TM 11-5805-451-15

TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL, DS, GS, AND DEPOT MAINTENANCE MANUAL

FOR

PHILCO EXPRESS ORDERWIRE MULTIDIRECTION HUT

HEADQUARTERS, DEPARTMENT OF THE ARMY
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Technical Manual)

HEADQUARTERS

DEPARTMENT OF THE ARMY

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OPERATOR, ORGANIZATIONAL, DS, GS, AND DEPOT MAINTENANCE MANUAL

PHILCO EXPRESS ORDERWIRE MULTIDIRECTION UNIT

TABLE OF CONTENTS (Continued)

This technical manual is an authentication of the manufacturer's commercial literature and does not conform with the format and content specified in AR 310-3, Military Publications. This technical manual does, however, contain available information that is essential to the operation and maintenance of the equipment.

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION 1

INTRODUCTION

1.A1. Scope.

This manual describes the Philco Express Orderwire Multidirection Unit. It covers operation, and organizational, direct and general support, and depot maintenance.

1.A2. Indexes of Equipment 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.

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

1.1. Forms and Records.

g. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions given in TM 38-750.

2. Report of Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Report of Packaging and Handling Deficiencies) as prescribed in AR 700-58 (Army)/NAVSUP PUB 378 (Navy)/AFR 71-4 (Air Force)/ and MCO P4030.29 (Marine Corps).

c. Discrepancy in Shipment Report (DISREP) (SF361). Fill out and forward Discrepancy in Shipment Report (DISREP) (SF361) as prescribed in AR 55-38 (Army)/NAVSUP PUB 459 (Navy)/AFM 75-34 (Air Force)/ and MCO P4610.19 (Marine Corps).

d. Reporting of Equipment Manual Improvements. Report 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 DA Publications) and forwarded direct to Commanding General, U.S. Army Electronics Command, ATTN: AMSEL-ME-NMP-EM, Fort Monmouth, N.J. 07703.

1.2 PURPOSE AND FUNCTION OF EQUIPMENT

The Express Orderwire Multidirection Unit, shown in figure l-l, provides facilities for multipoint conference connection of the express orderwire circuits while maintaining separation between the transmit and receive legs of the circuits. The interconnections are accomplished in four-way, four-wire hybrids, and associated amplifiers and attenuators are used to provide the gains and losses required to match external circuit level requirements. The Express Orderwire Multidirection Unit allows construction of a multipoint, four-wire orderwire circuit with all users having full-time talk and receive capability. Strapping options of the Express Orderwire Multidirection Unit allow the Express Orderwire Unit to be connected to as many as nine voice-frequency (VF) paths and/or radio circuits.

1.3 PHYSICAL DESCRIPTION

The Express Orderwire Multidirection Unit is a solid-state device, designed for mounting in a standard 19-inch equipment rack. The unit consists of a metal mounting shelf equipped with as many as 17 plug-in printed wiring board assemblies. A hinged cover plate is installed on the front of the unit. See figure 1-2.

The unit is approximately 3-1/2 inches high, 19 inches wide, and 12-1/4 inches deep. The assembly weighs approximately 8 pounds when equipped with a full complement of plug-in assemblies. All input and output signal connections are made to solderless terminals on barrier-type terminal strips at the rear of the unit. The unit contains no mechanical assemblies and therefore requires no lubrication.

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Figure l-l. Express Orderwire Multidirection Unit

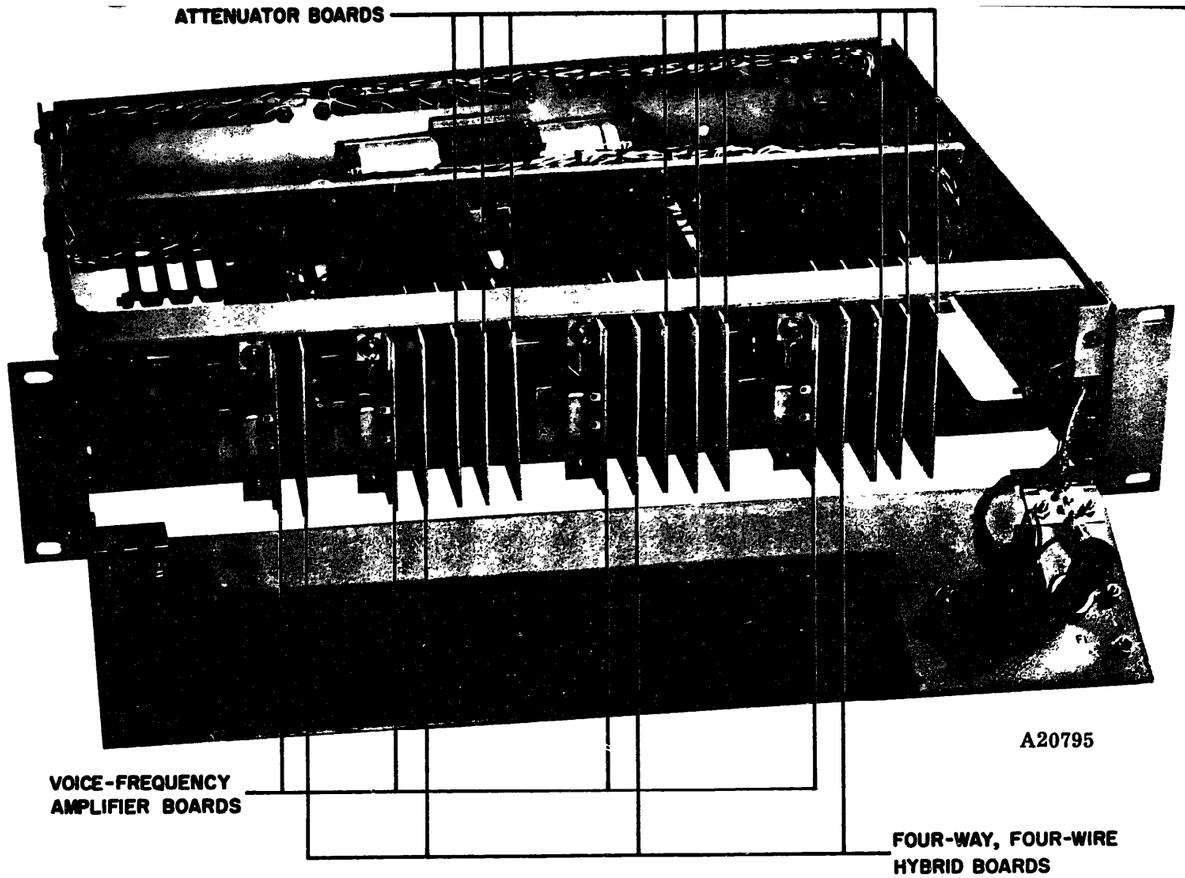


Figure 1-2. Express Orderwire Multidirection Unit, Showing Mounting of Printed Wiring Boards

The unit employs three types of printed wiring plug-in boards, consisting of four-way, four-wire hybrid, attenuator, and voice-frequency amplifiers boards.

1.4 TECHNICAL CHARACTERISTICS

Table 1-1 lists the technical characteristics of the Express Orderwire Multi-direction Unit.

TABLE 1-1. TECHNICAL CHARACTERISTICS

Environmental	
Operating Temperature	0 to 55°C
Relative Humidity	30 to 95%
Altitude	
Storage	30,000 ft
Operating	5,000 ft
Power Source	48 Vdc ±10%, 2 mV ripple
Power Consumption	44 mA per voice-frequency amplifier board
Printed Wiring Board Characteristics	
Voice-Frequency Amplifier Board (368-91965)	
Quantity.	4, max
Circuits.	2 per board
Input and Output Impedance	600 ohms &lo%, balanced
Input Signal Level	-40 to -0 dBm
Output Signal Level	+10 dBm, max
Gain	0 to 30 dB, continuously adjustable within ±0.5 dB
Crosstalk	-70 dB, max
Signal-to-Noise	70 dB below maximum output level

TABLE 1-1. TECHNICAL CHARACTERISTICS (Cont)

Printed Wiring Board Characteristics (Cont)	
Voice-Frequency Amplifier Board (368-91965) (Cont)	
Frequency Response	±1 dB from 300 Hz to 12 kHz ±1/2 dB from 300 Hz to 3.4 kHz
Distortion	Less than 2% at 10 dBm output Less than 1% at 0 dBm output
Four-Way, Four-Wire Hybrid Board (368-41964)	
Quantity	4, max
Circuits	1 per board
Input and Output Impedance	600 ohms ±10%, balanced
Input Signal Level	+7 dBm, max
Insertion Loss	
Nonassociated Input and Output	-15.0 ±0.5 dB
Associated Input and Output	-80 dB, min
Input to Input	-65 dB
Attenuator Board (368.42056)	
Quantity	9, max
Attenuator	0 to 31 dB in 1.0-dB steps, adjustable by strapping

1.5. Items Comprising an Operable Equipment

FSN	Item	Quantity	Height (in)	Depth (in)	Width (in)	Weight (lb)
5805-935-0046	Express Orderwire Multi-direction Unit- 3 Directions		3-1/2	12-1/4	19	Approx 8
	Four-way, Four-wire Hybrid Board	1				
	Five-pad Attenuator Board	3				
5805-935-0047	Express Orderwire Multi-direction Unit- 5 Directions		3-1/2	12-1/4	19	Approx.8
	Voice-Frequency Amplifier board	1				
	Four-way, Four-wire Hybrid Board	2				
	Five-pad Attenuator Board	5				
5805-936-5417	Express Orderwire Multi-direction Unit-7 direction		3-1/2	12-1/4	19	Approx 8
	Voice-Frequency Amplifier Board	2				
	Four-way, Four-wire Hybrid Board	3				
	Five-pad Attenuator Board	7				

SECTION 2

INSTALLATION INSTRUCTIONS

2.1 GENERAL

This section contains instructions for installing the Express Orderwire Multi-direction Unit, including locating and mounting instructions and electrical connections for the equipment.

2.2 SPECIAL TOOLS REQUIRED

No special tools are required for installing the unit.

2.3 mATDIG AND MOUNTING

2.3.1 Locating

The location of the unit will vary depending upon the requirements of the particular station.

2.3.2 Mounting

The unit is designed for mounting in a standard 19-inch equipment rack. Install the unit in the assigned rack space, and secure with the four front-panel mounting screws.

2.4 ELECTRICAL CONNECTIONS

-48 Vdc power is connected to TB7 terminals 1 (-) and 2 (+). All voice-frequency input and output connections are made to solderless connectors on barrier-type terminal strips at the rear of the assembly. (See figure 2-1.) Strapping for changing the number of outputs is also accomplished at these barrier strips. Tables 2-1 and 2-2 give the printed wiring board complement and strapping options, respectively. Strapping information for the adjustable attenuator boards is given in figure 7-4.

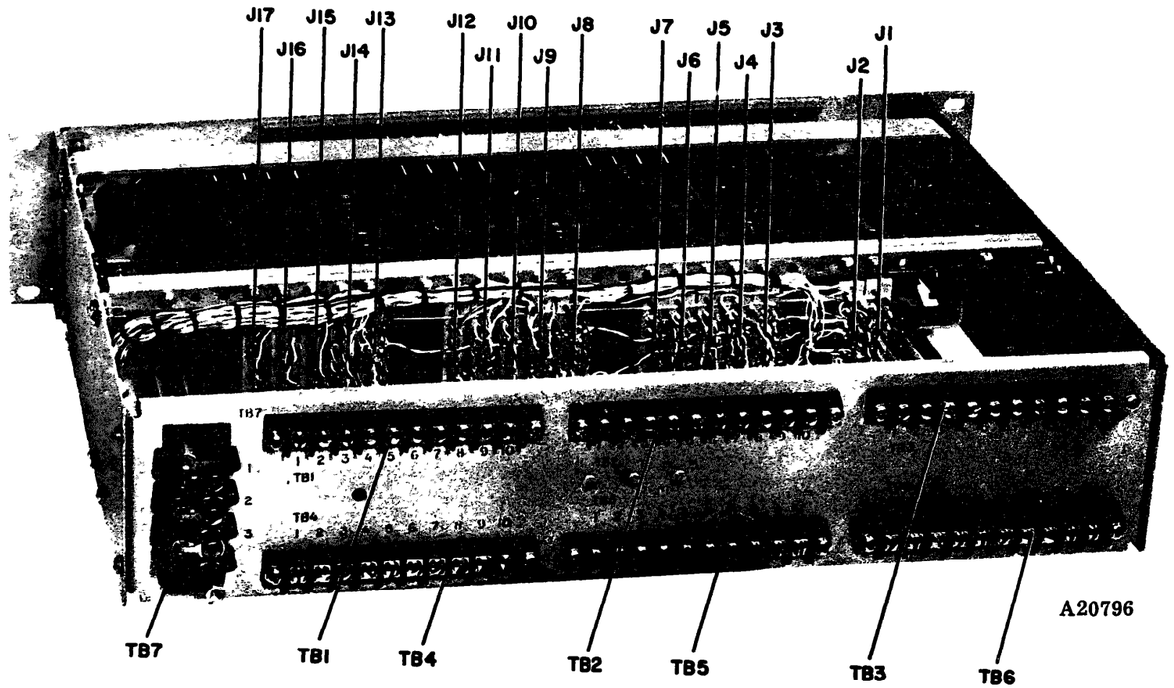


Figure 2-1. **Express** Orderwire Multidirection Unit, Rear View

TABLE 2-1. PRINTED WIRING BOARD COMPLEMENT

TYPE OF DATA	NO. DIRECTIONS							
	2	3	4	5	6	7	8	9
VOICE-FREQUENCY AMPLIFIER BOARD (PART NO. 368-41965)								
No.Boards Req	0	0	1	1	2	2	3	3
Ref Desig	-	-	AR2	AR2	AR2,3	AR2,3	AR2,3,4	AR2,3,4
Assoc Connectors*	-	-	J3	J3	J3, 8	J3, 8	J3, 8, 13	J3, 8, 13
FOUR-WAY, FOUR-WIRE HYBRID BOARD (PART NO. 368-41964)								
No. Boards Req	1	1	2	2	3	3	4	4
Ref Desig	A1	A1	A1, 2	A1, 2	A1,2,3	A1,2,3	A1,2,3,4	A1,2,3,4
Assoc Connectors*	J2	J2	J2, 4	J2, 4	J2,4,9	J2,4,9	J2,4,9, 14	J2,4,9, 14
FIVE-PAD ATTENUATOR BOARD (PART NO. 368-42056)								
No.Boards Req	2	3	4	5	6	7	8	9
Ref Desig	AT7, 8	AT7,8,9	AT1,2,3, 9	AT1,2,3, 8, 9	AT1,2,3, 4, 5, 6	AT1,2,3, 4, 5, 6, 9	AT1,2,3, 4, 5, 6, 7, 8	AT1,2,3, 4, 5, 6, 7, 8, 9
Assoc Connectors*	J15, 16	J15, 16, 17	J5, 6, 7, 17	J5, 6, 7, 16, 17	J5, 6, 7, 10, 11, 12	J5, 6, 7, 10, 11, 12, 17	J5, 6, 7, 10, 11, 12, 15, 16	J5, 6, 7, 10, 11, 12, 15, 16, 17

* The associated connectors are listed in the same respective order as the reference designations; for empIe, in a 6-direction unit, attenuator board AT3 plugs into connector J7.

