PRELIMINARY INSTRUCTION BOOK for PULSE ANALYZER EQUIPMENT MODELS AN/APA-6A and AN/SPA-1

REPORT OF FAILURE

FOR U. S. NAVY PERSONNEL:

Report of failure of any part of this equipment during its guaranteed life shall be made on Form N. Aer. 4112 "Report of Unsatisfactory or Defective Material" or a report in similar form and forwarded in accordance with the latest instructions of the Bureau of Aeronautics. In addition to other distribution required, one copy shall be furnished to the Inspector of Naval Material (location to be specified) and the Bureau of Ships. Such reports of failure shall include:

1. Reporting activity.
2. Nameplate data.
3. Date placed in service.
4. Part which failed.
5. Nature and cause of failure.
6. Replacement needed (yes-no).
7. Remedy used or proposed to prevent recurrence.

FOR U. S. ARMY AIR FORCE PERSONNEL:

In the event of malfunctioning, unsatisfactory design or unsatisfactory installation of any of the component units of this equipment, or if the material contained in this book is considered inadequate or erroneous, an Unsatisfactory Report, AAF Form No. 54 or a report in similar form shall be submitted in accordance with the provisions of Army Air Force Regulation No. 15-54, listing:

1. Station and organization.
2. Nameplate data (type number or complete nomenclature if nameplate is not attached to the equipment.
3. Date and nature of failure.
4. Airplane model and serial number.
5. Remedy used or proposed to prevent recurrence.
6. Handbook errors or inadequacies, if applicable.

FOR BRITISH PERSONNEL:

Form 1022 procedure shall be used when reporting failure of radio equipment.

DESTRUCTION OF ABANDONED MATERIEL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment and when ordered to do so.

DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS. MEANS:

1. Explosives, when provided.
2. Hammers, axes, sledges or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper or wood.
4. Grenades and shots from available arms.
5. Where possible, and when time permits, bury all debris or dispose of it in streams or other bodies of water.

PROCEDURE:

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch- and instrument-boards.
3. Destroy all controls, switches, relays, connections and meters.
4. Rip out all wiring in electrical equipment. Smash gas, oil and water cooling systems in gas-engine generators, etc.
5. Smash every electrical or mechanical part whether rotating, moving or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.

SAFETY NOTICE

Operation of this equipment involves the use of high voltages which are dangerous to life. Operating personnel must at all times observe all safety precautions. Do not change tubes or make adjustments inside equipment with high voltage supply on. Do not depend upon door switches or interlocks for protection but always shut down motor generators or other power equipment. Under certain conditions dangerous potentials may exist in circuits with power control in the "off" position due to charges retained by capacitors, etc. To avoid casualties always discharge and ground circuits prior to touching them.

The attention of officers and operating personnel is directed to Bureau of Engineering Circular Letter No. 5a of October 3, 1934, or subsequent revisions thereof, on the subject of Radio-Safety Precautions to be observed.

FIRST AID

PERSONNEL ENGAGED IN THE INSTALLATION, OPERATION AND MAINTENANCE OF THIS EQUIPMENT OR SIMILAR EQUIPMENT ARE URGED TO BECOME FAMILIAR WITH THE FOLLOWING RULES: BOTH IN THEORY AND IN THE PRACTICAL APPLICATION THEREOF. IT IS THE DUTY OF EVERY RADIOMAN TO BE PREPARED TO GIVE ADEQUATE FIRST AID AND THEREBY PREVENT AVOIDABLE LOSS OF LIFE. YOUR OWN LIFE MAY DEPEND ON THIS. Do these three things first in any emergency requiring First Aid:

1. Send for a doctor or carry the victim to a doctor.
2. Keep victim warm and quiet and flat on his back.
3. If breathing has stopped, apply artificial respiration. Stop all serious bleeding.

When, from any cause whatever, breathing has stopped, apply artificial respiration immediately and continue WITHOUT STOPPING until normal breathing returns, or a doctor pronounces the victim dead. SPEED IN BEGINNING ARTIFICIAL RESPIRATION IS ESSENTIAL.

THE PRONE PRESSURE METHOD OF ARTIFICIAL RESPIRATION IF DUE TO ELECTRIC SHOCK

1. PROTECT YOURSELF with dry insulating material.
2. BREAK THE CIRCUIT by opening the power switch or pulling the victim free of the live conductor. DON'T TOUCH THE VICTIM WITH YOUR BARE HANDS UNTIL THE CIRCUIT IS BROKEN.
3. SPREAD DRY BLANKET ON THE GROUND, and roll victim to center of blanket with his arms extended over his head, so that he lies FACE DOWN on blanket.
4. BEND ONE OF THE VICTIM'S ARMS at the elbow and rest victim's cheek on the back of his hand.
5. REMOVE FALSE TEETH, gum, candy, tobacco, food, etc., from victim's mouth.
6. LOOSEN ALL TIGHT CLOTHING, as belts or collars.
7. COVER VICTIM LOOSELY by wrapping the ends of the blanket around him.
8. STRADDLE VICTIM across thighs.
9. PLACE THE PALMS OF YOUR HANDS ON VICTIM'S BACK so that the little fingers of each hand just touch the victim's lowest ribs.
10. KEEP YOUR ARMS STIFF AND STRAIGHT and swing your body forward, allowing your weight to bear down on the victim.
11. DO NOT PUSH OR USE FORCE.
12. SWING BACK AT ONCE TO RELIEVE PRESSURE.
13. REPEAT Number 10.
14. REPEAT Number 12.
15. CONTINUE as above, maintaining a steady rhythm until victim regains consciousness or is pronounced dead by a doctor.
16. CONTINUE ARTIFICIAL RESPIRATION even after victim begins to breathe, and until he becomes conscious.
17. IF BREATHING STOPS AGAIN, continue artificial respiration at once.
18. DO NOT GIVE UP HOPE of reviving the victim. Four hours or more of continuous application of artificial respiration may be required before consciousness returns.
19. NEVER TRY TO FORCE LIQUIDS down an unconscious person's throat. He will drown.
20. ALWAYS WAIT UNTIL CONSCIOUSNESS RETURNS before administering liquid stimulants.
21. RECOMMENDED STIMULANTS ARE: Hot black coffee. Strong hot tea. Aromatic spirits of ammonia, one teaspoonful to a glass of water.
22. GIVE ONLY ONE STIMULANT, which should be sipped slowly.
23. ALCOHOLIC DRINKS are not recommended, unless absolutely nothing else is available.
24. WHEN VICTIM HAS RETURNED TO CONSCIOUSNESS, allow him to lie quietly where he is for at least one hour, taking care that he is well covered and free from worry.
25. IF POSSIBLE, CARRY, OR HAVE HIM CARRIED TO A DOCTOR.

WOUNDS

Neglected wounds can have serious consequences. Any break in the skin is a wound. Paint small cuts and scratches immediately with TINCTURE OF IODINE. Deep cuts and wounds should be KEPT CLEAN but DO NOT use Tincture of Iodine on them. Washing AROUND and AWAY from the wound with ordinary soap and water, if no other antiseptic is available, is recommended. Other antiseptics for use on deep wounds are: Violet gentian, Potassium permanganate, Tincture of Merthiolate, or ordinary baking soda and water. Cover the wound with a sterile gauze dressing and hold in place with adhesive tape or a strip of gauze.

In cases of serious bleeding, when an artery has been cut, firm pressure is necessary to stop the flow of blood. Arterial bleeding is BRIGHT RED and comes from the wound in SPURTS, with each beat of the heart. Bleeding from a vein is DARK RED and flows steadily. Pressure is not often needed for venous bleeding.

Pressure is applied ABOVE the wound, or between the WOUND AND THE HEART, to stop ARTERIAL BLEEDING. Pressure is applied BELOW the wound, or AWAY FROM THE HEART to stop VENOUS BLEEDING.

Pressure is best applied and maintained by means of a TOURNIQUET.

A TOURNIQUET is a strip of cloth, bandage, or other material, tied ABOVE or BELOW the wound. Tie a simple, double knot in the cloth and place a strong stick or other rigid member in the loop thus made, then tighten the knot by pulling the ends of the cloth.

With the rigid member thus held firmly in place, twist it, until the bleeding stops.

DO NOT maintain such pressure longer than 15 minutes at a time.

IF BLEEDING CONTINUES after loosening tourniquet, allow the blood to flow for about 30 to 60 seconds and then re-apply pressure. Continue until bleeding stops.

AFTER BLEEDING HAS STOPPED, the wound should be carefully covered with a sterile dressing. DO NOT TOUCH THE WOUND OR DRESSING WITH DIRTY HANDS!

Keep the victim LYING FLAT ON HIS BACK, AND WELL COVERED. DO NOT LET HIM SEE HIS WOUND. Divert his thoughts from himself.

Obtain the services of a DOCTOR AS SOON AS POSSIBLE.

BURNS

Burns whether caused by contact with high voltage electrical equipment, fire, or friction, require immediate attention.

1. Apply AT ONCE any one of the following:
   a. Tannic acid jelly.
   b. Butesin picrate.
   c. Paste made with baking soda and water.
   d. Very strong, cool tea.
2. Applications should be LIBERAL and the burned area covered with STERILE GAUZE.
3. If clothing sticks to the burned areas, DO NOT ATTEMPT TO REMOVE IT. Treat burn as above.
4. Keep the victim WELL COVERED and LYING FLAT ON HIS BACK. Soothe and reassure him.
5. Obtain the services of a DOCTOR AS SOON AS POSSIBLE.

GUARANTEE

This equipment, including all parts and spare parts, except vacuum tubes, is guaranteed for a period of ONE YEAR with the understanding that, as a condition of this contract, all items found to be defective as to design, material, workmanship or manufacture will be replaced without delay and at no expense to the Government; provided that such guarantee and agreement will not obligate the contractor to make replacement of defective material unless the failure, exclusive of normal expected shelf life deterioration, occurs within a period of ONE YEAR from the date of delivery of the equipment to an acceptance by the Government, and provided further, that if any part or parts fail or are found defective to the extent of ten per cent (10%) or more of the total number of similar units furnished under the contract (exclusive of spares), such part or parts, whether supplied in the equipment or as spares, will be conclusively presumed to be of defective design, and as a condition of contract subject to one hundred per cent (100%) replacement by suitable redesigned units.

Failure due to poor workmanship, while not necessarily indicating poor design, will be considered in the same category as failure due to poor design. Redesigned replacements which will assure proper operation of the equipment shall be supplied promptly, transportation paid, to the Naval activity using such equipment, upon receipt of proper notice and without cost to the Government.

All such defective parts will be subject to ultimate return to the contractor. In view of the fact that normal activities of the Naval service may result in the use of the equipment in such remote portions of the world or under such conditions as to preclude the return of the defective item or units prior to replacement without jeopardizing the integrity of Naval operations or communications, the exigencies of the service therefore may necessitate expeditious repair of such item or unit in order to prevent extended interruption of operations or communications. In such cases the return of the defective item or unit for examination by the contractor prior to replacement will not be required. The report of a responsible authority, including details of the conditions surrounding the failure, will be acceptable for effective adjustment under the provisions of this contractual guarantee.

The above period of ONE YEAR will not include any portion of the time that the equipment fails to give satisfactory performance due to defective items and the necessity for replacement thereof. All replacement parts will be guaranteed to give ONE YEAR of satisfactory service.

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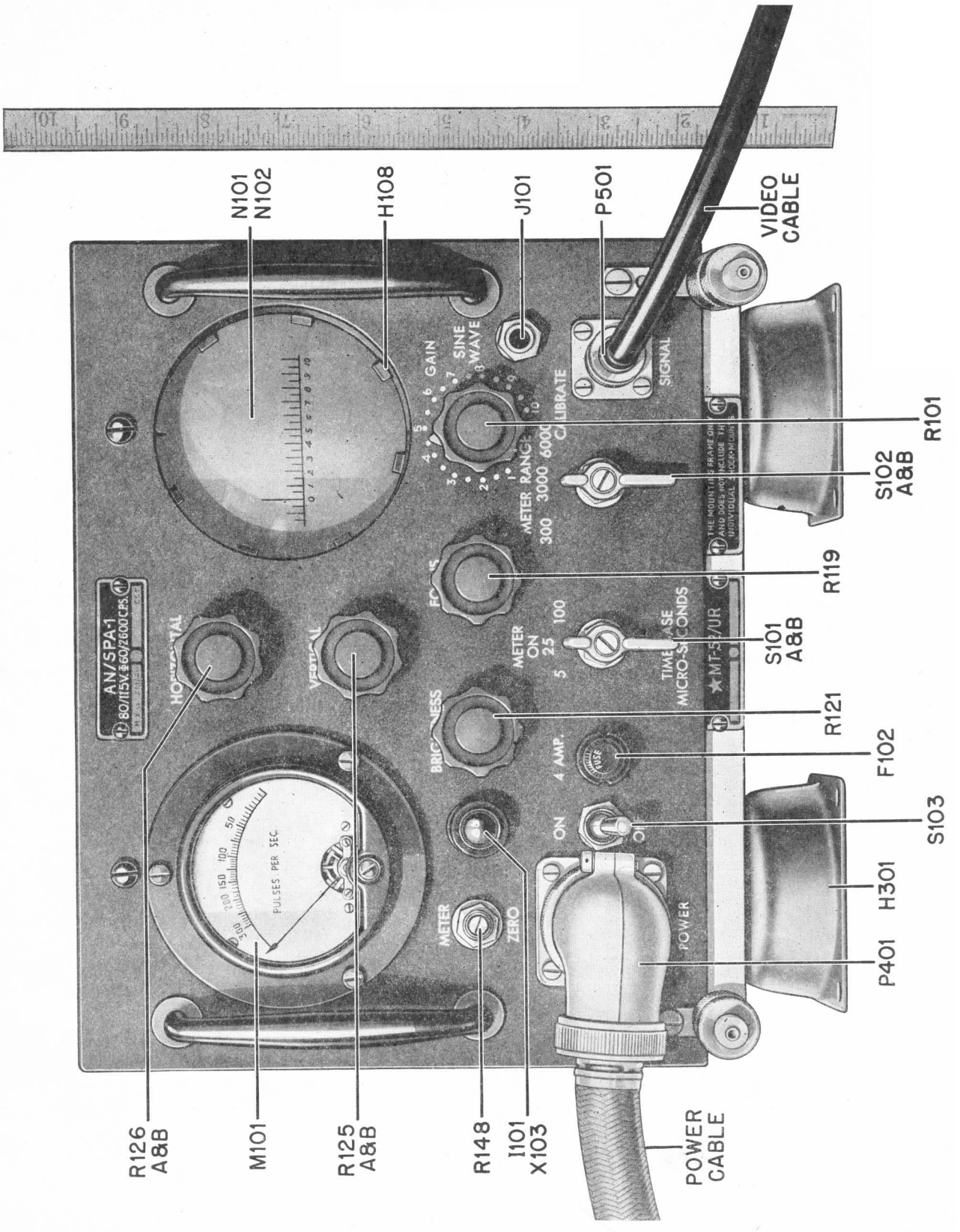


Figure 1. Pulse Analyzer Equipment, AN/SPA-1 or AN/APA-6A, Assembled Front View

SECTION I—DESCRIPTION

1. INTRODUCTION.

a. General.

WARNING: These instructions are to be read and fully understood before operation of this equipment is attempted.

The equipment should be thoroughly checked after unpacking, to make sure there has been no damage in shipment. Pulse Analyzer Equipment AN/SPA-1 is to be used with receivers of the pulse variety which are designed to receive pulsing carriers rather than continuous waves modulated by low frequency.

b. Characteristics.

Pulse Analyzer ID-46/SPA-1 consists of a wide band video amplifier which is capable of amplifying frequencies from 60 cycles to 2 megacycles. A linear sweep circuit is also included, which is automatically synchronized to the incoming pulse which is to be observed. Provisions are also made to read the rate of repetition of the pulses by means of a pulse meter. The circuit that provides horizontal sweep for the cathode ray tube also provides calibrating sine waves which when switched on to the screen of the cathode ray tube serve to determine the duration of any unknown pulse. By the use of the above mentioned circuits, one can determine all the characteristics of unknown pulses. The characteristics of an unknown pulse are carrier frequency, repetition rate, shape of pulse, and relative amplitude. The shape of the pulse is determined by observation on the screen of the cathode ray tube and by use of the calibrating sine waves the duration of this pulse can be obtained. One can also observe if the unknown pulse consists of a single sample pulse, or a combination of several pulses, each section being different. The relative amplitude of several pulses can be estimated by use of the attenuators in both the receiver and the analyzer. The carrier frequency is determined entirely by the receiver which receives the pulsed signal and reads directly the carrier frequency on the tuning dial.

c. Models.

There are two models of the analyzer, the AN/SPA-1 and the AN/APA-6A. The AN/SPA-1 is intended for shipborne operation. It uses heavy shock mounts designed for insulation against shock due to gun fire and explosions of other kinds. It also uses a heavy steel dust cover which gives it adequate protection against damage due to placement of heavy objects on the top surface. The AN/APA-6A is intended for use in aircraft where saving of weight is important. This model differs from the AN/SPA-1 in that it uses an aluminum dust cover which is much lighter than the steel dust cover used on the AN/SPA-1. This model also uses light shock mounts designed to insulate the analyzer against vibration due to aircraft motors and concussions of guns and light cannons. Both models are equipped with a universal power supply which will operate with a variable frequency power source between the limits of 60 and 2600 cycles.

d. Description.

The complete equipment set up for operation, the analyzer with proper cables connected and the set fastened to its mounting rack, occupies a space approximately 9½″ high by 11″ wide by 28″ long, refer to Figure 16 for outline drawings of the equipment. The equipment has a front panel which contains all the controls and cable connections for operation. There are two handles mounted on the panel which are used to carry the equipment and also to pull the equipment from its dust cover. The equipment mounts on a 1 ATR size shock mount. The mounting frame, *MT-52/UR, is made of duraluminum. This mounting frame has affixed to it four shock mounts for the purpose of insulation against vibration and to support the analyzer. The power connection is made to the lower left hand corner of the panel, with a standard AN power connector. The signal input is at the lower right hand corner of the front panel and uses a standard PL-259 plug and socket. The pulse meter is in the upper left hand corner of the panel and is a round 3″

panel type. The cathode ray tube screen is visible through an opening in the panel at the upper right hand corner and has placed before it two transparent screens. One of the screens is a green color which helps to eliminate reflections from the front of the cathode ray tube screen and thus serves to increase the apparent contrast of the trace produced on the screen of the cathode ray tube. The other screen is clear and contains calibration marks that are used to analyze the duration of unknown pulses. There are four round knobs to operate the controls of the analyzer. There are two other controls which are switches and are mainpulated by use of metal bar knobs. Below the pulse meter is a screwdriver control marked meter zero, which is used to set the hand of the pulse meter to the right hand index of the meter scale. The On-Off switch is directly to the right of the power connector at the lower left hand corner of the panel and is marked On-Off. The fuse holder for the line fuse is directly to the right of this On-Off switch and is marked FUSE on the fuse cap. The sine wave jack for connecting to an external audio oscillator is placed on the panel directly above the signal input plug. At the extreme lower right and lower left hand corners of the panel are hold-down brackets which hold the analyzer on to the mounting frame. The pilot light holder is directly to the right of the pulse meter zero control and below the pulse meter. The equipment nameplate which contains the nomenclature for the complete installation is mounted in the upper center of the front panel directly over the control marked HORIZONTAL.

2. OPERATING RANGE.

Pulse Analyzer Equipment AN/SPA-1 is capable of analyzing pulses of any repetition rate up to 6000 cycles. The pulse meter (M101) is calibrated up to this frequency, but the analyzer will still operate for observation purposes on frequencies up to as high as 10 kc. For higher frequency pulses, the picture will consist of "Sample Pulses." This means that the oscilloscope sweep will not operate each time a pulse is applied to the equipment, and is likely to operate on every other one, etc. The pulse meter is calibrated only up to 300 cycles, but the circuit is equipped with a switch which operates a multiplier of 10 times and 20 times and thus extends the range of the meter up to 6000 cycles. The switch which operates the meter multiplier is marked METER RANGE and is on the lower edge of the panel next to the signal input connector.

The analyzer has three ranges of sweep or time base. There is a 5 microsecond, 25 microsecond, and 100 microsecond range for operating on very short or very long pulses. The switch which changes the time base is marked TIME BASE MICROSECONDS. This switch is a three-position switch and is placed on the front panel, extreme lower center. Traces on the cathode ray tube screen, one inch or larger, can be obtained without distortion with one volt maximum input to the analyzer. If the highest of the observed pulses is kept below approximately 1½" at the cathode ray tube screen, there will be no distortion of the observed pulses. To observe the exact shape of the unknown pulse, it is of course necessary to keep the input below the level which produces distortion. The attenuator which is directly below the screen of the cathode ray tube has a range of attenuation of 40 db or 1000 times.

The analyzer is equipped with a circuit which permits the sweep to operate satisfactorily in the presence of a signal superimposed on a high noise level. If the signal is at least twice as large as the noise, satisfactory operation of the equipment will be obtained. This is due to the fact that this sweep circuit triggers on the peaks of the pulse which if of larger amplitude than the noise will generally give satisfactory automatic synchronization with the incoming pulse, depending upon the characteristics of the noise and the signal.

3. MAJOR UNITS, WEIGHTS AND DIMENSIONS.

Unit	*Overall Dimensions*	*Weight*
1—Pulse Analyzer 1D-46/SPA-1		14½ lbs.
1—Power Supply PP-54/SPA-1		21½ lbs.
1—Mounting *MT-52/UR	See Fig.	3 lbs.
1—Cover *CW-52/UR Steel (AN/SPA-1)	16	14 lbs.
1—Cover *CW-52/UR Aluminum (AN/SPA-6A)		4 lbs.
1—Video Cable		½ lb.
1—Power Cable		2 lbs.

4. WEIGHT ASSEMBLED.

Pulse Analyzer Equipment AN/APA-6A weighs 45½ pounds; AN/SPA-1 weighs 55½ pounds. This includes only the units pertaining to the Pulse Analyzer Equipment AN/APA-6A or AN/SPA-1 as described in paragraph 3.

5. POWER SOURCE.

Pulse Analyzer Equipment AN/APA-6A or AN/SPA-1 will operate from a single phase, 80 or 115 volts, 60 to 2600 cycle power source. The analyzer is nominally set up for 115 volt operation, but in the event an 80 volt source is to be used. a tap is provided on

the Power Transformer (T201). (See paragraph 21 for change of tap.) The analyzer is also normally connected to operate with a negative pulse input, although if necessary, tagged leads are provided to connect analyzer for positive pulse input.

6. POWER REQUIREMENTS.

Power Unit PP-54/SPA-1 is divided into two direct current supplies; one supply delivering approximately 1500 volts at 1 milliampere to the cathode ray oscilloscope tube circuit, and the other section supplying 280 volts at 100 milliamperes to the other tubes of the Pulse Analyzer ID-46/SPA-1.

The power necessary to heat the filaments of the various tubes in the analyzer is supplied by the power transformer (T201). The greater portion of the power from the high voltage supply, 1500 volts direct current is dissipated in the bleeder resistors R121, R120, R119, R118, R117, R116.

7. TUBE COMPONENTS OF PULSE ANALYZER AN/APA-6A or AN/SPA-1.

Major Units	*Tube*		*Function*
Pulse Analyzer ID-46/SPA-1	6SN7GT	(V101)	1st Video Amp. and Phase Inverter
	6SN7GT	(V102)	2nd Video Amp. and d-c Restorer
	6AG7	(V103)	3rd Video Amp.
	6AG7	(V104)	Keyer Tube
	6SN7GT	(V103)	Multivibrator
	6SN7GT	(V106)	Pulse meter Isolation Tube and Sawtooth Generator
	6SJ7GT	(V107)	Pulse meter tube
	3BP1	(V108)	Cathode Ray Tube
Power Supply PP-54/SPA-1	2X2/879	(V201)	Hi-Voltage Rectifier
	5Y3GT	(V202)	Low Voltage Rectifier
	VR150	(V203)	Voltage Regulator

8. DESCRIPTION OF MAJOR UNITS.

a. Pulse Analyzer 1D-46/SPA-1.—The Pulse Analyzer 1D-46/SPA-1 is composed of a three-stage video amplifier with a 1 microsecond delay line, multivibrator, sawtooth oscillator, calibration oscillator, pulse meter, isolating diode, and a cathode ray oscilloscope.

(1) A calibration oscillator is incorporated in the same tube as the sawtooth oscillator. The calibration oscillator supplies voltage for a sine wave on the screen of the oscilloscope tube, to calibrate the sweep in terms of microseconds, for estimating pulse durations.

(2) Pulse Meter is provided to give a numerical value of the repetition rate of pulse by direct reading.

*b. Cover *CW-52/UR.*—Cover *CW-52/UR serves as a dust cover for Pulse Analyzer Equipment AN/SPA-1. It is made of aluminum for airborne use, and steel for shipborne use, with dull black fine wrinkle finish. The cover is equipped with a fastener at the rear for securing onto the Analyzer.

c. *Mounting *MT-52/UR.*—Mounting *MT-52/UR is a mounting made of an aluminum alloy, for mounting the Pulse Analyzer AN/SPA-1. It is of airborne design and is equipped with shock mounts which are fastened to the mounting surface by 4 screws in each mount.

d. Power Supply PP-54/SPA-1.—Power Unit PP-54/SPA-1 is divided into 2 direct current supplies. One supply delivering approximately 1500 volts at one milliampere to the cathode ray oscilloscope circuit and the other section supplying 280 volts at 100 milliamperes to the other tubes of the Pulse Analyzer ID-46/SPA-1. The power necessary to heat the filaments of the various tubes in the analyzer is supplied by the transformer (T201). The greater portion of the power from the high voltage supply, 1500 volts direct current is dissipated in the bleeder resistors R121, R120, R119, R118, R117, and R116.

