TM 11-6625-368-10

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR'S MANUAL

PULSE GENERATOR SETS

AN/UPM-15 AND AN/UPM-15A

This reprint includes all changes in effect at the time of publication: change 3.

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SEPTEMBER 1960

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WASHINGTON 25, D. C., 27 September 1960

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Eighth US Army (2)	11-56	17
	11-57	39-51
	11-98	39-52

NG: None.
USAR: None.
For explanation of abbreviations used, see AR 320-50.

Changes in force: C 3

TM 11-6625-368-10
*C 3

CHANGE
No. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *17 May 1974*

Operator's Manual
PULSE GENERATOR SETS
AN/UPM-15 AND AN/UPM-15A

TM 11-6625-368-10, 27 September 1960, is changed as follows:

Page 1. After paragraph 1-2 add the foIIowing:

1-2.1. Indexes of Publications

a. DA Pam 310-4. Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment.

b. DA Pam 310-7. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO'S) pertaining to the equipment.

1-2.2. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Maintenance forms, records, and reports which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

b. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Report of Packaging and Handling Deficiencies) as prescribed in AR 700-58/NAVSUP PUB 378/AFR 71-4/MCO P4030.29, and DSAR 4145.8

c. Discrepancy in Shipment Report (DISREP) (SF 361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF 361) as prescribed in AR 55-38/NAVSUPINST 4610.33/AFM 75-18/MCO P4610.19A, and DSAR 4500.15.

1-23. Reporting of Equipment Publication Improvements

The reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to Commander, US Army Electronics Command, ATTN: AMSEL-MA-C Fort Monmouth, NJ 07703.

After paragraph 1-6 add:

1-6.1. Items comprising an Operable Equipment

FSN	Quantity AN/UPM-15	Quantity AN/UPM-15A	Nomenclature
6625-568-4899			Pulse Generator Set AN/UPM-15: 3 bands, 50 to 10,000 Hz pulse repetition freq; mtd and ext sync; 0.5 to 1000 Hz single ph; aluminum case, portable; 20-5/16 in. lg x 14 5/8 in. w x 11-2/8 in. h
6625-682-2581			Pulse Generator Set AN/UPM-15A: 50 to 10,000 Hz repetition freq; mtd or ext sync; 5 to 1000 v peak; 115 vac, 50 to 1000 Hz, 300 watts; aluminum case, portable; 23 in. w x 19-3/4 in. h x 15-3/4 in. d
			which include:

*This change supersedes C 1, 6 March 1962 and C 2, 12 June 1963.

FSN	Quantity AN/UPM-15	Quantity AN/UPM-15A	Nomenclature
5935-149-3534	3	3	Adapter, UG-273/U: rd male cont 1 end, split female cont other end; straight type; 1-7/32 in. lg x 23/32 in. dia
6625-502-6077			Cable Assembly CX-337/U
6625-577-8440	1	1	Cable Assembly CG-521A/U
6625-503-6897		1	Cable Assembly, Power Electrical CX-3135
6660-161-6436	1	1	Cable Assembly CG-409A/U
6625-537-5724	1		Pulse Generator TS-592A/UPM-15: 50 to 10,000 Hz pulse repetition freq; 3 bands; int and ext sync; calibrated 0.5 to 100 usec=10% accuracy; 50 v amplitude; portable; 19-7/8 in. lgX16-5/8 in. wX11-7/8 in. h
6625-755-1024		1	Generator Pulse SG-343/UPM-15A: 50 to 10,000 Hz pulse repetition freq; 3 bands; int and ext sync; calibrated 0.5 to 100 usec = 10% accuracy; 50 v amplitude; portable; 19 in. lgX 14 in. w X 11 in. h

Page 7. **Add section III.1 after section III:**

Section III.1. MAINTENANCE INSTRUCTIONS

3-1.1. Scope of Maintenance

The maintenance duties assigned to the operator of Pulse Generator AN/UPM-15 and AN/UPM-15A are listed below, together with a reference to the paragraphs covering the specific operator's maintenance function. The duties assigned require an oscilloscope to perform the operational check.

a. **Daily preventive maintenance checks and services (par. 3-1.5).**

b. **Weekly preventive maintenance checks and services (par. 3-1.6).**

c. **Cleaning (par. 3-1.7).**

3-1.2. Test Equipment Required

An oscilloscope, such as the AN/UPM-50 or equal is required for checking the operational capabilities of the pulse generator.

3-1.3. Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble to reduce downtime, and to assure that the equipment is serviceable.

c. Systematic Care. **The procedures given in paragraphs 3-1.5 through 3-1.7 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.**

b. Preventive Maintenance Checks and Services. The **preventive maintenance checks and services charts (par. 3-1.5 and 3-1.6 outline functions to be performed at specific intervals. These checks and services are designed to maintain Army equipment in a combat-serviceable condition; that is in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the charts indicate what to check, how to check, and what the normal conditions are; the Reference column lists the illustrations, paragraphs, or manuals that contain detailed repair or replacement procedures. If the defect cannot be remedied by the operator, higher echelon maintenance or repair is required. Records and reports of these checks and services must be made in accordance with TM 38-750.**

3-1.4. Maintenance Checks and Service Periods

Maintenance checks and service of Pulse Generator Sets AN/UMP-15 and AN/UMP-15A are required daily and weekly. Paragraphs 3-1.5 and 3-1.6 specify the items to be checked and serviced. In addition to the routine checks and services, the pulse generator should be checked and serviced immediately before use, after it has been transported in a vehicle, and as soon after completion of its assigned mission as possible.

3-1.5 . Daily **eventive** Maintenance Checks and Services Chart

Sequence No.	Item	Procedures	References
1	**pleteness** ----------	**Check the** pulse generator **for completness. All major components must be present.**	App. II.
2	**erior surfaces** ---------	**Clan the pulse** generator surfaces, **knobs, and dials**	--- Par. 3-1.7.
3	**os, dials, and switches** --	**While making the operating checks (item 4) observe that the macchanical** action of each **knob, dial, and switch is smooth and free of external or internal binding.**	
4	**ating check** ---------	**Check the pulse generator for proper operation. Refer to paragraphs 3-2 through 3-7.**	Section IIII.