TABLE 2-2. STRAPPING CHART

	2 DIRECTION	3 DIRECTION	4 DIRECTION	5 DIRECTION	6 DIRECTION	7 DIRECTION	8 DIRECTION	9 DIRECTION
Strapping Instructions	TB4-3 to TB4-1 TB4-4 to TB4-2 TB1-1 to TB4-5 TB1-2 to TB4-6	TB4-3 to TB4-1 TB4-4 to TB4-2 TB1-1 to TB4-5 TB1-2 to TB4-6 TB4-7 to TB4-9 TB4-8 to TB4-10	TB4-7 to TB4-9 TB4-8 to TB4-10	TB1-1 to TB4-5 TB1-2 to TB4-6 TB4-7 to TB4-9 TB4-8 to TB4-10		TB4-7 to TB4-9 TB4-8 to TB4-10		
600-Ohm Termination	TB4-7 & 8 TB1-9 & 10	- -	TB1-1 & 2 TB1-5 & 6	- -	TB4-7 & 8 TB1-9 & 10	- -	TB2-9 & 10 TB5-9 & 10	- -
Input From Express Orderwire	TB6-1& 2	TB6-1 & 2	TB6-1 & 2	TB6-1 & 2	TB6-1 & 2	TB6-1 & 2	TB6-1 & 2	TB6-1 & 2
Output to Express Orderwire	TB3-1 & 2	TB3-1 & 2	TB3-1 & 2	TB3-1 & 2	TB3-1 & 2	TB3-1 & 2	TB3-1 & 2	TB3-1 & 2

TABLE 2-2. STRAPPING CHART (Cont)

	2 DIRECTION	3 DIRECTION	4 DIRECTION	5 DIRECTION	6 DIRECTION	7 DIRECTION	8 DIRECTION	9 DIRECTION
Input Direction #1	TB1-7 & 8	TB1-7 & 8	TB3-3 & 4	TB3-3 & 4	TB3-3 & 4	TB3-3 & 4	TB3-3 & 4	TB3-3 & 4
Output Direction #1	TB5-5 & 6	TB5-5 & 6	TB6-3 & 4	TB6-3 & 4	TB6-3 & 4	TB6-3 & 4	TB6-3 & 4	TB6-3 & 4
Input Direction #2	TB1-5 & 6	TB1-5 & 6	TB3-5 & 6	TB3-5 & 6	TB3-5 & 6	TB3-5 & 6	TB3-5 & 6	TB3-5 & 6
Output Direction #2	TB5-7 & 8	TB5-7 & 8	TB6-5 & 6	TB6-5 & 6	TB6-5 & 6	TB6-5 & 6	TB6-5 & 6	TB6-5 & 6
Input Direction #3		TB1-9 & 10	TB3-7 & 8	TB3-7 & 8	TB3-7 & 8	TB3-7 & 8	TB3-7 & 8	TB3-7 & 8
Output Direction #3		TB5-9 & 10	TB6-7 & 8	TB6-7 & 8	TB6-7 & 8	TB6-7 & 8	TB6-7 & 8	TB6-7 & 8
Input Direction #4			TB1-9 & 10	TB1-9 & 10	TB3-9 & 10	TB3-9 & 10	TB3-9 & 10	TB3-9 & 10
Output Direction #4			TB5-9 & 10	TB5-9 & 10	TB6-9 & 10	TB6-9 & 10	TB6-9 & 10	TB6-9 & 10
Input Direction #5				TB1-5 & 6	TB2-1 & 2	TB2-1 & 2	TB2-1 & 2	TB2-1 & 2
Output Direction #5				TB5-7 & 8	TB5-1 & 2	TB5-1 & 2	TB5-1 & 2	TB5-1 & 2
Input Direction #6					TB2-3 & 4	TB2-3 & 4	TB2-3 & 4	TB2-3 & 4
Output Direction #6					TB5-3 & 4	TB5-3 & 4	TB5-3 & 4	TB5-3 & 4

TABLE 2-2. STRAPPING CHART (Cont)

	2 DIRECTION	3 DIRECTION	4 DIRECTION	5 DIRECTION	6 DIRECTION	7 DIRECTION	8 DIRECTION	9 DIRECTION
Input Direction #7 Output Direction #7						TB1-9 & 10 TB5-9 & 10	TB2-5 & 6 TB5-5 & 6	TB2-5 & 6 TB5-5 & 6
Input Direction #8 Output Direction #8							TB2-7 & 8 TB5-7 & 8	TB2-7 & 8 TB5-7 & 8
Input Direction #9 Output Direction #9								TB2-9 & 10 TB5-9 & 10

SECTION 3

OPERATING INSTRUCTIONS

3.1 GENERAL

This section contains instructions for operating the Express Orderwire Multi-direction Unit, including starting, operating, and stopping procedures. A functional description of the controls and indicators is also given.

3.2 CONTROLS AND INDICATORS

The controls and indicators associated with the operation of the Panel are as follows :

a. POWER switch

Controls the application of -48 Vdc power to the unit.

b. Power lamp

Illuminates to indicate that -48 Vdc power is applied to the unit.

c. Fuse

Provides overload protection for the power supply of the unit.

3.3 OPERATION

3.3.1 Starting Procedure

To place the unit in operation, set the POWER switch to the ON position. The power lamp illuminates to indicate application of -48 Vdc.

3.3.2 Operating Procedure

The unit is an automatic device; therefore, no operating procedures are required.

3.3.3 Stopping Procedure

To stop the unit, set the POWER switch to the OFF position. The power lamp extinguishes to indicate the removal of -48 Vdc.

SECTION 4

FUNCTIONAL DESCRIPTION

4.1 GENERAL

The Express Orderwire Multidirection Unit is a four-wire conference bridging device which can be used to connect the Express Orderwire Unit to a maximurn of nine points in a common voice-frequency path. It provides all points on the common voice path with full-duplex, two-way capability, while maintaining isolation between the transmit and receive paths. A block diagram of the equipment is shown in figure 4-1, and a brief functional description is provided in paragraph 4.2.

4.2 FUNCTIONAL DESCRIPTION

The circuit interconnections of the Express Orderwire Multidirection Unit are accomplished in the four-way, four-wire hybrid or hybrids, while the attenuators and amplifiers are used to maintain the proper input and output levels required by the circuit and the hybrid bridges. The block diagram in figure 4-1 shows representative levels. With the! input receive level from the multiplex equipment at +7 dBm the output of the hybrid is -8dBm. The pads in the output legs are adjusted to 8dB, giving a transmit output level to the line of -16dBm. The -8dBm hybrid output is amplified 15 dB to +7dBm if it is to be connected to another hybrid. The output level of the unit to the express orderwire is -8dBm, and the input from the express orderwire to the unit is +7dBm.

4.2.1 Four-Way, Four-Wire Hybrid Board

The four-way, four-wire hybrid board, Philco Part No. 368-41964, is a network of twenty-four 732-ohm resistors arranged in a double cube with four input ports and four output ports (see figure 4-2). The input and output impedance of the bridge is 600 ohms. The loss between any input and the three nonassociated outputs (i.e., input 1 to outputs 2, 3, and 4) is approximately 15 dB. The loss between any input and its associated output (i. e., input 1 to output 1) is approximately 80dB. The loss between any input port and the other input ports is approximately 65 dB.

An examination of figure 4-2 will help in analyzing how this loss differential is accomplished. At input port 1 ("A" of figure 4-2) notice that the 15-dB lossoutput ports are at three adjacent corners "B", "C" and "D"), which are separated from the input by only two resistors. The associated output port No. 1 is at the (opposite corner "E") of the cube which is separated from input 1 by three parallel paths of six resistors each. A further loss is obtained by the crossover of resistors

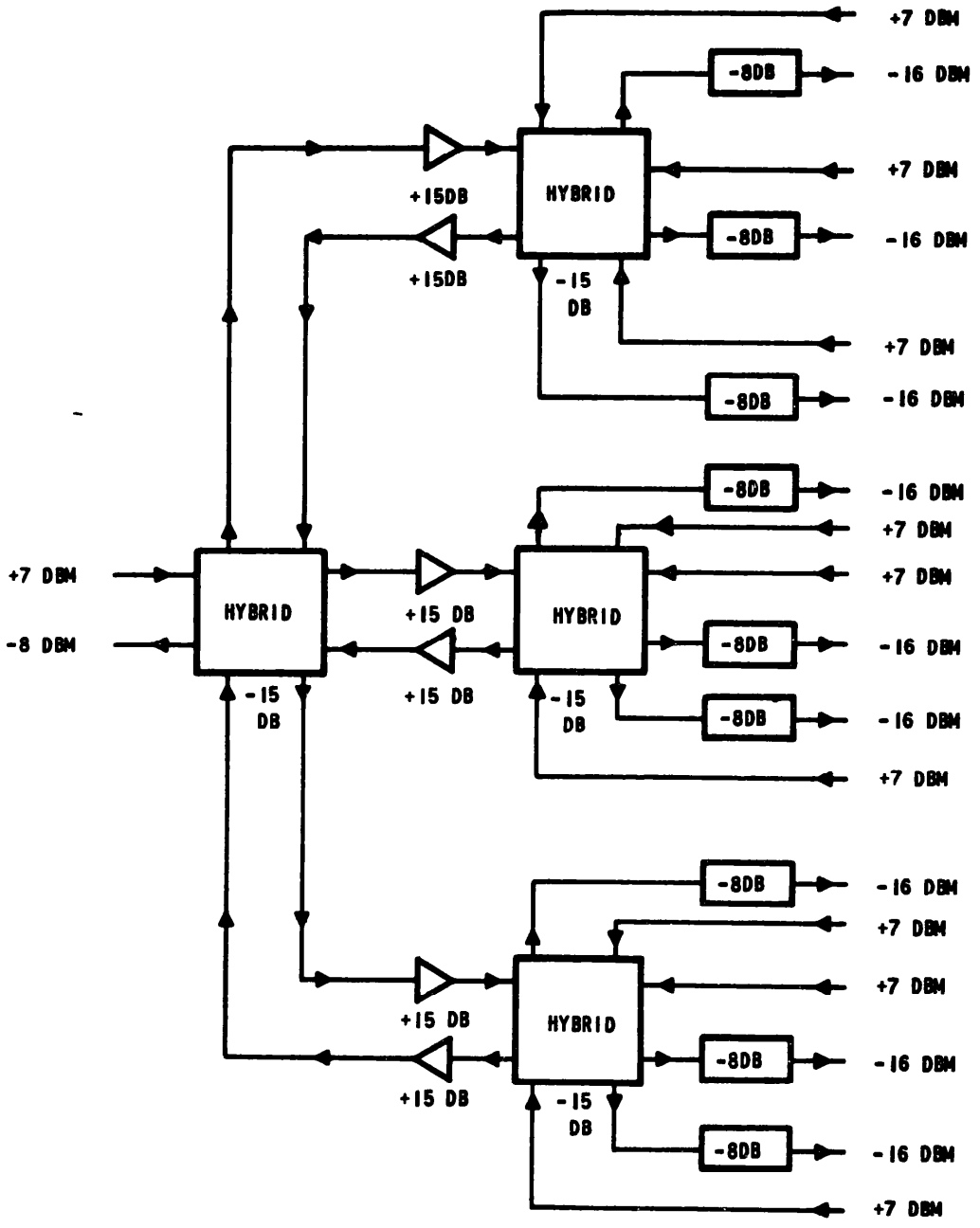


Figure 4-1. Express Orderwire Multidirection Unit, Block Diagram

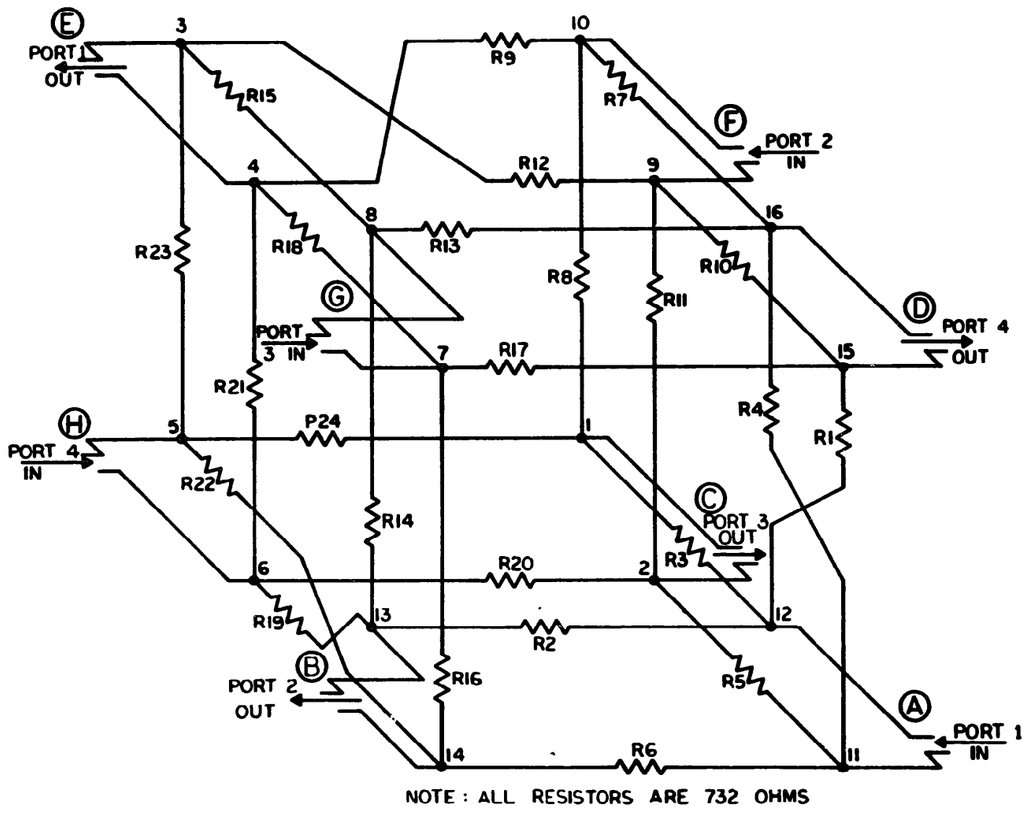


Figure 4-2. Cube Diagram of Four-Way, Four-Wire Hybrid Board

which cause two signals from input port 1 to reach output port 1 out of phase. The 65-dB loss between any input and the other inputs is due to the two equal-loss paths connected so that the signals arrive 180 degrees out of phase.

4.2.2 Adjustable Attenuator Board

The adjustable attenuator board, Philco part No. 368-42056, used in the Express Orderwire Multidirection Unit consists of five 600-ohm "H" pads of 1 dB, 2 dB, 4 dB, 8 dB, and 16 dB. By strapping various combinations of these pads, any value of attenuation between 0 and 31 dB can be obtained in 1-dB steps.

4.2.3 Voice-Frequency Amplifier Board

The voice-frequency amplifier board, Philco part No. 368-41965, used in the unit incorporates ultra-stable two-transistor amplifiers with a transformer-coupled input and output impedance of 600 ohms. The amplifiers can accept signal levels from -40 to 0 dBm and have a maximum output level of +10 dBm. They provide a maximum signal gain of 30 dB, and the gain is variable down to 0 dB. Two amplifiers, designated as “A” and “B" units, are mounted on each voice-frequency amplifier board with the “A” unit gain control at the top and the W” unit gain control at the bottom when the board is inserted in its connector. (Refer to figure 7-6.) There are seven test points provided on each amplifier-board. The black test point is the dc and signal common. The output test points are either red and orange or yellow and green. The input level is measured between either brown or blue and common.

