D E P A R T M E N T O F T H E A R M Y T E C H N I C A L M A N U A L

MAINTENANCE

ECHO BOX TS-488A/UP

Note. This manual replaces AF TO S3A1-371-2, 15 December 1955, for use within the Department of the Army.

This copy is a reprint which includes current pages from Changes 1 through 3.

H E A D Q U A R T E R S , D E P A R T M E N T O F T H E A R M Y
S E P T E M B E R 1 9 5 8

CHANGE
No. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC *4*, *October 1979*

MAINTENANCE, ECHO BOX TS-488A/UP
(NSN 6625-00-372-2368)

TM 11-6625-220-25,3 September 1958, is changed as follows:

Page 1. Paragraph 1-2.1 Delete paragraph 1-2.1 and replace with the following:

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.

Paragraph 1-2.2. Delete paragraph 1-2.2 and replace it with the following:

1-2.2. Reporting Errors and Recommending Improvements.

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to: Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. A reply will be furnished to you.

Paragraphs 1-2.3,1-2.4, and 1-2.5 are added after paragraph 1-2.2.

1-2.3. Reporting of Equipment Improvement Recommendations (EIR).

If your Maintenance, Echo Box TS-488A/UP needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF-368 (Quality Deficiency Report). Mail it to Commander, US Army Communications and Electronics Materiel Readiness Command, ATTN: DRSEL-ME-MQ, Fort Monmouth, NJ 07703. We'll send you a reply.

1-2.4. Administrative Storage.

Administrative storage of equipment issued to and used by Army activities shall be in accordance with TM 740-90-1.

1-2.5. Destruction of Army Electronics Materiel.

Destruction of Army electronics materiel to prevent enemy use shall be in accordance with TM 750-244-2.

Page 11. Paragraph 5.1-5 is superseded as follows:

5-1.5. Cleaning

Inspect the exterior of Echo Box TS-488A/UP. The exterior surfaces should be clean, and free of dust, dirt, grease, and fungus.

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

WARNING

Adequate ventilation should be provided while using TRICHLOROTRIFLUOROETHANE. Prolonged breathing of vapor should be avoided. The solvent should not be used near heat or open flame; the products of decomposition are toxic and irritating. Since TRICHLOROTRIFLUOROETHANE dissolves natural oils, prolonged contact with skin should be avoided. When necessary, use gloves which the solvent cannot penetrate. If the solvent is taken internally, consult a physician immediately.

b. Remove grease, fungus, and ground-in dirt from the cases; use a cloth dampened (not wet) with Cleaning Compound Freon TF, NSN 685000-105-3084.

c. Remove dust or dirt from plugs and jacks with a brush.

CAUTION

Do not press on the meter face (glass) when cleaning; the meter may become damaged.

d. Clean the front panel, meter, dials, and control knobs; use a soft clean cloth. If dirt is difficult to remove, dampen the cloth with water; mild soap may be used for more effective cleaning.

Paragraph 5-1.6, last line, change "TM 9-213" to read "TB 43-0118"

Page 13. Appendix A, References, is superseded as follows:

APPENDIX A
REFERENCES

DA Pam 310-4	Index of Technical Publications; Technical Manuals, Technical Bulletins, Supply Manuals (Types 7, 8, and 9), Supply Bulletins and Lubrication Orders.
DA Pam 310-7	Us Army Index of Modification Work Orders.
TB 43-0118	Field Instructions for Painting and Preserving Electronics Command Equipment Including Camouflage Pattern Painting of Electrical Equipment Shelters.
TM-11-6625-220-10	Operation: Echo Box TS-488A/UP.
TM 38-250	The Army Maintenance Management System (TAMMS).
TM 740-90-1	Administrative Storage of Equipment.
TM 750-244-2	Procedures for Destruction of Electronics Materiel to Prevent Enemy Use (Electronics Command).

Appendix B is superseded as follows:

APPENDIX B
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

B-1. General

This appendix provides a summary of the maintenance operations for Echo Box TS-488A/UP. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

B-2. Maintenance Function

Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition; i.e., to clean (decontaminate), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

d. Adjust. To maintain, within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement. Consists of comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment or system.

h. Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

j. Overhaul. That maintenance effort (service/ action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in

classifying Army equipments/components.

B-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "work time" figures will be shown for each category. The number of task-hours specified by the "work time" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C - Operator/Crew
O - Organizational
F - Direct Support
H - General Support
D - Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

f. Column 6, Remarks. Not applicable.

B-4. Tool and Test Equipment Requirements (Sec III).

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

B-5. Remarks (Sec IV).

Not applicable.

SECTION II MAINTENANCE ALLOCATION CHART
FOR
ECHO BOX TS-488A/UP

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment
01	Echo Box, TS-488A/UP	Inspect		0.5				
		Test		1.0				1,2,5,16 thru 19
		Service		0.5				
		Calibrate					2.0	1,3,4,6 thru 19
		Replace		0.5				5
		Repair				1.0		6
		Overhaul					2.0	1,3,4,6 thru 19
		Test				1.0		1,3,4,6 thru 19
		Test					1.0	1,3,4,6 thru 19
02	ANTENNA AT-68/UP	Inspect		0.5				
		Test		0.5				2,16 thru 19
		Service		0.5				
		Replace		0.5				5
		Repair					1.0	6
		Overhaul					1.0	6
		Rebuild					1.0	6
0201	ANTENNA BRACKET	Inspect		0.2				
		Service		0.2				
		Replace		0.2				5
		Repair				1.0		6
		Rebuild					1.0	6
03	CABLE ASSEMBLY CG-92A/U	Inspect		0.2				
		Replace		0.2				
		Repair				1.0		6
		Rebuild					1.0	6
04	TROUBLESHOOTING CHART	Inspect		0.2				
		Replace		0.2				
05	WRENCH	Inspect		0.2				
		Replace		0.2				

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
ECHO BOX TS-488A/UP

Tool or Test Equipment Ref Code	Maintenance Category	Nomenclature	National/NATO Stock Number	Tool Number
1	O,H,D	CRYSTAL RECTIFIER TEST SET T268/U	6625-00-669-1215	
2	O	MULTIMETER AN/URM-105	6625-00-581-2036	
3	H,D	MULTIMETER TS-352B/U	6625-00-242-5023	
4	H,D	TEST SET, ELECTRONIC METER TS-682/GSM-1	6625-00-669-0747	
5	O	TOOL KIT, ELECTRONIC EQUIPMENT TK-101/G	5180-00-064-5178	
6	H,D	TOOL KIT, ELECTRONIC EQUIPMENT TK-105/G	5180-00-610-8177	
7	H,D	MEASUREMENT SYSTEM, FREQUENCY/TIME SYSTEM -SYSTRON-DONNER MODEL 1037M-2 (P/D AN/USM-234)		
8	H,D	SIGNAL SOURCE W/RF HEAD, PRD MODEL CX7006 (P/O AN/USM-234)		
9	H,D	POWER SUPPLY, BWO PRD, MODEL 816-SIO (P/O AN/USM-234)		
10	H,D	SYNCHRONIZER W/ACCESSORIES SAGE INSTRUMENT MODEL 243C (P/O AN/USM-234)		
11	H,D	ADAPTER, WAVE GUIDE TO COAXIAL, PRD MODEL 354C (TWO REQUIRED) (P/O ANI/USM-234)		
12	H,D	ATTENUATOR, VARIABLE: PRD, MODEL 154A (P/O AN/USM-234		
13	H,D	CABLE ASSEMBLY (36 IN.) RG-9A/U (WITH N PLUG TERMINATIONS) (TWO REQUIRED) (P/O AN/USM-234)		
14	H,D	DIRECTIONAL COUPLER: PRD MODEL 408-S4 (P/O AN/USM-234)		
15	H,D	FREQUENCY CONVERTER SYSTEM - SYSTRON-DONNER MODEL 1292 (P/O AN/USM-234)		
16	O,H,D	RADAR TRANSMITTER SYSTEM	*	
17	O,H,D	RADAR RECEIVER SYSTEM WITH A AND PPI SCOPES	*	
18	O,H,D	T-R BOX	*	
19	O,H,D	DIRECTIONAL COUPLER (P/O RADAR SYSTEM)		
		NOTE **The National Stock Numbers that are missing from this list have been requested and will be added by a change to the list upon receipt.**		

By Order of the Secretary of the Army:

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Ft Carson (5)
Ft Gillem (10)
Ft Gordon (10)
Ft Richardson (CERCOM Ofc) (2)
USA Dep (1)
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Army Dep (1) except
LBAD (14)
SAAD (30)
SHAD (3)
TOAD (14)
Units org under fol TOE:
29-207 (2)
29-610 (2)
741)
7-100 (1)
11-16 (1)
11-97 (1)
11-98 (1)
11-500 (AA-AC) (1)
17-(1)
17-100 (1)
29-1(1)
29-15 (1)
29-16 (1)
29-21 (1)
29-25 (1)
29-26 (1)
29-35 (1)
29-36 (1)
29-75 (1)
29-79 (1)
29-109 (1)
29-105 (1)
3741)
37-100 (1)
5741)
57-100 (1)

ARNG: None
USAR: None
For explanation of abbreviations used, see AR 310-50.