3-1.6. Weekly Preventive Maintenance Checks and Services Chart

Sequence No	Item	Procedure	References
1	**es and cable connectors** -	**Inspect power and signal cables for cuts, cracks, strain or fraying. Replace cables that have broken connectors and injured sheathing.**	
2	**erior hardware** - - - - -	**Inspect handles, vent covers, front panel holddown screws, and power connector bolts for looseness. tighten if necessary.**	
3	**al surfaces** - - - - - - - -	**Inspect metal surfaces for rust or corrosion. Report evidence of rust or corrosion to higher echelon.**	

3-1.7. Cleaning

Inspect erior of the pulse generator. The exterior rfaces should be clean, free of dust, dirt, se, and fungus.

a. Remove st and loose dirt with a clean soft cloth.

Warnin **aning compound is flammable d its fu re toxic. Provide adequate ven- tion. D use near a flame.**

b. Remove ease, fungus, and ground-in dirt from the cases; use a cloth dampened (not wet) with Cleaning Compound (Federal stock No. 7930-395-9542).

c. Remove dust or dirt from connectors with a brush.

d. Clean the front panel, control knobs, and switches; use a soft clean cloth. If necessary, dampen the cloth with water; mild soap may be used to make the cleaning more effective.

Page 8. Delete section IV in its entirety.

Page 9. Add Appendix I after section IV.

APPENDIX I

REFERENCES

owing list of applicable references available to the operator of Pulse Generator Sets AN/ **M-15 a** N/UPM-15A:

PAM Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.

TM 38-750 The Army Equipment Record System and Procedures.

Page 9. After appendix I add appendix II:

APPENDIX II

BASIC ISSUE ITEMS LIST (BILL AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST (ITIAL)

Section I. INTRODUCTION

1. Scope

This appendix lists only basic issue items required by the crew/operator for installation, operation, and maintenance of Pulse Generator Sets AN/UPM-15 and AN/UPM-15A.

2. General

This Basic Issue Items and Items Troop Installed or Authorised List is divided into the following sections:

a. Basic Issue Item List-Section II. A list in alphabetical sequence, of items which are furnished with, and which must be turned in with the end item.

b. Items Troop Installed or Authorized List -Section III. Not applicable.

3. Explanation of Columns

The following provides an explanation of columns found in the tabular listings:

a. Illustration. Not applicable.

b. Federal Stock Number. Indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. Part Number. Indicates the primary number used by the manufacturer (individual, company, firm, corporation, or Government activity), which controls the design and characteristics of the item by means of its engineering drawings, specifications standards, and inspection requirements, to identify an item or range of items.

d. Federal Supply Code for Manufacturer (FSCM). The FSCM is a 5-digit numeric code used to identify the manufacturer, distributor, or Government agency, etc., and is identified in SB 708-42.

e. Description. Indicates the Federal item name and a minimum description required to identify the item.

f. *Unit of Masure (U/M).* Indicates the standard of basic quantity of the listed item as used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation, (e.g., ea, in., pr, etc.). When the unit of measure differs from the unit of issue, the lowest unit of issue that will satisfy the required units of measure will be requisitioned.

g. Quantity Furnished with Equipment (Basic Issue Items Only). Indicates the quantity of the basic issue item furnished with the equipment.

Section II. BASIC ISSUE ITEMS LIST

(1) ILLUSTRATION (A) FIG. NO.	(1) ILLUSTRATION (B) ITEM NO.	(2) FEDERAL STOCK NUMBER	(3) PART NUMBER	(4) FSCM	(5) DESCRIPTION	USABLE ON CODE	(6) UNIT OF MEAS	(7) Qty FURN WITH EQUIP
		6625-537-7885			CASE CY-672/U, PLYWOOD, 24-5/16 IN. LG X 13-3/16 IN. W X 15-1/2 IN. H		EA	1

By Order of the Secretary of the Army:

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OS Maj Comd (2)
USACC (2)
HISA Ft Monmouth (18)
Armies (1)
USASESS (5)
Svc Colleges (1)
Fort Huachuca (5)
WSMR (1)
Fort Carson (5)
USAERDAA (1)
USAEBDAW (1)
Army Dep (1) except
LBAD (10)
SAAD (30)
TOAD (14)
ATAD (10)
USA Dep (1)
Sig See USA Dep (2)
Sig Dep (2)
Sig FLDMS (1)
Ft Richardson (ECOM Ofc) (1)
Units org under fol TOE:
(1 copy each)
9-47
9-87
9-227
11-16
11-96
11-97
11-98
11-117
11-500 AA-AC
29-134
29-136
44-435
44-436
44-437
44-445
44-535
44-536
44-537
44-545
44-546
44-547
44-548

For explanation abbreviations used, see AR 310-50.

NG: **State AG (3)**

USAR: None

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TECHNICAL MANUAL)
)
NO. 11-6625-368-10)