SECTION 5

MAINTENANCE

5.1 GENERAL

The maintenance instructions given in this section are provided for use by maintenance personnel. Specific maintenance functions are listed in appendix B.

WARNING

Use caution in testing or servicing
this equipment as 48 volts dc is present.

5.2 TEST EQUIPMENT REQUIRED

The test equipment required for maintenance of the Express Orderwire Multidirection Unit is listed in table 5-1. The table provides the name and commercial and/or military designation for each equipment. Other test equipment with equivalent operating characteristics may be substituted for the items listed.

TABLE 5-1. TEST EQUIPMENT REQUIRED

NAME	DESIGNATION
Test Oscillator	Hewlett-Packard Model 200 CD
Vacuum-Tube Voltmeter	Hewlett-Packard Model 400L
Distortion Analyzer	Hewlett-Packard Model 330A
Board Extender	Philco Part No. 368-42411
600-Ohm Terminating Resistors	600-ohm, 1/2-watt, 1% resistors

TABLE 5-1. TEST EQUIPMENT REQUIRED (Cont)

NAME	DESIGNATION
Number of resistors required: 2 Direction - 6 3 Direction - 8 4 Direction - 10 5 Direction - 12 6 Direction - 14 7 Direction - 16 8 Direction - 18 9 Direction - 20	

5.3 PREVENTIVE MAINTENANCE

The preventive-maintenance routines given in table 5-2 should be conducted periodically to ensure maximum operating efficiency with minimum service interruption. The routines enable maintenance personnel to systematically survey the equipment's condition from both a physical and electrical standpoint.

TABLE 5-2. PREVENTIVE-MAINTENANCE ROUTINES

ITEM	DESCRIPTION
Electrical	Check to see that all terminal-strip connections are secure and free of dirt and corrosion. Check for and remove any defective or broken part, and remove any dirt or corrosion using a clean, lint-free cloth moistened with an approved cleaning solvent.
Mechanical	Check to see that all assemblies are secured and that all printed wiring boards are properly seated.
Operating Performance	Perform the operational performance tests given in paragraph 5.4

5.4 OPERATIONAL PERFORMANCE TESTS

The operational performance test procedure in table 5-3 is used to systematically check the unit under simulated operating conditions. Table 5-3 is applicable for all configurations of the Express Orderwire Multidirection Unit. All connection points used in the test procedure are identified in figure 7-1.

The operational performance test procedure requires that all inputs and outputs of the unit be properly terminated in 600-ohm dummy terminations.

NOTE

After the operational performance tests are completed, remove all of the terminating resistors that were connected for the tests.

Since the Express Orderwire Multidirection Unit is an accessory device with a wide range of possible input and output levels, the levels used in the performance checks provided in table 5-3 are not written for any specific operational system. Before any performance check can be accomplished on an operational system, it is necessary to know the specific levels required for the system in which the unit is used. The Express Orderwire Multidirection Unit is most commonly used with all but one of its ports connected directly to multiplex lines. The inputs and outputs to and from the assembly are at the normal multiplex input and output levels; the remaining port, terminals TB6-1 and 2 and TB3-1 and 2, is connected to the express orderwire.

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
2 AND 3 DIRECTION CONFIGURATIONS			
Printed Wiring Boards Provided: Voice-frequency amplifier boards iamplifiers): None Adjustable attenuator boards (attenuators): AT7 in J15, AT8 in J16, and (for 3-direction only) AT9 in J17 Four-way, four-wire hybrid boards (hybrids): Al in J2 Strapping Connections- TB4-3 to TB4-1, TB4-4 to TB4-2, TB1-1 to TB4-5, TB1-2 to TB4-6 and (for 3-direction only) TB4-7 to TB4-9, TB4-8 to TB4-10 Points Terminated: TB4-7 & 8 and TB1-9 & 10 (2-direction only)			
LEVEL CHECKS - 2 AND 3 DIRECTION			
1	Terminate the following terminals with 600-ohm resistors: TB1-5,6; TB1-7,8, TB3-1,2, TB5-5,6, TB5-7,8: and TB6-1.2, for 3 direction, also terminate TB1 -9,10 and TB5-9,10.		
2	a. Remove termination at TB6-1 & 2 and insert 1-kHz test tone at -5 dBm. b. Measure level at TB4-3 & 4.	-20 dBm	Faulty hybrid Al

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS 2 AND 3 DIRECTION (Cont)		
2 (Cont)	c. Measure level at TB5-5, 6.	-20 dBm less the dB loss of AT7	Faulty attenuator AT7
	d. Measure level at TB1-1 & 2.	-20 dBm	Faulty hybrid A1
	e. Measure level at TB5-7, 8.	-20 dBm less the dB loss of AT6	Faulty attenuator AT8
	f. For 3 direction only, measure level at TB4-7 & 8.	-20 dBm	Faulty hybrid A1
	g. For 3 direction only, measure level at TB5-9, 10.	-20 dBm less the dB loss of AT9	Faulty attenuator AT9
	h. Remove oscillator and re-terminate TB6-1 & 2.		
3	a. Remove termination and apply 1&Hz test tone at -5 dBm to TB1-7,8.		
	b. Measure level at TB3-1 & 2.	-20 dBm	Faulty hybrid A1
	c. Remove test oscillator and replace termination at TB1-7, 8.		
4	a. Remove termination and apply 1-kHz test tone at -5 dBm to TB1-5,6.		
	b. Measure level at TB3-1 & 2.	-20 dBm	Faulty hybrid A1

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS 2 AND 3 DIRECTION (Cont)		
4 (Cont)	c. Remove oscillator and reterminate TB1-5, 6.		
5	NOTE Perform following steps for 3 direction only. a. Remove termination and apply l&Hz test tone at -5 dBm to TB1-9 & 10. b. Measure level at TB3-1 & 2. c. Remove oscillator and re-terminate TB1-9 & 10.	-20 dBm	Faulty hybrid Al
	NOISE TESTS - 2 AND 3 DIRECTION		
	NOTE These tests are to be performed only if amplifier AR1 is used in the circuit under test. Noise tests are performed on the amplifiers only if excessive noise is suspected, or after an amplifier has been repaired.		
6	a. Remove hybrid Al from its socket (52) and set it aside. b. Remove amplifier board AR1 from its socket and insert it into 53 (normal position of amplifier board AR2).		

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	NOISE TESTS - 2 AND 3 DIRECTION (Cont)		
6 (Cont)	c. Disconnect strapping from TB4-3,4 and terminate TB4-3,4 with 600-ohms. d. Remove termination from TB3-3,4 and apply a 1-kHz test tone at -5 dBm. e. Measure and record level at test points J5 & J6 of amplifier "B", AR1. Label this reading amplifier "B". f. Increase gain of amplifier "B" to maximum. g. Remove test oscillator and reterminate TB3-3,4. h. Measure noise level at test points J5 & J6 of amplifier "B". i. Remove termination from TB3-3,4 and reapply the 1-kHz test tone at -5 dBm j. Readjust gain of amplifier "B" to obtain level recorded in step e. k. Remove test oscillator and reterminate TB3-3,4.	-55 dBm or less at maximum gain.	Faulty amplifier "B" (See Note 1)

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	NOISE TESTS - 2 AND 3 DIRECTION (Cont)		
6 (Cont)	l. Remove termination from TB4-3,4 and apply a 1-kHz test tone at -20 dBm. m. Measure and record level at test points J2 and J3 of amplifier "A". Label this reading amplifier "A". n. Increase gain of amplifier "A" to maximum. o. Remove test oscillator and reterminate TB4-3,4. p. Measure noise level at test points J2 and J3 of amplifier "A". q. Remove termination from TB4-3,4 and reapply the 1-kHz test tone at -20 dBm. r. Readjust gain of amplifier "A" to obtain level recorded in step m. s. Remove test oscillator and reterminate TB4-3,4. t. Remove amplifier board AR1 from J3 and return AR1 to its original position (J1).	-55 dBm or less at maximum gain.	Faulty amplifier "A" (see Note 1).

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cant)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	NOISE TESTS - 2 AND 3 DIRECTION (Cont)		
6 (Cont)	u. Return hybrid card A1 to its original socket (J2) and remove termination from TB4-3,4 and reconnect strapping disconnected in step c.		
	DISTORTION TESTS - 2 AND 3 DIRECTION		
7	Since amplifiers are not used, no distortion tests are required with these configurations.		
8	Remove all terminating resistors that were connected in step 1.		
	4 AND 5 DIRECTION CONFIGURATIONS		
Printed Wiring Boards Provided: Voice-frequency amplifier boards (amplifiers): AR2 in J3 Adjustable attenuator boards (attenuators): AT1 in J5, AT2 in J6, AT3 in J7, AT9 in J17, and (for 5 direction only) AT8 in J16 Four-way, four-wire hybrid boards (hybrid): A1 in J2, A2 in J4 Strapping Connections: TB4-7 to TB4-9, TB4-8 to TB4-10 and (for 5 direction only) TB1-1 to TB4-5, TB1-2 to TB4-6. Points Terminated: TB1-1 & 2 and TB1-5 & 6 (4 direction only)			

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Co&)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 4 AND 5 DIRECTION		
1	Terminate the following terminals with 600-ohm resistors: TB1-9, 10; TB3-1,2; TB3-3,4; TB3-5,6; TB3-7,8; TB5-9,10; TB6-1,2; TB6-3,4; TB6-5,6; and TB6-7,8; for 5 direction, also terminate TB1-5,6 and TB5-7,8.		
2	a. Remove termination and apply 1-kHz test tone at -5 dBm to TB6-1 & 2.		
	b. Measure level at TB4-3 & 4.	-20 dBm	Faulty hybrid A1
	c. Increase gain of amplifier AR2A to maximum and measure level at test points J2 and J3. Re-adjust gain of AR2A to provide an indication of -5 dBm at J2 & J3.	+10 dBm at maximum gain.	Faulty amplifier AR2A (see Note 1)
	d. Remove attenuator AT1 and insert board extender in its connector. Place AT1 in the board extender connector.		
	e. Measure input level to AT1 at terminals 10 and 12.	-20 dBm	Faulty hybrid A2
	f. Remove board extender and replace attenuator AT1.		
	g. Measure level at TB6-3,4.	-20 dBm less the dB loss of AT1.	Faulty attenuator AT1

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Coat)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 4 AND 5 DIRECTION (Cont)		
2 (Cont)	h. Remove attenuator AT2 and insert board extender in its connector. Place AT2 in board extender connector.		
	i. Measure input level to AT2 at terminals 10 & 12.	-20 dBm	Faulty hybrid A2
	j. Remove board extender and replace attenuator AT2.		
	k. Measure level at TB6-5, 6.	-20 dBm less the dB loss of AT2	Faulty attenuator AT2
	l. Remove attenuator AT3 and insert board extender in its connector. Place AT3 in board extender connector.		
	m. Measure input level to AT3 at terminals 10 and 12.	-20 dBm	Faulty hybrid A2
	n. Remove board extender and replace attenuator AT3.		
	o. Measure level at TB6-7, 8.	-20 dBm less the dB loss of AT3.	Faulty attenuator AT3
	p. Measure level at TB4-7 & 8.	-20 dBm	Faulty hybrid A1
	q. Measure level at TB5-9, 10.	-20 dBm less the dB loss of AT9.	Faulty attenuator AT9.
	r. For 5 direction only, measure level TB1-1 & 2.	-20 dBm	Faulty hybrid A1

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cent)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 4 AND 5 DIRECTION (Cont)		
2 (Cont)	s. For 5 direction only, measure level at TB5-7, 8.	-20 dBm less the dB loss of AT8	Faulty attenuator AT8
	t. For 4 and 5 direction, remove test oscillator and replace termination at TB6-1, 2.		
3	a. Remove amplifier AR2 and apply 1-kHz test tone at -5 dBm to TB1-7 & 8.		
	b. Measure level at TB3-1 & 2.	-20 dBm	Faulty hybrid A1
	c. Replace amplifier AR2, and remove test oscillator from TB1-7, 8.	-20 dBm	Faulty hybrid A1
4	a. Remove termination and apply 1-kHz test tone at -5 dBm to TB3-3, 4.		
	b. Measure level at test points J4 & J7 of amplifier AR2B.	-20 dBm	Faulty hybrid A2
	c. Increase gain of AR2B to maximum and measure level at test points J5 & J6 of AR2B. Readjust gain of AR2B to provide a level of -5 dBm at J5 & J6.	+10 dBm at maximum gain	Faulty amplifier AR2
	d. Remove test oscillator and replace termination at TB3-3, 4.		

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cant)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 4 AND 5 DIRECTION (Cont)		
5	a. Remove termination and apply 1-kHz test tone at -5 dBm to TB3-5, 6. b. Measure level at test points J7 & J4 of AR2B. c. Remove test oscillator and replace termination at TB3-5, 6.	-20 dBm	Faulty hybrid A2
6	a. Remove termination and apply 1- kHz test tone at -5 dBm to TB3-7, 8. b. Measure level at test points J7 & J4 of AR2A. c. Remove test oscillator and replace termination at TB3-7, 8.	-20 dBm	Faulty hybrid A2
7	a. Remove termination and apply 1-kHz test tone at -5 dBm to TB1-9 & 10. b. Measure level at TB3-1 & 2. c. Remove test oscillator and reterminate TB1-9 & 10.	-20 dBm	Faulty hybrid A1
8	NOTE Perform following steps for 5 direction only.		

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 4 AND 5 DIRECTION (Cont)		
8 (Cont)	a. Remove termination and insert 1-kHz test tone at -5 dBm to TB1-5, 6. b. Measure level at TB3-1 & 2. c. Remove oscillator and re-terminate TB1-5, 6.	-20 dBm	Faulty hybrid A1
	NOISE TESTS - 4 AND 5 DIRECTION		
	NOTE Noise tests are performed on the amplifiers only if excessive noise is suspected, or after an amplifier has been repaired.		
9	a. To test amplifier board AR2 proceed with steps b through s. b. Remove hybrid A1 from its socket (J2) and set it aside. c. Terminate TB4-3, 4 and TB1-7, 8 with 600-ohm resistors. d. Remove termination from TB3-3, 4 and apply a 1-kHz test tone at -5 dBm. e. Measure and record level at test points J5 and J6 of amplifier "B". Label this reading amplifier "B". f. Increase gain of amplifier "B" to maximum.		

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.).

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	NOISE TESTS - 4 AND 5 DIRECTION (Cont)		
9 (Cont)	g. Remove test oscillator and reterminate TB3-3,4.		
	h. Measure noise level at test points J5 & J6.	-55 dBm or less at maximum gain.	Faulty amplifier "B" (see Note 1)
	i. Remove termination from TB3-3,4 and reapply the 1-kHz test tone at -5 dBm		
	j. Readjust gain of amplifier "B" to obtain level recorded in step e.		
	k. Remove test oscillator and reterminate TB3-3,4.		
	l. Remove termination from TB4-3,4 and apply a 1-kHz test tone at -20 dBm.		
	m. Measure and record level at test points J2 & J3 of amplifier "A". Label this reading amplifier "A".		
	n. Increase gain of amplifier "A" to maximum.		
	o. Remove test oscillator and reterminate TB4-3,4.		

