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

OPERATOR'S, ORGANIZATIONAL

FIELD AND DEPOT MAINTENANCE

TRAINER

RADAR AN/ULT-T2

This copy is a reprint which includes current pages from Changes 1 through 5.

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

A P R I L 1 9 6 0

TABLE OF CONTENTS

SECTION		PAGE
SECTION I	GENERAL DESCRIPTION	1
	1-1. Type of Device	1
	1-3. Application to Training	1
	1-5. Trainer Signal Characteristics	1
	1-7. Physical Aspects	1
	1-12. Equipment Supplied	2
	1-14. Equipment Required But Not Supplied	2
SECTION II	OPERATION	3
	2-1. General	3
	2-3. Trainer Controls, Indicators, and Connectors	3
	2-6. Precautions to be Observed	4
	2-9. Operation of the Equipment	4
	2-16. Internal Adjustments	7
	2-18. Pre-operating Inspection	7
SECTION III	THE DEVICE AS AN AID TO TRAINING	9
	3-1. Training Situations, General	9
	3-4. Use In the Classroom	9
	3-7. Use in the Field	9
	3-14. Placement of the Trainer in the Radar Training Program	10
	3-17. Length of Training Time	10
SECTION IV	PROBLEMS, EXPERIMENTS, DEMONSTRATIONS	11
	4-1. General	11
	4-4. Equipment Preparation	11
	4-7. Drills and Problems	12
	4-12. Poet-demonstration Activities	15
SECTION V	INSTALLATION AND ADJUSTMENTS	16
	5-1. Unpacking the Trainer	16
	5-3. Installation	16
SECTION VI	THEORY OF DEVICE OPERATION	19
	6-1. Functional Operation of the Trainer	19
	6-3. Circuit Analysis	19
	6-4. Rf Section	19
	6-9. Modulator Section	20
	6-10. Introduction	20
	6-11. Sine-wave Generator Circuit	31
	6-12. Wien-bridge Circuit	31
	6-13. Output Signal	21
	6-14. Square-wave Generator	23

TABLE OF CONTENTS (cont)

PAGE

SECTION VI THEORY OF DEVICE OPERATIONS (cont)

6-9. Modulator Section (cont)
6-15. Pulse Generator Circuit 23
6-16. Noise Generator Circuit 23
6-17. Sweeper Circuit 24
6-18. Keyer Section 24
6-20. Audio Amplifier 25
6-22. Power Supply 25

SECTION VII MAINTENANCE 26

7-1. General.
7-2. Equipment Failure 26
7-3. Test Equipment Required 26

7-4. Preventive Maintenance 26
7-7. Cleaning the Trainer 27
7-9. Lubrication 27
7-11. Corrective maintenance 27
7-13. Trouble-shooting 29

7-14. Internal Adjustments 34
7-17. Square-wave Symmetry Adjustment 36
7-18. Sweep Zero Set Adjustment 36
7-19. Sweep Center adjustment 36

7-20. Reflector Voltage Tracking Procedure 36
7-1. Low Limit Control Adjustment 37
7-14. High Limit Control Adjustment 37
7-25. Procedure 37
7-26. Readjustment of Limit Controls 38

7-27. Sweep Amplitude Control 38
7-29. Sweep Time Adjustment 38

SECTION VIII SUPPLEMENTARY DATA 39

8-1. Student Testing and Scoring 39
8-4. Trainer Tube Complement 39

8-5. Component Color Code 40
8-7. Preparing Trainer for Storage 40
8-9. Preparation for Reshipment 40

SECTION IX PARTS LIST AND CATALOG 44

9-1. General 44
9-4. Major Assembly Parts List 44
9-5. Item Number Column 44
9-6. Reference Symbol Number Column or Figure and index Column 44
9-8. Part Name and Description Column 44
9-9. Attaching Part 44

TABLE OF CONTENTS (cont)