HEADQUARTERS,
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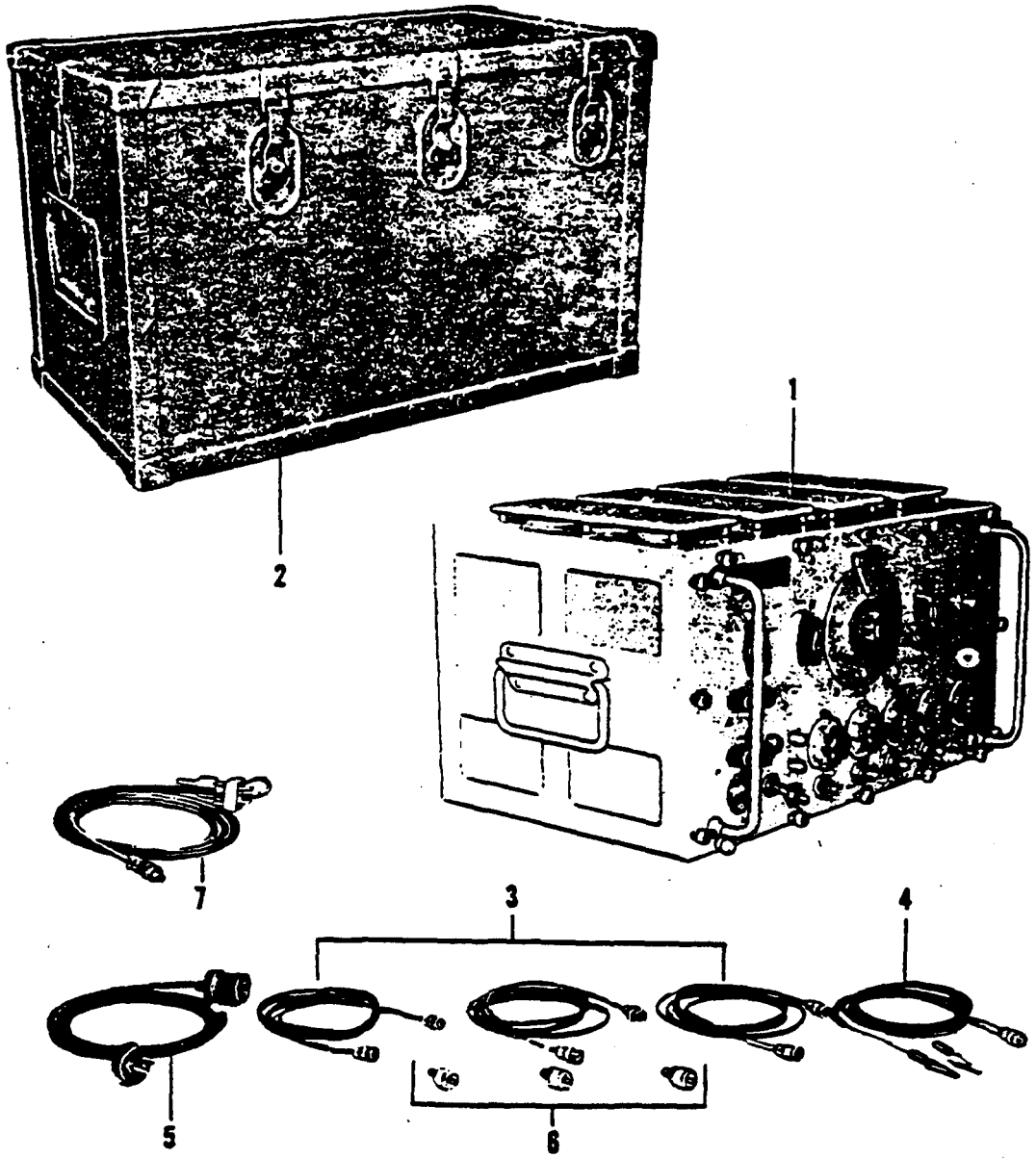
Washington 25, D. C., 27 September 1960

OPERATOR'S MANUAL

PULSE GENERATOR SETS AN/UPM-15 AND AN/UPM-15A

*This manual, together with TM 11-6625-368-24, 27 September 1960, and TM 11-6625-368-50, 27 September 1960, supersedes TM 11-1177, 1 February 1957.



1. Pulse Generator TS-592A/UPM-15, TS-592B/UPM-15 or SG-343/UPM-15A
2. Transit Case CY672/U
3. Cord CX-409E/U
4. RF Cable Assembly CG-521/U
5. Cord CX-337/U (supplied with AN/UPM-15)
6. Adapter UG-273/U
7. Cable Assembly, Power Electrical CX-3135/U (supplied with AN/UPM-15A)

Figure 1-1. Pulse Generator Set AN/UPM-15 and AN/UPM-15A

SECTION I

GENERAL DESCRIPTION

1-1. GENERAL

1-2. This handbook provides information for the operation of pulse Generator Set AN/UPM-15 and AN/UPM-15A, manufactured by A. R. F. Products, Inc., River Forest Illinois.

1-3. PURPOSE OF EQUIPMENT.

1-4. Pulse Generator Set AN/UPM-15 or AN/UPM-15A (figure 1-1) is a general purpose video electronic generator. It is intended to be used in the calibration of radar equipment in field and depot maintenance and in laboratory work It produces output wave shapes that are essentially rectangular. By means of manual controls it is possible to produce a wide range of pulse amplitudes, widths, repetition rates and delays. It is possible to synchronize the equipment either with an internal oscillator, or with external sources producing wide varieties of waveforms, frequencies and amplitudes.

1-5. EQUIPMENT SUPPLIED.

1-6. The pulse generator set consists of the components shown in Table 1-1 or 1-2. No other equipment is required.

Table 1-1. Equipment Supplied with AN/UPM-15

Qty	Name of Component	Government Type Designation
1	Pulse Generator	TS-592A/UPM-15 or TS-592B/UPM-15
1	Transit Case	CY-672/U
1	Cord (6 ft)	CX-337/U
3	Cord (6 ft)	CG-409E/U
1	Cord (6 ft)	CG-521/U
3	Adapter	UG-273/U

Table 1-2. Equipment Supplied with AN/UPM-15A

Qty	Name of Component	Government Type Designation
1	Pulse Generator	SG-343/UPM-15A
1	Transit Case	CY-672/U
1	Cable Assy, Power Electrical	CX-3135/U
3	Cord	CG-409E/U
3	Adapter	UG-273/U
1	RF Cable Assy	CG-521/U

1-7. CAPABILITIES.

1-8. OUTPUTS. The pulse generator provides a 1.5 usec sync pulse and one or two output pulses. The sync pulse and the output pulse(s) are available at different front panel connectors. Output pulses are essentially rectangular in shape. The total time base available is 250 usec. Minimum separation is 2 usec. The second output pulse can be turned off.

1-9. EXTERNAL SIGNALS. Externally supplied signals may have an amplitude of from 5 to 100 volts. External signal frequency may vary from 50 to 10,000 cps. However, if the signal is a sawtooth shape, the minimum acceptable frequency is 250 cps.

1-10. AMBIENT TEMPERATURE RANGE. The pulse generator is designed to operate within a temperature range of -20° C (-4°F) to +55° C (+131°F).

1-11. LIMITATIONS.

1-12. INTERNAL OSCILLATOR CALIBRATION. Calibration of the repetition rate ("PULSE RATE") dial is accurate within ±5 percent at a temperature of ±21°C (70°F). Accuracy is +10 percent at the high and low ends of the temperature range stated in paragraph 1-10.