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	NOISE TESTS - 4 AND 5 DIRECTION (Cont)		
9 (Cont)	p. Measure noise level at test points J2 & J3 of amplifier "A". q. Remove termination from TB4-3,4 and reapply the 1-kHz test tone at -20 dBm. r. Readjust gain of amplifier "A" to obtain level recorded in step m. s. Remove test oscillator and reterminate TB4-3,4. t. To check amplifier board AR1 proceed with steps u through x. If AR1 is not to be checked proceed directly to step y. u. Remove amplifier board AR2 from its socket (J3) and set it aside. v. Remove amplifier board AR1, from its socket (J1) and insert it into J3. w. Repeat steps c through s inclusive to check amplifier board AR1 for excessive noise. x. Remove AR1 from J3 and return the amplifier board to its original socket (J1).	-55 dBm or less at maximum gain.	Faulty amplifier "A" (see Note 1)

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	NOISE TESTS - 4 AND 5 DIRECTION (Cont)		
9	y. Return hybrid card A1 and amplifier board AR2 to their original sockets, J2 & J3 respectively, and remove terminations from TB4-3,4 and TB1-7,8.		
	DISTORTION TESTS - 4 AND 5 DIRECTION		
10	a. Remove termination and apply 1-kHz test tone at -5 dBm to TB3-5,6.		
	b. Measure distortion at test points J5 & J6 of AR2B.	Less than 1% if amplifier output level is less than 0 dBm. Less than 2% if amplifier output level is 0 to +10 dBm.	Faulty amplifier AR2B (see Note 1)
	c. Remove test oscillator and replace termination at TB3-5,6.		
	d. Remove termination and apply 1-kHz test tone at -5 dBm to TB6-1 & 2.		
	e. Measure distortion at test points J2 & J3 of AR2A.	Less than 1% if amplifier output level is less than -15 dBm. Less than 2% if amplifier output level is -15 to -5 dBm.	Faulty amplifier AR2A (see Note 1)

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	DISTORTION TESTS - 4 AND 5 DIRECTION (Cont)		
10 (Cont)	f. Remove all terminating resistors that were connected in step 1.		
	6 AND 7 DIRECTION CONFIGURATIONS		
	Printed Wiring Boards Provided: Voice-frequency amplifier boards (amplifiers): AR2 in J3 and AR3 in J8 Adjustable attenuator boards (attenuators): AT1 in J5, AT2 in J6, AT3 in J7, AT4 in J10, AT5 in J11, AT6 in J12, and (for 7 direction only) AT9 in J17 Four-way, four-wire hybrid boards (hybrids): A1 in J2, A2 in J4, and A3 in J9 Strapping Connections: For 6 direction, none; for 7 direction, TB4-7 to TB4-9 and TB4-8 to TB4-10 Points Terminated: For 6 direction, TB4-7 & 8 and TB1-9 & 10; for 7 direction, none		
	LEVEL CHECKS - 6 AND 7 DIRECTION		
1	Terminate the following terminals with 600-ohm resistors: TB2-1,2; TB2-3,4; TB3-1,2; TB3-3,4; TB3-5,6; TB3-7,8; TB3-9,10; TB5-1,2; TB5-3,4; TB6-1,2; TB6-3,4; TB6-5,6; TB6-7,8; and TB6-9,10; for 7 direction also terminate TB5-9,10 and TB1-9,10.		

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)
(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 6 AND 7 DIRECTION (Cont)		
2	a. Remove termination at TB6-1 & 2 and insert 1-kHz test tone at -5 dBm.		
	b. Measure level at TB4-3 & 4.	-20 dB	Faulty hybrid A1
	c. Increase gain of AR2A to maximum and measure level at test points J2 & J3 of AR2A. Readjust gain to provide a level of -5 dBm at test points J2 & J3.	+10 dBm at maximum gain.	Faulty amplifier AR2A
	d. Remove attenuator AT1 and insert board extender in J5. Insert AT1 in board extender.		
	e. Measure level at terminals 10 and 12 of AT1.	-20 dBm	Faulty hybrid A2
	f. Remove board extender and return attenuator AT1 to J5.		
	g. Measure level at TB6-3,4.	-20 dBm less the dB loss of AT1	Faulty attenuator AT1
	h. Remove attenuator AT2 and insert board extender in J6. Insert AT2 in board extender.		
	i. Measure level at terminals 10 and 12 of AT2.	-20 dBm	Faulty hybrid A2

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 6 AND 7 DIRECTION (Cont)		
2 (Cont)	j. Remove board extender and return attenuator AT2 to J6.		
	k. Measure level at TB6-5, 6.	-20 dBm less the dB loss of AT2	Faulty attenuator AT2
	l. Remove attenuator AT2 and insert board extender in J7. Insert AT3 in board extender.		
	m. Measure level at terminals 10 and 12 of AT3.	-20 dBm	Faulty hybrid A2
	n. Remove board extender and return attenuator AT3 to J7.		
	o. Measure level at TB6-7, 8.	-20 dBm less the dB loss of AT3.	Faulty attenuator AT3
	p. Measure level at point TB1-1 & 2	-20 dBm	Faulty hybrid A1
	q. Increase gain of AR3A to maximum and measure level at test points J2 & J3 of AR3A. Readjust gain of AR3A to provide a level of -5 dBm at test points J2 & J3.	+10 dBm at maximum gain.	Faulty amplifier AR3A (see Note 1)
	r. Remove attenuator AT4 and insert board extender in J10. Insert AT4 in board extender.		

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 6 and 7 DIRECTION (Cont)		
2 (Cont)	s. Measure level at terminals 10 and 12 of AT4.	-20 dBm	Faulty hybrid A3
	t. Replace AT4 in J10.		
	u. Measure level at TB6-9,10.	-20 dBm less the dB loss of AT4	Faulty attenuator AT4
	v. Remove attenuator AT5 and insert board extender in J11. Insert AT5 in board extender.		
	w. Measure level at terminals 10 and 12 of AT5.	-20 dBm	Faulty hybrid A3
	x. Return attenuator AT5 to J11.		
	y. Measure level at TB5-1,2.	-20 dBm less the dB loss of AT5	Faulty attenuator AT5
	z. Remove attenuator AT6 and insert board extender in J12. Place AT6 in board extender connector.		
	aa. Measure level at terminals 10 and 12 of AT6.	-20 dBm	Faulty hybrid A3
	ab. Return attenuator AT6 to J12.		
	ac. Measure level at TB5-3,4.	-20 dBm less the dB loss of AT6	Faulty attenuator AT6

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 6 AND 7 DIRECTION (Cont)		
2 (Cont)	ad. For 7 direction only measure level at TB4-7 & 8.	-20 dBm	Faulty hybrid A1
	ae. Measure level at TB5-9,10.	-20 dBm less the dB loss of AT9.	Faulty attenuator AT9
	af. Remove test oscillator and reterminate TB6-1 & 2.		
3	a. Remove termination and insert 1-kHz test tone at -5 dBm into TB3-3,4.		
	b. Measure level at input test points J4 & J7 of amplifier AR2B.	-20 dBm	Faulty hybrid A2
	c. Increase gain of AR2B to maximum and measure level at test points J5 & J6 of AR2B. Readjust gain of AR2B to provide a level of -5 dBm at test points J5 & J6.	+10 dBm at maximum gain.	Faulty amplifier AR2B (see Note 1)
	d. Measure level at TB3-1 & 2.	-20 dBm	Faulty hybrid A1
	e. Remove oscillator and reterminate TB3-3,4.		
4	a. Remove termination and insert 1-kHz test tone at -5 dBm in TB3-5,6.		

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 6 AND 7 DIRECTION (Cont)		
4 (Cont)	b. Measure level at test points J7 & J4 of AR2B. c. Remove oscillator and reterminate TB3-5, 6.	-20 dBm	Faulty hybrid A2
5	a. Remove termination and insert 1-kHz test tone at -5 dBm in TB3-7, 8. b. Measure level at test points J7 & J4 of AR2B. c. Remove oscillator and reterminate TB3-7, 8.	-20 dBm	Faulty hybrid A2
6	a. Remove termination and insert 1-kHz test tone at -5 dBm in TB3-9, 10. b. Measure level at input test points J4 & J7 of amplifier AR3B. c. Increase gain of AR3B to maximum and measure level at test points J5 & J6 of AR3B. Readjust gain of AR3B to provide a level of -5 dBm at test points J5 & J6. d. Measure level at TB3-1 & 2. e. Remove test oscillator and reterminate TB3-9, 10.	-20 dBm +10 dBm at maximum gain. -20 dBm	Faulty hybrid A3 Faulty amplifier AR3B Faulty hybrid A1

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 6 AND 7 DIRECTION (Cont)		
7	a. Remove termination and insert 1-kHz test tone at -5 dBm in TB2-1,2. b. Measure level at test points J7 & J4 of AR3B. c. Remove oscillator and re-terminate TB2-1,2.	-20 dBm	Faulty hybrid A3
8	a. Remove termination and insert 1-kHz test tone at -5 dBm in TB2-3,4. b. Measure level at test points J7 & J4 of AR3B. c. Remove oscillator and re-terminate TB2-3,4.	-20 dBm	Faulty hybrid A3
9	NOTE Perform following steps for 7 direction only. a. Remove termination and insert 1-kHz test tone at -5 dBm into TB1-9,10. b. Measure level at TB3-1 & 2. c. Remove oscillator and re-terminate TB1-9,10.	-20 dBm	Faulty hybrid A1

TABLE 5-3. **OPERATIONAL PERFORMANCE** TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	NOISE TESTS - 6 AND 7 DIRECTION		
	NOTE **Noise tests are performed on the amplifiers only if excessive noise is suspected, or after an amplifier has been repaired.**		
10	**a. To test amplifier board AR2 proceed with steps b through s.** **b. Remove hybrid A1 from its socket (J2) and set it aside.** **c. Terminate TB4-3,4 and TB1-7,8 with 600-ohm resistors.** **d. Remove termination from TB3-3,4 and apply a 1-kHz test tone at -5 dBm.** **e. Measure and record level at test points J5 & J6 of amplifier "B". Label this reading amplifier "B".** **f. Increase gain of amplifier "B" to maximum.** **g. Remove test oscillator and reterminate TB3-3,4.** **h. Measure noise level at test points J5 & J6.**	**-55 dBm or less at maximum gain.**	**Faulty amplifier "B" (see Note 1)**

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	NOISE TESTS - 6 AND 7 DIRECTION (Cont)		
10 (Cont)	i. Remove termination from TB3-3,4 and reapply the 1-kHz test tone at -5 dBm		
	j. Readjust gain of amplifier "B" to obtain level recorded in step e.		
	k. Remove test oscillator and reterminate TB3-3,4.		
	l. Remove termination from TB4-3,4 and apply a 1-kHz test tone at -20 dBm.		
	m. Measure and record level at test points J2 & J3 of amplifier "A". Label this reading amplifier "A".		
	n. Increase gain of amplifier "A" to maximum.		
	o. Remove test oscillator and reterminate TB4-3,4.		
	p. Measure noise level at test points J2 & J3 of amplifier "A".	-55 dBm or less at maximum gain.	Faulty amplifier "A" (see Note 1)
	q. Remove termination from TB4-3,4 and reapply the 1-kHz test tone at -20 dBm.		

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	NOISE TESTS - 6 AND 7 DIRECTION (Cont)		
10 (Cont)	r. Readjust gain of amplifier "A" to obtain level recorded in step m. s. Remove test oscillator and reterminate TB4-3,4. t. To check amplifier board AR1 or AR3, proceed with steps u through x. If AR1 or AR3 are not to be checked proceed directly to step y. u. Remove amplifier board AR2 from its socket (J3) and set it aside. v. Remove amplifier board AR1 or AR3 from its socket (J1 or J8) and insert it into J3. w. Repeat steps c through s inclusive to check amplifier board AR1 or AR3 for excessive noise. x. Remove AR1 or AR3 from J3 and return the amplifier board to its original socket (J1 or J8). y. Return hybrid card A1 and amplifier board AR2 to their original sockets, J2 & J3 respectively, and remove terminations from TB4-3,4 and TB1-7,8.		

TABLE 5-3. OPERATION PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	DISTORTION TESTS - 6 AND 7 DIRECTION		
11	a. Remove termination and apply 1-kHz test tone at -5 dBm to TB6-1 & 2.		
	b. Measure distortion at test points J2 & J3 of amplifier AR2A.	Less than 1% if amplifier output level is less than 0 dBm. Less than 2% if amplifier output is 0 to +10 dBm.	Faulty amplifier AR2A (see Note 1)
	c. Measure distortion at test points J2 & J3 of amplifier AR3A.	Less than 1% if amplifier output level is less than 0 dBm. Less than 2% if amplifier output is 0 to +10 dBm.	Faulty amplifier AR3A (see Note 1)
	d. Remove oscillator and reterminate TB6-1,2.		
	e. Remove termination and insert 1-kHz test tone at -5 dBm into TB3-3,4.		
	f. Measure distortion at test points J5 & J6 of amplifier AR2B.	Less than 1% if amplifier output level is less than 0 dBm. Less than 2% if amplifier output level is 0 to +10 dBm.	Faulty amplifier AR2B (see Note 1)
	g. Remove test oscillator and reterminate TB3-3,4.		

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL	PROBABLE CAUSE OF TROUBLE
	DISTORTION TESTS - 6 AND 7 DIRECTION (Cont)		
11 (Cont)	h. Remove termination and insert 1-kHz test tone at -5 dBm into TB3-9,10.		
	i. Measure distortion at test points J5 & J6 of amplifier AR3B.	Less than 1% if amplifier output is less than 0 dBm. Less than 2% if amplifier output level is 0 to +10 dBm.	Faulty amplifier AR3B (see Note 1)
	j. Remove test oscillator and reterminate TB3-9,10.		
	k. Remove all terminating resistors that were connected in step 1.		
	8 AND 9 DIRECTION CONFIGURATIONS		
Printed Wiring Boards Provided: **Voice-frequency amplifier boards (amplifiers): AR2 in J3, AR3 in J8, and AR4 in J13** **Adjustable attenuator boards (attenuators): AT1 in J5, AT2 in J6, AT3 in J7, AT4 in J10, AT5 in J11. AT6 in J12, AT7 in J15, AT8 in J16, and (for 9 direction only) AT9 in J17** **Four-way four-wire hybrid boards (hybrids): A1 in J2, A2 in J4, A3 in J9, and A4 in J14** **Points Terminated: TB2-9 & 10 and TB5-9 & 10 (8 direction only)**			

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 8 AND 9 DIRECTION		
1	Terminate the following terminals with 600-ohm resistors: TB2-1,2; TB2-3,4; TB2-5,6; TB2-7,8; TB3-1,2; TB3-3,4; TB3-5,6, TB3-7,8; TB3-9,10; TB5-1,2; TB5-3,4; TB5-5,6; TB5-7,8; TB6-1,2; TB6-3,4; TB6-5,6; TB6-7,8; and TB6-9,10; for 9 direction, also terminate TB2-9,10 and TB5-9,10.		
2	a. Remove termination and apply 1-kHz test tone at -5 dBm to TB6-1,2.		
	b. Measure level at TB4-3 & 4.	-20 dBm	Faulty hybrid A1
	c. Increase gain of AR2A to maximum and measure level at test points J2 & J3 of AR2A. Readjust gain to a level of -5 dBm at J2 & J2.	+10 dBm at maximum gain.	Faulty or maladjusted amplifier AR2A (see Note 1)
	d. Remove attenuator AT1 and insert board extender in J5. Insert AT1 in board extender.		
	e. Measure level at terminals 10 & 12 of AT1.	-20 dBm	Faulty hybrid A2
	f. Replace attenuator AT1 in J5.		
	g. Measure level at TB6-3,4.	-20 dBm less the dB loss of AT1	Faulty attenuator AT1.

