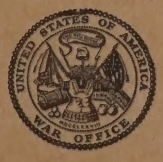
TM 11-2678

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

PULSE GENERATOR AN/PPM-1



DEPARTMENT OF THE ARMY • SEPTEMBER 1953

TECHNICAL MANUAL
No. 11-2678

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *1 September 1953*

PULSE GENERATOR AN/PPM-1

		Paragraphs	Page
CHAPTER 1.	INTRODUCTION		
Section I.	General	1, 2	7
II.	Description and data	3–11	7
CHAPTER 2.	OPERATING INSTRUCTIONS		
Section I.	Service upon receipt of the Set	12–16	12
II.	Controls	17, 18	17
III.	Operation under usual conditions	19–22	17
IV.	Operation under unusual conditions	23–26	18
CHAPTER 3.	ORGANIZATIONAL MAINTENANCE INSTRUCTIONS		
Section I.	Preventive maintenance services	27–32	20
II.	Lubrication and weatherproofing	33–35	23
III.	Trouble shooting at organizational maintenance level	36–39	24
CHAPTER 4.	THEORY	40–52	26
5.	FIELD MAINTENANCE INSTRUCTIONS		
Section I.	Trouble shooting at field maintenance level	53–60	39
II.	Repairs	61–63	46
III.	Final testing	64–66	47
CHAPTER 6.	SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE	67–69	49
APPENDIX I.	REFERENCES	-----	50
II.	IDENTIFICATION TABLE OF PARTS	-----	51
INDEX		-----	65

(WARNING)

HIGH VOLTAGE

is used in the operation
of this equipment.

DEATH ON CONTACT

may result if personnel fail
to observe safety precautions.

Be careful not to contact high-voltage connections or 115-volt input connections when working on or near this equipment. When working inside the equipment, after the power has been turned off, always short-circuit the high-voltage capacitors.

ARTIFICIAL RESPIRATION

GENERAL PRINCIPLES

1. Seconds count! Begin at once! Don't take time to move the victim unless you must. Don't loosen clothes, apply stimulants or try to warm the victim. Start resuscitation! Get air in the lungs! You may save a life!

2. Place the victim's body in a prone position, so that any fluids will drain from the respiratory passages. The head should be extended and turned sideward *never flexed forward;* the chin shouldn't sag, since obstruction of the respiratory passages may occur.

3. Remove any froth or debris from the mouth with your fingers. Draw the victim's tongue forward.

4. Begin artificial respiration. Continue it rhythmically and without any interruption until natural breathing starts or the victim is pronounced dead. Try to keep the rhythm smooth. Split-second timing is not absolutely essential.

5. When the victim starts breathing, or when additional help is available loosen the clothing; remove it, if it's wet; keep the victim warm. Shock should receive adequate attention. Don't interrupt the rhythmical artificial technique for these measures. Do them only when you have help or when natural breathing has started.

6. When the victim is breathing, adjust your timing to assist him. Don't fight his efforts to breathe. Synchronize your efforts with his. After resuscitation, keep him lying down until seen by a physician or until recovery seems certain.

7. Don't wait for mechanical resuscitation! If an approved model is available, use it, but, since mechanical resuscitators are only slightly more effective than properly performed "push-pull" manual technique, *never* delay manual resuscitation for it.

BACK-PRESSURE ARM LIFT METHOD

1. *Position of Victim.* Place the victim in the prone (face-down) position. Bend his elbows; place one hand upon the other. Turn his face to one side, placing his cheek upon his hands.

2. *Position of Operator.* Kneel on your left or right knee, at the victim's head, facing him. Your knee should be at the side of the victim's head close to his forearm, your foot should be near his elbow. Kneel on both knees if you find it more comfortable, with one knee on each side of the head. Place your hands on the flat of the victim's back so that their heels are just below the lower tip of his shoulder blades. With the tip of your thumbs touching spread your fingers downward and outward. (See A)

3. *Compression Phase.* Rock forward until your arms are approximately vertical and allow the weight of the upper part of your body to exert a slow, steady, even, downward pressure upon your hands. This forces air out of the lungs. Keep your elbows straight and press almost directly downward on the back. (See B)

4. *Expansion Phase.* Release the pressure, avoid any finish thrust, and commence to rock backward slowly. Place your arms upon the victim's arms just above the elbows, and draw his arms upward and toward you. Apply just enough lift to feel resistance and tension at the victim's shoulders.

Don't bend your elbows. As you rock backward, the victim's arms will be drawn toward you. (The arm lift expands the chest by pulling on the chest muscles, arching the back and relieving the weight on the chest.) Drop the arms gently to the ground or floor. This completes the cycle. (See C and D). Now, repeat the cycle.

5. *Cycle Timing and Rhythm.* Repeat the cycle 10 to 12 times per minute. Use a steady uniform rate of Press, Release, Lift, Release. Longer counts of about equal length should be given to the "Press" and "Lift" steps of the compression and expansion phases. Make the "Release" periods of minimum duration.

6. *Changing Position or Operator.*

(*a*) Remember that you can use either or both knees or can shift knees during the procedure, provided you don't break the rhythm. Observe how you rock forward with the back-pressure and backward with the arm-lift. The rocking motion helps to sustain the rhythm and adds to the ease of operation.

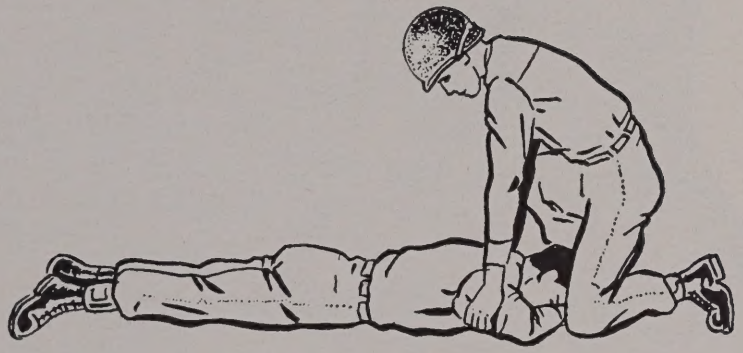
(*b*) If you tire and another person is available, you can "take turns." Be careful not to break the rhythm in changing. Move to one side and let your replacement come in from the other side. Your replacement begins the "Press-Release" after one of the "Lift-Release" phases, as you move away.



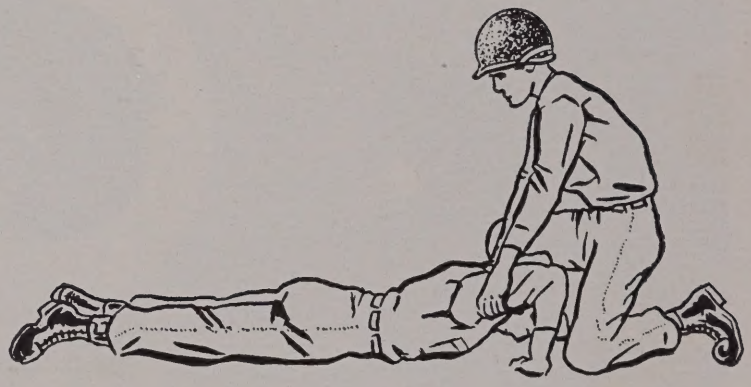
A Position of operator and victim



B Compression phase



C Expansion phase (arm lift)



D Expansion phase (arm release)

TM AR-4



Figure 1. Pulse Generator (AN–PPM–1)

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

This technical manual contains instructions for the installation, operation, maintenance, and repair of Pulse Generator AN/PPM-1 (fig. 1). Pulse Generator AN/PPM–1 is an operating set, hereinafter called "the set," is comprised of the basic unit, Generator Pulse FG–69/PPM–1, hereinafter called "the pulse generator," and AN Cable Assembly, Radio Frequency CG–999/U, for use in tests and calibration of radar sets, etc., wherever pulse measurement techniques will be useful. In addition to these instructions, two appendixes covering a list of references and an identification table of parts are included.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army materiel and equipment.

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5.

b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer as prescribed in SR 700–45–5.

c. DA AGO Form 11–238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 11).

d. DA AGO Form 11–239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 12).

e. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Pulse Generator AN/PPM–1 is a 25-tube test set used in determining the response of cir-

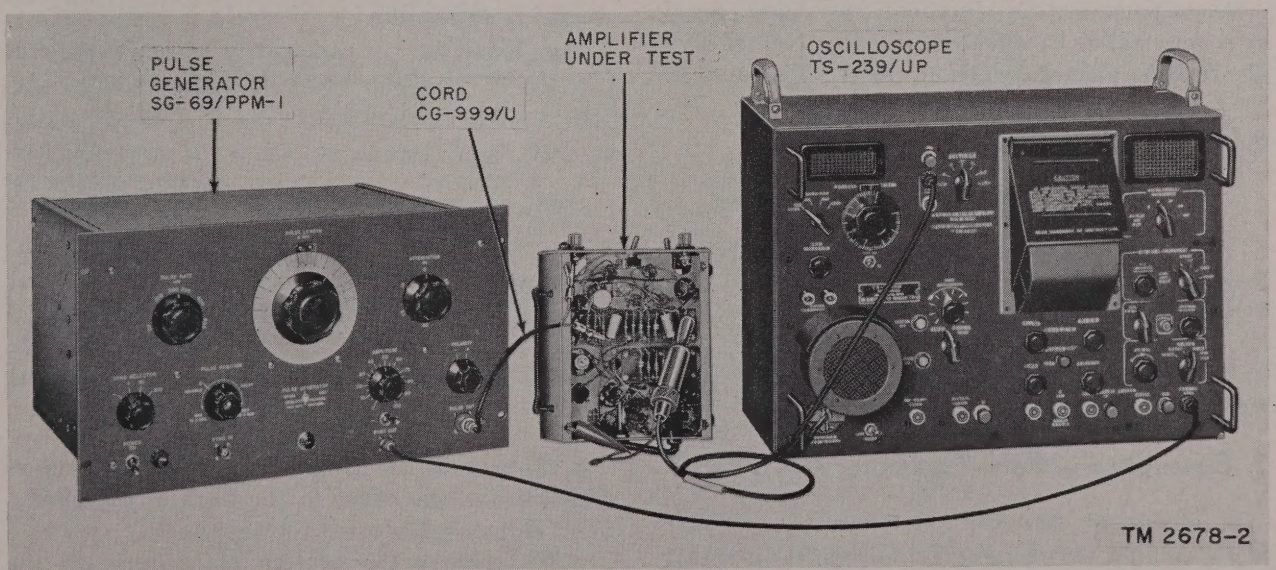


Figure 2. Pulse generator in use.

cuits to rapidly changing signals. This instrument is applicable to the testing of radar systems, nuclear counting circuits, television systems, video amplifiers, filters, and band pass circuits. Also, it may be used for the pulse modulation of uhf (ultra-high-frequency) signal generators. Detailed information on circuit testing with a square wave generator will be found in TM 11–671.

b. The equipment consists of a Pulse Generator SG–69/PPM–1 powered from a 115- or 230-volt, 50- to 60-cycle, a-c (alternating-current) source and a short adapter Cord CG–999/U. The equipment set-up for normal operation is shown in figure 2. This pulse generator is intended for use in a fixed field installation and not for mobile operation.

4. Technical Characteristics

Pulse length	Continuously variable from .07 to 10 μsec.
Pulse amplitude	Fifty volts into 50-ohm load maximum, with a 50-db, 6-position step attenuator (10 db per step) and an AMPLITUDE control providing 10 db of continuous variation.
Pulse shape	Rise and decay time approximately .02 μsec each (10 percent to 90 percent of maximum amplitude). Variation of crest voltage less than 5 percent at 50 volts output. Attenuation through use of the AMPLITUDE control causes some increase in crest variation; attenuation through use of the step attenuator causes no discernible increase in crest variation.
Pulse polarity	Positive or negative.
Internal impedance	50 ohms or less, either polarity.
Repetition rate	50 to 5,000 pulses per second.
Synchronization	Can be triggered from an external positive or negative pulse source having an amplitude of 5 volts at rates up to 5,000 pulses per second.
Trigger pulse	Provides 40-volt positive or 25-volt negative trigger pulses to a 200-ohm or greater load. Positive or negative pulses of approximately 1 μsec duration at the half-voltage points are available with less than .25 μsec rise time.
Delay provision	The main pulse can be delayed from 0 to 100 μsec with respect to the trigger pulse.
Advance provisions	The main pulse can be advanced from 0 to 10 μsec with respect to the trigger pulse.
Power supply rating	115 or 230 volts, 50 to 60 cycles per second, 325 watts.
Overall dimensions	19 inches wide by 10½ inches high by 14½ inches deep (including controls). Panel size is 19 inches by 10½ inches and the depth behind the panel is 13 inches.
Weight	48 lbs.

5. Packaging Data

(fig. 7)

When packaged for shipment, the set is placed in a corrugated cardboard container and packed in excelsior inside a wooden crate. The outside dimensions of the crate are 30½ inches wide by 19½ inches high by 10½ inches deep. The volume of the crate is 3.62 cubic feet. The shipping weight is 90 pounds.

Note. Items may be packaged in a manner different from that shown, depending on the supply channel.

6. Table of Components

Component	Required No.	Height (in.)	Depth (in.)	Length (in.)	Volume (cu ft)	Unit weight (lb)
Pulse Generator SG–69/PPM–1	1	10½	14½	19	1. 67	45
Cord CG–999/U	1	----------	----------	8¾	----------	----------

Note. This list is for general information only. See appropriate supply publications for information pertaining to requisition of spare parts.

7. Description of Pulse Generator AN/PPM–1

a. The pulse generator is housed in a single metal cabinet that is designed for bench mounting or rack mounting (figs. 2 and 6).

b. To remove the cover, unscrew the four screws which fasten the cover to the back of the instrument and slide the cover toward the rear.

c. To remove the bottom plate, unscrew the four screws, one in each corner of the plate.

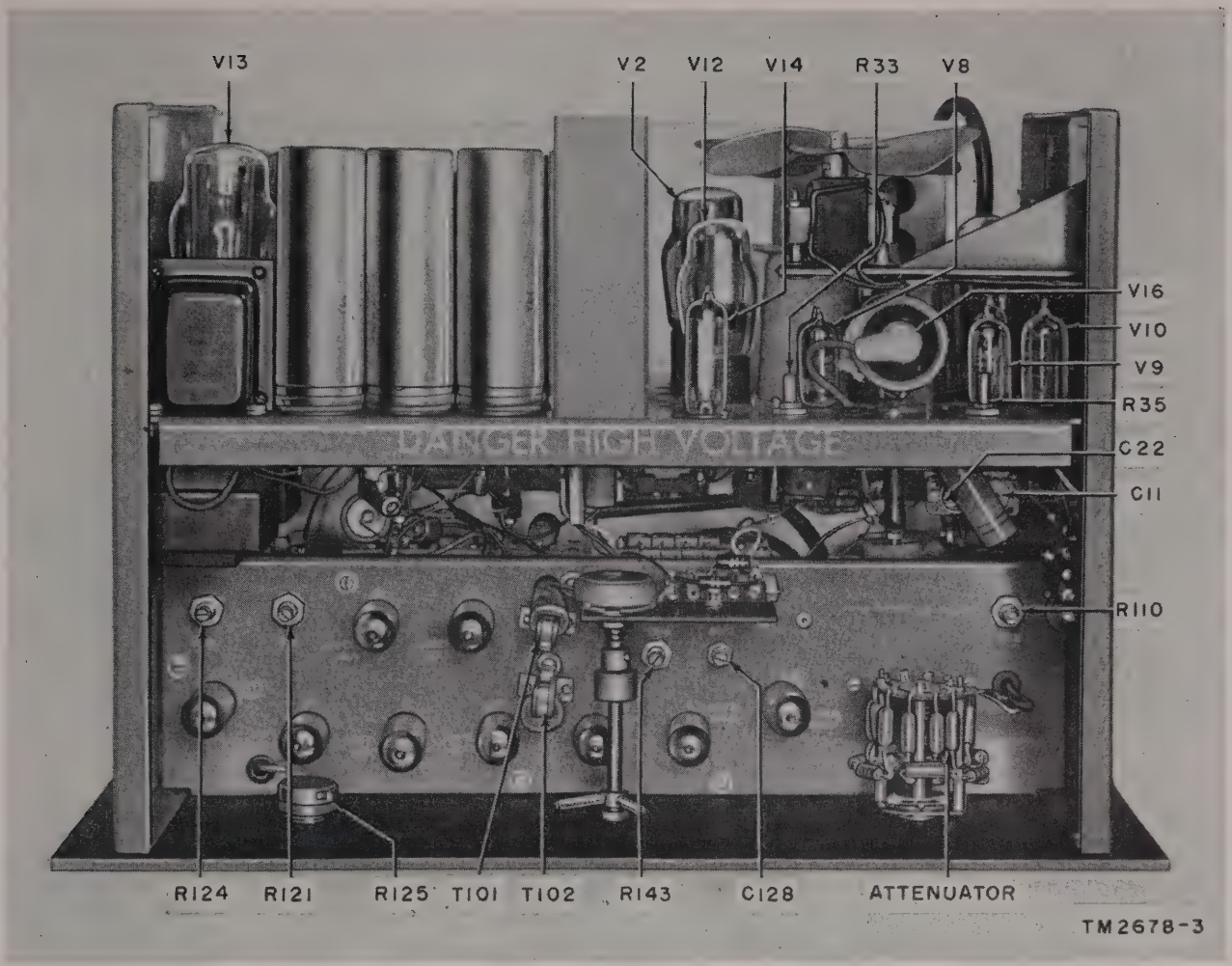


Figure 3. Pulse generator, top view, cover removed.

8. Description of Minor Components

Cord CG–999/U, and 8¾-inch adapter cable, is the only minor component supplied. This cable is terminated on one end to fit the PULSE OUT receptacle on the pulse generator. The other end is not terminated.

9. Running Spares

The following running spares are included in the packing case for each equipment:

1 electron tube	6X4
1 electron tube	6L6G
1 electron tube	6W4
1 electron tube	OB2
2 electron tube	6J6
1 electron tube	12AX7
2 electron tube	6AS7
1 electron tube	OD3/VR150
1 electron tube	5R4
1 electron tube	6AU6
4 electron tube	12AU7
2 electron tube	HP45/3HP45 (type 3C45 supplied in early models).
6 electron tube	211–37 fuse
1 electron tube	211–47 lamp

10. Additional Equipment Required

Connecting cables (50 ohms) and connectors, other than the short adapter cable (par. 8), are required but are not supplied. These are used for connecting the pulse generator to other items of test and driven equipment.

11. Differences in Models

The external appearances of the various models of the pulse generator are identical in all respects. Some of the later models, however, have been

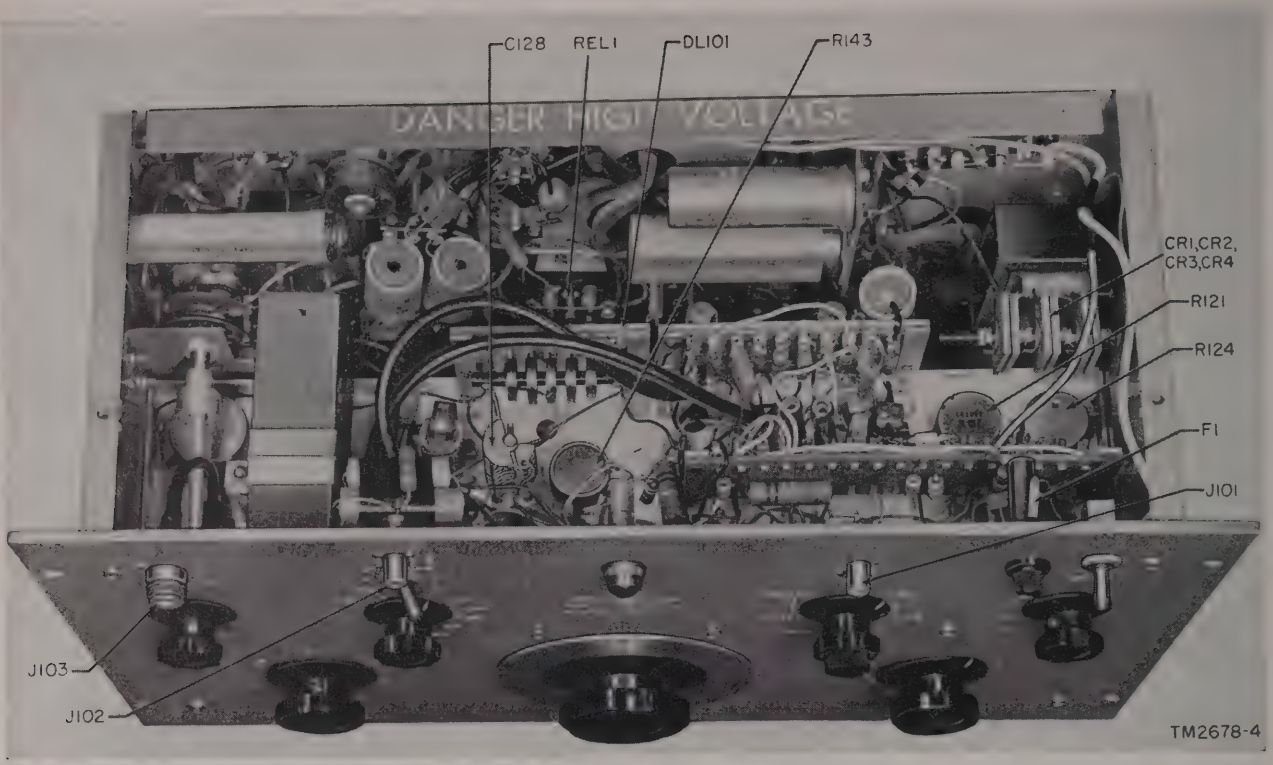


Figure 4. Pulse generator, bottom view, cover removed.

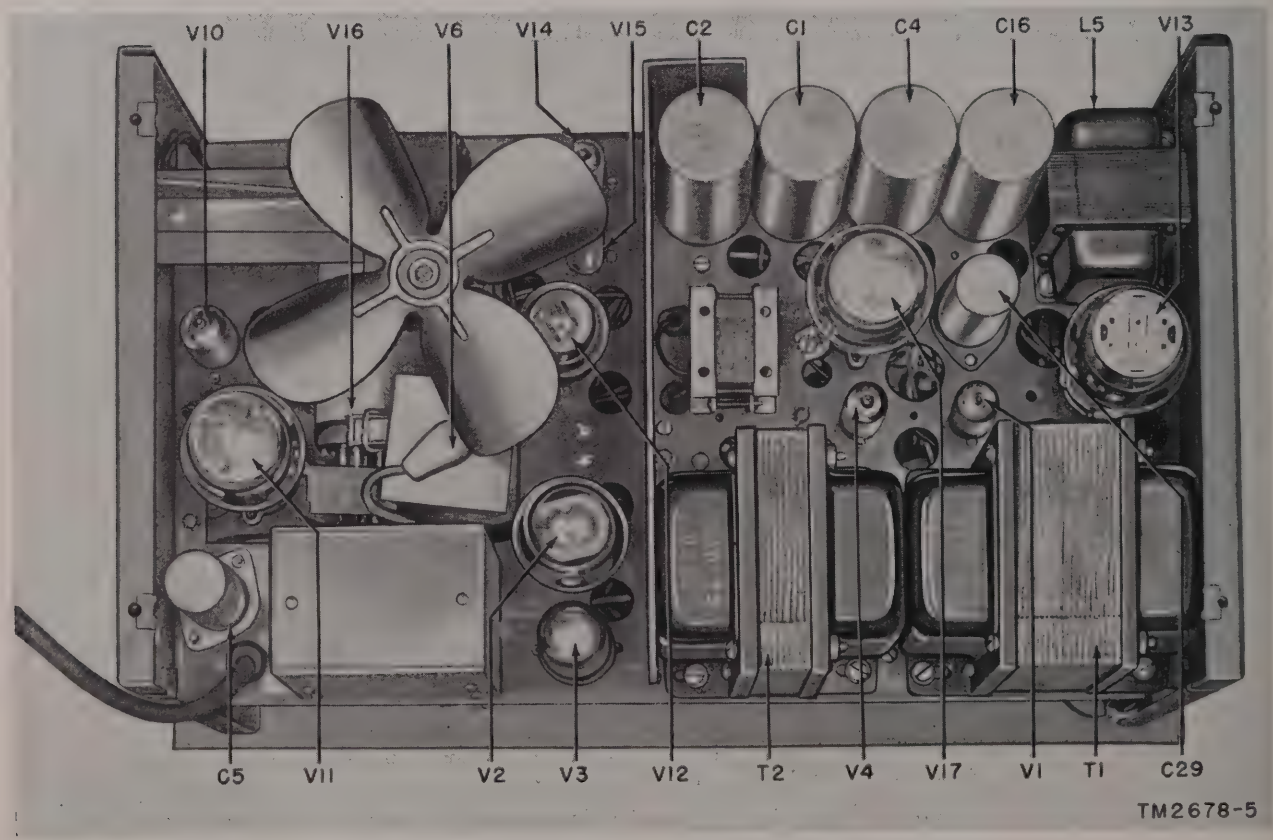


Figure 5. Pulse generator, rear view, cover removed.

modified to improve operational features. These differences are detailed in *a* and *b* below.

a. On equipment starting with serial No. 1039, the method of coupling the pulse from the pulse rate multivibrator to the SYNC OUT circuits is changed. Coupling capacitor C103 was reduced from 50 $\mu\mu$f (micromicrofarads) to 30 $\mu\mu$f. The difference in wiring is shown on the two schematics for the front deck (figs. 30 and 31).

b. On equipment starting with serial No. 1239, three resistors and one capacitor have been added to the rear deck to compensate for production tolerances in transformer T1. Also, the value of another resistor has been increased. The difference in wiring is shown by the two schematic diagrams for the rear deck (figs. 32 and 33). The added capacitor and resistors are as follows:

(1) R71, a 600-ohm 20-watt resistor, has has been added from the junction of chokes L4 and L5 to the plate of V1B (pin 5).

(2) R72 and R73, 220,000-ohm 2-watt resistors, have been added in parallel from the plate of pulse terminating thyratron V16 to ground.

(3) C32, a .05-μf (microfarad) 600-volt d-c (direct-current) capacitor, has been added in parallel with R71.

(4) The value of R19, plate load resistor for V15, has been increased from 1 to 1.5 megohm.

c. In equipments starting with serial No. 1439, the design of pulse transformers T101 to T103 is changed because of unavailability of former core materials. Use of these newer pulse transformers has required different circuitry in the blocking oscillator circuits on the front deck. These modifications are as follows:

(1) C106 is not used.

(2) C140, a 2000-$\mu\mu$f mica capacitor, has been added in the grid return path for V102B.

(3) C141, a 1000-$\mu\mu$f mica capacitor, has been added in the grid return path for V109A.

(4) C142, a 1000-$\mu\mu$f mica capacitor, has been added in the grid return path for V106B.

(5) R108 is not used.

(6) R111 has been replaced by R157, a 220,000-ohm 1-watt resistor.

(7) R158, a 27,000-ohm 1-watt resistor has been added in the grid return path of V102B.

(8) R151 and CR103 are rearranged in the grid circuit of V106B.

(9) R137 has been replaced by R159, 27,000-ohm 1-watt resistor.

(10) R150 has been replaced by R160, a 27,000-ohm 1-watt resistor.

(11) T101, stock No. 212A–60B has been replaced by 913–3.

(12) T102, stock No. 212A–60A has been replaced by 913–2.

(13) The value of C131, coupling capacitor in the pulse length multivibrator, has been increased from 5,000 to 5,600 $\mu\mu$f and now is a low temperature coefficient type. These modifications are included in figure 34.

d. Some of the later models will have type HP45/3HP45 tubes instead of type 3C45 (V6 and V16).

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF THE SET

12. Location for Use
(fig. 6)

The set should be located convenient to the radar and other equipments with which it will be used in servicing and adjustment procedures. Its moderate weight imposes no critical supporting requirements. It may be placed on a workbench or shelf or, in semipermanent or permanent installations, it may be mounted in a standard, 19-inch relay rack. A source of 115- or 230-volt, 50- to 60-cycle power must be provided.

13. Uncrating, Unpacking, and Checking New Equipment

Note. For used or reconditioned equipment, refer to paragraph 16.

a. General. Equipment may be shipped in oversea packing cases (*b* below) or in domestic packing cases (*d* below). When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements and which is convenient to the permanent or semipermanent installation location of the equipment.

Caution: Be careful in uncrating, unpacking, and handling the equipment; it is easily damaged. If it becomes damaged or exposed, a complete overhaul might be required or the equipment might be rendered useless.

b. Step-by-Step Instructions for Uncrating and Unpacking Export Shipments (fig. 7).

(1) Place the packing case as near the operating or installation position as convenient.

(2) Cut the wire binding.

(3) Fold back the top of the packing case. Do not attempt to pry off the sides and top; the equipment may be damaged.

(4) Remove the excelsior or corrugated paper covering the equipment inside the case.

(5) Remove the equipment from its inner case or wrapping and place it on the workbench near its final location.

(6) Inspect the equipment for possible damage incurred during shipment.

(7) Check the contents of the packing case against the master packing slip.

c. Opening Cardboard Carton and Waterproof Barrier. No special instructions are needed for opening the waterproof paper barrier and removing the equipment from the cardboard carton.

d. Unpacking Domestic Packing Cases. The set may be received in domestic packing cases. The instructions given in *b* above apply also to unpacking domestic shipments. Cut the wire binding. Open the cartons that protect the equipment; or, if heavy wrapping paper has been used, remove it carefully and take out the contents. Check the contents of the packing case against the master packing slip.

Note. Save the original packing cases and containers whether of the export or domestic type. They can be used again when the equipment is repacked for storage or shipment.

14. Installation of the Set

a. All components necessary to install the set are contained in the shipping case of the equipment.

b. In case the equipment is to be rack-mounted, access to the top, bottom, and rear of the unit must be provided for servicing. A distance equal to or slightly greater than the depth of the cover should be provided in addition to the depth of the equip-

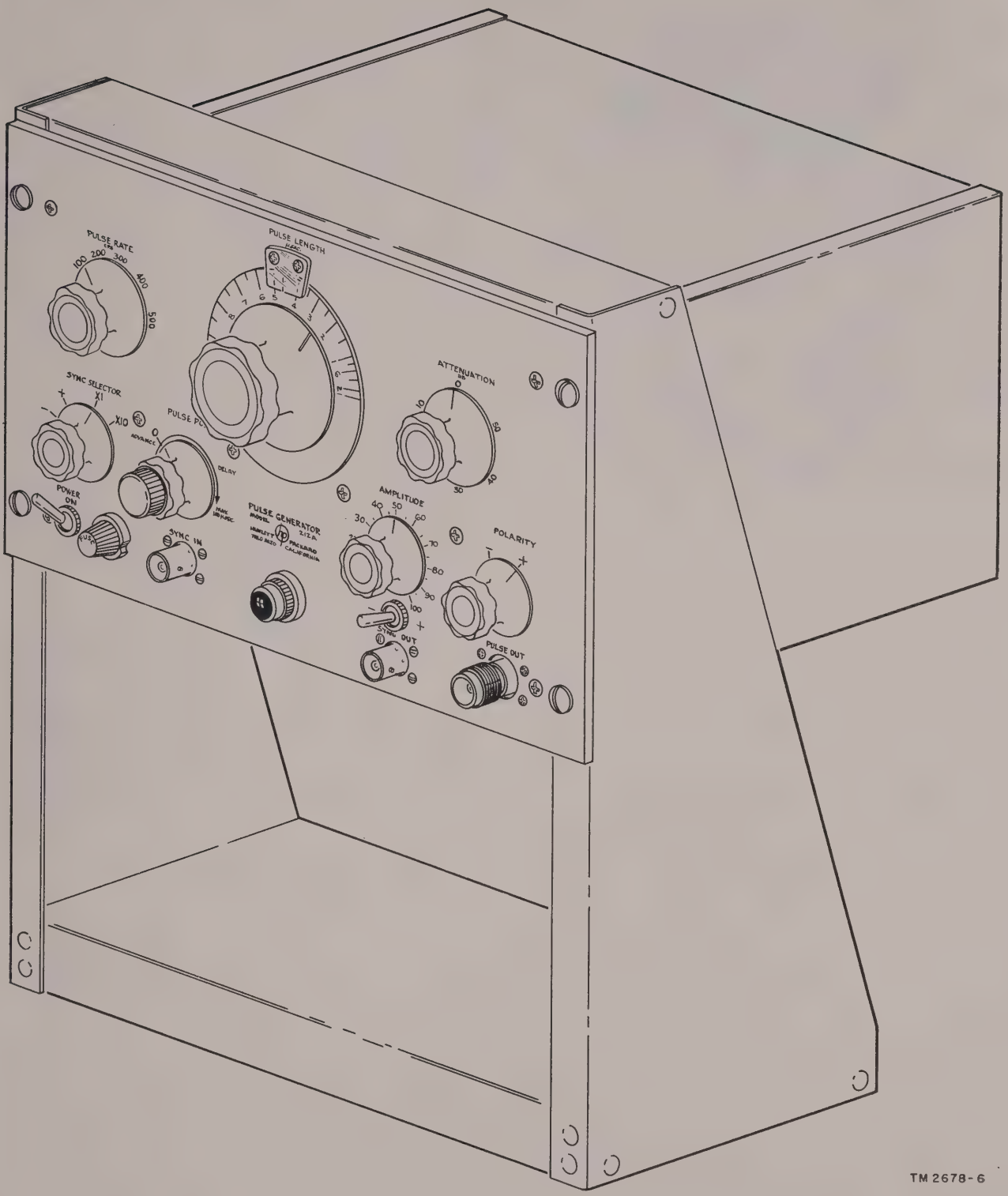


Figure 6. Pulse generator in rack mounting.

