

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

ORGANIZATIONAL, DIRECT SUPPORT, GENERAL SUPPORT
AND DEPOT MAINTENANCE MANUAL
INCLUDING REPAIR PARTS AND SPECIAL TOOLS LISTS

OSCILLOSCOPES
AN/USM-140B,
AN/USM-140C,
AN/USM-141A,
AND AN/USM-141B

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

HEADQUARTERS, DEPARTMENT OF THE ARMY
MAY 1966

FRONT MATTER

UNCLASSIFIED
NAVSHIPS 95706

Contents

TABLE OF CONTENTS

Paragraph	Page	Paragraph	Page
SECTION A-INTRODUCTION			
A-1. Indexes of publications	1-0.1	3-3. Description of Controls and Connectors ..	3-1
A-2. Forms and records.....	1-0.1	3-4. Operating Precautions	3-1
A-3. Reporting of errors.....	1-0.1	3-5. Operating Procedures	3-1
SECTION 1-GENERAL DESCRIPTION		3-6. Procedure for Turning On Oscilloscope; Compensating Test Prods and Making Initial Electrical Inspection	3-1
1-1. Scope	1-1	3-7. Selecting and Synchronizing the Sweep and Its Magnification	3-1
1-1.1. Items comprising an operable equip- ment	1-1	3-8. Horizontal Deflection by External Signals	3-5
1-2. General Description	1-1	3-9. Dual Trace Operation	3-5
1-3. Description of Units	1-1	3-10. Differential Operation	3-7
a. Oscilloscope OS-121B/USM-140	1-1	3-11. Signal-Sweep Operation	3-7
b. Oscilloscope Subassembly, Vertical Channel, Dual- Trace Preamplifier	1-1	3-12. Operation with Intensity Modulation	3-8
c. Oscilloscope Subassembly, Horizontal Channel, Auxiliary Plug-in Unit	1-1	3-13. Operation with Direct Connection to CRT for Vertical Deflection	3-8
1-4. Reference Data	1-1	3-14. Summary of Operating Procedures	3-8
a. Each Vertical Channel	1-1	3-15. Turn-Off Procedure	3-8
b. Differential Input	1-2	3-16. Operator's Maintenance	3-8
c. Sweep and Synchronization	1-2	3-17. Operating Checks and Adjustment	3-8
d. Horizontal Amplifier	1-2	a. Vertical Sensitivity Check	3-8
e. Calibrator	1-2	b. Balance Check	3-9
f. Cathode Ray Tube	1-2	c. Horizontal Sensitivity Check	3-9
g. Power Requirements	1-2	3-18. Preventive Maintenance	3-9
h. Dimensions	1-2	3-19. Emergency Maintenance	3-9
1-5. Equipment Supplied	1-2	a. Thermal Switch	3-9
1-6. Equipment and Publications Required But Not Supplied	1-2	b. Fuse Replacement	3-9
1-7. Auxiliary Accessory Equipment.....	1-6	c. Emergency Replacement of Tubes and Semiconductors	3-9
1-8. Equipment Similarities.....	1-7, 1-8	SECTION 4-TROUBLE SHOOTING	
1-9. Factory or Field Changes.....	1-7, 1-8	4-1. Introduction	4-1
1-10. Preparation for Reshipment	1-7, 1-8	a. Symptom Recognition	4-1
SECTION 2-INSTALLATION		b. Symptom Elaboration	4-1
2-1. Unpacking and Handling	2-1	c. Determining Probable Faulty Section	4-1
2-2. Power Requirements	2-1	d. Locating the Faulty Circuit	4-1
2-3. Cabinet Model AN/USM-140B Installation	2-2	e. Localizing the Faulty Circuit	4-1
2-4. Rack Model AN/USM-141 Installation	2-2	f. Failure Analysis	4-1
2-5. Cables and Connectors	2-3	g. Test Equipment Required for Trouble Shooting	4-1
a. Power Cable	2-3	4-2. Overall Oscilloscope	4-1
b. Test Prods	2-3	a. Functional Description of Oscilloscope	4-1
2-6. The CRT Bezel, Graticule and Filter	2-4	b. Low-Voltage Power Supplies	4-1
2-7. Initial Electrical Inspection	2-4	c. High-Voltage Power Supplies	4-1
SECTION 3-OPERATION		d. Beam Finder Circuit	4-1
3-1. Functional Operation	3-1	e. Main Vertical Amplifier	4-1
3-2. Preparation for Use	3-1	f. Horizontal Amplifier	4-1
		g. Sweep Generator	4-1
		h. MX-3078/USM Horizontal Plug-In	4-3