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 8 AND 9 DIRECTION (Cont)		
2 (Cont)	h. Remove attenuator AT2 and insert board extender in J6. Insert AT2 in board extender.		
	i. Measure level at terminals 10 and 12 of AT2.	-20 dBm	Faulty hybrid A2
	j. Replace attenuator AT2 in J6.		
	k. Measure level at TB6-5, 6.	-20 dBm less the dB loss of AT2	Faulty attenuator AT2
	l. Remove attenuator AT3 and insert board extender in J7. Insert AT3 in board extender.		
	m. Measure level at terminals 10 and 12 of AT3.	-20 dBm	Faulty hybrid A2
	n. Replace attenuator AT3 in J7.		
	o. Measure level at TB6-7, 8.	-20 dBm less the dB loss of AT3	Faulty attenuator AT3
	p. Measure level at test points J1 & J4 of amplifier AR3A.	-20 dBm	Faulty hybrid A1

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 8 AND 9 DIRECTION (Cont)		
2 (Cont)	q. Increase gain of AR3A to maximum and measure level at test points J2 & J3 of AR3A. Readjust gain of AR3A tc provide a level of -5 dBm at J2 & J3.	+10 dBm at maximum gain	Faulty amplifier AR3A (see Note 1)
	r. Remove attenuator AT4 and insert board extender in J10. Insert AT4 in board extender.		
	s. Measure level at terminals 10 and 12 of AT4.	-20 dBm	Faulty hybrid A3
	t. Replace attenuator AT4 in J10.		
	u. Measure level at TB6-9,10.	-20 dBm less the dB loss of AT4.	Faulty attenuator AT4
	v. Remove attenuator AT5 and insert board extender in J11. Insert AT5 in board extender.		
	w. Measure level at terminals 10 and 12 of AT5.	-20 dBm	Faulty hybrid A3
	x. Return attenuator AT5 to J11.		
	y. Measure level at TB5-1,2.	-20 dBm less the dB loss of AT5.	Faulty attenuator AT5

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cant)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 8 AND 9 DIRECTION (Cont)		
2 (Cont)	z. Remove attenuator AT6 and insert board extender in J11. Insert AT6 in board extender.		
	aa. Measure level at terminals 10 and 12 of AT6.	-20 dBm	Faulty hybrid A3
	ab. Return attenuator AT6 to J12.		
	ac. Measure level at TB5-3,4.	-20 dBm less the dB loss of AT6.	Faulty attenuator AT6
	ad. Measure level at test points J1 & J4 of AR4A.	-20 dBm	Faulty attenuator AT6
	ae. Increase gain of AR4A to maximum and measure level at test points J2 & J3 of AR4A. Readjust gain of AR4A to provide a level of -5 dBm at J2 & J3.	+10 dBm at maximum gain	Faulty amplifier AR4A (see Note 1)
	af. Measure level at TB4-1 & 2.	-20 dBm	Faulty hybrid A4
	ag. Measure level at TB5-5, 6.	-20 dBm less the dB loss of AT7.	Faulty attenuator AT7
	ah. Measure level at TB4-5 & 6.	-20 dBm	Faulty hybrid A4
	ai. Measure level at TB5-7, 8.	-20 dBm less the dB loss of AT8	Faulty attenuator AT8

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 8 AND 9 DIRECTION (Cont)		
2 (Cont)	aj. For 9 direction only, measure level at TB4-9 & 10.	-20 dBm	Faulty hybrid A4
	ak. Measure level at TB5-9,10.	-20 dBm less the dB loss of AT9.	Faulty attenuator AT9
	al. Remove test oscillator and replace termination at TB6-1 & 2.		
3	a. Remove termination and insert 1-kHz test tone at -5 dBm into TB3-3,4.		
	b. Measure level at input test points J4 & J7 of amplifier AR2B.	-20 dBm	Faulty hybrid A2
	c. Increase gain of AR2B to maximum and measure level at test points J5 & J6 of AR2B. Readjust gain of AR2B to provide a level of -5 dBm at J5 & J6.	+10 dBm at maximum gain	Faulty amplifier AR2B (see Note 1)
	d. Measure level at TB3-1 & 2.	-20 dBm	Faulty hybrid A1
	e. Remove test oscillator and reterminate TB3-3,4.		
4	a. Remove termination and insert 1-kHz test tone at -5 dBm in TB3-5,6.		

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 8 AND 9 DIRECTION (Cont)		
4 (Cont)	b. Measure level at test points J7 & J4 of amplifier AR2A.	-20 dBm	Faulty hybrid A2
	c. Remove test oscillator and reterminate TB3-5, 6.		
5	a. Remove termination and insert 1-kHz test tone at -5 dBm in TB3-7, 8.		
	b. Measure level at test points J7 & J4 of amplifier AR2A.	-20 dBm	Faulty hybrid A2
	c. Remove test oscillator and reterminate TB3-7, 8.		
6	a. Remove termination and insert 1-kHz test tone at -5 dBm in TB3-9, 10.		
	b. Measure level at test points J4 & J7 of amplifier AR3B.	-20 dBm	Faulty hybrid A3
	c. Increase gain of amplifier AR3B to maximum and measure level at test points J5 & J6 of AR3B. Readjust gain of AR3B to provide a level of -5 dBm at J5 & J6.	+10 dBm at maximum gain	Faulty amplifier AR3B (see Note 1)
	d. Measure level at TB3-1 & 2.	-20 dBm	Faulty hybrid A1
	e. Remove test oscillator and reterminate TB3-9, 10.		

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 8 AND 9 DIRECTION (Cont)		
7	a. Remove termination and insert 1-kHz test tone at -5 dBm in TB2-1,2. b. Measure level at test points J7 & J4 of amplifier AR3B. c. Remove test oscillator and reterminate TB2-1,2.	-20 dBm	Faulty hybrid A3
8	a. Remove termination and insert 1-kHz test tone at -5 dBm in TB2-3,4. b. Measure level at test points J7 & J4 of amplifier AR3B. c. Remove test oscillator and reterminate TB2-3,4.	-20 dbm	Faulty hybrid A3
9	a. Remove termination and insert 1-kHz test tone at -5 dBm in TB2-5,6. b. Measure level at test points J4 & J7 of amplifier AR4B. c. Increase gain of amplifier AR4B to maximum and measure level at test points J5 & J6 of AR4B. Readjust gain of AR4B to provide a level of -5 dBm at J5 & J6.	-20 dBm +10 dBm at maximum gain	Faulty hybrid A4 Faulty amplifier AR4B (see Note 1)

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	LEVEL CHECKS - 8 AND 9 DIRECTION (Cont)		
9 (Cont)	d. Measure level at TB3-1 & 2. e. Remove test oscillator and reterminate TB2-5, 6.	-20 dBm	Faulty hybrid A1
10	a. Remove termination and insert 1-kHz test tone at -5 dBm in TB2-7, 8. b. Measure level at test points J7 & J4 of amplifier AR4B. c. Remove test oscillator and reterminate TB2-7, 8.	-20 dBm	Faulty hybrid A4
11	NOTE Perform following steps for 9 direction only. a. Remove termination and insert 1-kHz test tone at -5 dBm in TB2-9, 10. b. Measure level at test points J7 & J4 of amplifier AR4B. c. Remove test oscillator and reterminate TB2-9, 10.	-20 dBm	Faulty hybrid A4

TABLE 5-3, OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	NOISE TESTS - 8 AND 9 DIRECTION		
	NOTE **Noise tests are performed on the amplifiers only if excessive noise is suspected, or after an amplifier has been repaired.**		
12	**a. To test amplifier board AR2 proceed with steps b through s.**		
	b. Remove hybrid A1 from its socket (J2) and set it aside.		
	c. Terminate TB4-3,4 and TB1-7,8 with 600-ohm resistors.		
	d. Remove termination from TB3-3,4 and apply a 1-kHz test tone at -5 dBm		
	e. Measure and record level at test points J5 & J6 of amplifier "B". Label this reading amplifier "B".		
	f. Increase gain of amplifier "B" to maximum.		
	g. Remove test oscillator and reterminate TB3-3,4.		
	h. Measure noise level at test points J5 & J6.	**-55 dBm or less at maximum gain.**	**Faulty amplifier "B" (see Note 1)**

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	NOISE TESTS - 8 AND 9 DIRECTION (Cont)		
12 (Cont)	i. Remove termination from TB3-3,4 and reapply the 1-kHz test tone at -5 dBm j. Readjust gain of amplifier "B" to obtain level recorded in step e. k. Remove test oscillator and reterminate TB3-3,4. l. Remove termination from TB4-3,4 and apply a 1-kHz test tone at -20 dBm. m. Measure and record level at test points J2 & J3 of amplifier "A". Label this reading amplifier "A". n. Increase gain of amplifier "A" to maximum. o. Remove test oscillator and reterminate TB4-3,4. p. Measure noise level at test points J2 & J3 of amplifier "A". q. Remove termination from TB4-3,4 and reapply the 1-kHz test tone at -20 dBm.	-55 dBm or less at maximum gain	Faulty amplifier "A" (see Note 1)

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	NOISE TESTS - 8 AND 9 DIRECTION (Cont)		
12 (Cont)	r. Readjust gain of amplifier "A" to obtain level recorded in step m. s. Remove test oscillator and reterminate TB4-3,4. t. To check amplifier board AR1, AR3, or AR4 proceed with steps u through x. If AR1, AR3, or AR4 is not to be checked proceed directly to stepy. u. Remove amplifier board AR2 from its socket (J3) and set it aside. v. Remove amplifier board AR1, AR3, or AR4 from its socket (J1, J8, or J13) and insert it into J3. w. Repeat steps c through s to check amplifier board AR1, AR3, or AR4 for excessive noise. x. Remove AR1, AR3, or AR4 from J3 and return the amplifier board to its original socket (J1, J8, or J13).		

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	NOISE TESTS - 8 AND 9 DIRECTION (Cont)		
12 (Cont)	y. Return hybrid card A1 and amplifier board AR2 to their original sockets, J2 & J3 respectively, and remove terminations from TB4-3,4 and TB1-7,8.		
	DISTORTION TESTS - 8 AND 9 DIRECTION		
13	a. Remove termination and apply 1-kHz test tone at -5 dBm to TB6-1 & 2.		
	b. Measure distortion at test points J2 & J3 of amplifier AR2A.	Less than 1% if amplifier output level is less than 0 dBm. Less than 2% if amplifier output level is 0 to +10 dBm.	Faulty amplifier AR2A (see Note 1)
	c. Measure distortion at test points J2 & J3 of amplifier AR3A.	Less than 1% if amplifier output level is less than 0 dBm. Less than 2% if amplifier output level is 0 to +10 dBm.	Faulty amplifier AR3A (see Note 1)
	d. Measure distortion at test points J2 & J3 of amplifier AR4A.	Less than 1% if amplifier output level is less than 0 dBm. Less than 2% if amplifier output level is 0 to +10 dBm.	Faulty amplifier AR4A (see Note 1)

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	DISTORTION TESTS - 8 AND 9 DIRECTION (Cont)		
13 (Cont)	e. Remove oscillator and reterminate TB6-1 & 2.		
	f. Remove termination and insert 1-kHz test tone at -5 dBm in TB3-5, 6.		
	g. Measure distortion at test points J5 & J6 of amplifier AR2B.	Less than 1% if amplifier output level is less than 0 dBm. Less than 2% if amplifier output level is 0 to +10 dBm.	Faulty amplifier AR2B (see Note 1)
	h. Remove test oscillator and reterminate TB3-5,6.		
	i. Remove termination and insert 1-kHz test tone at -5 dBm in TB2-1, 2.		
	j. Measure distortion at test points J5 & J6 of amplifier AR3B.	Less than 1% if amplifier output level is less than 0 dBm. Less than 2% if amplifier output level is 0 to +10 dBm.	Faulty amplifier AR3B (see Note 1)

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	DISTORTION TESTS - 8 AND 9 DIRECTION (Cont)		
13 (Cont)	e. Remove oscillator and reterminate TB6-1 & 2.		
	f. Remove termination and insert 1-kHz test tone at -5 dBm in TB3-5, 6.		
	g. Measure distortion at test points J5 & J6 of amplifier AR2B.	Less than 1% if amplifier output level is less than 0 dBm. Less than 2% if amplifier output level is 0 to +10 dBm.	Faulty amplifier AR2B (see Note 1)
	h. Remove test oscillator and reterminate TB3-5,6.		
	i. Remove termination and insert 1-kHz test tone at -5 dBm in TB2-1, 2.		
	j. Measure distortion at test points J5 & J6 of amplifier AR3B.	Less than 1% if amplifier output level is less than 0 dBm. Less than 2% if amplifier output level is 0 to +10 dBm.	Faulty amplifier AR3B (see Note 1)

TABLE 5-3. OPERATIONAL PERFORMANCE TEST PROCEDURE (Cont)

(Refer to figure 7-1.)

TEST	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF TROUBLE
	DISTORTION TESTS - 8 AND 9 DIRECTION (Cont)		
13 (Cont)	k. Remove test oscillator and reterminate TB2-1,2. l. Remove termination and insert 1-kHz test tone at -5 dBm in TB2-7,8. m. Measure distortion at test points J5 & J6 of amplifier AR4B. n. Remove test oscillator and reterminate TB2-7,8.	Less than 1% if amplifier output level is less than 0 dBm. Less than 2% if amplifier output level is 0 to +10 dBm.	Faulty amplifier AR4B (see Note 1)
14	Remove all terminating resistors that were connected in step 1.		

NOTE 1. When an amplifier board is replaced, adjust both amplifiers on the replacement board.

5.5 VOLTAGE AND RESISTANCE MEASUREMENTS

Table 5-4 provides a voltage and resistance chart to aid in troubleshooting the Express Orderwire Multidirection Unit.

NOTES

1. All voltage readings are made with the POWER switch on and with all printed wiring boards, except the amplifier board on which measurement is being made, in their connectors. The amplifier board on which voltage is being measured should be placed in the board extender, and the board extender inserted in the proper amplifier board connector. Voltage measurements are then made at terminals provided on the board extender.
2. Resistance measurements are made at connector points on the printed wiring boards with the boards removed from the unit.