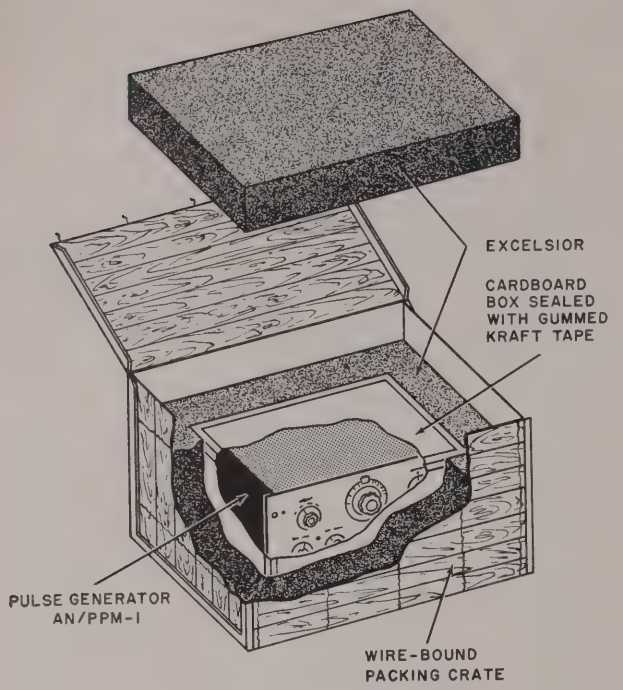


Figure 7. Packaging diagram.

ment so that the cover may be removed without removing the unit from the rack.

c. The set is shipped with all electron tubes installed. Refer to figure 8 and check to see that all tubes are seated firmly in their proper sockets.

Caution: Make certain that a 4-ampere fuse (F1) is inserted in the fuseholder (fig. 10). Damage to components because of overloads may be caused by using a fuse with a higher rating.

15. Connections

a. Connection of the set to the equipment with which it is to be used will vary with the application. In general, however, the equipment to be driven should be connected to the PULSE OUT terminal through Cord CG–999/U; the SYNC OUT terminal will be connected to the synchronizing terminals on an oscilloscope; and the power cord should be plugged into an appropriate 115-volt, 50- to 60-cycle power line. Typical connections are shown in figure 9.

b. This equipment can be powered from a 230-volt, 50- to 60-cycle power source if required. It is necessary to reconnect the primaries of transformers T1 and T2. For 230-volt operation, the two primary windings on each transformer must be connected in series (see schematic, figs. 32 and 33). The fan and resistor R26 remain in series from one side of the line to the center tap in the primary of T2.

16. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 13 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications pertaining to changes in the wiring of the equipment. If any changes in wiring have been made, note the change in this manual, preferably on the schematic diagram.

c. Check the operating controls for ease of rotation.

d. Perform the installation and connection procedures given in paragraphs 14 and 15.

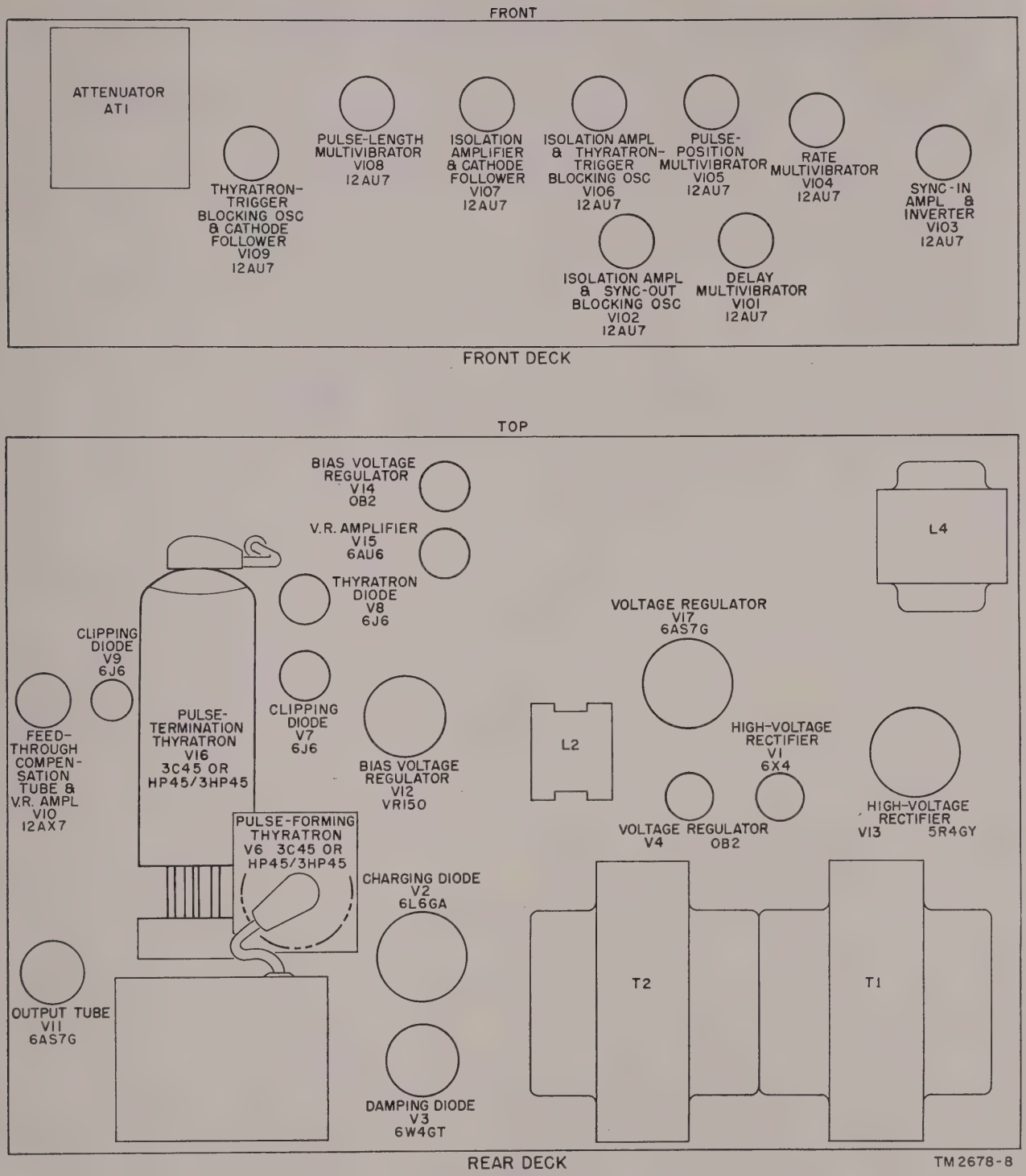


Figure 8. Pulse generator, tube location diagram.

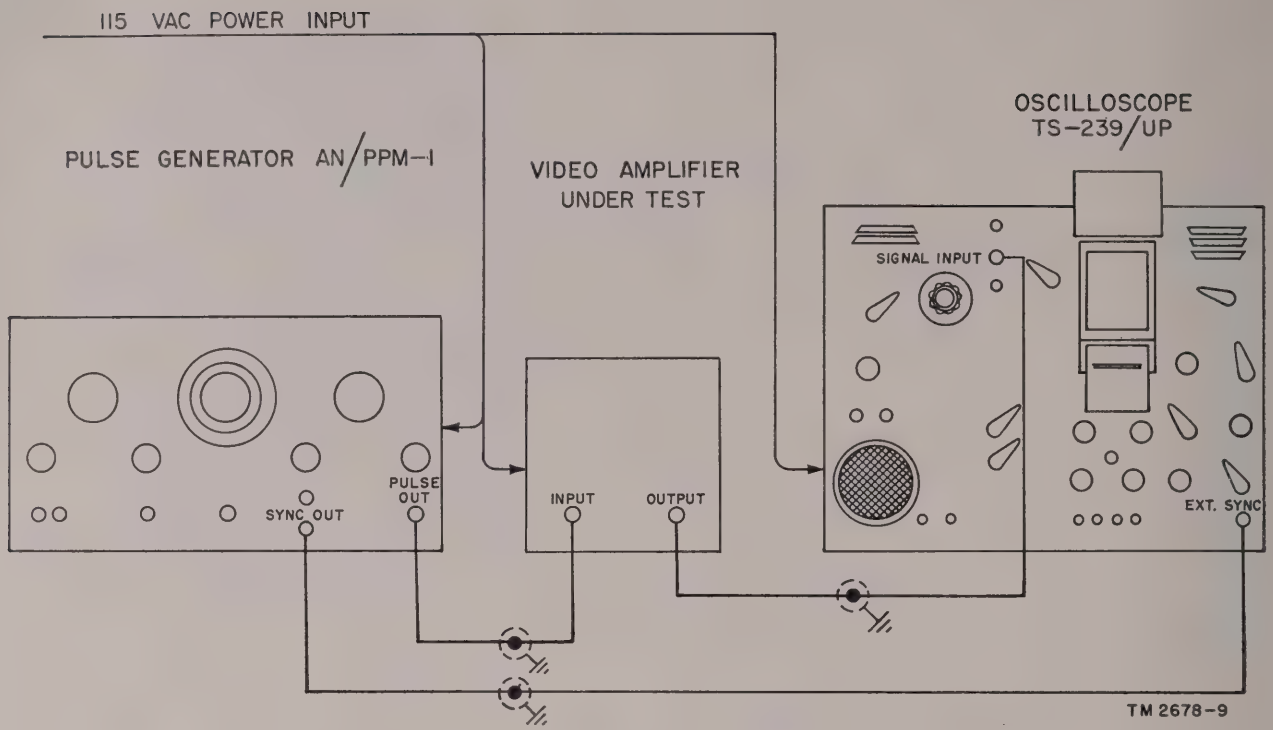


Figure 9. Typical connection diagram.

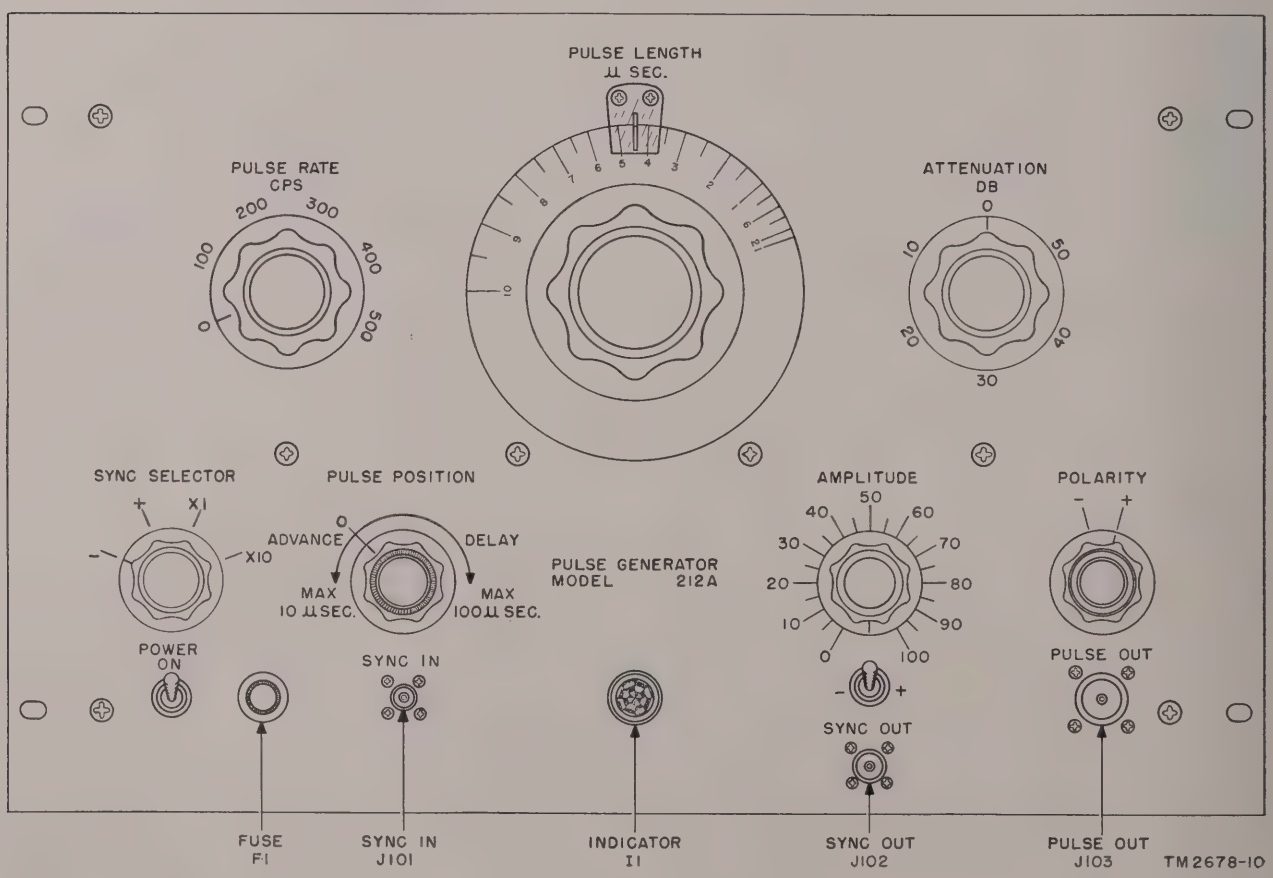


Figure 10. Pulse generator, front panel showing controls.

Section II. CONTROLS

17. General

Haphazard operation or improper setting of the controls can cause damage to electronic equipment. For this reason, it is important to know the function of every control. The actual operation of the equipment is discussed in the next section of this manual.

18. Pulse Generator Controls

The following table lists the controls and terminals of the pulse generator and indicates their functions.

Control or terminal	Function
POWER ON switch (S1) Indicator (I 1)	In ON position, connects pulse generator to a-c power source and lights indicator I 1.
PULSE LENGTH dial (R142)	Controls the length of the main output pulse.
PULSE RATE dial (R125)	Adjusts the repetition rates of the pulse from 50 to 5,000 pulses per second in conjunction with the X1 and X10 positions of the SYNC SELECTOR switch.
SYNC SELECTOR switch (S102)	Selects two ranges of internally generated pulse rates and also necessary circuitry for external synchronization from either positive or negative externally generated synchronizing pulses.
PULSE POSITION dial (R132)	Adjusts the timing between the main pulse output and the synchronizing pulse output. Its main use is to position the main pulse on an oscilloscope screen when the oscilloscope has been synchronized with the sync out pulse. A vernier control is provided for fine adjustment.
AMPLITUDE dial (R4A, R4B)	Controls the amplitude of the main output pulse over a 10–db (decibel) range.
ATTENUATION switch (AT1)	Provides attenuation of the main output pulse in 10–db steps up to 50 db.
POLARITY switch (S3)	Controlls the polarity (positive or negative) of the main output pulse available at the PULSE OUT terminal.
SYNC OUT switch (S101)	Controls the polarity (positive or negative) of the sync out voltage available at the SYNC OUT terminal.
Fuse terminal (F1)	Contains a 4-ampere cartridge fuse which may be replaced by unscrewing the cap and inserting a new fuse.
PULSE OUT terminal (J103)	Output connection for the main pulse.
SYNC OUT terminal (J102)	Output connection for sync out voltage for synchronizing purposes.
SYNC IN terminal (J101)	Input connection for introducing a trigger voltage into the pulse generating circuits.

Section III. OPERATION UNDER USUAL CONDITIONS

19. Starting Procedure

a. Make certain that the driven equipment is connected to the vertical amplifier or vertical deflection plates of the oscilloscope. Set the front panel controls and make connections to the terminals as follows:

Control or terminal	Position or connection
PULSE LENGTH dial (R142)	*7.
PULSE RATE dial (R125)	*300.
SYNC SELECTOR switch (S102)	X1.
PULSE POSITION dial (R132)	*0.
AMPLITUDE dial (R4A, R4B)	*50.
ATTENUATION switch (AT1)	*30.
POLARITY switch (S3)	*+.
SYNC OUT switch (S101)	*+.
PULSE OUT terminal (J103)	To equipment to be driven.
SYNC OUT terminal (J102)	To oscilloscope.
SYNC IN terminal (J101)	No connection.
POWER ON switch (S1)	ON.

*Nominal setting.

Note. An overload relay is incorporated in the equipment to protect the thyratron if for any reason continuous plate current conduction occurs. Operation of the relay is indicated by a buzzing sound. If this sound is noted when the instrument is turned on, it may indicate that the warm-up time has been insufficient. Turn the SYNC SELECTOR to the positive or negative position (without external synchronization) and allow the equipment to warm up for 2 or 3 minutes. After warm-up, the SYNC SELECTOR again should be set to X1 or X10. This should restore the equipment to its normal condition; if not, refer to paragraph 60*e*.

b. If the driven equipment has been placed in operation, pulses generated by the pulse generator now should respond in position, length, and amplitude to adjustments of the controls on the pulse generator. If no pulses are observed on the oscilloscope screen and the driven equipment is known to be operative, refer to paragraph 39, equipment performance checklist, to determine the cause of malfunctioning of the pulse generator.

c. The SYNC OUT switch, located directly above the SYNC OUT terminal, may be thrown to either the positive or negative position, which-

ever provides the best synchronization. Any pulse rate between 50 and 5,000 cycles may be selected by setting the SYNC SELECTOR switch to either the X1 or X10 position and adjusting the PULSE RATE dial to the desired rate. Set the PULSE LENGTH dial to give the desired pulse width and the PULSE POSITION control to position the pulse on the oscilloscope screen. The amplitude of the pulse is adjusted primarily by the ATTENUATION switch. The AMPLITUDE dial is used for fine adjustments.

d. The length of the main output pulse is adjustable from less than .07, μsec (microsecond) to 10, μsec. This pulse length is correct within plus or minus 10 percent, except in the case of very short pulses where considerably more variation in accuracy will be noted from time to time. Internal adjustments are provided for correcting for variation in tube characteristics which affect the length of the pulse (par. 60).

20. Precautions in Operation

Several precautions must be taken to obtain the best results from the pulse generator.

a. The best output waveshape is obtained with the AMPLITUDE control set close to maximum. As the amplitude is reduced by the AMPLITUDE control, the waveshape deteriorates slightly. To avoid this deterioration, make all major adjustments of output level with the ATTENUATION switch. As a general rule, the AMPLITUDE dial should be set at a position slightly less than its maximum setting.

b. Do not set the PULSE POSITION dial to greater than approximately 50 μsec when a repetition rate of more than 2,500 pps (pulses per second) is used. Maximum delay of 100 μsec may be used for repetition rates up to 2,500 pps. Above this point, the maximum delay must be decreased as the repetition rate is increased in order not to overload the tubes in the pulse-position circuit. Setting the PULSE POSITION dail to *2 o'clock* corresponds to approximately 50-μsec delay.

c. Do not drive the pulse generator at a repetition rate in excess of 5,000 pps. Performance at this end of the range is limited mainly by the duty cycle of the thyratrons. There is practically no limit to the repetition rate at the low-frequency end, provided the synchronizing pulses have a rise time in the order of 1 or 2 μsec.

21. Types of Operation

There are two basic modes of operation of the set. The choice of operation to be used depends on the availability of, and the need for, external synchronization.

a. If external synchronization is not required, the pulse generator will serve as a source of controlled width pulses at any repetition rate between 50 and 5,000 pps. The starting procedure and operating information provided in paragraph 19 is applicable. The SYNC SELECTOR switch must be set at either the X1 or X10 position, depending on the desired repetition rate. If this switch is set on either the + or — position and external synchronization is not provided, there will be no output signal from the pulse generator.

b. If external synchronization is desired, the trigger pulse can be either a negative or positive 5-volt signal whose repetition rate is less than 5,000 pps. This signal is injected to the appropriate circuits through the SYNC IN jack on the front panel of the pulse generator. In this mode of operation, the SYNC SELECTOR switch must be set at either + or — position, depending on the polarity of the input trigger pulse. If this switch is set on either the X1 or X10 position, the external synchronization will have no effect, and the repetition rate of the output pulse will be determined by the setting of the PULSE RATE control.

22. Stopping Procedure

Turn the POWER-ON switch to the down (off) position. Remove connections to other equipment unless the pulse generator is to be used again immediately.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

23. General

The operation of the set may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. In paragraphs 24 through 26 instructions are given in procedures for minimizing the effect of these unusual operating conditions.

24. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of electronic equipment. Instructions

and precautions for operation under such adverse conditions follow:

a. Handle the equipment carefully.

b. Keep the equipment warm and dry. If the pulse generator is not kept in a heated inclosure, construct an insulated box for the equipment.

c. Make certain the equipment is warmed up sufficiently before attempting to use it. This may take 10 to 15 minutes, depending on the temperature of the surrounding air.

d. When equipment which has been exposed to the cold is brought into a warm room, it will start to sweat and will continue to do so until it reaches room temperature. When the pulse generator has reached room temperature, dry it thoroughly.

25. Operation in Tropical Climates

When operated in tropical climates, electronic equipment may be installed in tents, huts or, where necessary, in underground dugouts. When equipment is installed below ground and when it is set up in swamp areas, moisture conditions are more acute than normal in the tropics. Ventilation usually is very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the ambient air. To minimize this condition, place lighted electric bulbs under the equipment.

26. Operation in Desert Climates

a. Conditions similar to those encountered in tropical climates often prevail in desert areas. Use the same measures to insure proper operation of the equipment.

b. The main problem which arises with equipment operation in desert areas is the large amount of sand or dust and dirt which enters the moving parts of radio equipment, such as capacitor shafts and switch contacts. The ideal preventive precaution is to house the equipment in a dustproof shelter. Since, however, such a building seldom is available and would require air conditioning, the next best precaution is to make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors, cover the inside walls with heavy paper, and secure the sidewalls of tents with sand to prevent their flapping in the wind.

c. Never tie power cords, signal cords, or other wiring connections to either the inside or the outside of tents. Desert areas are subject to sudden wind squalls which may jerk the connections loose or break the lines.

d. Take care to keep the equipment as free from dust as possible. Make frequent preventive maintenance checks (ch. 3).

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE SERVICES

27. Tools and Materials Supplied

No tools or materials are supplied with this equipment. However, tools and materials contained in Tool Equipment TE–41, normally available to maintenance personnel, will be useful in performing maintenance operations on the equipment.

28. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to prevent certain troubles from occurring. See AR–750–5.

29. General Preventive Maintenance Techniques

a. Use No. 0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary—except for electrical contacts—moisten the cloth or brush with solvent, dry cleaning (SD); then wipe the parts dry with a cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride; then wipe them dry with a cloth.

Caution: Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Make sure adequate ventilation is provided.

c. If available, dry compressed air may be used at a line pressure not exceeding 60 pounds per square inch to remove dust from inaccessible places; be careful, however, or mechanical damage from the air blast may result.

d. For further information on preventive maintenance techniques, refer to TB SIG 178.

30. Use of Preventive Maintenance Forms (figs. 11 and 12)

a. The decision as to which items on DA AGO Forms 11–238 and 11–239 are applicable to this equipment is a tactical decision to be made in the case of first echelon maintenance by the communication officer/chief or his designated representative and, in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. Circled items in figures 11 and 12 are partially or totally applicable to the pulse generator. References in the Item block refer to paragraphs in the text which contain additional maintenance information.

31. Performing Exterior Preventive Maintenance

Caution: Tighten screws, bolts, and nuts carefully. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

a. Check for completeness and satisfactory condition of the set (par. 16).

b. Check suitability of location and installation for normal operation (par. 12).

c. Remove dirt and moisture from all external surfaces of the pulse generator and connector receptacles (par. 29).

d. Inspect all plugs and connectors (fig. 10).

e. Inspect all controls for binding, scraping, excessive looseness, misalinement, and positive action (fig. 10 and par. 18).

f. Check for normal operation (par. 39).

g. If rack-mounted, tighten all panel mounting screws (fig. 6).

h. Inspect all exposed metal surfaces for rust, corrosion, and moisture (par. 35).

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE: PULSE GENERATOR AN/PPM-1

EQUIPMENT SERIAL NO.:

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.

NOTE: Strike out items not applicable.

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).* PAR 31g							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR 31b							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR 31c							
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR 31d							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR 31e							
6	CHECK FOR NORMAL OPERATION. PAR 31f							

WEEKLY

NO.	ITEM	CONDITION	NO	ITEM	CONDITION
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR 31g		13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR 31h		14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. PAR 31k	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR 31i		15	INSPECT METERS FOR DAMAGED GLASS AND CASES.	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.		16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.		17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR 31j		18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	

19 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. PAR 31l

DA AGO FORM 1 MAY 51 11-238 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

Figure 11. DA AGO Form 11-238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE: PULSE GENERATOR AN/PPM-1

EQUIPMENT SERIAL NO.:

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	CONDITION
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).* PAR. 31a	
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR. 31b	
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR. 31c	
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR. 31d	
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR. 31e	
6	CHECK FOR NORMAL OPERATION. PAR. 31f	
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR. 31g	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 31h	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR. 31i	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR. 31j	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.	
14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES. PAR. 31k	
15	INSPECT METERS FOR DAMAGED GLASS AND CASES.	
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	
19	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS: INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES. PAR. 32a	
20	INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. PAR. 32b	
22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS. PAR. 32c	
23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS. PAR. 32d	
24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. PAR. 32e	
25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS. PAR. 32f	
26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. PAR. 32g	
27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS. PAR. 32h	
28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER.	
30	INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR.	
31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS CHOKES, POTENTIOMETERS, AND RHEOSTATS. PAR. 32i	
32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE. PAR. 32j	
33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES.	
34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	
35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS.	
36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS.	
37	MOISTURE AND FUNGIPROOF. PAR. 32k	
38	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION. PAR. 32l	

DA AGO FORM 1 MAY 51 11-239 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE. e6—16—64382-1

TM 2678-12

Figure 12. DA AGO Form 11-239.

i. Inspect power cord and cables for cuts, breaks, fraying, deterioration, kinks, and strain (fig. 2).

j. Inspect for looseness of accessible items: switches, knobs, jacks, and connectors (fig. 10).

k. Clean nameplate, dials, and pilot light jewel assembly (par. 29 and fig. 10).

l. If deficiencies noted are not corrected during inspection, indicate action taken for correction (fig. 11, item 19).

32. Performing Interior Preventive Maintenance

Caution: Disconnect all power before performing the following operations. Upon completion, reconnect the power and check for satisfactory operation.

a. Inspect electron tubes for loose envelopes, loose cap connectors, cracked sockets, and insufficient spring tension; remove dust and dirt carefully; check emission of receiver type tubes. Note that tubes with final letters W or Y in their nomenclature can replace tubes of the same type; for example, type 6J6W can replace tube type 6J6 (fig. 8).

Note. New thyratrons may require aging (par. 60*e*).

b. Inspect all fixed capacitors for leakage of dielectric, bulging, or evidence of overheating (figs. 3, 4, and 5).

c. Inspect overload relay REL–1 for loose mounting; burned, pitted, or corroded contacts; misalinement of contacts and springs; insufficient spring tension; and binding of hinge parts (fig. 4).

d. Inspect variable capacitor C128 for dirt, moisture, misalinement of plates, and loose mounting (fig. 4).

Caution: Do not disturb the setting for C128 or it will be necessary to recalibrate the pulse length circuits in accordance with paragraph 60*b*.

e. Inspect resistors, bushings, and insulators for cracks, chipping, blistering, discoloration, and moisture (figs. 3, 4, and 5).

f. Inspect terminals for filter capacitors C1, C2, C14, C15, C16, and C101 for corrosion, dirt, and loose contacts (figs. 3, 4, and 5).

g. Clean and tighten switches, terminal blocks, relay mountings, and interior of chassis and case not readily accessible (figs. 3, 4, and 5).

h. Inspect terminal boards for loose connections, cracks, and breaks (figs. 3, 4, and 5).

i. Clean and tighten connections and mountings for transformers, chokes, potentiometers, and rheostats (figs. 3, 4, and 5).

j. Inspect transformers, chokes, potentiometers, and rheostats for overheating (figs. 3, 4, and 5).

k. Check adequacy of moistureproofing and fungiproofing treatment (par. 34*b*).

l. If deficiencies noted are not corrected during inspection, indicate action taken for correction (fig. 12, item 38).

Section II. LUBRICATION AND WEATHERPROOFING

33. Lubrication

The set requires no lubrication.

34. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

b. Tropical Maintenance. A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained fully in TB SIG 13, and TB SIG 72.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained fully in TB SIG 66 and TB SIG 219.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained fully in TB SIG 75.

35. Rustproofing and Painting

a. When the finish on the case has been scarred or damaged badly, rust and corrosion can be prevented by touching up bared surfaces. Use No. 00 or No. 000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to

complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section III. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

36. Scope

a. The trouble shooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is limited necessarily in scope by the tools, test equipment, and replaceable parts issued, and by the existing tactical situation. Accordingly, trouble shooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out tubes, cracked insulators, etc.

b. Paragraphs 37 through 39 help in determining which of the portions of the pulse generator are at fault and in localizing the fault in that portion to the defective stage or item, such as a tube or fuse.

37. Visual Inspection

a. Failure of the pulse generator to operate properly usually will be caused by one or more of the following faults:

(1) Improperly connected power cable, or no voltage at the outlet into which the power cable is plugged.
(2) Burned-out fuse.
(3) Wires broken because of excessive vibration.
(4) Defective tubes.
(5) Improperly connected output and/or input cables.
(6) Worn, broken, or disconnected cords or plugs.

b. When failure is encountered and the cause is not immediately apparent, check as many of the items in *a* above as is practicable, before starting a detailed examination of the individual parts of the circuit. If possible, obtain information from the person who normally uses the equipment regarding performance at the time trouble occurred.

38. Trouble Shooting, Using Equipment Performance Checklist

a. General. The equipment performance checklist (par. 39) will help the person normally using the pulse generator to locate trouble in the equipment. The list gives the items to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator of the pulse generator can take. *To use this list, follow the items in numerical sequence.*

b. Action or Condition. For some items, the information given in the action or condition column consists of various switch and control settings under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indications given in the normal indications column.