☆U.S. GOVERNMENT PRINTING OFFICE: 1979SII512157

CHANGE
NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *10 September 1976*

MAINTENANCE, ECHO BOX TS 488A/UP

TM 116625220-25, 3 September 1958, is changed as follows:
Page 13. Change appendix to appendix A. Add appendix B.

APPENDIX B
MAINTENANCE ALLOCATION

Section I. INTRODUCTION

B-1. General
This appendix provides a summary of the maintenance operations for TS488A/UP. It authorizes categories of maintenance for specific maintenance functions on repairable items and components and the tools and equipment required to perform each function. This appendix may be used as an aid in planning maintenance operations.

B-2- Maintenance Function
Maintenance functions will be limited to and defined as follows:

a. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

b. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean, preserve, drain, paint, or to replenish fuel lubricants/hydraulic fluids or compressed air supplies.

d. Adjust. Maintain within prescribed limits by bringing into proper or exact positions, or by setting the operating characteristics to the specified parameters.

e. Align. To adjust specified variable elements of an item to about optimum or desired performance.

f. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

g. Install The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment/system.

h. Replace. The act of substituting a serviceable like-type part, subassembly, model (component or assembly) for an unserviceable counterpart.

i. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, replace) or other maintenance actions (welding, grinding, riveting, straightening, facing, remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly

module/component/assembly, end item or system. This function does not include the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

j. Overhaul That periodic maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e.g., DMWR) in appropriate technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

k. Rebuild. Consists of those services/actions necessary for the restoration of unserviceable equipment to like-new condition in accordance with original manufacturing standards. Rebuild is the highest degree of material maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurements (hours, miles, etc.) considered in classifying Army equipment/components.

B-3. Column Entries

a. Column 1, Group Number. Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies and modules with the next higher assembly.

b. Column 2, Component/Assembly. Column 2 contains the noun names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 lists the functions to be performed on the item listed in column 2. When items are listed without maintenance functions, it is solely for purpose of having the group numbers in the MAC and RPSTL coincide.

d. Column 4, Maintenance Category. Column 4 specifies, by the listing of a "worktime" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform that maintenance function at the indicated category of maintenance. If the number of complexity of the tasks within the listed maintenance function vary at different maintenance categories, appropriate "worktime" figures will be shown for each category. The number of man-hours specified by the "worktime" figure represents the average time required to restore an item (assembly, subassembly, component, module, end item or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time and quality assurance/ quality control time in addition to the time required to perform the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. Subcolumns of column 4 are as follows:

C - Operator/Crew
O - Organizational
F - Direct Support
H - General Support
D - Depot

e. Column 5, Tools and Equipment. Column 5 specifies by code, those common tool sets (not individual tools) and special tools, test, and support equipment required to perform the designated function.

B-4. Tool and Test Equipment Requirements (Table 1)

a. Tool or Test Equipment Reference Code. The numbers in this column coincide with the numbers used in the tools and equipment column of the MAC. The numbers indicate the applicable tool or test equipment for the maintenance functions.

b. Maintenance Category. The codes in this column indicate the maintenance category allocated the tool or test equipment.

c. Nomenclature. This column lists the noun name and nomenclature of the tools and test equipment required to perform the maintenance functions.

d. National/NATO Stock Number. This column lists the National/NATO stock number of the specific tool or test equipment.

e. Tool Number. This column lists the manufacturer's part number of the tool followed by the Federal Supply Code for manufacturers (5-digit) in parentheses.

SECTION II MAINTENANCE ALLOCATION CHART
FOR
ECHO BOX TS-418A/UP

(1) Group Number	(2) Component/ Assembly	(3) Maintenance Function	(4) Maintenance Category C	O	F	H	D	(5) Tools and Equipment
01	Echo Box, TS-488A/UP	Inspect		0.5				
		Test		1.0				1,2,5,16,17,18,19
		Service		0.5				
		Calibrate					2.0	1,3,4,6,7-19
		Replace		0.5				5
		Repair				1.0		6
		Overhaul					2.0	1,3,4,6,7-19
		Test				1.0		1,3,4,6,16-19
		Test					1.0	1,3,4,6,7-19
02	Antenna, AT-68/UP	Inspect		0.5				
		Test		0.5				2,16-19
		Service		0.5				
		Replace		0.5	5			
		Repair					1.0	6
		Overhaul					1.0	6
		Rebuild					1.0	6
021	Antenna Bracket	Inspect		0.2				
		Service		0.2				
		Replace		0.2				5
		Repair				1.0		6
		Rebuild					1.0	6
03	Cable Assembly, CG-92A/U	Inspect		0.2				
		Replace		0.2				
		Repair				1.0		6
		Rebuild					1.0	6
04	Troubleshooting Chart	Inspect		0.2				
		Replace		0.2				
05	Wrench	Inspect		0.2				
		Replace		0.2				

TABLE 1. TOOL AND TEST EQUIPMENT REQUIREMENTS
FOR
ECHO BOX TS-488A/UP

Tool or Test Equipment Ref Code	Maintenance Category	Nomenclature	National/NATO Stock Number	Tool Number
1	0,H,D	CRYSTAL RECTIFIER TEST SET T268/U	6625-00-669-1215	
2	0	MULTIMETER, AN/URM-105	6625-00-581-2036	
3	H,D	MULTIMETER, TS-352B/U	6625-00-242-5023	
4	D	METER, TEST SET Ts-682/u	6625-00-669-0747	
5	0	TOOL KIT, ELECTRONIC EQUIPMENT TK-101/G	5180-00-064-5178	
6	H,D	TOOL KIT, ELECTRONIC EQUIPMENT TK-105/G	5180-00-610-8177	
7	D	MEASUREMENT SYSTEM, FREQUENCY/TIME SYSTEM SYSTRON-DONNER MODEL 1037M-2 (P/O AN/USM-234)		
8	D	SIGNAL SOURCE W/RF HEAD, PRD MODEL CX7006 (P/O AN/USM-234)		
9	D	POWER SUPPLY, BWO PRD, MODEL 816-Sio (P/O AN/USM-234)		
10	D	SYNCHRONIZER W/ACCESSORIES (SACE INSTRUNT MODEL 243C (P/O AN/USM-234)		
11	D	ADAPTER, WAVE GUIDE TO COAXIAL, PRD MODEL 354C (Two required) (P/O AN/USM-234)		
12	D	ATTENUATOR, VARIABLE. PRD MODEL 154A (P/O AN/USM-234)		
13	D	CABLE ASSEMBLY (361N.) RC-9A/U (WITH N PLUG TERMINATIONS, (TWO REQUIRED) (P/O AN/USM-234)		
14	D	DIRECTIONAL COUPLER PRD MODEL 4o8-S4 (P/O AN/USM-234)		
15	D	FREQUENCY CONVERTER SYSTEM-SYSTRON-DONNER MODEL 1292 (P/O AN/lUSM-234)		
16	O,H,D	RADAR TRANSMITTER SYSTEM		
17	O,H,D	RADAR RECEIVER SYSTEM W/"A" and "PPI" SCOPES		
18	O,H,D	T-R BOX		
19	O,H,D	DIRECTIONAL COUPLER (P/O RADAR SYSTEM)		

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LOGCOMDS (3)	1-56
MICOM (2)	7
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MDW (1)	11-97
Armies (2)	11-98
Corps (2)	11-117
HISA (Ft Monmouth) (33)	11ZWAA-AC)
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USASESS (6)	17-100
USAADS (2)	291
USAFAS (2)	2915
USAARMS (2)	2916
USAIS (2)	29-21
USAES (2)	29-25
USAICS (3)	2926
Instl (2) except	29-35
Fort Gillem (10)	29-36
Fort Gordon (10)	2975
Fort Huachuca (10)	29-79
Fort Carson (5)	29-105
Ft Richardson (ECOM) (2)	29-109
LBAD (14)	37
SAAD (30)	37-100
TOAD (14)	57
SHAD (3)	57-100

NG: State AG (3) Units - Same as Active Army except allowance in one copy per unit.
USAR: None

For explanation of abbreviations used, see AR 3106.

☆ U.S. GOVERNMENT PRINTING OFFICE 1983 0 - 381-302 (2587)

MAINTENANCE, ECHO BOX TS-488A/UP

CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *3 January 1963*

TM 11-6625-220-25, 3)September 1958, is changed as follows:

Page 1. Add paragraphs 1-2.1 and 1-2.2 after paragraph 1-2.

1-2.1. Index of Publications
Refer to the latest issue of DA Pam 310-4 to determine whether there are new editions, changes, or additional publications pertaining to your equipment. DA Pam 3104 is an index of current technical manuals, technical bulletins, supply manuals, supply bulletins, lubrication orders, and modification work orders which are available through publications supply channels. The index lists the individual parts (-10, -20, -35P, etc) and the latest changes to and revisions of each equipment publication.

