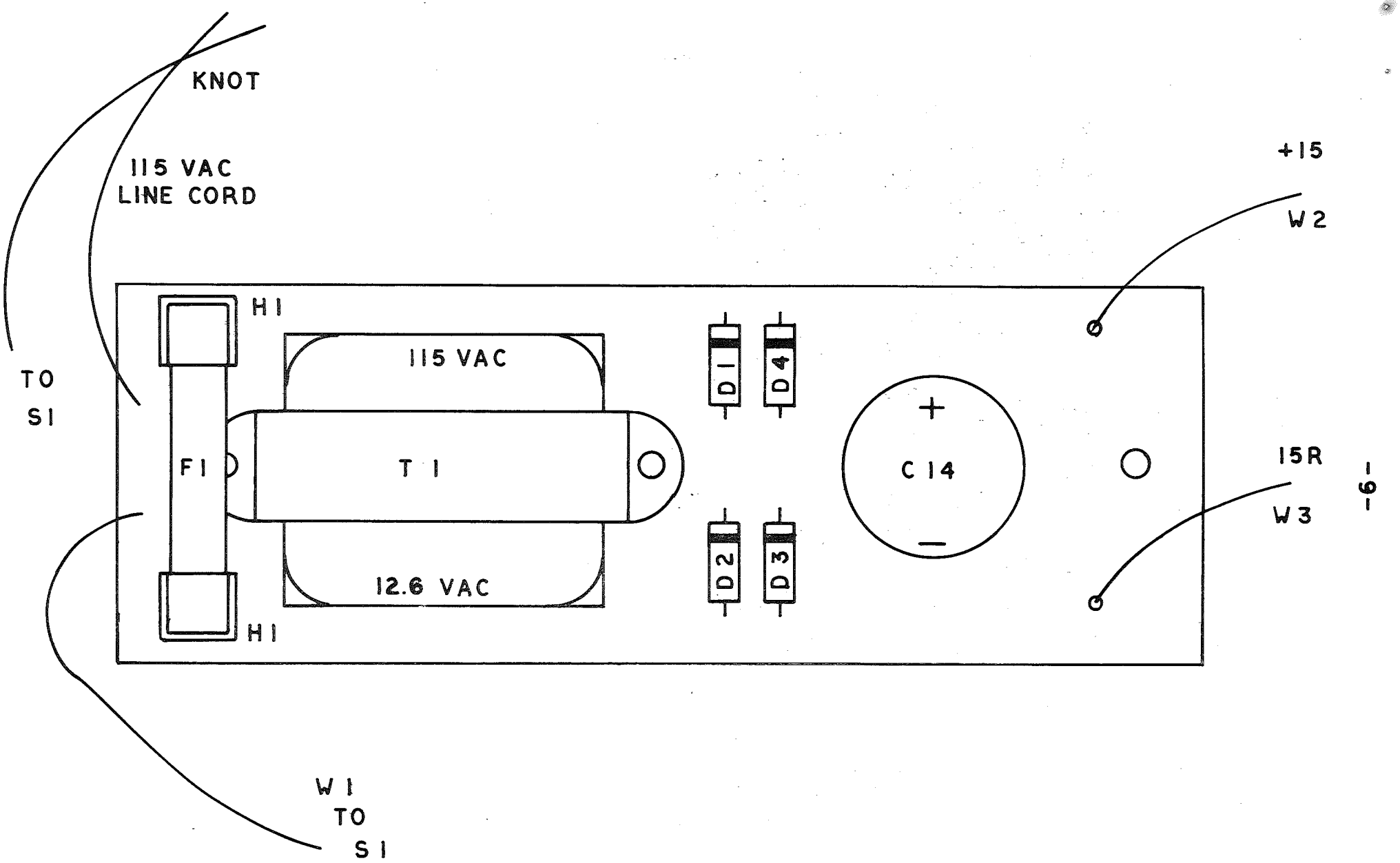

KNOT
115 VAC
LINE CORD
TO
S1
H1
115 VAC
F1
T 1
12.6 VAC
H1
D1
D4
D2
D3
C 14
+15
W2
15R
W3
W1
TO
S1
6-1

FIGURE 2

Power Supply Assembly

1.0 In the following steps do not solder the components into place. (Refer to figure 2).

1.1 Insert D1, D2, D3, D4 as indicated 1N4002 ( )
1.2 " C14 " " 2200 uf 25v ( )

1.3 Note; before soldering make sure that the band located on each diode agrees with the pictorial in figure 2. Also, the polarity of these capacitors must be observed carefully. Solder and cut the remaining leads. ( )

2.0 Install T1 making sure that the 115 VAC input side is oriented as shown in figure 2. Caution should be exercised in positioning the transformer terminals into the printed circuit board holes since excessive bending of the terminals can break the fine wires connected to them. ( )

2.1 Solder the terminals by holding the iron on the terminals and feeding solder until the whole area is filled. ( )

3.0 Install fuse clips H1 as indicated. Note the correct orientation necessary for the fuse to be installed. Make sure they rest flat on the board, then solder. ( )

3.1 Install fuse F1 into the clips. ( )

Initial Checkout

*Caution: While the Model 22 pulse generator is designed for maximum safety, never lose respect for the high voltage present in this instrument. This is especially true in the initial checkout phase of operation.

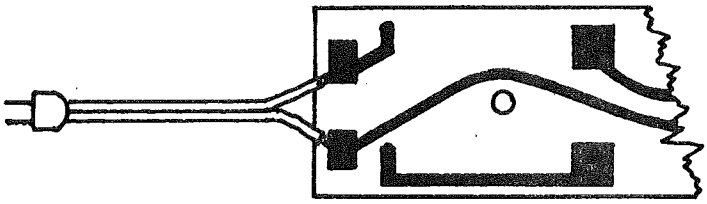
The purpose of this "Initial Checkout" section is to determine if the unit is working in a normal fashion prior to adjustment and calibration. The only necessary equipment for checkout is an oscilloscope covering the frequency range D.C. to 10 MHz.

1.0 Examine the power supply and main board carefully for any solder bridging between foil areas. ( )