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those the operator can make without turning in the equipment for repairs. A reference to the table in paragraph 54 indicates that the trouble cannot be corrected during operation and that trouble shooting by an experienced repairman is necessary. If the set is completely inoperative or if the recommended corrective measures do not yield results, trouble shooting is necessary. However, if the tactical situation requires that the pulse generator must be used and if it is not completely inoperative, the operator must maintain the equipment in operation as long as it is possible to do so.

39. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	POWER ON switch	Set in down (off) position.		
	2	POWER cord	Insert into 115-v, a-c source.		
	3	Cord CG–999/U from PULSE OUT.	Connect to vertical amplifier of test oscilloscope.		
	4	Cable from SYNC OUT	Connect to sync terminals on oscilloscope.		
	5	SYNC OUT polarity switch.	Set to + or −.		
	6	Cable to SYNC IN	Not connected.		
	7	SYNC SELECTOR switch.	Set to X1.		
	8	PULSE POSITION dial	Set to 0.		
	9	AMPLITUDE dial	Set to 50.		
	10	POLARITY switch	Set to + or −.		
	11	ATTENUATION switch	Set to 20.		
	12	PULSE RATE dial	Set to 50.		
	13	PULSE LENGTH dial	Set to 5.0.		
START	14	POWER ON switch	Turn to ON position	Pilot lamp lights	Check fuse on front panel; check line cord; check 115-v power source.
				Pulses appear on oscilloscope screen.	Check power and other connections to driven equipment.
EQUIPMENT PERFORMANCE	15	PULSE LENGTH dial	Vary dial from one extreme to other.	Pulse length changes on oscilloscope screen.	If pulses appear but do not change in length, trouble shooting is necessary. See chapter 5.
	16	PULSE POSITION dial	Vary through advance and delay settings.	Pulse changes position on oscilloscope screen.	Check SYNC OUT cable; if normal, trouble shooting is necessary. Refer to paragraph 54.
	17	PULSE RATE dial	Vary from 50 to 500	Pulses are spaced more closely together as rate is increased.	If no change, trouble shooting is necessary. Refer to paragraph 54.
	18	ATTENUATION switch	Vary from 10 to 50	Pulse amplitude decreases as attenuation is increased.	If no change, trouble shooting is necessary. Refer to paragraph 54.
	19	POLARITY switch	Switch from − to +	Pulses are inverted	If no change, trouble shooting is necessary. Refer to paragraph 54.
	20	SYNC SELECTOR switch.	Set at X1 and then at X10.	Pulses are spaced more closely together by factor of 10.	If no change, trouble shooting is necessary. Refer to paragraph 54.
STOP		POWER ON switch	Turn to off (down) position.	Pilot lamp goes out.	

CHAPTER 4
THEORY

40. Block Diagram

The block diagram of the set is shown in figure 13. A complete schematic diagram of the pulse generator is shown in figures 30 through 34.

a. General. The set is a basic test equipment for determining the action of circuits which are subject to rapid variations. This equipment generates pulses; pulse duration is continuously variable from .07 to 10 usec at repetition rates of from 50 to 5,000 pulses per second. Fifty-volt pulse amplitudes, either positive or negative in polarity, are obtained easily when working into 50-ohm loads. The pulse generator may be triggered externally by applying 5-volt, positive or negative pulses, at rates up to 5,000 pulses per second to SYNC IN jack J101. Output sync pulses for triggering external equipment are available at SYNC OUT jack J102 in advance of, or following, the output pulse. The amplitude of the main output pulse may be controlled in five 10-db steps by the ATTENUATION control in the step attenuator circuit. The AMPLITUDE control serves as a vernier to the step attenuator circuit, giving continuous control of the amplitude of the output pulse.

b. Functional Sections. A simplified functional block diagram of the pulse generator is shown in figure 14. The pulse generator consists of three basic functional circuit sections. They are the triggering and synchronizing section, pulse generating section, and B+ and bias power supply section. Each of these three sections is described in (1), (2), and (3) below.

(1) *Triggering and synchronizing section.* This section consists of nine 12AU7 vacuum tubes (V101 through V109) and their accompanying circuits. Physically, the triggering and synchronizing section occupies the front deck (fig. 3). This section has several functions. The rate, position, and length of the output pulse are controlled from the front panel by potentiometers and switches electrically located in this section. A triggering pulse, which initiates, and a terminating pulse, which *shuts off* the output pulse, both are developed in this section. Thus, the triggering and synchronizing circuits provide stable, yet adjustable, control of the output pulse. The pulse generator may be synchronized by injecting external sync pulses to SYNC IN jack J101. However, rate multivibrator V104 is also capable of performing as a free-running multivibrator, functioning independently of external sync pulses. In either case, sync pulses for triggering external equipment may be obtained at SYNC OUT jack J102.

(2) *Pulse generating section.* The pulse generating section uses the triggering and terminating pulses from the triggering and synchronizing section to control the main output pulse. This section produces high-voltage pulses by means of a self-contained high-voltage power supply which charges a pulse-forming artificial transmission line. Control of the high-voltage pulse is maintained by a pair of thyratron switch tubes. The thyratrons are controlled by the triggering and terminating pulses generated by the triggering and synchronizing circuits. The output pulse is clipped, and its amplitude is controlled by an attenuator which feeds the output to PULSE OUT jack J103.

(3) *B+ and bias power supply section.* To maintain maximum stability in the output pulse, B+ and bias voltages must be controlled by regulated power supplies. Conventional power supplies are used, furnishing d-c supply voltages regulated by glow discharge-type regulator tubes V4, V12, and V14, or by electronic regulators and amplifiers V15, V10B, and V17. Additional data on glow tube and electronic regulators and amplifiers can be found in TM 11–466.

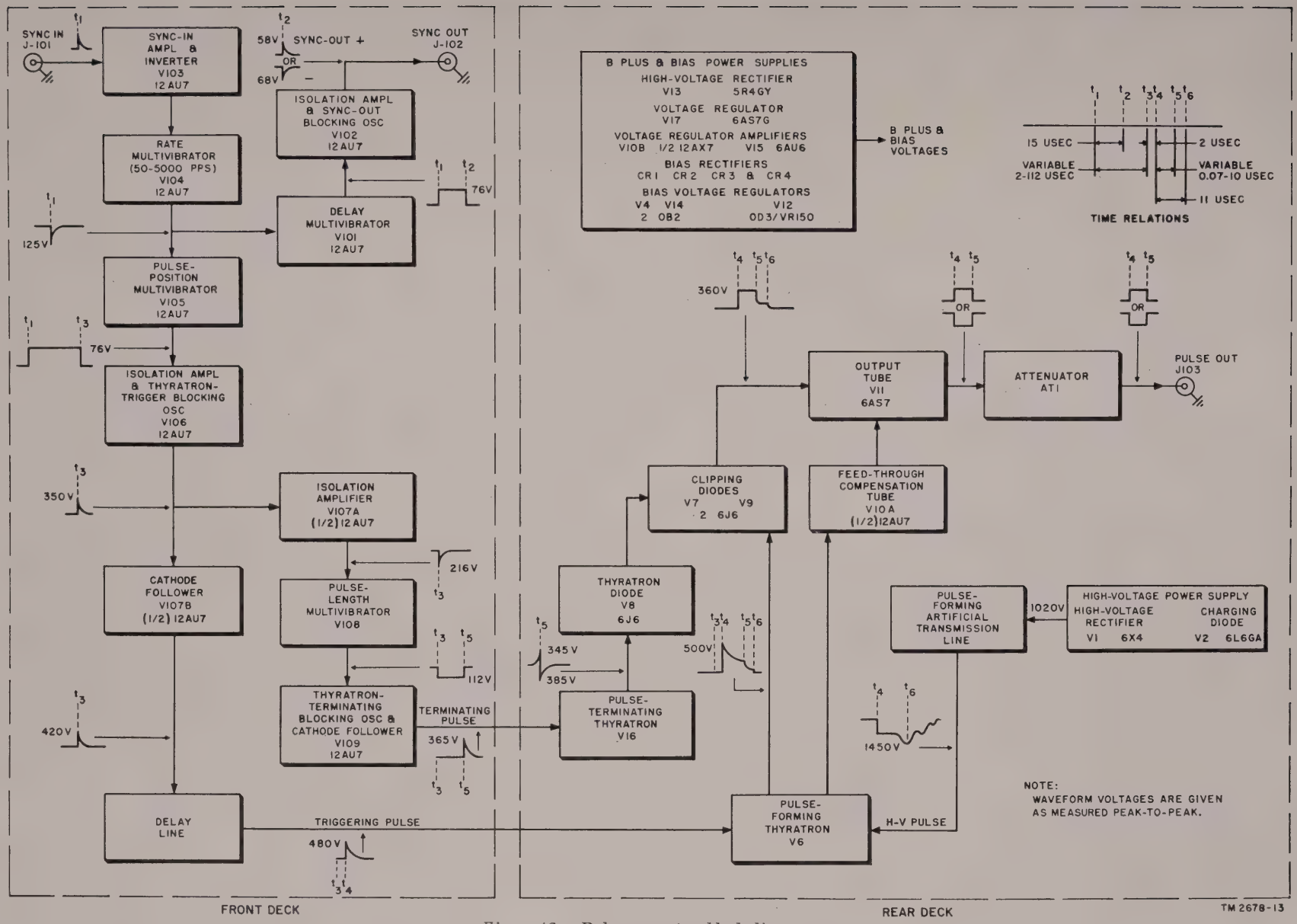


Figure 13. Pulse generator, block diagram.

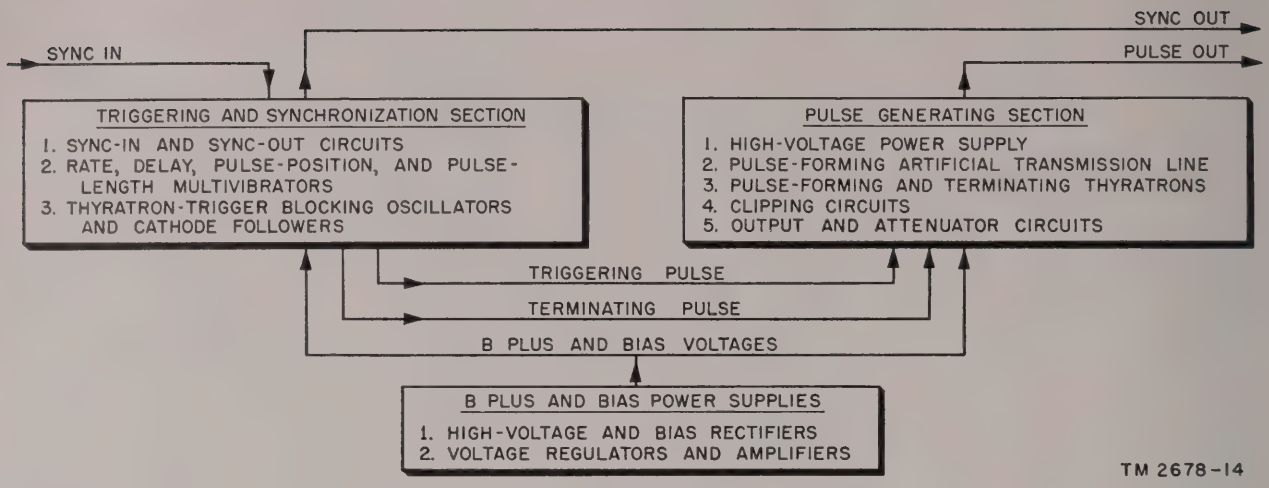


Figure 14. Functional block diagram.

41. Stage Analysis

The general theory and purpose of each of the three basic functional sections of the pulse generator have been developed in paragraph 40. Paragraphs 42 through 52 provide a detailed analysis of each stage in the pulse generator. To understand completely the function of all circuits in this equipment, while reading the remainder of this section, constant reference should be made to the system block diagram (fig. 13) and the functional diagrams that apply to the various stages.

42. Sync-in Amplifier and Inverter
(fig. 15)

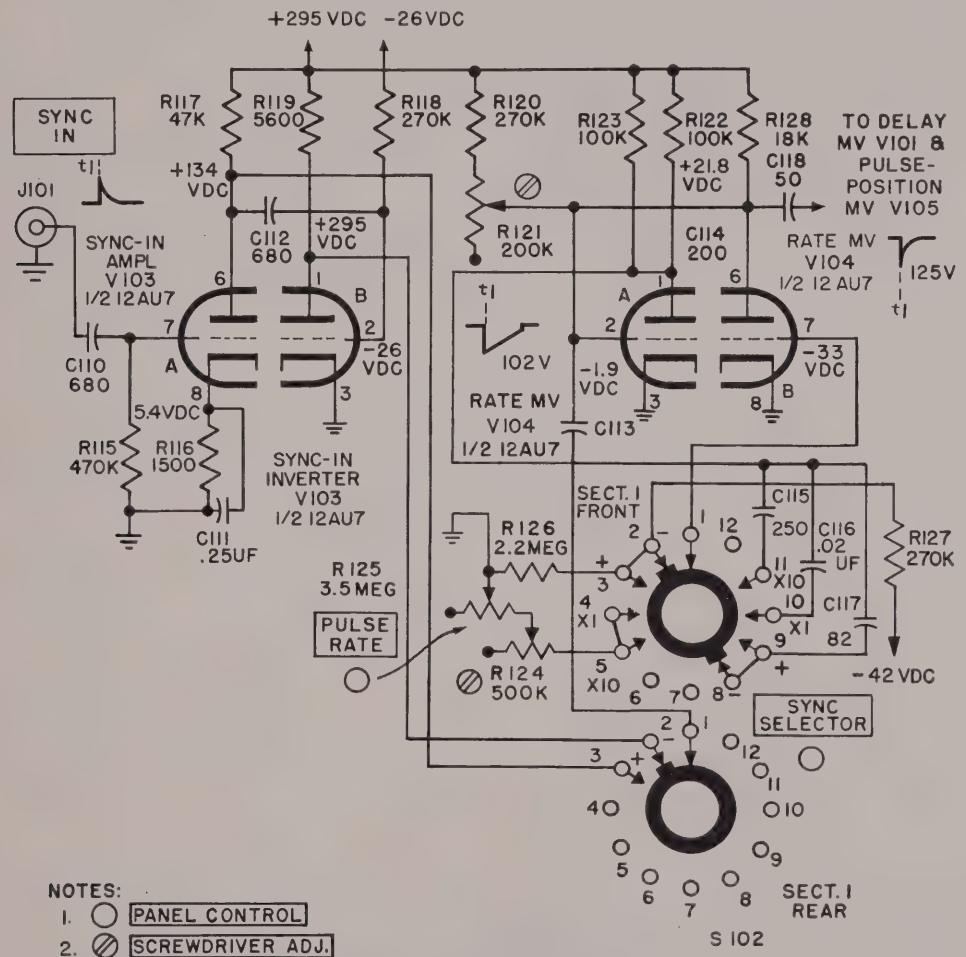
When external negative or positive 5-volt sync pulses are supplied through jack J101 to the pulse generator, either they are amplified or amplified and inverted by twin-triode V103. The amplifying or amplifying and inverting action is such that, in combination with the SYNC SELECTOR switch, a negative pulse is obtained from V103 to trigger the biased-off rate multivibrator V104. If the SYNC SELECTOR switch is in the + position, the trigger pulse is obtained from the plate of sync-in amplifier V103A and is opposite in polarity to the input sync pulse. In the — position, the trigger pulse is obtained from the plate of sync-in inverter V103B and is the same in polarity as the input synchronization pulse. No output pulse will be obtained when the SYNC SELECTOR switch is in the + or — position unless an external sync pulse is supplied to jack J101. Input coupling capacitor C110 prevents any d-c voltage present on the input synchronizing signal from reaching the grid (pin 7) of V103A. This grid is biased to —5.4 volts with respect to the cathode by cathode resistor R116. The grid (pin 2) of sync-in inverter V103B is held at a negative 26 volts bias by a regulated bleeder-bias network.

43. Rate Multivibrator
(fig. 15)

This stage, V104, with its associated circuitry acts as either a driven or free-running multivibrator; when operated free-running, it determines the repetition rate of the output pulse. During externally synchronized (driven) operation, the multivibrator is biased so that a new cycle can be initiated only by an external trigger pulse and PULSE RATE control R125 is disabled by switch S102 (front). The driving trigger is obtained through switch S102 (rear) from the plate of either V103A or V103B, depending on the polarity of the input trigger pulse. In the free-running condition, multivibrator V104 has ranges of from 50 to 500 and 500 to 5,000 pulses per second, depending on the setting (X1 or X10) of the SYNC SELECTOR switch. Switch S102 (front) controls the time constant of the grid circuit of V104B. When the switch is in the X10 position, rate determining capacitor C115 (250 $\mu\mu$f) is placed in the circuit, giving the shortest time constant and the highest repetition frequency. A longer time constant and a frequency one-tenth as great is obtained with switch S102 in the X1 position. Rate-adjust potentiometers R121 and R124 are provided for higher echelon calibration of the repetition rate. The + and — positions of switch S102 are discussed in paragraph 42.

44. Sync-out Circuits
(fig. 16)

a. Pulses for synchronizing external equipment are generated and shaped by the sync-out circuits which consist of one-shot multivibrator V101, isolation amplifier V102A, blocking oscillator V102B, and associated circuitry. The repetition rate of the sync pulse provided by these circuits is controlled by rate multivibrator V104. Crystal CR102 clips the positive portions of the output signal from V104B. The remaining negative pulse is applied to the plate of V101. In equipments starting with serial number 1039, this pulse is applied to the cathode of V101B. (It also is applied to V105A which is discussed in paragraph 45.) This negative pulse triggers one-shot, cathode-coupled multivibrator V101. V101A is biased to cutoff by the cathode current of V101B flowing through resistor R103. The grid of V101B is held effectively at zero bias by resistor R102 which returns to the cathode of V101B. The length of the pulse appearing at the plate of V101B controls the delay of the synchronizing signal with respect to the output pulse. This pulse



NOTES:
1. ○ PANEL CONTROL
2. ⊘ SCREWDRIVER ADJ.
3. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED. K=1,000 MEG=1,000,000
4. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000-OHMS-PER-VOLT METER.
5. VOLTAGES MEASURED WITH CONTROLS SET AS FOLLOWS: SYNC SELECTOR, + OR −; SYNC OUT, +; ATTENUATION, 20 DB; PULSE POSITION, 0; PULSE LENGTH, 5 USEC; PULSE RATE, 400 CPS; AMPLITUDE, 50; POLARITY, +.
6. ROTARY SWITCHES ARE VIEWED FROM END OPPOSITE CONTROL KNOB.
7. WAVEFORM VOLTAGES ARE GIVEN AS MEASURED PEAK-TO-PEAK.

TM 2678-15

Figure 15. Sync-in amplifier and inverter and rate multivibrator circuits, functional diagram.

length, which has a nominal value of 15 μsec, is determined by the time constant of resistor R102 and capacitor C102. The positive pulse at the plate of V101B is coupled to the grid of isolation amplifier V102A by capacitor C104. The grid of isolation amplifier V102A is held at a negative 26 volts bias by a regulated bleeder-bias network. The negative pulse at the plate of V102A is differentiated by capacitor C105 and resistor R108, resulting in a short negative going pulse followed by a positive going pulse.

These pulses correspond closely in position to the leading and trailing edges of the negative pulse at the plate of V102A. The negative portion of this differentiated signal is clipped by crystal CR101, and the positive portion is applied through the secondary winding of transformer T101 to the grid of blocking oscillator V102B.

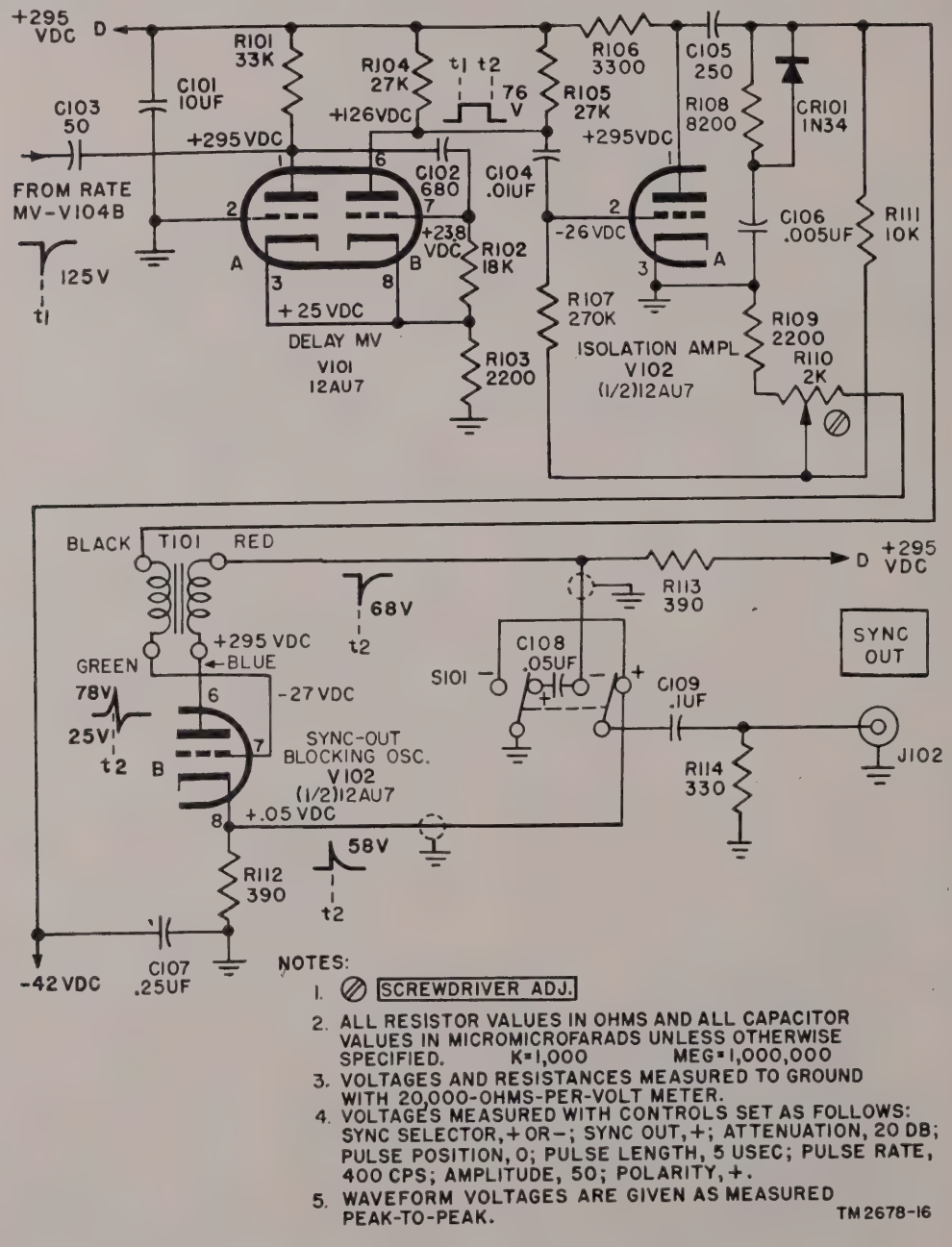


Figure 16. Sync-out circuits, functional diagram.

The grid of blocking oscillator V102B is held at a negative 27 volts bias by a regulated bleeder-bias network. Blocking oscillator V102B forms the actual sync-out pulse and delivers it to SYNC OUT jack J102 through polarity reversing switch S101. In the — position, this switch selects the negative pulses from the plate winding of transformer T101 and couples them to the SYNC OUT jack while simultaneously shorting out cathode resistor R112. In the + position, this switch selects the positive pulses developed across cathode resistor R112 and provides an a-c ground through capacitor C108 for the negative pulses developed in the plate circuit. Resistor R114 serves as a terminating load resistance.

b. In instruments having serial numbers of 1439 and above, the circuitry is modified to accommodate a newer design of pulse transformer. In the newer circuit, crystal CR101 shorts to ground the negative pulse from V102A, but allows the positive-going trailing edge of the pulse to feed to the grid winding of the pulse transformer to trigger blocking oscillator V102B.

45. Pulse Positioning Circuits

(fig. 17)

a. The negative pulse developed by rate multivibrator V104 is used to trigger one-shot, cathode-coupled multivibrator V105. V105A is biased to cut off by the cathode current of V105B flowing through resistor R131. The grid of V105B is held effectively at zero bias by resistor R133 and the two-section potentiometer (R132 and R132A) which return to the cathode. The grid voltage with respect to ground of V105B is 23.8 volts. The PULSE POSITION potentiometer sections are connected in series, and R132A acts as a vernier on R132. Resistor R133 maintains a minimum resistance of 680 ohms from grid to cathode. At this minimum setting, the pulse from this multivibrator is 2 μsec long. At the maximum setting of the PULSE POSITION control, the pulse is 112 μsec in length. This positive, variable length pulse is applied to the grid of isolation amplifier V106A and is inverted. The negative, variable length pulse at the plate of V106A is differentiated by capacitor C123 and resistor R137, resulting in a short negative going pulse followed by a short positive going pulse. The positive portion of this signal after differentiation, which corresponds in time to the trailing edge of the pulse at the plate of V106A, is applied through crystal rectifier CR103 and the grid winding of transformer T102 to the grid of thyratron trigger blocking oscillator V106B. This blocking oscillator generates the trigger pulse which is used to trigger pulse forming thyratron V6.

b. In instruments having serial numbers of 1439 and above, circuitry is modified to accommodate a newer design of pulse transformer. In the newer circuit, crystal CR103 shorts to ground the negative pulse from V106A but allows the positive-going trailing edge of the pulse to feed to the grid winding of the pulse transformer to trigger blocking oscillator V106B.

c. The pulse from V106B is applied to cathode-follower V107B and delay line DL101 which are used for impedance-matching and fixed delay insertions, respectively.

d. The fixed delay introduced by delay line DL101 is 2 μsec. This additional delay is required because of the design characteristics of pulse length multivibrator V108 which has a minimum pulse length of 2 μsec. In series with the grid of cathode-follower V107B is crystal rectifier CR104. This crystal rectifier prevents positive transients from the grid of pulse forming thyratron V6 from feeding back to blocking oscillator V106B through the delay line and the cathode-grid capacitance of cathode-follower V107B. Crystal rectifier CR103 is used in the grid circuit of blocking oscillator V106B to reduce further the possibility of interaction because of feedback coupling from pulse forming thyratron V6.

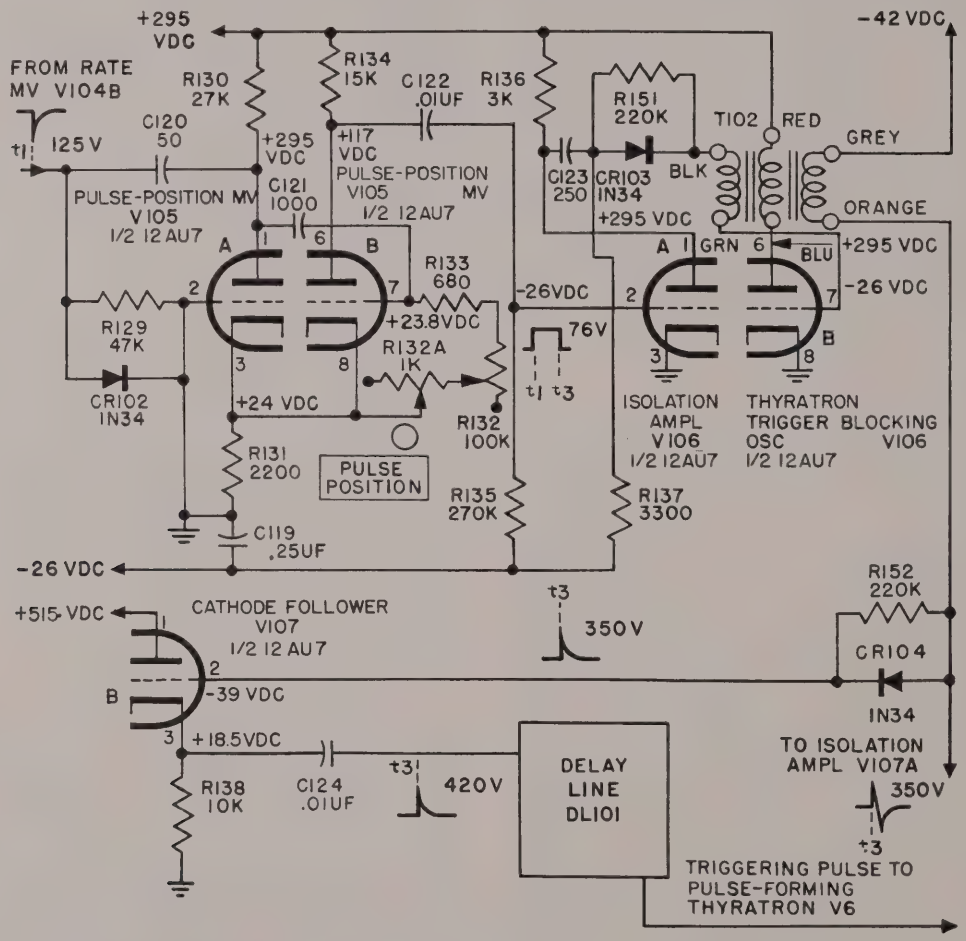
46. Pulse Length Circuits

(fig. 18)

a. The pulse generated by V107B serves as the triggering pulse for the main output signal. The pulse length circuits consisting of V107A, V108, and V109 develop a pulse which is used to terminate the main output pulse. The positive output pulse at the tertiary winding of transformer T102 is coupled through capacitor C127 to the grid of isolation amplifier V107A. The inverted pulse at the plate is coupled to the grid of positive grid-return, one-shot multivibrator V108. This multivibrator differs from V101, V104, and V105 in the method of biasing the grid of the first or conducting section of V108. With the grid returned to B+, a negative trigger may be used, a negative output pulse may be obtained, and more accurate control of the pulse length is available. Actual control of the pulse length is accomplished

by potentiometer R142, PULSE LENGTH control on the front panel. The minimum pulse length may be adjusted by setting potentiometer R143 (a front deck screwdriver adjustment). The maximum length may be adjusted by varying C128 (also a screwdriver front deck adjustment).

The negative pulse at the plate of V108B is differentiated by capacitor C132 and resistor R150, resulting in a negative going pulse closely followed by a positive going pulse. The negative and positive going pulses correspond in time position to the leading and trailing edges of the adjustable length pulse developed by multivibrator V108. This signal is applied through the grid winding of transformer T103 to the grid of V109A. The positive pulse serves as a trigger for thyratron terminating blocking oscillator V109A. Crystal rectifier CR106 clamps the grid of V108B to the fixed bias supply to minimize changes in grid bias with changes in pulse rate. This minimizes variation in pulse length with changes in pulse rate. Crystal rectifier CR105 minimizes coupling of the positive trigger pulse to the grid bias supply. At the same time, CR105 provides a low-impedance discharge path for the grid of V109A. In instruments having serial numbers of 1439 and



NOTES:

1. ○ PANEL CONTROL
2. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED. K=1,000 MEG=1,000,000
3. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000-OHMS-PER-VOLT METER.
4. VOLTAGES MEASURED WITH CONTROLS SET AS FOLLOWS: SYNC SELECTOR, + OR −; SYNC OUT, +; ATTENUATION, 20 DB; PULSE POSITION, 0; PULSE LENGTH, 5 USEC; PULSE RATE, 400 CPS; AMPLITUDE, 50; POLARITY, +.
5. WAVEFORM VOLTAGES ARE GIVEN AS MEASURED PEAK-TO-PEAK.

TM 2678-17

Figure 17. Pulse initiating circuits, functional diagram.