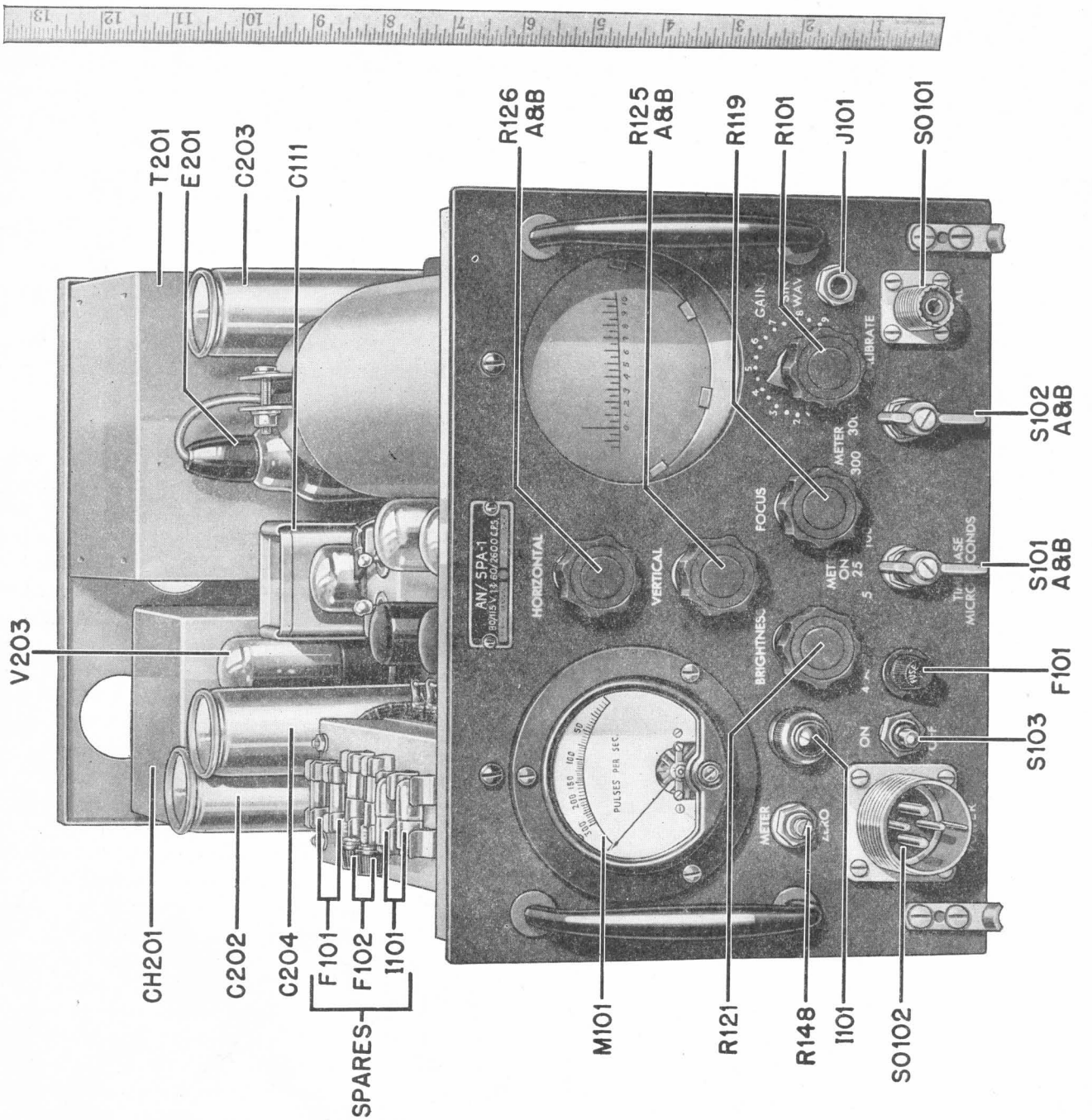


Figure 2. Pulse Analyzer Equipment AN/SPA-1 or AN/APA-6A, Partial Top View, Showing Spares and Main Components of Power Supply PP-54/SPA-1

SECTION II—INSTALLATION

9. GENERAL.

The analyzer should be located in a convenient place alongside the receiver with which it is to be used. The preferred position for the analyzer is on the right hand side of the receiver. This is so that the operator's right hand is free to manipulate the controls of the analyzer which is somewhat more elaborate than that of the receiver. The analyzer and the receiver with which it is to be used should be located in a place of minimum disturbance, vibration, and noise pick-up. The 56″ video lead which connects the analyzer to the receiver makes it possible to locate the analyzer further away than the aforementioned adjacent position which may be necessary in some circumstances where space is limited. It is advisable not to locate the receiver or analyzer next to rotating machinery or any appliances which would produce interference with the equipment. The cathode ray tube being mounted on the right hand side of the analyzer makes it unlikely to be affected by the power equipment of the receiver with which the analyzer is used. This is another reason for the analyzer to be mounted on the right hand side of the receiver. If the analyzer is mounted close to large power machinery or transformers it will be found that the strong alternating fields produced by the machines will affect the spot on the cathode ray tube and produce a widening of the trace. The widening of the trace due to magnetic interference sometimes is not objectionable. If the signal being picked up by the analyzer is a multiplier or sub-multiplier of the frequency of the disturbing electro-magnetic field producing the widening of the spot on the scope, it will be found then that the trace will be unstable, depending upon how much difference there is between the frequencies of the incoming signal and the disturbing electro-magnetic field. It will be found that the steel dust cover used on the shipborne equipment AN/SPA-1 will be of great help to shield the cathode ray tube from external electro-magnetic fields. The aluminum dust cover of course, is not a magnetic material, therefore, does not help to shield the cathode ray tube against magnetic disturbances.

10. SETTING UP THE APPARATUS.

The equipment should very carefully be unpacked so that none of the parts will be damaged. All the components should be carefully unwrapped and all paper in packing be examined for small items. The equipment should be checked over to make sure that all items on the packing slips have been unpacked and not left in packing material. All cables should be carefully unwrapped and examined to make sure that none of the material has been damaged in shipment. The set is shipped in the packing case mounted to its mounting rack. This mounting rack should be removed from the analyzer by unfastening the 2 sets of knurled fasteners on the front panel. The analyzer equipment will then come free of the mounting rack. The mounting rack should be carefully examined to make sure that all components of the rack are undamaged. The analyzer should be removed from the dust cover by unfastening the lock on the back of the dust cover. This is done with the edge of a screwdriver and by turning the stud ¼ turn to the left. It should now be possible to pull the equipment from the dust cover by use of the handles on the front panel. The set should carefully be checked over to make sure that there has been no damage done in shipment to the components. All the tubes should be examined that they are firmly fastened into their sockets. Any broken tubes should be replaced from the spare parts kit, supplied with the equipment. The tap on the power transformer should be adjusted to the correct position for the power source which is to supply the analyzer with power. For 115 volt operation the tap on the power transformer should be on terminal #3 which is clearly marked 115 volts. For 80 volt operation the power lead should be on terminal #2 which is clearly marked 80 volts. The equipment as supplied has been connected to operate on input pulses of negative polarity. If the receiver with which the analyzer is to be used supplies a positive polarity of pulse output it will be necessary to change the analyzer to receiver positive pulses. This operation is described in paragraph 20, under Maintenance. This change can be made by switching 2 wires in the analyzer which are clearly marked for the purpose. After the set has been inspected and found to be in good mechanical shape, it can be put back in the dust cover and the dust cover fastened on to the set by means of the dust cover fasteners. The mounting rack should now be fastened on to the surface determined. The dimensions for the drilling of the holes to fasten the mounting rack to the surface are shown in Figure 16. Enough space should be provided around the mounting rack to allow the equipment to vibrate rigorously from side to side and

up and down. It is suggested that at least 2 inches all around the equipment be allowed as adequate spacing for vibration. The mounting rack should be fastened to the surface with suitable screws and the grounding straps which are connected to each shock mount should be securely fastened under one of the screws which mounts the shock mount to the mounting surface. Care should be taken that all contacts are free from dirt, paint, and make good electrical connections. The analyzer may now be placed on to the mounting frame and the knurled fasteners on the front of the frame securely clamped to hold the analyzer on to the mounting frame. The power connector and the video connector can now be connected to the front panel of the analyzer. The video cable should be connected to the socket on the receiver with which it is to be used and the power cable can be connected to the plug or outlet which is to be used with a source of power to the analyzer. All ring nuts and connectors should be very securely tightened down to prevent loose connections from causing electrical disturbances in either the receiver or analyzer.

11. CABLING.

The cables which interconnect the various units must be lashed and clamped to structural braces of the aircraft or ship along their length. The power cable is made up of flexible conduit cover with metal paint which may produce an electrical noise, unless it is carefully bonded with metal structures with which it is likely to touch or rub thereon. The cable should be bonded at intervals of approximately 18 inches and the intervening lengths between bonds wrapped with friction tape or some insulation to eliminate added possibility of receiver noise arising from the source. In most cases interconnecting cables have thread retaining collars on the connectors. Make sure that the retaining collars are threaded on the sockets firmly as they provide the connection for the shield of the cable. Loose connectors cause interference.

CAUTION

Be sure the power transformer T201 of Power Supply PP-54/SPA-1 is connected to the proper primary tap for the power source available, 115 volts or 80 volts. (Par. 20.)

Insert the plug on the analyzer end of the power cable into the power plug on the front panel of Pulse Analyzer Equipment AN/SPA-1 and screw on the retaining collar.

Power Plug S0102 has four pin terminals lettered A, B, C, D, however, only A and C are used connecting ac voltage to Power Supply PP-54/SPA-1.

SECTION III—OPERATION

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. Operating personnel must at all times observe all safety precautions.

12. GENERAL.

Ascertain that all interconnecting cables and power cables are properly connected. The unit should be then turned ON by means of the ON-OFF switch S103, located on the front panel of the analyzer. A red jewel also located on the front panel indicates when the unit is ON. A period of one minute is required for the equipment to warm up, before adjusting the controls.

The two bar knobs labeled TIME BASE MICROSECONDS and METER RANGE-CALIBRATE should be placed in a vertical position. This places the left hand knob in the METER ON position and also sets the switch for a 25 microsecond time base. The meter range switch in the vertical position is on the 3000 pulses per second position. The gain control which is a knob directly below the cathode ray tube should be turned completely counter-clockwise or in the off position. The brightness control should be turned completely counter-clockwise in the off position and the focus control should be adjusted to somewhere in the middle of its range of rotation. The centering controls marked HORIZONTAL and VERTICAL should be set somewhere in the middle of their range or rotation. The power switch marked ON-OFF may now be turned to the on position. When this is done the pilot light which is directly over the ON-OFF switch should glow, indicating that power is being supplied to the equipment. After a short while the pulses per second meter should begin to indicate and the hand of the meter moved to the right hand index of the meter scale. The control marked METER ZERO has a screwdriver adjustment directly below the pulses per second meter. This control adjusts the hand of the pulses per second meter to the right hand index of the meter. The brightness control should now be turned clockwise until a spot appears on the screen of the cathode ray tube. If the horizontal and vertical controls were adjusted somewhere within the center of their range the spot should appear somewhere in the middle of the screen of the cathode ray tube. This spot is turned up until it is just visible, it can then be focused to a fine spot by rotating the FOCUS control for smallest spot size. If the receiver is now operating and putting out a signal or noise it should be possible by turning the gain control clockwise for the noise or signal input in the analyzer to increase the height of the spot until a level is reached which will cause the sweep circuits of the analyzer to trigger.

13. OPERATION OF CONTROLS.

a. "Horizontal" Centering Control.—The horizontal centering control is a dual potentiometer, which is connected between ground and low voltage B+. The movable arms of the control are connected to the 2 horizontal plates of the cathode ray tube. When the arm is moved, one plate is made more positive with respect to ground and the other plate is made less positive with respect to ground since the dual controls are connected in a "criss-cross" manner. This, therefore, permits a variable potential, either plus or minus to be applied between the 2 horizontal plates of the cathode ray tube. This makes the beam of the cathode ray tube be attracted to the plate which is positive and thus changes the direction in which the beam is moving.

b. Vertical Centering Control.—The vertical centering control is also a dual potentiometer connected in a similar fashion to that of the horizontal centering control. Rotating this control changes the position of the spot on the cathode ray tube screen in a vertical direction.

c. Brightness Control.—The brightness control is a part of the high voltage bleeder string across which the negative grid bias voltage is supplied to the grid of the cathode ray tube. By rotating this control in a counter-clockwise direction increases this negative bias developed across the resistor and therefore reduces the intensity of the spot on the cathode ray tube screen. It is possible to completely cut off the beam of the cathode ray tube by this control.

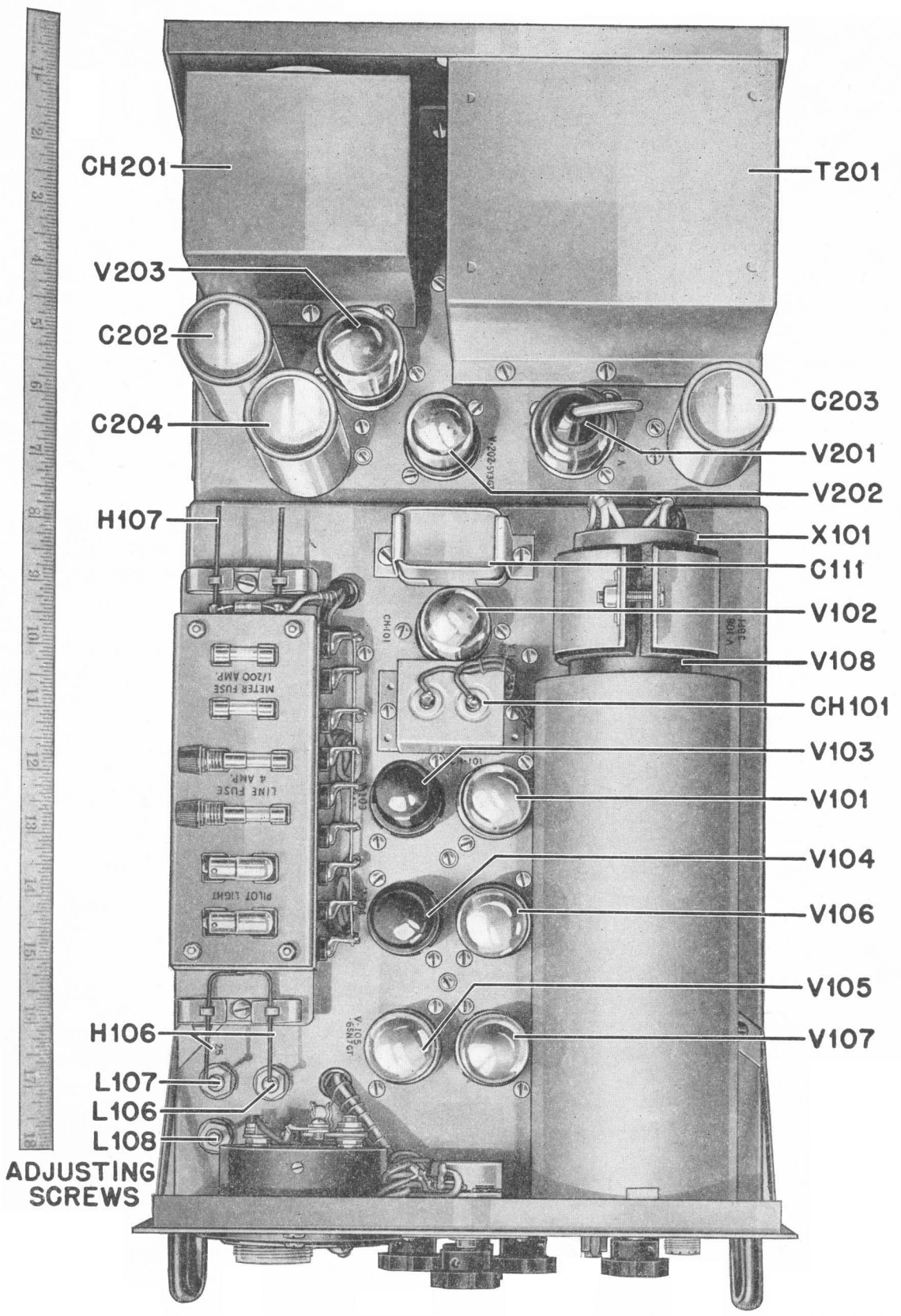


Figure 3. Pulse Analyzer Equipment AN/SPA-1 or AN/APA-6A, Top View Showing Location of Tubes and Allen Wrenches

d. Focus Control.—The focus control is also a part of the high voltage bleeder string. The first anode of the cathode ray tube commonly called the focus electrode is connected to the movable arm of this control. Rotating this control changes the voltage on this electrode and changes the electron lens in the gun of the cathode ray tube.

e. Gain Control.—The gain control is a 1000 ohm potentiometer connected across the input of the analyzer. The video amplifier is connected to the movable arm of this control. By rotating this gain control it is possible to increase or decrease the amount of voltage impressed on this video amplifier. This, of course, increases or decreases the height of the trace on the screen of the cathode ray tube in a vertical direction. This control also could be called vertical amplitude control. It is important to bear in mind when connecting the analyzer to any other piece of equipment that it is necessary to isolate any dc which may get into the analyzer by use of an external by-pass capacitor, otherwise the input control which is 1000 ohms may be burned out. It is also necessary to remember that the 1000 ohm control is a very low impedance and a suitable source must be used so that there will be no amplitude distortion due to bad coupling.

f. Time Base Microseconds Switch.—This switch controls the horizontal axis of the sweep of the cathode ray tube. This switch has 3 positions, a 5, 25, and 100 microsecond range. In the center position of the switch marked METER ON the pulse meter circuit is connected into the circuit for use in measuring repetition rates of unknown pulses. This switch changes the time constants of the multivibrator. This switch also changes the time constants in the sawtooth forming circuit in the different time bases. This switch also changes the tuned circuits in the CALIBRATE circuit, since the frequency of the tuned circuits must change with each range of time base. On the 5 microsecond range the frequency of this circuit is one mc. and should produce 5 sine waves on the screen of the cathode ray tube. Each one of these sine waves is one microsecond in duration. On the 25 microsecond range the frequency of the calibrate circuit is 200 kc. This produces also 5 sine waves on the screen of the cathode ray tube, each sine wave being 5 microseconds in duration. On the 100 microsecond position the resonant frequency of the calibrate circuit is 50 kc. producing also 5 sine waves, each sine wave being 20 microseconds in duration. Knowing the duration of these sine waves it is possible to estimate the duration of any unknown pulse which appears on the screen of the cathode ray tube, by shifting the METER RANGE switch to CALIBRATE position.

g. Meter Range—Calibrate.—This switch is a 4 position switch marked 300-3000-6000-CALIBRATE. This switch changes the time constants in the differentiating circuit of the pulse meter and serves as a multiplier for the meter. In the 300 position the multiplier is one, in the 3000 position the multiplier is 10, in the 6000 position the multiplier is 20 times the pulse meter scale reading. In the calibrate position the output of the video amplifier to the vertical plates of the oscilloscope tube are removed and the signal across the calibrate circuit is connected instead to the vertical plates of the tube. By shifting this switch from the calibrate to meter range and back again it is possible to estimate the duration of an unknown pulse by knowing the duration of the calibrate signal as mentioned in the above paragraph.

h. Meter Zero.—This control is a screwdriver adjustment and varies the fixed bias on the pulse meter tube, V107. By changing the position of this control it is possible to set the pulse meter hand to the right hand index of the dial scale. The resetting of this control may be necessary from time to time as the tube ages or the meter tube is replaced.

i. On-Off Switch.—The On-Off switch is connected in series with the power input lead to the equipment and serves to connect or disconnect the equipment from the power source.

j. Dial Light Holder.—The dial light holder is a "Dim Out" design. By rotating the shell of the panel light holder it is possible to increase or decrease the illumination produced by the pilot light in the holder. This is accomplished by 2 polaroid lenses or films which compose the removable shell which snaps into the holder. When the 2 polaroid lenses are polarized at right angles there is little illumination to get through the lenses. When the 2 lenses are polarized in the same direction there is no attenuation of the light through the lenses. This shell is removable from the panel light holder mounted on the panel by merely pulling the shell. This allows one to replace the pilot light in the holder without removing the set from its dust cover.

k. Fuse Holder.—The fuse is contained in a fuse holder gun to the right of the On-Off control and can be removed by unscrewing the knob marked FUSE and withdrawing the cap from the body of the fuse holder. The fuse is attached to the cap and can be replaced in this manner.

I. Sine Wave Jack.—Sine wave jack is on the right hand side of the panel above the signal input lead and is used to connect an external sine wave source to the horizontal plates of the cathode ray tube. Inserting a plug in this jack removes the automatic synchronized sawtooth sweep normally used in the equipment and allows the external sine wave source to produce the deflection in the horizontal direction. Inserting a plug in this jack also removes "D-C Restorer" circuit which is a part of the normal horizontal sweep circuit.

14. OPERATING WITH SIGNAL.

After adjustments are made as per paragraph titled "Initial Adjustment, the equipment should be ready to operate with a signal. When there is no signal coming in the tube, noise and Schott effect produces noise which is amplified by the analyzer and produces a trace on the screen of the cathode ray tube, commonly called "Grass." With the analyzer disconnected from the receiver or the gain control turned completely off no grass or trace should be produced on the screen of the cathode ray tube. With the gain control of the analyzer, and the gain control of receiver full on, and the input receiver shorted or the antenna removed, the amount of noise or grass should be about $\frac{1}{16}$ of an inch. This amount of noise or grass, of course, depends on the sensitivity of the equipment used and varies between units. With the antenna connected to the receiver enough noise is picked up, with no signal input, to completely fill the screen of the cathode ray tube at full gain on both the receiver and the analyzer. In operating the equipment the gain should be held to a minimum necessary to produce suitable size of a picture on the screen of the cathode ray tube. With no signal, a recommended amount of noise or grass should be about $\frac{1}{4}$ of an inch on the cathode ray tube. As soon as a signal is picked up by the receiver undoubtedly the amplitude of the picture will be much too large and it will be necessary to retard the gain control of the receiver to the point below the level at which distortion is produced to the signal due to overload. It is recommended that most of the attenuation to the signal be so taken by the gain control on the receiver and that the analyzer be operated in the full ON position as much as possible. This will be the condition which produces least amount of distortion to the signal due to overload. After a suitable picture is obtained on the screen of the cathode ray tube and it is recentered to correspond to the calibration marks on the transparent screen it is possible to make a rough sketch of the shape of the pulse or to take photographs of the signal if it is of suitable stability. The recommended size for a picture on the screen of the cathode ray tube is approximately $\frac{3}{4}$" at this level. One can be sure that there is no distortion due to overload. The pulse meter should be reading the repetition rate of the pulse if the time base microsecond switch is in the METER ON position. One can then note the repetition rate of the signal which gives one of the necessary unknown characteristics. By observation one can tell if the pulse is a simple single pulse or a group of pulses. The shape of the pulse can also be determined whether it is triangular or square or rounded.

The action of the delay line in the video amplifier is such as to allow the horizontal sweep to begin about one microsecond before the pulse appears on the screen of the cathode ray tube. This shows up on the 5 microsecond range as a space of approximately $\frac{3}{16}$" from the beginning of the pulse, to the point where the pulse begins to show in a vertical direction. This assures one that the total pulse will be observed on the screen and that there will be no part of the pulse which does not appear in view.

The equipment has several applications. One is for use in observing characteristic shapes of a signal for use in beacon spotting or flying on a beam. Beacons usually consist of a group of pulses with variable spacing between them. They may consist of a single short pulse followed by two long ones or any combination of long and short pulses which is of course necessary to be able to recognize the characteristic signal of a beacon, either one's own or the enemy's. By being able to see on the cathode ray tube the exact shape of this unknown signal the characteristic may be recognized and can be of use in telling one's position. Another application of the equipment is to tell the difference in time between two pulses with range finding equipment. There will be two pulses appearing on the screen of the cathode ray tube. The first pulse will be that of the transmitted pulse, the second will be that of the received or echo pulse. By knowing the distance between these pulses, one can tell how far away is the object that produces the echo. All this estimation of distance or duration of time is done by switching the calibrate switch so that sine waves appear on the screen to calibrate the horizontal time base, as explained in operation of controls.

SECTION IV—ELECTRICAL CHARACTERISTICS

15. PULSE ANALYZER 1D-46/SPA-1, ELECTRICAL FUNCTION.

Analyzer Equipment AN/SPA-1 is used in conjunction with a receiver, such as the Radio Receiver Equipment AN/APR-1 or AN/SPR-1, capable of receiving pulse signals. The output of the radio receiver is connected to the Pulse Analyzer 1D-46/SPA-1, video input receptacle (SO 101), by a shielded video cable supplied with the proper connectors. The input signal is impressed across the GAIN potentiometer (R101). A portion of the signal is then taken from the GAIN potentiometer (R101) by the rotating arm and is coupled to the grid of Tube 6SN7GT (V101), pin #1 through capacitor (C102). Resistor (R104) is a grid coupling resistor which connects the grid of Tube 6SN7GT (V101) with its bias supply. Resistor (R102) is the plate load resistor across which is developed the signal coupled to the grid of Tube 6SN7GT (V101), pin #4 through capacitor (C103). Coil (L101) is a high frequency boost coil which compensates for the distributed capacity of the associated circuit wiring. Capacitor (C101) is a by-pass capacitor to ground which constitutes the return for the signal current to ground; capacitor (C101) also in conjunction with resistor (R103), constitutes a plate filter to eliminate hum from being impressed on the signal, and also functions as a low frequency compensating circuit. The signal developed across resistor (R102) by the plate current of Tube 6SN7GT (V101), section A, is coupled to the grid of Tube 6SN7GT (V101), section B, through coil (L102) and capacitor (C103). Coil (L102) and coil (L101) together constitutes a high frequency filter which compensates for the distributed capacity of the associated circuit wiring. Capacitor (C103) is a coupling capacitor which serves to keep high positive plate voltage from being impressed on the grid of Tube 6SN7GT (V101), section B. Resistor (R105) is a grid coupling resistor and also serves as a d-c return to ground for the grid of Tube 6SN7GT (V101), section B. Resistor (R106) is a cathode bias resistor and also serves as a cathode coupling resistor for Tube 6SN7GT (V101), section B.

The signal impressed upon the grid of Tube 6SN7GT (V102), section A, is developed by the plate current of Tube 6SN7GT (V101) section B, through resistors (R107 and R108). Tube 6SN7GT (V101), section B, is a phase spliter which supplies both positive and negative phase output signal. The signal in the plate circuit of Tube 6SN7GT, (V102), section B, is coupled to the DELAY LINE (DL101) through resistor (R107).

The DELAY LINE (DL101) consists of a condensed transmission line with high delay constant which delays the signal traveling the line. The purpose of this delay line is to permit the start of the sweep of the Cathode Ray Tube oscilloscope one microsecond before the signal to be observed is applied to the vertical plates of the oscilloscope, thus permitting the total signal to be observed. Resistor (R108) is the terminating resistor for DELAY LINE (DL101). Capacitors (C104 and C105) are plate by-pass capacitors which together with resistor (R109) constitutes a plate filter of Tube 6SN7GT (V101), section B. The signal developed across resistor (R108) by the plate current of Tube 6SN7GT (V101), section B is coupled to the grid of Tube 6SN7GT (V102), section A, by capacitor (C106). Resistor (R110) is a grid coupling resistor and supplies grid return to the bias supply for Tube 6SN7GT (V102), section A. Resistor R111 is the plate load resistor for Tube 6SN7GT (V102), section A. Coils (L103 and L104) constitutes a plate filter which compensates for the distributed capacity of the associated circuit wiring. The signal developed across resistor (R111) by the plate current of Tube 6SN7GT (V102), section A, is coupled to the grid of Tube 6AG7 (V103) through coil (L104) and capacitor (C107). Resistor (R112) is a grid coupling resistor. Resistors (R113 and R114) are the screen grid dropping resistors for Tube 6AG7 (V103). Capacitor (C108) is a screen grid by-pass capacitor for Tube 6AG7 (V103). Resistor (R115) is a plate load resistor for Tube 6AG7 (V103) across which is developed the signal by the plate current of the tube. Coil (L105) is a high frequency compensating coil which together with the distributed capacity of the associated circuit wiring constitute a low pass filter and compensates for distributed capacity of the circuit wiring.

Switch (S102A), is a single pole-four position switch which connects the video amplifier signal to the vertical deflecting plates of the Cathode Ray Tube 3BP1 (V108) in the first three positions. The fourth position disconnects the video amplifier from the oscilloscope plates and connects the calibrating circuit in its place.