1.1 Be sure all components are soldered. ( )

1.2 Check once more all the components that required specific orientation or polarization when installed. ( )

1.3 Connect the 115 VAC power cord temporarily on the copper side of the printed circuit board as shown. ( )



1.4 Connect the oscilloscope between the 15R and +15v position (figure 2). Set the vertical sensitivity switch for 1v/cm. ( )

1.5 Initial power turn on must be exercised with care. Plug in the line cord and observe if +15 volts dc is present. If +15 volts is absent, immediately unplug the power cord and go to the "In case of difficulty section". ( )

1.6 If the +15 volts dc reading is within ±20% tolerance, continue. ( )

2.0 Unplug the power cord and connect W2 and W3 to the power supply board. Observe carefully where each wire must go by looking at figures 1 and 2. ( )

2.1 Put knobs on S2 and S3 temporarily. ( )

2.2 Turn S2 and S3 to their most CCW position (100 nsec.) and turn R14 to its most CW position. ( )

2.3 Place the scope probe on wire W4 and W5 (output and return respectively). ( )

2.4 Plug in the power cord and observe the high frequency square wave (approximately 15 Vpp). If no square wave is present, go to the "In case of difficulty section". ( )

Initial Checkout (Continued)

2.5 Rotate S2 and S3 simultaneously one step at a time and observe the output square wave. Note, until calibration, the duty cycle will vary substantially. If in any position a squarewave is absent, go to the "In case of difficulty section." ( )

Calibration

The only piece of equipment necessary to calibrate the Model 22 pulse generator is an oscilloscope. The only requirement is that the frequency response be flat from d.c. to 10 MHz.