TABLE 5-4. VOLTAGE AND RE8lSTANCE CHART

PLUG OR JACK	TERMINALS		NORMAL READING
	FROM	TO	
VOLTAGE (SEE NOTE 1)			
J1	2 (-)	8 & 9 (+)	-48 Vdc
J1	15 (-)	8 & 9 (+)	-48 Vdc
RESISTANCE - AMPLIFIER BOARD (SEE NOTE 2)			
P1	1	2	820 ohms
P1	3	4	100 ohms
P1	13	14	100 ohms
P1	15	16	820 ohms
P1	5	6	100 ohms
P1	11	12	100 ohms
RESISTANCE - ATTENUATOR BOARD (SEE NOTE 2)			
P1	3	5	600 ohms
P1	10	12	600 ohms
RESISTANCE - HYBRID BOARD (SEE NOTE 2)			
P1	1	2	600 ohms
P1	3	4	600 ohms
P1	5	6	600 ohms
P1	7	8	600 ohms
P1	9	10	600 ohms
P1	11	12	600 ohms
P1	13	14	600 ohms
P1	15	16	600 ohms
VOLTAGE (REAR OF MAIN CHASSIS)			
JB-7	1 (-)	3 (+)	-48 Vdc

TABLE 5-4 VOLTAGE AND RESISTANCE CHART

PLUG OR JACK	TERMINALS		NORMAL READING
	FROM	TO	
VOLTAGE (SEE NOTE 1)			
J1	2 (-)	8 & 9 (+)	-48 Vdc
J1	15 (-)	8 & 9 (+)	-48 Vdc
RESISTANCE - AMPLIFIER BOARD (SEE NOTE 2)			
P1	1	2	820 ohms
P1	3	4	100 ohms
P1	13	14	100 ohms
P1	15	16	820 ohms
P1	5	6	100 ohms
P1	11	12	100 ohms
RESISTANCE - ATTENUATOR BOARD (SEE NOTE 2)			
P1	3	5	600 ohms
P1	10	12	600 ohms
RESISTANCE - HYBRID BOARD (SEE NOTE 2)			
P1	1	2	600 ohms
P1	3	4	600 ohms
P1	5	6	600 ohms
P1	7	8	600 ohms
P1	9	10	600 ohms
P1	11	12	600 ohms
P1	13	14	600 ohms
P1	15	16	600 ohms
VOLTAGE (REAR OF MAIN CHASSIS)			
JB-7	1 (-)	3 (+)	-48 Vdc

SECTION 6

REPAIR

6.1 GENERAL

Repairs to the Express Orderwire Multidirection Unit consists of the replacement of the plug-in printed wiring boards and the power supply, and their component parts. To remove a printed wiring board, grasp the front edge of the board and carefully withdraw it from the mounting slot. When replacing a printed wiring board, insert the board into the mounting slot and slide it into the mating connector. Make sure that the board is positioned properly with relation to the mating connector. If the board cannot be inserted easily, it is incorrectly positioned. Withdraw the board from the slot, invert it, and reinsert in the mating connector, Whenever an amplifier or attenuator board is replaced, always check to verify proper adjustment of the replacement; refer to the operational performance tests, paragraph 5.4.

Caution: The procedures set forth in TB SIG 222 should be followed when replacing components on the printed circuit boards.

SECTION 7

ILLUSTRATIONS

7.1 GENERAL

This section contains illustrations in the form of schematic and component layout diagrams that should be used in conjunction with the maintenance data given in Section 5 for servicing the Express Orderwire Multidirection Unit.

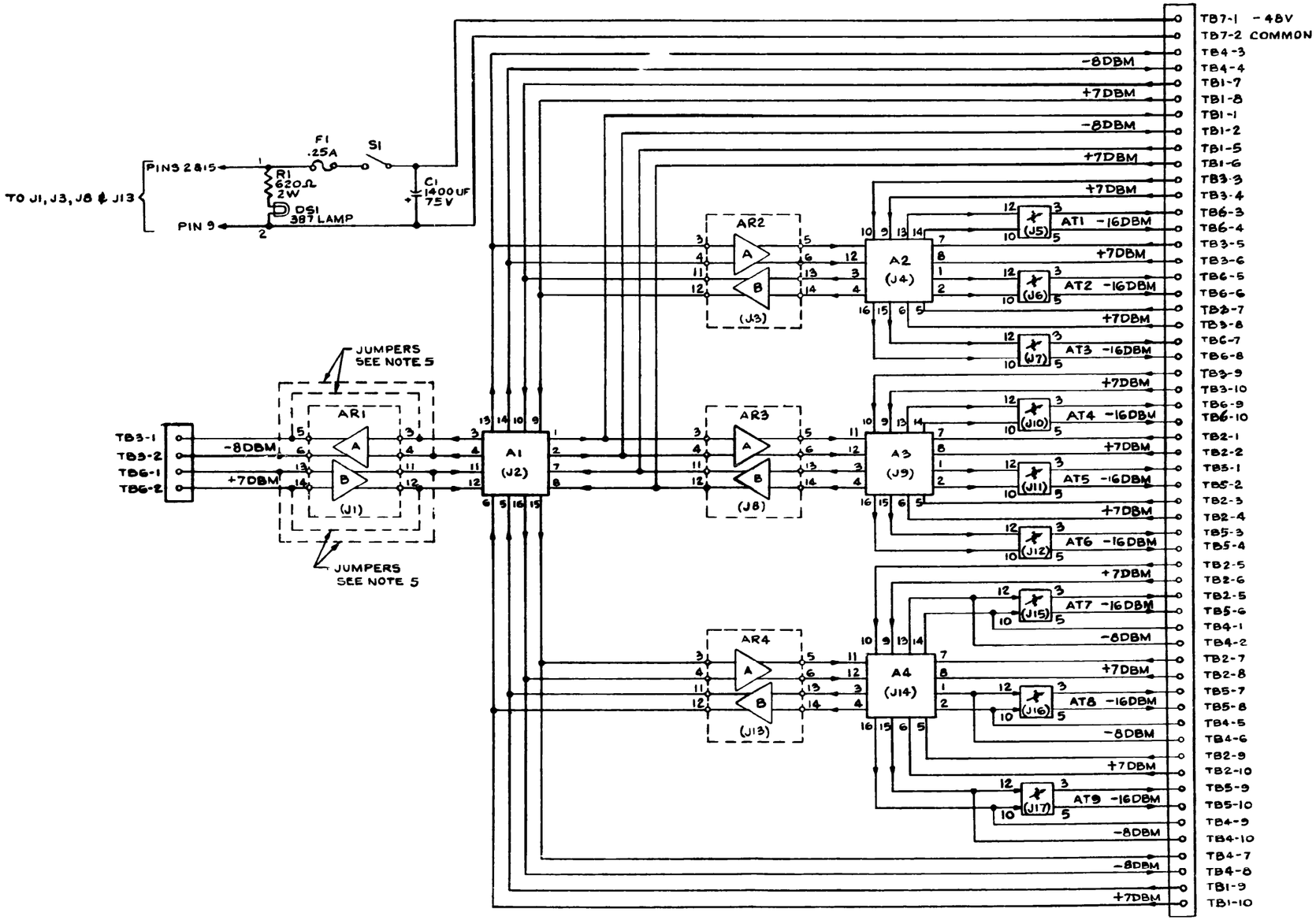


Figure 7-1. Express Orderwire Multi-direction Unit, Schematic Diagram, (Sheet 1 of 2)

NOTES:

1. SYMBOL A = 4 WAY/4 WIRE HYBRID P. C. BOARD ASSY 305-41264.
   SYMBOL AT = 5 PAD ATTENUATOR P. C. BOARD ASSY 368-42056.
   SYMBOL AR - VOICE FREQUENCY AMPLIFIER P.C. BOARD ASSY 368-41965.
2. ALL INPUT AND OUTPUT IMPEDANCES ARE 600 OHMS. TERMINATIONS SHOULD BE USED AS SPECIFIED IN TABLE 1.
s. THE TRANSMISSION LOSS THROUGH A 4 WAY/4 WIRE HYBRID IS NOMINALLY 15 DB. THE VOICE FREQUENCY AMPLIFIERS HAVE A CONTINOUSLY VARIABLE GAIN BETWEEN 0 - 30 DB. THE 5 PAD ATTENUATOR SUPPLIES ATTENUATION LEVELS OF 0 - 31 DB ON A STRAPPABLE BASIS IN 1 DB STEPS.
4. NUMBERS SHOWN AT PORTS OF FUNCTIONAL BLOCKS ARE CONNECTOR PIN NUMBERS. AMPLIFIERS AR1A. AR2A. AR3A. & AR4A HAVE THEIR GAIN ADJUSTMENTS AT THE TOP AND AMPLIFIERS AR1B, AR2B, AR3B, & AR4B HAVE THEIR GAIN ADJUSTMENTS AT THE BOTTOM.
a. AMPLIFIER BOARD AR1 IS NOT USED WHEN THE MULTIDIRECTION UNIT IS DRIVEN AT TERMINALS TB2-1. TB2-2, TB6-1 & TB6-2 FROM A SINGLE DIRECTION EXPRESS ORDERWIRE. ANY OTHER APPLICATION REQUIRING AN AMPLIFIER BOARD IN THIS POSITION CAN BE IMPLEMENTED BY REMOVING THE JUMPERS ON J1 AND INSERTING THE AMPLIFIER BOARD 368-41965.

TABLE 1

UNIT ASSEMBLY NUMBER	368-42375-1	368-42375-2	368-42375-3	368-42375-4	———	368-42375-5	———	———
INSTALLATION INSTRUCTIONS	2 DIRECTION	3 DIRECTION	4 DIRECTION	5 DIRECTION	6 DIRECTION	7 DIRECTION	8 DIRECTION	9 DIRECTION
STRAPPING CONNECTIONS	TB4-3 TO TB4-1	TB4-3 TO TB4-1						
"	TB4-4 TO TB4-2	TB4-4 TO TB4-2						
" "	TB1-1 TO TB4-5	TB1-1 TO TB4-5		TB1-1 TO TB4-5				
" "	TB1-2 TO TB4-6	TB1-2 TO TB4-6		TB1-2 TO TB4-6				
" "		TB4-7 TO TB4-9	TB4-7 TO TB4-9	TB4-7 TO TB4-9		TB4-7 TO TB4-9		
STRAPPING CONNECTIONS		TB4-8 TO TB4-10	TB4-8 TO TB4-10	TB4-8 TO TB4-10		TB4-8 TO TB4-10		
600 Ω TERMINATION	TB4-7, -8	———	TB1-1, -2	———	TB4-7, -8	———	TB2-9, -10	———
600 Ω TERMINATION	TB1-9, -10	———	TB1-5, -6	———	TB1-9, -10	———	TB5-9, -10	———
INPUT FROM EXPRESS ORDER WIRE OUTPUT TO EXPRESS ORDER WIRE	TB6-1, -2 TB3-1, -2	TB6-1, -2 TB3-1, -2	TB6-1, -2 TB3-1, -2	TB6-1, -2 TB3-1, -2	TB6-1, -2 TB3-1, -2	TB6-1, -2 TB3-1, -2	TB6-1, -2 TB3-1, -2	TB6-1, -2 TB3-1, -2
INPUT DIRECTION 1 OUTPUT DIRECTION 1	TB1-7, -8 TB5-5, -6	TB1-7, -8 TB5-5, -6	TB3-3, -4 TB6-3, -4	TB3-3, -4 TB6-3, -4	TB3-3, -4 TB6-3, -4	TB3-3, -4 TB6-3, -4	TB3-3, -4 TB6-3, -4	TB3-3, -4 TB6-3, -4
INPUT DIRECTION 2 OUTPUT DIRECTION 2	TB1-5, -6 TB5-7, -8	TB1-5, -6 TB5-7, -8	TB3-5, -6 TB6-5, -6	TB3-5, -6 TB6-5, -6	TB3-5, -6 TB6-5, -6	TB3-5, -6 TB6-5, -6	TB3-5, -6 TB6-5, -6	TB3-5, -6 TB6-5, -6
INPUT DIRECTION 3 OUTPUT DIRECTION 3		TB1-9, -10 TB5-9, -10	TB3-7, -8 TB6-7, -8	TB3-7, -8 TB6-7, -8	TB3-7, -8 TB6-7, -8	TB3-7, -8 TB6-7, -8	TB3-7, -8 TB6-7, -8	TB3-7, -8 TB6-7, -8
INPUT DIRECTION 4 OUTPUT DIRECTION 4			TB1-9, -10 TB5-9, -10	TB1-9, -10 TB5-9, -10	TB3-9, -10 TB6-9, -10	TB3-9, -10 TB6-9, -10	TB3-9, -10 TB6-9, -10	TB3-9, -10 TB6-9, -10
INPUT DIRECTION 5 OUTPUT DIRECTION 5				TB1-5, -6 TB5-7, -8	TB2-1, -2 TB5-1, -2	TB2-1, -2 TB5-1, -2	TB2-1, -2 TB5-1, -2	TB2-1, -2 TB5-1, -2
INPUT DIRECTION 6 OUTPUT DIRECTION 6					TB2-3, -4 TB5-3, -4	TB2-3, -4 TB5-3, -4	TB2-3, -4 TB5-3, -4	TB2-3, -4 TB5-3, -4
INPUT DIRECTION 7 OUTPUT DIRECTION 7						TB1-9, -10 TB5-9, -10	TB2-5, -6 TB5-5, -6	TB2-5, -6 TB5-5, -6
INPUT DIRECTION 8 OUTPUT DIRECTION 8							TB2-7, -8 TB5-7, -8	TB2-7, -8 TB5-7, -8
INPUT DIRECTION 9 OUTPUT DIRECTION 9								TB2-9, -10 TB5-9, -10
P.C BOARD COMPLEMENT								
V.F.AMPLIFIER (368-41965)			AR2	AR2	AR2,AR3	AR2,AR3	AR2,AR3,AR4	AR2,AR3,AR4
4W/4W HYBRID (368-41964)	A1	A1	A1,A2	A1,A2	A1,A2,A3	A1,A2,A3	A1,A2,A3,A4	A1,A2,A3,A4
5 PAD ATTENUATOR (368-42056)	AT7,AT8	AT7,AT8,AT9	AT1,AT2,AT3,AT9	AT1 AT2,AT3,AT8 AT9	AT1,AT2,AT3,AT4 AT5,AT6	AT1,AT2,AT3,AT4 AT5,AT6,AT9	AT1,AT2,AT3,AT4 AT5,AT6,AT7,AT8	AT1,AT2,AT3,AT4 AT5,AT6,AT7,AT8 AT9

Figure 7-1. Express Orderwire Multidirection Unit, Schematic Diagram (Sheet 2 of 2)