The Pulse Analyzer ID-46/SPA-1 as supplied by

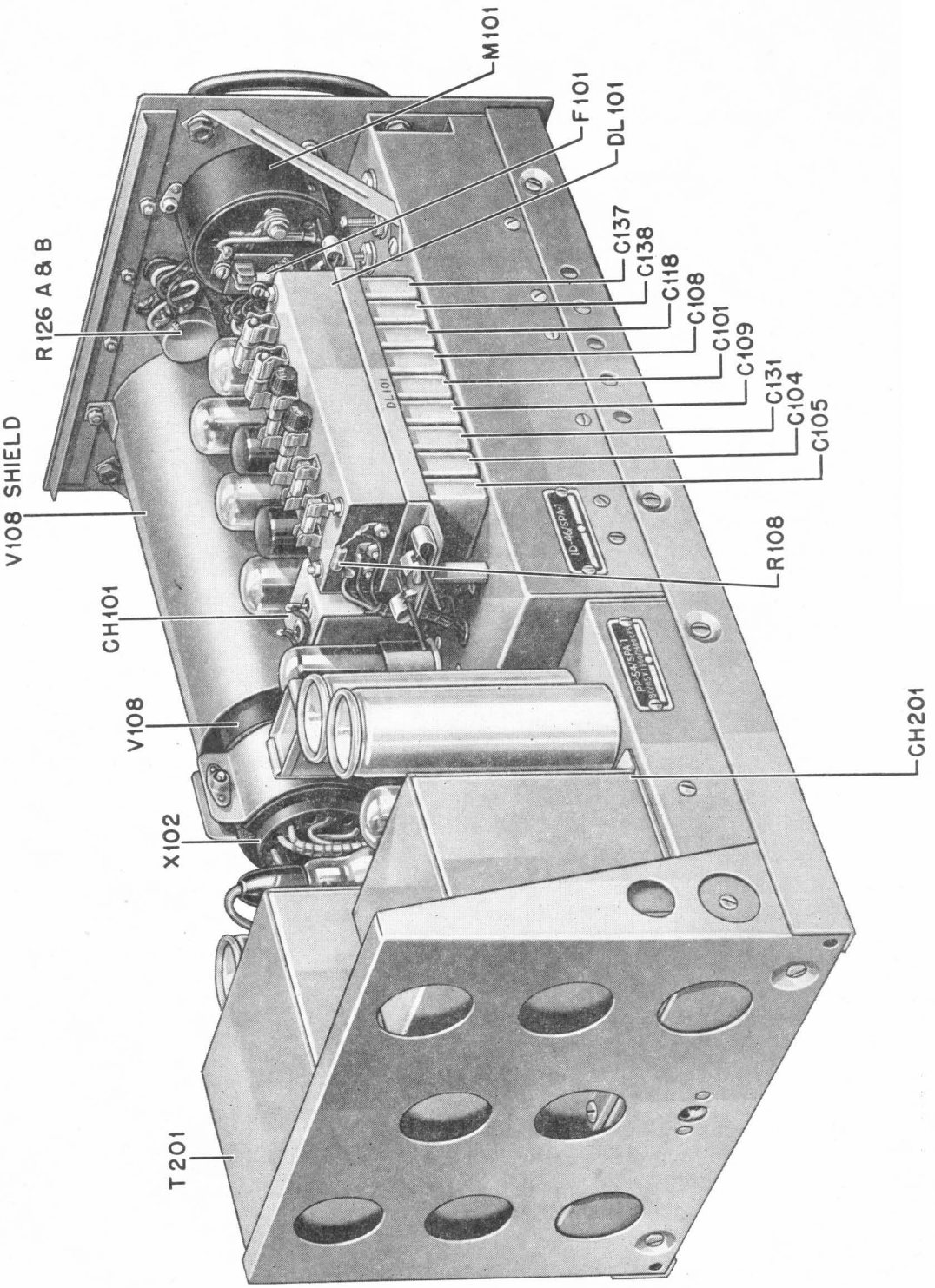


Figure 4. Pulse Analyzer Equipment AN/SPA-1 or AN/APA-6A, Left Rear View, Showing Location of Delay Line and Capacitors

the manufacturer is connected to receive negative polarity signals. In order to operate the analyzer with positive pulse signals, it will be necessary to shift two tagged leads on the bottom of the analyzer to positions labeled with red tags, as shown on the schematic diagram, Figure 17. Moving these tagged leads shifts the bias of Tube 6AG7 (V103) from a minus value to zero to allow full swing of the signal on the grid since the signal to be observed is usually asymetrical. Shifting the lead on terminal strip "C" changes the polarity of the signal impressed upon the grid of Tube 6AG7 (V104). It is necessary for proper operation of the sweep that the polarity of this signal be positive.

Capacitor (C115) is a grid coupling capacitor to the grid of Tube 6AG7 (V104). Resistor (R128) is the grid coupling resistor for Tube 6AG7 (V104). Resistor (R130) is a screen dropping resistor for Tube 6AG7 (V104). Capacitor (C116) is a screen by-pass capacitor. Resistors (R131 and R130) constitute a voltage divider to supply the proper voltage to screen of Tube 6AG7 (V104). Capacitor (C116) and Resistor (R131) constitute a time constant which allows the screen voltage to adjust itself to a value which will maintain approximately uniform keying sensitivity of the keyer-multivibrator combination throughout the operating range. Resistor (R134) is a plate load for tube 6AG7 (V104). The signal developed across (R134) is coupled to the grid of Tube 6SN7GT (V105), section B, by capacitor (C120). Tube 6SN7GT (V105), sections A and B, is a multivibrator which fires once for each incoming pulse. The two sections are arranged in a multivibrator circuit with one grid biased beyond cut-off which makes the circuit inoperative. Tube 6SN7GT (V105), section B, is the ON tube, section A is the OFF tube. Plate current for both sections flows through resistor (R135) which supplies grid bias for the multivibrator. Capacitor (C118) is a by-pass capacitor for the cathode of Tube 6SN7GT (V105), sections A and B. The grid return for tube 6SN7GT (V105), section B, namely resistor (R137), is connected to B plug. The grid for Tube 6SN7GT (V105), section A, is returned to ground by resistor (R140). The ON tube has plate current flowing during the period that the multivibrator is not being triggered by a signal. The cathode and the grid of Tube 6SN7GT (V105), section B, are at practically the same potential due to the diode action between these elements, thus this section has practically no d-c bias to prevent flow of plate current. Resistor (R136) is a plate load resistor for the multivibrator. Tube 6SN7GT (V105), section B. Capacitor (C119) couples the plate of the multivibrator tube 6SN7GT (V105), section B, to the grid of section A. Resistor (R133) is the plate load resistor for section A of the multivibrator. The negative input signal from the keyer drives of the grid Tube 6SN7GT (V105), section B, beyond cut-off, thus stopping the flow of plate current in this section of the multivibrator and causing the voltage on the plate to rise in a positive direction. This positive signal is coupled to the grid of section A through capacitor (C119). The grid current flowing through resistor (R140) during the firing period tends to keep the grids of Tube 6SN7GT (V105), section A, and Tube 6SN7GT (V107), section A, at a constant potential, thus shaping the pulse applied to the frequency meter Tube 6SJ7GT (V107). When this positive pulse is impressed upon the grid of tube 6SN7GT (V105), section A, plate current flows through resistor (R133) and the voltage on the plate of this section is reduced, thus producing a negative pulse. This negative pulse is coupled back to the grid of section B of the multivibrator through capacitors (C123, C124) and the stray wiring capacity, depending upon which range is chosen for the multivibrator. This negative pulse drives the grid of tube 6SN7GT (V105), section B, far beyond cut-off and due to the constant voltage on the grid of section A, the amplitude of this pulse is practically constant for all conditions of operation. The time constant determined by capacitors (C123, C124) and the stray wiring capacity with resistor (R137) determines how long a period of time will elapse before this negative voltage permits section B to operate again. The grid voltage of Tube 6SN7GT (V105), section A, and the plate voltage of section B is approximately a square wave. This square wave is used to key the intensity grid of the cathode ray tube 3BP1 (V108), thus producing a trace on the screen during the time that the multivibrator is operating. The negative pulse which appears on the grid of Section B and the plate of section A is coupled to the grid of tube 6SN7GT (V106), section B through capacitor (C121) and the parallel circuit of resistor (R139) and capacitor (C122). Resistor (R139) and capacitor (C122) in parallel constitute a partially differentiating circuit which serves to square up the pulse supplied by the multivibrator to the grid of Tube 6SN7GT (V106), section B. Resistor (R141) is a grid coupling resistor for tube 6SN7GT (V106), section B. Resistors (R142, R143) and choke (CH101) is the plate load for Tube 6SN7GT (V106), section B. Choke (CH101) is an iron core choke of approximately 100 henries which increases the linearity and amplitude of the sawtooth developed in the plate circuit of Tube 6SN7GT (V106), section B. Capacitors (C126, C127) and the stray wiring capacity are the discharge

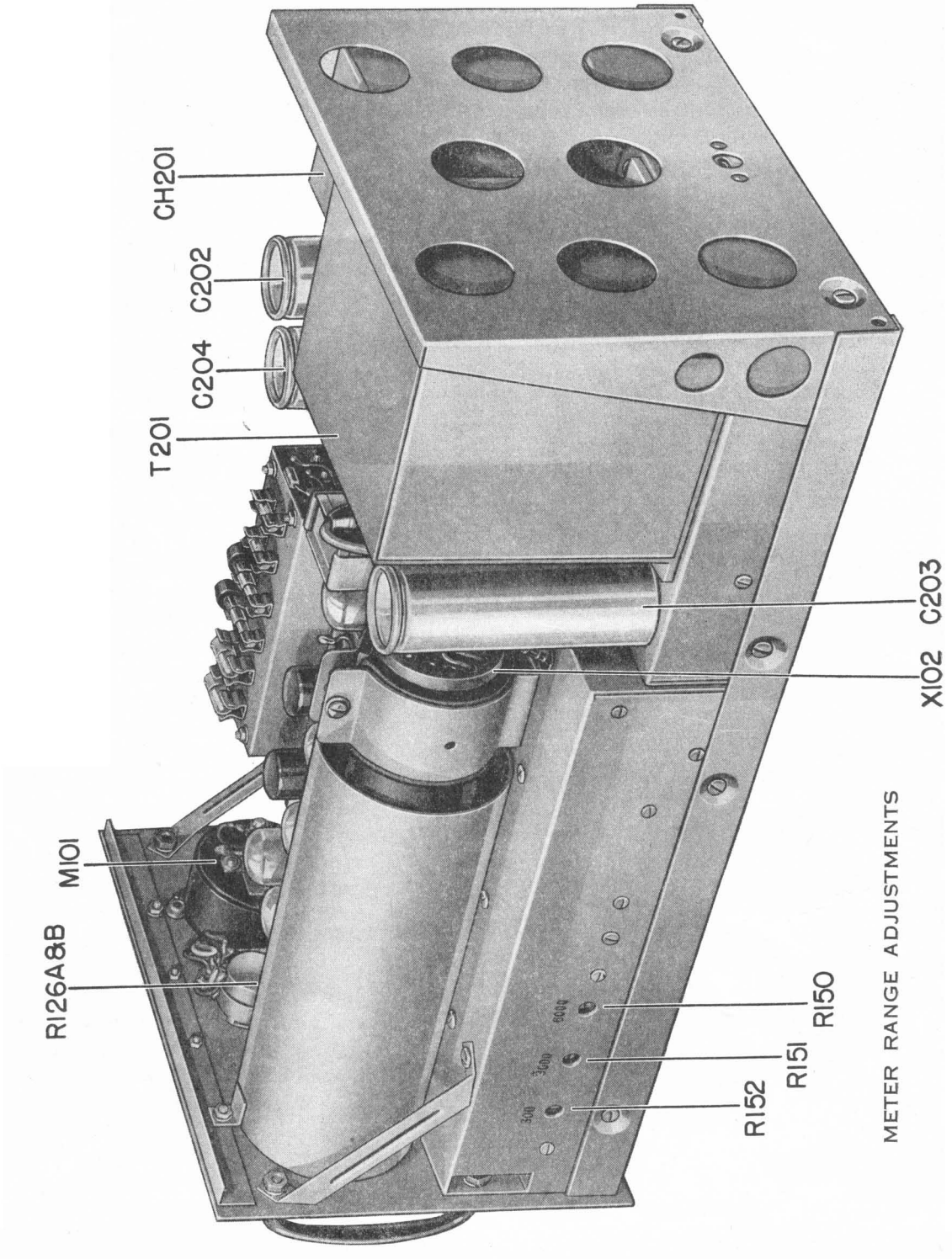


Figure 5. Pulse Analyzer Equipment AN/SPA-1 or AN/APA-6A, Right Rear View, Showing Location of Meter Range Adjustment Controls

capacitors for the sawtooth forming circuit. In the cathode circuit of Tube 6SN7GT (V106), section B, is a tuned circuit which is used to form the calibrating sine waves to be placed on the cathode ray tube screen for analyzing the duration of pulses. Coil (L108) with capacitor (C128) supply the 50 kc. signal, coil (L107) and capacitor (C129) supply the 200 kc. signal, coil (L106) and capacitor (C130) supply the 1 mc. signal. These are switched into the circuit by the range switch S101A TIME BASE. The meter range-calibrate switch S102A shorts out these coils during the observation of pulses. The negative pulse from the plate circuit of tube 6SN7GT (V105), section A, when applied to the grid of tube 6SN7GT (V106), section B, cuts off the plate current in that section of the tube and allows the plate voltage across the tube to increase and charge the capacitors (C126, C127) and the stray wiring capacity in a sawtooth form. After the duration of this negative pulse the grid voltage returns to zero and allows plate current again to flow in the tube. This causes the voltage on the plate to decrease to a value determined by the steady plate current of tube 6SN7GT (V106), section B, through resistors (R142, R143), and choke (CH101). When the calibrating circuit is connected in the cathode of tube 6SN7GT (V106), section B, the stopping of plate current through this tube by the negative pulse applied to the grid causes the tuned circuit in the cathode to oscillate with a sine waveform for the duration that the tube is cut off. When the plate current again starts to flow in the tube it effectively damps the oscillations for the cathode circuit. These oscillations are picked off by switching S102 to CALIBRATE position which connects the vertical plates of cathode ray tube 3BP1 (V108) across this tuned circuit. This switch also removes the video signal which was formerly connected to these vertical plates. The positive pulses which appears on the grid circuit of Tube 6SN7GT (V105), section A, is directly coupled to the grid of tube 6SN7GT (V106), section A. This tube is an isolation tube for the pulse meter circuit. Resistor (R138) is a plate load for this amplifier tube. This tube also acts as a limiter which prevents differences of multivibrator amplitude from causing false readings on the pulse meter. Switch (S101B) connects the pulse meter circuit to the multivibrator in the center position of the switch. The negative pulse output from the isolation tube 6SN7GT (V106), section A, is differentiated and applied to the grid of Tube 6SJ7GT (V107). There are 3 ranges for the pulse meter circuit: 300 cycle, 3,000 cycle, and 6,000 cycle range. Capacitor (C135) and resistor (R152) is the time constant for the 300 range. Capacitor (C134) and resistor (R151) is the time constant for the 3000, range. Capacitor (C133) and resistor (R150) in series with the resistor (R149) is the time constant for the 6,000 cycle range. Tube 6SJ7GT (V107) is a pentode tube which acts as a peak vacuum tube voltmeter and measures the voltage across the resistor of the differentiating circuit mentioned before. The potentiometers (R150, R151, and R152) are adjusted to calibrate the meter circuit for each range. Capacitor (C132) is the grid coupling capacitor through which this differentiated pulse is applied. Resistor (R144) is the grid coupling resistor which supplies the grid return for Tube 6SJ7GT (V107). Resistors (R147) and (R148) are the cathode bias resistors for Tube 6SJ7GT (V107). Resistor (R148) is an adjustable control to set the maximum deflection on the pulse meter. Capacitor (C136) is a by-pass capacitor for the cathode. Capacitor (C138) is the by-pass capacitor for the screen grid of this tube. Resistor (R146) is a screen dropping resistor which supplies the tube with screen voltage. Resistor (R145) is a plate load resistor for Tube 6SJ7GT (V107) and serves to prevent the a-c voltage developed across the plate circuit of tube 6SJ7GT (V107) from being applied to the pulse meter (M101) directly. Fuse (F101) is a meter fuse and prevents overloads or accidental short circuits from burning out the meter. The zero signal plate current is set by resistor (R148) and corresponds to maximum deflection of the meter. When a signal is applied to the analyzer, the multivibrator circuit is triggered with each incoming pulse. The multivibrator pulses differentiated by the time constants and applied to the grid of tube 6SJ7GT (V107) vary in amplitude in accordance with the repetition rate of the observed pulse, that is, the higher the repetition rate the higher will be the amplitude of the differentiated pulse across this circuit. The higher voltage applied to grid of tube 6SJ7GT (V107) causes the grid to draw more current due to grid rectification and produces a higher bias on the grid of this tube. This higher grid bias causes the plate current to decrease and since the pulse meter is connected in the plate circuit the reading on the meter will have a lesser deflection. The scale on the meter is calibrated in pulses per second with higher frequency corresponding to lesser plate current through the meter, thus the higher the repetition rate of the multivibrator, the higher will be the grid voltage on the meter tube causing higher grid bias with lesser plate current flowing through the meter and lesser indication. Capacitor (C136) is a coupling capacitor which couples the video signal from the video amplifier to the vertical plates of the cathode ray tube 3BP1 (V108). Cathode ray tube 3BP1 (V108) is a

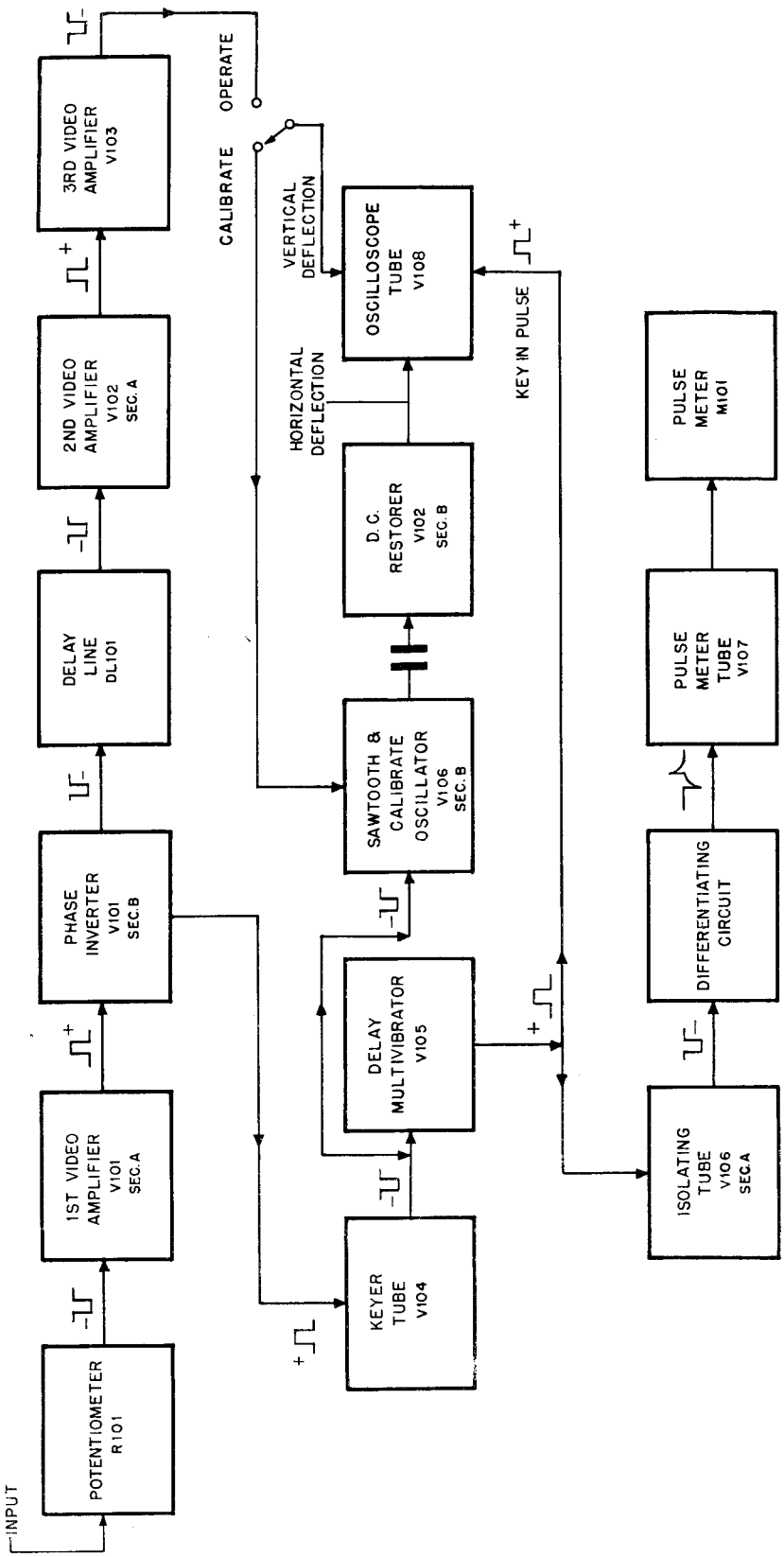


Figure 6. Block Diagram for Pulse Analyzer ID-46/SPA-1

3-inch cathode ray oscilloscope tube. A short duration sawtooth is applied to the horizontal plate of this tube through capacitor (C125) and causes the beam to sweep in a horizontal direction with each incoming pulse to the analyzer. This sawtooth sweep is obtained from Tube 6SN7GT (V106), section B. The vertical pulses of this oscilloscope tube are connected to the video amplifier in 3 positions of the meter range switch (S102A and B) and to the calibrating circuit in the cathode of Tube SSN7GT (V106), section B, when switch (S102A and B) is in the CALIBRATE position.

In order that the cathode ray tube work only for the short duration of the sweep and not burn the screen during the no sweep time, the grid is biased beyond cut-off by adjusting resistor (R121). During the sweep period the grid is pulsed in a positive direction which unbiases the grid of cathode ray tube 3BP1 (V108) and allows a spot to appear on the cathode ray tube screen. The pulse for this operation is obtained from tube 6SN7GT (V105), section B of the multivibrator and is applied to the cathode ray tube grid through capacitor (C114) in parallel with resistor (R129) and in series with capacitor (C110).

Capacitor (C114) and resistor (R129) is a time constant which partially differentiates the pulse from the multivibrator and causes a square wave to be available for unbiasing the grid of the cathode ray tube (V108). Resistor (R122) is a grid coupling resistor for (V108). Resistor (R121) is the "Brightness" control. Resistors (R116, R117, R118, R119, R120 and R121) constitute the bleeder string for the high voltage power supply. Resistor (R119) is the FOCUS control and adjusts the voltage on the focus anode on the cathode ray tube 3BP1 (V108). Capacitor (C109) is a by-pass capacitor for the grid bias developed by this high voltage supply across resistors (R117 and R116). Grid bias developed across resistor (R116) is applied to the first and third video amplifier tubes. Voltage developed across (R117 and R116) is used to bias the last video amplifier tube 6AG7 (V103). Capacitor (C111) is a high voltage filter capacitor. In series with capacitor (C125), the capacitor which couples the horizontal sawtooth sweep into the horizontal plate of cathode ray tube 3BP1 (V108), is connected a "sine wave jack" (J101). The purpose of this jack is to allow the removal of the sawtooth sweep and to permit an external sine wave sweep to be inserted on the horizontal plate of cathode ray tube 3BP1 (V108) as an additional method of determining the repetition rate of the pulse to be analyzed.

The frequency of this sine wave signal can be varied until the picture of the unknown pulse is stationary on the screen of the cathode ray tube. Then, if there is no double trace or bias line showing across the bottom of the observed pulse, the repetition rate of the unknown signal is the same as that of the calibrated sine wave source which is applied to the sine wave jack. Capacitor (C117) is a coupling capacitor which couples the sine wave signal to the horizontal plates of tube 3BP1 (V108). Resistor (R132) is a coupling resistor for the horizontal plate of cathode ray tube 3BP1 (V108). Resistor (R123) is a coupling resistor for the vertical plates. Capacitor (C112A) is a by-pass capacitor for the grounded plate of the vertical deflection circuit. Capacitor (C112B) is the by-pass for the grounded plate of the horizontal deflection circuit. Capacitor (C113A) is the by-pass capacitor for potentiometer (R125A) and serves to prevent a-c ripple from being applied to the vertical plate of oscilloscope tube 3BP1 (V108) through resistor (R123). Capacitor (C113B) is a by-pass capacitor for potentiometer (R126A) and serves the same purpose as capacitor (C113A). Potentiometer (R126B) and R126A) is the horizontal centering control and supplies the horizontal plates with the necessary voltage for shifting the beam over the screen of cathode ray tube 3BP1 (V108). Potentiometer (R125B and R125A) is the vertical centering control and serves to shift the beam over the screen of the cathode ray tube 3BP1 (V108) in a vertical direction. These controls are so connected that an equal d-c voltage is applied to each plate of the pair but of opposite polarity. This keeps the voltage between the two deflecting plates balanced and prevents spot distortion. Resistors (R127) and (R124) are resistors which permit the average voltage on the vertical plates to be the same as the average voltage on the horizontal plates. This also helps to prevent spot distortion on the cathode ray tube 3BP1 (V108).

16. POWER SUPPLY PP-54/SPA-1, ELECTRICAL FUNCTION.

Either 80 or 115 volt, single phase, power having any frequency from 60 to 2600 cycles can be used with Power Supply PP-54/SPA-1. This unit contains a power transformer T201, having a tapped primary winding for operation at either 80 or 115 volts (connected at the factory for 115 volts) and five secondary windings. No. 1 (terminals 9 and 10) supplies 2.5 volts, 1.75 amperes a-c to the heater of rectifier tube 2X2/879 (V201). Between terminals 10 and 5 is high voltage a-c to develop the cathode ray tube potential. No. 2 (terminals 4 and 6 with 5 C.T.) supplies 300 volts, 100 ma. a-c to the plates of rectifier tube 5Y3GT (V202). No. 3 (terminals 7 and 8) supplies

5 volts, 2 amperes to the heaters of rectifier tube 5Y3GT (V202). No. 4 (terminals 13 and 14) supplies 6.3 volts, .60 amperes to heater of 3BP1 (V108). No. 5 (terminals 11 and 12) supplies 6.3 volts, 3.65 amperes to all the other heaters of Pulse Analyzer ID-46/SPA-1. The output of rectifier tube 2X2/879 (V201) is filtered by capacitor C201 and resistor R201, connected to terminal #1 of terminal strip E201. The output of rectifier tube 5Y3GT (V202) is filtered by capacitors (C202, C203, C204), and choke (CH201). Resistor R204 acts as a bleeder. The outupt is connected to terminal #6 of terminal strip E201. Voltage regulator tube VR-150/30 (V203) is connected to terminal #6 of terminal strip E201. The current for the voltage regulator VR-150/30 flows through resistor R203. The output supplies regulated 150 volts, connected to terminal #5 of terminal strip E201.

SECTION V—MAINTENANCE

17. EQUIPMENT RECOMMENDED FOR SERVICING SET.

1. SYN-15 Synchroscope manufactured by Galvin Mfg. Corp., or equivalent.
2. One RCA Voltohmyst, Jr., or equivalent.
3. Hewlitt-Packard audio oscillator #205A or equivalent.
4. One square wave generator, Hewlitt-Packard #201A, or equivalent.
5. One Simpson multi-range meter #260, or equivalent.

No doubt a lot of the above-mentioned equipment will not be available in the fields, therefore, substitutions will have to be made to accomplish the same purpose for which the equipment is to be used.

18. PULSE METER.

In place of the audio oscillator and square wave generator which is to be used in checking and calibrating the pulse meter circuit, it is possible to use radar signals or pulses of any high signal whose repetition rates are accurately known and can be used to adjust and calibrate the meter circuit of the analyzer. If the pulse meter circuit is to be checked due to suspicions of inaccuracy or if changing tubes, the following procedure should be followed: The signal should be removed from the analyzer and the time base microsecond switch placed in the meter ON position. At this time the meter zero control should be adjusted so that the meter pointer is at the right hand index of the dial scale. Then a signal of known repetition rate should be connected to the analyzer and the reading of the meter noted. The meter range should be placed in the position which will include the repetition rate of the signal in its range. If the meter reading is off calibration, the adjustments on the right hand side of the analyzer chassis will have to be realigned.