1.0 Connect the oscilloscope input to W4 and W5 (output and return wires respectively). ( )

1.1 Turn S2 and S3 to their most CCW positions (100 nsec.). ( )

1.2 Turn R1 and R2 control pots such that they are in their most CCW positions (1X Cal.). ( )

1.3 Plug in the power cord and observe the high frequency squarewave. ( )

1.4 Adjust R7 and R8 such that the on time T1 and the off time T2 equal 100 nsec. ( )

1.5 Adjust R5 and R6 such that the on time T1 and the off time T2 in the next four cw postions of S2 and S3 equal 1 us, 10 us, 100 us and 1 ms respectively. The maximum error should be ±5%. ( )

1.6 Adjust R3 and R4 such that when S2 and S3 are both in their most cw position T1 and T2 equal 10 ms±5%. ( )

1.7 Turn S2 and S3 through all their positions and check the designated times with the actual times. All readings should be within ±5%. ( )

Final Assembly

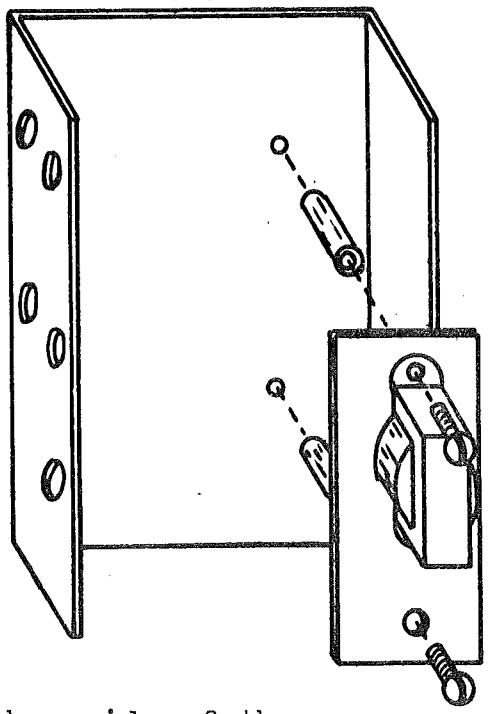
1.0 Put the black rubber grommet in the rear back cover hole. ( )

1.1 Mount J1 (red) and J2 (blk) binding posts as follows: (Red goes through the hole nearest the label "output"). Remove the two nuts, one terminal lug and one insulating washer. Place through the front panel the remaining binding post assembly. Put back, in the same order of removal, the insulating washer, terminal lug and nut. Tighten the nut keeping the terminal stationary. Screw the second nut on to lock the assembly in place. ( )

1.2 Put the 6-32 screw through the transformer hole nearest the fuse. ( )

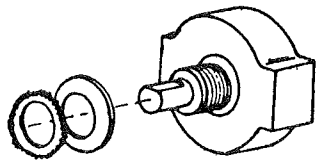
1.3 Place the fiber spacer (SP1) over the screw extending through the printed circuit board. ( )

1.4 With the chassis on its side as shown below, mount the power supply board by passing the screw through the chassis and securing it with a nut. ( )



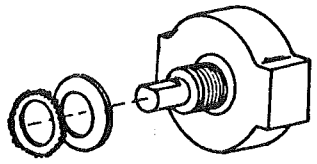
1.5 To secure the other side of the power supply board, put the assembly flat down and slide the spacer between the p.c. board and metal chassis until the holes line up. ( )

1.6 Position the flat washer and the lock washer on S2 and S3 as shown below. ( )



Final Assembly (Continued)