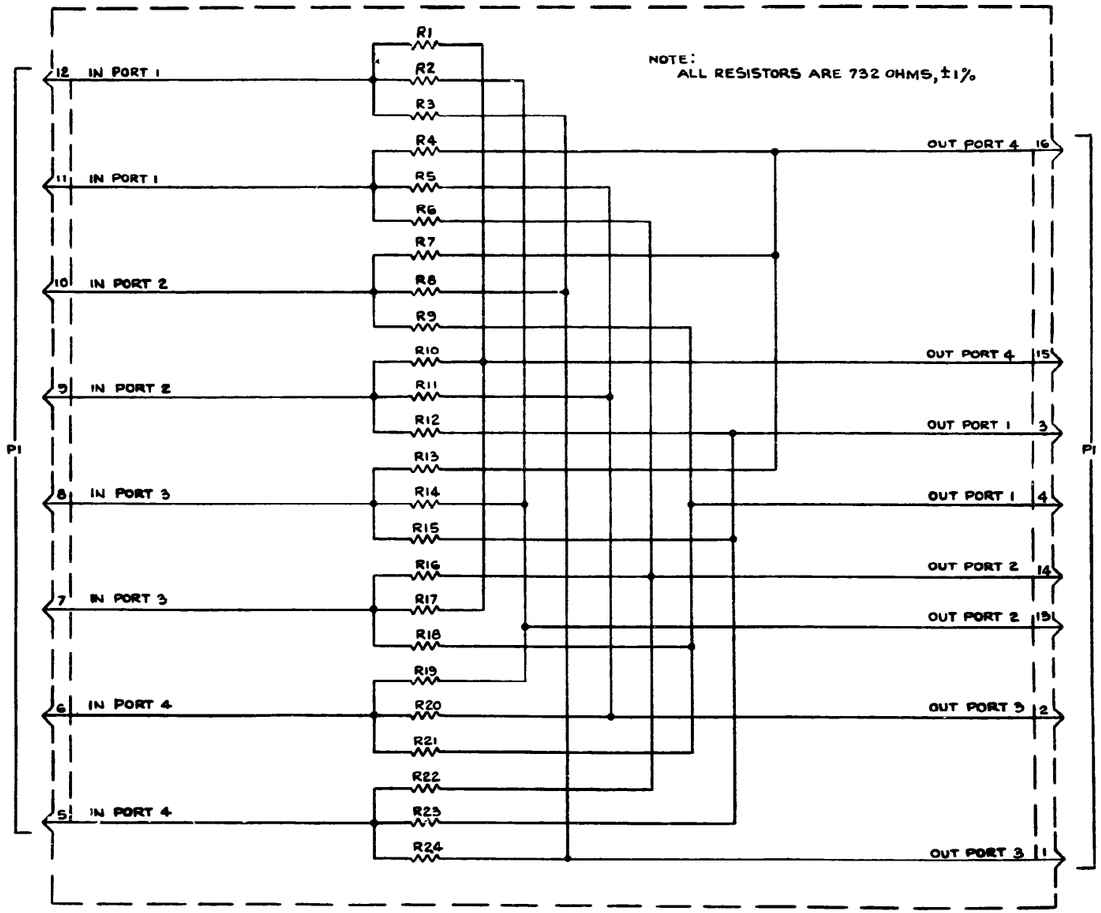


Figure 7-2. Four-Way, Four-Wire Hybrid Board, Schematic Diagram

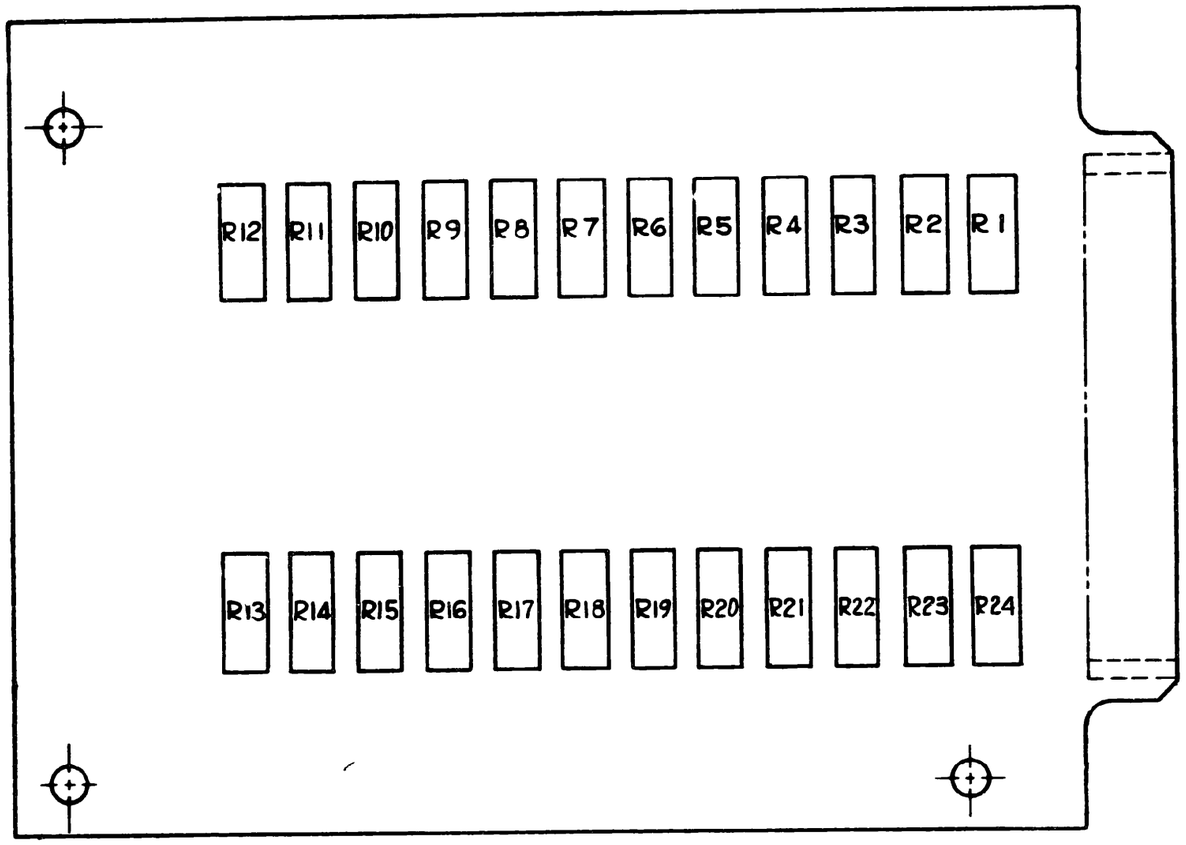


Figure 7-3. Four-Way, Four-Wire Hybrid Board, Component Layout

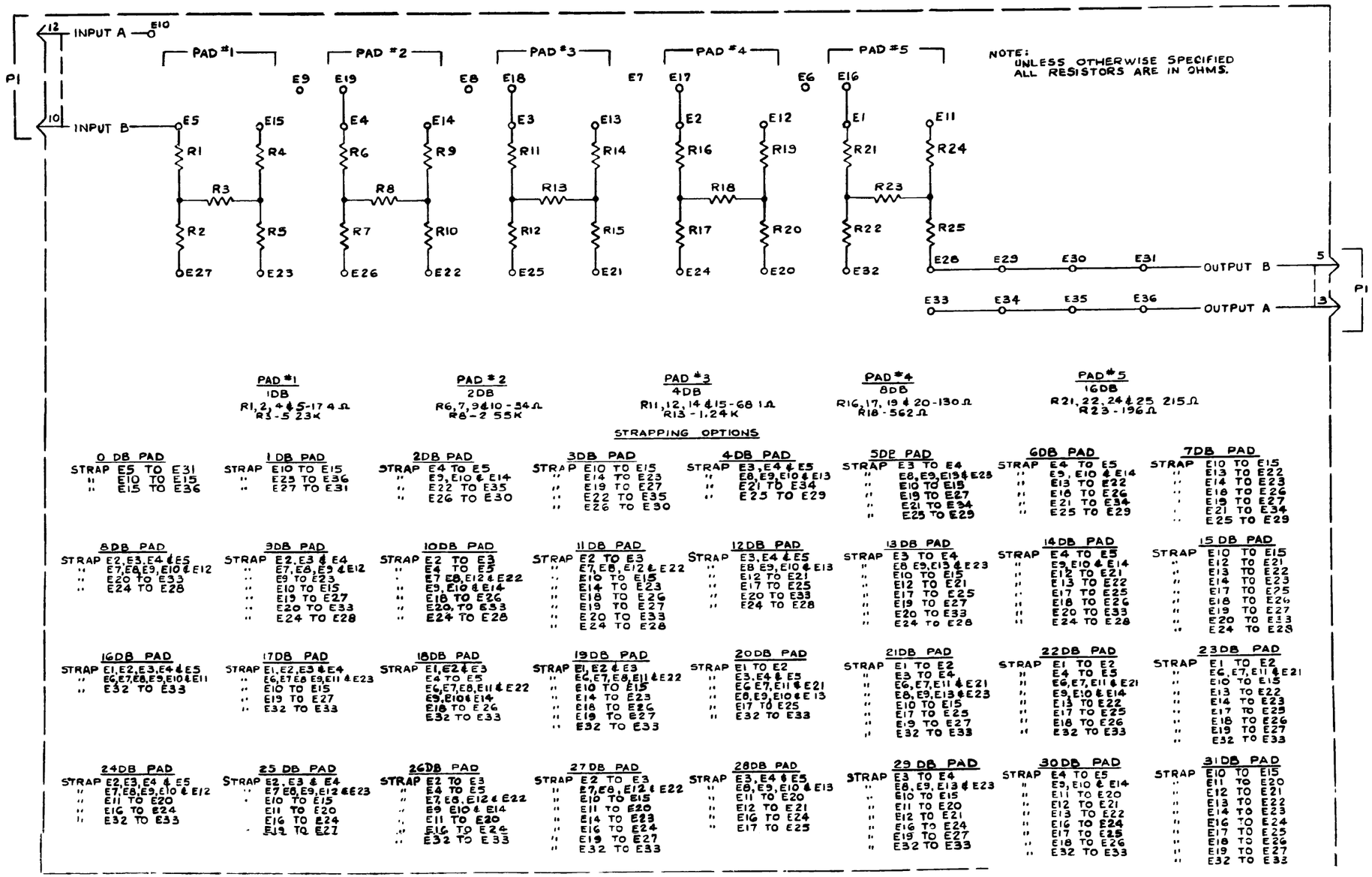


Figure 7-4. Attenuator Board, Schematic Diagram

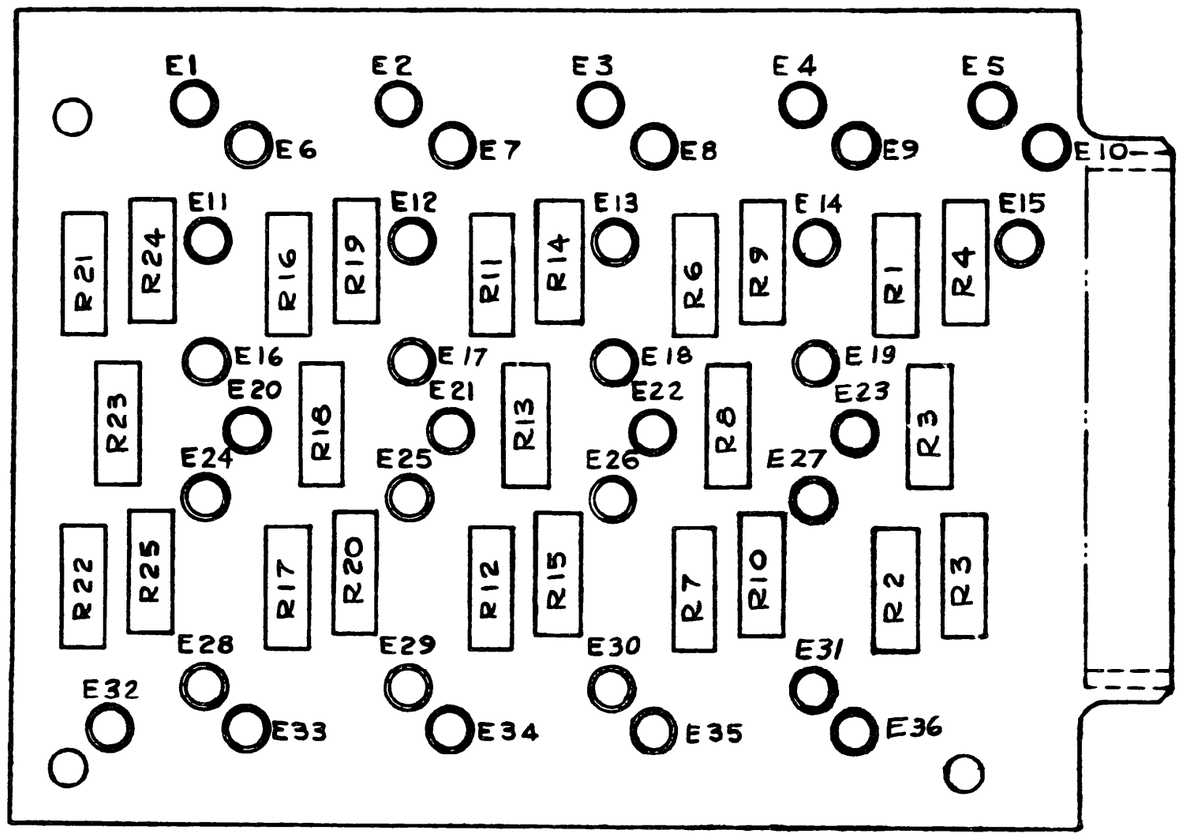
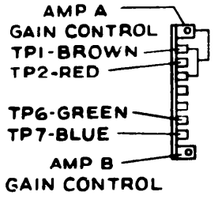
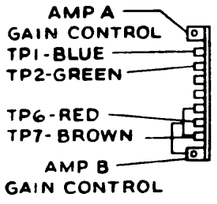


Figure 7-5. Attenuator Board, Component Layout

NOTES:
1. UNLESS OTHERWISE SPECIFIED
   ALL RESISTORS ARE IN OHMS, ±5%
   ALL CAPACITORS APE IN UF
2. SCHEMATIC DIAGRAM SHOWS AMP A, AMP B ANO TP NUMBERS AND COLORS IN FOLLOWING RACK POSITION