This necessitates removing the analyzer equipment off its shock mount and from the dust cover. After the analyzer is pulled part way from the dust cover, (about 4 inches is adequate), a screwdriver may be inserted through the proper hole in the side of the chassis which corresponds to the setting of the meter range switch and the control varied until the meter reads the correct repetition rate of the calibrating signal. All the 3 ranges may be adjusted in this manner if enough known signals are provided.

19. CALIBRATING COILS.

The SYN-15 Synchroscope is very useful in adjusting the sine wave calibrating circuit because it has a self-produced trigger circuit which will operate analyzer and an oscilloscope section which can be used to pick off the sine wave signal from the calibrating circuit in the analyzer. By superimposing the known markers contained in the SYN-15 Synchroscope upon the sine wave signal being picked off the analyzer, it is possible to adjust the tuned coils and the sine wave signal circuit to the exact frequency required. It will be found that an additional amplifier may be necessary to pick off the signal when the equipment is operated on the 5 microsecond time base. For this position the analyzer calibrating tuned circuit frequency is one mc. and unless a very small capacitor of not more than 2 $\mu\mu$f is used for coupling, detuning of the calibrating circuit in the analyzer will be produced. With a 2 $\mu\mu$f capacitor, for coupling, very little signal will be available in the synchroscope, therefore, an additional amplifier will be necessary to get this signal up to a usable level. On the other two ranges of sweep no trouble should be experienced by detuning due to the coupling, by the added capacity of the synchroscope, on the tuned circuits of the calibrating section. The markers on the synchroscope are calibrated in 2, 10 and 25 microseconds. On the 5 microsecond range on the analyzer each sine wave is 1 microsecond, therefore, one marker on the synchroscope should appear on every other sine wave picked up on the analyzer. On the 25 microsecond range of the analyzer the resonant frequency is 200 kc., therefore, each sine wave is 5 microseconds long and the 10 microsecond marker should be used on the SYN-15 Synchroscope. This will then permit one marker on the synchroscope to appear on every other sine wave picked up from the analyzer. See Paragraph 40, applicable to all three ranges of calibrating signal.

In the 100 microsecond position on the analyzer the calibrating sine wave is 50 kc. This means that each sine wave will be 20 microseconds long in duration. The 10 microsecond marker should again be used on the SYN-15 and superimposed on the sine waves picked up from the analyzer. One marker on the synchroscope should appear on the peak and the valley of each sine wave as seen on the SYN-15, if correctly aligned. The adjustments for the calibrating coils are mounted on the analyzer chassis directly behind the pulse meter. These are clearly labeled 5,

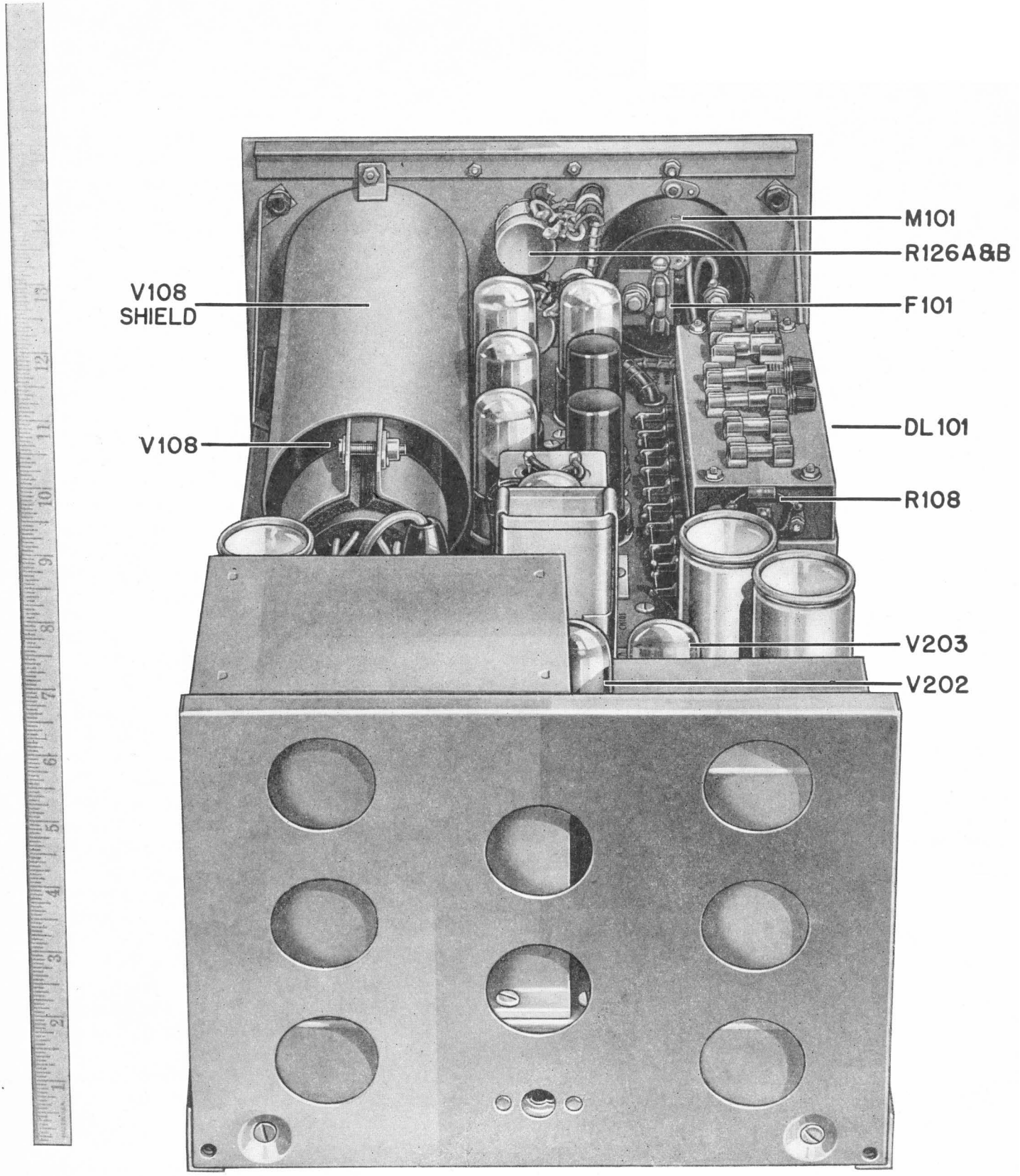


Figure 7. Pulse Analyzer Equipment AN/SPA-1 or AN/APA-6A, Rear View

25, and 100 which corresponds to the 3 positions of the time base microseconds switch. A 3/16" hex wrench is required for adjusting these screws and the one supplied with APR-1 radar receiver is suitable for this purpose. Any 3/16" hex wrench or spintite may be used, but care should be taken when adjusting these screws so as not to short circuit the meter due to accidentally grounding the wrench against the exposed pulse meter terminal. These coils are tuned with an iron core and the inductance is increased by turning the wrench to the right which screws the core into the coil and thereby increasing its inductance. An alternative method for adjusting these calibrating coils in case there is no SYN-15 synchroscope, is to rely on the width of a known pulse. It is possible to line up the 3 ranges of calibrating circuit if a large enough assortment of these known pulses are available. The procedure is to apply the pulse to the analyzer and observe on the cathode ray tube screen the width of the pulse and then to adjust the calibrating circuit tuning coils until the proper number of sine waves or a fraction of a sine wave fills up the same space. This method is, of course, very much less accurate than the method mentioned, using the SYN-15 Synchroscope or equivalent.

20. POLARITY SWITCH.

The AN/SPA-1 pulse analyzer as supplied from the factory is connected to operate on negative input pulses. In order to use the analyzer with receivers which have a positive pulse output it is necessary to change the analyzer for correct operation. This is accomplished by changing the two tagged leads in the bottom side of the analyzer. One tagged lead is on terminal strip B, on the left hand side of the chassis, which for negative polarity is connected between terminal #16 and terminal #18 of the board. To operate on positive polarity this tagged lead should be disconnected and reconnected so as to join terminal #14 and terminal #18. The other tagged lead is on terminal strip C, on the right side of the chassis base and is the lead which comes from the keyer tube. It is connected to terminal #17 for negative polarity. For positive polarity it is necessary to disconnect it from terminal #17 and connect it to terminal #16.

Changing these 2 leads accomplishes two purposes. The first change on terminal strip B changes the bias on the last video tube V103 for negative polarity. It is necessary that the bias on this tube be high, due to the fact that the signal polarity at that particular grid is in a positive direction. In positive input polarity, however, the polarity of the signal at the grid of the last video is in the negative direction. Therefore, there is no need of bias on this tube. The second lead which is on terminal strip C, merely changes the input connection of the keyer tube so that it will always have a positive polarity on its grid. This is necessary for proper operation on the keyer circuit. This switching is accomplished by connecting this lead either to the plate or the cathode circuit of the phase inverter tube, since there is a phase difference of 180° between signal appearing on the plate circuit, and that on the cathode.

21. 80 VOLT OPERATION.

The AN/SPA-1 equipment as supplied by the factory is connected for 115 volt operation. Some installations are equipped with 80 volt sources which make it necessary to have a means of operating 115 volt equipment on this lower voltage. A tap is provided on the power transformer from the analyzer which permits the equipment to operate on 80 volts. Without this tap an auto transformer or other kind of step-up transformer would be required. The change of 80 volt operation is accomplished by merely disconnecting the flexible lead to terminal #3 on the power transformer and moving it to terminal #2. Both terminal are clearly marked with their proper voltage.

22. REPLACING COMPONENTS.

a. The cathode ray tube 3BP1 is the only tube used in the analyzer which is slightly difficult to replace. The procedure to replace this tube is as follows: After the set is removed from the dust cover, the clamp which holds the 3BP1 tube base and tube socket together should be loosened by removing the screw on the clamp. After this is done it will be possible to push the cathode ray tube back into the set by pressing on the screen of the cathode ray tube, through the opening on the front panel. Pressing it back 1/4" approximately, will be adequate for removal purposes. The flange or screen retaining strap which holds the transparent screens against the face of the cathode ray tube should be removed from the front of the panel. To remove this strap it is necessary to grip the lip of the strap which hangs down from the top of the cathode ray tube opening with a pair of pliers and by pulling downward and out, with a slight turning of the wrist, the strap should come loose from its seat inside the cathode ray tube opening. After this retaining strap is out it is very easy to remove the two transparent screens in front of the cathode ray tube by pressing the back of the cathode ray tube forward until the screens fall out. Now the tube socket

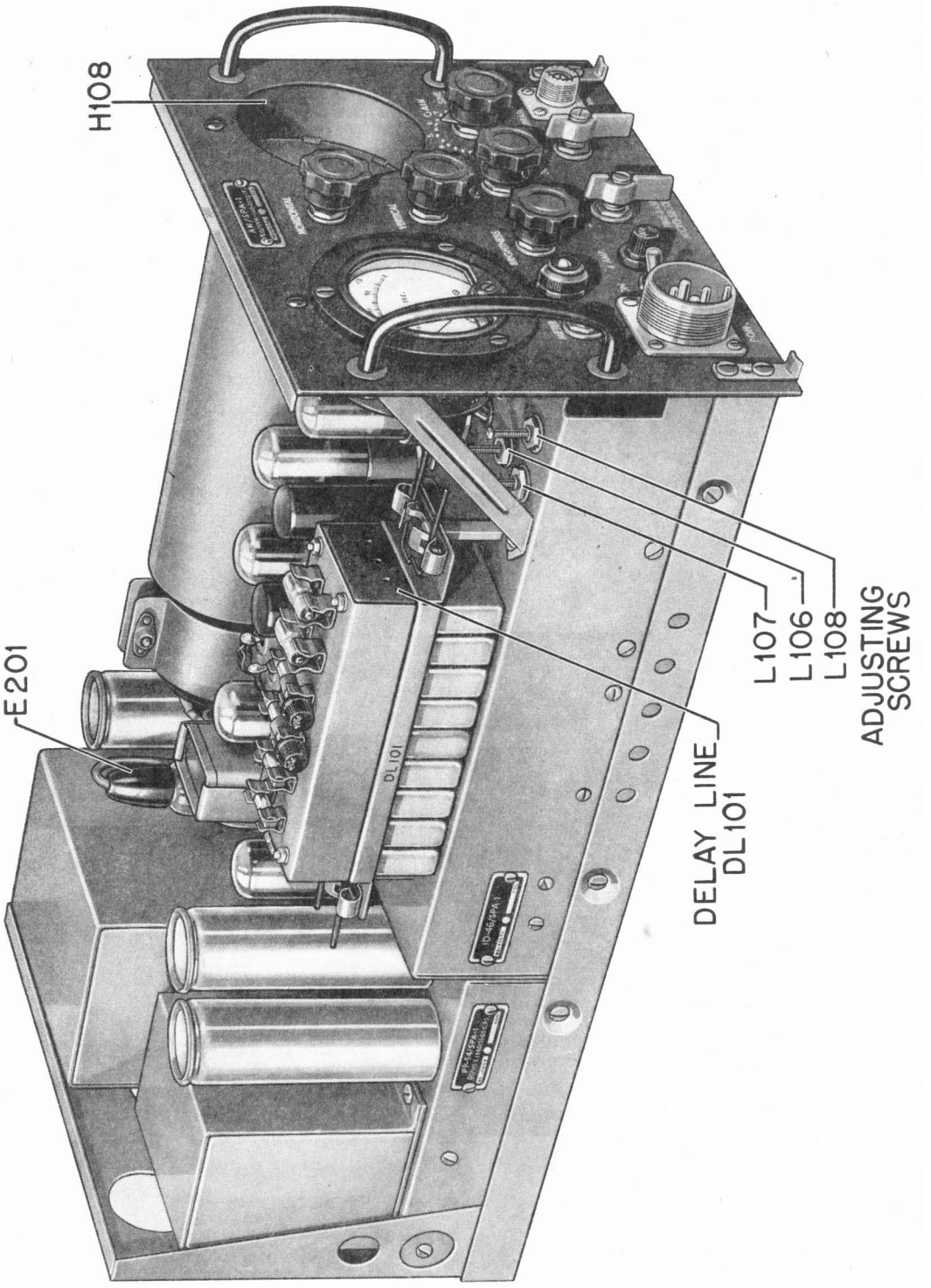


Figure 8. Pulse Analyzer Equipment AN/SPA-1 or AN/APA-6A, Left Side View

should be removed from the base of the cathode ray tube by inserting a small screwdriver between the tube socket and base. It may also be possible to remove the tube from the tube socket by pressing on the center locating pin on the tube base, which extends through the tube socket. After the tube is loosened from the tube socket the tube may be pushed out through the front opening in the panel from the back, being very careful, so as not to drop the tube. The reverse of this procedure is necessary to put everything back in its proper place. If the tube is replaced, it will be necessary to line up the horizontal deflection produced by the tube with the calibrated screen and to align both in a horizontal position. This is accomplished by rotating the tube and tube socket in the tube socket clamp before clamping the socket and tube base securely.

b. To replace the pilot light on the front panel it is merely necessary to remove the shell, which contains the dial light jewel, with the fingers. The pilot light bulb will now be exposed and by pressing inwardly and rotating slightly to the left, it will be possible to remove pilot light bulb itself. The jewel that was removed can be replaced merely by pressing it into the dial light holder. The spring around the skirt of the jewel holder will snap in place in the pilot light holder. To remove the fuse the knob marked FUSE should be unscrewed and it will be possible to extract the fuse which is fastened into this cap. If the fuse is burned out the old fuse should be pulled off from the fuse cap and a new fuse pressed into the socket in the cap. This knob may then be placed back into its proper position and screwed into place. Spare fuses and spare pilot lights are found in the operating spares kit which is mounted on the delay line cover mounted on the left hand side of the analyzer chassis.

c. If it is necessary, for any reason, to remove the power supply PP-54/SPA-1 from the analyzer, it can be done by removing the two screws on the side of the sub-frame which fastens the power supply to the analyzer and the two screws which fasten the power supply chassis to the frame on the back. The connections to the terminal strip which come from the analyzer chassis should now be removed. These leads are held together by a lacing which joins the leads together in their proper order. This helps to avoid making wrong connections to the terminal strip when the power supply is removed. After the power supply is loosened from the frame, it is removed by lifting the power supply straight up until the chassis hits the back of the sub-mounting frame. It is then necessary to hold the chassis slightly forward to clear this back flange in order to remove it.

23. SPARE PARTS BOXES.

a. Equipment Spares.—The equipment spares are packed in a standard metal box which is approximately 9″ x 15″ x 18″ and contains the parts that are necessary for the replacement in the analyzer that are most likely to need replacement. This metal box is equipped with two handles at either end to facilitate carrying the equipment spares box around. In the lid of the spare parts box is a holder which contains "Spare Parts List." This list contains the number of spare parts contained in the box, an adequate description of the part, as well as the part number required in re-ordering spare parts. This list corresponds to the list contained in the instruction books which facilitates replacement in the field.

b. Tender Spares.—The tender spare parts box is larger than the equipment spare parts box (approximately 12″ x 24″ x 15″) and contains items which are not so likely to need replacement in the field. The quantity of spares in the tender spares box is different than the quantity in the equipment spares for this reason. This box is also equipped with a spare parts list which is mounted in a holder in the lid of the box.

c. Stock Spares.—Stock spares contain items which are least likely to need replacement in the field and do not appear in either equipment or tender spares. Due to the fact that these parts are to be stock, they are shipped from the factory in wooden cases and are not contained in special metal boxes.

24. TROUBLE SHOOTING.

NOTE: In case of inoperation of the equipment all voltage measurements and resistance measurements at the terminals of the tube sockets should be tested and checked with the proper charts. See Figures 11 and 12.

Symptom.—Equipment completely inoperative, no pilot light operating, no reading on pulse meter and no picture on screen of cathode ray tube.

Remedy.—This may be a result of an open line to the equipment. The most likely cause of an open line may be a burned out fuse. The fuse should be examined and if burned out, a new one inserted. Another cause of an open line may be that the on-off switch is not working, in which case it will be necessary to short circuit switch with external jumper so that the switch may be determined to be making contact. Another cause may be loose connections in the power cable itself. The power cable connector should be

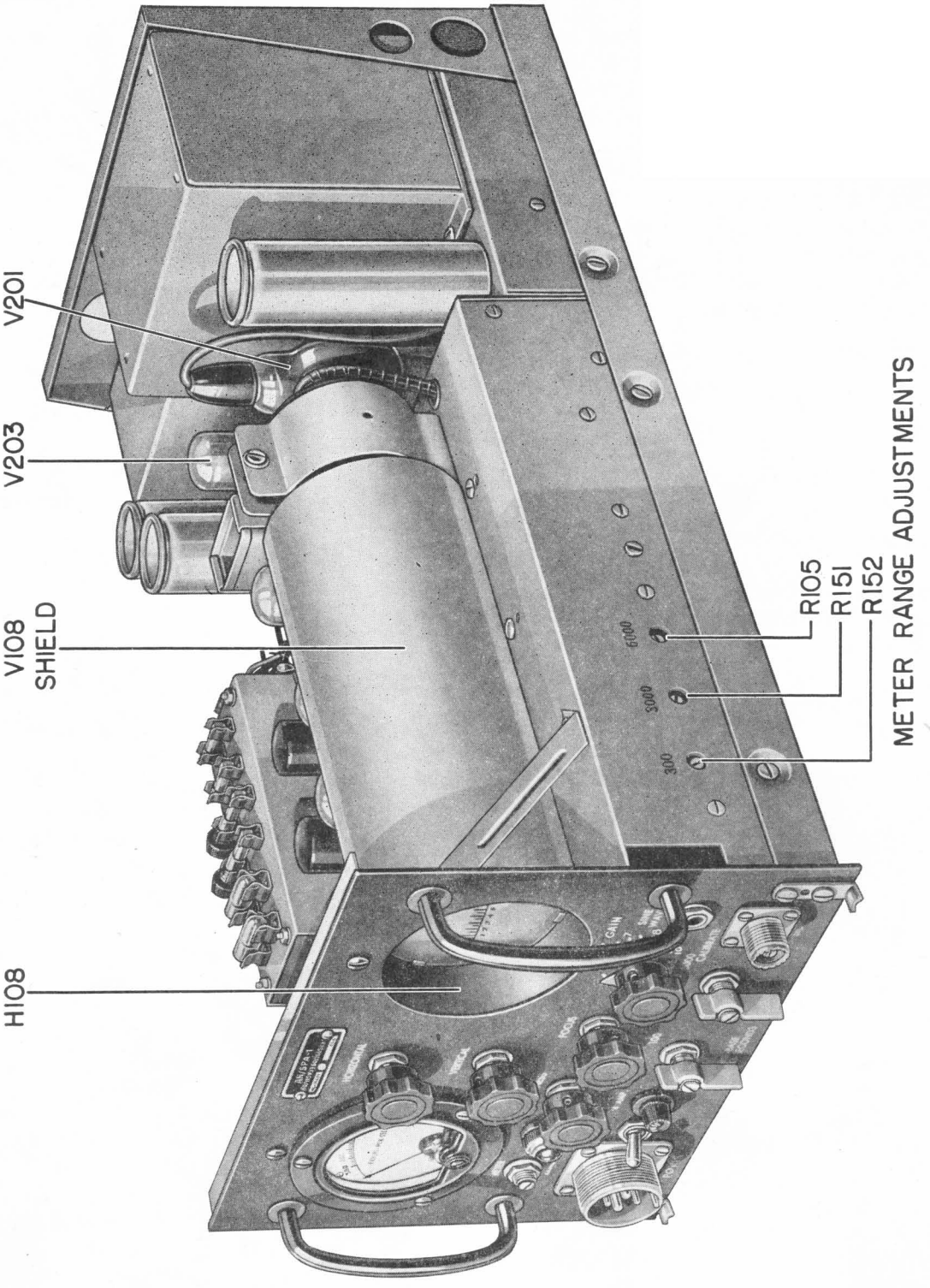


Figure 9. Pulse Analyzer Equipment AN/SPA-1 or AN/APA-6A, Right Side View

removed and disassembled to make sure there are no broken leads in the cable. If the set is withdrawn from the dust cover, the voltmeter can be used to determine if there is voltage at the terminal of the power transformer. By the use of a suitable line voltmeter it should be possible to trace the voltage from the power source to the terminals of the transformer and determine where continuity ceases to exist. If the tubes in the equipment are not glowing and the pilot light is not lighting, it may be sure that there is no voltage getting to the power transformer.

Symptom.—Equipment working except for pulse meter.

Remedy.—If the equipment appears to be operating normally with the exception of the pulse meter, that is, a satisfactory picture is obtained on the screen of the cathode ray tube and all the controls seem to work on the front panel except the meter zero control, it may be assumed that there is an open in the pulse meter circuit. This open may be due to several different causes. The most likely open would be due to a burned-out meter fuse. The meter fuse is mounted on the terminals of the meter and should be examined and checked to be sure that it is operating. Another cause may be an inoperative meter tube V107. If this tube is burned out or otherwise not drawing plate current, there will be no reading on the pulse meter tube. Any other open in the pulse meter circuit will, of course, cause the meter not to indicate. Connections from the B+ voltage terminal to the plate of the meter tube should be examined to make sure that there is continuity and that plate voltage appears at the plate of the meter tube.

Symptom.—Pulse meter reading maximum range but no indication on meter with variable pulse input.

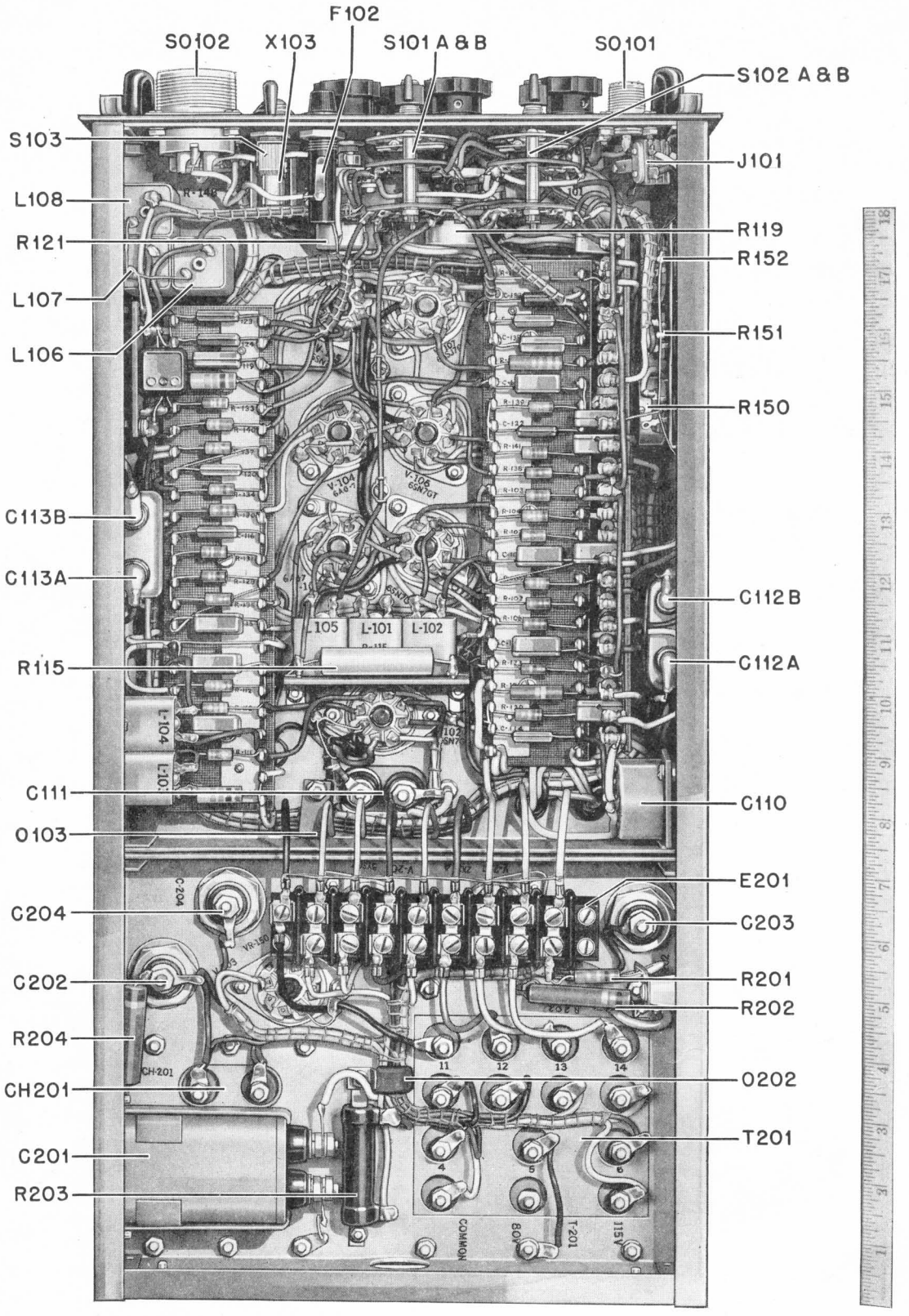
Remedy.—If a full scale reading is obtained on the pulse meter with the time base microsecond switch in the METER ON position, a pulse is obtained on the screen of the cathode ray tube. This would indicate that there is an open in the grid of the meter tube circuit. This means that the meter tube is not getting pulses supplied to its grid. This likely will be due to a short circuit in the grid circuit, in which case distortion may be produced on the pulse received on the screen of the cathode ray tube. If there is an open in this circuit, it will very likely be due to bad switch contacts on switch S101B. These switch contacts should be examined to see that there is continuity.