1.7 Position one flat washer and one lockwasher on R1, R2, and R14 as shown below prior to front panel mounting. ( )



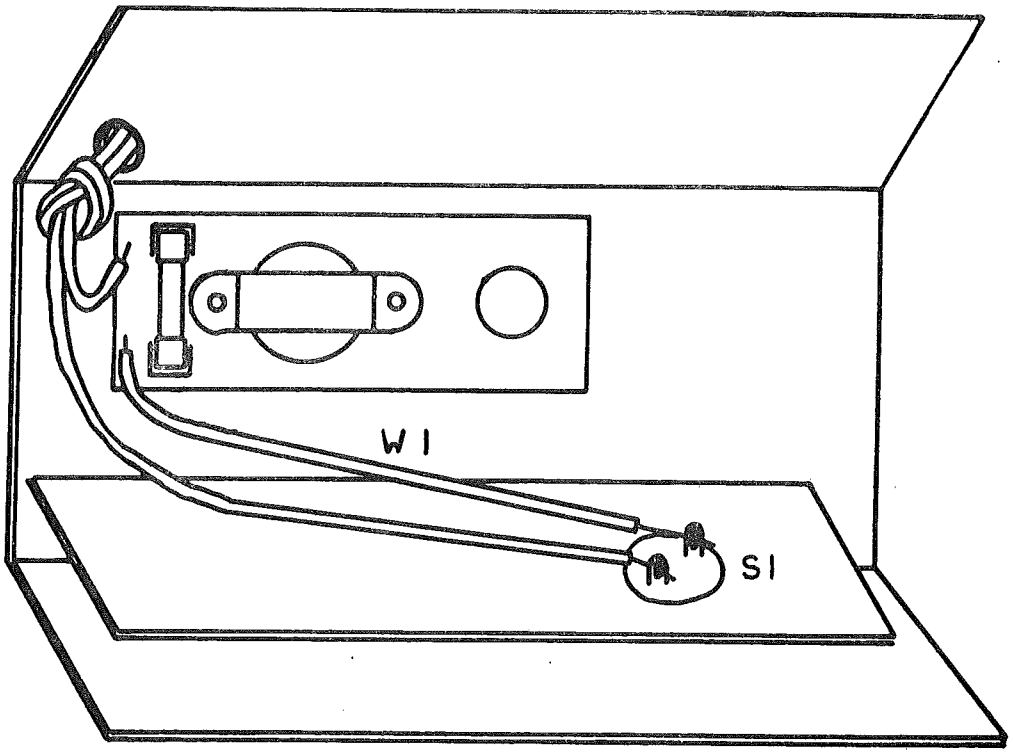
1.8 Insert wires W4, W5 and W8 into J1, J2 and J3 respectively, (see figure 1) and solder. ( )

1.9 Mount the main board by inserting the switches and control pots through the front panel. ( )

1.10 Note, read this step completely before implementing it. Secure the main board to the front panel via the five nuts provided with the kit. Note, the different type nuts required for each switch and control potentiometer. Use extreme care when tightening these nuts since any slipping of tools could cause a scratch on the panel. ( )

1.11 Insert the line cord through the rear panel hole which has the rubber grommet. ( )

1.12 Separate the twin lead power cord so that after a knot is made, one lead will reach the power switch (S1). Cut the other lead to one half that length. Strip the insulation off and insert the wires as shown below. Note, this step is simplified if you bend the wire abruptly and insert it into the power supply board. Stand cabinet on its side. The solder and soldering iron can fit between the bottom chassis and p.c. board to make these final connections. Connect W1 between the P.C. board and S1. ( )



Final Assembly (Continued)

1.13 Slide the chassis into the cover starting with the panel entering from the rear end of the cover. Slide until all four holes line up. Screw in the four rubber feet to only a snug fit, otherwise the feet will fall off. ( )

1.14 Install the five front panel knobs (K1, K2, K3, K4, K5) making sure that the dots on the knobs align correctly with the switch setting marks. Remember to align the dots with the 1X cal. mark when R1 and R2 (Pots) are in the most CCW position. Also align the level control dot with the PWR off position mark. ( )

1.16 Plug in the Model 22 pulse generator and check the calibration. ( )

Operation

1.0 The instrument power switch is combined with the level control on the front panel. When the level control is fully counter clockwise the instrument is turned off. The first 5 to 10 degrees of clockwise rotation turns the Model 22 pulse generator on.

1.1 The level control adjusts the amplitude of the output pulses at the red binding post. In the most clockwise rotation position the maximum amplitude signal is available.