TABLE OF CONTENTS (Cont)

SECTION 4 - TROUBLE SHOOTING (Cont)		SECTION 5 - MAINTENANCE	
Paragraph	Page	Paragraph	Page
i. MX-2930B/USM Vertical Plug-In	4-3	5-1. Failure, and Performance and Operational Reports	5-1
j. Calibration Circuit	4-3	5-2. Preventive Maintenance	5-1
4-3. Overall Oscilloscope Trouble Shooting	4-3	a. Servicing the Air Filter	5-1
a. Test Equipment and Special Tools	4-3	b. Fan Motor	5-1
b. Trouble-Shooting Procedure	4-3	5-3. Reference Standards Procedures...	5-1
c. Servicing Block Diagram	4-3	5-4. Adjustments	5-10
4-4. Low-Voltage Power Supply	4-7	a. Low-Voltage Power Supply Adjustment	5-10
a. Low-Voltage Power Supply Functional Description	4-7	b. High-Voltage Power Supply Adjustment	5-10
b. Low-Voltage Power Supply Trouble Shooting	4-7	c. Geometry Adjustment	5-12
4-5. High-Voltage Power Supply	4-15	d. Horizontal Amplifier Adjustment	5-12
a. High-Voltage Power Supply Functional Description	4-15	(1) Balance	5-12
b. High-Voltage Power Supply Trouble Shooting	4-15	(2) Sensitivity	5-12
4-6. Beam Finder Circuit	4-15	(3) Frequency Compensation	5-12
a. Beam Finder Circuit Functional Description	4-15	e. Sweep Generator Adjustment	5-14
b. Beam Finder Circuit Trouble Shooting	4-17	(1) Preset Sensitivity and Trigger Symmetry	5-14
4-7. Main Vertical Amplifier	4-21	(2) Sweep Length and Sweep Rate	5-14
a. Main Vertical Amplifier Functional Description	4-21	f. Main Vertical Amplifier Adjustment	5-15
b. Main Vertical Amplifier Trouble Shooting	4-21	(1) Low Frequency Gain	5-15
4-8. Horizontal Amplifier	4-29	(2) High Frequency Compensation and Pulse Response	5-15
a. Horizontal Amplifier Functional Description	4-29	g. MX-2930B/USM Vertical Plug-In	5-15
b. Horizontal Amplifier Trouble Shooting	4-29	(1) Balance	5-15
4-9. Sweep Generator	4-35	(2) Sensitivity	5-15
a. Sweep Generator Functional Description	4-35	(3) Input Capacitance	5-15
(1) Synchronizing Circuit	4-35	(4) Attenuator Compensation	5-17
(2) Sweep Generator Circuit	4-35	(5) High Frequency Response	5-17
(3) Single Sweep Operation	4-35	(6) Switching Multivibrator Frequency	5-17
b. Sweep Generator Trouble Shooting	4-36	5-5. Replacement of Components	5-17
4-10. Calibrator Circuit	4-41	a. Tubes	5-17
a. Calibrator Circuit Functional Description	4-41	b. Transistors and Diodes	5-17
b. Calibrator Circuit Trouble Shooting	4-41	c. Removal of Cathode Ray Tube	5-19
4-11. MX-2930B/USM Vertical Plug-In Unit	4-42	d. Removal of High-Voltage Power Supply Tubes	5-19
a. MX-2930B/USM Vertical Plug-In Functional Description	4-42	e. Access to Sweep Generator	5-19
(1) Input Attenuators	4-42	f. Component Replacement on Etched Circuit Boards	5-20
(2) Amplifiers	4-42	g. Access to Fan and Power Supply Transistors	5-20
b. MX-2930B/USM Vertical Plug-In Trouble Shooting	4-42	h. Replacement of Horizontal Display Switch Assembly, A200	5-20
		i. Replacement of Sweep Time Switch Assembly, A1000	5-22