Symptom.—Inability to set pulse meter hand at right hand index of scale by meter zero control.

Remedy.—If it is found impossible to set the hand of the pulse meter to the right hand index of the dial scale by the meter zero control, it should be checked to make certain that the voltage of the pulse meter voltage is approximately 150 volts. The voltage across the voltage regulator tube should be checked to make certain that the tube is operating properly. If the voltage regulator tube V203 is removed or is not working properly, the voltage may be too high on the meter tube circuit and this will produce an abnormally high plate current in the meter tube V107, and cause the hand of the meter to read off scale to the right. This means that the meter tube V107 is working outside of the specifications for that particular type of tube 6SJ7. If the tube draws too much plate current and does not meet JAN specifications, it will be found impossible to set the hand on to the scale and the hand will always read way off scale. If it is impossible to cause the meter to read full scale by turning the meter zero control all the way to the right, this means that the meter tube has become too weak and it has not met specifications for that type and should be replaced.

Sympton.—Cathode ray tube completely inoperative, pulse meter operation normal.

Remedy.—If the pulse meter appears to be operating normally but there is no picture obtainable on the screen of the cathode ray tube, this would indicate that the cathode ray circuit is at fault. The cathode ray tube should be examined to ascertain that the heater of the tube is lighted, which will indicate that the tube is getting filament voltage. The high voltage d-c to the cathode ray tube circuit should be tested to see that there is voltage on the cathode ray tube. If there is no d-c voltage on the cathode ray tube it may indicate that the high voltage rectifier tube V201 is burned out. If this is the case the tube should be replaced. It may also be found that there is an open circuit in the high voltage lead from the power supply to the cathode ray tube. This would be indicated by d-c voltage appearing on the input capacitor C291 on the power supply and the lack of d-c voltage on the second high voltage capacitor C111. Possibly R201, which is the high voltage filter resistor, may be found to be burned out. A short on the analyzer chassis from the high voltage to ground will also remove the high voltage from the cathode ray tube and still allow high voltage to appear on the filter capacitor. If normal voltages appear at the socket of the cathode ray tube according to the measurements on the voltage measurements chart, see Figure 11, it would indicate that the cathode ray tube is at fault and should be replaced.



COMPONENTS ON TERMINAL BOARDS ARE SHOWN IN FIGURE 13

Figure 10. Pulse Analyzer Equipment AN/SPA-1 or AN/APA-6A, Bottom View

Symptom.—Cathode ray tube operating but no control or brightness.

Remedy.—If the set is working normally in all other respects, that is, a sweep is obtained on the cathode ray tube and the pulse meter is working normally but it is impossible to turn down the intensity, it will be found that the cathode ray tube grid is not getting control grid bias. The most likely cause of this symptom would be a shorted cathode ray tube. This happens when due to heavy shock or vibration, the elements of the tube may short together. A new tube 3BP1 should be substituted, to test if it is the tube which is at fault. If the tube is found normal, the bias across the brightness control should be checked to see that the two leads are not shorted. With the set turned off, the short circuit may be traced with a continuity meter which may be due to bad wiring, broken leads, etc. If the grid of the cathode ray tube is not getting a negative bias, there may also be an open circuit in the grid return of this tube. Examine the leads in this circuit and test resistor R122 for an open circuit.

Symptom.—No horizontal sweep on cathode ray tube, but normal pulse meter operation.

Remedy.—This symptom may be produced by an open circuit to the horizontal plates of the cathode ray tube. Normal pulse meter operation would indicate that the multi-vibrator is working normally but that there is no horizontal voltage developed across the plates of the cathode ray tube. The discharge tube V106 should be replaced to see if that section of the circuit is at fault. An oscilloscope should be used to check that there is grid voltage being impressed on the grid of the discharge tube from the multivibrator. If there is no a-c sawtooth signal appearing on the plate of the discharge V106, Section B, but there is a-c grid voltage being impressed on this grid, this will indicate a defective tube. If there is a-c sawtooth plate voltage appearing on this tube yet there is no horizontal sweep on the cathode ray tube, this will indicate possibly an open coupling capacitor C125 or an open circuit in the sine wave jack J101.

Symptom.—No calibrate signal on cathode ray tube in the calibrate position.

Remedy.—If normal operation is obtained with the equipment other than the lack of sine waves in the calibrate position, it may be found that the coils in the tuned circuit L106, L107, and L108 are at fault. All ranges should be checked to ascertain if it is only one range that is at fault. If there is no calibrating signal in any position of the time base microsecond switch when in the calibrate position, it may be found that there is a short or an open circuit on the sine waves tuned circuit. An open circuit may be caused by a bad contact on switch S101A or S102A. An oscilloscope should be used to determine if there is signal across the circuit L106, L107, and L108. If there is signal appearing across these tuned circuits but none appears on the screen of the cathode ray tube, it will indicate that the cathode ray tube is not connected due to an open coupling capacitor or switch contact. If there is no signal appearing across the tuned circuit even though the switch is in calibrate position, it will indicate that there is a short circuit in the tuned circuit. This short across the tuned circuit may be due to a bad tuning capacitor or may be due to loose wires or bad solder connections.

Symptom.—Pulse meter operating normally, no deflection on cathode ray tube—horizontal line appearing on screen of cathode ray tube, no vertical deflection.

Remedy.—This symptom would indicate that there is discontinuity in the video amplifier after the phase inverter stage V101, section B. This means that the signal is producing multivibrator operation and producing normal sweep in the horizontal position. The two tubes V102 and V103 in the video amplifier should be replaced to ascertain if these tubes are defective. There also may be an open circuit in the coupling capacitors between stages on the coupling coils L104, L105 or the delay line. An oscilloscope will be helpful in tracing the signal through the video amplifier to the point of discontinuity. The likely cause of video amplifier being inoperative is the compensator coils in series with the plate circuit or the plate resistors.

Symptom.—Non-linear sweep in the horizontal direction.

Remedy.—If it is found that the sweep in the horizontal direction is non-linear and is abnormally short, this may indicate that the choke CH101 is short circuited or that the plate voltage on the plate of the discharge tube V106, Section B is low. This voltage should be checked according to voltage measurements chart, see Figure 11.

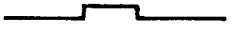
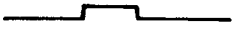
Symptom.—Stationary spot appearing on screen of cathode ray tube, no vertical or horizontal deflection and pulse meter inoperative.

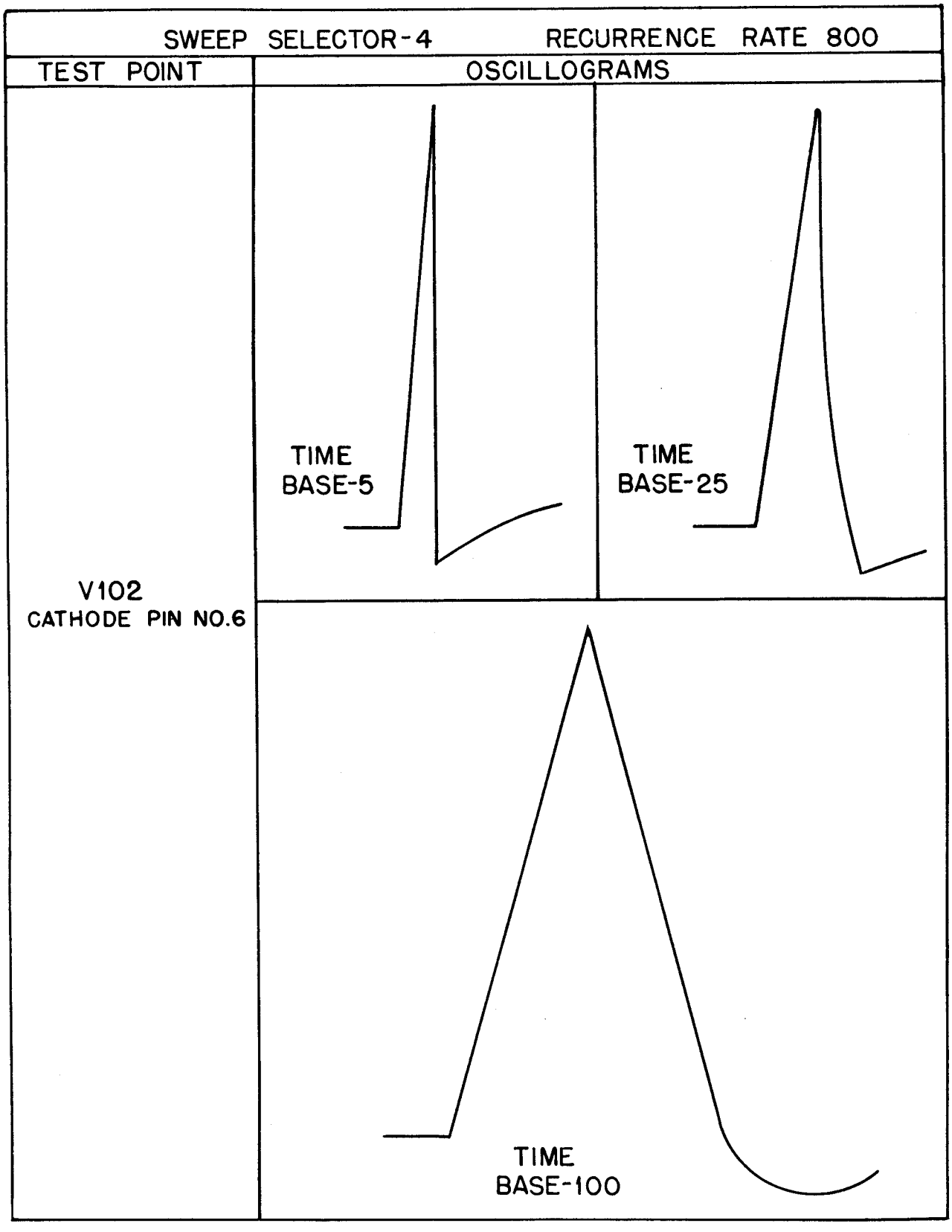
Remedy.—If a stationary spot appears on the screen of the cathode ray tube, that may be con-

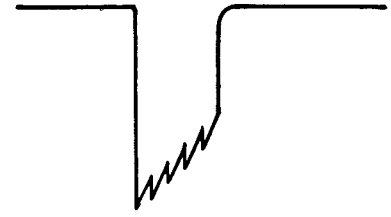
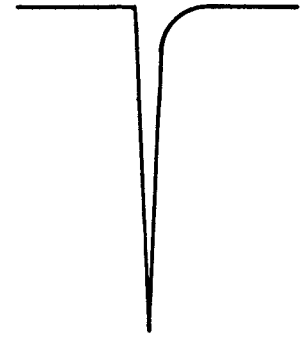
trolled by the brightness, focus, vertical, and horizontal controls, but the rest of the equipment is inoperative, this would indicate that the circuits associated with the cathode ray tube are in normal operation but that the low voltage part of the equipment is inoperative. Likely cause will be a defective low voltage rectifier tube 5Y3GT. The defective 5Y3GT will remove the low voltage B+ to the equipment and will not permit any of the circuits to operate which produce deflections and sweeps to the cathode ray tube.

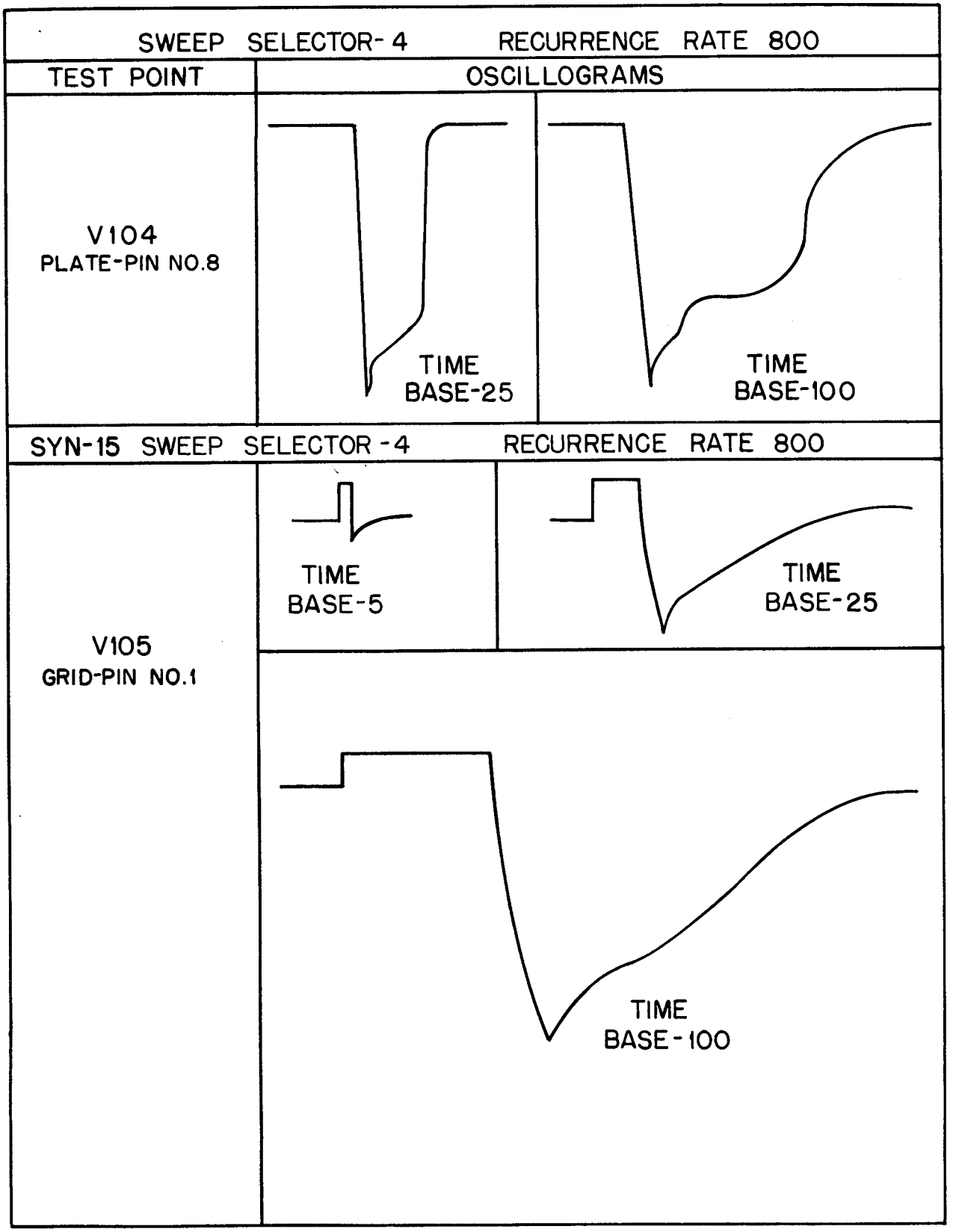
Symptom.—Abnormally bright spot at beginning of trace on cathode ray tube.

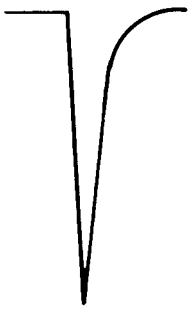
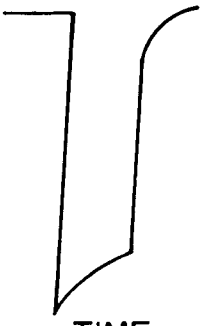
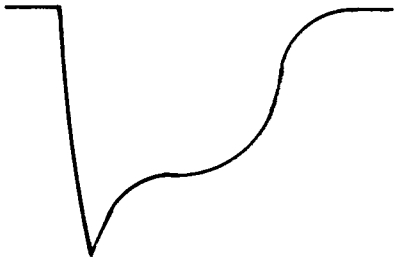
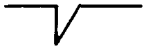
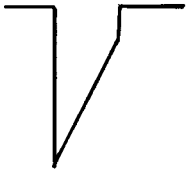
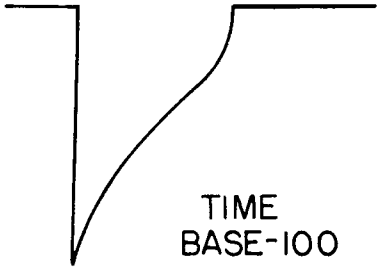
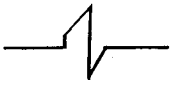
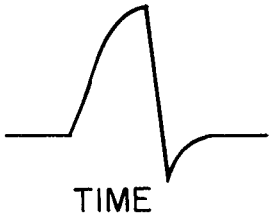
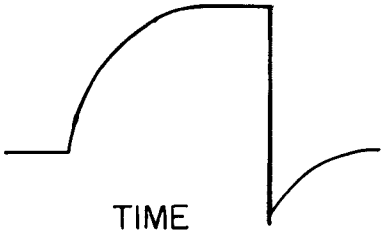
Remedy.—Abnormally bright spot on the cathode ray tube when the equipment is operating normally otherwise may be due to the lack of "blanking in" voltage. This can be tested by turning the brightness control down, in which case the trace in the vertical and horizontal directions will disappear long before the spot. If this is the case, there is either an open or short circuit in the connection to the grid of the cathode ray tube 3BP1 from the multivibrator V105 which produces the blanking in voltage. An open circuit may be due to open coupling capacitor C110 or C114. A short circuit at the junction of C110 and C114 to ground, also will remove the blanking in voltage from the cathode ray tube but will also produce a distortion of the wave form on the multivibrator which may also show up as a distorted waveform in the horizontal deflection on the screen of the cathode ray tube. An oscilloscope will prove to be very useful for tracing the pulses on the analyzer and correcting the faults.

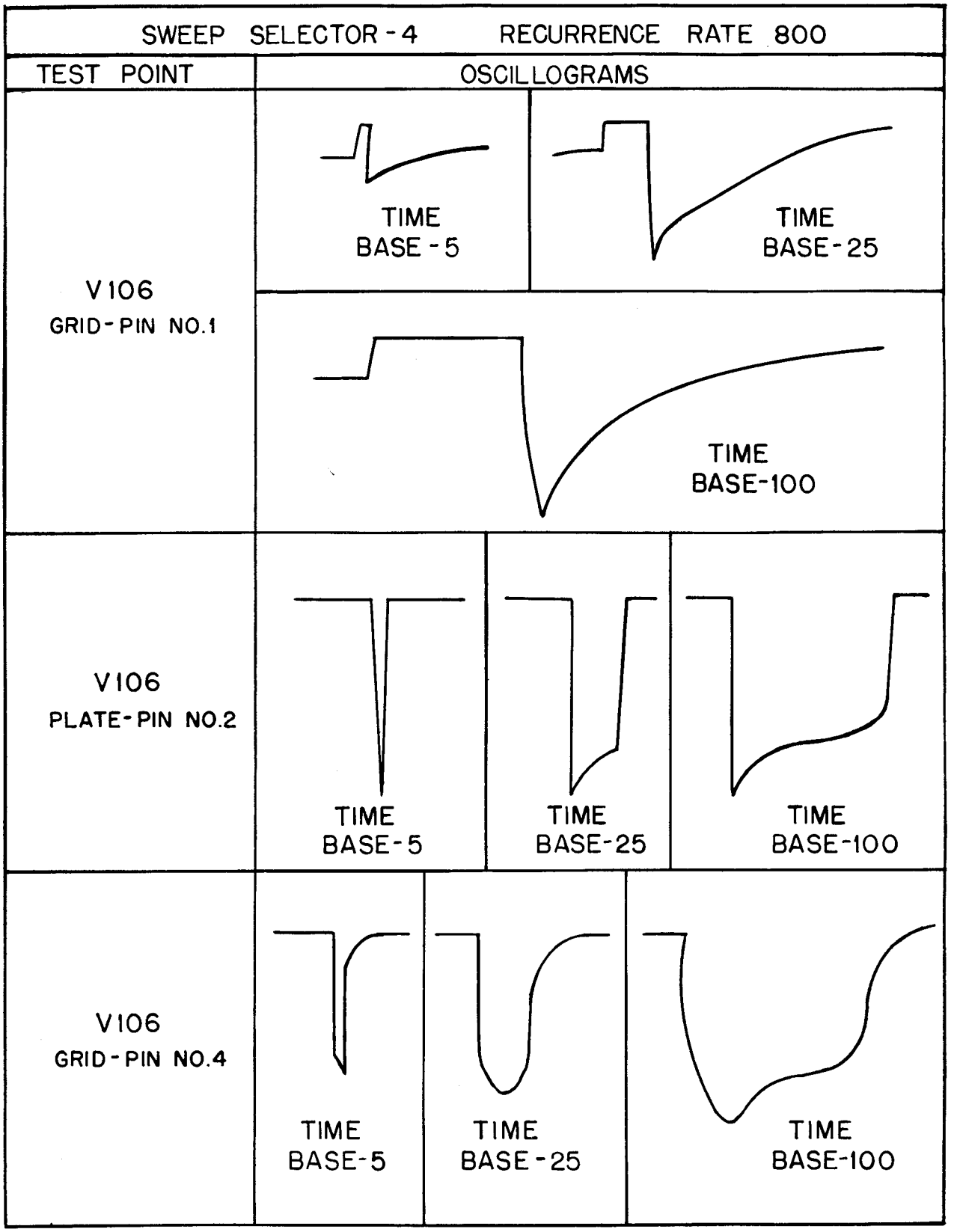
NOTE: ALL OSCILLOGRAMS ARE TAKEN ON SYN-15 SYNCHROSCOPE. PULSE ANALYZER EQUIPMENT AN/SPA-1 IN NORMAL OPERATING CONDITION WITH PULSE INPUT. ALL DRAWINGS ARE ACTUAL SIZE	
SWEEP SELECTOR-2 RECURRENCE RATE 800	
TEST POINT	OSCILLOGRAMS
V 101 GRID - PIN NO.1	NONE
V 101 PLATE - PIN NO.2	
V 101 GRID - PIN NO.4	
V 101 PLATE - PIN NO.5	
V 101 CATHODE - PIN NO.6	
SWEEP SELECTOR-2 RECURRENCE RATE 800	
V 102 GRID - PIN NO.1	NONE
V 102 PLATE - PIN NO.2	

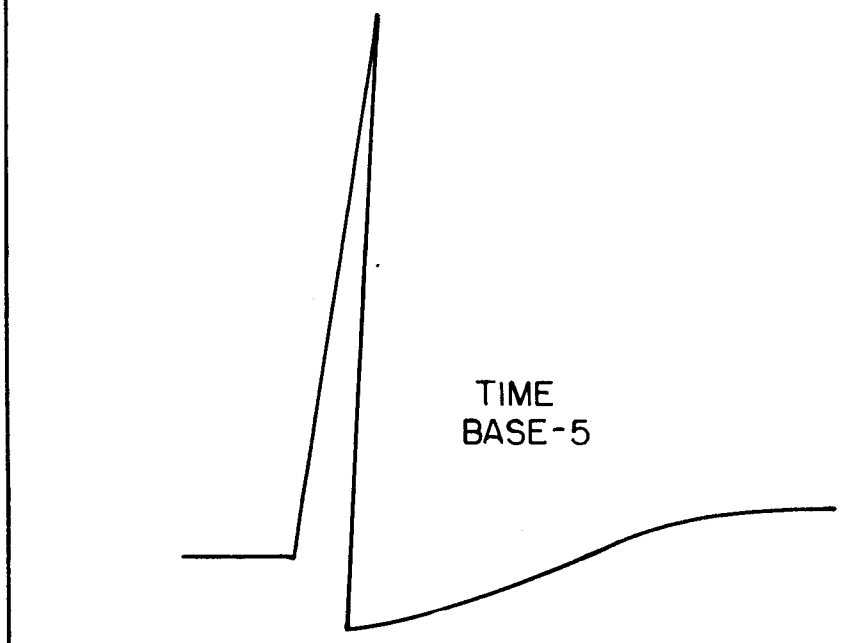
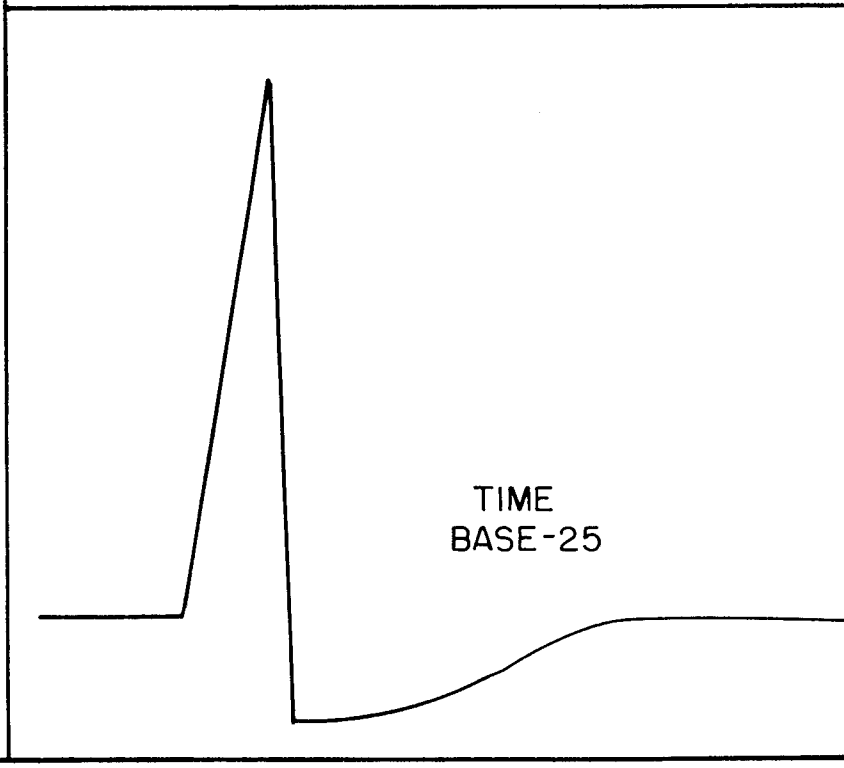

SWEEP SELECTOR-4
RECURRENCE RATE 800
TEST POINT
OSCILLOGRAMS
TIME BASE-5
TIME BASE-25
V102
CATHODE PIN NO.6
TIME BASE-100