1-2.2 Reporting of Equipment Manuals Improvements.
The direct reporting, by the individual user, of errors, omissions, and recommendations for improving this manual is authorized and encouraged. DA Form 2028 (Recommended Changes to DA Technical Manual Parts Lists or Supply Manual 7, 8, or 9) will be used for reporting these improvements. This form will be completed in triplicate by the use of pencil, pen, or typewriter. The original and one copy will be forwarded direct to Commanding Officer, U. S. Army Electronics Materiel Support Agency, ATTN: SELMS-MP, Fort Monmouth, N. J. 07703. One information copy will be furnished to the individual's immediate supervisor (officer, noncommissioned officer, supervisor, etc.).

Page 10. Delete paragraph 5-21 and 5-22.

Page 11. Add section V.1 after section V.

SECTION V.1
ORGANIZATIONAL PREVENTIVE MAINTENANCE

5.1-1. Scope of Maintenance
The maintenance duties assigned to the organizational repairman of Echo Box TS488A/UP are listed below, together with a reference to the paragraphs covering the specific maintenance functions.

a. Monthly preventive maintenance checks and services (para. 5.1-4).

b. Cleaning (para. 5.1-5).

c. Touchup painting (para. 5.1-6).

5.1-2. Preventive Maintenance

a. Preventive maintenance is the systematic care, inspection, and servicing of equipment to maintain it in serviceable condition, prevent breakdowns, and assure maximum operation capability. Preventive maintenance is the responsibility of all echelons concerned with the equipment and includes the inspection, testing, and repair or replacement of parts, subassemblies, or units that inspection and tests indicate would probably fail before the next scheduled periodic service. Preventive maintenance checks and services of Echo Box TS488A/UP at the second echelon level are made at monthly intervals unless otherwise directed by the commanding officer.

b. Maintenance forms and records to be used and maintained on this equipment are specified in TM 38-750.

5.1-3. Monthly Maintenance
Perform the maintenance functions indicated in the monthly preventive maintenance checks and services chart (para. 5.14) once each

month. A month is defined as approximately 30 calendar days of 8-hour-per-day operation. If the equipment is operated 16 hours a day, the monthly preventive maintenance checks and services should be performed at 15-day intervals. Adjustment of the maintenance interval must be made to compensate for any unusual operating conditions. Equipment maintained in a standby (ready for immediate operation) condition must have monthly preventive maintenance checks and services performed on it. Equipment in limited storage (requires service before operation) does not require monthly preventive maintenance.

5.1-4. Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Completeness	See that the equipment is complete (para. 1-4)	Para. 1-4.
2	Exterior surfaces	a. Clean the exterior surfaces, including the panel and meter glasses (para. 5.1-5). Check all meter glasses and indicator lenses for cracks. b. Check exposed metal surfaces for rust and corrosion. Clean and paint as required (para. 5.1-6).	
3	Interconnecting cable	Check cable for chafed, cracked, or frayed insulation. Replace cable with connectors that are broken, arced, stripped, or worn excessively.	
4	Handles and latches	Inspect handles and latches for looseness. Replace or tighten as necessary.	
5	Dust caps	Check for proper mating of the front panel dust caps.	
6	Pickup antenna and antenna bracket.	a. Check pickup antenna for dust and dirt inside antenna horn. Clean if necessary. b. Check antenna bracket suction cups for proper suction. Replace cups if antenna bracket cannot hold up antenna.	
7	Interior surfaces	a. Clean the interior surfaces, including dial (fig. 5-2). b. Check dehydrator (para. 5-16). Replace if necessary.	
8	Lubrication	Check lubrication schedule	Para. 5-18.
9	Controls and indicators	While making the operational checks (sequence No. 10), observe that the mechanical action of each knob and dial is smooth and free of external or internal binding, and that there is no excessive looseness. Also, check the meter for sticking or bent pointer.	
10	Operation	Operate the equipment. During operation, be alert for unusual conditions or performance.	
11	Publications	See that all publications are complete, serviceable, and current.	DA Pam 310-4.
12	Modifications	Check DA Pam 310-4 to determine if new applicable MWO's have been published. All URGENT MWO's must be applied immediately. All NORMAL MWO's must be scheduled.	TM 38-750 and DA Pam 310-4.

5.1-5. Cleaning

Inspect the exterior of Echo Box TS488A/UP. The exterior surfaces should be clean, and free of dust, dirt, grease, and fungus.

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

Warning

Cleaning compound is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

b. Remove grease, fungus, and ground-in dirt from the cases; use a cloth dampened (not vet) with Cleaning Compound (FSN 7930 395-9542).

c. Remove dust or dirt from plugs and jacks with a brush.

Page 13. Add the appendix after section VII.

Caution

Do not press on the meter face (glass) when cleaning; the meter may become damaged.

d. Clean the front panel, meter, dials, and control knobs; use a soft clean cloth. If dirt is difficult to remove, dampen the cloth with water; mild soap may be used for more effective cleaning.

5.16. Touchup Painting Instructions

Remove rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices specified in TM 9-213.

APPENDIX
REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply Manuals, (Types 4, 6, 7, 8, and 9), Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TM 9-213	Painting Instructions for Field Use.
TM 11-6625-220-10	Operation: Echo Box TS-488A/UP.
TM 38-750	The Army Equipment Record System and Procedures.

By Order of the Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

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Active Army:

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USAECOM (7)
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ARADCOM (2)
ARADCOM Rgn (2)
OS Maj Comd (3)
OS Base Comd (2)
LOGCOMD (2)
MDW (1)
Armies (2)
Corps (2)
Div (2)
Instl (2) except
    Ft Gordon (5)
    Ft Huachuca (10)
    Ft Monmouth (63)
    Ft Hancock (4)
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Sig Sec, GENDEP (5)
Sig Sep (OS) (12)
Army Dep (2) except
    Lexington (12)
    Sacramento (28)
    Tobyhanna (12)
    Ft Worth (8)
Svc Colleges (2)
Br Svc Sch (2)
USATC AD (2)
USATC Armor (2)
USATC Engr (2)
USATC Inf (2)
USATC FA (2)
USASTC (2)
WRAMC (2)
USA Tml Comd (1)
Army Tml (1)
POE (1)
USAOSA (1)
USA Elct RD Lab, Trp Comd (10)
AMS (1)
Army Pic Cen (2)
USA Mbl Spt Cen (1)
USA Elct Mat Agcy (9)
Chicago Proc Dist (1)
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CSTATC (2)
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    57-100 (2)

NG: State AG (3); units-same as Active Army except allowance is one copy to each unit.
USAR: None.

For explanation of abbreviations used, see AR 32050.

Technical Manual

No. 11-6625-220-25

HEADQUARTERS,
DEPARTMENT OF THE ARMY
Washington 25, D. C., 3 September 1958

ECHO BOX TS-488A/UP

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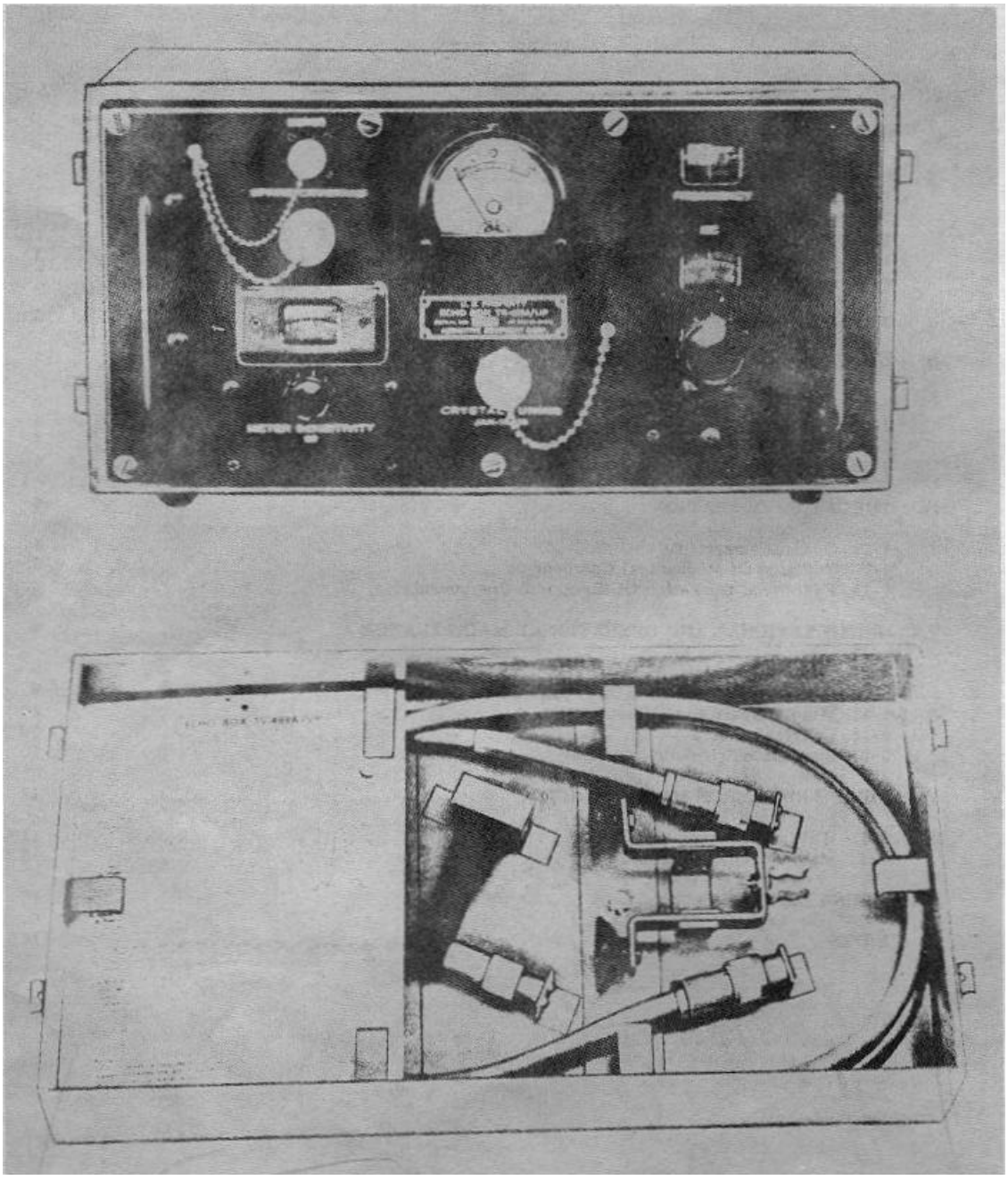


Figure 1-1. Echo Box TS-488A/UP

SECTION I
DESCRIPTION AND LEADING PARTICULARS

1-1. GENERAL.