1-13. PULSE OUTPUTS. Accuracy of all controlable characteristics of pulse outputs is ±10 percent.

1-14. BIAS CONTROL. With an externally applied synchronizing signal of up to 100 volts, the pulse output may be synchronized by the bias control with any positive value of the external signal up to 95 volts.

1-15. POWER REQUIREMENTS. This pulse generator requires 115 volts ±10 percent, single phase, 50 to 1000 cps. It draws approximately 275 watts.

NOTE

Illustration of waveforms and specific numerical values. stated are based on waveforms produced in an oscilloscope having 0.03 usec rise time.

1-16. THEORY OF OPERATION.

1-17. PULSES. The pulse generator supplies a sync pulse and a choice of one or two output pulses. The sync pulse in figures 1-2 and 1-3 is available at the SYNC OUT connector shown in figure 2-1. The output pulses in figures 1-2 and 1-3 are available at the OUTPUT connector shown in figure 2-1. In the rest of this discussion the sync pulse and the one or two output pulses are lumped together and called the pulse pattern. The pulse pattern is repeated at a frequency of from 50 to 10,000 cps depending on the setting of the operating controls. A typical pulse pattern is shown at the top of figure 1-2. The repetition of the same pulse pattern is shown at the bottom of figure 1-2.

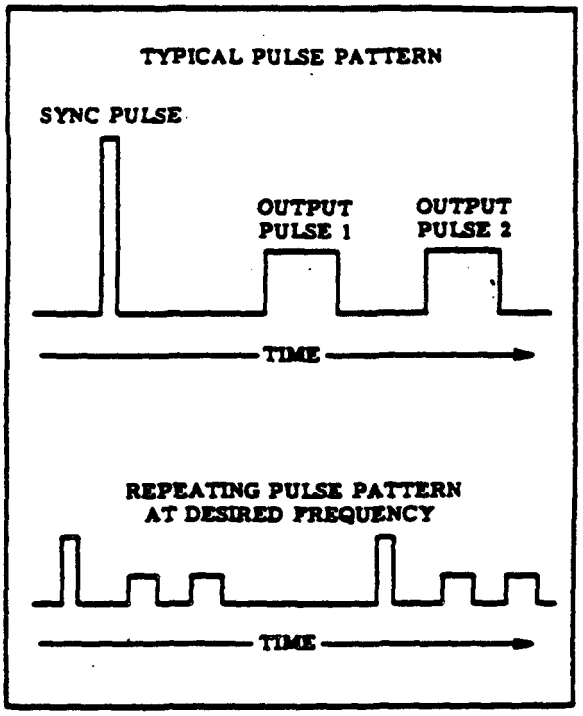


Figure 1-2. Function of pulse Generator

1-18. In the pulse pattern, this pulse generator provides two distinct types of pulse relationships. They are called Sync Lead Condition and Sync Lag Condition. Time measurements in the following explanations are made between leading edges of pulses. Leading edges are the left sides of the waveforms in figures 1-2 and 1-3.

1-19. SYNC LEAD CONDITION. (see figure 1-3). In this condition, the pulse pattern starts at zero time (T-o). Delay time (T-d) can be set to occur 2 to 220 usec after T-o. Separation time (T-s) can be set to occur 2 to 30 usec after T-d.

1-20. SYNC LAG CONDITION. (See figure 1-3). The significant alterations from sync lead condition are:
a. Overall length of the pulse pattern is reduced to 220 usec.
b. T-s now is variable with reference to T-o rather then T-d.

1-21. The connection between T-o, T-d and T-s and the individual pulses is shown by figure 1-3.

1-22. PULSE CHARACTERISTICS.

1-23. SYNC PULSE. Characterietics of the sync pulse are constant Polarity is positive. Width is 1.5 usec. Rise time 0.10 usec. Decay time is 0.4 usec. Amplitude is from 25 to75 volts.

1-24. OUTPUT PULSES. Waveforms of the output pulses are identical because control adjustments af - fect both pulses when the second output is used. Polarity may be either positive or negative. Width may be from 0.5 to 100 usec. Amplitude may range from 0.0 to 200 volts. Rise time ranges from 0.05 to 0.25 usec. Deay time varies from 0.1 to 0.3 usec. Rise time is a function of the output loading. At the higher output voltages of from 2 volts to the maximum of 200 volts, better rise time can be gained by using shortest possible connecting leads. Follow instructions in the note at the end of paragraph 2-23.

1-25. RESPONSE TO EXTERNAL TRIGGERING. External triggering of from 50 to 10,000 cps can be applied to this pulse generator. When an external sync waveform is connected to the pulse generator "BIAS" and "EXT SYNC" controls are available to adjust the phase relationship of the output pulses to the externlly applied waveform. The "BIAS" adjustment allows the triggering potential to be varied contionuous-