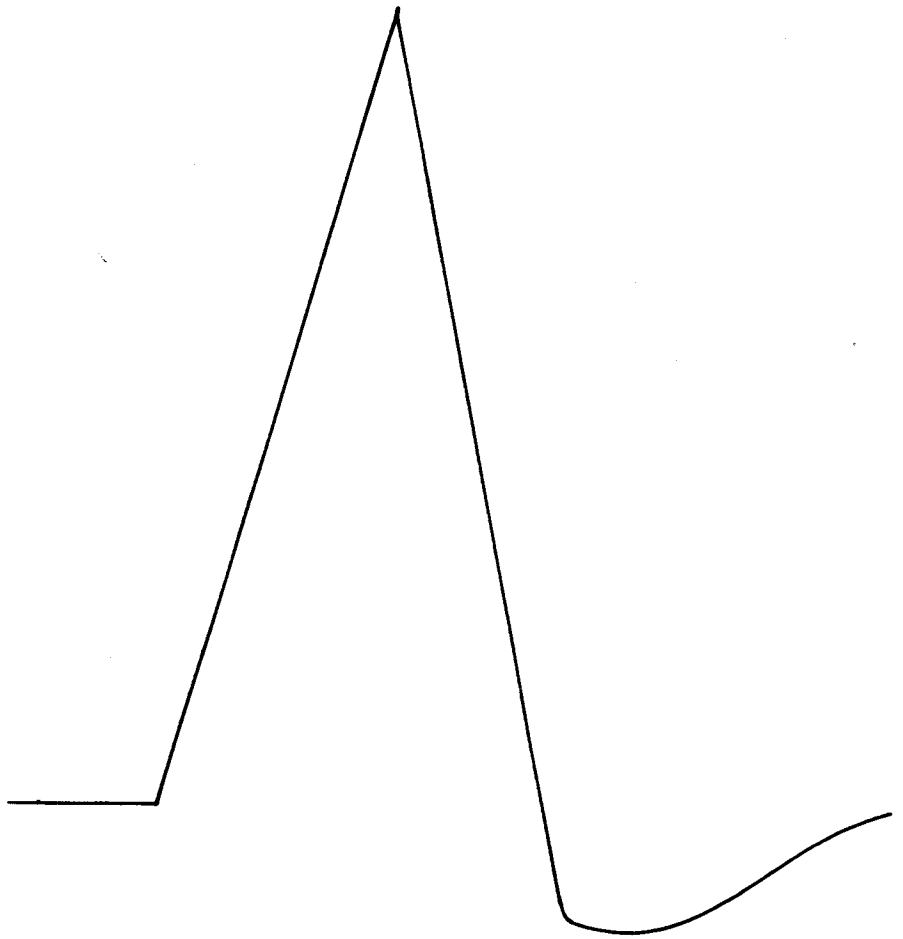
SWEEP SELECTOR-1	RECURRANCE RATE 800
TEST POINT	OSCILLOGRAMS
V103 GRID-PIN NO 4	
V103 SCREEN-PIN NO.6	NONE
SWEEP SELECTOR-2	
V 103 PLATE - PIN NO. 8	
SWEEP SELECTOR-1	RECURRENCE RATE 800
V104 GRID-PIN NO.4	
SWEEP SELECTOR-4	
V104 SCREEN-PIN NO.6	
V104 PLATE-PIN NO.8	TIME BASE-5 


SWEEP SELECTOR-4 RECURRENCE RATE 800
TEST POINT
OSCILLOGRAMS
V104
PLATE-PIN NO.8
TIME
BASE-25
TIME
BASE-100
SYN-15 SWEEP SELECTOR-4 RECURRENCE RATE 800
V105
GRID-PIN NO.1
TIME
BASE-5
TIME
BASE-25
TIME
BASE-100

SWEEP SELECTOR-4	RECURRENCE RATE 800		
TEST POINT	OSCILLOGRAMS		
V105 PLATE-PIN NO.2	 TIME BASE-5	 TIME BASE-25	 TIME BASE-100
V105 GRID-PIN NO.4	 TIME BASE-5	 TIME BASE-25	 TIME BASE-100
V 105 PLATE-PIN NO.5	 TIME BASE-5	 TIME BASE-25	 TIME BASE-100

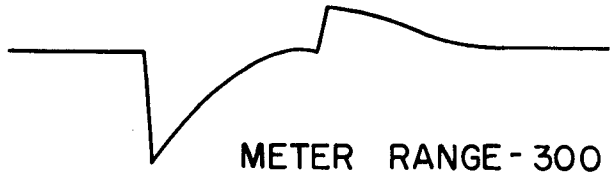
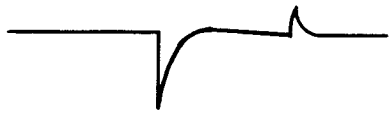
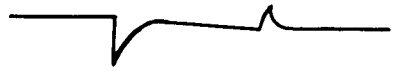
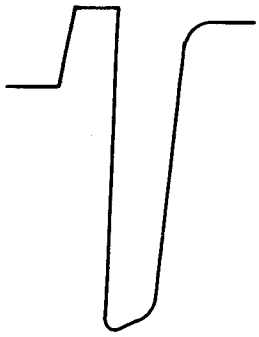
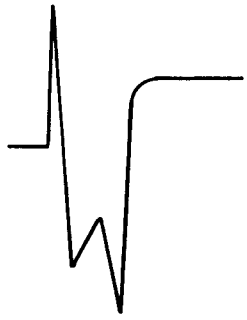
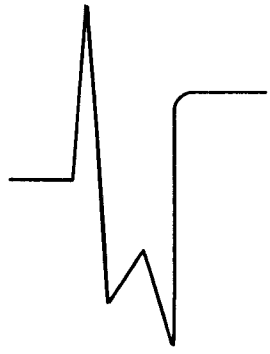

SWEEP SELECTOR - 4
RECURRENCE RATE 800
TEST POINT
OSCILLOGRAMS
V106
GRID - PIN NO.1
TIME
BASE - 5
TIME
BASE - 25
TIME
BASE-100
V106
PLATE - PIN NO.2
TIME
BASE-5
TIME
BASE-25
TIME
BASE-100
V106
GRID - PIN NO.4
TIME
BASE-5
TIME
BASE - 25
TIME
BASE-100

SWEEP SELECTOR-4	RECURRENCE RATE 800
TEST POINT	OSCILLOGRAMS
V106 PLATE-PIN NO.5	 

SWEEP SELECTOR-4	RECURRENCE RATE 800
TEST POINT	OSCILLOGRAMS
V106 PLATE-PIN NO.5	 TIME BASE-100

SWEEP SELECTOR-1 METER RANGE → CALIBRATE
SWEEP ADJUST EXTREME COUNTER CLOCKWISE
RECURRENCE RATE 800

TEST POINT	OSCILLOGRAMS
V106 CATHODE-PIN NO.6	 TIME BASE-5
SWEEP SELECTOR-2	
V106 CATHODE-PIN NO.6	 TIME BASE-25
SWEEP SELECTOR-3	
V106 CATHODE-PIN NO.6	 TIME BASE-100

SWEEP SELECTOR-3 RECURRENCE RATE 800	SWEEP ADJUST EXTREME COUNTER CLOCKWISE		
TEST POINT	OSCILLOGRAMS		
V107 GRID-PIN NO.4 TIME BASE-25	 METER RANGE-300		
	 METER RANGE-3000	 METER RANGE-6000	
SWEEP SELECTOR-4	RECURRENCE RATE-200		
V107 PLATE PIN NO.8 TIME BASE-25	 METER RANGE-300	 METER RANGE-3000	 METER RANGE-6000

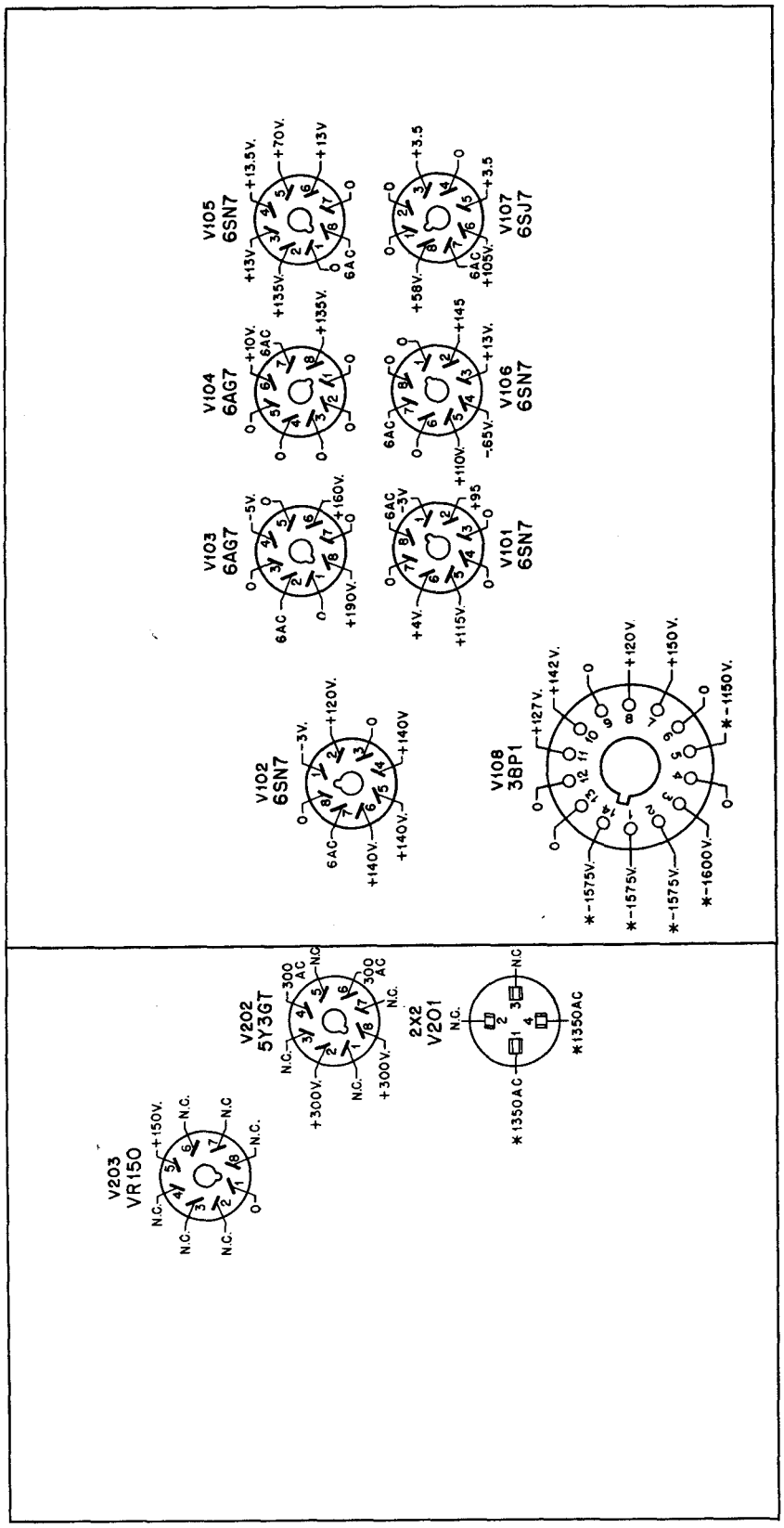


Figure 11. Pulse Analyzer ID-46/SPA-1 and Power Supply PP-54/SPA-1, Tube Socket Voltage Diagram

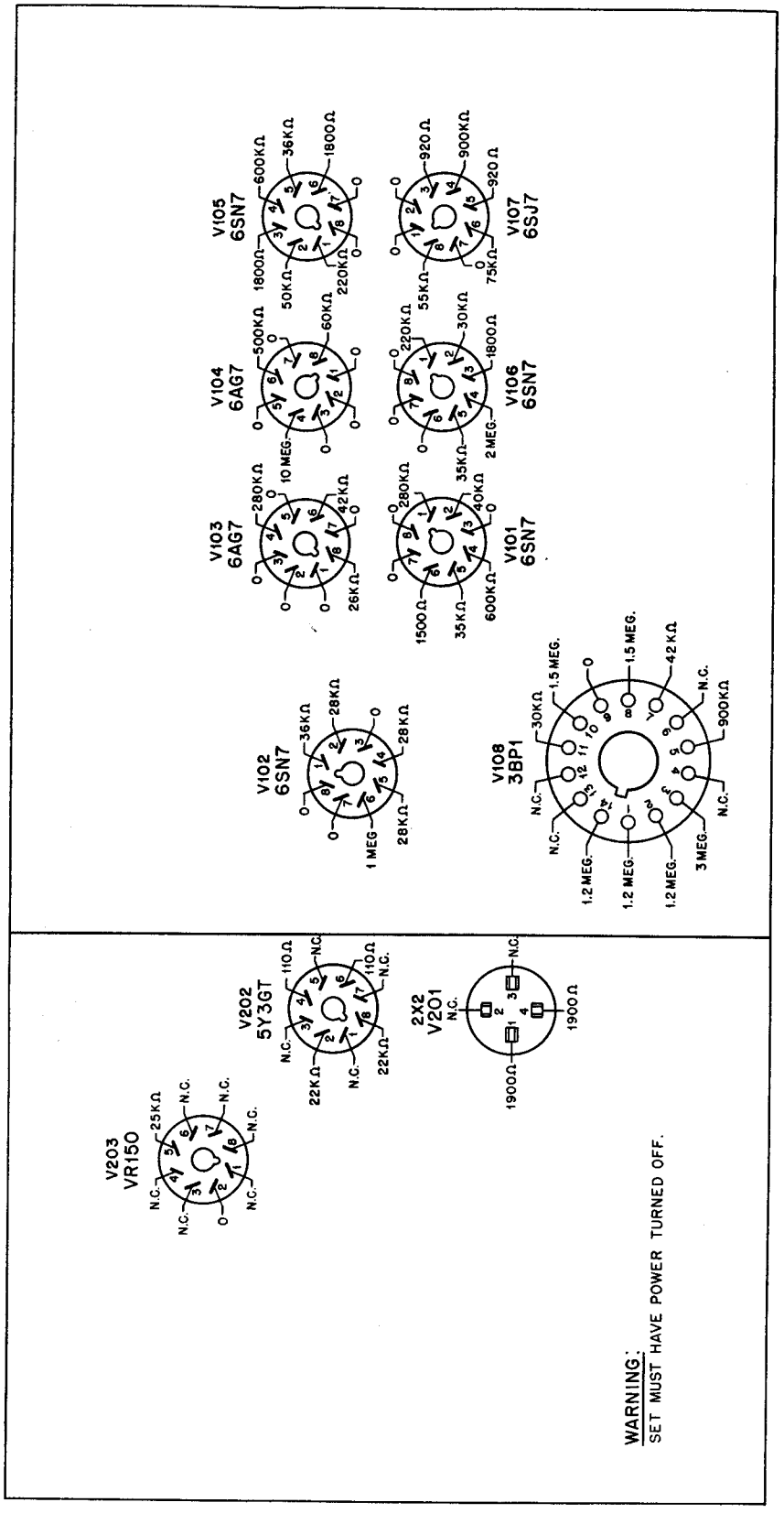


Figure 12. Pulse Analyzer ID-46/SPA-1 and Power Supply PP-54/SPA-1, Tube Socket Resistance Diagram

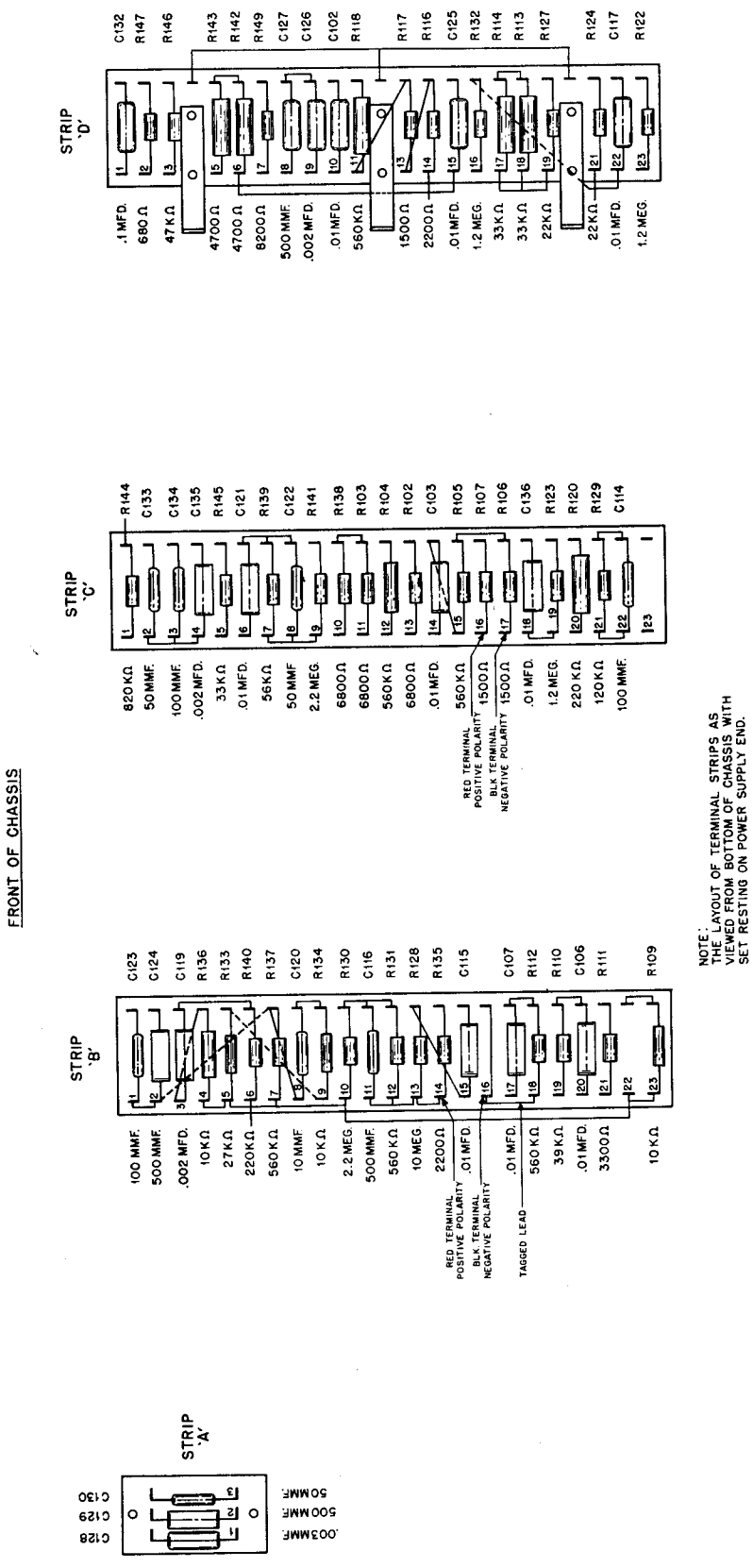


Figure 13. Pulse Analyzer ID-46/SPA-1, Terminal Board, Parts Location Diagram

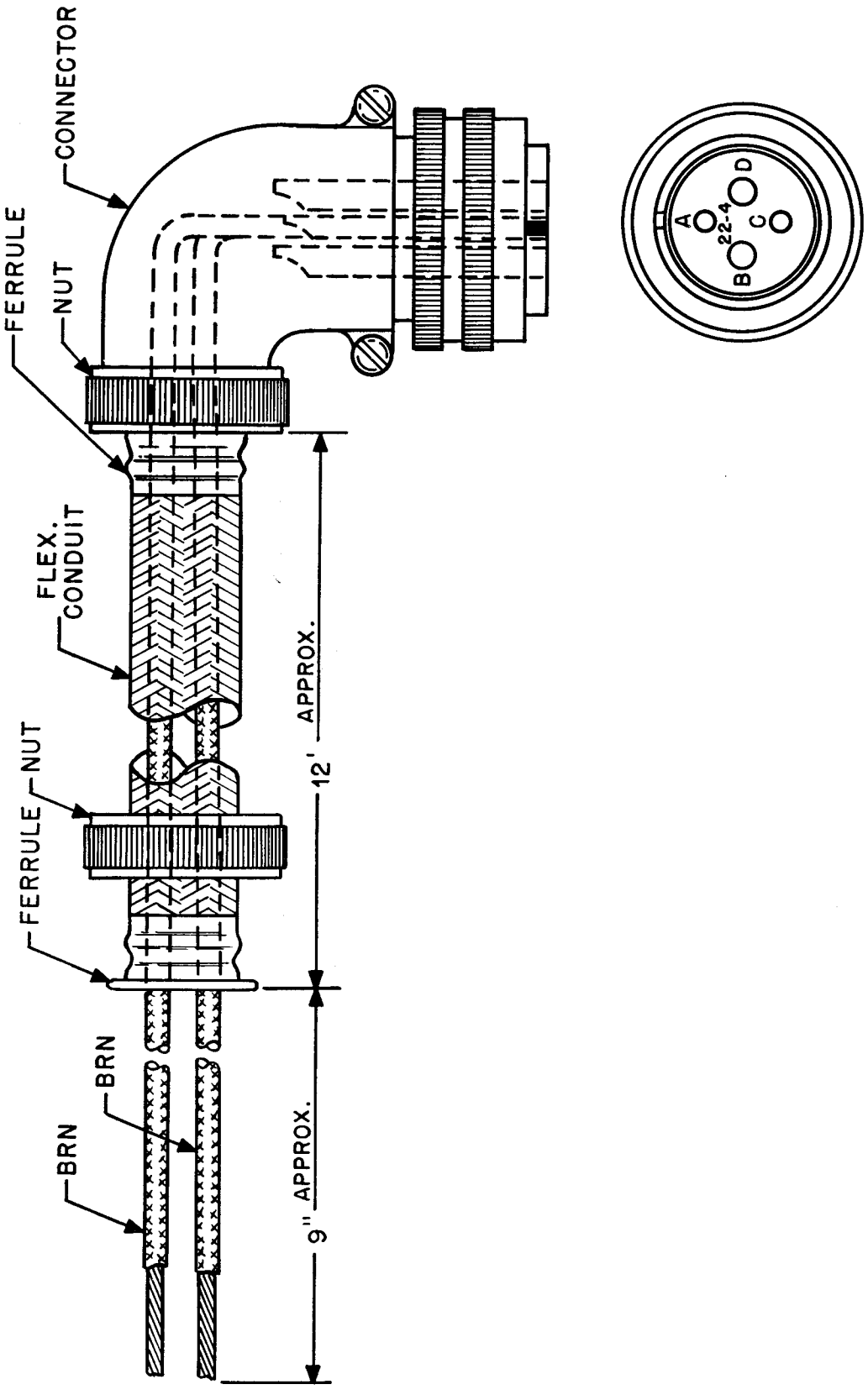


Figure 14. Power Cable Assembly, Detail

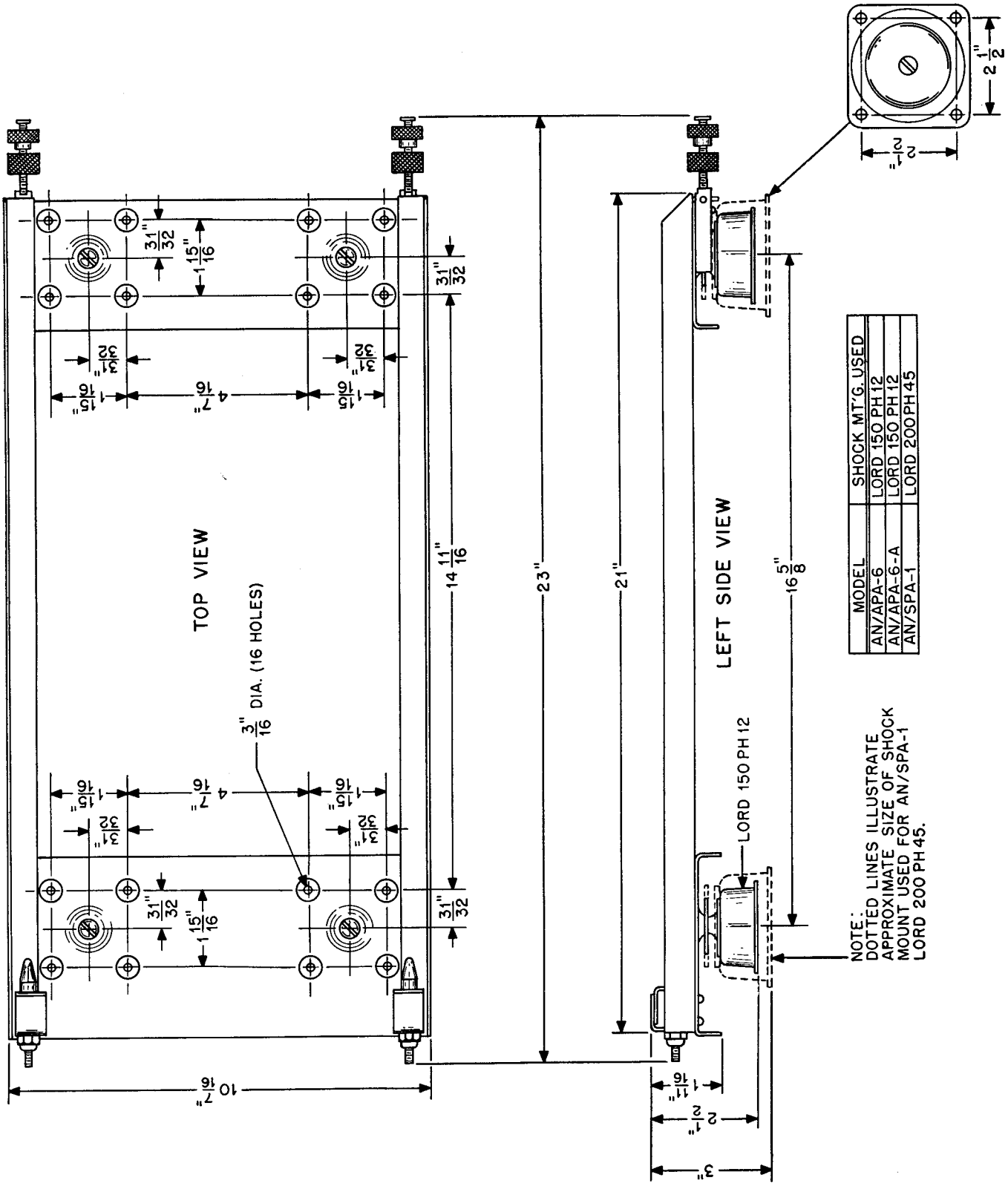


*Figure 15. Outline Dimensional Diagram of Mounting *MT-54/UR*

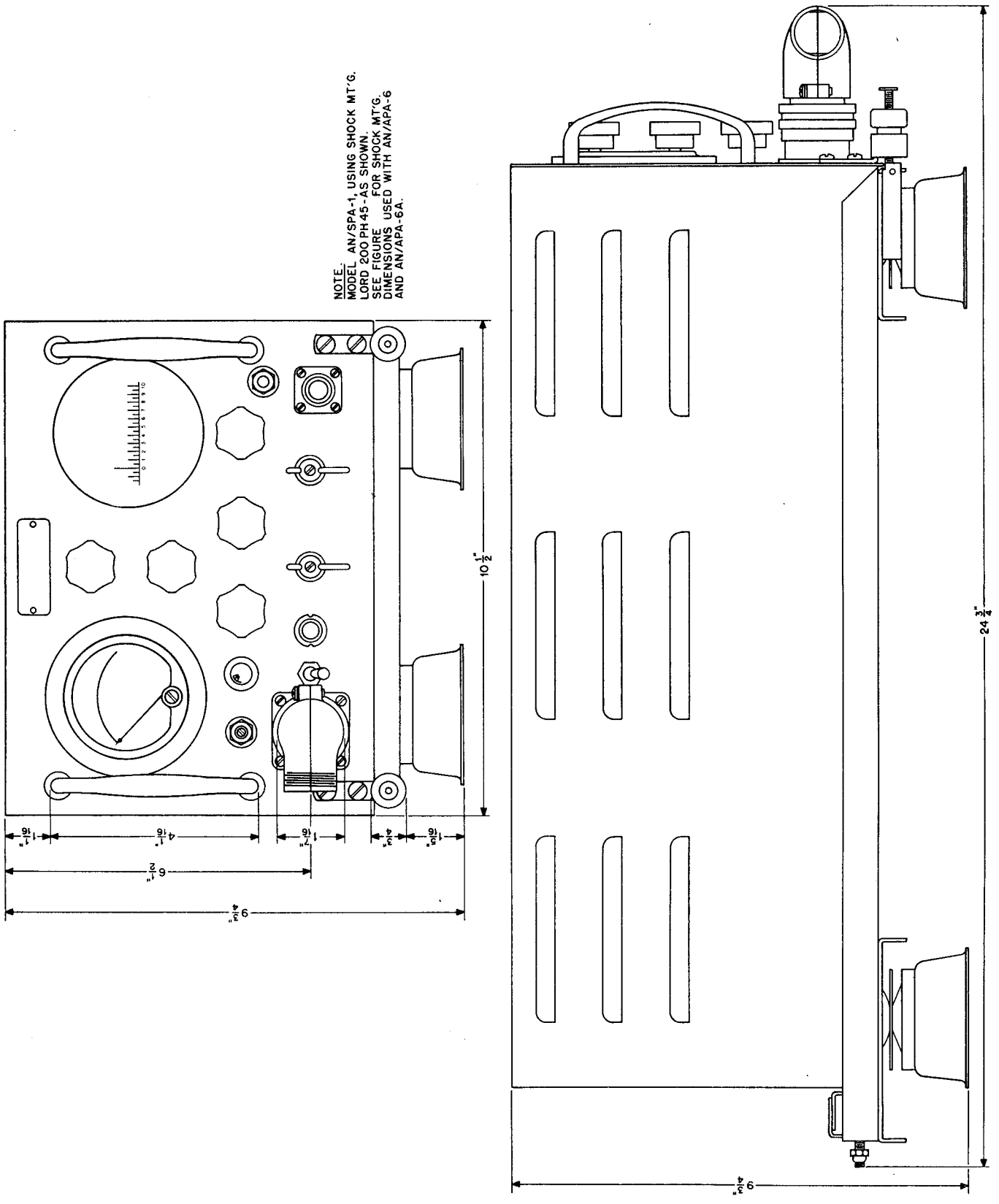


Figure 16. Outline Dimensional Diagram of Pulse Analyzer Equipment AN/SPA-1 or AN/APA-6A

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 **MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1**

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
C101		CAPACITOR: fixed, paper; 1.0 μf, ±20%; oil filled; 600 v. d-c working; capacity and voltage stamped on can; 2¾" long, 1 5/16" wide, ⅝" thick; two solder lug terminals. (Also C104, C105, C108, C109, C118, C131, C137 and C138).	Plate by-pass V101, section A.	35 OM-601-0	8A48561	9	
C102		CAPACITOR: fixed, mica; .01 μf, ±20%; 300 v. d-c working; color coded: black, brown, black, orange; 25/32" long, 25/32" wide, 11/32" thick; axial leads, 1⅛" long.	Grid coupling, V101, section A.	28 C-06110	21X101066	10	
		or:					
		CAPACITOR: fixed, mica; .01 μf, +14% −6%; 300 v. d-c working; color coded: brown, black, orange, blue, orange; 25/32" long, 25/32" wide, ¼" thick; axial leads, 1⅛" long. (Also C103, C106, C107, C115, C117, C121, C125, C132, C136).		2 1469X 20 XWMR 35 ILL	21B6609		
C103		CAPACITOR: same as C102.	Grid coupling, V101, section B.				
C104		CAPACITOR: same as C101.	Plate by-pass, V101, section B.				
C105		CAPACITOR: same as C101.	Plate by-pass, V101, section B.				
C106		CAPACITOR: same as C102.	Grid coupling, V102, section A.				
C107		CAPACITOR: same as C102.	Grid coupling, V103.				