SECTION 6--PREVENTIVE MAINTENANCE CHECKS AND SERVICES	
Paragraph	Page
6-1. Scope of Maintenance	6-1
6-2. Preventive Maintenance	6-1
6-3. Preventive Maintenance Checks and Services Periods	6-1
6-4. Daily Preventive Maintenance Checks and Services Chart	6-3
6-5. Weekly Preventive Maintenance Checks and Services Chart	6-4
6-6. Monthly Preventive Maintenance Checks and Services Chart	6-4
6-7. Quarterly Preventive Maintenance Checks and Services Chart	6-5
6-8. Cleaning	6-7
6-9. Touchup Painting Instructions	6-7

Paragraph		Page
APPENDIX	I. References	A1-1
	II. BASIC ISSUE ITEMS LIST (BIIL) and ITEMS TROOP INSTALLED OR AUTHORIZED LIST (ITIAL)	
SECTION	I. Introduction	A2-1
	II. Basic issue items list	A2-2
	III. Items troop installed or au- thorized list (Not appli- cable)	
APPENDIX	III. Maintenance Allocation Chart	A3-1

Change 3 iv.1

LIST OF ILLUSTRATIONS

Figure		Page	Figure		Page
SECTION 1 - GENERAL DESCRIPTION			SECTION 4 - TROUBLE SHOOTING (Cont)		
1-1.	Oscilloscope AN/USM-140B	1-0	4-9.	Horizontal Amplifier Functional and Servicing Block Diagram	4-33, 4-34
SECTION 2 - INSTALLATION			4-10.	Schmitt Trigger Simplified Circuit with Waveforms	4-36
2-0.	Exploded View of Supply Package for AN/USM-140B Oscilloscope	2-0	4-11.	Sweep Generator Functional and Servicing Block Diagram	4-39, 4-40
2-1.	Power Connections for Operating the Oscilloscope on 230-volt Power Line	2-1	4-12.	Construction of Vertical Plug-In Extender 162A-39A	4-44
2-2.	AN/USM-140B Dimensions	2-2	4-13.	Vertical Plug-In Functional and Servicing Block Diagram	4-45, 4-46
2-3.	AN/USM-141 Dimensions	2-3	4-14.	Bottom View, Location of Test Points on Low-Voltage Power Supply	4-47
SECTION 3 - OPERATION			4-15.	Top View, Location of Test Points on High-Voltage Power Supply	4-48
3-1.	Oscilloscope Front-Panel Controls and Connectors	3-2	4-16.	Bottom View, Location of Test Points on Horizontal Pre-amplifier Assembly	4-49
3-2.	Procedure for Turning On Oscilloscope ,Compensating Probe, and Making Initial Electrical Inspection	3-4	4-17.	Top View, Location of Test Points on Main Horizontal Amplifier and Divider Assembly	4-50
3-3.	Selecting and Synchronizing the Sweep and Sweep Magnifications .	3-6	4-18.	Bottom View, Location of Test Points on Sweep Generator Assembly	4-51
SECTION 4 - TROUBLE SHOOTING			4-19.	Top View, Location of Test Points on Main Vertical Amplifier Assembly	4-52
4-1.	Overall Functional Block Diagram ..	4-2	4-20.	Fan Shroud and Power Transistor Assembly, Location of Test Points and Connections	4-53
4-2.	Overall Servicing Block Diagram	4-6	4-21.	Left Side View of MX-2930B/USM Vertical Plug-In Assembly, Location of Test Points	4-54
4-3.	Low-Voltage Power Supply Functional and Servicing Block Diagram	4-13, 4-14	4-22.	Right Side View of MX-2930B/USM, Location of Test Points	4-54
4-4.	High-Voltage Power Supply Functional and Servicing Block Diagram	4-19, 4-20			
4-5.	Simplified Schematic Diagram of the Beam Finder Circuit	4-18			
4-6.	Cascode Amplifier/Simplified Schematic Diagram and Cross-Coupled Cathode Follower	4-22			
4-7.	Constant Current Generator Simplified Schematic Diagram	4-23			
4-8.	Main Vertical Amplifier Functional and Servicing Block Diagram	4-27, 4-28			