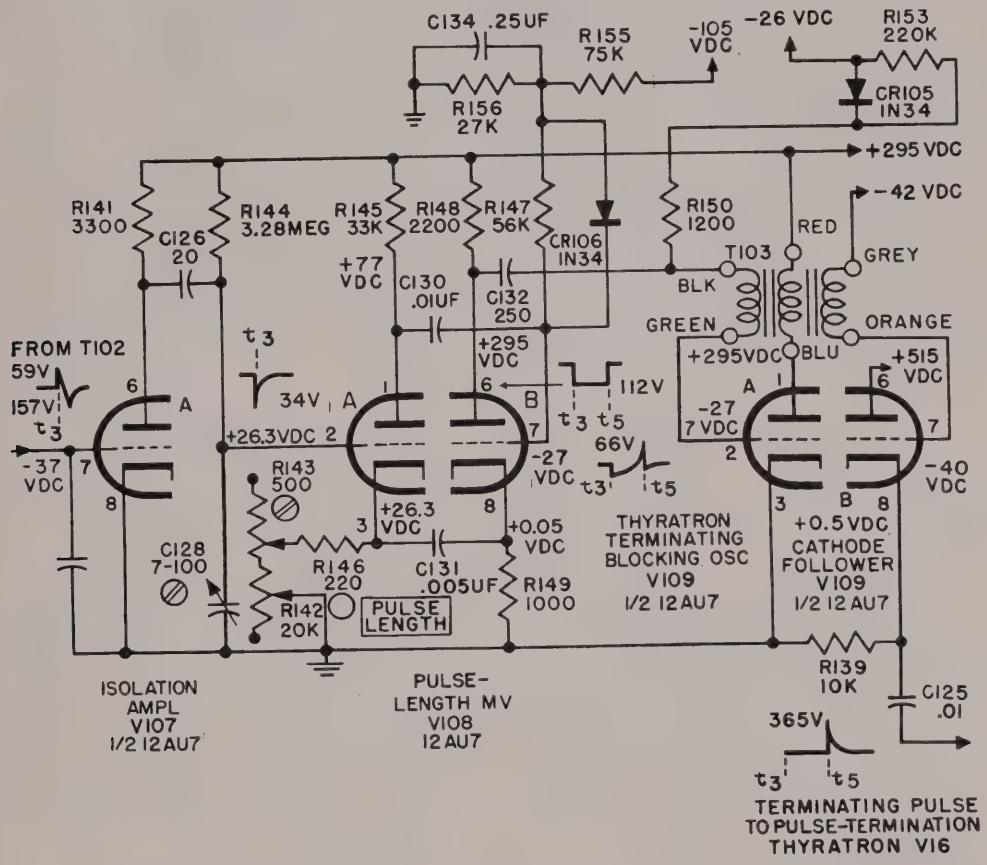
above, the circuitry is modified to accommodate a newer design of pulse transformer. In the newer circuit, crystal CR105 shorts to ground the negative pulse from V108B but allows the positive-going trailing edge of the pulse to feed to the grid winding of the pulse transformer to trigger blocking oscillator V108A.

b. The positive pulse developed across the tertiary winding of transformer T103 is fed to the grid of cathode-follower V109B, and the resulting positive pulse at the cathode (developed across cathode resistor R139) is fed to the grid of pulse-terminating thyratron V16.

47. Pulse Generating Section

(fig. 19)

The circuits of the triggering and synchronizing section, which are described in paragraphs 42 through 46, develop critically timed pulses which control the generation and length of the output pulse. Actual control is accomplished in the grid circuits of pulse-forming thyratron V6 and pulse-termination thyratron V16, which turn the output pulse on and off, respectively. The high voltage required by pulse-forming thyratron V6 is supplied by high-voltage rectifier V1. The



NOTES:

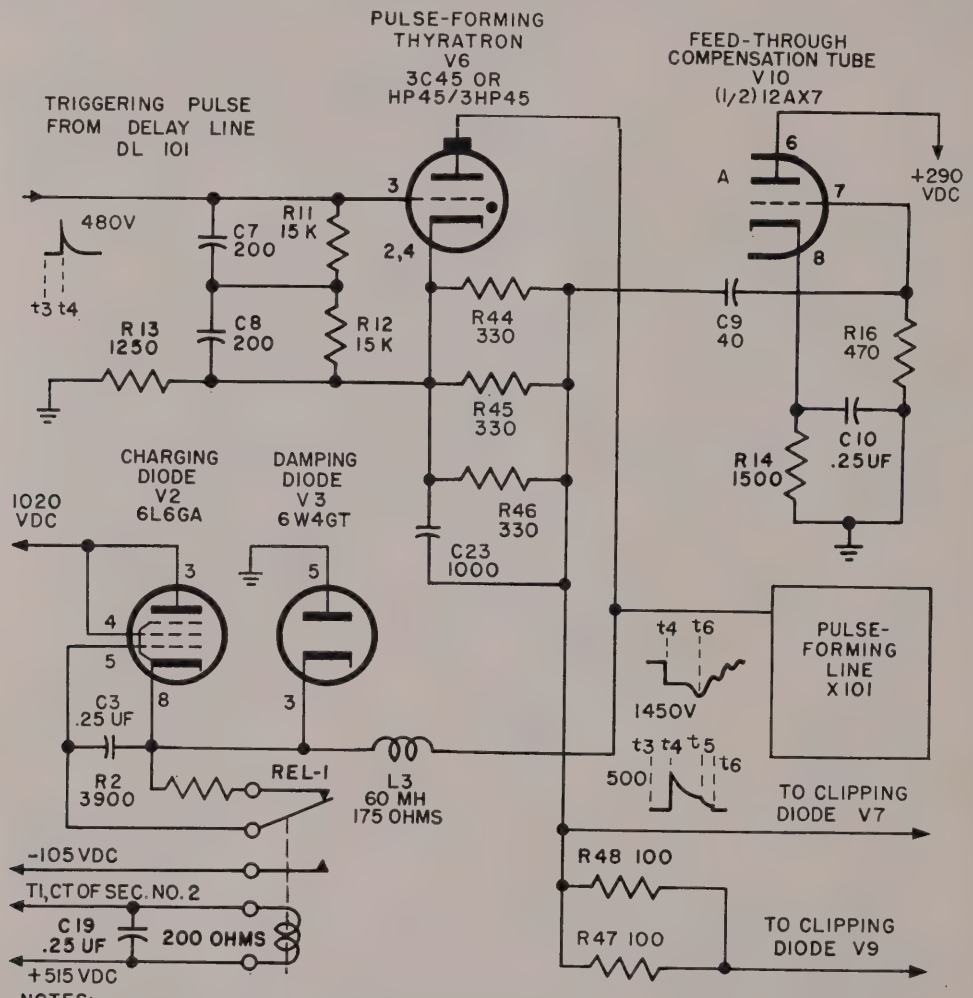
1. ◯ PANEL CONTROL
2. ⊘ SCREWDRIVER ADJ.
3. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED. K=1,000 MEG=1,000,000
4. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000-OHMS-PER-VOLT METER.
5. VOLTAGES MEASURED WITH CONTROLS SET AS FOLLOWS: SYNC SELECTOR, + OR −; SYNC OUT, +; ATTENUATION, 20 DB; PULSE POSITION, 0; PULSE LENGTH, 5 USEC; PULSE RATE, 400 CPS; AMPLITUDE, 50; POLARITY, +.
6. WAVEFORM VOLTAGES ARE GIVEN AS MEASURED PEAK-TO-PEAK.

TM 2678-18

Figure 18. Pulse length circuits, functional diagram.

264004—53——5

effective d-c voltage from this rectifier is raised by connecting the center tap of the high-voltage secondary winding to the 590-volt d-c output of rectifier V13 instead of to ground. The center tap of the low-voltage secondary winding of transformer T2 is grounded. The resulting 1,100 volts (approximately) which are available at the cathode of high-voltage rectifier V1 is supplied to charging choke L2, through filter choke L1 (fig. 32) and then to the plate and screen of charging diode V2. The cathode of charging diode V2 at approximately 1,020 volts, is connected to the plate of pulse-forming thyratron V6 and pulse-forming line X101. The solenoid of relay REL1 which is in series with the center tap of the high-voltage secondary winding of transformer T1 serves as an overload protector. Should V6 draw an excessive current, relay REL1 energizes and applies a large negative voltage to the grid of charging diode V2. This drives V2 to cutoff and removes plate voltage from thyratron V6. With thyratron V6 no longer drawing current, relay REL1 is no longer energized, returns to its original position, and applies d-c to the plate of V6. This



NOTES:

1. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED. K=1,000 MEG=1,000,000
2. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000-OHMS-PER-VOLT METER.
3. VOLTAGES MEASURED WITH CONTROLS SET AS FOLLOWS: SYNC SELECTOR, + OR −; SYNC OUT, +; ATTENUATION, 20 DB; PULSE POSITION, 0; PULSE LENGTH, 5 USEC; PULSE RATE, 400 CPS; AMPLITUDE, 50; POLARITY, +.
4. WAVEFORM VOLTAGES ARE GIVEN AS MEASURED PEAK-TO-PEAK.

TM 2678-19

Figure 19. Line charging and pulse forming circuits, functional diagram

action is repetitive as long as excessive current is drawn through the center tap of the high-voltage secondary winding of transformer T1.

48. Pulse Forming Thyratron

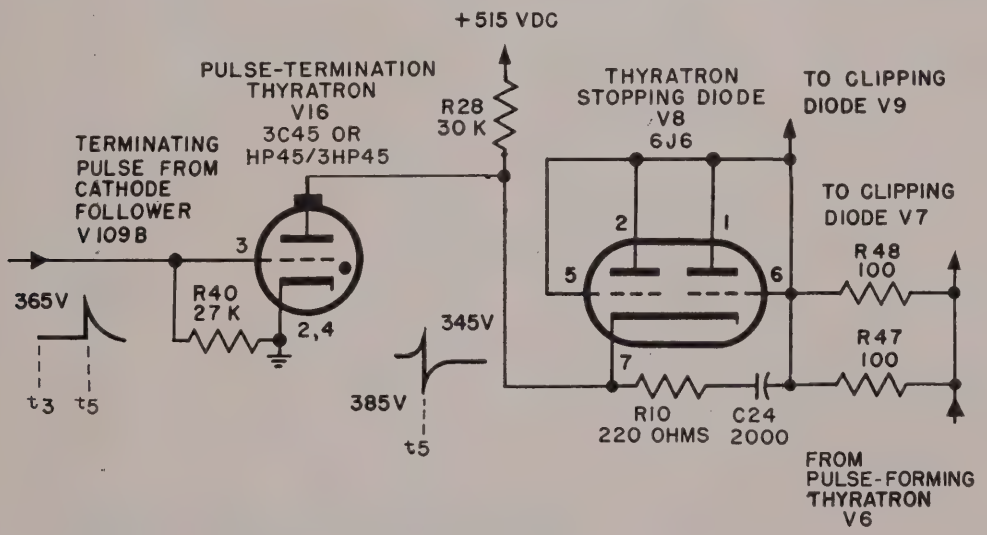
(fig. 19)

Application of d-c voltage to pulse forming line X101 through charging choke L2 causes the voltage across X101 to rise considerably above the d-c supply voltage because of the initial charging transient. The voltage across X101 acts as the plate voltage for thyratron V6. The voltage reaches approximately 1,600 volts and is prevented from discharging back to the power supply voltage of 1,100 volts by charging diode V2. Thyratron V6 does not conduct until a trigger pulse is applied to the grid. This trigger pulse is obtained from cathode-follower V107B through delay line DL101 and represents the leading edge of the main output pulse. This trigger pulse when applied to the grid of thyratron V6 causes V6 to conduct heavily. This current flow discharges pulse forming line X101, and the plate voltage on V6 falls. Pulse forming line X101 has been designed so that this fall in plate voltage results in a reflection from the open end of the line which drives the plate of thyratron V6 still further negative and stops conduction in the tube. This reflected negative voltage appears at the plate of V6 approximately 10.5 μsec after the application of the trigger pulse and the start of conduction. Immediately after V6 stops conducting, plate voltage starts to rise and the pulse forming line recharges in preparation for the application of the next trigger pulse to the grid of V6, at which time the cycle repeats. Damping diode V3 conducts when the negative reflection from X101 exceeds the voltage required to stop conduction in V6. During periods when V6 is conducting, a positive voltage is developed across cathode resistor R13. Since C6 goes from the nonconducting to the conducting condition in a very short time, the voltage at the cathode of V6 is a pulse having a very short, steep, leading edge and a duration of approximately 10.5 μsec.

49. Pulse Terminating Circuit

(fig. 20)

Precision control of the length of the main output pulse is maintained by pulse termination thyratron V16 and thyratron stopping diode V8.



NOTES:

1. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED. K=1,000 MEG=1,000,000
2. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000-OHMS-PER-VOLT METER.
3. VOLTAGES MEASURED WITH CONTROLS SET AS FOLLOWS: SYNC SELECTOR, + OR −; SYNC OUT, +; ATTENUATION, 20 DB; PULSE POSITION, 0; PULSE LENGTH, 5 USEC; PULSE RATE, 400 CPS; AMPLITUDE, 50; POLARITY, +.
4. WAVEFORM VOLTAGES ARE GIVEN AS MEASURED PEAK-TO-PEAK.

TM 2678-20

Figure 20. Pulse terminating circuitry, functional diagram.

V16 does not conduct until triggered by a pulse from cathode-follower V109B. This pulse terminating trigger, which follows the trigger applied to the grid of pulse forming thyratron V6, is applied to the grid and causes conduction. The plate of V16 is connected to the cathode of thyratron stopping diode V8. The positive pulse developed in the cathode circuit of V6, after limiting to approximately 300 volts, is applied to the plate of V16 through diode V8. This pulse voltage, in addition to the d-c voltage supplied through R28, causes V16 to conduct when its grid is fired by the pulse terminating trigger. This conduction accomplishes two things: First, this diode presents a very low impedance to the pulse, from pulse forming thyratron V6, and causes a very rapid fall of the pulse to form the trailing edge; second, in conjunction with resistor R10 and capacitor C24, it allows thyratron V16 to be extinguished.

50. Pulse Clipping Circuits

(fig. 21)

The pulse appearing on the cathode of thyratron V6 is applied to the plate of clipping diode V7. The cathode of V7 is supplied with a bias variable from approximately 260 to 320 volts by means of the AMPLITUDE control. Therefore, V7 clips the pulse at approximately the value of the bias. This clipped pulse is passed through a second clipping network, consisting of resistors R47 and R48 and diode V9, and to the plates of thyratron stopping diode V8. The cathode of the second clipping diode V9 is also biased to the 260-320-volt value. The action of V9 is to further smooth the top of the pulse. V9 also reduces along the top of the pulse any variation resulting from the action of thyratron stopping diode V8. From V9, the pulse is fed to the grid of output tube V11.

51. Feedthrough Compensating Stage

(fig. 19)

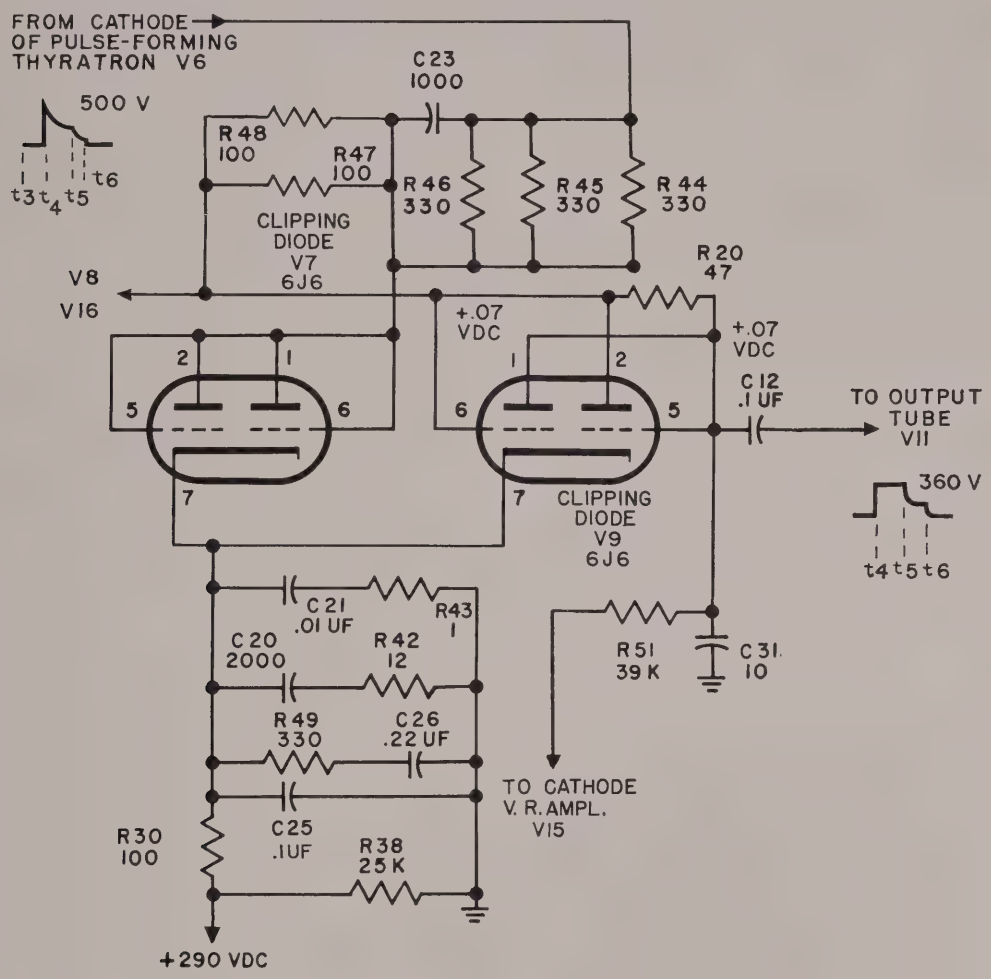
To compensate for distortion in the output pulse caused by the grid-to-plate capacitance in output tube V11, a feedthrough compensation stage V10 has been incorporated. The grid-to-plate capacitance of V11 causes a relatively low-amplitude positive spike to appear in the output of V11 at the time of the start of the main output pulse. When a negative output pulse is selected, this spike appears as a short positive pip immediately preceding the leading edge of the negative pulse. When a positive output is selected, this spike appears as a notch in the leading edge of the output pulse. V10A minimizes this effect. The grid of V10A is fed from a differentiating network (capacitor C9 and resistor R16) which connects to the cathode circuit of pulse forming thyratron V6. The resulting short positive and negative pulses correspond in time to the leading and trailing edge of the pulse at the cathode of V6. These pulses are amplified and inverted by V10A and the negative, leading pulse is applied to the plate of V11 through adjustable capacitor C11 (fig. 22). C11 is used to vary the amplitude of the compensating spike which cancels out the undesired leading edge spike generated in V11.

52. Output Circuits

(fig. 22)

After the final shaping and smoothing action of the upper portions of the output pulse by clipping diode V9, it is coupled to the paralleled grids of output stage V11 through capacitor C12. These paralleled grids are connected to a bias supply (−360 volts) through potentiometer R4A. This potentiometer, which is one section of the AMPLITUDE control, permits varying the bias voltage on the grids from −300 to −360 volts. Potentiometer R4B, the second section of the AMPLITUDE control, controls the grid bias on voltage regulator amplifier V15 which in conjunction with voltage regulator V17A controls the plate voltage applied to output tube V11 and the cathode bias on clipping diodes V7 and V9. Polarity switch S2 provides facilities for selecting a positive or negative polarity pulse for application to attenuator AT1. When in the − position, resistor R21 is the cathode load and resistor R22 is the plate load across which the output pulse is developed. In the + position, resistor R22 is switched in series with resistor R21 in the cathode circuit and an a-c ground, capacitors C5 and C27 (fig. 33), is connected to the plate. The positive pulse voltage developed across resistors R21 and R22 is coupled to attenuator AT1 through capacitor C13. To provide a more constant pulse amplitude, with changes in repetition rate and pulse length, a compensation circuit is incorporated. When either the rate or pulse length is increased, a positive voltage is applied to the cathode of voltage regulator amplifier V15 through resistor R51 (fig. 33) which causes the plate voltage of output tube V11 and

the cathode bias of clipping diodes V7 and V9 to increase. This compensates for the decrease in amplitude which otherwise would occur when the rate or pulse length was increased. Attenuator AT1 is used to reduce the amplitude of the output pulse in 10-db steps with a maximum attenuation of 60 db available. Intermediate values of attenuation may be obtained by setting the AMPLITUDE control which has a continuous range of over 10 db.

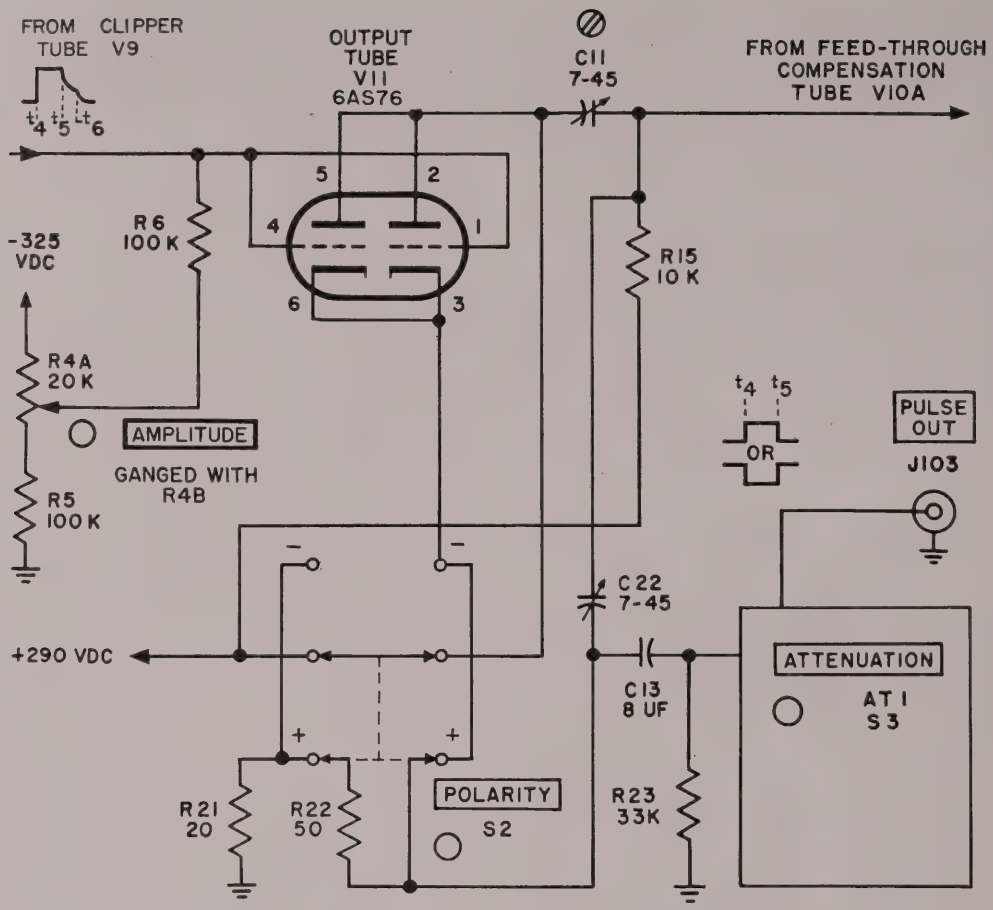


NOTES:

1. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED. K=1,000 MEG=1,000,000
2. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000-OHMS-PER-VOLT METER.
3. VOLTAGES MEASURED WITH CONTROLS SET AS FOLLOWS: SYNC SELECTOR, + OR −; SYNC OUT, +; ATTENUATION, 20 DB; PULSE POSITION, 0; PULSE LENGTH, 5 USEC; PULSE RATE, 400 CPS; AMPLITUDE, 50; POLARITY, +.
4. WAVEFORM VOLTAGES ARE GIVEN AS MEASURED PEAK-TO-PEAK.

TM 2678-21

Figure 21. Pulse clipping and shaping circuits, functional diagram.



NOTES:

1. ○ PANEL CONTROL
2. ⊘ SCREWDRIVER ADJ.
3. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED. K=1,000 MEG=1,000,000
4. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000-OHMS-PER-VOLT METER.
5. VOLTAGES MEASURED WITH CONTROLS SET AS FOLLOWS: SYNC SELECTOR, + OR −; SYNC OUT, +; ATTENUATION, 20 DB; PULSE POSITION, 0; PULSE LENGTH, 5 USEC; PULSE RATE, 400 CPS; AMPLITUDE, 50; POLARITY, +.
6. WAVEFORM VOLTAGES ARE GIVEN AS MEASURED PEAK-TO-PEAK.

TM 2678-22

Figure 22. Pulse output circuits, functional diagram.

CHAPTER 5

FIELD MAINTENANCE INSTRUCTIONS

Note. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available, and by the skill of the repairman.

Section I. TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

Warning: When servicing the pulse generator, be extremely careful because of the high voltages exposed. With the high voltage off, potentials as great as 500 volts may be retained as charges in capacitors. Keep one hand in pocket when measuring socket voltages with the probe. Before touching any part after the voltage is shut off, short the part to ground.

53. Trouble-Shooting Procedures

a. General. The first step in servicing any defective electronic component is to sectionalize the fault. Sectionalization means tracing the fault to the *major circuit* responsible for the abnormal operation of the equipment. The second step is to localize the fault. Localization means tracing the fault to the defective *part* responsible for the abnormal condition. Some faults, such as burned-out resistors and shorted transformers, can often be located by sight, smell, and hearing. The majority of faults, however, must be localized by *checking voltage and resistance.*

b. Component Sectionalization and Localization. The tests listed below aid in isolating the source of trouble. To be effective, the procedure should be followed in the order given. Remember that servicing procedure should cause no further damage to the pulse generator. First, trouble should be localized to a single stage or circuit. Then the trouble may be isolated within that stage or circuit by appropriate voltage, resistance, and continuity measurements. The service procedure is summarized as follows:

(1) *Visual inspection.* The purpose of visual inspection (par. 37) is to locate any visible trouble. Through this inspection alone, the repairman frequently may discover the trouble or determine the stage in which the trouble exists. This inspection is valuable in avoiding additional damage to the pulse generator which might occur through improper servicing methods and in forestalling future failures.

(2) *Input resistance measurements.* These measurements (par. 57) prevent further damage to the pulse generator from possible short circuits. Since this test gives an indication of the condition of the filter circuits, its function is more than preventive.

(3) *Operational test.* The operational test (par. 58) is important because it frequently indicates the general location of the trouble. In many instances the information gained will determine the exact nature of the fault. In order to utilize this information fully, all symptoms must be interpreted in relation to one another.

(4) *Trouble-shooting chart.* The trouble symptoms listed in this chart (par. 59) will aid greatly in localizing trouble.

(5) *Intermittents.* In all these tests the possibility of intermittents must not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the set. It is possible that the trouble may not be in the pulse generator itself but in the installation or other external conditions.

54. Trouble-Shooting Data

Take advantage of the material supplied in this manual. It will help you in the rapid location of faults. Consult the following trouble-shooting data:

Fig. No.	Description
30	Schematic diagram, front deck serial Nos. up to 1038.
31	Schematic diagram, front deck, serial Nos. from 1039.
32	Schematic diagram, rear deck, serial Nos. up to 1238.
33	Schematic diagram, rear deck, serial Nos. from 1239.
34	Schematic diagram, front deck, serial Nos. from 1439.
23	Tube socket voltage and resistance chart.
24	Terminal board voltage and resistance diagram.
25	Pulse forming line voltage and resistance diagram.
3	Pulse generator top view, cover removed.
4	Pulse generator, bottom view, cover removed.
5	Pulse generator, rear view, cover removed.
8	Tube sockets and location diagram.
13	Pulse generator, block diagram.
28	Capacitor color and letter codes.
29	Resistor color and letter codes.

55. Test Equipment Required for Trouble Shooting

The test equipment required for trouble shooting the set is listed below. The technical manuals associated with the test equipment are also listed.

Test equipment	Technical manuals
Tube Tester I–177 and I–177–A, or equal.	TM 11–2627.
Oscilloscope TS–239/UP	AN 16–35TS239–3.
Frequency Meter FR–67/U, or equivalent.	TM 11–2698.

56. General Precautions

Whenever the pulse generator is serviced, observe the following precautions very carefully.

a. Be careful when the cover is removed; dangerous voltages are exposed.

b. Careless replacement of parts often makes new faults inevitable. Note the following points:

(1) Before a part is unsoldered, note the position of the leads. If the part, such as a transformer, has a number of connections, tag each of the leads to it.

(2) Be careful not to damage other leads by pulling them or pushing them out of the way.

(3) Do not allow drops of solder to fall into the set, since they may cause short circuits.

(4) A carelessly soldered connection may create a new fault. It is very important to make well-soldered joints, since a poorly soldered joint is one of the most difficult faults to find.

(5) When a part is replaced it must be placed exactly as the original one was. A part which has the same electrical value but a different physical size may cause trouble. Give particular attention to proper grounding when replacing a part. Use the same ground as in the original wiring. Failure to observe these precautions may result in unwanted oscillations or instability.

(6) Do not disturb the adjustment of calibration controls R33, R35, R110, R121, R124, R143, C11, C22, and C128 (fig. 3).

57. Checking Filament and B+ Circuits for Shorts

Trouble within the pulse generator often may be detected by checking the resistance of the filament and high-voltage circuits before applying power to the equipment, thereby preventing damage to the power supply. Make the following checks before attempting to put the pulse generator into operation. Do not plug in the power cord or turn on the POWER ON switch for these measurements. Remove all tubes from their sockets.

a. Measure the resistance between pin No. 7 of VI and ground. The reading should be approximately 650,000 ohms. For instruments having serial numbers of 1239 and above, this reading should be approximately 550,000 ohms. If the resistance is less than the above values, check capacitor C1 or C2 for shorts.

b. Measure the resistance between pin No. 8 of V13 and ground. The reading should approximate 200,000 ohms. For instruments having serial numbers 1239 and above, this reading should be approximately 83,000 ohms. If the resistance

is less than the above values, check capacitor C16, C14, or C15 for shorts.

c. Measure the resistance to ground from pin No. 1 of V16, pin No. 4 of V15, pin No. 9 of V10, and pin No. 8 of V11. The resistance should be zero in all cases. If a reading is noted, check for grounds in the wiring from the appropriate winding of transformer T2 to the listed tube pins.

d. Measure the resistance between pin No. 8 of V3 and ground. There should be infinite resistance. If a reading is noted, check for a ground in the wiring between this pin and transformer T2. Also check for an internal short in transformer T2 from this winding to another winding on the case.

e. Measure the resistance between pin No. 4 of V8 and ground. There should be approximately 1,350 ohms resistance. If zero reading is noted, check for a ground.

f. Measure the resistance between the capacitor of V6 and ground. There should be infinite resistance. If a reading is noted, check for a ground.

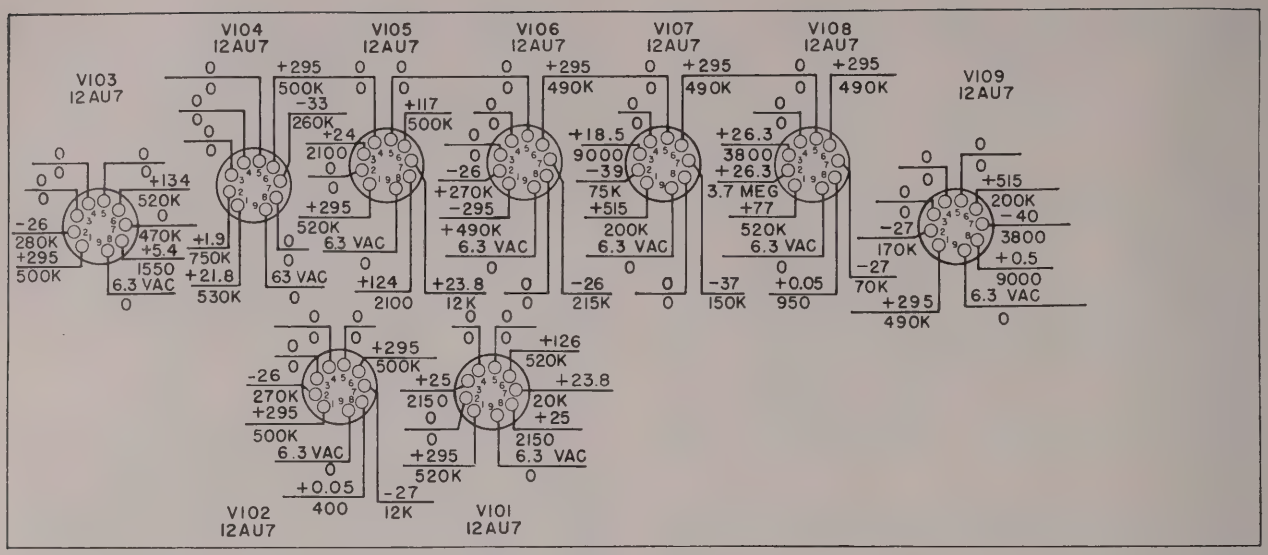
58. Operational Test

Connect Oscilloscope TS–239/UP to the PULSE OUT jack and to the SYNC OUT jack. Operate the generator as described in the equipment performance checklist in paragraph 39. This checklist is important because it frequently indicates the general location of trouble. Also listen for a buzzing noise which indicates that the overload relay is operating. Check the equipment for smoke and the odor of burned or overheated parts.