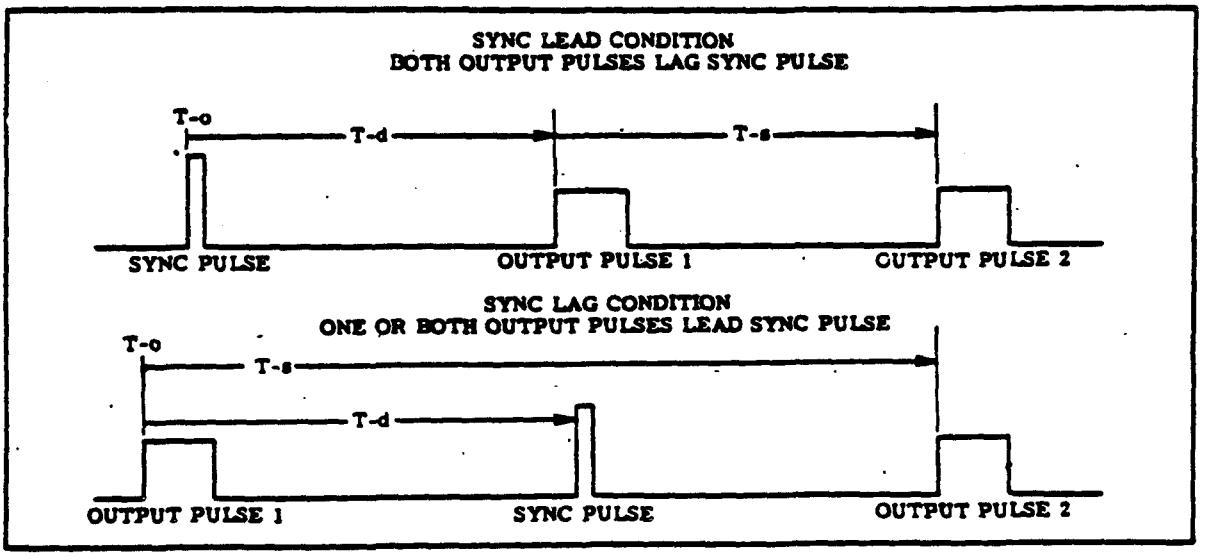


Figure 1-3. Pulse Relationships

ly from 0.0 to +95 volts. The "EXT SYNC" control senses the slope of the external waveform. Thus the trigger potential selected by the "BIAS" control will be either the potential occurring on the going positive slope of the input waveform or the going negative slope according to the position of the "EXT SYNC" control (see figure 1-4).

1-26. INTERNAL TRIGGERING CHARATERISTICS. When triggered by its internal oscillator, the pulse generator has a fixed bias. Frequency range is variable 50 to 10,000 cps.

1-27. SERVICES SUPPLIED BY PULSE GENERATOR. The following is a general summary of the services provided by the pulse generator.

a. It provides a pulse pattern consisting of a sync pulse and one or two output pulse.

b. Sequence of sync and output pulses may be selected.

c. Waveform of the output pulses may be controlled to provide a variety of triggers and gates for calibrating other equipment.

d. The pulse pattern selected may be repeated at from 50 to 10,000 cps, depending on the pulse pattern's width.

e. When an external oscillator is used to repeat the pulse pattern, the point of triggering the pulse generator may be biased from 0 to +95 V. Also, the point of triggering may be set at any point "GOING +" or "GOING -" along the external wave from, within the 95 volt limit.

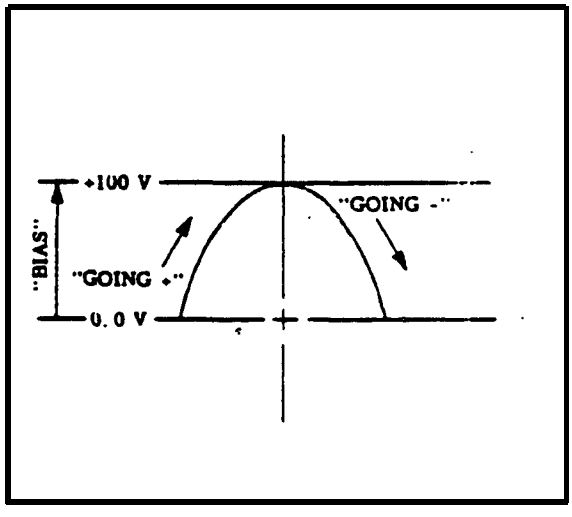
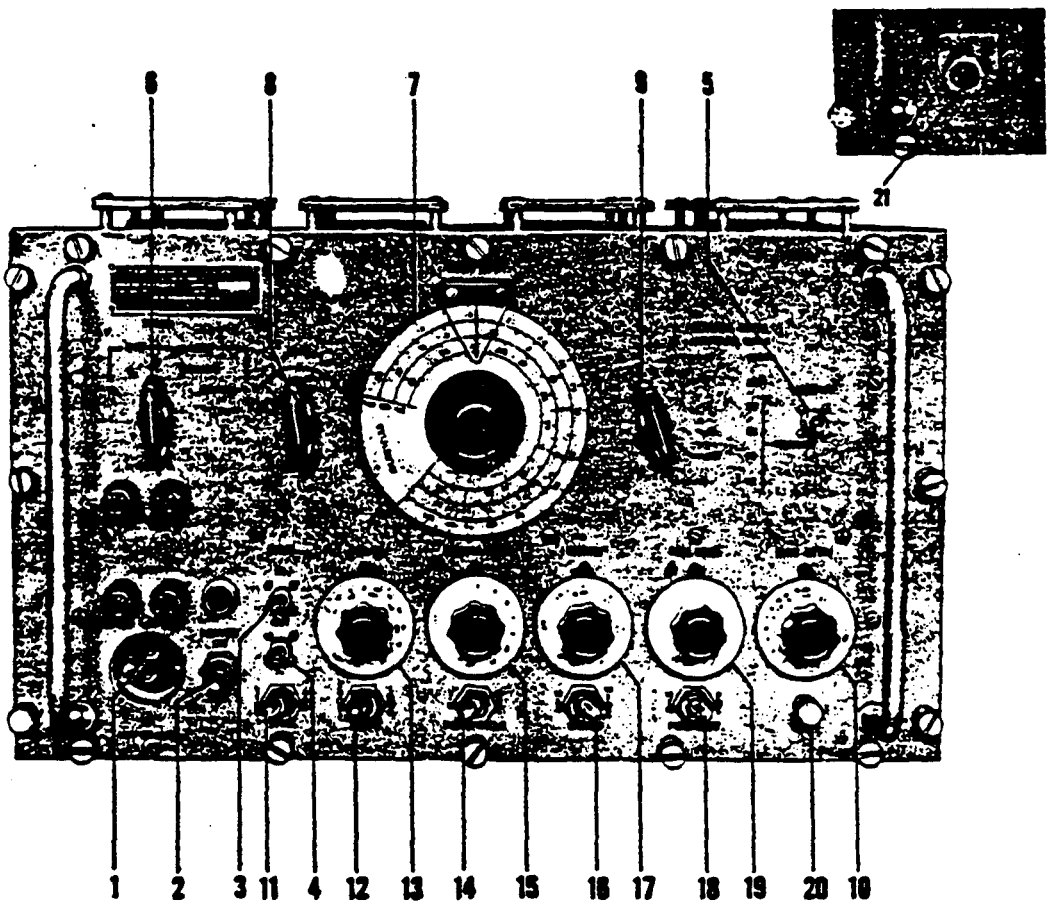


Figure 1-4. External Triggering Range



1.	"POWER" connector (AN/UPM-15)	11.	"SYNC" switch
2.	"POWER" switch	12.	"DELAY" switch
3.	"SYNC IN" connector	13.	"DELAY" dial
4.	"SYNC OUT" connector	14.	"PULSE NO. 2" switch
5.	"OUTPUT" connector	15.	"SEPARATION" dial
6.	"SYNC" selector knob	16.	"WIDTH" switch
7.	"PULSE RATE" dial	17.	"WIDTH" dial
8.	"BIAS" knob	18.	"POLARITY" switch
9.	"COARSE ATTEN" knob	19.	"RISE TIME" dial
10.	"FINE ATTN" dial	20.	"GND" connector
		21.	"POWER" connector (AN/UPM-15A)

Figure 2-1. Pulse Generator Operating Controls

SECTION II

OPERATING PROCEDURES

2-1. DESCRIPTION OF CONTROLS.