LIST OF ILLUSTRATIONS (Cont)

Figure		Page	Figure		Page
SECTION 5 - MAINTENANCE			SECTION 5 - MAINTENANCE (Cont)		
5-1.	Main Vertical Amplifier Test Connector	5-2	5-25.	Calibrator Switch Assembly, Location of Parts	5-41
5-2.	Location of Low-Voltage Power Supply Adjustments	5-10	5-26.	High-Voltage Power Supply Etched Circuit Assembly, Location of Parts	5-43
5-3.	Top View, Location of Adjustments	5-11	5-27.	High Voltage Distribution Etched Circuit Assembly, Location of Parts	5-45
5-4.	Bottom View, Location of Adjustments	5-13	5-28.	Low Voltage Rectifier Etched Circuit Assembly, Location of Parts	5-46
5-5.	Location of Adjustments in MX-2930B/USM	5-16	5-29.	Low Voltage Regulator Amplifier Etched Circuit Assembly, Location of Parts	5-47, 5-48
5-6.	Top and Bottom Views, Location of Electron Tubes	5-18	5-30.	MX-2930B/USM, Location of Parts	5-49
5-7.	Removal of Cathode-Ray Tube	5-19	5-31.	MX-2930B/USM Dual Channel Vertical Amplifier Etched Assembly, Location of Parts	5-51
5-8.	Wiring Between Switch S202 and Etched Circuit Board A201	5-20	5-32.	MX-2930B/USM Vertical Switching Etched Circuit Assembly, Location of Parts	5-53
5-9.	Top View, Location of Parts	5-24	5-33.	MX-2930B/USM Vernier/ Sensitivity Switch Assembly, Location of Parts	5-54
5-10.	Bottom View, Location of Parts	5-25	5-34.	MX-2930B/USM Vertical Presentation Switch Assembly, Location of Parts	5-55
5-11.	Right-Side View, Location of Parts	5-26	5-35.	MX-2817/U Test Prod, Location of Replaceable Parts	5-56
5-12.	Left-Side View, Location of Parts	5-27	5-36.	MX-3078/USM Horizontal Auxiliary Plug-In Unit, Location of Parts	5-57
5-13.	Front-View, Location of Parts	5-27	5-37.	Main Vertical Amplifier Schematic Diagram	5-59, 5-60
5-14.	Main Vertical Input Amplifier and Internal Sync Source Etched Circuit Assembly, Location of Parts	5-29	5-38.	Sweep Generator Schematic Diagram	5-61, 5-62
5-15.	Main Vertical Amplifier and Driver Etched Circuit Assembly	5-31	5-39.	Sweep-Time Switch, Functional Schematic Diagram	5-63, 5-64
5-16.	Scanner Output Etched Circuit Assembly, Location of Parts	5-32	5-40.	Sweep-Time Switch, Wiring Diagram	5-65, 5-66
5-17.	Sweep Generator Etched Circuit Assembly, Location of Parts	5-33	5-41.	Horizontal Amplifier Schematic Diagram	5-67, 5-68
5-18.	Sweep Time Switch Assembly, Location of Parts	5-34	5-42.	Horizontal Display Switch Schematic Diagram	5-69, 5-70
5-19.	Sweep Mode/Trigger Source Switch Assembly, Location of Parts	5-34	5-43.	High-Voltage Power Supply and Calibrator Schematic Diagram	5-71, 5-72
5-20.	Trigger Level/Trigger Slope Switch Assembly, Location of Parts	5-34	5-44.	Low-Voltage Power Supply Schematic Diagram	5-73, 5-74
5-21.	Ext. Vernier/Horizontal Display Switch Assembly, Location of Parts	5-35, 5-36	5-45.	Electron Tube Heater Circuit, Functional Diagram	5-57, 5-75
5-22.	Horizontal Sensitivity Adjustment Etched Circuit Assembly, Location of Parts	5-37	5-46.	MX-2930B/USM Dual-Trace Preamplifier Schematic Diagram	5-77, 5-78
5-23.	Main Horizontal Amplifier and Driver Etched Circuit Assembly, Location of Parts	5-39, 5-40			
5-24.	Horizontal Impedance Matching Preamp Etched Circuit Assembly, Location of Parts	5-41			