59. Trouble-Shooting Chart

The following chart is supplied as an aid in locating trouble in the pulse generator. This chart lists the symptoms which the repairman observes, either visually or audibly, while making a few simple tests. After the trouble has been localized to a stage or circuit, a tube check and voltage and resistance measurements of this stage or circuit ordinarily should be sufficient to isolate the defective part. Normal voltage and resistance measurements, are given in figures 23, 24 and 25.

Symptom	Probable trouble	Correction
1. POWER ON switch in ON position. Indicator lamp fails to light and no output is observed.	1. Open fuse F1.	1. Replace fuse. If the replaced fuse blows, check filter capacitors and tube V1 or V13. Replace defective parts.
2. Poor leading edges on pulse.	2. V6 defective.	2. Replace V6.
3. Poor trailing edge on pulse.	3. V16 defective.	3. Replace V16.
4. Pulse amplitude decays.	4. V11 or C5 defective.	4. Replace V11 or C5.
5. Trailing edge of pulse jitters at long pulse length.	5. V4 or V108 defective.	5. Replace V4 or V108.
6. Output pulse trailing edge jitters.	6. CR106, V16, or V109 defective.	6. Replace CR106, V16, or V109.
7. Pulse shifts when equipment is vibrated.	7. Defective V101, V105, or V108.	7. Replace V101, V105, or V108.
8. Output pulse decreases in amplitude with increase in rate.	8. Defective V11.	8. Replace V11.
9. Deterioration of top of output pulse at low rate.	9. Leakage of V2.	9. Replace V2.
10. Low amplitude of sync out pulse.	10. Defective CR101.	10. Replace CR101.
11. Abrupt jump in position of output pulse as pulse position is varied.	11. Defective CR102 or R132	11. Replace CR102 or R132.
12. V6 does not fire, or jitter occurs at front edge of output pulse.	12. Defective CR103 or CR104.	12. Replace CR103 or CR104.
13. Jitter or absence of definite trailing edge of output pulse.	13. Defective CR105.	13. Replace CR105.
14. Large variation of pulse length with change in rate.	14. Defective CR106.	14. Replace CR106.
15. Generally unstable operation of instrument.	15. Regulated plate and bias supplies not supplying proper voltage.	15. Adjust regulated voltage supply.
16. Incorrect calibration of PULSE LENGTH dial.	16. Aging of tubes.	16. Adjust pulse length calibration controls (par. 60*b*).
17. Incorrect calibration of PULSE RATE dial.	17. Aging of tubes.	17. Adjust rate calibration controls (par. 60*d*).



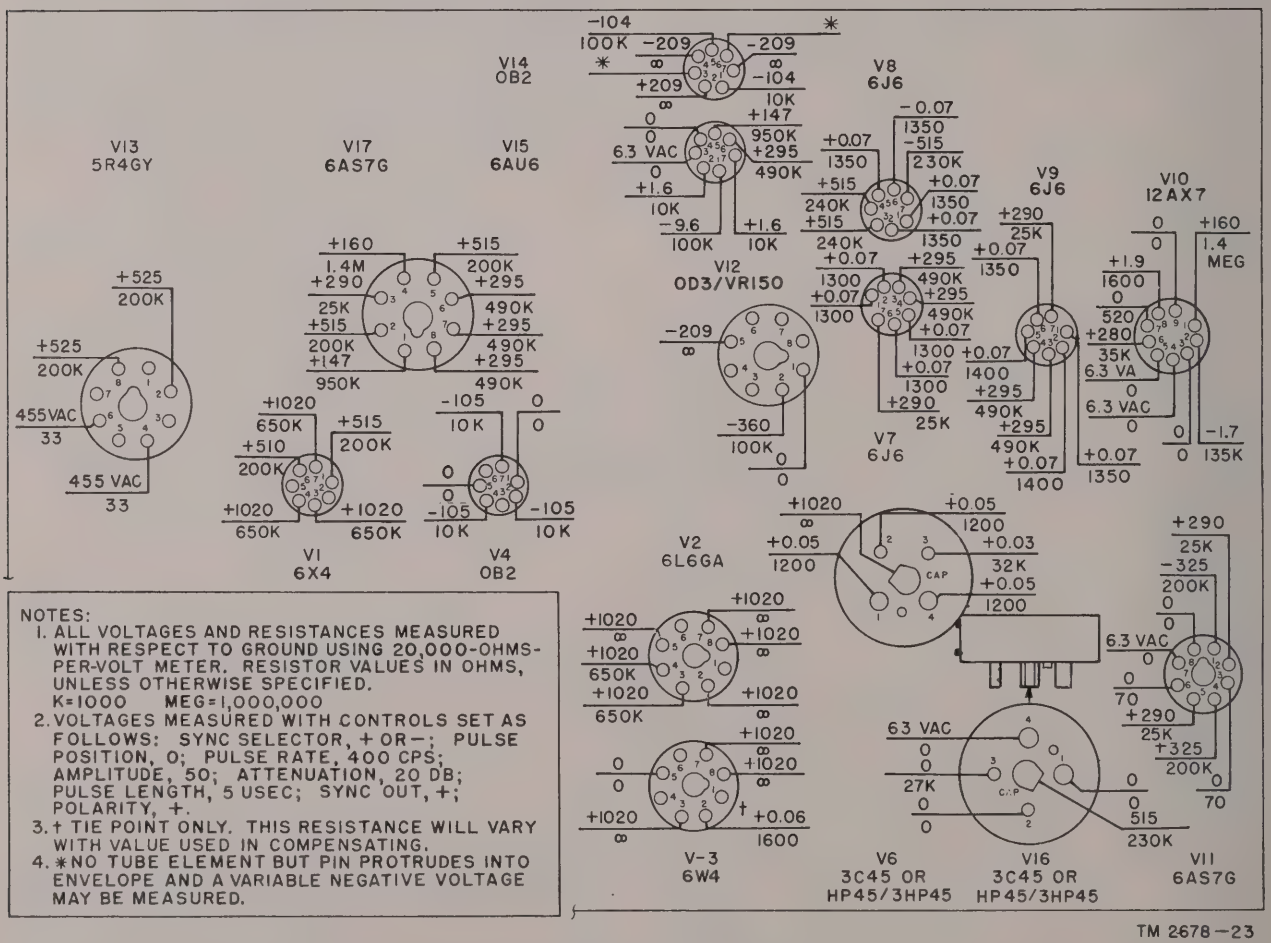
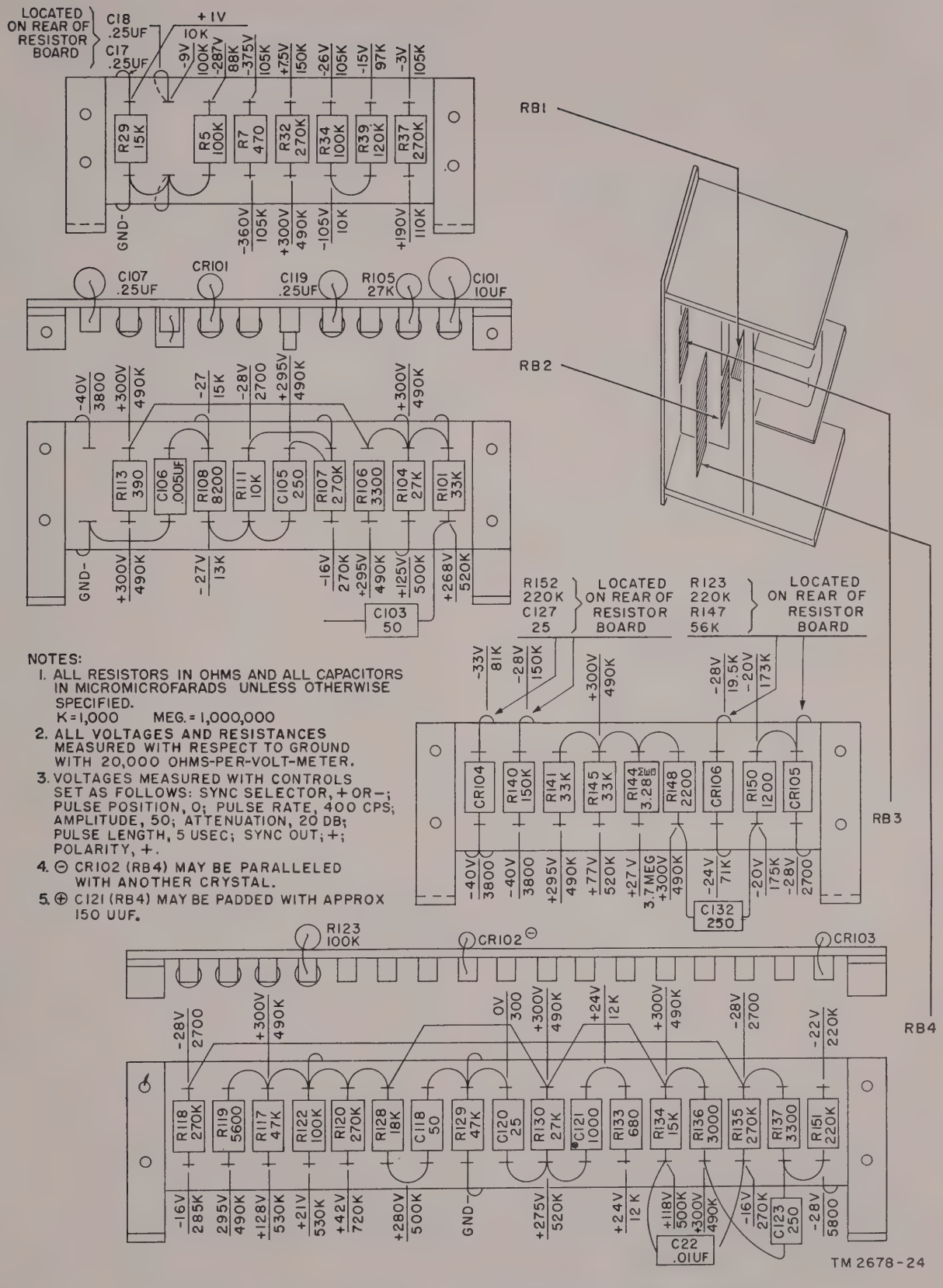


Figure 23. Tube socket voltage and resistance diagram.



NOTES:

1. ALL RESISTORS IN OHMS AND ALL CAPACITORS IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED.
   K = 1,000 MEG. = 1,000,000
2. ALL VOLTAGES AND RESISTANCES MEASURED WITH RESPECT TO GROUND WITH 20,000 OHMS-PER-VOLT-METER.
3. VOLTAGES MEASURED WITH CONTROLS SET AS FOLLOWS: SYNC SELECTOR, + OR −; PULSE POSITION, 0; PULSE RATE, 400 CPS; AMPLITUDE, 50; ATTENUATION, 20 DB; PULSE LENGTH, 5 USEC; SYNC OUT, +; POLARITY, +.
4. ⊖ CR102 (RB4) MAY BE PARALLELED WITH ANOTHER CRYSTAL.
5. ⊕ C121 (RB4) MAY BE PADDED WITH APPROX 150 UUF.

Figure 24. Pulse generator, terminal board voltage and resistance diagram.

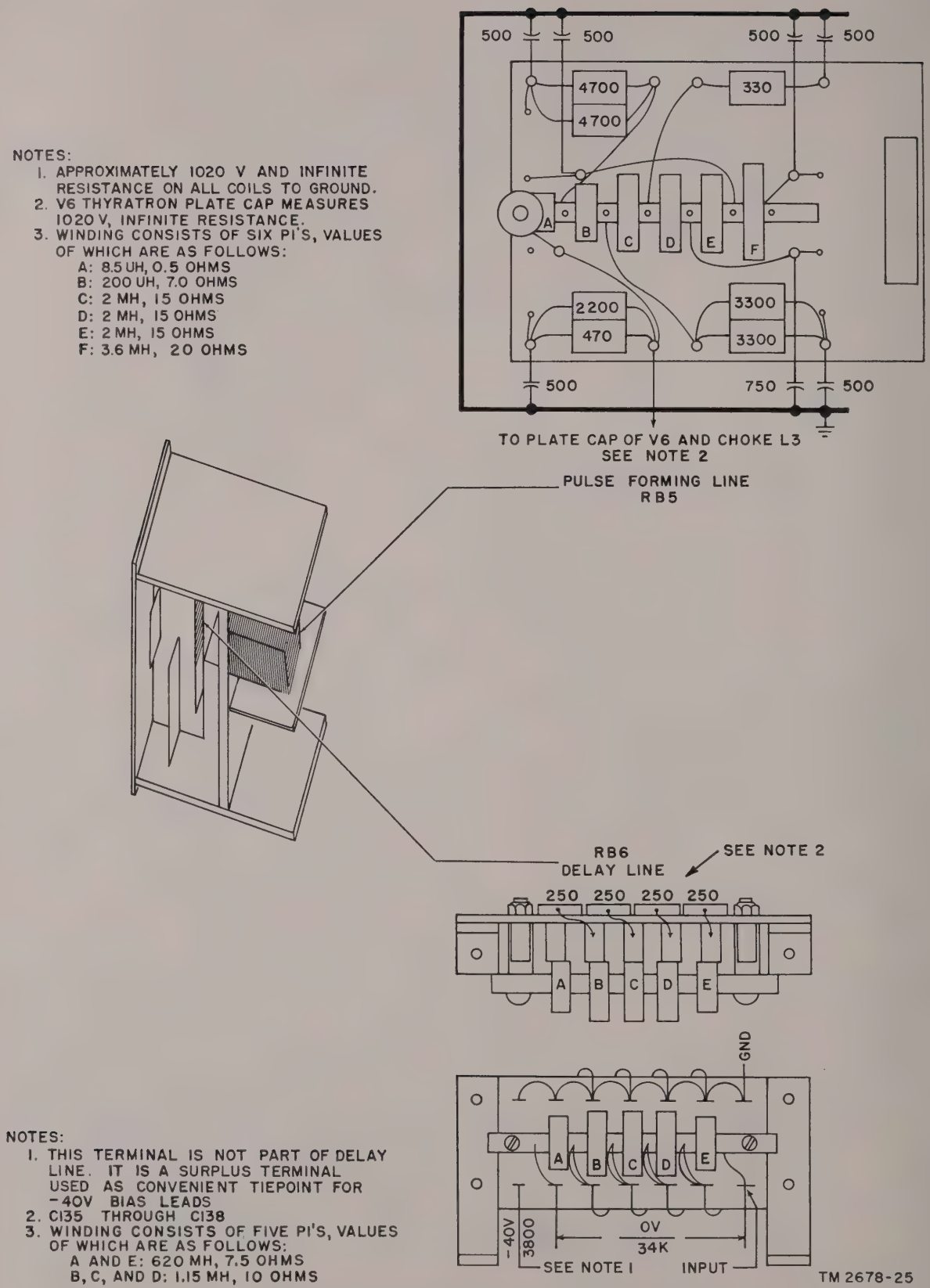


Figure 25. Delay in pulse forming line, voltage, and resistance diagram.

60. Additional Trouble-Shooting Information

a. Regulated Voltage Adjustment. Check tubes V4, V10B, V12, V13, V14, and V17. Then set variable resistor R33 (fig. 3) so that the voltage between point D on the schematic diagram (figs. 30, 31, 32, 33, and 34, as appropriate) and the chassis is +300 volts. Set variable resistor R110 (fig. 3) so that voltage from the central terminal of R110 is −28 volts WITH SYNC SELECTOR switch set to either + or − with no external sync voltage applied.

b. Pulse Length Calibration. Connect a calibrated oscilloscope to the PULSE OUT and SYNC OUT jacks. Set PULSE RATE control to 100 and SYNC SELECTOR to X10 so that a rate of 1,000 pps is obtained. Set PULSE LENGTH dial to 5 μsec. If necessary, slip the dial on its shaft so that a 5-μsec pulse occurs when the dial is set at 5 μsec. Next, set the dial to 10 μsec. After a short interval, adjust C128 so that a 10-μsec pulse occurs. Then set the dial to .2 μsec and adjust R143 so that a .2-μsec pulse occurs. Repeat process from beginning to obtain best accuracy.

c. Maximum Pulse Amplitude Adjustment. This adjustment should be made whenever the amplitude falls below 50 volts. When correcting this condition, set up the instrument for normal operation with zero attenuation and the AMPLITUDE control set in its maximum position. Connect a 50-ohm load from the PULSE OUT jack to ground in parallel with the calibrated oscilloscope. Adjust variable resistor R35 (fig. 3) until a maximum of 60 volts is indicated by the oscilloscope.

d. Calibration of Pulse Rate Dial. Setting of the PULSE RATE dial is not intended to be made with great accuracy. However, if, because of aging of tubes, the calibration error becomes greater than 10 percent, follow the procedure below to reset the dial.

(1) Set the SYNC SELECTOR to the X10 range and turn the PULSE RATE dial to the maximum clockwise position.
(2) Adjust R124 (fig. 3) so that the rate is 5,100 pps as indicated on Frequency Meter FR-67/U or equivalent.
(3) Turn the PULSE RATE dial so that the rate is now 1,000 pps.
(4) Set the SYNC SELECTOR switch to the X1 range and adjust R121 (fig. 3) until the rate is 100 pps.
(5) Loosen the setscrew and set the PULSE RATE dial so that it reads 100. Retighten the setscrew.
(6) Return the SYNC SELECTOR switch to the X10 range and turn the PULSE RATE dial to the maximum clockwise position.
(7) If necessary, readjust R124 so that the rate is 5,100 pps.
(8) Check other points on the dial for accuracy of calibration. If they are off, it may be necessary to displace the 1,000-pps point to either side of the 100 point on the dial by loosening the setscrew and resetting the dial. This compromise is necessary because of the differences in tapers of the pulse-rate potentiometers.

e. Aging of Thyratrons. Newly installed thyratrons will require aging. If the overload relay buzzes when the equipment is turned on after a thyratron has been replaced, turn the SYNC SELECTOR switch to either of the external settings (− or +), and with the external sync disconnected. If the relay stops buzzing, the thyratron was insufficiently aged. To age the thyratron, turn the SYNC SELECTOR switch to X1 and the PULSE RATE dial to its lowest setting, and allow the unit to operate for a short time, increasing the rate as much as possible without causing the overload relay to buzz. Thyratrons may require as much as 90 hours of aging for stable operation. During the time the thyratrons are aging, there may occur a noticeable change in ionization time. The time required for ionization will increase as the aging progresses. During the aging period, however, stability usually will improve, and jitter of the main pulse will become less and less.

f. Sources of Jitter. Jitter of the main pulse usually is traceable to three sources; tubes, crystals, and ripple in the power supply. In Pulse Generator AN/PPM–1, jitter usually appears as a thick or multiple trace of the leading edge, the trailing edge, or both edges of the pulse. V6 will affect jitter on the leading edge. V16, crystals CR105 and CR106, and width multivibrator V108 will affect trailing edge jitter. Delay multivibrators V101 and V105 and crystal CR102, if defective, may cause jitter on both the leading and trailing edges. Similarly, power-supply ripple may

cause jitter, and such ripple may affect V101 and V105 in varying degrees.

Note. When replacing tubes or crystal rectifiers to clear jitter symptoms, remember that it may be necessary to try several tubes or crystals known to be good before finding one that provides proper operation. Therefore, replace a tube or crystal at least twice before looking elsewhere for trouble. Tubes or crystals which do not prove satisfactory in this equipment may be suitable for most other applications and should not be considered defective without test.

Section II. REPAIRS

61. Replacement of Parts

a. General. Most of the parts in the set are accessible readily and are replaced easily if found to be faulty. In all instances involving multiple connections, however, tag each wire as it is removed so that it may be replaced correctly.

b. Resistors and Capacitors. Certain resistors and capacitors in the set, are factory adjusted to provide certain conditions of operation. The actual value may not be exactly the same as that shown on the schematic diagram. If it becomes necessary to replace any of these parts, the replacement should be made on a cut and try basis. That is, vary the value of the part until the desired operation is obtained. The following subparagraphs list these critical resistors and capacitors and detail the effect of changes in their values.

(1) *Resistor R3.* The original design value of this resistor was 4,000 ohms; however, tolerance variations in transformer T1 have made minor changes necessary. The criterion for the value of R3 should allow the series of voltage regulator tubes V4, V12, and V14 to draw approximately 8 ma (milliamperes) when the applied line voltage is 105 volts. Under these conditions the voltage regulator will operate properly. Resistor R3 is factory set and should not require adjustment or change during normal operation. If transformer T1 is changed, resistor R3 should be checked to make sure that the combination of T1, R3, and the voltage regulator tubes produce the required 8-ma current.

(2) *Resistor R10.* The usual value for this resistor is 200 ohms. Increasing the value of R10 slightly increases the slope of the trailing edge of the main output pulse and reduces overshoot. The value selected should not exceed 330 ohms. Only occasionally does R1 differ from its 220-ohm nominal value.

(3) *Resistor R30.* The usual value for this resistor is 100 ohms. Changing the value of R30 affects the final 30 percent of the top of the main output pulse when the main output pulse is of 10-μsec duration. That is, the value of R30 affects the top of the main output pulse in the region corresponding to from 7 to 10 μsec. Decreasing R30 reduces the voltage of this portion of the pulse, while increasing R30 raises the voltage during this portion. This resistor is factory adjusted for maximum flatness for the top of the pulse.

(4) *Resistor R50.* (See also capacitor C28.) Resistor R50 may vary from 330 to 560 ohms. The actual value is selected, in combination with capacitor C28, for minimum *hump* during the first tenth μsec of the top of the main positive output pulse.

(5) *Capacitor C28.* The value of this capacitor may vary from 200 to 600 $\mu\mu$f. In combination with resistor R50, C28 aids in reducing the hump described in (4) above.

(6) *Resistors R155 and R156.* The nominal values of these resistors are 75,000 and 27,000, respectively. Either one may be adjusted by a few percent in order to obtain the proper bias at the junction of these two resistors. This proper value is between −28 and −30 volts. Usually the adjustment is in the form of a shunt resistor across either R155 or R156.

(7) *Capacitor C121.* The nominal value of C121 is 1,000 $\mu\mu$f. It is part of the pulse-length determining network for pulse position multivibrator V105B. C121 occasionally is shunted with another capacitor of up to 250 $\mu\mu$f. This is done to obtain a full 100-μsec delay at a repetition rate of 2,500 pps.

(8) *Capacitor C31.* This capacitor is used only occasionally and, when used, its value is between 5 and 15 $\mu\mu$f. The purpose of C31 is to bypass excessive ringing (overshoot oscillations) in the main output pulse. This ringing may occur when the rise and decay of the main output pulse are exceptionally fast.

C31 is used only when ringing is not sufficiently reduced by capacitors C11 and C22.

c. Differences. The pulse generators previously supplied with type 3C45 thyratrons should use type HP45/3HP45 thyratrons when the spare tubes have been expended. If the type HP45/3HP45 tubes are not available, a type 3C45 may be selected from supply sources, using a trial and error process at finding one that will function properly in the circuit.

62. Refinishing

Badly marred panels or other portions of the pulse generator which show evidence of wear should be refinished before the equipment is returned to service by field and other personnel. Instructions for refinishing badly marred panels on exterior cabinets are given in TM 9–2851.

63. Apparatus Adjustment

In the event of damage to any of the moving controls of the set which might require their replacement, dial settings and calibration should be adjusted as provided in paragraph 60.

Section III. FINAL TESTING

64. General

This section is intended as a guide to be used in determining the quality of a repaired set. The minimum test requirements outlined in paragraph 66 may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

65. Test Equipment Required for Final Testing

The instruments for testing the repaired equipment are listed below:

Oscilloscope TS–239/UP
Signal Generator TS–382A/U
Frequency Meter FR–67/U or equipment
Connecting cable consisting of a type–N plug, 50-ohm coaxial cable, and one 50-ohm and one 100-ohm resistor.

Note. Because of the fast rise time of the pulses generated by the set, oscilloscopes having unusually fast response times are used for factory alinement of the equipment. Oscilloscope TS–239/UP, which is used for field alinement and testing of the pulse

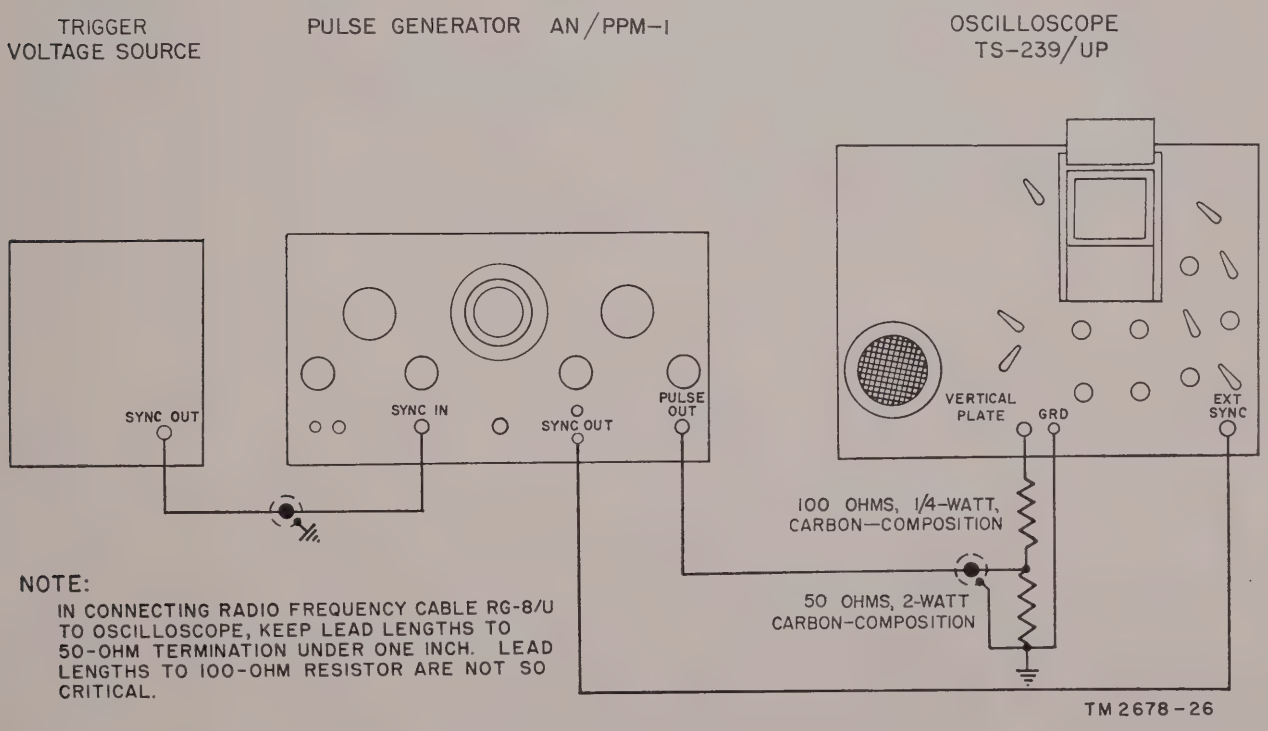


Figure 26. Connections for final test.

generator, will introduce some slight distortion of the output pulse because of the resonances in the internal wiring. Figure 27 shows a 1-μsec pulse from the pulse generator as reproduced on the Oscilloscope TS–239/UP, when connected as shown on figure 26. The slight distortion at the top of the leading edge and bottom of the trailing edge of the pulse should be expected and will not interfere with the normal test and adjustment of the pulse generator.



ONE USEC PULSE FROM AN/PPM-1 AS VIEWED ON TS-239/UP. INTERCONNECTED AS SHOWN ON FIG. 26.

TM 2678-27

Figure 27. Typical distortion of 1-μsec pulse by Oscilloscope TS–239/UP.

66. Test

(fig. 25)

a. Prepare the connecting cable and make connections directly to the deflection plate terminal board of the oscilloscope. Adjust the trigger amplitude on the oscilloscope to the minimum necessary to prevent the trigger pulse from feeding through to the deflection plates.

b. Turn on the pulse generator and, after allowing sufficient time for warm-up, note that pulses which appear on the oscilloscope screen change in length and position as the controls on the pulse generator are varied. Measure the pulse amplitude by setting the ATTENUATION control at 0 and the AMPLITUDE control at 100. Pulses should be approximately 60 volts. The deflection sensitivity of Oscilloscope TS–239/UP is about 110 volts per inch when connected directly to the vertical plate. Check the calibration of the ATTENUATION control by moving it successively to the 50, 40, 30, 20, and 10 settings. Note that adjustment of the AMPLITUDE control varies the output over a 10-db range.

c. Adjust the PULSE POSITION control over its extremes of travel. Note that it controls smoothly the positioning of the pulses on the oscilloscope screen.

d. Connect Frequency Meter FR–67/U to the output of the set. Vary the PULSE RATE dial. Note that the pulse repetition rate on the frequency meter varies accordingly. Set the PULSE RATE dial to any frequency at the low end of the X1 range. Check the dial setting against the actual frequency as read on Frequency Meter FR–67/U. Repeat this check at the middle and upper ends of the X1 range and at three similar points on the X10 range. If the PULSE RATE dial calibration is in agreement with the reading on Frequency Meter FR–67/U within limits of ±10 percent, the internal pulse rate circuits of the pulse generator are operating properly.

e. With the PULSE RATE dial, the PULSE POSITION dial, the AMPLITUDE control, and the ATTENUATION control adjusted to give a normal pulse, vary the PULSE LENGTH dial from its lowest to its highest setting. Note that the pulses as seen on the oscilloscope change in length corresponding to the calibrations on the PULSE LENGTH dial.

f. If the pulse generator meets these tests successfully, it is ready for operation as a primary test instrument.

CHAPTER 6

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

67. Repacking for Shipment or Limited Storage

The exact procedure in repacking for shipment or limited storage depends on the material available and the conditions under which the equipment is to be shipped or stored. Refer to paragraph 13 and reverse the instructions. Whenever practicable, place a dehydrating agent such as silica gel inside the inner wrapping of the packing case. Protect the equipment by moistureproofing the inner wrapper and sealing the seams with waterproof sealing compound or tape. Pack the wrapped equipment in a padded wooden case providing at least 3 inches of excelsior padding or some similar material between the paper barrier and the packing case.

68. Demolition of Materiel

The demolition procedures outlined in paragraph 69 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon order of the commander.

69. Methods of Destruction

a. Smash. Smash the controls, resistors, capacitors, coils, tubes, switches, transformers, and other interior parts, using sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. Cut. Cut cords and wiring, using axes, handaxes, or machetes.

c. Burn. Burn cords, resistors, capacitors, coils, wiring, and technical manuals, using gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend panels, cabinet, and chassis.

e. Explosives. If explosives are necessary, use firearms, grenades, or TNT.

f. Disposal. Bury or scatter the destroyed parts in slit trenches, foxholes, or other holes, or throw them into streams.

g. Destroy everything.