1.2 The T1 decade switch located above T1 on the front panel determines the minimum positve pulse time.

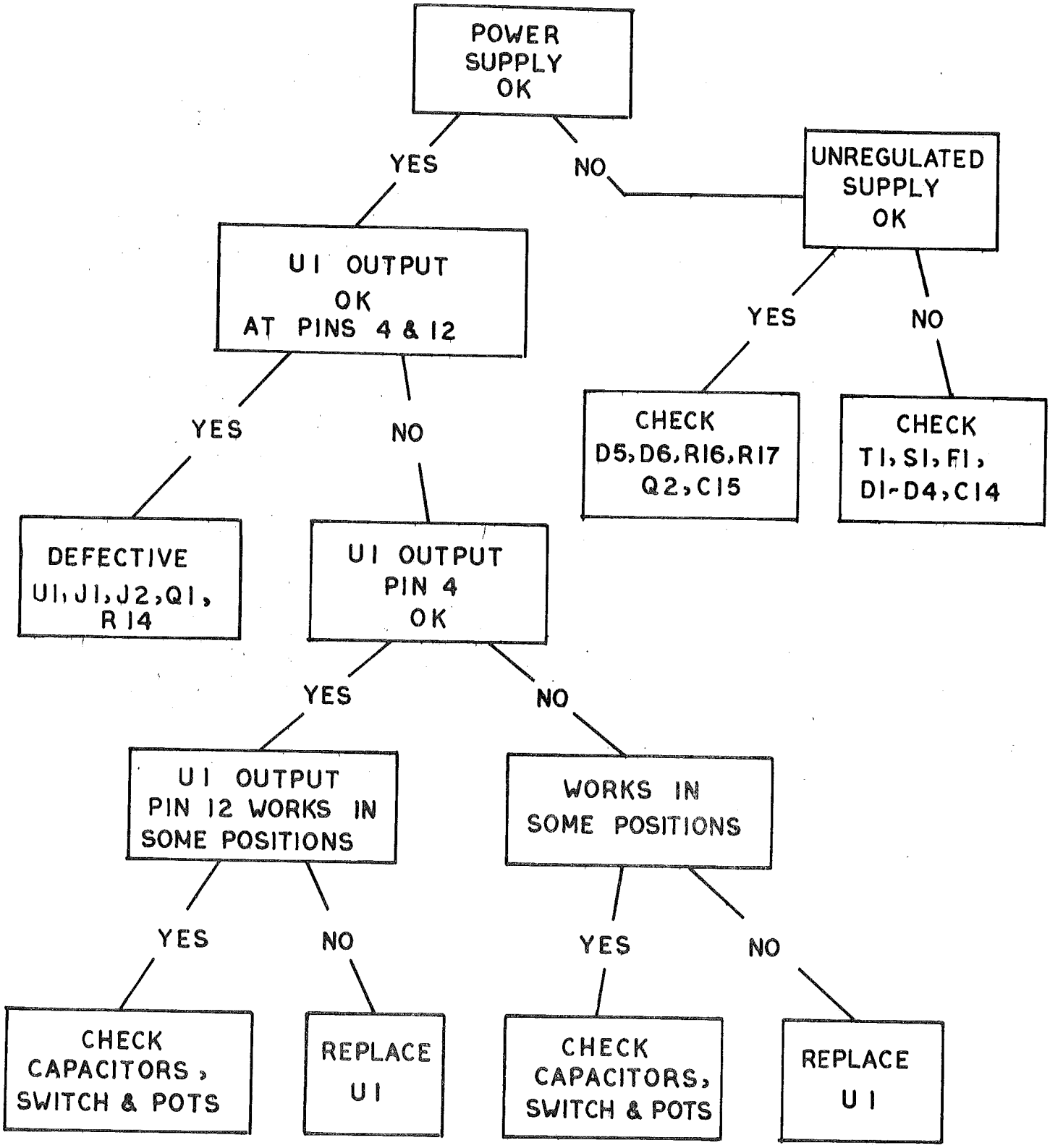
1.3 The T1 control potentiometer located below T1 on the front panel provides continuous adjustment of the positive pulse duration time. When this control is in the 1X cal. position (most ccw) the output positive pulse is 5% of the T1 decade switch setting.