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
C108		CAPACITOR: same as C101.	Screen grid by-pass, V103.				
C109		CAPACITOR: same as C101.	Grid bias supply by-pass, V101, V102, V103.				
C110		CAPACITOR: fixed, mica; .01 μf, ±20%; 2500 v. d-c working; capacity and voltage stamped on case; 1¾" long, 1 5/16" wide, 25/32" thick; brass, 6-32 tapped inserts for terminals.	Grid coupling, V108.	28 A2-5110	21A52480	1	
C111		CAPACITOR: fixed, paper; .5 μf; oil filled; 2000 v. d-c working; metal case, 2⅞" high (less insulators), 3¾" (with insulators), 1 13/16" wide, 1 1/16" thick, insulator terminals 13/16" centers, 2¼" mounting hole centers.	High voltage filter, V108.	14 20SAK50	8B52262	1	
C112		CAPACITOR: fixed, paper; dual; .1 μf, ±20%; 600 v. d-c working; oil filled; capacity and voltage stamped on metal can; 2½" long, 1 11/32" wide, 51/64" thick; 2⅛" mounting hole centers.	Deflection plate by-pass, V108.	35 RLO-6210	8A42241	2	
C112A		CAPACITOR: One section of C112.					
C112B		CAPACITOR: One section of C112.					
C113		CAPACITOR: same as C112	Deflection plate by-pass, V108.				
C113A		CAPACITOR: One section of C113.					
C113B		CAPACITOR: One section of C113.					

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
C114		CAPACITOR: fixed, mica; 100 $\mu\mu$f, $\pm$10%, 400 v. d-c working; color coded: brown, black, brown, silver; $^{11}/_{16}$" long, $^{7}/_{16}$" wide, $^{11}/_{64}$" thick; axial leads, 1$^{1}/_{4}$" long. (Also C123, C134).	Coupling, V108.	2 1468X 20 XOM 11 5LL	21B6565	3	
C115		CAPACITOR: same as C102.	Grid coupling, V104.				
C116		CAPACITOR: fixed, mica; 500 $\mu\mu$f, $\pm$10%, 400 v. d-c working; color coded: green, black, brown, silver; $^{11}/_{16}$" long, $^{7}/_{16}$" wide, $^{11}/_{64}$" thick; axial leads, 1$^{1}/_{4}$" long. (Also C124, C127, C129).	Screen grid by-pass, V104.	2 1468 20 OM 11 5	21B6551	4	
C117		CAPACITOR: same as C102.	Deflection plate coupling, V108.				
C118		CAPACITOR: same as C101.	Cathode by-pass, V105.				
C119		CAPACITOR: fixed, mica; 2000 $\mu\mu$f, $\pm$10%; 500 v. d-c working; color coded: black, red, black, red; $^{3}/_{4}$" long, $^{3}/_{4}$" wide, $^{1}/_{4}$" thick; axial leads, 1$^{1}/_{8}$" long. or: CAPACITOR: fixed, mica; 2000 $\mu\mu$f, $\pm$10%; 500 v. d-c working; color coded: red, black, red, green; $^{25}/_{32}$" long, $^{25}/_{32}$" wide, $^{1}/_{4}$" thick; axial leads, 1$^{3}/_{8}$" long. (Also C126, C135).	Grid coupling, V105, section A.	28 C-1220 2 S1467X 20 XWM 11 1WLS	21X101443 21B6549	3	

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER AN/SPA-1 **MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1**

Reference Symbol	Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
C120		CAPACITOR: fixed, mica; 10 $\mu\mu$f, $\pm$10%; 500 v. d-c working; color coded; black, brown, black, black; $^{23}/_{32}$" long, $^{15}/_{32}$" wide, 1/5" thick; axial leads, 1$^{1}/_{8}$" long. or: CAPACITOR: fixed, mica; 10 $\mu\mu$f, $\pm$10%; 400 v. d-c working; color coded; brown, black, black, silver; $^{11}/_{16}$" long, $^{7}/_{16}$" wide, $^{11}/_{64}$" thick; axial leads, 1$^{1}/_{4}$" long.	Grid coupling, V105, section B.	28 K1410 2 1468X XOM 11 5LL	21X102587 21B6575	1	
C121		CAPACITOR: same as C102.	Grid coupling, V106, section B.				
C122		CAPACITOR: fixed, mica; 50 $\mu\mu$f, +14% −6%; 400 v. d-c working; color coded: green, black, black, blue, yellow; $^{11}/_{16}$" long, $^{7}/_{16}$" wide, $^{11}/_{64}$" thick; axial leads, 1$^{1}/_{4}$" long. (Also C133).	Grid coupling, V106, section B.	2 1468X 20 XOM 11 5LL	21B6614	2	
C123		CAPACITOR: same as C114.	Multivibrator time constant, 25 range.				
C124		CAPACITOR: same as C116.	Multivibrator time constant 100 range.				
C125		CAPACITOR: same as C102.	Deflection plate coupling, V108.				
C126		CAPACITOR: same as C119.	Sawtooth forming circuit 25 range.				

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 **MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1**

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
C127		CAPACITOR: same as C116.	Sawtooth forming circuit 100 range.				
C128		CAPACITOR: fixed, mica; .003 μf, $\pm$10%; 500 v. d-c working; color coded: orange, black, red, silver; $^{25}/_{32}$" long, $^{25}/_{32}$" wide, $^{1}/_{4}$" thick; axial leads, 1$^{1}/_{4}$" long.	Calibrate signal tuning, 5 range.	2 1467 20 WM 11 1	21B6655	1	
C129		CAPACITOR: same as C116.	Calibrate signal tuning, 25 range.				
C130		CAPACITOR: fixed, mica; 50 $\mu\mu$f, +14% −6%; 400 v. d-c working; color coded; green, black, black, blue, yellow; $^{11}/_{16}$" long, $^{7}/_{16}$" wide, $^{11}/_{64}$" thick; axial leads, 1$^{1}/_{4}$" long.	Calibrate signal tuning 100 range.	2 1468X 20 XOM 11 5LL	21B6614	1	
C131		CAPACITOR: same as C101.	B+ by-pass, 150 volts.				
C132		CAPACITOR: same as C102.	Grid coupling, V107.				
C133		CAPACITOR: same as C122.	Pulse meter differentiating time constant, 6000 range.				
C134		CAPACITOR: same as C114.	Pulse meter differentiating time constant 3000 range.				
C135		CAPACITOR: same as C119.	Pulse meter differentiating time constant, 300 range.				

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
C136		CAPACITOR: same as C102.	Deflection plate coupling, V108.				
C137		CAPACITOR: same as C101.	Cathode by-pass, V107.				
C138		CAPACITOR: same as C101.	Screen grid by-pass, V107.				
CH101		CHOKE, FILTER: 275 henries; core size: 3/8" x 1/2" stack; 10,000 turns of No. 42; steel can 2 1/2" long, 1 3/8" wide, 2 3/8" high; 2 solder lug terminals on top. 2 1/8" mounting hole centers.	Sawtooth forming circuit.	33 5C56	25B48366	1	
DL101		DELAY LINE ASSEMBLY: consists of 4 coils, each consisting of 350 turns #30 B & S double formex wire, over copper foil, over 1/4" diameter bakelite rod 5" long; flash dipped in white halowax; coils mounted with 2 bakelite support blocks, 2 3/16" long, 1/2" thick, 1" high, mounted on aluminum base, (capacitor hold-down bracket) 7 3/4" long, 2 17/32" wide, 13/32" high; two .187" mounting holes, 7.125" C to C; sand blast finish; 3 solder lug terminals for connections.	Microsecond delay line.	1 Special	1B101479	1	
E101		FUSE, RECEPTACLE: molded phenolic, black; spring contact at base; screw contact at top; 1 3/4" long, 1/2" diameter, 1/2-24 thread for mounting.	Line fuse receptacle.	19 1087A	65A42168	1	
E102		KNOB, CONTROL: zamak #3 alloy, 1 13/32" long, 7/32" wide, 13/32" high, .190" hole for shaft; .144" hole for fastening screw; olive drab paint over sandblast finish.	Switch handles S101A and B and S102A and B.	1 Special	36K48541	2	

"Special" means made for or by Galvin.

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
E103		KNOB, CONTROL: black bakelite, 1⅛″ diameter; brass insert: .257″ hole for shaft; 2 #8-32 thread setscrews, 7/32″ long, set 90° apart.	Knobs of potentiometer controls.	18 S-308-64B	36A48542	4	
E104		KNOB, POINTER: black bakelite, 1⅛″ diameter; brass insert; .257″ hole for shaft; 2 setscrews, set 90° apart. Pointer, 1/32″ brass, nickel plated.	Knob for gain control R101.	18 S-308-64-522	36A102582	1	
E105		MOUNTING, METER FUSE: linen bakelite base, 1″ wide, 1⅛″ long, 5/64″ thick; mounts directly on one meter binding post.	Meter protecting fuse holder.	19 1059	31A42858	1	
E106		CAP, FUSE HOLDER: bakelite knob, threaded brass insert to fit 1212B Littelfuse holder.	Fuse holder cap.	19 Part of 1212B	65K48800	2	
F101		FUSE: 1/200 amperes; 8AG glass encased; 1¼″ long, ¼″ diameter (2 spares).	Meter protecting fuse.	8 8AG	65X42869	3	
F102		FUSE: 4 ampere; 8AG glass encased; 1″ long, ¼″ diameter (2 spares).	Line fuse.	8 8AG	65X42243	3	
H101		SETSCREW: 6-32 thread, ⅛″ long; #6 Allen head; cup point; cold rolled steel, white nickel finish.	Fastening slide coupling to shaft.	37 †	3S7148	8	
H102		CLIP, FAHNESTOCK: phosphor bronze; nickel plated; .031″ thick; overall dimensions: 2 1/16″ long, ⅜″ high; 5/32″ diameter hole in center for mounting to chassis.	Allen wrench holder.	1 Special	42A48491	2	

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†Order from supplier with Galvin Part No. and description.

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1

Reference Symbol	Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
H103		CLIP, FUSE: phosphor bronze; nickel plated; 9/16″ high, 3/8″ wide, 13/32″ long; .171″ diameter mounting hole.	Mounting spare pilot lamps.	19 1319	42A81194	4	
H104		CLIP, FUSE: phosphor bronze; U-shaped; 29/64″ high, 5/16″ wide, .134″ hole for mounting; fits 1/4″ diameter fuses.	Mounting spare fuses.	19 1011	42K31278	8	
H105		SETSCREW: 8-32 thread, 3/16″ long, #8 Allen head; cup point; cold rolled steel, white cadmium finish.	Fastening knobs to control shafts.	25 †	3S7110	10	
H106		WRENCH, ALLEN: (#6) "L"; .063″ diameter; hexagonal; 3/4″ wide, 2 3/16″ long.	Flexible coupling setscrew wrench.	25 †	66A10704	2	
H107		WRENCH, ALLEN: (#8) "L"; 5/64″ diameter; hexagonal; 7/8″ wide, 2 1/4″ long.	Control knob setscrew wrench.	25 †	66K21442	2	
H108		STRAP, SCREEN RETAINER: brass; .020″ thick, 10 1/8″ long. 1″ wide; 10 1/4″ wide x 1/8″ long tabs on one side bent to 45° angle; slightly curved 1″ from each end; dull black paint over copper flash finish.	Retainer for calibrated screen.	1 Special	42B42946	1	
J101		JACK, PHONE: closed circuit; 3/8-32 thread, brass mounting stud.	Sine wave jack.	38 IJ-102	40A52808	1	
I101		BULB, PILOT LIGHT: .15 amperes, 6-8 volts; miniature bayonet base; brown bead (2 spares).	ON-OFF indicator.	34 #47 39 #47 36 #47	65K48499	3	

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TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
L101		ASSEMBLY, COIL AND SHIELD: approx. 210 turns of No. 6/42 S. CEL. E. copper wire, universal wound on .312″ diameter form; dipped white halowax; mounted in .860″ x .860″ x 1″ high aluminum can; sandblast finish.	Video compensating coil, plate V101, section A.	1 Special	1K103901	1	
L102		ASSEMBLY, COIL AND SHIELD: same as L101, except L102 stamped on can.	Video compensation coil, coupling V101, section A to section B.	1 Special	1K103902	3	
L103		ASSEMBLY, COIL AND SHIELD: approx. 170 turns of No. 6/42 S. CEL. E. copper wire; universal wound on .312″ diameter bakelite form; dipped in white halowax; mounted in .860″ x .860″ x 1″ high aluminum cans; sandblast finish.	Video compensation coil plate V102, section B.	1 Special	1K103903	1	
L104		ASSEMBLY, COIL AND SHIELD: approx. 140 turns of No. 6/42 S. CEL. E. copper wire; universal wound on .312″ bakelite form; dipped in white halowax; mounted in .860″ x .860″ x 1″ high aluminum can; sandblast finish.	Video compensating coil, coupling V102, section B to grid V103.	1 Special	1K1 .3904	1	
L105		ASSEMBLY, COIL AND SHIELD: same as L103, except L105 stamped on can.	Video compensating coil, V103.	1 Special	1K103905		
L106		ASSEMBLY, COIL AND SHIELD: 130 turns of No. 6/42 S.S.E. copper wire on bakelite form, dipped in white halowax; iron slug tuned; mounted in aluminum can. .860″ x .860″ x 1.920″ high; 2 solder lugs on base for connections; mounts with 5/16-24 thread bushing and nut.	Calibrating generator, tuning coil, 5 range.	1 Special	24B52842	1	

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TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
L107		ASSEMBLY, COIL AND SHIELD: 2 pi, spaced 1/16" apart, each pi, 200 turns of No. 7/44 S. CEL. E. copper wire on bakelite form, dipped in white halowax; iron slug tuned; mounted in aluminum can .860" x .860" x 1.920" high; 2 solder lugs on base for connections; mounts with 5/16-24 thread bushing and nut.	Calibrating signal generator tuning coil, 25 range.	1 Special	24B52843	1	
L108		COIL AND SHIELD ASSEMBLY: 2 pi, spaced 1/16" apart, each pi 375 turns of No. 7/44 S. CEL. E. copper wire on bakelite form, dipped in white halowax; iron slug tuned; mounted in aluminum can. .860" x .860" x 1.920" high; 2 solder lugs on base for connections; mounts with 5/16-24 thread bushing and nut.	Calibrating signal generator tuning coil, 100 range.	1 Special	24B52844	1	
M101		METER, PULSE: D.C. milliampere, 2.75 full scale, special scale; 3 1/2" outside diameter flange; 2 3/4" body diameter; 3 mounting holes.	Repetition rate indicator.	29 25	52B42157	1	
N101		SCREEN, CALIBRATED: clear celluloid, 3.250" diameter, .038" thick; black printed range marked.	Pulse shape indicator.	1 Special	61A103103	1	
N102		SCREEN, PLAIN: clear celluloid, 3.250" diameter, .030" thick.	Reflecting suppressor for V108 screen.	1 Special	61A42909	1	
O101		COUPLING, SLIDE: ceramic body 1" x 1" x 3/16" thick; brass inserts and springs, cadmium plated; 1/4" holes for shafts; #6-32 x 1/8" Allen head, cup point setscrews; white nickel plated.	Shaft coupler (flexible) R119, R121.	21 K39006	58A48562	2	
O102		SHAFT, COUPLING: brass, .248" to .250" outside diameter, 1 5/16" long; white cadmium finish.	Coupling shafts.	1 Special	47A42816	2	

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TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
O103		CLAMP, CABLE: grey fibre, 3/32" thick, 1 7/8" long, 15/32" wide, .196" diameter hole for mounting.	Cable support clamp.	30	42A52669	1	
P101		PLUG (PL-55): 2 circuit plug with a plastic cover over terminals. Overall dimensions: 2 27/32" long, 1/2" diameter. PL-55 is printed on cover.	Connector, external sine wave source.	4 PL-55	28A35896	1	
R101		POTENTIOMETER: overall resistance 1,000 ohms, ±20%, 1/2 watt, linear taper; 3/8-32 thread mounting stud; overall dimensions: 1 3/8" long x 1 13/32" diameter, including lugs.	Gain control.	9 35	18A42204	1	
R102		RESISTOR: fixed, carbon; 6,800 ohms, ±5%; 1/2 watt; insulated; 7/16" long, .218" diameter; axial leads, 1 1/2" long.	Plate load, V101, section A.	13 504 Ins. 32 MB-1/2 Ins. 15 BT-1/2 Ins.	6B2001	1	
R103		RESISTOR: fixed, carbon; 6,800 ohms, ±10%; 1/2 watt; insulated; 7/16" long, .218" diameter; axial leads, 1 1/2" long. (Also R138).	Plate filter, V101, section A.	13 504 Ins. 32 MB-1/2 Ins. 15 BT-1/2 Ins.	6B6428	2	
R104		RESISTOR: fixed, carbon; 560,000 ohms, ±10%; 1/2 watt; insulated; 7/16" long, .218" diameter; axial leads, 1 1/2" long. (Also R105, R112, R131, R137).	Grid coupling, V101, Section A.	13 504 Ins. 32 MB-1/2 Ins. 15 BT-1/2 Ins.	6B5697	5	
R105		RESISTOR: same as R104.	Grid coupling, V101, section B.				

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1

Reference Symbol	Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
R106		RESISTOR: fixed, carbon; 1,500 ohms, ±10%; ½ watt; insulated; 7/16" long, .218" diameter; axial leads, 1½" long. (Also R107, R117).	Cathode load, V101, section A.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B6038	3	
R107		RESISTOR: same as R106.	Plate load, V101, section B.				
R108		RESISTOR: fixed, carbon; 220 ohms, ±5%; ½ watt; insulated; 7/16" long, .218" diameter; axial leads, 1½" long.	Delay line terminating resistor.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B2002	1	
R109		RESISTOR: fixed, carbon; 10,000 ohms, ±10%; 1 watt; insulated; ⅞" long, .281" diameter; axial leads, 1½" long. (Also R134, R136).	Plate filter V101, section B.	13 518 Ins. 32 MB 1 Ins. 15 BT 1 Ins.	6B6430	3	
R110		RESISTOR: fixed, carbon; 39,000 ohms, ±10%; ½ watt; insulated; 7/16" long, .218" diameter; axial leads, 1½" long.	Grid coupling, V102, section A.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B6487	1	
R111		RESISTOR: fixed, carbon; 3300 ohms, ±5%; ½ watt; insulated; 7/16" long, .218" diameter; axial leads, 1½" long.	Plate load, V102, section A.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B2003	1	

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
R112		RESISTOR: same as R104.	Grid coupling, V103.				
R113		RESISTOR: fixed, carbon; 33,000 ohms, ±10%; 1 watt; insulated; 7/8" long, .281" diameter; axial leads, 1½" long. (Also R114, R145).	Screen grid dropping, V103.	13 518 Ins. 32 MB 1 Ins.	6B6400	3	
R114		RESISTOR: same as R113.	Screen grid dropping, V103.				
R115		RESISTOR: fixed, wire wound; 3,500 ohms, ±10%; 10 watt, insulated; 1 27/32" long, 15/32" diameter; axial leads, 2½" long.	Plate load, V103.	31 Koolohm	17K42235	1	
R116		RESISTOR: fixed, carbon; 2,200 ohms, ±10%; ½ watt; insulated; 7/16" long, .218" diameter; axial leads, 1½" long. (Also R135).	Grid bias supply, V101, section A and V102, section A.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B6069	2	
R117		RESISTOR: same as R106.	Grid bias, supply V103.				
R118		RESISTOR: fixed, carbon; 560,000 ohms, ±10%; 1 watt; insulated; 7/8" long, .281" diameter; axial leads, 1½" long.	High voltage bleeder, V108.	13 518 Ins. 32 MB 1 Ins.	6B5666	1	
R119		POTENTIOMETER: overall resistance 500,000 ohms, ±20%; ½ watt, linear taper; 3/8-32 thread mounting stud; overall dimensions: 1 11/64" long x 1 13/32" diameter, including lugs.	Focus control.	9 35	18A42208	1	

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 **MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1**

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
R120		RESISTOR: fixed, carbon; 220,000 ohms, ±10%; 1 watt; insulated; 7/8" long, .281" diameter; axial leads, 1½" long.	High voltage bleeder, V108.	13 518 Ins. 32 MB 1 Ins.	6B5574	1	
R121		POTENTIOMETER: overall resistance 250,000 ohms, ±20%; ½ watt; linear taper; 3/8-32 thread mounting stud; overall dimensions: 1 11/64" long x 1 13/32" diameter including lugs.	Intensity control.	9 35	18A42209	1	
R122		RESISTOR: fixed, carbon; 1.2 megohms, ±10%; ½ watt; insulated; 7/16" long, .218" diameter; axial leads, 1½" long. (Also R123, R132).	Grid coupling, V108.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B5653	3	
R123		RESISTOR: same as R122.	Deflection plate coupling, V108.				
R124		RESISTOR: fixed, carbon; 22,000 ohms, ±10%; ½ watt; insulated; 7/16" long, .218" diameter; axial leads, 1½" long. (Also R127).	Voltage divider, vertical centering control.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B6397	2	
R125		POTENTIOMETER: two identical sections; 100,000 ohms, ±20%, ½ watt; linear taper; 3/8-32 thread mounting stud; overall dimensions: 1 13/16" long x 1 13/32" diameter including lugs.	Vertical centering control.	9 35	18K52612	1	
R125A		POTENTIOMETER: One section of R125.					
R125B		POTENTIOMETER: One section of R125.					

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 **MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1**

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
R126		POTENTIOMETER: two identical sections; 500,000 ohms, ±20%, ½ watt; linear taper; ⅜-32 thread mounting stud; overall dimensions: $1\frac{13}{16}$″ long x $1\frac{13}{32}$″ diameter including lugs.	Horizontal centering control.	9 35	18A42206	1	
R126A		POTENTIOMETER: One section of R126.					
R126B		POTENTIOMETER: One section of R126.					
R127		RESISTOR: same as R124.	Voltage divider, vertical centering control.				
R128		RESISTOR: fixed, carbon; 10 megohms, ±10%; ½ watt; insulated; 7/16″ long, .218″ diameter; axial leads, 1½″ long.	Grid coupling, V104.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B5622	1	
R129		RESISTOR: fixed, carbon; 120,000 ohms, ±10%; ½ watt; insulated; 7/16″ long, .218″ diameter; axial leads, 1½″ long.	Pulse shaping circuit grid V108.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B5631	1	
R130		RESISTOR: fixed, carbon; 2.2 megohms, ±10%; ½ watt; insulated; 7/16″ long, .218″ diameter; axial leads, 1½″ long. (Also R141).	Screen grid dropping, V104.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B6433	2	
R131		RESISTOR: same as R104.	Screen grid voltage divider, V104.				