APPENDIX I

REFERENCES

Note. For availability of items listed, check the SR 310–20 series of Special Regulations and Department of the Army Supply Manual SIG 1.

1. Army Regulations

AR 380–5	Safeguarding Security Information.
AR 750–5	Maintenance Responsibilities and Shop Operation.

2. Auxiliary Equipment and Test Equipment

TM 11–303	Test Sets I–56–C, I–56–D, I–56–H, and I–56–J.
TM 11–307	Signal Generators I–72–G, H, J, K, and L.
TM 11–321	Test Set I–56–E.
TM 11–671	Cathode-Ray Tubes and their Associated Circuits.
TM 11–2613	Voltohmmeter I–166.
TM 11–2624B	Voltohmmeters TS–294/U, TS–294B/U, and TS–294C/U.
TM 11–2626	Test Unit I–176, I–176–A, and I–176–B.
TM 11–2627	Tube Tester I–177 and I–177–A.
TM 11–2698	Frequency Meter FR–67/U.
TM 11–4700	Electrical Indicating and Measuring Instruments; Repair Instructions.
TM 11–5527	Multimeter TS–352/U.
AN 16–35TS239–3	Handbook of Operation and Maintenance Instructions for Oscilloscope TS–239/UP.

3. Painting, Preserving, and Lubrication

TB SIG 13	Moistureproofing and Fungiproofing Signal Corps Equipment.
TM 9–2851	Painting Instructions for Field Use.

4. Other Publications

SR 700–45–5	Unsatisfactory Equipment Report (Reports Control Symbol CSGLD–247).
SR 725–405–5	Preparation and Submission of Requisitions for Signal Corps Supplies.
SR 745–45–5 Navy Shipping Guide Article 1850-4. AFR 71–4	Shipment of Supplies and Equipment, Report of Damaged or Improper Shipment.
TB SIG 25	Preventive Maintenance of Power Cords.
TB SIG 66	Winter Maintenance of Signal Equipment.
TB SIG 72	Tropical Maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.
TB SIG 178	Preventive Maintenance Guide for Radio Communication Equipment.
TB SIG 219	Operation of Signal Equipment at Low Temperatures.
TM 11–455	Radio Fundamentals.
TM 11–466	Radar Electronic Fundamentals.
TM 11–661	Electrical Fundamentals (Direct Current).
TM 11–671	Cathode-Ray Tubes and their Associated Circuits.
TM 11–681	Electrical Fundamentals (Alternating Current).
TM 11–4000	Trouble Shooting and Repair of Radio Equipment.

APPENDIX II

IDENTIFICATION TABLE OF PARTS

1. Requisitioning Parts

The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as a specific T/O & E, T/A, SIG 7 & 8, list of allowances of expendable material, or other authorized supply basis. The Department of the Army supply manual applicable to the equipment covered in this manual is SIG 7 & 8 AN/PPM–1. For an index of available supply manuals in the Signal portion of the Department of the Army supply manual, see SIG 1.

2. Identification Table of Parts for Pulse Generator AN/PPM–1

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	PULSE GENERATOR AN/PPM–1: 2 bands, 50 to 5,000 pulses per sec repetition rate; int and ext sync calibrated; .07 to 10 usec pulse wd range ±10% accuracy; sq wave pulse, 500 ohms or less impedance, 50 v, pos and neg; 115 v, 50/60 cyc, 1 ph.	Generates variable width, flat-top pulses with fast rise and decay time.	3F3825.2–1
	TECHNICAL MANUAL: TM 11–2678.		
	CABLE, RF: Radio Frequency Cable RG–58/U; coax; 1 cond; #20 AWG; 53.5 ohms nom impedance.	Cable for Cord CG–999/U	IF425–58
	FLANGE, waveguide: Radio Frequency Coupling UG–117/U; choke fl end for K band.	For Cord CG–999/U	2Z7390–117
	PULSE GENERATOR SG–69/PPM–1: 2 bands, 50 to 5,000 pulses per sec repetition rate; int and ext sync; .07 to 10 sec pulse wd range ±10% accuracy; sq wave pulse, 50 ohms or less impedance, 50 v, pos and neg, .07 to 10 sec pulse wd; ac, 115 v, 50/60 cyc per sec, 1 ph; portable type.	Provides variable repetition rate, variable length pulses for testing radar circuitry.	3F3825.4
AT1	ATTENUATOR, variable: resistive type, pie pad, comp resistors; 0 to 50 db range; 2¾″ dia x 3¼″ d approx o/a; Hewlett-Packard part #212A–19B.	Provides attenuation of the main pulse.	2Z395.103
A116	BLADE, fan: cooling fan for rear deck electron tubes; 4 bladed fan; 5½″ x $^{23}/_{32}$″ d o/a; Torrington part #0–5527–5.	Cooling fan for rear deck electron tubes.	3H370.1–20
	CABLE, power: UL type SJ; 2 #18 AWG stranded cond; 300 v.	Provides connection to external source of power.	1B3018–2.28
C126, C133	CAPACITOR, fixed: mica dielectric; 20 μμf ±5%; 500 vdcw; JAN type CM20C200J.	C126: V107A plate coupling. C133: V107A grid bypass.	3K2020032
C127	CAPACITOR, fixed: mica dielectric; 24 μμf ±5%; 500 vdcw; JAN type CM20C240J.	V107A grid coupling	3K2024032

2. Identification Table of Parts for Pulse Generator AN/PPM-1—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C9	CAPACITOR, fixed: mica dielectric; 30 μμf ±5%; 500 vdcw; JAN type CM20C300J.	Grid of V101A differentiating	3K2030032
C113	CAPACITOR, fixed: mica dielectric; 39 μμf ±5%; 500 vdcw; JAN type CM20C390J.	V104A grid coupling	3K2039032
C103, C118, C120.	CAPACITOR, fixed: mica dielectric; 51 μμf ±5%; 500 vdcw; JAN type CM25D510J.	C103: V101 cathode coupling C118: V104B plate coupling. C120: V105A plate coupling.	3K2551042
C117	CAPACITOR, fixed: mica dielectric; 82 μμf ±5%; 500 vdcw; JAN type CM25D820J.	V104A plate coupling	3K2582042
C7, C8, C28, C114.	CAPACITOR, fixed: mica dielectric; 200 μμf ±5%; 500 vdcw; JAN type CM20D201J.	C7, C8: V6 grid feed back capacitor C28: Compensation network capacitor. C114: V104A grid coupling.	3K2020142
C105, C115, C123, C132, C135 through C138.	CAPACITOR, fixed: mica dielectric; 240 μμf ±5%; 500 vdcw; JAN type CM20D241J.	C105: Plate circuit of V102A differentiator. C115: Plate circuit of V104A rate determining. C123: Plate circuit of V106A differentiator. C135 through C138: Delay line DL101 pulse delay network.	3K2024142
C102, C110, C112.	CAPACITOR, fixed: mica dielectric; 680 μμf ±5%; 500 vdcw; JAN type CM30D681J.	C102: V101A plate coupling C110: SYNC EN coupling. C112: V103A plate coupling.	3K3068142
C23, C121	CAPACITOR, fixed: mica dielectric; 1,000 μμf ±5%; 500 vdcw; JAN type CM30D102J.	C23: V6 cathode coupling C121: V105A plate coupling.	3K3010242
C20, C24	CAPACITOR, fixed: mica dielectric; 2,000 μμf ±5%; 500 vdcw; JAN type CM30D202J.	C20: +290-volt d-c bypass network C24: V16 de-ionization network.	3K3020242
C106, C131	CAPACITOR, fixed; mica dielectric; 5,100 μμf ±5%; 500 vdcw; JAN type CM35D512J.	C106: CR101 d-c blocking C131: V104A grid coupling.	3K3551242
C104, C122, C124, C125, C130, C21.	CAPACITOR, fixed: paper dielectric; 10,000 μμf ±10%; 600 vdcw; 1 1/16" lg x 7/16" dia; Aerovox type #P688.	C104: V101B plate coupling C122: V105B plate coupling. C124: V107B cathode coupling. C125: V109B cathode coupling. C130: V108A plate coupling. C21: +290-volt d-c bypass network.	3DA10–593.
C116	CAPACITOR, fixed: paper dielectric; 20,000 μμf −10% +30%; 600 vdcw; 1½" lg x ½" dia; Aerovox type #684.	V104A rate determining	3DA20–13.1.
C108	CAPACITOR, fixed: paper dielectric; 50,000 μμf −10% +30%; 600 vdcw; 1 5/8" lg x 17/32" dia o/a excluding term.; Aerovox type #688.	V102B plate bypass	3DA50–484.
C12, C25, C109	CAPACITOR, fixed: paper dielectric; 100,000 μμf ±10%; 600 vdcw; 2" lg x 21/32" dia o/a excluding term.; Aerovox type #P688.	C12: V9 grid coupling C25: +290-volt d-c network capacitor. C109: SYNC OUT coupling.	3DA100–1121.
C26	CAPACITOR, fixed: paper dielectric; 220,000 μμf ±20%; 400 vdcw; 2" lg x 21/32" dia; Aerovox type #P488.	+290-volts d-c filter network capacitor.	3DA22–16.

2. Identification Table of Parts for Pulse Generator AN/PPM–1—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C3, C10, C17 through C19, C107, C111, C119, C134.	CAPACITOR, fixed: paper dielectric; 250,000 μμf ±20%; 200 vdcw; 1⅛″ lg x 17/32″ dia; Sprague type #68P.	C3: V2 grid bias capacitor C10: V10A cathode bypass. C17: V15 cathode bypass. C18: V15 grid blocking. C19: Relay coil bypass. C107: Bypass. C111: V103A cathode bypass. C119: Bypass. C134: Bypass.	3DA250–618.
C27	CAPACITOR, fixed: paper dielectric; 250,000 μμf ±20%; 600 vdcw; 2″ lg x ⅝″ dia o/a excluding term.; Sprague type #68P.	High-voltage filter	3DA250–617.
C30	CAPACITOR, fixed: paper dielectric; 1 sect.; .1 μf ±20%; 400 vdcw; JAN type CPA1EF104M.	Bypass capacitor	3DA100–720.
C1, C2, C4, C16.	CAPACITOR, fixed: paper dielectric; 4 μf ±10%; 600 vdcw; 4½″ lg x 1½″ dia; Girard-Hopkins part #T64.	High-voltage filter capacitors	3DB4–397.
C13	CAPACITOR, fixed: paper dielectric; 8 μf ±20%; 600 vdcw; 4¼″ lg x 2″ wd x 1⅜″ thk; Girard-Hopkins type #P6–8.	V11 output coupling	3DB8–232.
C101	CAPACITOR, fixed: electrolytic; 10 μf; 450 vdcw; 1¾″ lg x 13/16″ dia; Mallory part #TC72.	Filter capacitor	3DB10–273.
C5, C14, C15, C29.	CAPACITOR, fixed: electrolytic; 40 μf; 450 vdcw; 3″ lg x 1″ dia; Aerovox type #AF8J.	C5, C14, C15: Filter capacitors C29: Filter network capacitor.	3DB40–90.
C128	CAPACITOR, variable: air dielectric: plate meshing type; 102.7 μμf max, 7.5 μμf min; 17/32″ lg x 15/16″ wd x 1 25/32″ h o/a excluding shaft bushing; Sarkes Tarzian part #0–103L.	Maximum pulse length adjustment	3D9102VE7–1.
C11, C22	CAPACITOR, variable: ceramic dielectric; rotary type, 1 sect., 500 μμf per μf per deg C temp coef; 4 to 30 μμf ea sect.; 500 vdcw; JAN type CV11C300.	V11 variable output coupling	3D9030V–20.
L6, L7	COIL, RF: choke designed for rf above 10 mc; 1½″ lg x 1″ dia; Mallory part #RF581.	L6: Isolates filament of V6 from transformer T2. L7: Isolation choke.	3C1084Z109.
	CONNECTOR, plug: 2 male flat prong cont; straight type; 15/32″ lg x 1 17/32″ dia; 9/16″ dia max cable opening; Hubbell part #7057.	Terminates power cable W1	6Z1727.
J103	CONNECTOR, receptacle: Radio Frequency Receptacle UG–58A/U; 1 round female; straight type.	PULSE OUT connector	2Z7390–58A.
J101, J102	CONNECTOR, receptacle: receptacle connector UG–625A/U; 1 round female cont.	J101: SYNC IN connector J102: SYNC OUT connector.	2Z3062–188.
CR101 through CR106.	CRYSTAL UNIT, rectifying: germanium type; JAN type IN70.	CR101, CR102, CR106: Cathode clipper crystals. CR103, CR105: Grid return crystals. CR104: Isolation crystal.	2J1N70.
F1	FUSE, cartridge: 4 amp; MIL type F02G4R00A.	Overload protector for pulse generator.	3Z2604.12.

2. Identification Table of Parts for Pulse Generator AN/PPM–1—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
XF1	FUSEHOLDER: extractor post type; accom 1 fuse cartridge type; 1¼″ lg x ¼″ dia o/a; Littelfuse catalog No. 342001.	Holder for fuse F1	3Z3275–1.
H102 through H104.	KNOB: round knurled; black; 1½″ dia x ¾″ thk o/a; white line marking; Kurz-Kasch part #S–380–DD–L–522.	Knobs for SYNC SELECTOR, AMPLITUDE, and POLARITY.	2Z5822–651.
H101	KNOB: round knurled; black; 1½″ dia x ¾″ thk; Hewlett-Packard stock #212A–74A.	Pulse position knob	2Z5822–706.
H105, H106	KNOB: round knurled; black; 2″ dia x ¾″ thk o/a; Kurz-Kasch stock #S–311–64–DD–522–L.	Knobs for PULSE RATE and ATTENUATION.	2Z5822–708.
H107	KNOB: round knurled; black; 3″ dia x ⅞″ thk o/a; Hewlett-Packard stock #212A–74.	PULSE LENGTH knob	2Z5822–707.
B101	MOTOR, AC: shaded pole induction type; 1/250 hp 1550 rpm; 110 v, 60 cyc, 1 ph; 3⅛″ lg excluding shaft x 2″ wd x 1¾″ d, 11/64″ dia shaft extending ¾″ from frame; W W Grainger, Inc part #3K926.	Motor for rotating fan A 116	3H3000–198.
DL101	NETWORK, pulse delay: delays main pulse 0 to 100 μsec w/respect to SYNC OUT pulse; 3⅜″ lg x 2½″ wd incl mtg feet x 1⅝″ h o/a; Hewlett-Packard stock #212A–60C.	Delays pulse initiation trigger for 2 microseconds.	2Z6840–176.
L3	REACTOR: 60 mh, 100 ma dc; 175 ohms dc; ⅝″ lg x 1⅛″ dia; Miller JW part #693.	Isolation choke	3C573D–1.
L2	REACTOR: 1.2 hy, 50 ma dc; 70 ohms dc; open metal frame; 1 11/16″ lg x 1 7/16″ wd x 1 13/16″ h o/a; Hewlett-Packard part #911–24.	Charging choke	3C557Z10.
L5	REACTOR: 6 hy, 125 ma dc; 240 ohms dc; metal case, half shells on ea side of core; 2⅞″ lg x 2 3/16″ wd x 2⅞″ h; Hadley part #8169–A.	Filter choke	3C323–9R.
L1, L4	REACTOR: 6 hy, 125 ma dc; 240 ohms dc; metal open frame; 3¾″ lg x 2″ wd x 2¼″ h; Hadley part #8186D.	Filter chokes	3C557Z11.
CR1 through CR4.	RECTIFIER, metallic: selenium; 130 v rms; 120 to 150 v dc depending on shunt capacitance, 65 ma max cur, half-wave rectification; 1″ lg x 1″ wd x ¾″ h; Federal Tele & Rad part #402D 3452–A.	Bias rectifiers	3H4860–103.
REL1	RELAY, armature: mercury type; DPDT; universal wnd; 1½″ wd x 1⅝″ lg x 1⅞″ h o/a incl housing; Allied Cont type #B0–D–6–35.	Protective relay	2Z7588–83.
R43	RESISTOR, fixed: comp; 1 ohm ±10%; ½ w; .375″ lg x .140″ dia; Hewlett-Packard part #212A–67C.	Bypass network resistor	3Z5991–129.
R42	RESISTOR, fixed: comp; 12 ohms ±10%; ½ w; JAN type RC20VF120K.	Bypass network resistor	3RC20BF120K.
R21	RESISTOR, fixed: film; 20 ohms ±1%; 5 w; 2″ lg x ½″ dia; Concarbon part #X–5.	V11 output load	3Z6002–87.

2. Identification Table of Parts for Pulse Generator AN/PPM-1—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R41	RESISTOR, fixed: comp; 33 ohms ±10%; 1 w; JAN type RC30BF330K.	Voltage-dropping resistor for pilot light I 1.	3RC30BF330K.
R20	RESISTOR, fixed: comp; 47 ohms ±10%; 2 w; JAN type RC42BF470K.	V9 clipping resistor	3RC42BF470K.
R22	RESISTOR, fixed: ww; 50 ohms ±3%; 10 w; JAN type RW33G500.	V11 output load resistor	3RW16548.
R26	RESISTOR, fixed: ww; 50 ohms ±10%; 10 w; Lectrohm type #1¾E.	Fan circuit resistor	3Z6005–21.
R61 through R64.	RESISTOR, fixed: film; 96.25 ohms ±1%; ½ w; ⅝″ lg x .255″ dia; Wilkor type CP–½.	Attenuation resistors	3Z6009F6–3.
R70	RESISTOR, fixed: film; 96.25 ohms ±1%; 1 w; ⅞″ lg x 5/16″ dia; Wilkor type CP–1.	Attenuation resistor	3Z6009F6–2.
R30	RESISTOR, fixed: comp; 100 ohms ±1%; 1 w; .562″ lg x .225″ dia; Concarbon type X–1.	Slope compensation resistor	3Z6010–215.
R47, R48	RESISTOR, fixed: comp; 100 ohms ±10%; 2 w; JAN type RC42BF101K.	Clipping resistors	3RC42BF101K.
R68, R69	RESISTOR, fixed: film; 142.3 ohms ±1%; 1 w; ⅞″ lg x 5/16″ dia; Wilkor type CP–1.	Attenuation resistors	3Z6014B2–3.
R146	RESISTOR, fixed: comp; 220 ohms ±10%; 1 w; JAN type RC30BF221K.	V108A minimum cathode resistor	3RC30BF221K.
R10	RESISTOR, fixed: comp; 270 ohms ±1%; 2 w; .688″ lg x .312″ dia; Wilkor type CP–2.	Thyratron de-ionization network resistor.	3Z6027–35.
R65, R66, R67	RESISTOR, fixed: film; 288.7 ohms ±1%; 1 w; 15/16″ lg x 5/16″ dia; Wilkor type CP–1.	Attenuation resistors	3Z6028H8–1.
R27, R49, R114	RESISTOR, fixed: comp; 330 ohms ±10%; 1 w; JAN type RC30BF331K.	R27: Filament voltage compensation resistor. R49: +290-volt d-c filter network resistor. R114: SYNC OUT termination resistor.	3RC30BF331K.
R44 through R46.	RESISTOR, fixed: comp; 330 ohms ±10%; 2 w; JAN type RC42BF331K.	Clipping resistors	3RC42BF331K.
R112, R113	RESISTOR, fixed: comp; 390 ohms ±10%; 1 w; JAN type RC30BF391K.	R112: V102B cathode load R113: V102B plate load.	3RC30BF391K.
R16	RESISTOR, fixed: comp; 470 ohms ±10%; 1 w; JAN type RC30BF471K.	V10A differentiator network	3RC30BF471K.
R7	RESISTOR, fixed: comp; 470 ohms ±10%; 2 w; JAN type RC42BF471K.	Filter network resistor	3RC42BF471K.
R50	RESISTOR, fixed: comp; 560 ohms ±10%; 1 w; JAN type RC30BF561K.	Compensation network resistor	3RC30BF561K.
R133	RESISTOR, fixed: comp; 680 ohms ±10%; ½ w; JAN type RC20BF681K.	V105B grid minimum positive resistor.	3RC20BF681K.
R149	RESISTOR, fixed: comp; 1000 ohms ±10%; 1 w; JAN type RC30BF102K.	V108B cathode resistor	3RC30BF102K.
R150	RESISTOR, fixed: comp; 1200 ohms ±10%; 1 w; JAN type RC30BF122K.	V109A grid return	3RC30BF122K.
R13	RESISTOR, fixed: ww; 1250 ohms ±10%; 10 w; JAN type RW29G122.	V6 pulse forming resistor	3RW24930.
R14, R116	RESISTOR, fixed: comp; 1500 ohms ±10%; 1 w; JAN type RC30BF152K.	R14: V10A cathode bias R116: V103A cathode bias.	3RC30BF152K.
R103, R131, R148.	RESISTOR, fixed: comp; 2200 ohms ±10%; 1 w; JAN type RC30BF222K.	R103: V101 cathode bias R131: V105 cathode bias. R148: V108B plate load.	3RC30BF222K.

2. Identification Table of Parts for Pulse Generator AN/PPM–1—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R109	RESISTOR, fixed: comp; 2700 ohms ±10%; 1 w; JAN type RC30BF272K.	Bias voltage divider	3RC30BF272K.
R136	RESISTOR, fixed: ww; 3000 ohms ±10%; 10 w; 1¾″ lg x 5/16″ OD x 3/16″ ID; Lectrohm type #1¾E.	V106A plate load	3Z5430.8.
R106, R137	RESISTOR, fixed: comp; 3300 ohms ±10%; 1 w; JAN type RC30BF332K.	R106: V102A plate load R137: V106B grid return.	3RC30BF332K.
R2	RESISTOR, fixed: comp; 3900 ohms ±10%; 1 w; JAN type RC30BF392K.	V2 grid return	3RC30BF392K.
R3	RESISTOR, fixed: ww; 4000 ohms ±10%; 20 w; 2″ lg x ½″ dia; Lectrohm type 2R.	Filter network resistor	3Z6400–132.
R119	RESISTOR, fixed: comp; 5600 ohms ±10%; 1 w; JAN type RC30BF562K.	V103B plate load	3RC30BF562K.
R154	RESISTOR, fixed: comp; 6800 ohms ±10%; 2 w; JAN type RC42BF682K.	Bias voltage-dropping resistor	3RC42BF682K.
R108	RESISTOR, fixed: comp; 8200 ohms ±10%; ½ w; JAN type RC20BF822K.	Part of differentiator network at plate of V102A.	3RC20BF822K.
R52	RESISTOR, fixed: comp; 10,000 ohms ±10%; ½ w; JAN type RC20BF103K.	Compensation resistor	3RC20BF103K.
R111, R15, R138, R139.	RESISTOR, fixed: comp; 10,000 ohms ±10%; 1 w; JAN type RC30BF103K.	R111: V102B grid return R15: V10A plate load. R138: V107B cathode load. R139: V109B cathode load.	3RC30BF103K.
R11, R12, R29	RESISTOR, fixed: comp; 15,000 ohms ±10%; 1 w; JAN type RC30BF153K.	R11, R12: V6 grid leak R29: V15 cathode bias.	3RC30BF153K.
R134	RESISTOR, fixed: ww; 15,000 ohms ±10%; 10 w; 1¾″ lg x 5/16″ OD x 3/16″ ID; Lectrohm type #1¾E.	V105B plate load resistor	C3Z6615–100.
R102, R128	RESISTOR, fixed: comp; 18,000 ohms ±10%; ½ w power dissipation; JAN type RC20BF183K.	R102: V101B grid leak R108: V104B plate load.	3RC20BF183K.
R38	RESISTOR, fixed: ww; 25,000 ohms ±10%; 10 w; Lectrohm type 1¾E.	Bleeder network resistor	3Z6625–35.
R156	RESISTOR, fixed: comp; 27,000 ohms ±10%; ½ w; JAN type RC20BF273K.	Voltage divider	3RC20BF273K.
R40, R130	RESISTOR, fixed: comp; 27,000 ohms ±10%; 1 w; JAN type RC30BF273K.	R40: V16 grid return R130: V105A plate load.	3RC30BF273K.
R104, R105	RESISTOR, fixed: comp; 27,000 ohms ±10%; 2 w; JAN type RC42BF273K.	V101B plate load	3RC42BF273K.
R28	RESISTOR, fixed: ww; 30,000 ohms ±10%; 10 w; 1¾″ lg x 5/16″ OD x 3/16″ ID; Lectrohm type #1¾E.	V8 cathode resistor	3Z6630–45.
R53 through R60.	RESISTOR, fixed: film; 33,000 ohms ±10%; ½ w; 5/8″ lg x .255″ dia; Wilcor type CP–½.	Attenuation resistors	3Z6633–47.
R101, R141, R145, R23.	RESISTOR, fixed: comp; 33,000 ohms ±10%; 1 w; JAN type RC30BF333K.	R101: V101A plate load R141: V107A plate load. R145: V108A plate load. R23: Bleeder resistor.	3RC30BF333K.
R51	RESISTOR, fixed: comp; 39,000 ohms ±1%; 1 w; .562″ x .225″ dia; Wilcor type #CP–1.	Compensation coupling resistor	3Z6639–32.
R117, R129	RESISTOR, fixed: comp; 47,000 ohms ±10%; ½ w; JAN type RC20BF473K.	R117: V103A plate load R129: V105A grid differentiating resistor.	3RC20BF473K.
R147	RESISTOR, fixed: comp; 56,000 ohms ±10%; 1 w; JAN type RC30BF563K.	V108B grid leak	3RC30BF563K.

2. Identification Table of Parts for Pulse Generator AN/PPM-1—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R155	RESISTOR, fixed: comp; 75,000 ohms ±5%; ½ w; JAN type RC20BF753J.	Voltage divider	3RC20BF753J.
R5, R6, R24, R25, R34.	RESISTOR, fixed: comp; 100,000 ohms ±10%; 1 w; JAN type RC30BF104K.	R5, R34: Voltage divider resistors R6: V11 grid return. R24, R25: Bleeder resistors.	3RC30BF104K.
R122, R123	RESISTOR, fixed: comp; 100,000 ohms ±10%; 2w; JAN type RC42BF104K.	V104A plate load	3RC42BF104K.
R39	RESISTOR, fixed: comp; 120,000 ohms ±10%; 1 w; JAN type RC30BF124K.	Voltage divider resistor	3RC30BF124K.
R140	RESISTOR, fixed: comp; 150,000 ohms ±10%; 1 w; JAN type RC30BF154K.	V107A grid leak	3RC30BF154K.
R151 through R153.	RESISTOR, fixed: comp; 220,000 ohms ±10%; 1 w; JAN type RC30BF224K.	Crystal limiting resistors	3RC30BF224K.
R107, R118, R135.	RESISTOR, fixed: comp; 270,000 ohms ±10%; ½ w; JAN type RC20BF274K.	R107: V102A grid return R118: V103B grid return. R135: V106A grid return.	3RC20BF274K.
R37, R120, R127.	RESISTOR, fixed: comp; 270,000 ohms ±10%; 1 w; JAN type RC30BF274K.	R37: +290-volt d-c voltage divider network. R120: V104A grid leak. R127: V107A grid return.	3RC30BF274K
R32	RESISTOR, fixed: comp; 330,000 ohms ±10%; 1 w; JAN type RC30BF334K.	Voltage divider resistor	3RC30BF334K
R9, R115	RESISTOR, fixed: comp; 470,000 ohms ±10%; 1 w; JAN type RC30BF474K.	R115: V103A grid leak R9: High-voltage supply bleeder.	3RC30BF474K.
R19, R31	RESISTOR, fixed: comp; 1 meg ±10%; 1 w; JAN type RC30BF105K.	R19: V15 plate load R31: V10B plate load.	3RC30BF105K.
R126	RESISTOR, fixed: comp; 2.2 meg ±10%; 1 w; JAN type RC30BF225K.	V107A grid return	3RC30BF225K.
R144	RESISTOR, fixed: film; 3.28 meg ±1% w; ⅞″ lg x .325″ dia; Wilcor type CP–1.	V108A grid leak	3Z6803B2.
R143	RESISTOR, variable: comp; 500 ohms ±10%; ¾ w; 1⅛″ dia x 9/16″ d; Central lab part #BA33–010–1466.	Minimum pulse length adjusting variable resistor.	3Z7250–89.
R110	RESISTOR, variable: comp; 2500 ohms ±10%; ¼ w; JAN type RV2ATSD252A.	Bias voltage divider	3RV32523.
R142	RESISTOR, variable: comp; 20,000 ohms ±10%; 2 w; 1 1/16″ dia x 9/16″ d; AB part #JA2031.	Minimum pulse length adjusting variable resistor.	3Z7420–125.
R4	RESISTOR, variable: comp; 2 sect.; 20,000 ohm-per sect. ±20%; 1 w; 1⅜″ dia x 1 1/16″ d; Hewlett-Packard part #210–68.	Output bias control	3Z7420–126.
R33	RESISTOR, variable: comp; 50,000 ohms ±10%; 2 w; JAN type RV4ATSD503A.	Regulator voltage adjustment	3RV45041.
R132	RESISTOR, variable: comp; 2 sect, 100,000 ohms front sect., 100 ohms rear sect., 20% tol per sect.; 1⅛″ dia x 1⅛″ d; Hewlett-Packard part #210–74.	Pulse position variable resistor	3Z7480–217.
R121	RESISTOR, variable: comp; 200,000 ohms ±20%; ¼ w; 1⅛″ dia x 9/16″ d; Clarostat type #37.	Pulse rate adjusting resistor	3Z7498–20.36.
R35	RESISTOR, variable: comp; 250,000 ohms ±10%; 2 w; JAN type RV4ATSD254A.	Voltage divider resistor	3RV52540.
R124	RESISTOR, variable: 500,000 ohms ±10%; comp; 1 w; JAN type RV4ATSD504A.	Pulse rate adjusting resistor	3RV55054.