1.4 The T2 decade switch located above T2 on the front panel determines the minimum time between the positive pulses (T1).

1.5 The T2 control potentiometer located below T2 on the front panel provides continuous adjustment of the time between positive pulses. When this control is in the 1X cal. position (most ccw) the time between pulses is 5% of the T2 decade switch setting.

1.6 The red binding post provides the output signal while the black binding post provides the signal return.

IN CASE OF DIFFICULTY



Specifications

Frequency Range:	5 Hz to 5 MHz (5% Accuracy)
Pulse Width:	100 nsec. to .1 sec (unlimited duty cycle)
Rise and Fall Time:	Less than 20 nsec. on all ranges
Output Voltage:	0 to +15 volts
Output Impedance:	100 (5 Vpp into 50 ohms)
Input Voltage:	105 to 125 VAC 60 Hz
Input Power:	5 watts
Operating Temp:	$0^{o}C$ to $50^{o}C$
Size, Weight:	8" x 5" x 3.5", 1.5 lb.

Description

The Model 22 pulse generator consists of two monostable multivibrators, one triggering the other. The result is a continous clock signal with each half period separately controlled. To minimize propagation delay causing unsymetrical waveforms at the highest frequency a R-S flip-flop is triggered by both one-shots. The amplitude is elevated to 15 Vpp via U2 (7426) and R14 (level control). Finally, the output drive amplifier consists of emitter follower Q1 and a current sinking stage of U2.

The unregulated power supply consists of power transformer (T1), full wave bridge rectifier and filter capaciter (C14). The regulated supply provides +15 volts and +5 volts via zener diodes D5 and D6 respectively. Q2 minimizes dissipation in D5 and permits operation at low line.