1-2. This handbook contains service instructions for Echo Box TS-488A/UP manufactured by Aermotive Equipment Corporation, Kansas City, Missouri and is issued as one of four basic handbooks covering the equipment. The other three handbooks are: Handbook of Operating Instructions (T.O. 33A1-3-71-1); Handbook of Overhaul Instructions (T.O. 33A1-3-71-3) and Illustrated Parts Breakdown (T.O. 33A1-3-71-4).

1-3. EQUIPMENT SUPPLIED.

1-4. The complete equipment consists of the items listed in Table I.

1-5. DESCRIPTION. (See figure 1-1.)

1-6. The complete equipment is housed in a metal carrying case with a removable cover. The pick-up antenna, antenna mounting bracket, wrenches, trouble shooting chart, and interconnecting cable are all mounted to the inside of the cover. The instrument controls and indicators are exposed when the cover is removed. The top of the instrument serves as a control panel and contains the controls and indicators necessary for operation of the Echo Box. The controls and indicators are: TUNING control, two FREQUENCY indicator dials, METER SENSITIVITY control, DB indicator dial, CRYSTAL TUNING control, and Output Meter. In addition, the control panel contains a holder for spare JAN -1N23B crystals and the Echo Box INPUT connector for connecting the Echo Box to radar directional coupler or to the pick-up antenna. The pickup antenna is used to pick up transmitted energy from the radar and reradiate the energy from the Echo Box back to the radar.

1-7. PURPCSE OF EQUIPMENT.

1-8. Echo Box TS-488A/UP is a portable test instrument used to check the performance of radar equipment. The Echo Box is used to check the over-all radar system performance and to make the following radar equipment checks:

a. Comparative measurement of average power output of radar transmitter.
b. Frequency spectrum of radar transmitter.
c. Radar transmitter for multiple moding.
d. Radar transmitter for frequency pulling.
e. Speed of recovery of radar T-R box and receiver.

1-9. FREQUENCY RANGE.

1-10. The Echo Box operates over a frequency range of 8990 to 9610 megacycles per second. Frequency measurements may be obtained to within $\pm$8 megacycles at normal temperature and humidity. Frequencies 60 megacycles apart may be read to within $\pm$1.5 megacycles.

1-11. POWER SUPPLY.

1-12. Operation of the Echo Box is entirely dependent on r-f energy picked up from the radar transmitter under test.

TABLE I
EQUIPMENT SUPPLIED

Quantity	Name	Army/Navy Type Designation
1	Echo Box (including the following items)	TS-488A/UP
1	Pick-up Antenna	AT-68/UP
1	Antenna Bracket	
1	Interconnecting Cable	CG-92A/U
1	Trouble Shooting Chart	
2	Wrench	

1-13. LOCATION AND FUNCTION OF OPERATING AND ADJUSTMENT CONTROLS. (See figure 1-2.)

1-14. Table II contains a list of the operating controls and indicators and their functions.

TABLE II
OPERATING AND ADJUSTMENT CONTROLS

Index No.	Control	Function
1	METER SENSITIVITY Control	Operates an attenuator in the meter output circuit of the resonant cavity to reduce the amount of r-f energy fed to the meter circuit and thus reduce the output meter readings. Minimum attenuation is in the circuit when the control is in the full clockwise position. **CAUTION** **Never leave the METER SENSITIVITY control in the full clockwise position. Always return the control to the full counterclockwise position (maximum attenuation) after use. This precaution may prevent damage to the instrument caused by the application of an unknown amount of power.**
2	Output Meter	Serves as a tuning indicator and also provides a comparative output measurement for the radar transmitter. The meter scale is calibrated in microamperes.
3	DB Indicator Dial	Indicates attenuation in the output meter circuit. The dial is calibrated in decibels in one decibel graduations from zero to 25 decibels. The dial is driven by the METER SENSITIVITY control.
4	TUNING Control	Operates a piston within the resonant cavity to tune the cavity by changing its dimensions.
5	FREQUENCY Indicator Dial	Indicates the frequency of the resonant cavity. Consists of two dials driven by the TUNING control. The two dials are divided into two calibrated scales. The top dial indicates frequency in 10 megacycle intervals. The bottom dial is divided into large intervals indicating one-half megacycle and into small intervals indicating 0.1 megacycle.
6	CRYSTAL TUNING Control	The CRYSTAL TUNING control is the crystal extractor. The control adjusts the position of the crystal rectifier which results in an increase or decrease in the output meter reading. (Always adjust for maximum meter reading.)

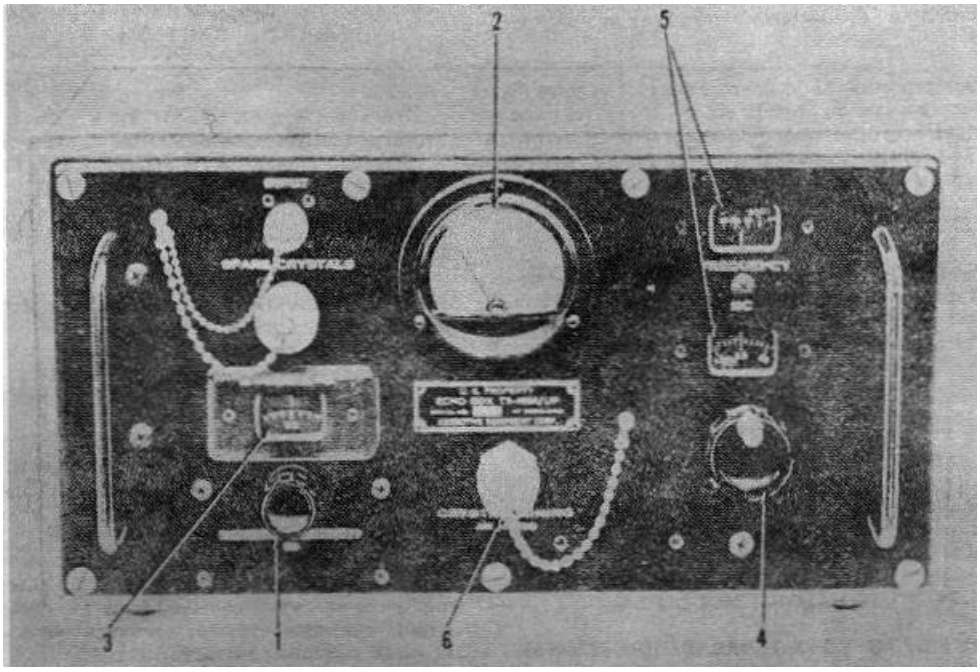


Figure 1-2. Echo Box TS-488A/UP Operating And Adjustment Controls

SECTION II
TEST EQUIPMENT AND SPECIAL TOOLS

2-1. No special test equipment or tools are required for servicing Echo Box TS-488A/UP.

SECTION III
PREPARATION FOR USE AND RESHIPMENT

3-1. UNPACKING AND INSPECTION.

CAUTION
The Echo Box is a precision instrument. Use particular care when unpacking and handling.

3-2. Place the packing tape packing case in a convenient place.

cut the binding tape and open top of box.

3 -3. Carefully lift the instrument from the packing case and remove the wrapping paper. Remove the instrument case cover and check all items received against the packing list. Operate each control on the panel and make sure they are working properly. Inspect equipment thoroughly for possible damage during shipment.

3-4. Loosen the seven captive screws securing panel in case, remove panel and inspect components on rear of panel. Make sure input and output cables to transducers

and attenuator are securely connected. Handle panel carefully as components on the rear are unprotected.

3-5. Check condition of dehydrator plug. Crystals in dehydrator should be blue in color. If crystals are pink, moisture is present and dehydrator must be replaced. See Section V, paragraph 5-16 for detailed instructions.

3-6. PREPARATION FOR USE.

3 -7. Echo Box TS-488A/UP is a portable test instrument and may be placed in a location which is within the limits of the connecting cord and will be convenient for the operator to observe the radar indicator screen.