2-2. The continuously adjustable controls in this equipment are in several cases, associated with switches of almost the same name. Througth such switches the associated control is given two ranges of adjustment. Both cord connections and controls are explained in the following list. (To identify parts, see figure 2-1.)

2-3. "SYNC IN" connector (3). This is the input point for external sync signals and any externally applied waveform.

2-4. "SYNC OUT" connector (4). The sync pulse of this generator is always available at this connector.

2-5. "OUTPUT" connector (5). The output pulses are available at this connector.

2-6. "SYNC" selector knob (6). Its "INT" position "A, B, C," permit a frequency band of the internal oscillator to be selected, position "A" covers 50 to 280 cycles, position "B" covers 280 to 1600 cycles, position "C" covers from 1600 to 10,000 cycles. The "EXT" position are "GOING +" and "GOING -". They permit triggering of the pulse generator to occur in positive or negative-going slopes of externally-applied waveforms.

2-7. "PULSE RATE" dial (7) allows frequency of the internal oscillator to be varied after a frequency band is selected.

2-8. "BIAS" knob (8) sets the negative or positive voltage level at which the pulse generator triggers when a fed a waveform through the "SYNC IN" connector.

2-9. "COARSE ATTN" knob (9) enables selection of voltage multipliers and internal resistances for the pulse output. Panel markings are as follows:

"COARSE ATTN"

Multiplier	Ohms	
10	2500	
1	250	
.1	50	Matched
.01	50	
.001	50	
1	75	

2-10. "FINE ATTN" dial (10) works in conjunction with the "COARSE ATTN" knob (9). Black engraved numerals at the "FINE ATTN" dial are multiplied by the blue engraved multiplier value indicated by the "COARSE ATTN" knob. Red engraved numerals on the "FINE ATTN" dial combine with the red engraved multiplier values indicated by the "COARSE ATTN" knob. Full instructions for determining output voltages are given in paragraphs 2-7 through 2-10.

2-11. "SYNC" switch (11). This switch establishes wether the sync pulse will lead the output pulses or whether it will lag me or botb of the output pulses. The switch has "LEAD" and "LAG" positions.

2-12. "DELAY" switch (12) is associated with the "DELAY" dial (13). The switch has "SHORT" and "LONG" positions.

2-13. "DELAY" dial (13) is the continuous control for varying the time between T-o and T-d (see figure 1-3). The dial has the "SHORT" scale of 2-20 usec and the "LONG" scale of 20 to 220 usec. These scales are selected by the "DELAY" switch. Red markings are the "LONG" scale.

2-14. "PULSE NO. 2" switch (14) switches on, or eliminates the pulse that occurs late in time. Positions of the switch are "IN" and "OUT".

2.15. "SEPARATION" dial (15) permits adjusting the time between the output pulses from 2 to 30 usec. "PULSE NO. 2" switch must be in "IN" position.

2-16. "WIDTH" switch (16) is associated with the "WIDTH" dial (17). The switch has "NAR" (narrow) and "WIDE" positions.

2-17. "WIDTH" dial (17) is the continuous control for setting the width of output pulses. The dial has the narrow scale of 0.5 to 10 usec, and wide scale of 10 to 100 usec. These scales are selected by the "WIDTH" switch. Red markings are the "WIDE" scale.

2-18. "POLARITY" switch (18) has "NEG" (negative) and "POS" (positive) position. This switch determines the polarity of the output pulses.

2-19. "RISE TIME" dial (19) provides adjustment of the rise time of the output pulses. The dial has two scales. Each scale is calibrated from 0.05 to 0.25 usec. One scale is for positive pulses and the other scale for negative pulses.

2-20. "GND" connector (20) is an extra ground point, often helpful when hooking up several instruments.

2-21. SEQUENCE OF OPERATION.

2-23. ENERGIZING EQUIPMENT. With the power cable assembly (5 or 7, figure 1-1) connect the "POWER" connector (1 or 21, figure 2-1) to a source of 115 v, 50 to 1000 cps, single phase. Turn "POWER" switch (2, figure 2-1) to "ON" position.

NOTE

Allow 15 minutes warm-up time after turning power "ON" to assure uniform performance.

2-23. CONNECTING CORDS. Connect one cord CG-409E/U (3, figure 1-1) to "SYNC OUT" connector (5). When an external oscillator or waveform is to be used it is connected with another cord CG-409E/U at the "SYNC IN" connector (3). Then "EXT SYNC" position "GOING +" and "GOING -" of the "SYNC" selector knob take effect and the "BIAS" knob (8) also becomes effective. Whenever there is need for a cord with clip ends, use cord CG-521/U (4, figure 1-1). The pulse generator is now prepared to provide pulses and waveforms for the testing of other equipment.

NOTE

To secure the best rise time when output pulses of 2 to 200 volt amplitude are wanted, use the shortest possible connecting leads of unshielded wire from the "OUTPUT" connector. The best rise time is obtained when the r-f cable is not used.