LIST OF ILLUSTRATIONS (Cont)

Figure	Page	Figure	Page
SECTION 5 - MAINTENANCE (Cont)		SECTION 5 - MAINTENANCE (Cont)	
5-47. MX-3078/USM Horizontal Channel Auxiliary Plug-In Unit Schematic Diagram	5-79	5-48. Connections to the Horizontal and Vertical Plug-In Connectors J105 and J1	5-80
LIST OF TABLES			
Table	Page	Table	Page
SECTION 1 - GENERAL DESCRIPTION		SECTION 5 - MAINTENANCE	
1-1. Equipment Supplied with Oscilloscope AN/USM-140B	1-3	5-1. Reference Standards Procedures	5-2
1-2. Equipment and Publications Required but not Supplied	1-4	5-2. Test Equipment for Reference Standards Procedures	5-2
1-3. Accessories for Oscilloscope AN/USM-140B	1-7, 1-8	5-3. Power Supply Reference Standards Procedures	5-3
SECTION 3 - OPERATION		5-4. Calibrator Reference Standards Procedures	5-4
3-1. Description of Front-Panel Controls and Connectors	3-2	5-5. Horizontal Amplifier Reference Standards Procedures	5-5
3-2. Procedure for Turning On Oscilloscope and Preparing it for Use	3-4	5-6. Sweep Generator Reference Standards Procedures	5-6
3-3. Selecting and Synchronizing the Sweep and Sweep Magnification ...	3-6	5-7. Main Vertical Amplifier Reference Standards Procedures	5-7
3-4. Adjustments Required Following Tube and Semiconductor Replacement	3-10	5-8. MX-2930B/USM Vertical Plug-In..... Reference Standards Procedures	5-7 5-8
SECTION 4 - TROUBLE SHOOTING		5-9. Test Equipment for Adjustment Procedures Reference Standards Procedures	5-10
4-1. Test Equipment Required for Trouble Shooting	4-3	5-10. Sweep Calibration Reference Standards Procedures	5-14
4-2. Overall Oscilloscope Trouble Shooting	4-4	SECTION 6 - PARTS LIST	
4-3. Low-Voltage Power Supply Trouble Shooting	4-8	6-1. List of Units	6-1
4-4. High-Voltage Power Supply Trouble Shooting	4-16	6-2. Maintenance Parts List	6-2
4-5. Main Vertical Amplifier Trouble Shooting	4-23	6-3. List of Manufacturers	6-27
4-6. Horizontal Amplifier Trouble Shooting	4-30		
4-7. Sweep Generator Trouble Shooting	4-37		
4-8. Calibrator Circuit Trouble Shooting	4-41		