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 **MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1**

Reference Symbol	Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
R132		RESISTOR: same as R122.	Deflection plate coupling V108.				
R133		RESISTOR: fixed, carbon; 27,000 ohms, ±10%; ½ watt; insulated; 7/16" long, .218" diameter; axial leads, 1½" long.	Multivibrator plate load, V105, section A.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B6434	1	
R134		RESISTOR: same as R109.	Plate load, V104.				
R135		RESISTOR: same as R116.	Cathode bias, V105.				
R136		RESISTOR: same as R109.	Multivibrator plate load, V105, section B.				
R137		RESISTOR: same as R104.	Grid coupling V105, section B and multivibrator time constant.				
R138		RESISTOR: same as R103.	Plate load, V106, section A.				
R139		RESISTOR: fixed, carbon; 56,000 ohms, ±10%; ½ watt; insulated; 7/16" long, .218" diameter; axial leads, 1½" long.	Pulse shaping circuit, grid V106, section B.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B6378	1	

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
R140		RESISTOR: fixed, carbon; 220,000 ohms, ±10%; ½ watt; insulated; 7/16" long, .218" diameter; axial leads, 1½" long.	Grid coupling, V106, section A and V105, section A.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B6407	1	
R141		RESISTOR: same as R130.	Grid coupling, V106, section B.				
R142		RESISTOR: fixed, carbon; 4,700 ohms, ±10%; 1 watt; insulated; ⅞" long, .281" diameter; axial leads, 1½" long. (Also R143).	Sawtooth forming plate load, V106, section B.	13 518 Ins. 32 MB 1 Ins.	6B5576	2	
R143		RESISTOR: same as R142.	Sawtooth forming plate load, V106, section B.				
R144		RESISTOR: fixed, carbon; 820,000 ohms, ±10%; ½ watt; insulated; 7/16" long, .218" diameter; axial leads, 1½" long.	Grid coupling, V107.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B6429	1	
R145		RESISTOR: same as R113.	Plate load, V107.				
R146		RESISTOR: fixed, carbon; 47,000 ohms, ±10%; ½ watt; insulated; 7/16" long, .218" diameter; axial leads, 1½" long.	Screen grid dropping, V107.	13 504 Ins. 32 MB-½ Ins. 15 BT-½ Ins.	6B6048	1	

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 **MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1**

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
R147		RESISTOR: fixed, carbon; 680 ohms, ±10%; 1/2 watt; insulated; 7/16" long, .218" diameter; axial leads, 1 1/2" long.	Cathode bias, V107.	13 504 Ins. 32 MB-1/2 Ins. 15 BT-1/2 Ins.	6B6040	1	
R148		POTENTIOMETER: overall resistance 500 ohms, ±20%; 1/2 watt; linear taper; 3/8-32 thread mounting stud; overall dimensions: 1" long x 1 13/32" diameter including lugs. Screw-driver slot.	Meter zero adjust-ment.	9 35	18A42205	1	
R149		RESISTOR: fixed, carbon; 8,200 ohms, ±10%, 1/2 watt; insulated; 7/16" long, .218" diameter; axial leads, 1 1/2" long.	Pulse meter multi-vibrator time con-stant.	13 504 Ins. 32 MB1/2- Ins. 15 BT-1/2 Ins.	6B2004	1	
R150		POTENTIOMETER: overall resistance 15,000 ohms, ±20%; 1/2 watt; linear taper; 3/8-32 thread mounting stud; overall dimensions: 7/8" long x 13/32" diameter including lugs. Screw-driver slot. (Also R151, R152).	6,000 cycle meter range control.	9 35	18A42207	3	
R151		POTENTIOMETER: same as R150.	3,000 cycle meter range control.				
R152		POTENTIOMETER: same as R150.	300 cycle meter range control.				
S101		SWITCH: 3-position: 2 gang; laminated bakelite insulation, phosphor bronze spring; 7/16-32 thread mounting stud.	Time base micro-second switch.	23 25928-H2	40B42729	1	

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
S101A		SWITCH: One section of S101.					
S102B		SWITCH: One section of S101.					
S102		SWITCH: 4-position: 2 gang; laminated bakelite insulation, phosphor bronze spring; 7/16-32 thread mounting stud.	Meter range and calibrate switch.	23 25927-H2	40B42728	1	
S102A		SWITCH: One section of S102.					
S102B		SWITCH: One section of S102.					
S103		SWITCH: toggle; single-pole, single-throw; 1/2-32 thread mounting stud.	ON-OFF switch.	6 20994-MJ	40A42169	1	
SO101		RECEPTACLE, CHASSIS: aluminum shell, mica filled bakelite insulation; overall dimensions: 1″ square, 1 1/16″ long; 5/8-24 thread; mounting plate; 1″ square, 5/64″ thick, 4 holes .120″ diameter.	Input receptacle.	5 83-1R	9A42309	1	
SO102		PLUG, CHASSIS: aluminum shell; mica filled bakelite insulation; 4 pins silver plated; 1 3/8-18 thread on upper end; 1 5/8″ long; mounting plate 1 5/8″ square, 3/32″ thick, 4 holes .120″ diameter for mounting.	Power plug.	5 AN 3102-22-4P	28A42125	1	
V101		RADIO TUBE: twin triode amplifier. (Also V102, V105, V106).	1st stage video and phase inverter.	34 6SN7GT	6SN7GT	4	
V102		RADIO TUBE: same as V101.	2nd stage video and d-c restorer.				
V103		RADIO TUBE: video beam power amplifier. (Also V104).	3rd stage and output video.	26 6AG7	6AG7	2	

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 **MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1**

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Designation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
V104		RADIO TUBE: same as V103.	Keyer tube multivibrator.				
V105		RADIO TUBE: same as V101.	Multivibrator.				
V106		RADIO TUBE: same as V101.	Sawtooth and calibrate oscillator, and limiter tube for pulse meter.				
V107		RADIO TUBE: triple-grid amplifier.	Pulse meter tube.	34 6SJ7GT	6SJ7GT	1	
V108		CATHODE RAY TUBE:	Indicator.	22 3BP1	3BP1	1	
X101		SOCKET, TUBE: standard octal; steatite body; saddle type; $1\frac{3}{4}''$ between slotted mounting hole centers, caustic etched aluminum; phosphor bronze contacts, silver plated.	Tube receptacle.	5 RSS8	9A103950	2	
X101-1		SOCKET, TUBE: same as X101.					
X101-2		SOCKET, TUBE: same as X101.					
X101-3		SOCKET, TUBE: same as X101.					
X101-3		SOCKET, TUBE: same as X101.					
X101-4		SOCKET, TUBE: same as X101.					
X101-5		SOCKET, TUBE: same as X101.					
X101-6		SOCKET, TUBE: same as X101.					
X101-7		SOCKET, TUBE: same as X101.					

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 **MAJOR UNIT—PULSE ANALYZER ID-46/SPA-1**

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
X102		SOCKET, CATHODE RAY TUBE: molded phenolic; $2\frac{1}{4}$" diameter, $1\frac{3}{8}$" thick, 14 contact receptacles.	Tube socket, V108.	10 9450	9B42170	1	
X103		SOCKET, LIGHT AND JEWEL: Includes pol-laroid red jewel and cap, reducer bushing, 3 insulator washers, collar bushing and light socket bracket; overall dimensions assembled: $2\frac{1}{32}$" long, $\frac{15}{16}$" diameter; external parts black nickel finish; internal parts white cadmium plated.	ON-OFF indicator.	12 80	60A42288	1	

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—POWER SUPPLY PP-54/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
C201		CAPACITOR: fixed, paper; .5 μf; oil filled; 2000 v. d-c working; metal case, 2 7/8" high (less insulators), 3 3/4" (with insulators), 1 13/16" wide, 1 1/16" thick, insulator terminals 13/16" centers, 2 1/4" mounting hole centers.	High voltage filter, V108 supply.	14 20SAK50	8B52262	1	
C202		CAPACITOR: fixed; dykanol filled electrolytic; 4 microfarads, ±10%, 600 v. d-c working; single hole mounting with stud and locknut; 5 7/16" long, 1 1/2" diameter. (Also C203, C204).	Low voltage filter, −300 volts.	11 TLA-6040	8K42196	3	
C203		CAPACITOR: same as C202.	Low voltage filter, +300 volts.				
C204		CAPACITOR: same as C202.	Input filter low voltage supply, +300 volts.				
CH201		CHOKE, FILTER: 20 henries: 515 ohms d-c. maximum. Case dimensions: 3 7/8" high, 3 7/8" long, and 3 5/8" wide. Terminals are 6-32 studs with nuts, mounted on 1/2" insulators; studs extend 3/8" beyond insulators; 6 mounting holes for #8 screws.	B+ filter.	33 5C51	25B42230	1	
E201		TERMINAL BOARD: bakelite; 5" long, 1 1/4" wide, 5/8" thick; 8 screw terminals are separated by raised barriers; 2 mounting holes at each end for #6 screws.	Power supply connector for analyzer power cable.	17 8-142	31A51723	1	
E202		INSULATOR, CONE: Steatite or Alsimag white glaze; 5/8" long, 5/8" large end diameter, 7/16" small end diameter; brass inserts at each end, tapped for 6-32 thread, 7/32" deep.	Terminal post.	16 600	14A80153	1	

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—POWER SUPPLY PP-54/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
E203		GRID, CAP AND LEAD: cap insulated with a bakelite cover; lead; AWP 4484 wire; (white) 9 5/8" long.	Top cap plate connector for V201.	1 Special	42A42201	1	
E204		SLEEVE, RUBBER: black; 17/32" outside diameter, 13/32" inside diameter, 3/4" long.	O202 cable clamp insulator.	7 27	37K2191	1	
O201		BRACKET, RESISTOR MOUNTING: cold rolled steel; "L" shaped, hook at one end, overall dimensions: 1 1/16" long, 15/16" high, 1/4" wide; 3/16" hole for mounting; white cadmium finish.	Mounting brackets for R203.	38 P-3747	7A101644	2	
O202		CLAMP, CABLE: cold rolled steel, round edge flat wire .035" stock; one mounting hole .171" diameter; radius of cable 5/16"; 1 1/16" long, 3/8" wide, 5/16" high.	Laced cable clamp.	10 292L	42A16152	1	
R201		RESISTOR: fixed, carbon; 100,000 ohms, ±10%, 1 watt; insulated; 3/4" long, .281" diameter; axial leads, 1 1/2" long.	High voltage filter.	13 518 Ins. 32 MB 1 Ins.	6B6425	1	
R202		RESISTOR: fixed, carbon; 10 megohms, ±10%; 2 watt; insulated; 1 3/4" long, .344" diameter; axial leads, 1 1/2" long.	High voltage bleeder.	15 BT-2 Ins.	6B5696	1	
R203		RESISTOR: fixed, wire wound; 3,000 ohms, ±10%; 20 watt; insulated, brown vitreous enamel, 2" long, 19/32" outside diameter; 2 lug terminals, 3/16" long.	Dropping resistor, V203	38	17A101061	1	
R204		RESISTOR: fixed, carbon; 100,000 ohms, ±10%; 2 watt; insulated; 1 3/4" long, .344" diameter; axial leads, 1 1/2" long.	Low voltage bleeder, +300 volts.	15 BT-2 Ins.	6B5685	1	

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—POWER SUPPLY PP-54/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
T201		TRANSFORMER, POWER: 60-2800 cycles: Primary winding terminals #1 and #3 for 115 v. a-c with tap, terminal #2 for 80 v. a-c. five secondary windings; #1, terminals 9 and 10, 2.5 volts, 1.75 amperes; #2, terminals 4 and 6 with 5 C.T., 300 volts, 100 milliamperes; #3, terminals 7 and 8, 5 volts, 2 amperes; #4, terminals 13 and 14, 6.3 volts, 3.65 amperes; #5, terminals 11 and 12, 6.3 volts, 3.65 amperes; screw stud terminals on insulators; metal case, 5 7/8" high (including insulators), 5 1/4" long, 4 7/8" wide; gray enamel finish.	Power Supply PP-54/SPA-1 power transformer.	33	25C48383	1	
V201		RADIO TUBE: half wave rectifier, high vacuum; filament type.	High voltage rectifier tube.	2X2/879	2X2/879	1	
V202		RADIO TUBE: full wave rectifier, high vacuum; filament type.	B+ rectifier tube.	5Y3GT	5Y3GT	1	
V203		RADIO TUBE: voltage regulator.	Voltage regulator.	VR-150/30	VR-150/30	1	
X201		SOCKET, TUBE: standard octal; steatite body; saddle type; 1 3/4" between slotted mounting hole centers, caustic etched aluminum; phosphor bronze contacts, silver plated.	Tube receptacle.	5 RSS8	9A103950	2	
X201-1		SOCKET, TUBE: same as X201.					
X201-2		SOCKET, TUBE: same as X201.					
X202		SOCKET, TUBE: 4 prong steatite socket; mounting plate, .064" thick aluminum; contacts are separated by raised barriers; mounting holes centers 1 1/2" to 1 7/8".	Tube socket for V201	5 RSS4	9A6769	1	

TABLE OF REPLACEABLE PARTS

MODEL—PULSE ANALYZER EQUIPMENT AN/SPA-1 MAJOR UNIT—ACCESSORIES ID-46/SPA-1

Reference Symbol	Army Stock Number Navy Type Number British Ref. Number	NAME OF PART AND DESCRIPTION	Function	Mfr. and Design-nation	Drawing or Specification Number	Quant. per Maj. Unit	Unit Cost
H301		SHOCK MOUNT (Lord): 45 lb. shock mount; cold rolled steel; 3″ long, 3″ wide, 1½″ high; 4 mounting holes, 2½″ centers.	Mounts for Mounting *MT-52/UR.	40 200PH	37B48493	4	
P401		RECEPTACLE, POWER: four prong female connector; two #8 contacts, two #12 contacts; die cast aluminum split shell; 3″ long, 2¼″ diameter, including right angle shell.	Power cable connector.	5 AN-3108-22-4S	9B42282	1	
P501		PLUG, VIDEO CABLE: coaxial cable plug for single conductor; brass, 1½″ long, 23/32″ diameter; low loss mica filled bakelite insulation.	Video cable plug.	5 83-1SP	28A42310	2	

LIST OF MANUFACTURERS NAMES AND ADDRESSES

1.	Galvin Mfg. Corporation	4545 W. Augusta Blvd.	Chicago	Illinois
2.	Aerovox		New Bedford	Massachusetts
3.	Allen-Bradley		Milwaukee	Wisconsin
4.	American Microphone	208 N. Wells Street	Chicago	Illinois
5.	American Phenolic Corp.	1830 S. 54th Street.	Cicero	Illinois
6.	Arrow, Hart & Hegeman	103 Hawthorn Street	Hartford	Connecticut
7.	Atlantic India Rubber	1453 W. VanBuren Street	Chicago	Illinois
8.	Bussmann Fuse Corp.	9. S. Clinton Street	Chicago	Illinois
9.	Chicago Telephone Supply Co.		Elkhart	Indiana
10.	Cinch Mfg. Co.	2339 W. VanBuren Street	Chicago	Illinois
11.	Cornell-Dubilier	1000 Hamilton	S. Plainfield	New Jersey
12.	Drake Electric Co.	3654 N. Lincoln Ave.	Chicago	Illinois
13.	Erie Resistor Corp.	644 W. 12th	Erie	Pennsylvania
14.	Industrial Condenser Corp.	1725 W. North Ave.	Chicago	Illinois
15.	International Resistance Corp.	401 N. Broad St.	Philadelphia	Pennsylvania
16.	Johnson, E. F. Co.		Waseca	Minnesota
17.	Jones, H. Band Co.	2300 Wabansia Ave	Chicago	Illinois
18.	Kurz-Kasch Co.	608 S. Dearborn St.	Chicago	Illinois
19.	Littelfuse Corp.	4757 N. Ravenswood	Chicago	Illinois
20.	Micamold Corp.	1087 Flushing Ave.	Brooklyn 6	New York
21.	Millon, James Mfg. Co.	549 Washington Blvd.	Chicago	Illinois
22.	National Union Co.	1181 McCarter Highway	Newark 4	New Jersey
23.	Oak Mfg. Co.	1260 Clybourn Ave.	Chicago	Illinois
24.	Ohio Carbon Co.	12508 Berea Road	Cleveland	Ohio
25.	Pedersen Bros.	625 W. Washington Blvd.	Chicago	Illinois
26.	R.C.A. Mfg. Co., Inc.		Harrison	New Jersey
27.	Salisbury, W. M. & Co.	401 N. Morgan St.	Chicago	Illinois
28.	Sangamo Electric Co.		Springfield	Illinois
29.	Simpson Electric Co.	5216 W. Kinzie St.	Chicago 44	Illinois
30.	Spaulding Fibre Co.	4757 N. Ravenswood	Chicago	Illinois
31.	Sprague Spec. Co.		N. Adams	Massachusetts
32.	Stackpole Carbon Co.	Elk County	St. Mary's	Pennsylvania
33.	Standard Transformer Corp.	1500 N. Halsted Street	Chicago	Illinois
34.	Sylvania Electric Prod., Inc.		Emporium	Pennsylvania
35.	Tobe Deutschmann		Canton	Massachusetts
36.	Tung Sol Radio Tube	95 8th Avenue	Newark	New Jersey
37.	United Screw & Bolt	3590 W. 58th St.	Cleveland 2	Ohio
38.	Utah Radio Products	820 Orleans St.	Chicago	Illinois
39.	Westinghouse Lamp Div.	2211 W. Pershing Road	Chicago	Illinois
40.	Lord Mfg. Co.		Erie	Pennsylvania

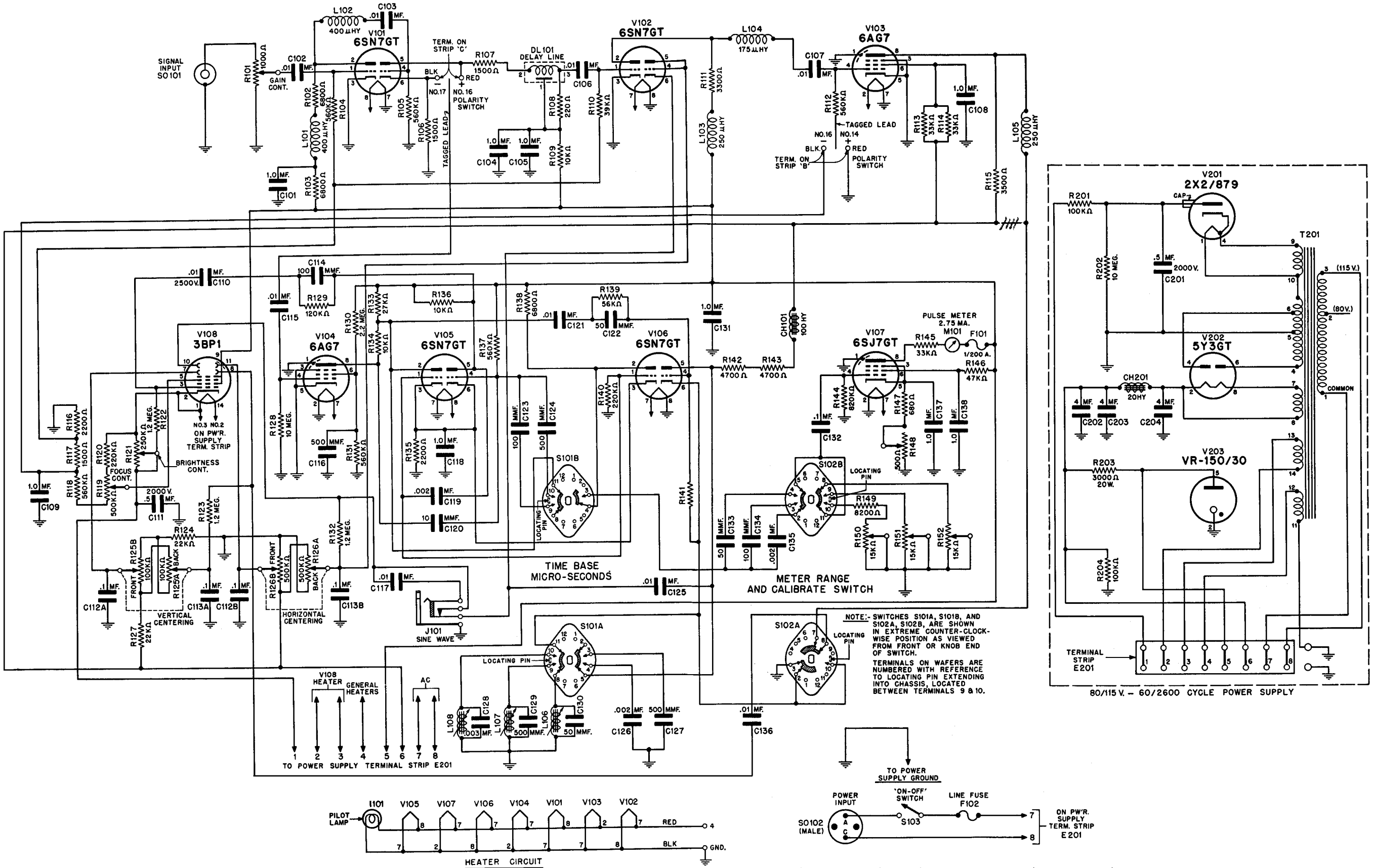
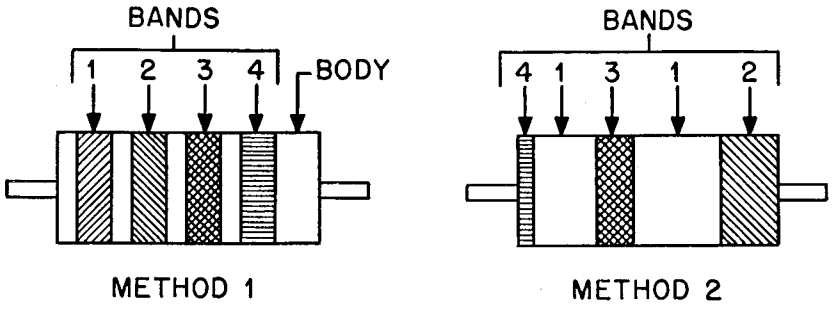


Figure 17. Pulse Analyzer Equipment AN/SPA-1 or AN/APA-6A, Schematc Diagram

RMA STANDARD COLOR CODE CHART

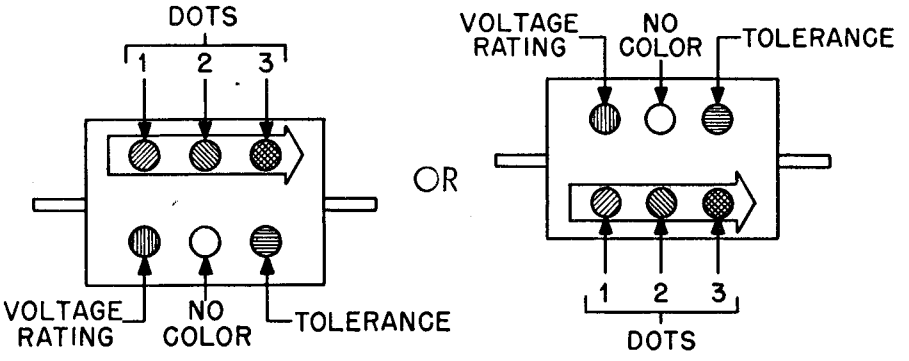
For Resistors



COLOR	1st Band	2nd Band	3rd Band	4th Band
	1st Digit	*2nd Digit*	*Decimal Multiplier*	*Tolerance*
Black	0	0	1	
Brown	1	1	10	
Red	2	2	100	
Orange	3	3	1,000	
Yellow	4	4	10,000	
Green	5	5	100,000	
Blue	6	6	1,000,000	
Violet	7	7	10,000,000	
Gray	8	8	100,000,000	
White	9	9	1,000,000,000	
Gold	...	...	.....	± 5%
Silver	...	...	.....	±10%
No Color	...	...	.....	±20%

3-DOT COLOR CODE CHART

For Capacitors



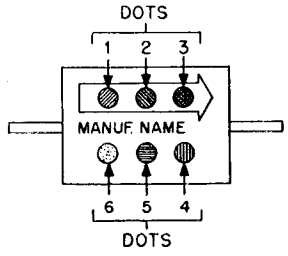
COLOR	1st Dot	2nd Dot	3rd Dot	*Tolerance*	*Voltage Rating*
	1st Digit	*2nd Digit*	*Decimal Multiplier*		
Black	0	0	1		
Brown	1	1	10	1%	100v.
Red	2	2	100	2%	200v.
Orange	3	3	1,000	3%	300v.
Yellow	4	4	10,000	4%	400v.
Green	5	5	100,000	5%	500v.
Blue	6	6	1,000,000	6%	600v.
Violet	7	7	10,000,000	7%	700v.
Gray	8	8	100,000,000	8%	800v.
White	9	9	1,000,000,000	9%	900v.
Gold	...	...	0.1		1000v.
Silver	...	...	0.01	10%	2000v.
Body	...	...	.....	20%	*

*When no Color is indicated the Voltage Rating may be as low as 300 volts.

RESTRICTED

AMERICAN WAR STANDARD 6-DOT COLOR CODE CHART

For Capacitors (Molded Mica)



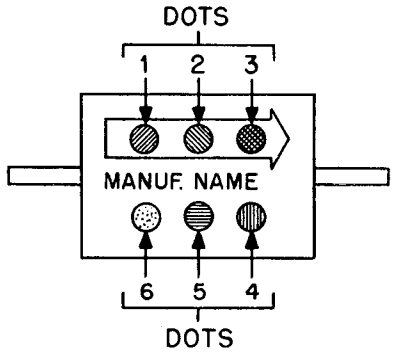
Color	1st Dot *1st Digit*	2nd Dot *2nd Digit*	3rd Dot *3rd Digit*	4th Dot *Decimal Multiplier*	5th Dot *Tolerance*	6th Dot *Characteristics*
Black	0	0	0	1	±20%	*A
Brown	1	1	1	10		B
Red	2	2	2	100	± 2%	C
Orange	3	3	3	1,000		D
Yellow	4	4	4	10,000		E
Green	5	5	5	100,000		F
Blue	6	6	6	1,000,000		G
Violet	7	7	7	10,000,000		
Gray	8	8	8	100,000,000		
White	9	9	9	1,000,000,000		
Gold	...	...	...	0.1	± 5%	
Silver	...	...	...	0.01	±10%	

*A—Ordinary Mica By-pass.
B—Same as A—Low Loss Case.
C—By-pass or Silver Mica Capacitor (±200 parts/Million/C)
D—Silver Mica Capacitor (±100 Parts/Million/C)
E—Silver Mica Capacitor (0 to +100 Parts/Million/C)
F—Silver Mica Capacitor (0 to +50 Parts/Million/C)
G—Silver Mica Capacitor (0 to −50 parts/Million/C)

RESTRICTED

RMA STANDARD 6-DOT COLOR CODE CHART

For Capacitors (Molded Mica)



Color	1st Dot *1st Digit*	2nd Dot *2nd Digit*	3rd Dot *3rd Digit*	4th Dot *Decimal Multiplier*	5th Dot *Tolerance*	6th Dot *Voltage*
Black	0	0	0	1	....	....
Brown	1	1	1	10	1%	100v.
Red	2	2	2	100	2%	200v.
Orange	3	3	3	1,000	3%	300v.
Yellow	4	4	4	10,000	4%	400v.
Green	5	5	5	100,000	5%	500v.
Blue	6	6	6	1,000,000	6%	600v.
Violet	7	7	7	10,000,000	7%	700v.
Gray	8	8	8	100,000,000	8%	800v.
White	9	9	9	1,000,000,000	9%	900v.
Gold	...	...	...	0.1		1,000v.
Silver	...	...	...	0.01	10%	2,000v.
Body	...	...	...	.....	20%	500v.

RESTRICTED

AN/APA-6A and AN/SPA-1

REVISION

The following information is published by Galvin Manufacturing Corporation, on Order No. NXss 22659, covering Pulse Analyzer Equipment AN/APA-6A and AN/SPA-1.

Capacitor C132, .01 μf, 300 V. D.C. working, Galvin Part No. 21X101066 or 21B6609, has been changed to .1 μf, 120 V. D.C. working, —10% + 50%, Galvin Part No. 8A106370.

Change reading of pin #9 on Tube Socket V108 in Figure 11 from 0 to 150 volts.

Change reading of pin #9 on Tube Socket V108 in Figure 12 from 0 to 25K ohms.

On page 3, paragraph 7, change 6SN7GT (V103) multivibrator to read 6SN7G7 (V105) multivibrator.

Above revision effective on Order No. NXss 22659, starting with Serial No. 94.

TABLE OF REPLACEABLE PARTS

MODEL: Pulse Analyzer Equipment AN/SPA-1 **MAJOR UNIT: Pulse Analyzer ID-46/SPA-1**

Ref. Symbol	Army Stock No. Navy Stock No. British Ref. No.	Name of Part and Description	Function	Mfg. & Designation	Drwg. or Specification No.	Quantity Per Major Unit
Revise:						
C132		CAPACITOR: fixed, mica; .1 μf, —10% + 50%, 120V. D.C. working; color coded: brown, black, yellow, brown; $1\frac{5}{32}$" long, $\frac{5}{8}$" wide, $\frac{1}{4}$" thick; axial leads $1\frac{5}{16}$" long.	Grid coupling V107.	20 340-22	8A106370	1