PAGE

SECTION IX PARTS LIST AND CATALOG (cont)
9-4. Major Assembly Parts List (cont)
9-10. Prime Contractor's Drawing Number (Part Number) 44
9-11. Government Type Designation Number 44
9-12. Commercial Manufacturer and Catalog Designations 44
9-13. Numerical Parts List 44
9-15. Part Number Column 44
9-16. Manufacturer's Code Column 44
9-17. Item Number Column 44
9-18. Government Stock Number Column 45
9-19. Quantity per Kit 45
9-20. Quantity per Trainer 45
9-21. Reference Symbol Number List 45
9-22. Reference Symbol Number Column 45
9-23. Part Number Column 45
9-24. Item Number Column 45

9-25. How to Find a Part Number 45
9-27. How to Find the Description of a Part 45
9-29. How to Order Repair Parts 45

SECTION X DRAWINGS 113

10-1. Drawings and Photographs 113
10-2. Cabling Diagram 113
10-3. Functional Block Diagram 113
10-4. Schematic Diagram 113
10-5. Alphabetical Index 113

LIST OF ILLUSTRATIONS

FIGURE PAGE

1-1. Radar Signal Interference Trainer (X-Band) Device 15X12 vi
1-2. Trainer Accessories 2

2-1. Radar Signal Interference Trainer, Front Panel 5-6

3-1. Block Diagram Showing Classroom Training, Typical Situation 8

4-1. Normal and Jammed Radar Scope Target Displays 15

LIST OF ILLUSTRATIONS (cont)

FIGURE		PAGE
5-1.	Data Sheet, Installation Standards (sheet 1 of 2)	17
5-1.	Typical Field Installation Standards (sheet 2 of 2)	18
6-1.	Reflex Klystron, Simplified Sectional View	19
6-2.	Reflector Mode, Sine-wave Modulation	20
8-3.	Reflector Mode, Pulse and Square-wave Modulation	20
6-4.	Sine-wave Generator, Simplified Schematic Diagram	21
6-5.	Square-wave Generator, Simplified Schematic Diagram	22
6-6.	Pulse Generator Circuit, Simplified Schematic Diagram	23
6-7.	Noise Generator Circuit, Simplified Schematic Diagram	24
6-8.	Audio Amplifier Circuit, Simplified Schematic Diagram	25
7-1.	Noise Modulation Waveform at J204	33
7-2.	Amplitude Modulation Waveform at J206	33
7-3.	Square-wave Modulation Waveform at J207	33
7-4.	Pulse Modulation Waveform at J208	33
7-5.	Location of Internal Adjustments and Test Jacks	35
7-6.	Modulator Chassis showing Location of Square-wave Symmetry, Sweep Zero Set and Sweep Time Adjustments	36
7-7.	Test Set-up, Reflector Voltage Adjustments	37
7-8.	Typical Mode Trace	37
7-9.	Phase Shifting Network, Schematic Diagram	38
8-1.	Resistor Color Codes	42
8-2.	Capacitor Color Codes	43
10-1.	Trainer Cabling Diagram	114
10-2.	Trainer Less Blower Assembly and Dust Cover, Top View	115
10-3.	Trainer Less Dust Cover, Bottom View	116
10-4.	Trainer Lees Duet Cover, Left Side View	117
10-5.	Trainer Less Dust Cover, Right Side View	118
10-6.	Trainer Less Blower Assembly and Dust Cover, Rear View	119
10-7.	Modulator Chassis, Bottom View (sheet 1 of 2)	120
10-7.	Modulator Chassis, Bottom View (sheet 2 of 2)	121
10-8.	Keyer Chassis, Bottom View	122
10-9.	Keyer Chassis, Oblique View	122
10-10.	Audio Amplifier Chassis, Top View	123
10-11.	Audio Amplifier Chassis, Bottom View	123
10-12.	Power Supply Chassis, Front Top View	124
10-13.	Power Supply Chassis, Rear Top View	124
10-14.	Power Supply Chassis, Bottom View	125
10-15.	Klyztron Tube Mount and Waveguide Assembly	125
10-16.	Front Panel, Rear View	126