2-24. ESTABLISHING THE PULSE PATTERN. (See figure 2-1.) To establish the pulse pattern, use the following controls:

a. Assuming that internal sync is to be used set "SYNC" selector knob (6) to the desired pulse rate band.

b. Tune "PULSE RATE" dial (7) to the proper frequency.

c. Set the "SYNC" switch (11) in "LEAD" position if the sync pulse is to lead the output pulses. Set the switch to "LAG" position if the sync pulse is to lag one or both of the output pulses.

d. Set the "DELAY switch (12) to "SHORT" position if required delay time falls within 2 to 20 usec. Set switch to "LONG" position if required delay time falls within 20 to 220 usec.

e. Set the "PULSE NO. 2" switch (14) to "IN" position if two output pulses are wanted. Use "OUT" position if only one output pulse is wanted.

f. If a second pulse is used, adjust the separation time with "SEPARATION" dial (15).

g. Turn "DELAY" dial (13) to secure exact delay time required

h. Set the "WIDTH" switch (16) to "NAR" position if required width falls within 0.5 to 10 usec. Set switch to "WIDE" position if required pulse width falls within 10 to 100 usec.

i. Turn "WIDTH" dial (17) to secure the exact pulse width required.

J. Set "POLARITY" switch (18) to "NEG" or "POS" position to secure either negative or positive pulses.

k. Adjust "RISE TIME" dial (19) as requircd.

2-25. ESTABLISHING OUTPUT PULSE VOLTAGE. The voltage of output pulses is determined directly when the 2500 and 250 ohm outputs are unloaded. The blue engraved multiplier shown by the "COARSE ATTN" knob (9), figure 2-1 is multiplied by the black number shown by the - "FINE ATTN" dial (10). But voltage becomes different from the indicated value when the output is loaded. The following formula shows how to calculate actual output voltages in the 2500 and 250 ohm positions.

$$V_{out} = V_{dial} \times Multiplier \times \frac{1}{1 + \frac{Rg}{Rl}}$$

Where: V out is the actual voltage.

Where: V dial is value set on "FINE ATTN" dial.

Where: Multiplier is numeral selected by "COARSE ATTN" knob.

Where: Rg is "OHMS" resistance selected "COARSE ATTN" knob.

Where: Rl is ohms resistance of connected load.

2-26. In the following example by substituting the indicated values the 50 volts indicated by the control position reveals itself to be an actual 33 volts. For this reason, calculate voltages when exact pulse amplitudes are needed.

$$V_{out} = 5 \times 10 \times \frac{1}{1 + \frac{2500}{5000}}$$

$$= 50 \times 2/3$$

$$V_{out} = 33 \text{ volts}$$

2-27. For the "MATCHED" positions of the "COARSE ATTN" knob (9, figure 2-1) a slightly different formula is necessary. All the identifications of factors are the same as in paragraph 2-25. The formula is:

$$V_{out} = V_{dial} \times Multiplier \times \frac{2}{1 + \frac{Rg}{Rl}}$$

2-28. In the "MATCHED" position calculation is not necessary when the connected load offers the same reinstance as indicated on the pulse generator panel namely 50 or 75 ohms.

2-29. ESTABLISHING TRIGGERING POINT ON EXTERNAL WAVEFORM. When the pulse generator is fed by an external oscillator through the "SYNC IN" connector, the "EXT SYNC" and the "BIAS" controls are usable. The pulse generator may be triggered at any point on the external waveform by adjusting the "BIAS"and the "EXT SYNC" controls. (See figure 1-4.

2-30. PRECAUTIONS TO BE OBSERVED.

2-31. PULSE RATE AND PULSE PATTERN OVERLAP. No damage will occur, but no usable output can be secured if the pulse pattern is too wide for the pulse rate. Maximum pulse pattern width at 10,000 cps is approximately 80 usec. Maximum pulse rate

available at the maximum pulse width of 100 uses, is approximately 5000 cps. A jumbled presentation on the oscilloscope indicates an overlapping condition. In such a condition dial readings are meaningless.

2-32. PULSE WIDTH AND SEPARATION OVERLAP. When two output pulses are used, their width must be kept smaller than the separation or there will be overlap and only one pulse of irregular and non-usable charactertstics will result. Keep "PULSE WIDTH" values smaller than "SEPARATION" values. when two output pulses are used.

SPECIAL NOTICE

To stop equipment in an emergency, turn "POWER" switch (2, figure 2-1) to "OFF" position. Disconnect the power cable assembly (5 or 7, figure 1-1) from the front panel "POWER" connector (1 or 21, fig- 2-1).

SECTION III

OPERATING CHECKS AND ADJUSTMENTS

3-1 GENERAL CHECKS.

3-2. POWER CHECK when the pilot light is lit, it means that power is reaching the pulse generator.

3-2. Operating hook-ups of this pulse generator practically alway include an oscilloscope to permit results to be observed. With an oscilloscope in the test hook-up it is a simple matter to vary controls of the pulse generator and note whether there is an equivalent change in the indicator presentation. Failure to respond means further check should be made.

3-4. CHECKING WITH AN OSCILLOSCOPE

3-5. A direct check of operation may be made by connecting the "OUTPUT" connector and the "SYNC" OUT" connector to signal input and the external sync connentors of an oscilloscope. Turn power on in both units and give them 15 minutes to warmup and stabilize.

3-6. Set controls of the pulse generator in the following manner: - (See figure 2-1).

a. "SYNC" selector knob (6) - "C" position.
b. "PULSE.RATE" dial (7) - 4. 0 kc.
c. "SYNC" switch (11) - "LEAD" position.
d. "DELAY" knob (13) - 40 usec.
e. "DELAY" switch (12) - "LONG" position.
f. "SEPARATION" knob (15) - 20 usec.
g. "PULSE NO. 2" switch (14) - "IN" position.
h. "WIDTH" knob (17) - 10 usec.
i. "WIDTH" switch (16) - "NAR" position.
j. "RISE TIME" knob (19) - 0. 05 usec.
k. "POLARITY" switch (18) - "POS" position.
l. "FINE ATTN" knob (10) - 20 (black numerals).
m. "COARSE ATTN" knob (9) - "1. 250 ohms".