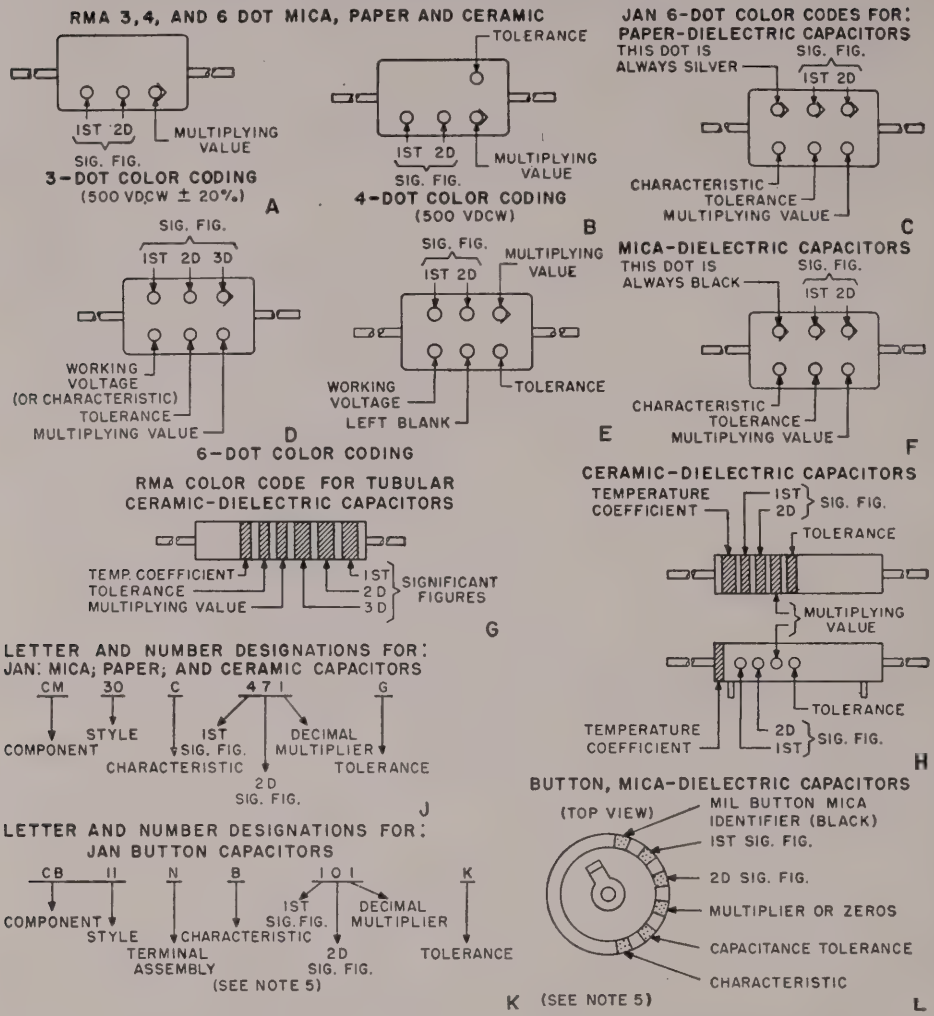
2. Identification Table of Parts for Pulse Generator AN/PPM-1—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R125	RESISTOR, variable: comp; 3.5 meg ±10%; 2 w; JAN type RV4ATSD355E.	Pulse rate variable resistor	3RV63504.
E2, E3	SHIELD, electron tube: cylindrical; 3″ lg x 1½″ dia x 1/16″ thk; Hewlett-Packard part #212A–6A.	Tube shields	2Z8304.319.
	SOCKET, electron tube: 7 cont miniature; JAN type TS102P01.	Tube socket	2Z8677.94.
	SOCKET, electron tube: 8 cont octal; JAN type TS101P02.	Tube socket	2Z8678.326.
	SOCKET, electron tube: 4 pin; amphenol type #RSS–4.	Tube socket	2Z8762.1.
S2	SWITCH, rotary: DPDT; 23/32″ lg x 1¾″ wd x 2″ d; mts by ⅜″ lg x ⅜″–32 thd bushing; Oak part #43054–H1.	Polarity switch	3Z9825–62.705.
S102	SWITCH, rotary: 4 pole 12 throw; 23/32″ lg 1¾″ wd x 2″ d; Oak #43057–H1.	SYNC SELECTOR switch	3Z9825–62.704.
S3	SWITCH, rotary: 2 sect.; 6 pole 6 throw; 3 5/16″ lg x 1½″ wd x 1⅞″ h; mts by ⅜″ lg x ⅜″–32 thd bushing; Oak park #43056–H2.	ATTENUATION switch	3Z9825–62.706.
S1	SWITCH, toggle: SPST; JAN type ST42A.	POWER ON switch	3Z9863–42A.
S101	SWITCH, toggle: DPDT; JAN type ST52P.	SYNC OUT polarity switch	3Z9863–52P.
T2	TRANSFORMER, power: step-down; input 115/230 v ac, 60 cyc single ph; 7 output wdg #1 thru #5 secd 6.3 v, #6 secd 5.0 v, #7 secd 6.3 v, #1 secd 8.75 amp, #2 secd .5 amp, #3 secd .6 amp, #4 secd 2.5 amp, #5 secd 3.4 amp, #6 secd 2.0 amp, #7 secd 2.45 amp; 3¾″ lg x 3⅜″ wd x 4½″ h; Hadley part #9293.	Filament transformer	2Z9621–466.
T1	TRANSFORMER, power: step-up; input 115/230 v ac, 60 cyc single ph; 2 output wdg, #1 secd 410 v, #2 secd 400 v, #1 secd 250 ma, #2 secd 50 ma, #1 #2 secd ct; 3¾″ lg x 4 5/16″ wd x 4½″ h; Hadley part #6819.	Power transformer	2Z9621–465.
T101	TRANSFORMER, pulse: blocking osc type; pri wdg 300 v peak voltage .5 amp peak cur, secd wdg 1 wdg 300 v ea wdg, no cur rating; 1″ lg x 1 1/16″ d x 1½″ h; Hewlett-Packard #212A–60B.	Blocking oscillator transformer	2Z9627–201.
T102, T103	TRANSFORMER, pulse: blocking osc type; pri 300 v peak voltage, .5 amp peak cur, secd wdg 2 wdg 300 v 600 v peak voltage for secd tertiary respectively, no cur rating for either wdg; 1″ lg x 1 1/16″ d x 1½″ h excluding term.; Hewlett-Packard part #2–2A–60A.	Blocking oscillator transformers	2Z9627–200.
V4, V14	TUBE, electron: JAN type 0B2	Bias voltage regulators	2J0B2.
V12	TUBE, electron: JAN type 0D3	Bias voltage regulator	2J0D3
V6, V16	TUBE, electron: JAN type 3C45	V6: Pulse forming thyratron V16: Pulse termination thyratron.	2J3C45.
V13	TUBE, electron: JAN type 5R4WGY	High-voltage rectifier	2J5R4WGY.
V11, V17	TUBE, electron: JAN type 6AS7G	V11: Output tube V17: Voltage regulator tube.	2J6AS7G.
V15	TUBE, electron: JAN type 6AU6	Voltage regulator amplifier tube	2J6AU6.

2. Identification Table of Parts for Pulse Generator AN/PPM-1—Continued

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
V7 through V9	TUBE, electron: JAN type 2J6J6	V7, V9: Clipping diodes V8: Thyratron diode.	2J6J6.
V2	TUBE, electron: JAN type 6L6GA	Charging diode	2J6L6GA.
V3	TUBE, electron: diode; RMA type 6W4GT.	Damping diode	2J6W4GT.
V1	TUBE, electron: JAN type 6X4W	High-voltage rectifier	2J6X4W.
V101, V102A, V102B, V103A, V103B, V104, V105, V106A, V106B, V107A, V107B, V108, V109A, V109B.	TUBE, electron: JAN type 12AU7	V101: Delay multivibrator tube V102A, V106A, V107A: Isolation amplifiers. V102B: Sync out blocking oscillator. V103A: Sync in amplifier. V103B: Sync in inverter. V104: Pulse rate multivibrator. V105: Pulse position multivibrator. V106B, V109A: Thyratron trigger blocking oscillator. V107B, V109B: Cathode-follower. V108: Pulse length multivibrator. V109A, V109B: Thyratron trigger blocking oscillator and cathode follower.	2J12AU7.
V10A, V10A	TUBE, electron: JAN type 12AX7	V10A: Feedthrough compensation tube. V10B: Voltage regulator amplifier tube.	2J12AX7.

CAPACITOR COLOR AND LETTER CODES



- STANDARDS -					JAN MICA-CM		JAN PAPER-CM		JAN CERAMIC-CC					
										CAP. TOL. FOR MORE THAN 10 UUF		CAP. TOL. FOR 10 UUF OR LESS		
COLOR	SIG. FIG.	DECIMAL MULTIPLIER	% TOL.	VDCW	LETTER TOL.	CHARAC-TERISTIC	LETTER TOL.	CHARAC-TERISTIC	DEC. MULT.	%	LETTER DESIG-NATION	UUF	LETTER DESIG-NATION	CHARAC-TERISTIC
BLACK	0	1	±20	500	M	A	M	A	1	±20	M	±2.0	G	C
BROWN	1	10	± 1	100	-	B	-	E	10	± 1	F	-	-	H
RED	2	100	± 2	200	G	C	-	H	100	± 2	G	-	-	L
ORANGE	3	1,000	± 3	300	-	D	N*	J	1,000	-	-	-	-	P
YELLOW	4	10,000	± 4	400	-	E	-	P	-	-	-	-	-	R
GREEN	5	100,000	± 5	500	-	F	-	R	-	± 5	J	±0.5	D	S
BLUE	6	1,000,000	± 6	600	-	G	-	S	-	-	-	-	-	T
VIOLET	7	10,000,000	± 7	700	-	-	-	T	-	-	-	-	-	U
GRAY	8	100,000,000	± 8	800	-	-	-	-	0.01	-	-	±0.25	C	B
WHITE	9	1,000,000,000	± 9	900	-	-	-	-	0.1	± 10	K	±1.0	F	SL
GOLD	-	0.1	± 5	1,000	J	-	-	-	-	-	-	-	-	A
SILVER	-	0.01	±10	2,000	K	-	K	-	-	-	-	-	-	-
NO COLOR	-	-	±20	500	-	-	-	-	-	-	-	-	-	-
* THE TOLERANCE OF THIS CAPACITOR IS ±30%, NOT ±3%														

NOTES

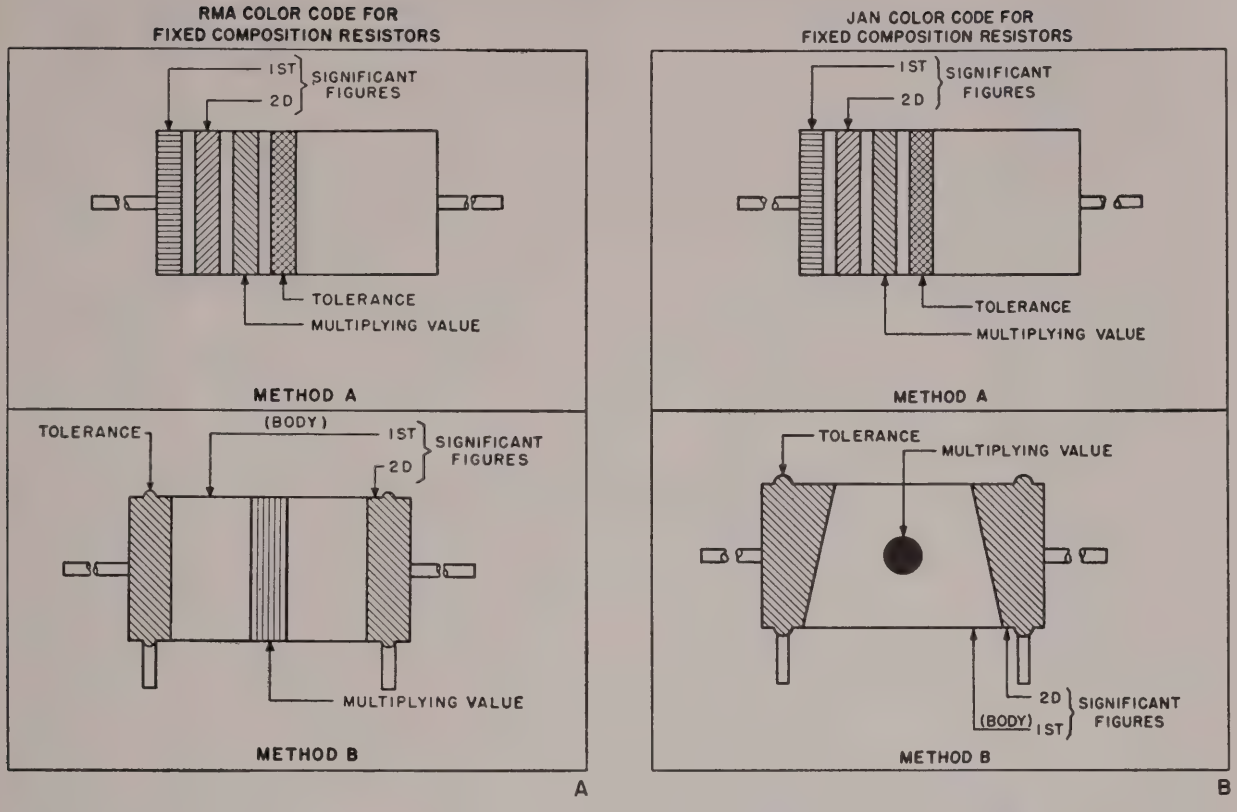
JAN: JOINT ARMY-NAVY
RMA: RADIO MANUFACTURERS ASSOCIATION

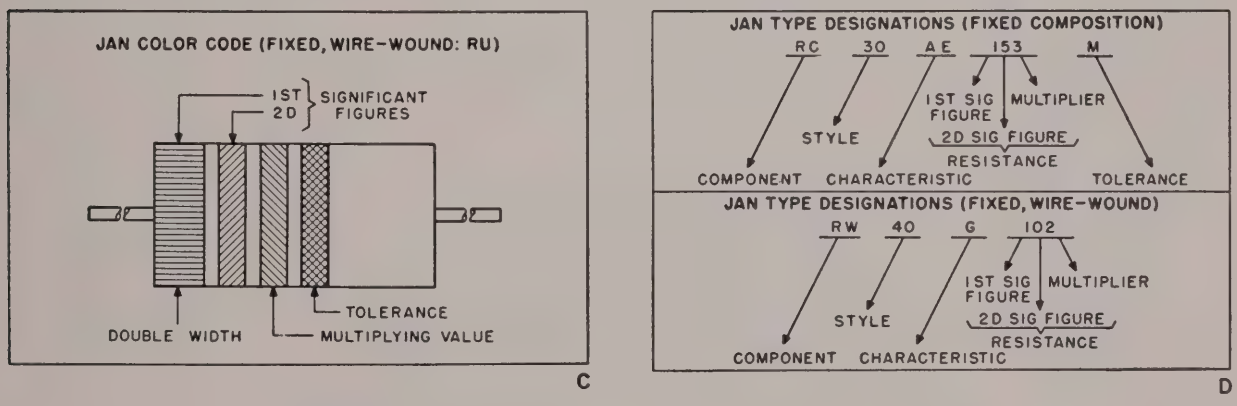
1. THESE COLOR AND LETTER CODES GIVE CAPACITANCES IN MICROMICROFARADS
2. THIS TABLE IS ADAPTED FOR JAN AND RMA COLOR AND JAN LETTER TYPE DESIGNATIONS
3. CERAMIC AND MICA CAPACITORS, BOTH JAN AND RMA, ARE GENERALLY 500 VDCW
4. BUTTON CAPACITORS ARE GENERALLY 300 VDCW
5. READ BUTTON CAPACITOR TOLERANCE UNDER CERAMICS OF MORE THAN 10 UUF
6. CHARACTERISTICS ARE AVAILABLE IN JAN CAPACITOR SPECIFICATION MANUALS
7. THE COMPONENTS USED ABOVE FOR JAN LETTER TYPE DESIGNATIONS ARE:
   CB MICA BUTTON; *CC* CERAMIC; *CM* MICA MOULDED; *CN* PAPER MOULDED

TM CC

Figure 28. Capacitor color and letter codes.

RESISTOR COLOR AND LETTER CODE





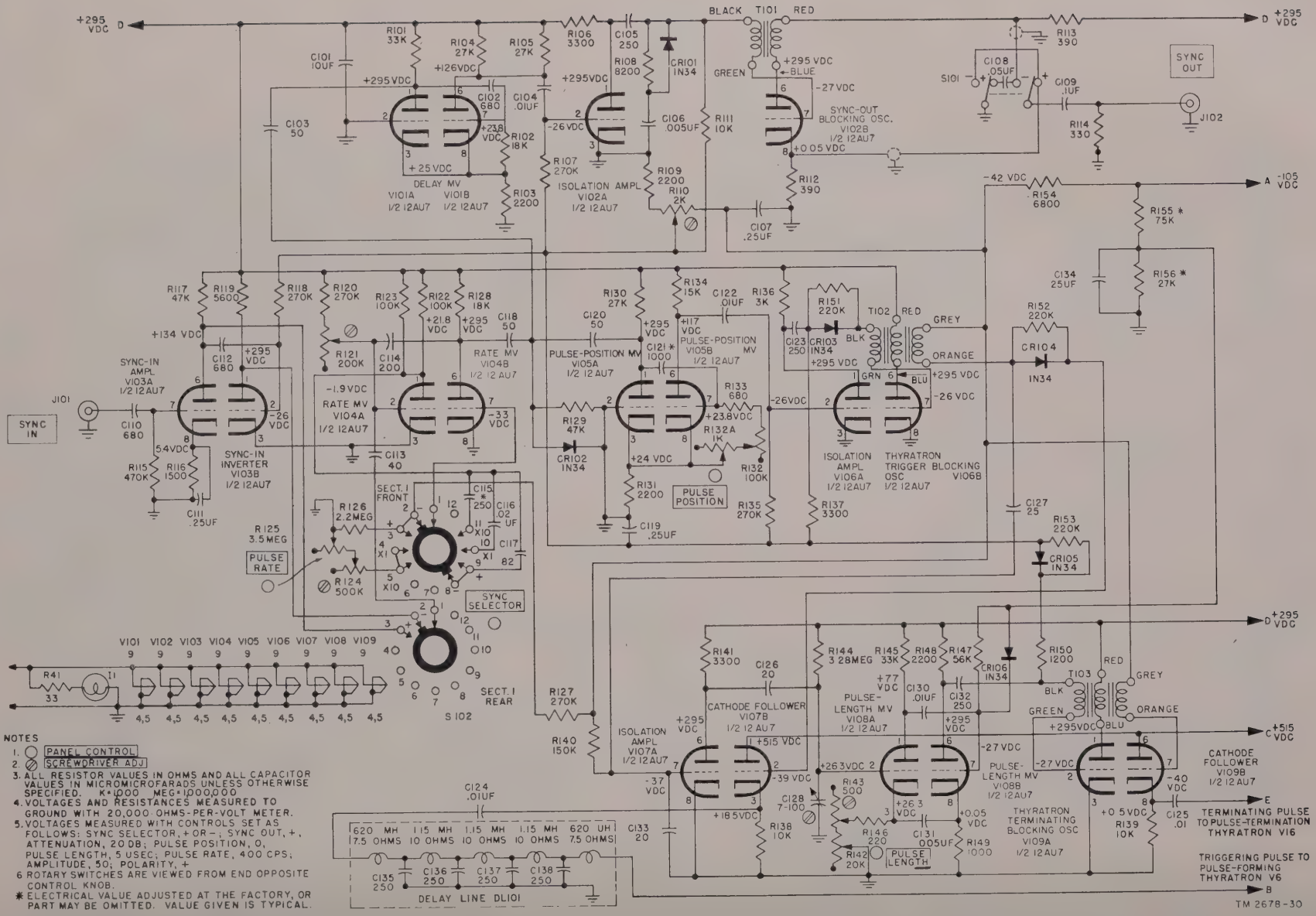
STANDARDS				
COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)	JAN LETTER TOLERANCE
BLACK	0	1	–	–
BROWN	1	10	± 1	F
RED	2	100	± 2	G
ORANGE	3	1,000	± 3	–
YELLOW	4	10,000	± 4	–
GREEN	5	100,000	± 5	–
BLUE	6	1,000,000	± 6	–
VIOLET	7	10,000,000	± 7	–
GRAY	8	100,000,000	± 8	–
WHITE	9	1,000,000,000	± 9	–
GOLD	–	0.1	± 5	J
SILVER	–	0.01	±10	K
NO COLOR	–	–	±20	M

NOTES:

1. RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.
2. RMA: RADIO MANUFACTURERS ASSOCIATION.
3. JAN: JOINT ARMY-NAVY.
4. THESE COLOR AND NUMBER CODES GIVE ALL RESISTANCE VALUES IN OHMS.
5. RESISTIVE COMPONENTS USED FOR LETTER TOLERANCES ARE: RC, RN, AND RU.
6. WATTAGE FOR RW TYPES IS FOUND IN THE JAN SPECIFICATIONS UNDER CHARACTERISTICS.

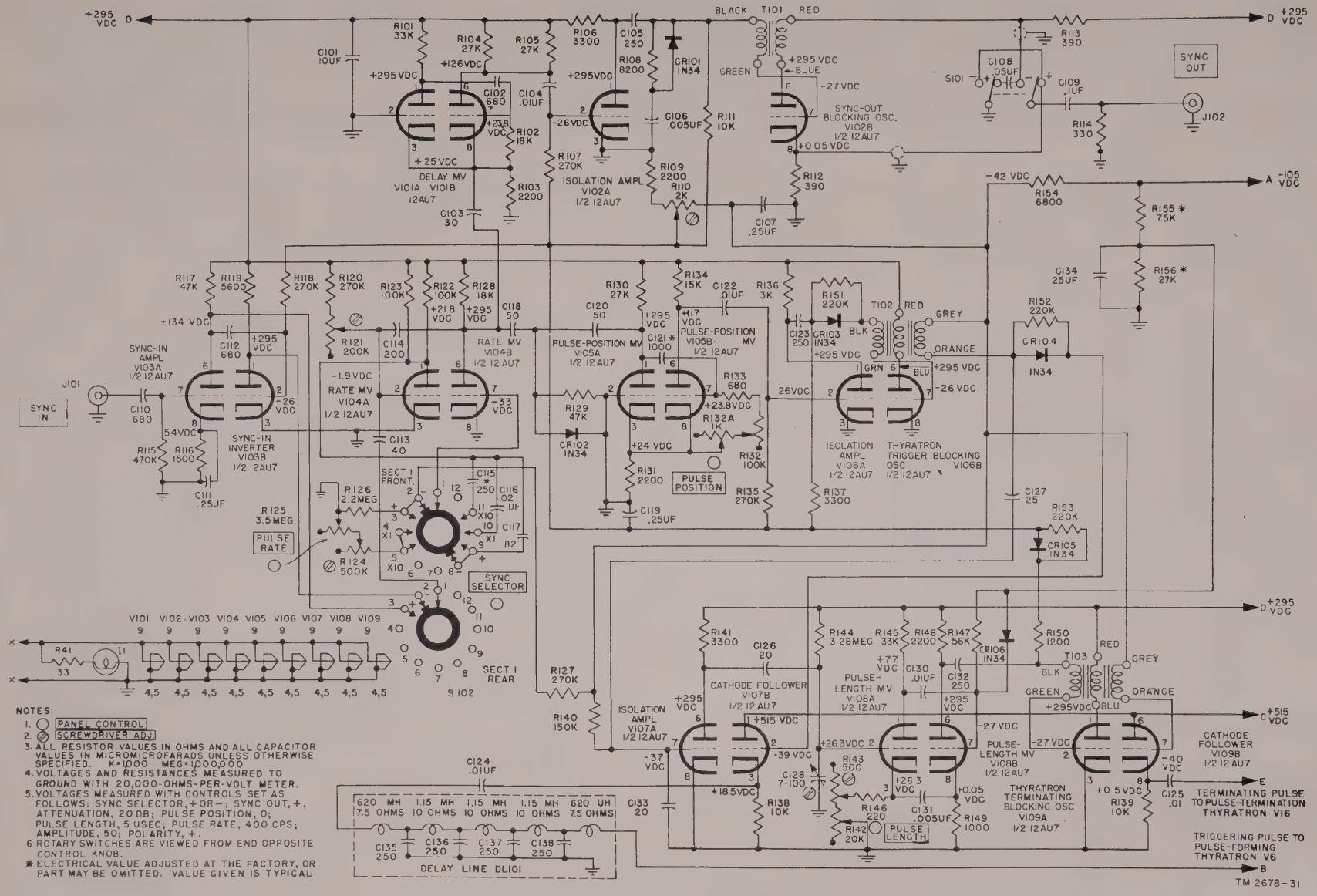
TM RC

Figure 29. Resistor color and letter codes.



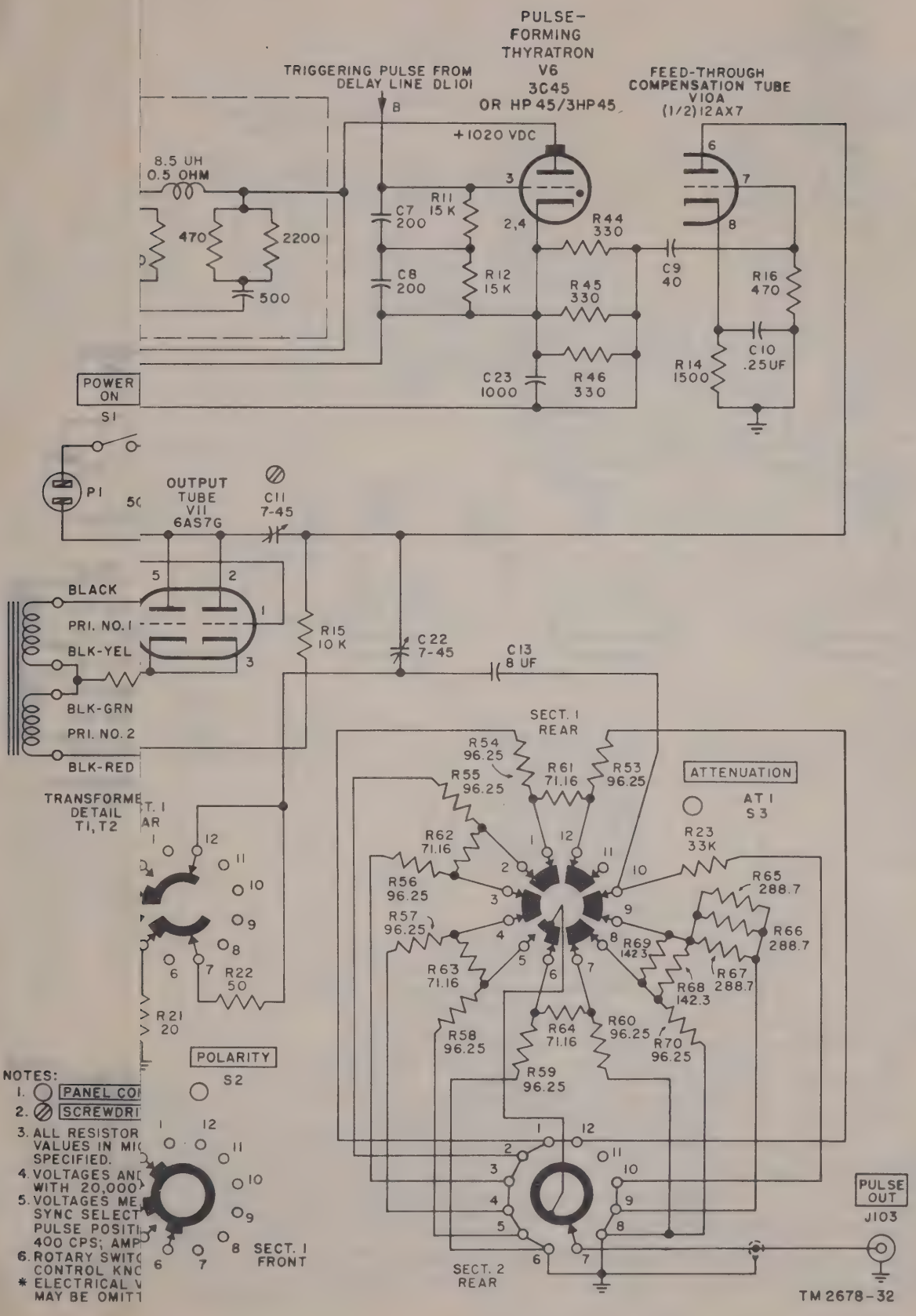
NOTES
1. ○ PANEL CONTROL
2. ⊘ SCREWDRIVER ADJ
3. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED. K=1000 MEG=1000,000
4. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER.
5. VOLTAGES MEASURED WITH CONTROLS SET AS FOLLOWS: SYNC SELECTOR, + OR −, SYNC OUT, +, ATTENUATION, 20 DB; PULSE POSITION, 0, PULSE LENGTH, 5 USEC; PULSE RATE, 400 CPS; AMPLITUDE, 50; POLARITY, +
6. ROTARY SWITCHES ARE VIEWED FROM END OPPOSITE CONTROL KNOB.
* ELECTRICAL VALUE ADJUSTED AT THE FACTORY, OR PART MAY BE OMITTED. VALUE GIVEN IS TYPICAL.

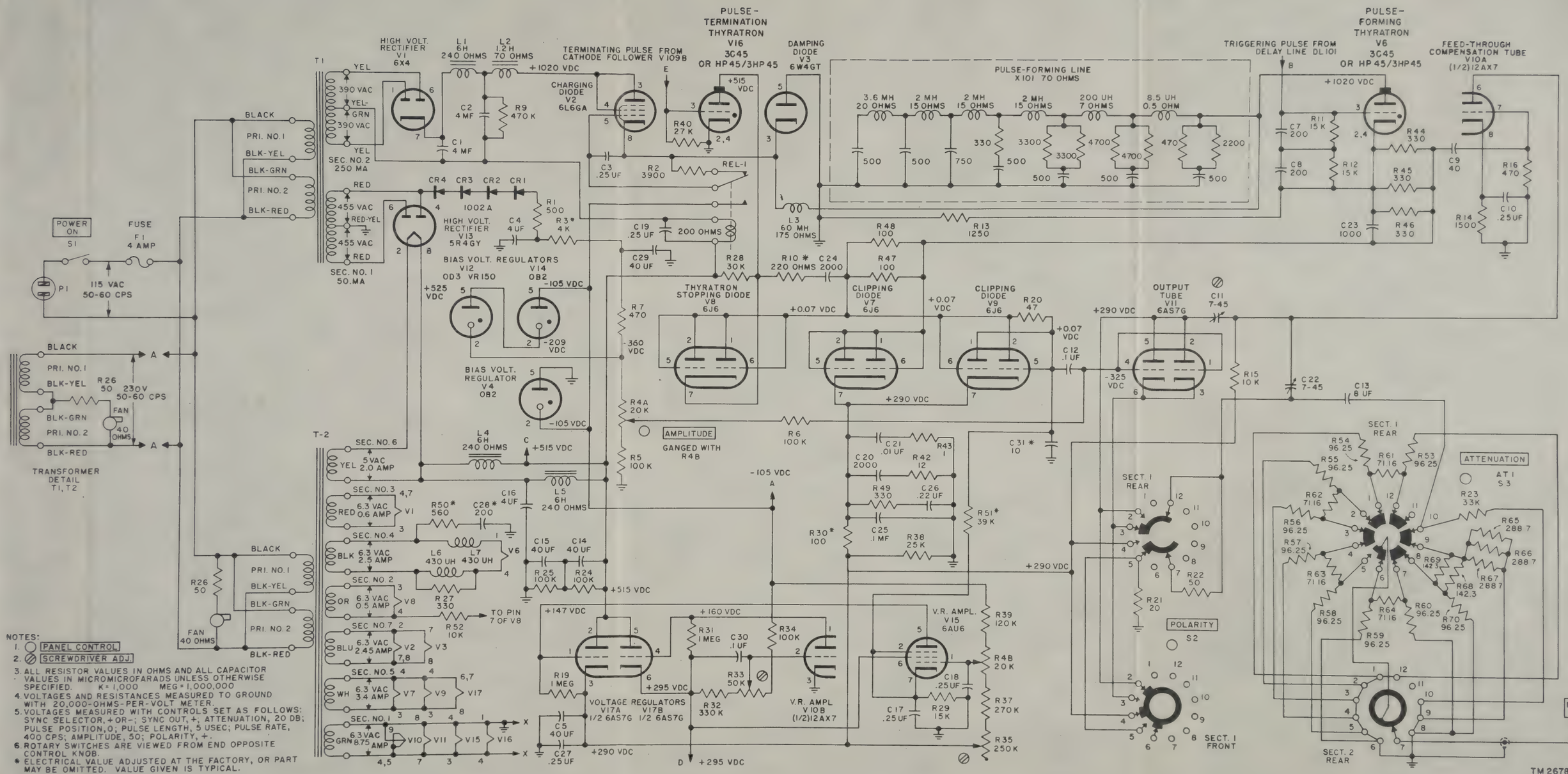
Figure 30. Schematic diagram, front deck, serial numbers up to 1038.



NOTES:
1. ○ PANEL CONTROL
2. ⊘ SCREWDRIVER ADJ
3. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED. K=1000 MEG=1,000,000
4. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000-OHMS-PER-VOLT METER.
5. VOLTAGES MEASURED WITH CONTROLS SET AS FOLLOWS: SYNC SELECTOR, + OR −; SYNC OUT, +, ATTENUATION, 20 DB; PULSE POSITION, 0; PULSE LENGTH, 5 USEC; PULSE RATE, 400 CPS; AMPLITUDE, 50; POLARITY, +.
6. ROTARY SWITCHES ARE VIEWED FROM END OPPOSITE CONTROL KNOB.
* ELECTRICAL VALUE ADJUSTED AT THE FACTORY, OR PART MAY BE OMITTED. VALUE GIVEN IS TYPICAL.