LIST OF ILLUSTRATIONS(cont)

FIGURE		PAGE
10-17.	Blower	126
10-18.	Radar Signal Interference Trainer (X-Band) Device 15X12, Simplified Functional Block Diagram	127-128
10-19.	Radar Signal Interference Trainer (X-Band) Device 15X12, Schematic Diagram	129-130

LIST OF TABLES

NUMBER		PAGE
1-1.	Equipment supplied	2
2-1.	Front Panel Control	S
2-2.	Front Panel Indicators and Connectors	4
3-1.	Tactical Situations	10
4-1.	Suggested Procedures for Training Demonstrations	11
4-2.	Drills and Procedure for Fixed Frequency Operation	13
4-3.	Drills and Procedures for Swept Frequency Operation	14
7-1.	Preventive Maintenance Check	26
7-2.	Trouble-shooting Chart	27
7-3.	Voltage and Resistance Measurements	30
7-4.	Power Supply Adjustment	34
8-1.	Trainer Tube Complement	41
9-1.	List of Manufacturers	46
9-1.	List of Major Assemblies	47
9-3.	Major Assembly Parts List	48
9-4.	Numerical Parts List	93
9-5.	Reference Symbol Number List	104

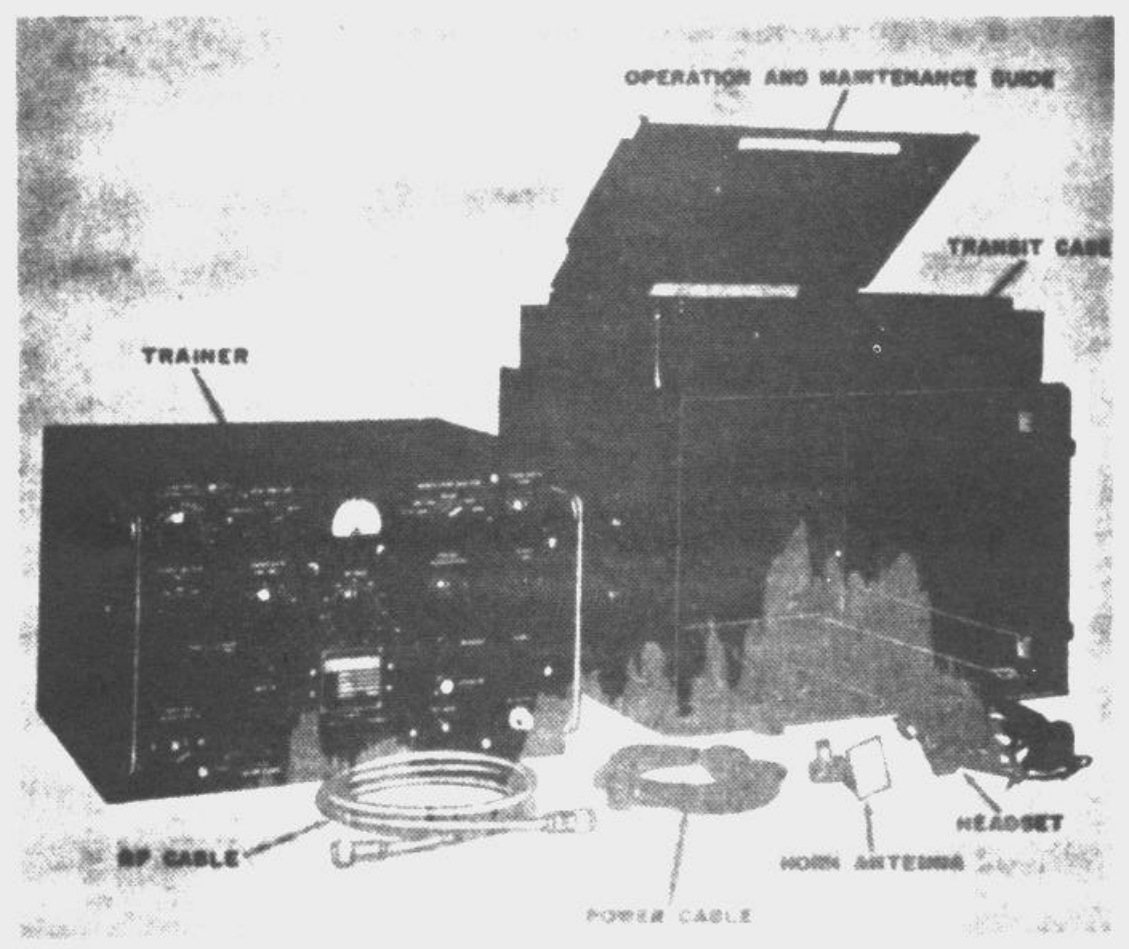

Figure 1-1. Radar Signal Interference Trainer (X-Band) Device 15X12

INTRODUCTION

This guide describes the theory of operation and the procedures necessary to install, operate, maintain and repair Radar Signal Interference Trainer (X-Band) Device 15X12. The trainer is a low power transmitter used to provide various types of interference signals necessary to instruct student radar operators in anti-jamming procedures. This guide also includes material to aid the instructor in utilizing the trainer in the training program.

SECTION I

GENERAL DESCRIPTION

1-1. TYPE OF DEVICE.

1-2. Radar Signal Interference Trainer (X-Band), Device 15X12, Is a low-power radar transmitter capable of generating and transmitting various types of interference signals in the 8500 to 9600 mc radar X-Band. (See figure 1-1.) Device 15X12 (hereafter called the trainer) is designed to operate in conjunction with an X-Band radar and enables an operator to practice anti-jamming techniques. The carrier signal which it transmits can be manually tuned to the frequency of the radar set and modulated in amplitude by a sine wave, square wave, pulse, noise, or modulation from an external source. The signal frequency is variable and can be set to any fixed frequency within the X-Band. A swept signal frequency within the X-Band is also available.