CAUTION

Never locate Echo Box in the direct antenna beam or place equipment where it will be exposed to strong r-f fields while in use.

3 -8. COUIPLING TO RADAR FOR TESTING.

3-9. COUPLING USING RADAR DIRECTIONAL COUPLER.

3-10. Generally, radar systems are equipped with a directional coupler in the transmission line to the antenna. R-f energy can be taken from wave guide transmission line for test purposes. If the directional coupler has a coupling loss of 20 to 25 decibels, it will be well suited for ring time observation. To use this method, connect cord CG-92A/U between the directional coupler on the radar and INPUT connector on front panel of the Echo Box.

CAUTION

Be sure METER SENSITIVITY control is turned fully counterclockwise to maximum db attenuation position before turning on radar.

3-11. COUPLING USING PICK-UP ANTENNA AT68/UP.

3-12. Normally, the pick-up antenna is used only for periodic checks at the radar antenna, which takes into account the loss in the radar antenna transmission line. Connect pick-up antenna AT-68/UP to Echo Box using cord CG-92A/U and attach antenna bracket to the pick-up antenna.

3-13. Turn radar equipment on and allow to warm up. Position radar antenna so there will be no interference from echo signals which might interfere with the measurement of ring time.

3-14. Select a location for the pick-up antenna where maximum energy is received from the radar antenna. Avoid locations where interference patterns are formed by large reflecting surfaces.

3-15. The antenna may be secured to any smooth surface by means of the suction cups attached to the antenna bracket.

3-16. RESHIPMENT.

3-17. Wrap the instrument in wrapping paper and replace in the original or similar packing case. Make sure all accessory items are secured in their proper place in the instrument cover.

SECTION IV
THEORY OF OPERATION

4-1. GENERAL OPERATION.

4 -2. The general principle of operation of the Echo B ox may be compared to that of a sharply tuned resonant circuit, tunable over a range of 8990 to 9610 megacycles. The resonant cavity performs a similar function in the Echo Box and is used in place of a conventional resonant circuit because of certain advantages at extreme high frequencies. Among these are the relative large size, simple structure, lower losses and resultant high Q.

4-3. In the design and construction of the resonant cavity, every effort has been made to keep internal losses at a minimum. All critical reflecting surfaces 4 are silver plated and highly polished. As a result, the Q is very high (approximately 60,000). The Q of a resonant circuit using lumped inductance and capacitance is seldom greater than 1,000 even under very favorable conditions.

4-4. The resonant cavity roughly resembles an electrical circuit in which lumped inductance and capacitance are tuned to resonance at the frequency of the r-f energy being measured. Figure 4-1 shows a block diagram of the Echo Box and an equivalent L-C circuit. The tuned circuit will store energy for a period of time depending on the efficiency of the circuit and amount of energy fed to the circuit.

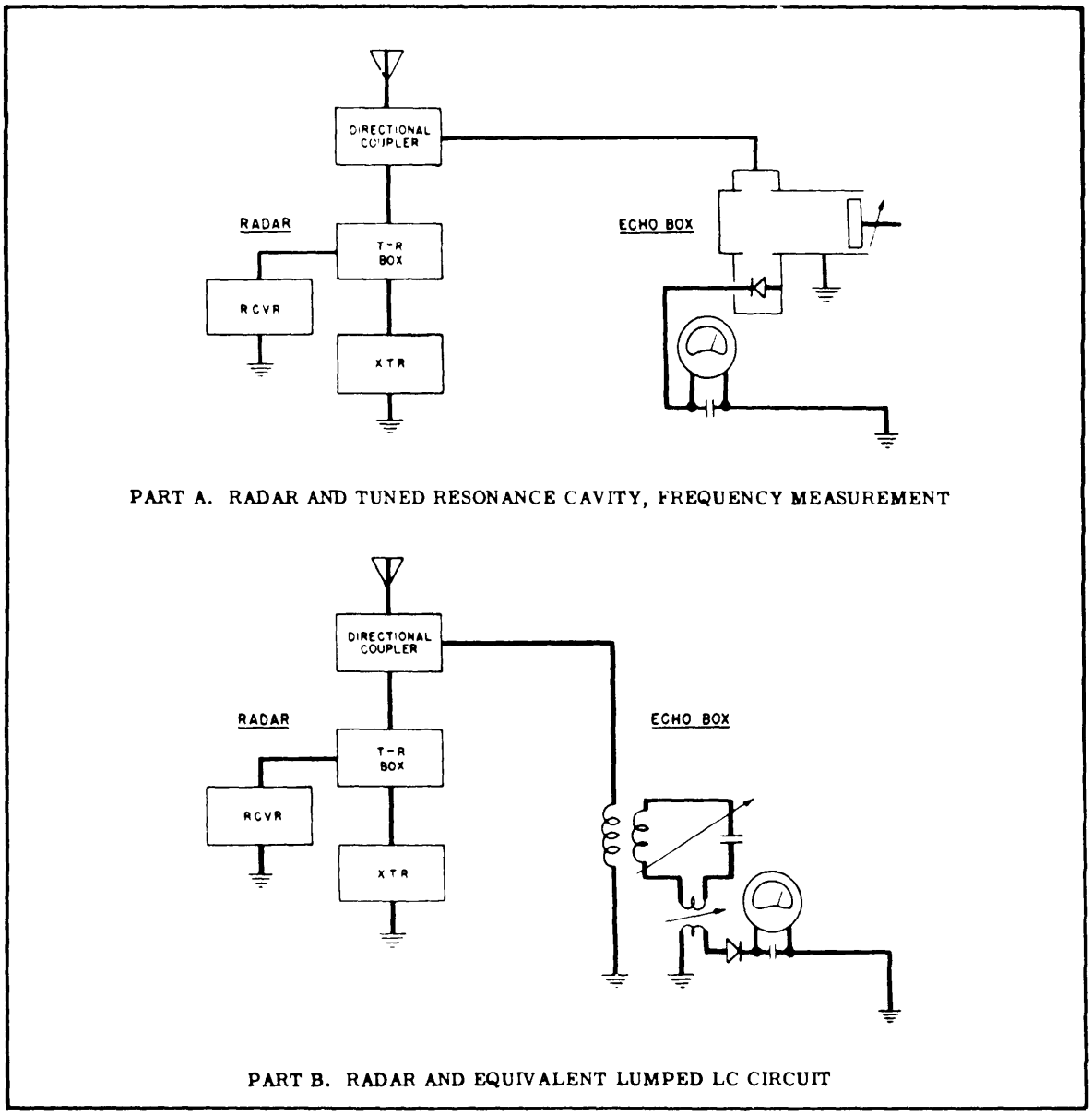


Figure 4-1. Echo Box TS-488A,UP, Equivalent Circuit

4-5. The method of using this principle, as applied to the Echo Box, Is to shock excite the circuit quickly by means of the transmitted pulse from the radar. Feeding r-f energy into the circuit has a similar effect as striking a bell with a hammer. The amplitude of the oscillations gradually decrease just as the ringing sound of the bell diminishes. Because of this close analogy, the resonant cavity is sometimes called a “ringing cavity.”

4-6. The r-f energy Is stored in the resonant cavity, during the transmitting cycle, in the form of damped oscillations. At the completion of the transmitting cycle, the energy is discharged or reradiated back into the radar receiver where it appears as a signal on the indicator. The shape and character of the pattern, resulting from the energy returned to the radar by the Echo Box shows the condition of the radar receiver. A portion of the energy stored in the Echo Box resonant cavity is rectified and measured on the output meter on the Echo Box panel. The meter serves as a tuning indicator for the Echo Box and also provides a comparative power output measurement for the radar transmitter.