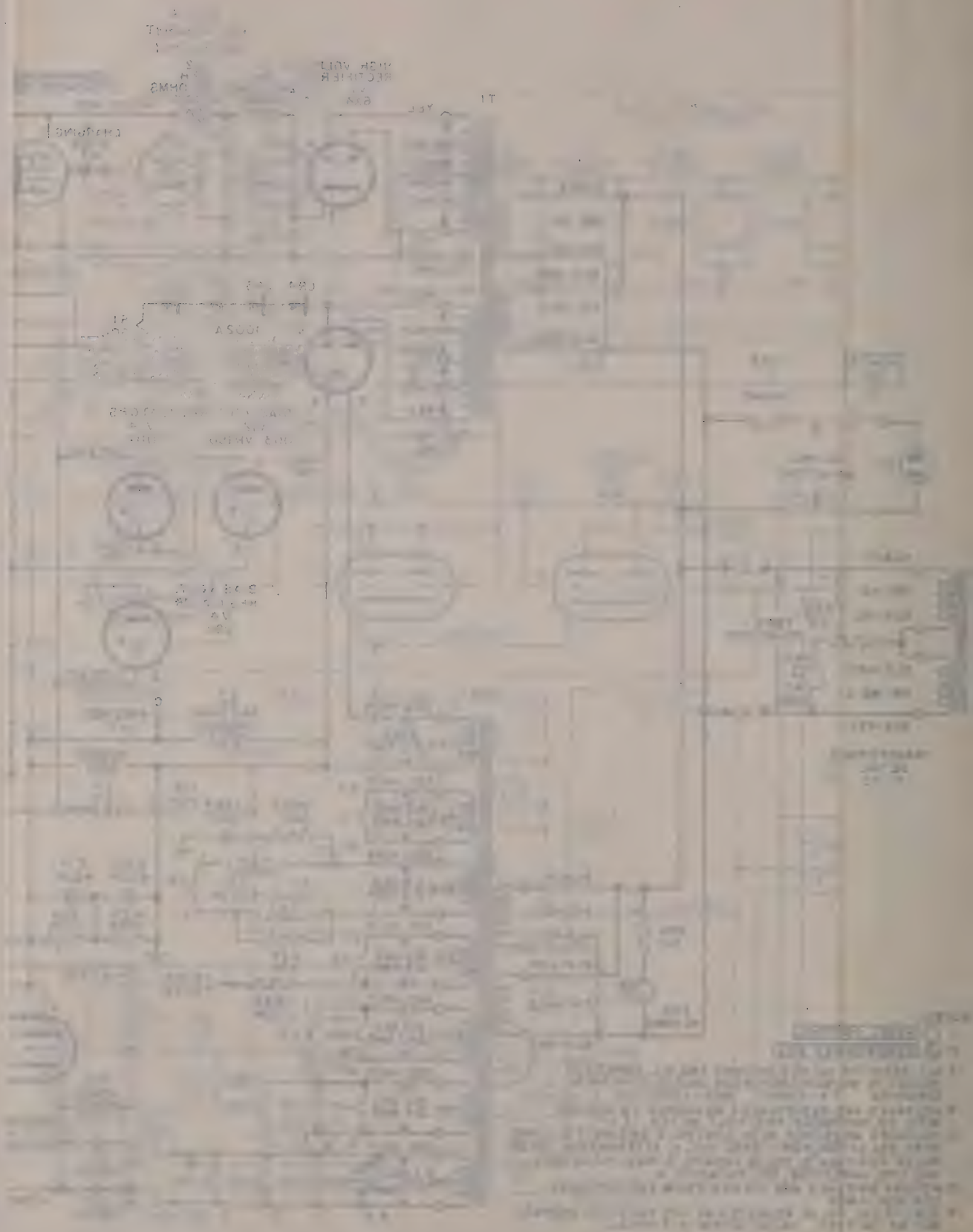
Figure 31. Schematic diagram, front deck, serial numbers from 1039.

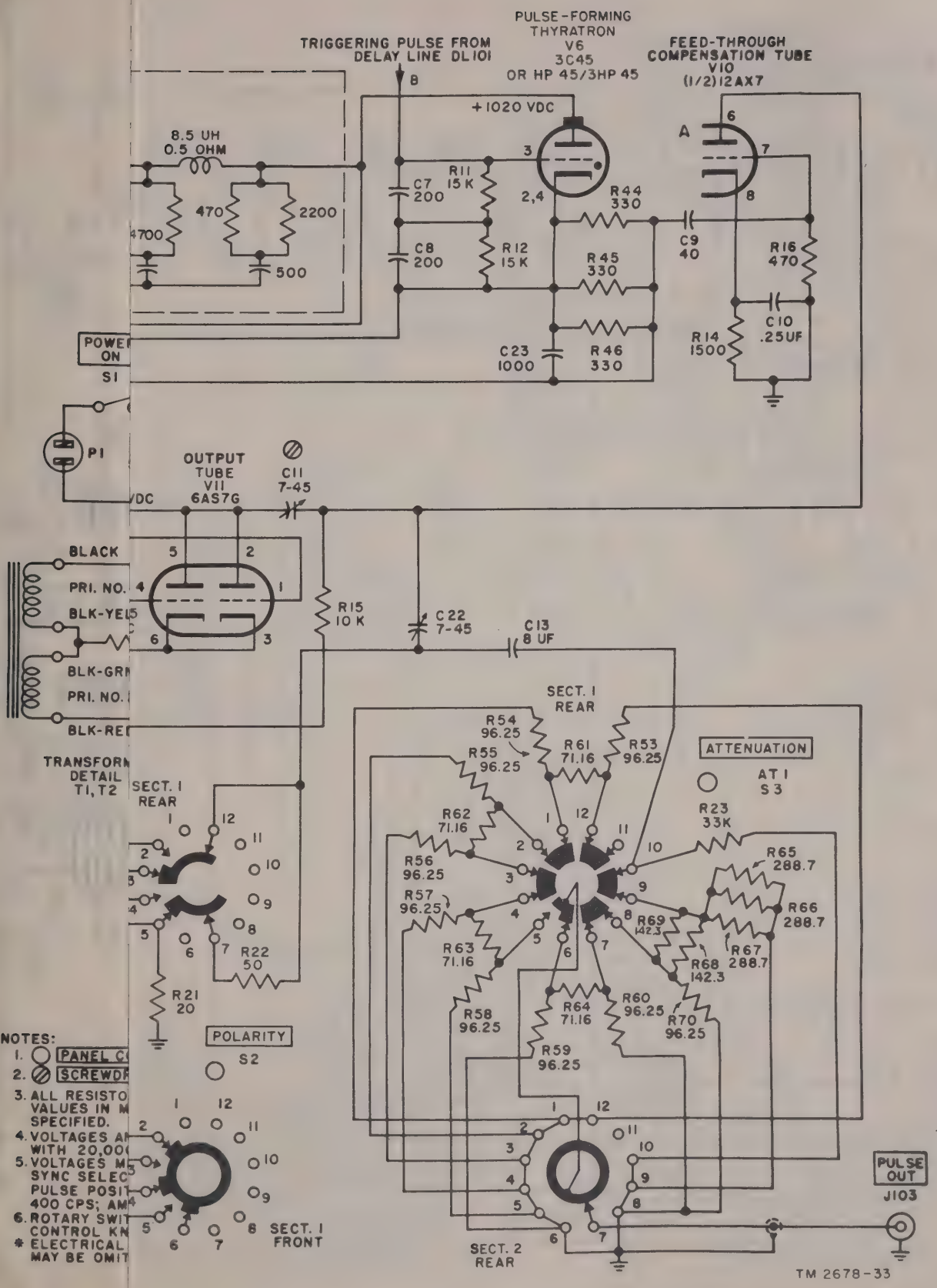

PULSE-FORMING THYRATRON V6 3C45 OR HP 45/3HP45
TRIGGERING PULSE FROM DELAY LINE DL101
FEED-THROUGH COMPENSATION TUBE V10A (1/2) 12AX7
+1020 VDC
8.5 UH 0.5 OHM
470
2200
500
C7 200
R11 15K
C8 200
R12 15K
R44 330
R45 330
R46 330
C23 1000
C9 40
R16 470
C10 .25UF
R14 1500
POWER ON S1
P1
OUTPUT TUBE V11 6AS7G
C11 7-45
BLACK
PRI. NO. 1
BLK-YEL
BLK-GRN
PRI. NO. 2
BLK-RED
R15 10K
C22 7-45
C13 8 UF
TRANSFORMER DETAIL T1, T2
SECT. 1 REAR
R54 96.25
R55 96.25
R61 71.16
R53 96.25
ATTENUATION
AT 1 S3
R23 33K
R62 71.16
R56 96.25
R57 96.25
R63 71.16
R58 96.25
R64 71.16
R60 96.25
R70 96.25
R59 96.25
R65 288.7
R66 288.7
R67 288.7
R68 142.3
R69 142.3
R22 50
R21 20
POLARITY S2
SECT. 1 FRONT
SECT. 2 REAR
PULSE OUT J103
NOTES:
1. PANEL CO
2. SCREWDRI
3. ALL RESISTOR VALUES IN MI SPECIFIED.
4. VOLTAGES AN WITH 20,000
5. VOLTAGES ME SYNC SELECT PULSE POSITI 400 CPS; AMP
6. ROTARY SWITC CONTROL KNC
* ELECTRICAL V MAY BE OMITT
TM 2678-32

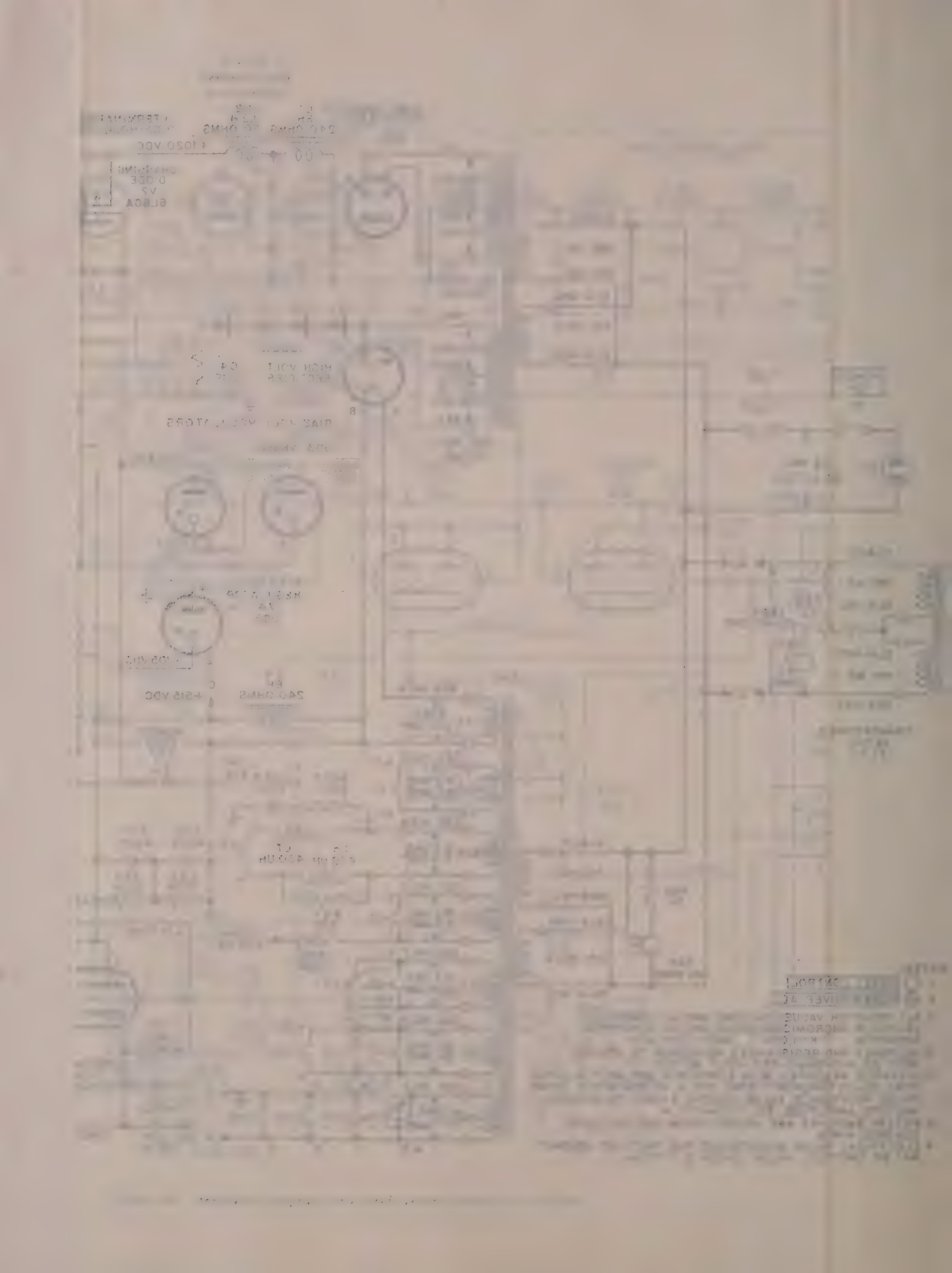


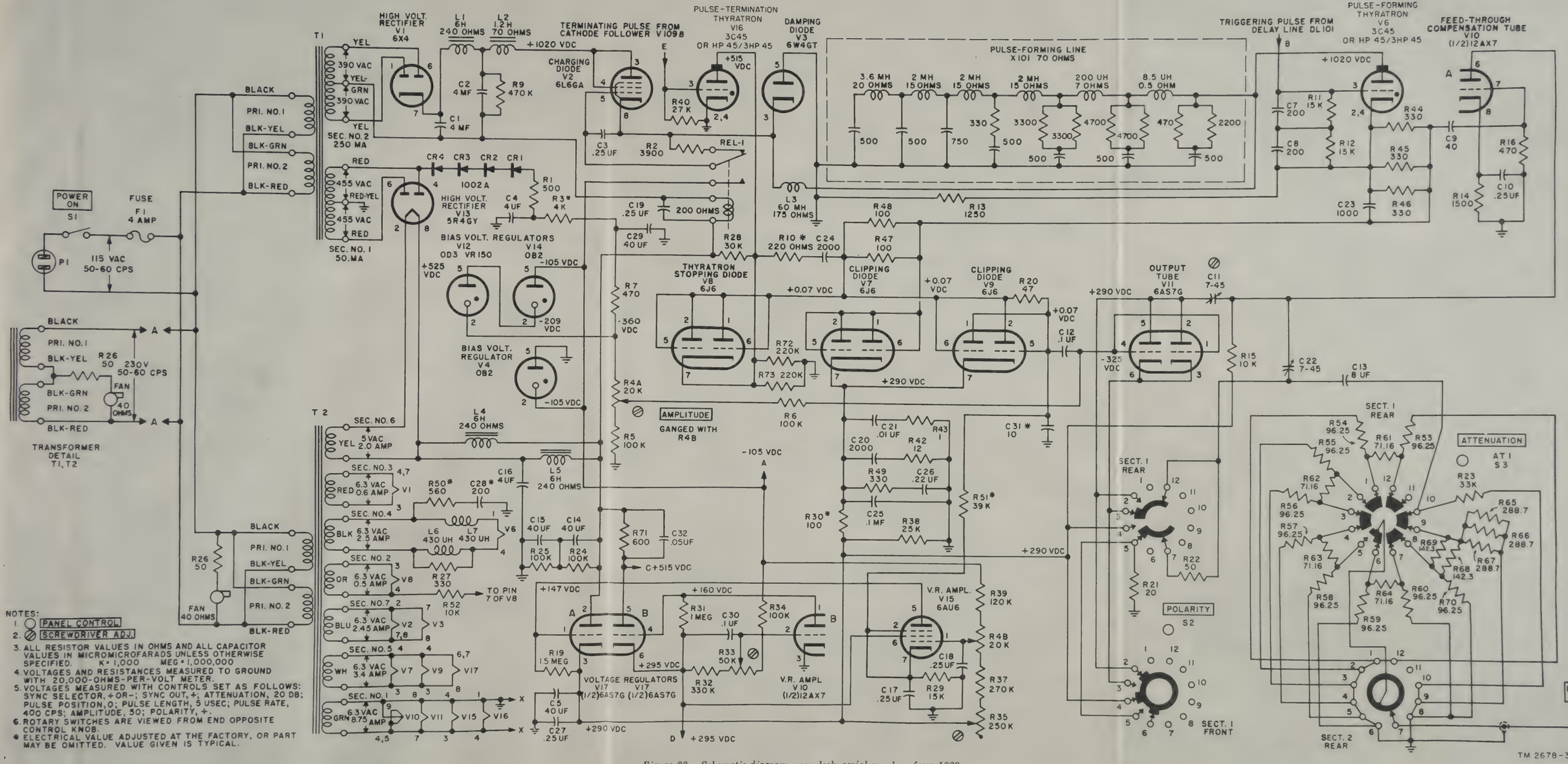
NOTES:
1. ○ PANEL CONTROL
2. ⊘ SCREWDRIVER ADJ.
3. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED. K = 1,000 MEG = 1,000,000
4. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000-OHMS-PER-VOLT METER.
5. VOLTAGES MEASURED WITH CONTROLS SET AS FOLLOWS: SYNC SELECTOR, +OR−; SYNC OUT, +; ATTENUATION, 20 DB; PULSE POSITION, 0; PULSE LENGTH, 5 USEC; PULSE RATE, 400 CPS; AMPLITUDE, 50; POLARITY, +.
6. ROTARY SWITCHES ARE VIEWED FROM END OPPOSITE CONTROL KNOB.
* ELECTRICAL VALUE ADJUSTED AT THE FACTORY, OR PART MAY BE OMITTED. VALUE GIVEN IS TYPICAL.

Figure 32. Schematic diagram, rear deck, serial numbers up to 1238.



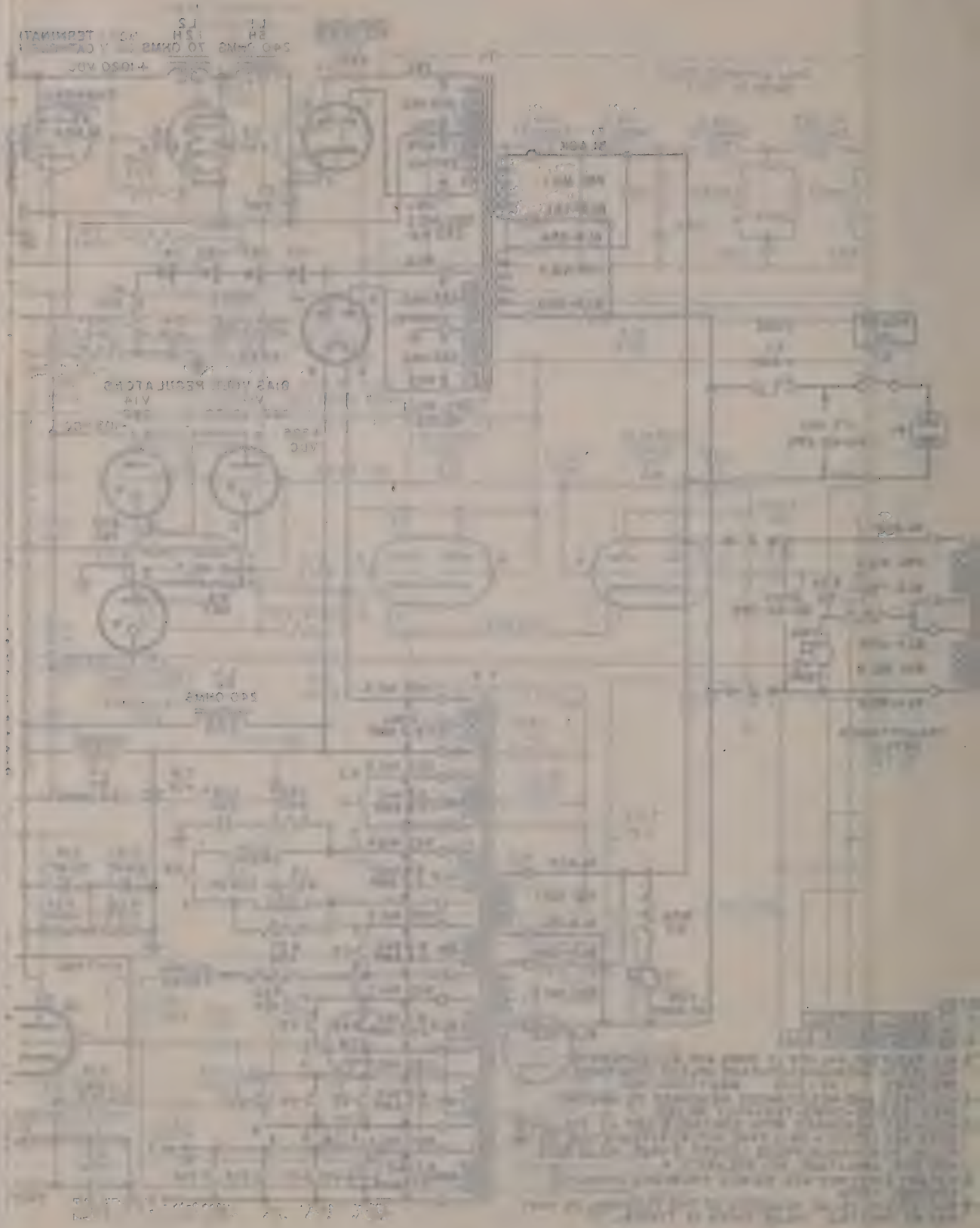

TRIGGERING PULSE FROM DELAY LINE DL101
PULSE-FORMING THYRATRON V6 3C45 OR HP 45/3HP 45
FEED-THROUGH COMPENSATION TUBE V10 (1/2)12AX7
+1020 VDC
8.5 UH 0.5 OHM
4700
470
2200
500
C7 200
C8 200
R11 15K
R12 15K
R44 330
R45 330
R46 330
C23 1000
C9 40
R16 470
C10 .25UF
R14 1500
POWER ON S1
P1
OUTPUT TUBE V11 6AS7G
C11 7-45
VDC
BLACK
PRI. NO.
BLK-YEL
BLK-GRN
PRI. NO.
BLK-RED
TRANSFORMER DETAIL T1, T2
R15 10K
C22 7-45
C13 8 UF
SECT. 1 REAR
R54 96.25
R55 96.25
R61 71.16
R53 96.25
ATTENUATION
AT1 S3
R23 33K
R62 71.16
R56 96.25
R57 96.25
R63 71.16
R58 96.25
R64 71.16
R60 96.25
R70 96.25
R59 96.25
R65 288.7
R66 288.7
R67 288.7
R68 142.3
R69 142.3
SECT. 1 REAR
R22 50
R21 20
POLARITY S2
SECT. 1 FRONT
SECT. 2 REAR
PULSE OUT J103
NOTES:
1. PANEL C
2. SCREWDR
3. ALL RESISTO VALUES IN M SPECIFIED.
4. VOLTAGES A WITH 20,00
5. VOLTAGES M SYNC SELEC PULSE POSIT 400 CPS; AM
6. ROTARY SWIT CONTROL KN
* ELECTRICAL MAY BE OMIT
TM 2678-33





NOTES:
1. ○ PANEL CONTROL
2. ⊘ SCREWDRIVER ADJ.
3. ALL RESISTOR VALUES IN OHMS AND ALL CAPACITOR VALUES IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED. K = 1,000 MEG = 1,000,000
4. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000-OHMS-PER-VOLT METER.
5. VOLTAGES MEASURED WITH CONTROLS SET AS FOLLOWS: SYNC SELECTOR, + OR −; SYNC OUT, +; ATTENUATION, 20 DB; PULSE POSITION, 0; PULSE LENGTH, 5 USEC; PULSE RATE, 400 CPS; AMPLITUDE, 50; POLARITY, +.
6. ROTARY SWITCHES ARE VIEWED FROM END OPPOSITE CONTROL KNOB.
* ELECTRICAL VALUE ADJUSTED AT THE FACTORY, OR PART MAY BE OMITTED. VALUE GIVEN IS TYPICAL.

Figure 33. Schematic diagram, rear deck, serial numbers from 1239.



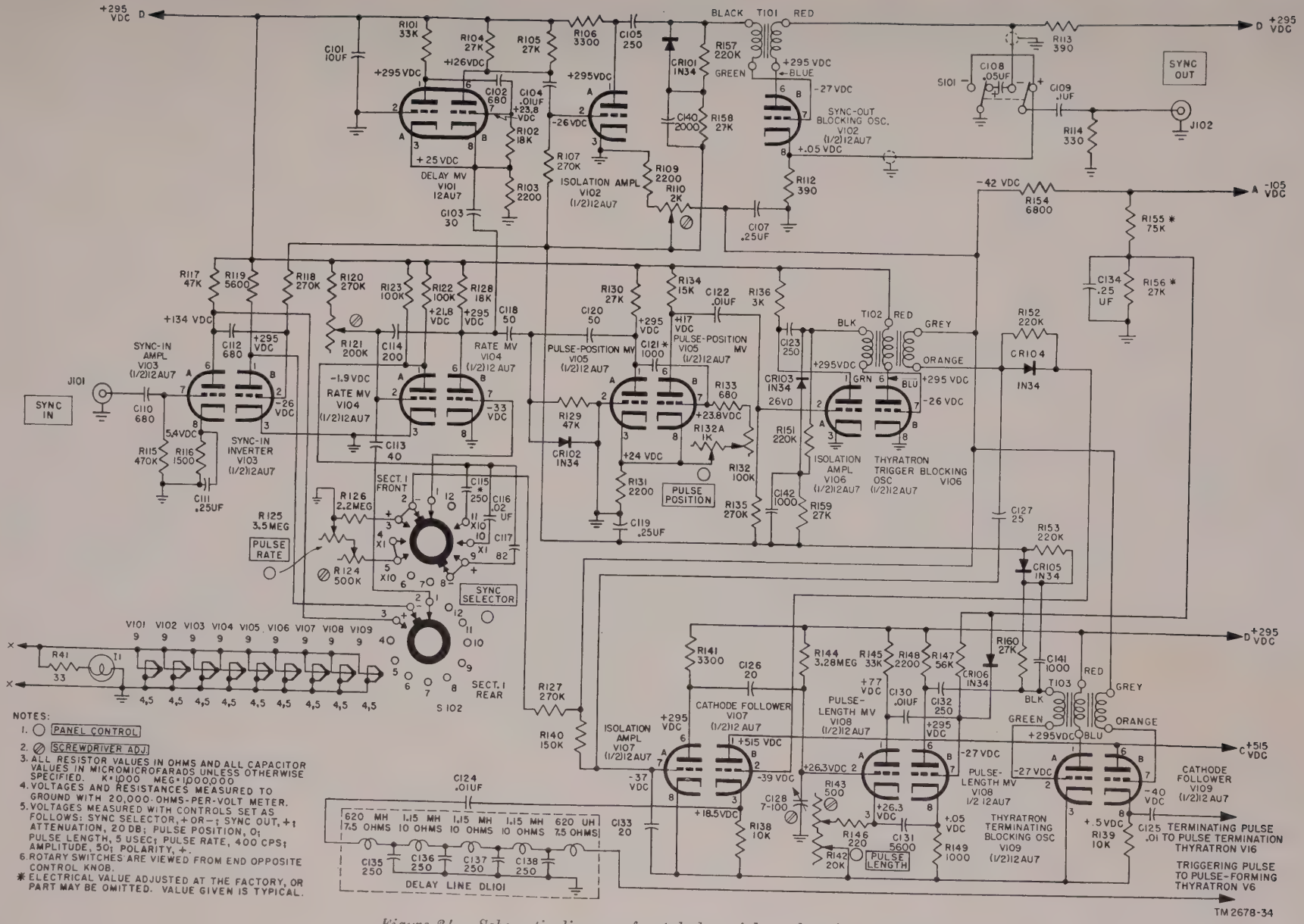


Figure 34. Schematic diagram, front deck, serial numbers from 1439.

INDEX

	Paragraphs	Page
Block diagram	40	26
Calibration:		
Pulse length	60*b*	45
PULSE RATE dial	60*d*	45
Checking filament and B+ circuits for shorts	57	40
Connections	15	14
Controls:		
General	17	17
Pulse generator controls	18	17
Description and data:		
Additional equipment required	10	9
Differences in models	11	9
Minor components	8	9
Packaging data	5	8
Pulse Generator AN/PPM–1	7	8
Purpose and use of equipment	3	7
Running spares	9	9
Table of components	6	8
Technical characteristics	4	8
Equipment performance checklist	39	25
Final testing:		
General	64	47
Test equipment required	65	47
Tests	66	48
Forms and records	2	7
General precautions	56	40
Identification table of parts	App II	51
Installation of pulse generator	14	12
Location for use	12	12
Lubrication and weatherproofing:		
Lubrication	33	23
Rustproofing and painting	35	23
Weatherproofing	34	23
Maintenance, tropical	34*b*	23
Maintenance, winter	34*c*	23
Methods of destruction	69	49
Operation:		
Under unusual conditions:		
Arctic climates	24	18
Desert climates	26	19
General	23	18
Tropical climates	25	19
Under usual conditions:		
Precautions	20	18
Starting	19	17
Stopping	22	18
Types	21	18
Packaging data	5	8
Preventive maintenance:		
Definition	28	20
Exterior	31	20
Forms	30	20
Interior	32	23
Techniques	29	20
Tools and materials	27	20
Repacking for shipment or limited storage	67	49
Repairs:		
Apparatus adjustment	63	47
Refinishing	62	47
Regulated voltage adjustment	60*a*	45
Replacement of parts	61	46
Rustproofing and painting	35	23
Sources of jitter	60*f*	45
Service upon receipt of used or reconditioned equipment	16	14
Table of components	6	8
Technical characteristics	4	8
Test equipment:		
Final testing	65	47
Trouble shooting	55	40
Theory:		
Block diagram	40	26
Feedthrough compensating stage	51	36
Output circuits	52	36
Pulse clipping circuits	50	36
Pulse forming thyratron	48	39
Pulse generating section	47	33
Pulse length circuits	46	31
Pulse positioning circuits	45	31
Pulse terminating circuit	49	35
Rate multivibrator	43	28
Stage analysis	41	28
Sync in amplifier and inverter	42	28
Sync out circuits	44	29
Tools and materials supplied	27	20
Trouble shooting:		
Field maintenance level:		
Additional information	60	45
Chart	59	41
Checking filament and B+ circuits for shorts	57	40
Data	54	40
General precautions	56	40
Operational test	58	41
Procedures	53	39
Test equipment required	55	40
Organizational maintenance level:		
Equipment performance checklist	39	25
Scope	36	24
Using equipment performance checklist	38	24
Visual inspection	37	24
Uncrating, unpacking, and checking new equipment	13	12

[AG 412.41 (27 Mar 53)]

BY ORDER OF THE SECRETARY OF THE ARMY:

M. B. RIDGWAY,
General, United States Army,
Chief of Staff.

OFFICIAL:

WM. E. BERGIN,
Major General, United States Army,
The Adjutant General.

DISTRIBUTION:

Active Army:

Tech Svc (1); Tech Svc Bd (1); AFF Bd (ea Svc Test Sec) (1); AFF (5); AA Comd (2); OS Maj Comd (5); Base Comd (5); MDW (2); Log Comd (5); A (5); CHQ (2); FT (2); Sch (5) except 11 (25); PMS & T 11 (1); Gen Dep (2); Dep 11 (20) except Sig Sec, Gen Dep (10); Tng Div (2); POE (10), OSD (2); Lab 11 (5); Mil Dist (3); Field Maint Shops 11 (3); Two (2) copies to each of the following T/O & E's: 11–107; 11–127A; 11–128; 11–500A, CA, CB, CC, CD; 11–587; 11–592; 11–597.

NG: Same as Active Army except one copy to each unit.

Army Reserve: Same as Active Army except one copy to each unit.

For explanation of distribution formula, see SR 310–90–1.

U. S. GOVERNMENT PRINTING OFFICE: 1953