1-3. APPLICATION TO TRAINING.

1-4. The trainer operating controls are calibrated, and thus permit an instructor to re-create identical jamming signals for individual students. The effect of each type of jamming signal on the radar set can be observed, and anti-jamming techniques can thus be practiced and developed.

1-5. TRAINER SIGNAL CHARACTERISTICS.

1-6. The characteristics of the transmitted signal may be adjusted with front panel controls. These characteristics are cw (continuous wave) frequency, sweep rate, sweep sector, percent modulation, type of modulation, and pulse width.

1-7. PHYSICAL ASPECTS.

1-8. Radar Signal Interference Trainer (X-Band) Device 15X12 is manufactured by the Polarad Electronics Corporation, 43-20 34th Street, Long Island City 1, N. Y., under contract number N61339-29.

1-9. The trainer consists of a panel-chassis assembly and blower enclosed in a painted aluminum dust cover. It is stored and carried in a shock-resistant transit case with removable cover. Secured in the transit case cover are the Operation and Maintenance Guide and accessories. The accessories (figure 1-2) consist of a horn antenna, power cable, an rf cable and headset. The trainer, when enclosed in its olive-drab transit case, is carried by means of hinge-type handles located at each side of the case.

1-10. The trainer is made up of five sections: power supply, modulator (containing four modulating signal circuits and a sweeping circuit), rf section (containing a klystron oscillator, tube mount, horn antenna and wave guide), keyer, and audio amplifier.

1-11. The front panel (see figure 2-1)features eleven operating controls which can be used by the Instructor to select the type of interference signal desired. It also mounts receptacles for input power; operating, blower, and spare fuses; and external modulation, rf and audio output connectors.