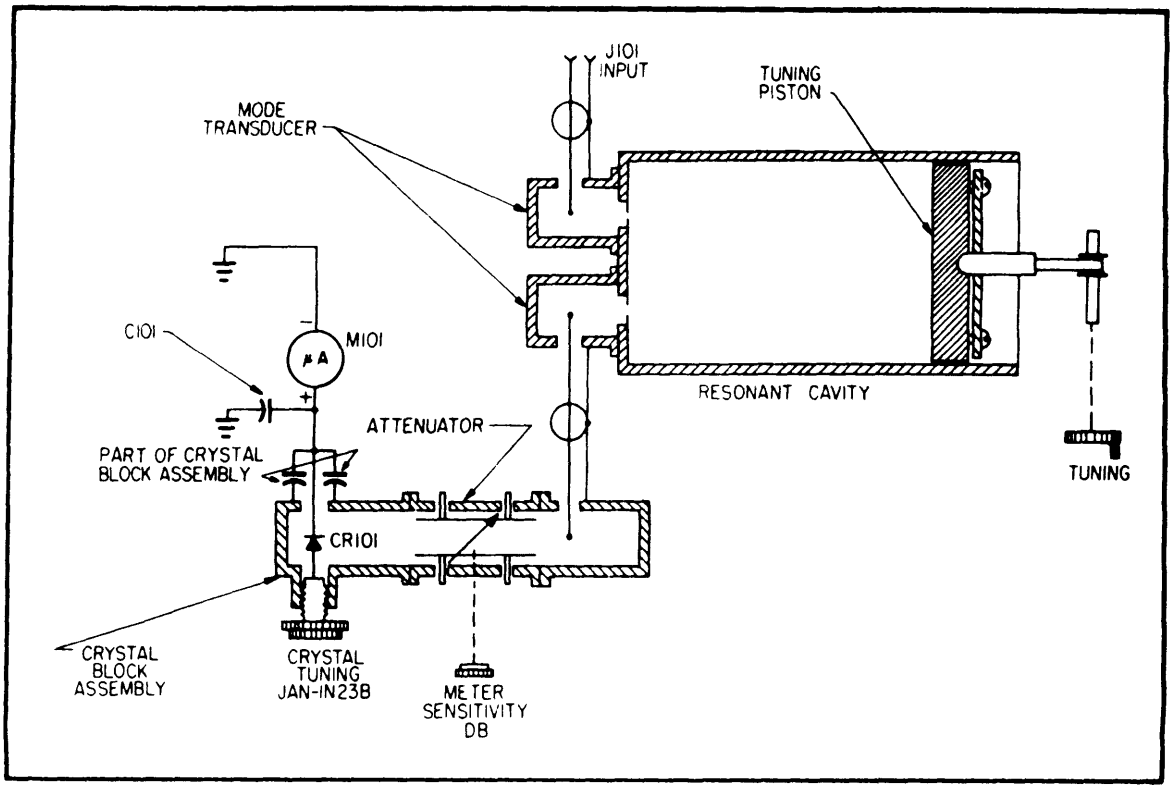


Figure 4-2. Echo Box TS-488A/UP Functional Schematic

4-7. FUNCTION OF MECHANICAL COMPONENTS. (See figure 4-2 and 5-2.)

4-8. The resonant cavity is a brass cylinder, silver plated and highly polished on the inside. Within the cylinder is a piston which is moved in or out by the tuning drive gear mechanism actuated by the TUNING control. The position of the piston within the cylinder determines the resonant frequency of the cavity. R-f energy is fed into and out of the cavity by means of wave guide transducers on the end of the cavity opposite the piston.

4-9. TUNING DRIVE. (See figure 5-2.)

4-10. The tuning drive contains the mechanisms that position the piston to tune the resonant cavity and to drive the frequency dials. The tape assembly (5) is attached to the piston at one end and to an eccentric (3) at the tuning drive end. The eccentric is driven through a worm gear (6) and worm (11) by turning the tuning knob (16) located at the front of the panel. Therefore, the tape assembly will wind up on the eccentric to move the piston out when the tuning knob is turned to decrease the frequency and will unwind from the eccentric, caused by the spring loaded piston, when the tuning knob 6 is turned to increase the frequency. Frequency dial (17) is turned directly by the tuning knob and frequency dial (1) is driven from the same shaft at the eccentric through gear (2) and gear assembly (19). Gear assembly (19) consists of two spring loaded gears to keep backlash at a minimum. Gear assembly (13) is driven by gear (15) and gear assembly (14) attached to the tuning knob shaft. Gear assemblies (13) and (14) are equipped with stop plates which limit the travel of the tuning drive and consequently the travel of this piston.

4-11. FUNCTIONAL OPERATION OF ELECTRICAL COMPONENTS. (See figure 4-2.)

4-12. TRANSMISSION CIRCUIT.

4-13. R-f energy is fed to the Echo Box through connection cord CG-92A/U which plugs into INPUT jack J101 on the front of the panel. A short coaxial cable connects the INPUT jack to a waveguide transducer which feeds into the resonant cavity. This transducer also provides a path for the energy to be reradiated back to the radar receiver after each transmitted pulse. Another transducer serves as an output path for power measurements and tuning of the Echo Box. This transducer connects through another short coaxial cable to a third transducer at the input of the waveguide assembly.

4-14. RESONANT CAVITY.

4-15. The electrical action of the resonant cavity can be compared with that of a low loss (high Q) resonant circuit in which energy can be stored in the form of rapidly alternating electric and magnetic fields. When r-f energy is introduced into the resonant cavity by the input transducer, oscillations continue until they are dissipated by resistive losses within the cavity itself and by energy fed to the output meter and back through the input transducer.

4-16. Both the Echo Box circuit and the L-C circuit shown in figure 4-1 are basically equivalent. The frequency at which the cavity is resonant, may be varied by moving the piston in or out of the cylinder (changing the cavity dimension), while the frequency of the L-C circuit is varied by changing either the value of the inductance or capacitance, or both. In either resonant circuit, maximum energy is stored in the circuit when it is tuned to resonance with the frequency of the incoming r-f energy.

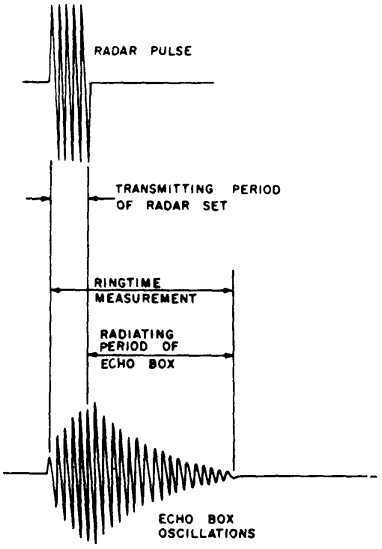


Figure 4-3. Relationship Between Radar Pulse and Echo Box Oscillations

4-17. When the Echo Box resonant cavity is tuned to the frequency of the transmitted radar signal, oscillations build up in the cavity for the duration of the pulse width as shown in figure 4-3. These oscillations decrease gradually after the transmitted pulse has ended. During this interval, part of the stored r-f energy is dissipated within the cavity and part is transmitted back through the input transducer to the directional coupler and reradiated to the radar receiver where it appears as a trace on the radar indicator. During this time, the cavity is said to be “ringing”. The time between the beginning of the transmitted pulse and the Instant the reflected signal decreases to the point where it disappears into the background noise or grass, is usually referred to as “ringtime.”

4-18. The ringing time provides a comparative measure of the transmitter power output, the efficiency of the r-f system, and radar receiver sensitivity, since maximum energy stored in the resonant cavity is proportional to the transmitter power output, while the instant the reflected signal can no longer be detected on the indicator will depend on the losses in the r-f system and receiver sensitivity.

4-19. Figure 4-3 shows only a few cycles of oscillations during both the radar pulse interval and ring time interval. Actually, the radar pulse extends over about 3,000 cycles and the ring time over about 200,000 cycles for a typical radar system.

4-20. The oscillations continue to build up during the duration of the transmitted pulse because of the high Q of t he resonant cavity. Also, the higher the Q of the cavity, the slower the oscillations decay. Consequently, the resonant cavity continues to oscillate for a comparatively long time after the transmitted pulse has ceased.

4-21. The total amount of energy stored up in the resonant cavity and the time required for the r-f energy to be dissipated, depends on the amplitude and duration of the transmitted pulse. A radar system operating correctly with a transmitted pulse width of about 3/8ths microsecond will cause enough energy to be stored in the Echo Box to give a ring time indication of about 25 microseconds or 4,000 yards.

4-22. ATTENUATOR.

4-23. The absorption type vane attenuator, located in the coupling wave guide, controls the amount of r-f energy delivered from the output circuit of the resonant cavity to the crystal block assembly. The action of the attenuator is to reduce the amount of r-f energy fed to the crystal rectifier in the crystal block assembly, thus reducing the output meter reading. The DB dial is calibrated directly in decibels. Maximum attenuation is in the circuit with METER SENSITIVITY control rotated to full counterclockwise position (vanes toward center of waveguide).

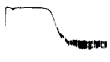
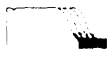
4 -24. CRYSTAL BLOCK ASSEMBLY.

4-25. The output of the attenuator is coupled to the crystal block assembly containing a crystal diode rectifier (CR101) which rectifies the r-f energy delivered from the resonant cavity. The crystal rectifier consists of a small piece of silicon and its spring contact mounted in a ceramic case. The crystal sensitivity can be varied by increasing or decreasing its insertion into the wave guide by adjusting the CRYSTAL TUNING CONTROL. This varies the r-f impedance match and coupling of the crystal.

4-26. OUTPUT METER.

4-27. The rectified output of the crystal rectifier is connected to the d-c microammeter (M-101). A smoothing capacitor (C101) is connected across the meter.

TABLE III. TROUBLE SHOOTING CHART

EFFECT	APPEARANCE ON		PROBABLE CAUSE
	RADAR INDICATOR	ECHO BOX METER	
Ringtime and test set output satisfactory.			Radar performance satisfactory.
Ringtime low, output reading satisfactory.			Receiver trouble: Detuned mixer or local oscillator, bad crystal, excessive I-F noise, adjustment of probes in mixer cavity. Detuned T-R box.
Ringtime low, test set output very low.			Low power output. Check spectrum.
Ringtime low, test set meter reading low.			Trouble probably in transmitter and receiver and/or trouble in transmission line.
Ringtime erratic, test set meter reading steady.			Test set detuned, bad pulsing, double moding transmitter, or local oscillator power supply trouble. Check spectrum.
Ringtime erratic, test set output reading erratic.			Faulty transmission line or connection - condition worse when line is rapped.
End of ringtime slopes gradually, perhaps even excessive ringing. Grass appears coarse. Test set output reading steady and satisfactory.			Oscillating I-F and/or narrow band receiver.
Pronounced dip in ringtime at end of pulse.			Bad T-R tube.
Ringtime very slightly low. Poor or bad spectrum.		 Poor Spectrum	Transmitter trouble.
Blank spaces or rough pattern on PPI ringtime indicator, test set output reading varies as radar antenna is rotated.			Frequency pulling of transmitter due to bad rotating joint or to reflecting object near radar antenna.