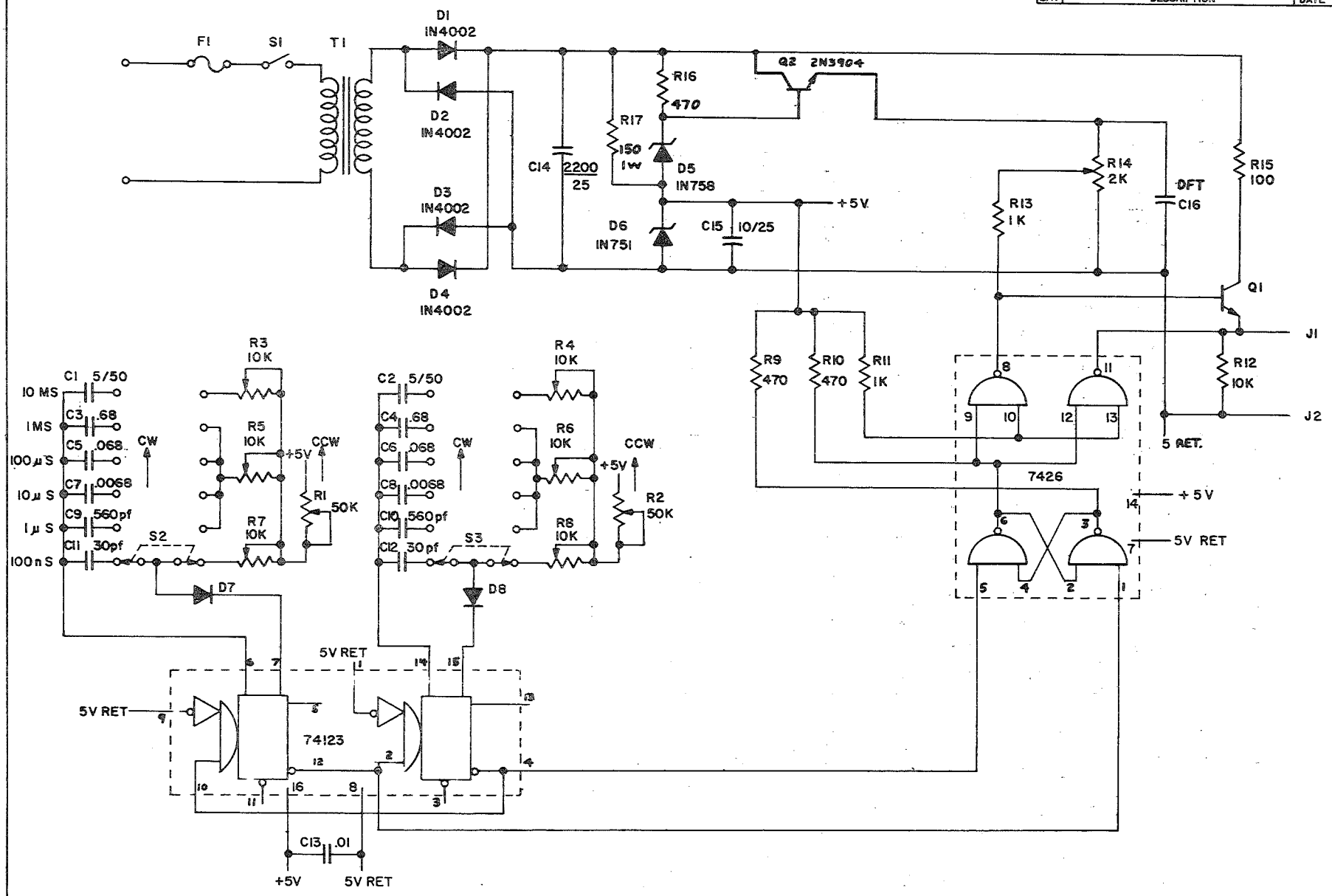
Applications

1. Clocks for Digital Computers & Microprocessors
2. Pulse modulation for lasers and light emitting diodes (LED's)
3. Amplifier testing* using square waves and pulse techniques. Frequency response information from time domain data
4. AC voltage calibration waveforms using low temperature coefficient zener diodes
5. CMOS, TTL, RTL, I^2L, DTL, ECL, HINL and etc. logic testing
6. Switching circuits signal sources, i.e. switching regulators, pulsed servo systems and transponders
7. Dynamic testing of power supplies for determining the transient response
8. Natural resonances in coils, inductors, capacitors and transformers
9. Exciting mechanical systems with impulses and determining the natural frequencies
10. Testing and evaluating ultrasonic transducers for their performance. These would include mechanical, electro-mechanical and optical systems.

*Electronic Measurements, McGraw-Hill by Terman & Pettit Page 257-260, Page 327-333

Electronic Amplifier Circuits, McGraw-Hill by Pettit and McWhorter, Page 121-129

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



NOTES:

UNLESS OTHERWISE SPECIFIED:

1. RESISTOR VALUES ARE IN OHMS
2. CAPACITOR VALUES ARE IN MICROFARADS PER RATED VOLTAGE

USED ON	A E CORP NEWTON, MASS.
NEXT ASSY	MODEL 22 PULSE GENERATOR
DWN BY BRL DATE 11/26/75	
CHKD ENGR	
SIZE C / CODE IDENT NO / DWG NO / REV	
SCALE / SHEET / OF /	

Warranty & Customer Service

90 Day Full Warranty

A E Corp will replace or repair, free of charge, any parts which are defective. You can obtain these parts directly from A E Corp, P.O. Box 63, Newton, MA 02161, (617)-449-3142. We will pay shipping charges to get those parts quickly to you.

We guarantee that during the first ninety days of ownership, our products, when correctly assembled, calibrated and used in accordance with our instruction manual, will meet the published specifications.

A E Corp will provide free consultations on any problem you might encounter in the assembly, checkout or use of your instrument. Just drop us a line or give us a call. Unfortunately, we cannot accept collect calls.

This warranty does not cover damage caused by use of corrosive solder, defective tools, incorrect assembly, misuse, fire, customer made modifications or acts of God.