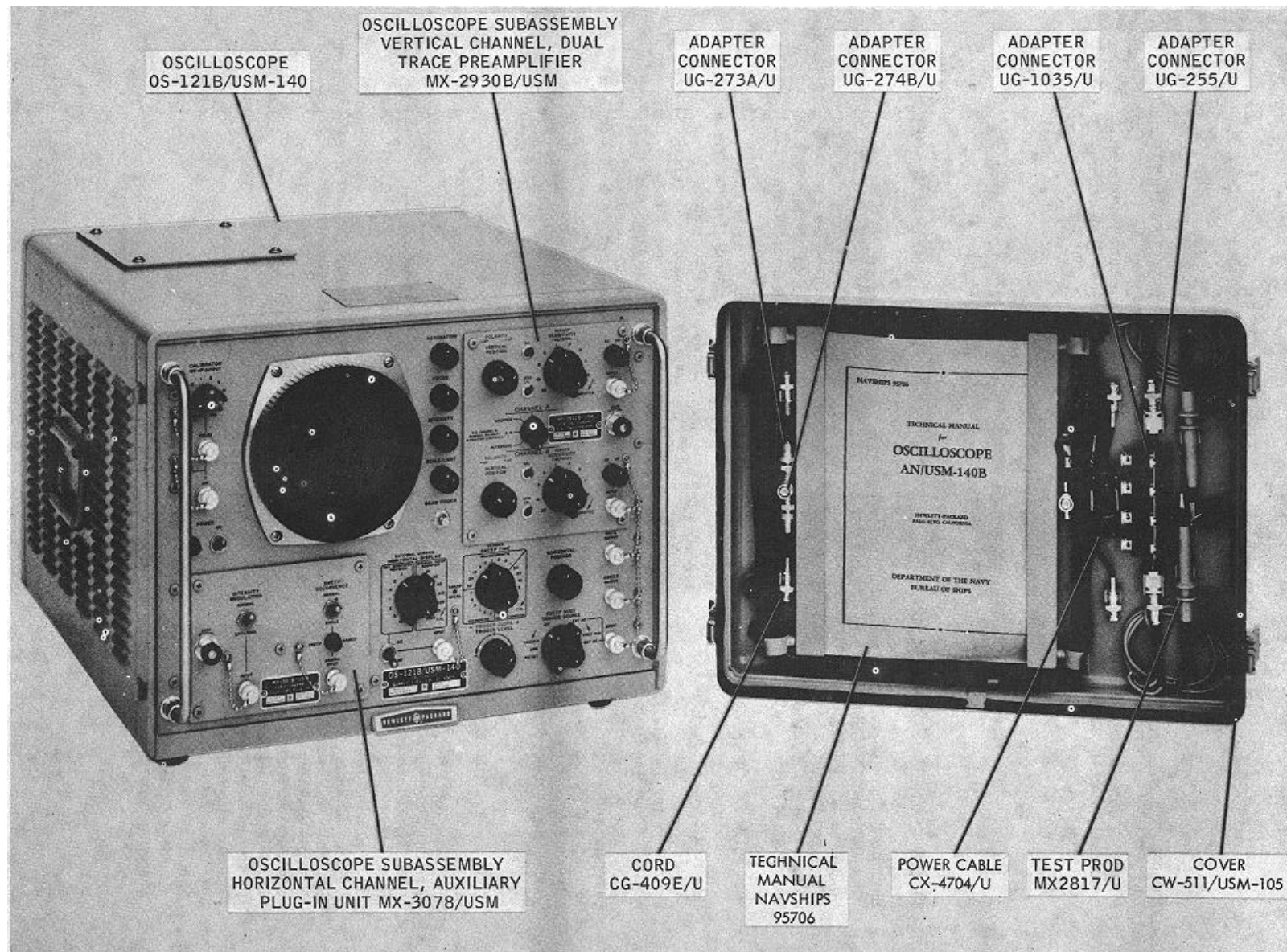


Figure 1-1. Oscilloscope AN/USM-140B

SECTION A INTRODUCTION

A-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 Form 310-7*. Refer to DA Pam 310-7 to determine whether there are modification work orders (MWO's) pertaining to the equipment.