SECTION V
ORGANIZATIONAL AND OPERATIONAL MAINTENANCE

5-1. TROUBLE ANALYSIS.

5-2. Due to the nature of the equipment, and critical adjustments, no specific test procedures can be established for field maintenance of the equipment. In certain instances, when conducting radar performance tests or radar equipment checks, a condition may exist which may indicate a faulty condition in the Echo Box.

5-3. The Trouble Shooting Chart, Table m, shows typical ringtime patterns, both good and bad, and indicates the probable cause of the trouble. If a given condition cannot be identified from the chart, the trouble may be traced to the Echo Box.

5-4. Repair or replacement of components other than those mentioned in this section should not be attempted at Organizational and Operational levels, but should be forwarded to the proper maintenance activity.

5-5. LOW METER READINGS.

5-6. The output meter will read low when the radar power is low, the spectrum of the transmitter is bad, or the pulse is too short. These are among the radar system faults which it is the purpose of the Echo Box to detect. If the Echo Box is suspected as the reason for low meter readings, try another Echo Box, if available, to make sure the difficulty lies within the test equipment. Low meter readings may result from the following:

a. The Echo Box is tuned to a side lobe of the transmitter spectrum. If the transmitter has comparatively large side lobes, it is possible to unknowingly tune to the wrong peak. Careful tuning will eliminate this difficulty. Always tune completely through the transmitter spectrum and carefully locate the main peak.

b. METER SENSITIVITY control not set at standard position (on D-B dial indicator).

c. Crystal burned out or damaged.

d. Damaged coaxial connectors or cables.

e. Incorrect connection to directional coupler.

f. Meter filter capacitor open or partially shorted.

g. Meter damaged, shorted or disconnected. If the meter is suspected of being faulty, it should be tested as follows: Disconnect all leads from the meter. Connect a 1.5 volt dry cell through a 100,000 ohm resistor to the meter. The meter should read between one-half and full scale.

CAUTION

Never test the Echo Box output meter with an ohmmeter. The meter movement is so sensitive that the current from the ohmmeter may cause damage. The case of the meter should never be opened.

h. Attenuator damaged. If the attenuator is suspected of being faulty, the complete unit should be sent to the responsible FIELD or FASRON maintenance activity for replacement of the complete wave guide assembly.

5-7. LOW RINGTIME AND NORMAL METER READING.

5-8. When it is known that the radar receiver sensitivity, the T-R box recovery, and the Echo Box meter reading are normal, a reduction in ringtime can be caused by the following faults in the Echo Box.

a. METER SENSITIVITY control readjusted when low meter reading existed as in paragraph 5-5. If this control has been readjusted to nearly 0 db, using the radar system with reduced transmitter power, the crystal may thus be coupled too closely to the Echo Box resonant cavity. This closer coupling to the cavity may increase the meter reading to a normal value, but the ringtime will still remain low. In this case the true difficulty is low meter reading, and the causes may be the same as those listed in paragraph 5-5.

b. If trouble cannot be traced to those specified in paragraph 5-5, the Echo Box is probably defective internally and should be replaced with another unit.

CAUTION

Do not tighten or attempt to adjust any of the adjustment screws on the cavity. Adjustment and orientation of the wave guide transducers on the cavity are factory adjustments, and must not be altered. The Echo Box cavity should not be opened under any circumstances as the ringing time of the Echo Box may be seriously impaired.

5-9. CARE AND REPLACEMENT OF CRYSTAL DIODE. (CR101)

5-10. The electrical characteristics of the crystal diode (AN-IN32B) will be seriously impaired if excessive electrical current passes through it. Minute

static charges are sufficient to cause damage. Therefore, the possibility of a static discharge through the crystal diode must be prevented. Damage to the crystal diode, resulting from static discharge, maybe avoided by touching the crystal holder with the bare hand that holds the crystal diode, before and while inserting the new crystal diode in the holder. A crystal diode, exposed to a strong radio frequency field, may absorb enough energy to damage or destroy it. Since it may be necessary to remove a crystal diode from its holder or the spare crystal while in the vicinity of a radar transmitter or other source of strong electromagnetic field, it will be necessary to shut down the equipment generating such a field. If it is not practical to shut down the transmitter, the Echo Box should be moved some distance away before changing the crystal. Crystal diodes not mounted in the Echo Box should always be kept in the SPARE CRYSTALS holder on the front panel.

CAUTION

Be sure the correct procedure for replacing the crystal diode is followed to prevent damage to the crystal or holder.

1. Crystal Retainer
2. Crystal
3. Crystal Extractor
4. Washer
5. Nut
6. Crystal Block Assy

Figure 5-1. Crystal Holder

5-11. MINOR REPAIR AND ADJUSTMENT.

5-12. REMOVINGCRYSTAL DIODE. (See figure 5-1.)

a. Remove crystal holder cover.

b. Loosen crystal retainer in the crystal extractor.

c. Unscrew and remove crystal extractor.

d. Unscrew and remove crystal retainer from crystal extractor.

e. Remove crystal by inverting the crystal extractor.

5-13. REPLACING CRYSTAL DIODE.

a. Follow instructions given in paragraph 5-10 for proper handling of crystal diodes.

b. Place crystal diode in crystal extractor and screw in the retainer so the crystal is held loosely. Do not tighten the retainer enough to grip the crystal.

c. Insert crystal extractor, making sure the crystal terminal pin enters the socket, then tighten retainer.

d. Crystal extractor (CRYSTAL TUNING) is adjusted for optimum sensitivity during radar test.

e. Replace crystal holder cover.

5-14. TEMPORARY REPLACEMENT OF METER.

5-15. If the output meter in the Echo Box is damaged, a 0-50 microampere meter may be substituted temporarily. This substitution should be made only as an emergency measure and under no circumstances should the reading be permitted to exceed 20 microamperes. Replace with proper meter as soon as possible.

5-16. DEHYDRATOR REPLACEMENT.

5-17. The dehydrator plug is screwed into a bracket on the inside of the carrying case under the panel assembly.

a. Loosen the seven captive screws securing the panel to the case, and lift the panel from the case.

b. Check the crystals in the dehydrator which should be blue in color. If crystals are pink, moisture is present and the dehydrator must be replaced.

c. Remove old dehydrator plug and screw new one in its place.

d. Insert panel back in to carrying case and secure with the seven captive screws.

5-18. LUBRICATION.

5-19. All bearings in the tuning drive mechanism are oilite type bearings and should not require lubrication for the life of the instrument. Lubrication schedule for items or components requiring periodic lubrication are given in the Lubrication Chart, Table IV.

5-20. The oil specified is general purpose, low temperature, lubrication oil, Specification No. AN-0-6a or AN-0-11. The grease to be used is Grease, Low Temperature Lubricating (Low Volatility Type), specification No. AN-G-25. Figure 5-2 shows all lubrication points. The index numbers are correlated with the parts listed in the Lubrication Chart.

5-21. INSPECTION SCHEDULE.

5-22. Periodic inspection of the equipment is not required. Faulty operation of the equipment may be detected during radar tests as indicated in paragraph 5-1.

1. Dial
2. Spur Gear
3. Eccentric
4. Nut
5. Tape Assembly
6. Worm Gear
7. Resonant Cavity
8. Connector
9. Connector
10. Collar
11. Worm
12. Slide Plates
13. Compound Gear Assy
14. Stop Gear Assy
15. Pinion Gear
16. Tuning Knob
17. Dial
18. Screw and Washer
19. Anti-backlash Gear Assy
20. Panel