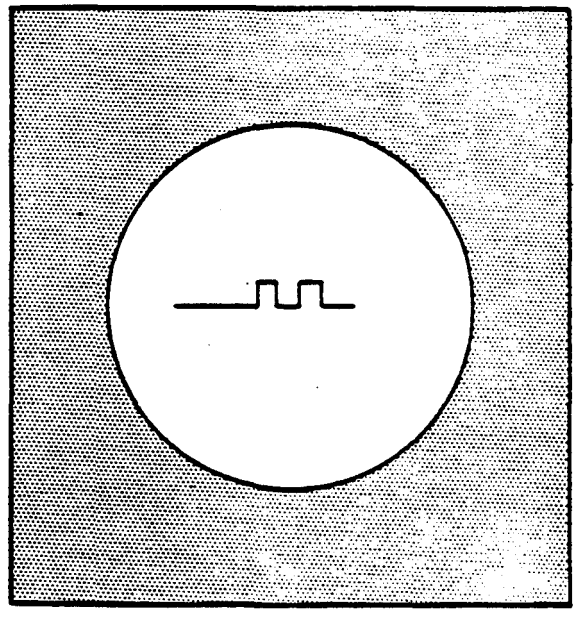


Figure 3-1. Test Pulse Pattern

3-7. In the oscilloscope, set the controls for 200 uses sweep time, positive polarity and external sync. If the external sync control has several positions, use a position which includes the 50 volt range. Adjust the oscilloscope controls as necessary to reveal the complete pulse pattern. It should be as indicated in Figure 3-1. It will be seen that the 20 volt amplitude 40 usec delay 10 usec width and 20 usec separation are occuring properly in accordance with control settings.

SECTION IV

EMERGENCY OPERATION

4-1. EMERGENCY OPERATION.

4-2. If the pulse generator does not oscillate with the "SYNC" selector knob in "INT" position. it is possible to secure pulse repetition from an external source. Switch "SYNC" selector knob (6, figure 2-1) to the desired "EXT" position. Connect an external oscillator to the "SYNC IN" connector (3).

4-3. Output pulse voltages may be below the bias level of the equipment under test. Raise the "COARSE ATTN" and "FINE ATTN" knobs (9 and 10, figure 2-1) to their highest readings if equipment does not react at a low amplitude.

4-4. If the pulse generator stops operating, check the power cord. Then replace the fuses on the front panel with the spare fuses which are also located on the front panel and are marked "SPARES". The pilot light may also be replaced by unscrewing the lens.

4-5. REPLACEMENT OF ELECTRON TUBES.

4-6. Any of the electron tubes in this pulse generator may be replaced by the operator. The electron tubes are all located on the top of the chassis. Their reference symbol numbers and JAN type numbers are stamped on the chassis in black ink close to the tube sockets. The electron tubes are exposed by loosening the captive screws at the edges of the front panel and then pulling the chassis out of the dust cover.

WARNING

Disconnect power while removing the equipment from the case.

4.7. When an electron tube does not glow, and does not feel warm to the touch while power is on. It is likely that the tube has failed. Remove the tube and insert another of the same type.

4-8. Table 4-1 is a list of the reference symbol numbers and the types of the electron tubes.

Table 4-1. Electron Tube Complement

Qty	Reference Symbol Number	JAN TYPE Number	Qty	Reference Symbol Number	JAN TYPE Number
4	V1	JAN 6AU6WA		V15	JAN 5814A
5	V2	JAN 5814A	2	V16	JAN 6AH6
	V3	JAN 6AU6WA		V17	JAN 6AH6
	V4	JAN 6AU6WA	1	V18	JAN 6AN5
1	V5	JAN 6D4	1	V19	JAN 829B
	V6	JAN 5814A	1	V20	JAN 6005/6AQ5W
4	V7	JAN 12AT7WA	1	V21	JAN 5R4WGA
2	V8	JAN 5725/6AS6W	2	V22	JAN 6AS7G
	V9	JAN 12AT7WA		V23	JAN 6AS7G
	V10	JAN 5725/6AS6W		V24	JAN 6AU6WA
	V11	JAN 12AT7WA	1	V25	USN 6626/OA2WA
	V12	JAN 12AT7WA	1	V26	JAN 6X4W
	V13	JAN 5814A	1	V27	USN 6627/OB2WA
	V14	JAN 5814A			

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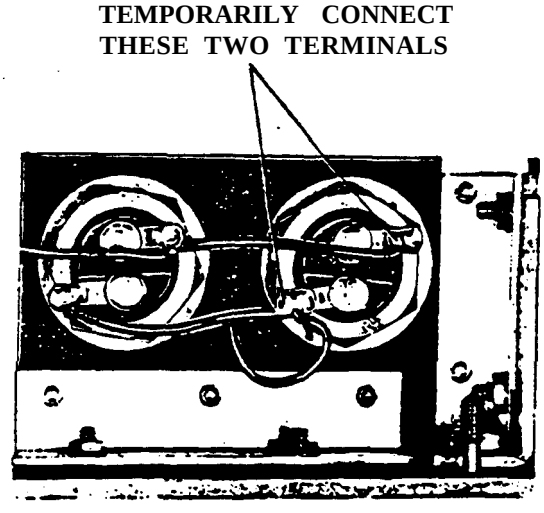

Figure 4-1 Bypassing Output Capacitors

4-9. BYPASSING OUTPUT CAPACITORS.

4-10. Capacitors C62 and C63 on the back of the front panel eliminate d-c voltage from the output pulses, which is desriable in certain situations. These capacitors cause a maximum of 10 percent drop-off from square wave pulse shape in the "MATCHED" position of the "COARSE ATTN" knob. When the presence of d-c voltage is not important and the best pulse shape is wanted, bypass the output capacitors. Connect a wire across the terminals shown in figure 4-1.

4-11. TRIMMER CONTROLS.

4-12. The pulse generator contains trimmer controls. They allow an operator to correct the pulse characteristics if an oscilloscopse shows that output does not match the characteristics required by the control dial settings. The trimmer controls provide a range of adjustment that compensates for variations which normally occur in electron tubes, fixed resistors, and capacitors.

4-13. Use these trimmer controls only when certain that a dial reading is in error by more than ±10 percent. Check the dial at three points after any adjustment of the trimmer controls. When readings appear to be severely in error at the high or low end of a dial scale, the dial may have been shifted on its shaft. Loosen the setscrews which hold the dial and move it in the proper direction while the control shaft is against its internal stop. The correct dial position for TS-592B/UPM-15 and SG-343/UPM-15A pulse generators is found by turning the dial fully clockwise; at this point the indicator should align with slot in dial. On TS-592A/UPM-15 pulse generators the correct position is found by trial and error.

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