A-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 yard 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.

A-3. Reporting of Errors

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 Publication and Blank Forms) and forwarded direct to Commander, UIS Army Electronics Command, ATTN: AMSEL-MA-C, Fort Monmouth, NJ 07703.

Change 3 1-0.1

AN/USM-140B
GENERAL DESCRIPTION

UNCLASSIFIED
NAVSHIPS 0967-133-7010

SECTION I GENERAL DESCRIPTION

1-1. SCOPE

NAVSHIPS 95706 is a single-volume technical manual that includes operating and servicing instructions and a list of replaceable parts prepared in accordance with MIL-M-15071 E (SHIPS) for Oscilloscopes AN/USM-140B, AN/USM-140C, AN/USM-141A, and AN/USM-141B. The electrical specifications, operating and servicing instructions, schematic diagrams and parts list are identical for all models with noted exceptions. The AN/USM-140B and AN/USM-140C are portable models for benchtop use; the AN/USM-141A and AN/USM-141B are designed for permanent installation in a standard 19-inch wide rack. No other publications are required or supplied for these oscilloscopes at the date of this publication. Subsequent references to the Oscilloscopes in this manual will list only the cabinet model AN/USM-140B except to indicate minor differences in details.

1-1.1. Items Comprising an Operable Equipment

<i>FSN</i>	<i>Qty</i>	<i>Nomenclature</i>
6625-987-6603		Oscilloscope AN/USM-140B consisting of:
6625-400-2681	1	Oscilloscope OS-121B/USM-140
	1	Preamplifier, Dual Trace MX-2930B/USM (Plugged into OA-121/USM-140)
6625-961-5888	1	Auxiliary Plug-In MX-3078/USM (Plugged into OS-121/USM-140)
6625-973-4775	2	Prod, Test MX-4073/U (Mounted in equipment)
5935-823-0639	2	Connector, Adapter UG-255A/U (Mounted in equipment)
5935-149-3534		Connector, Adapter UG-273/U (Mounted in equipment)

<i>FSN</i>	<i>Qty</i>	<i>Nomenclature</i>
5995-985-7744		Cable Assembly, Power, Electrical CX-4704/U (8 ft 0 in.) (Mounted in equipment)
5995-752-8781	2	Cord CG-409F/U (Mounted in equipment)
5935-683-7892	2	Connector, Adapter: MIL type MS35173-274B (Mounted in equipment)
4935-992-6112	4	Adapter, Connector UG-1441/U

1-2. General Description

The AN/USM-140B is a precision high-speed oscilloscope for displaying the waveforms of electrical voltages at frequencies ranging from direct current to 22 megacycles (equivalent to a risetime of 16 nanoseconds). Vertical deflection sensitivity is continuously adjustable from 200 volts to 20 millivolts per centimeter; horizontal deflection sensitivity is continuously adjustable from 100 volts to 0.1 volt per centimeter at frequencies from direct current to 1 megacycle per second. Sweep rates are continuously adjustable from 15 seconds to 0.1 microsecond per centimeter. The sweep can be synchronized with an external signal or with the signal being viewed. Polarity and sensitivity of the synchronization are selectable to permit synchronization from different voltage points on complex waveforms. The AN/USM-140B is especially developed for general-purpose use in US Navy ship and shore electronic maintenance and research facilities. It is designed for versatility, and reliability under a wide range of environmental conditions, combined with wide frequency range, accurate calibration, and stable synchronization at high sweep rates. Sweep rate, sweep expansion and sensitivity controls are direct-reading. Each calibrated step-type control is equipped with a potentiometer to give

Change 3 1-1