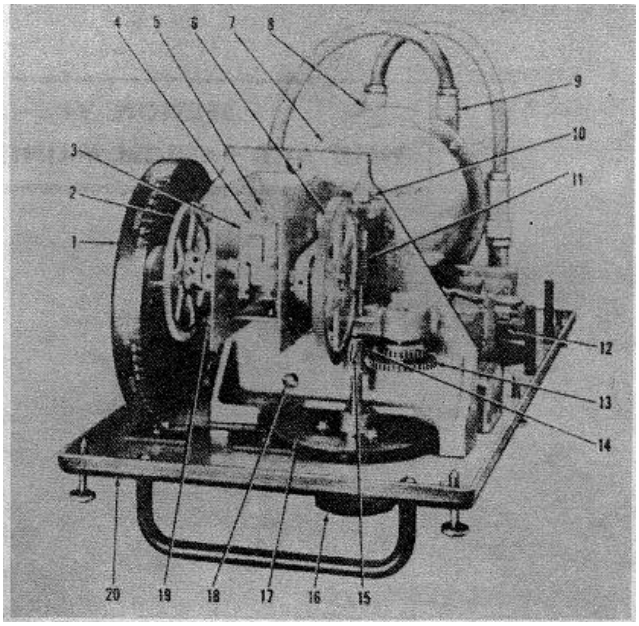
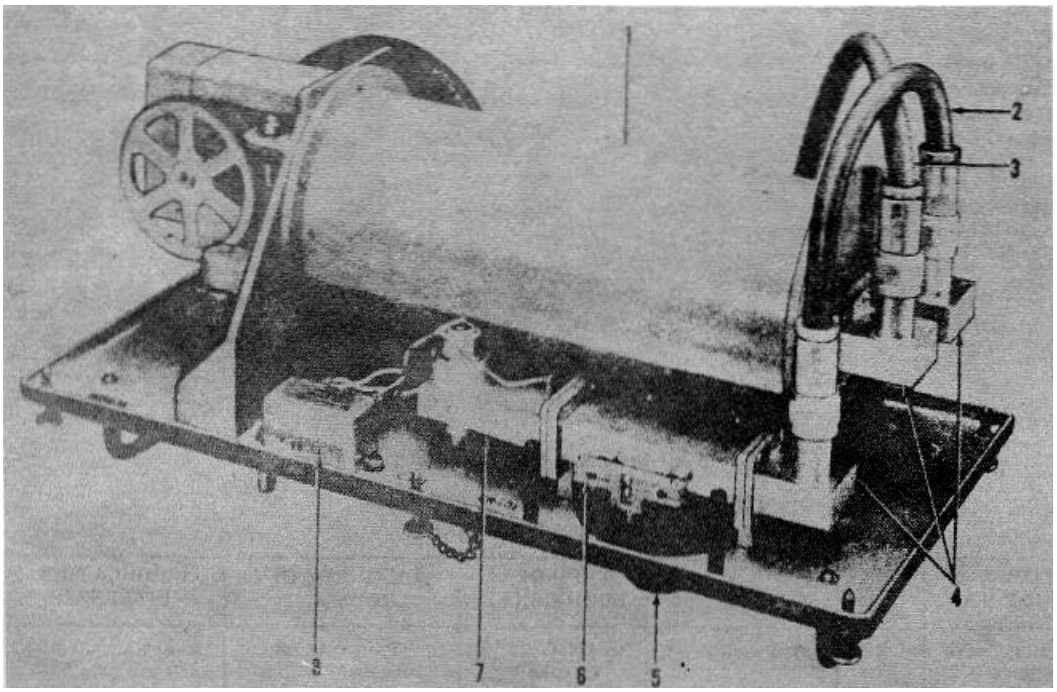


Figure 5-2. Echo Box TS-488A/UP, Tuning Drive

TABLE IV
LUBRICATION CHART

ASSEMBLY & FIGURE NO.	INDEX NO.	PART	TYPE OF LUBRICANT	QUANTITY OF LUBRICANT	LUBRICATION INTERVAL
Tuning Drive (Figure 5-2)	2	Spur Gear	AN-G-25 Grease	Thin coat on teeth	Every six months
	6	Worm Gear	AN-G-25 Grease	Thin coat on teeth	Every six months
	11	Worm	AN-G-25 Grease	Thin coat on working surface	Every six months
	14	Stop Gear	AN-G-25 Grease	Thin coat on teeth	Every six months
	13	Compound Gear	AN-G-25 Grease	Thin coat on teeth	Every six months
	15	Pinion, Gear	AN-G-25 Grease	Thin coat on teeth	Every six months
	19	Anti-backlash Gear	AN-G-25 Grease	Thin coat on teeth	Every six months
		Rubber seal on Tuning Shaft	Dow-Corning DC 4 Grease	Thin coat on shaft	When friction causes backlash
Attenuator (Figure 5-2)	12	Slide Plates	AN-0-11 or AN-0-6a Oil	Small drop between slides	Every six months
		Rubber Seal on Control Shaft	Dow-Corning DC 4 Grease	Thin coat on shaft	When friction causes backlash

SECTION VI
FIELD AND FASRON MAINTENANCE



1. Resonant Cavity
2. Cable Assy
3. Cable Assy
4. Transducer
5. Dial Knob
6. Attenuator
7. Crystal Block
8. Capacitor

Figure 6-1. Echo Box Panel Assembly, Rear View

6-1. GENERAL.

6-2. Because the Echo Box is a calibrated measuring instrument, field maintenance of the equipment is necessarily limited to trouble shooting in the electrical circuits as given in Section V, and replacement of complete assemblies in the wave guide plumbing.

Maintenance personnel should be very careful, when working on the equipment, to avoid disturbing fixed adjustments of any calibrated assembly. If calibration of any part is changed, then the only practical field procedure is to replace the entire assembly with a factory calibrated unit.

6-3. WAVEGUIDE ASSEMBLY. (See figure 6-1.)

6-4. REMOVAL.

a. Remove crystal diode from crystal holder. See instructions paragraph 5-9.

b. Detach cable (2) from the wave guide transducer.

c. Unsolder the red and white wire from the crystal block (7) and the black and white wire from the ground terminal.

d. Remove dial knob (5) by loosening the two set screws which secure it to the shaft.

e. Remove the large nut which holds the crystal holder on the panel.

f. Remove the two screws which secure the wave guide assembly to the front panel and carefully slide wave guide assembly out and away from the panel.

g. Unscrew four screws and detach the transducer from the attenuator.

CAUTION

Do not disassemble the attenuator as it is factory calibrated. If attenuator is damaged or suspected of being off calibration, replace the complete wave guide assembly which is supplied as a spare.

6-5. REPLACEMENT.

a. Reassemble the transducer and crystal block on the attenuator assembly. Apply Glyptal No. 1276 to the heads of the screws before securing them.

b. Replace the complete wave guide assembly carefully and secure the wave guide to the panel. Apply Glyptal No. 1201 to the two screws before tightening them.

c. Replace crystal in the crystal holder using instructions given in paragraph 5-9.

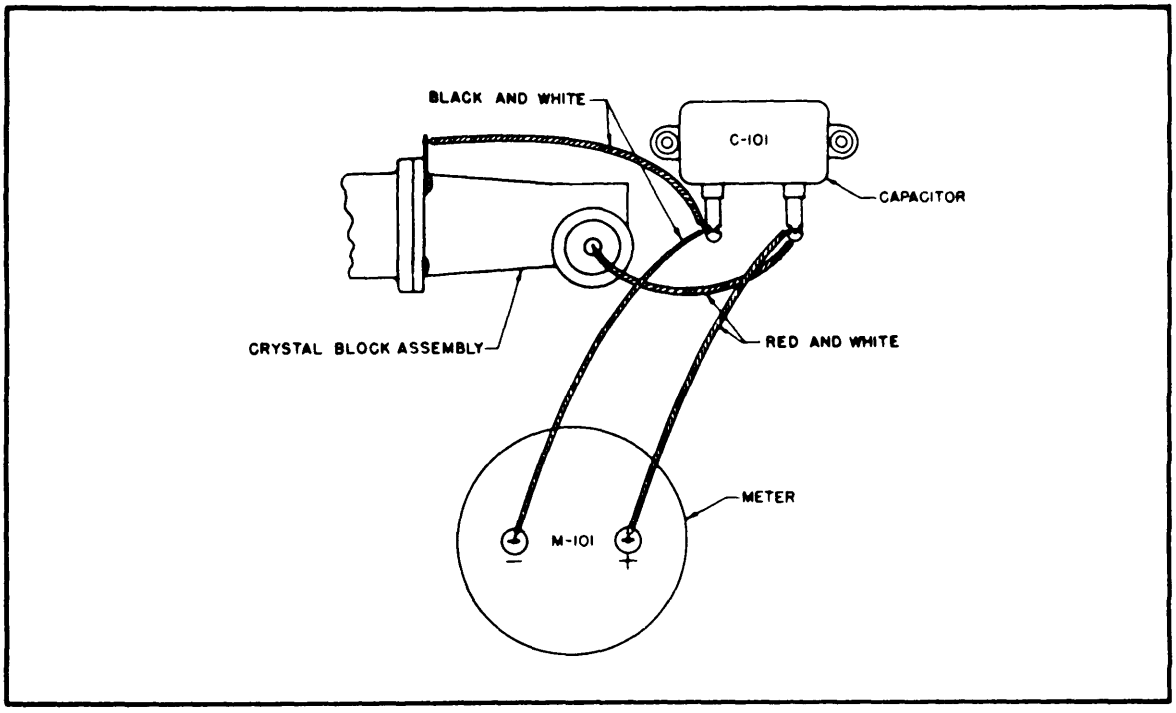
d. Replace dial knob, attach cable to wave guide transducer, and resolder wires in place.

6-6. MINOR TROPICALIZATION.

6-7. Where minor repairs or replacement of components have been made, tropicalization treatment can be done by applying the fungicidal lacquer with a small brush. If fungus growth appears extensively over components of the equipment, it should be thoroughly overhauled and retropicalization performed in accordance with the specifications specified below.

6-8. Refer to specification JAN-C-173 for the proper type of fungus preventive compound and to specification JAN-T-152 for specific instructions for applying the compound for tropicalization of electronic equipment.

SECTION VII
DIAGRAMS



7-1. Echo Box TS-488A/UP Wiring Diagram

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