IN THE FOLLOWING RACK POSITION AMP A, AMP 8 AND TP NUMBERS AND COLORS ARE AS INDICATED



PIN 1 ON CONNECTORS J1 THROUGH J12 IS ALWAYS AT TOP OF RACK

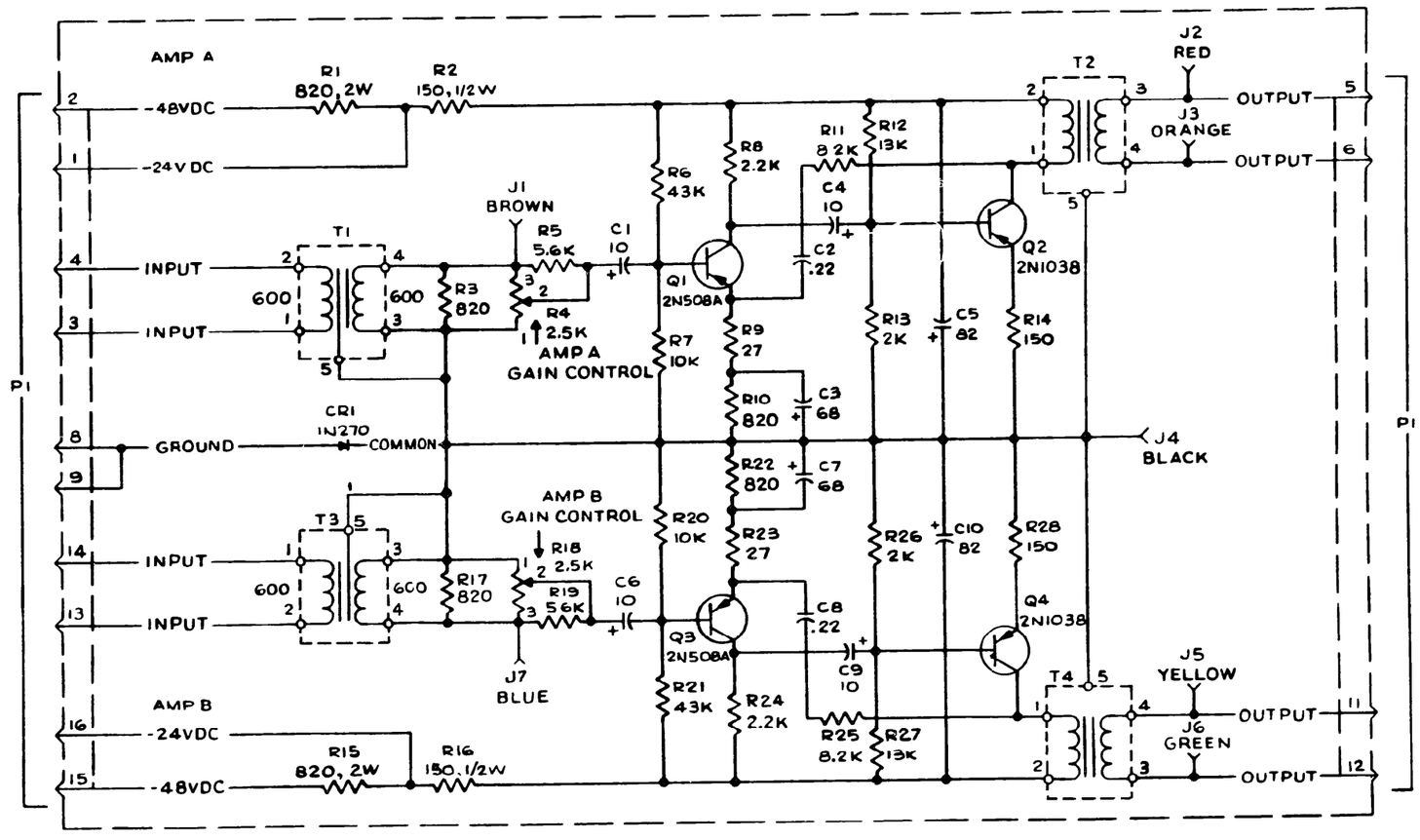


Figure 7-6. Voice-Frequency Amplifier Board, Schematic Diagram

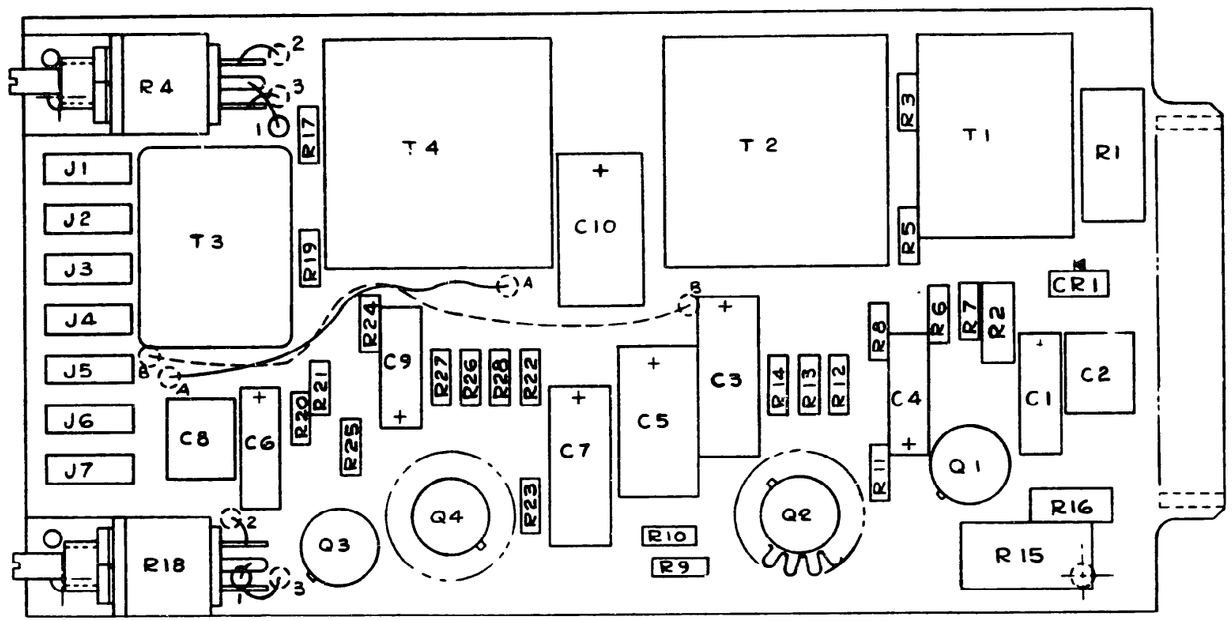


Figure 7-7. Voice-Frequency Amplifier Board, Component Layout

SECTION 8

REPLACEABLE PARTS LOCATION

8.1 GENERAL

This section lists and Illustrates all replaceable electrical and electronic assemblies, subassemblies, and component parts for the Express Orderwire Multi-direction Unit.

SECTION 8

REPLACEABLE PARTS LOCATION

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This section lists and Illustrates all replaceable electrical and electronic assemblies, subassemblies, and component parts for the Express Orderwire Multi-direction Unit.

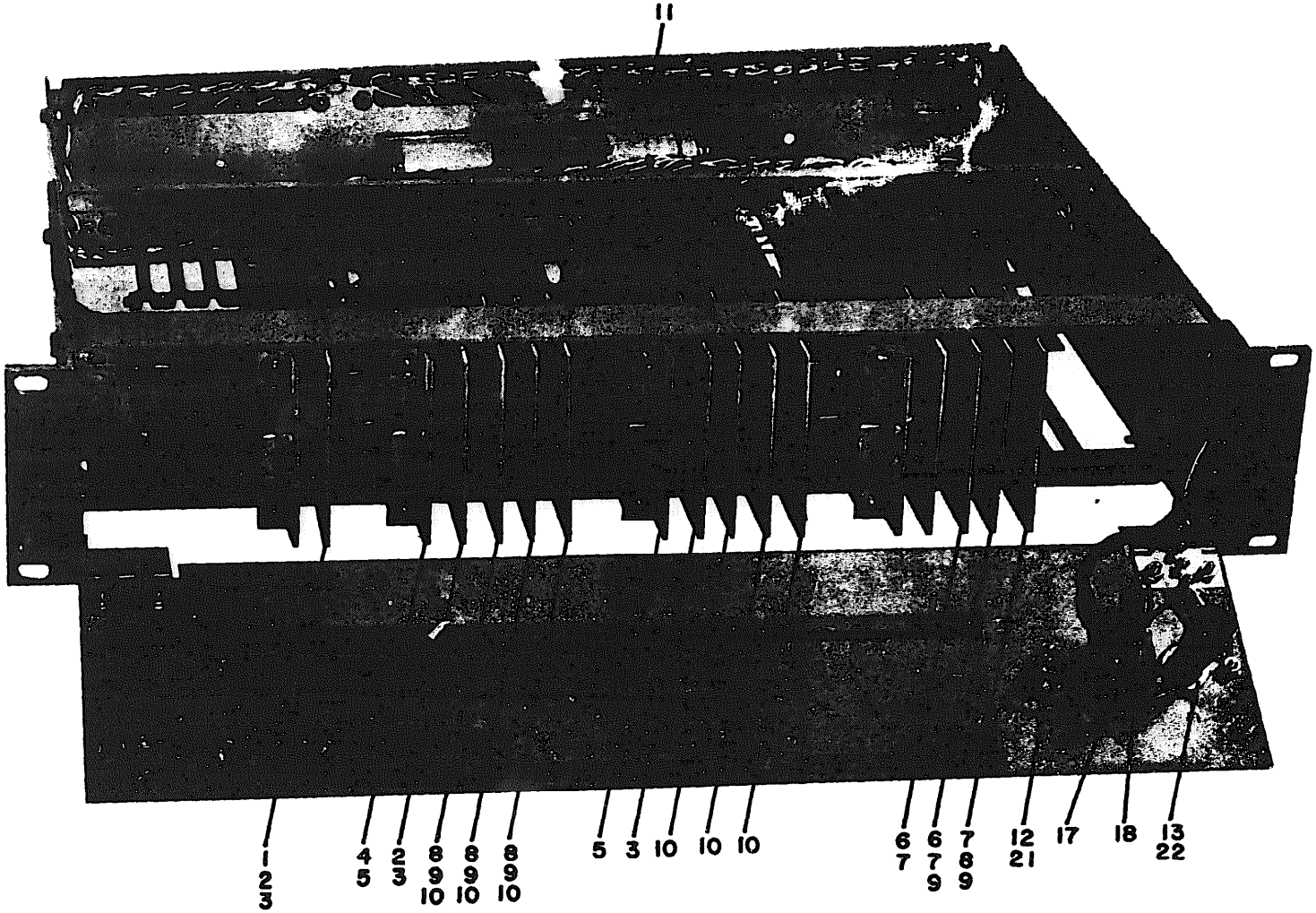

Figure 8-l. Express Orderwire Multidirection Unit (Sheet 1 of 2)

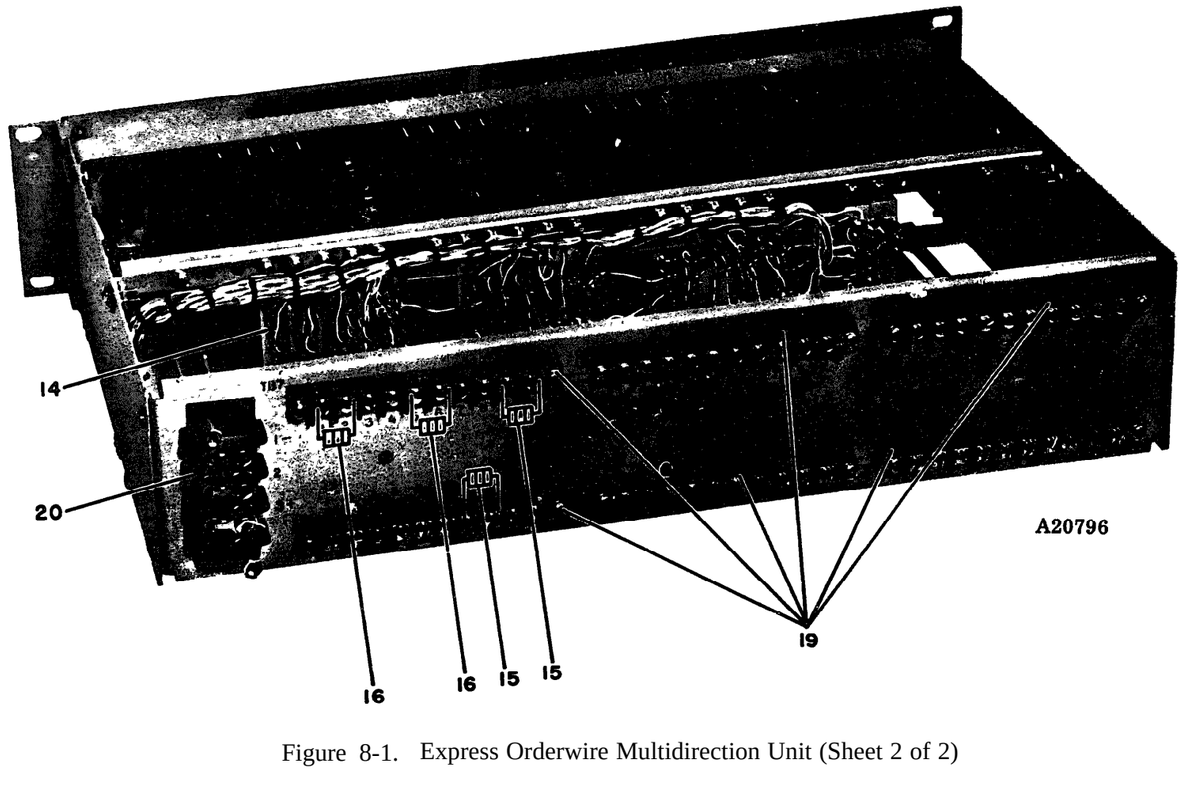

Figure 8-1. Express Orderwire Multidirection Unit (Sheet 2 of 2)

TABLE 8-1. LEGEND FOR FIGURE 8-1.

FIG. AND INDEX NO.	REF DESIG	DESCRIPTION	QTY
8-1		EXPRESS ORDERWIRE MULTIDIRECTION UNIT	1
		EXPRESS ORDERWIRE MULTIDIRECTION UNIT	1
		EXPRESS ORDERWIRE MULTIDIRECTION UNIT	1
		EXPRESS ORDERWIRE MULTIDIRECTION UNIT	1
		EXPRESS ORDERWIRE MULTIDIRECTION UNIT	1
-1	A1	PRINTED CIRCUIT BOARD ASSEMBLY, 4-way, 4-wire hybrid,used on 368-42375-1 and 368-42375-2 (See fig. 8-2)	1
-2	A1, A2	PRINTED CIRCUIT BOARD ASSEMBLY, 4-way, 4-wire hybrid, used on 368-42375-3 and 368-42375-4 (See fig. 8-2)	2
-3	A1, A2, A3	PRINTED CIRCUIT BOARD ASSEMBLY, 4-way, 4-wire hybrid, used on 368-42375-5 (See fig. 8-2)	3
-4	AR2	PRINTED CIRCUIT BOARD ASSEMBLY, Voice frequency amplifier, used on 368-42375-3 and 368-42375-4 (See fig. 8-3)	1

TABLE 8-1. LEGEND FOR FIGURE 8-1. (Cont)

FIG. AND INDEX NO.	REF DESIG	DESCRIPTION	QTY
8-1-5	AR2, AR3	PRINTED CIRCUIT BOARD ASSEMBLY, Voice frequency amplifier, used on 368-42375-5 (See fig. 8-3)	2
-6	AT7, AT8	PRINTED CIRCUIT BOARD ASSEMBLY, 5 pad attenuator, used on 368-42375-1 (See fig. 8-4)	2
-7	AT7, AT8, AT9	PRINTED CIRCUIT BOARD ASSEMBLY, 5 pad attenuator, used on 368-42375-2 (See fig.8-4)	3
-8	AT1, AT2, AT3, AT9	PRINTED CIRCUIT BOARD ASSEMBLY, 5 pad attenuator, used on 368-42375-3 (See fig. 8-4)	4
-9	AT1, AT2 AT3, AT8, AT9	PRINTED CIRCUIT BOARD ASSEMBLY, 5 pad attenuator, used on 368-42375-4 (See fig. 8-4)	5
-10	AT1, AT2 AT3, AT4 AT5, AT6 AT9	PRINTED CIRCUIT BOARD ASSEMBLY, 5 pad attenuator, used on 368-42375-5 (See fig. 8-4)	7
-11	C1	CAPACITOR, Fixed, elect., 1400 μf, +50, -10%, 75 vdcw	1
-12	DS1	LAMP, Flanged	1
-13	F1	FUSE, 0.25 amp	1

TABLE 8-1. LEGEND FOR FIGURE 8-1 (Cont)

FIG. AND INDEX NO.	REF DESIG	DESCRIPTION	QTY
8-1-14	J1 thru J17	CONNECTOR, Receptacle, elect.	17
-15		RESISTOR, Fixed, composition, 620 ohms, ±5%, 1/2 w (used on 368-42375-1)	2
-16		RESISTOR, Fixed, composition, 620 ohms ±5%, 1/2 w (used on 368-42375-3)	2
-17	R2	RESISTOR, Fixed composition, 620 ohms, ±5%, 2 w	1
-18	S1	SWITCH, toggle, spst	1
-19	TB1 thru TB6	BOARD, Terminal	6
-20	TB7	BOARD, Terminal	1
-21	XDS1	LIGHT ASSEMBLY	1
-22	XF1	FUSEHOLDER	1

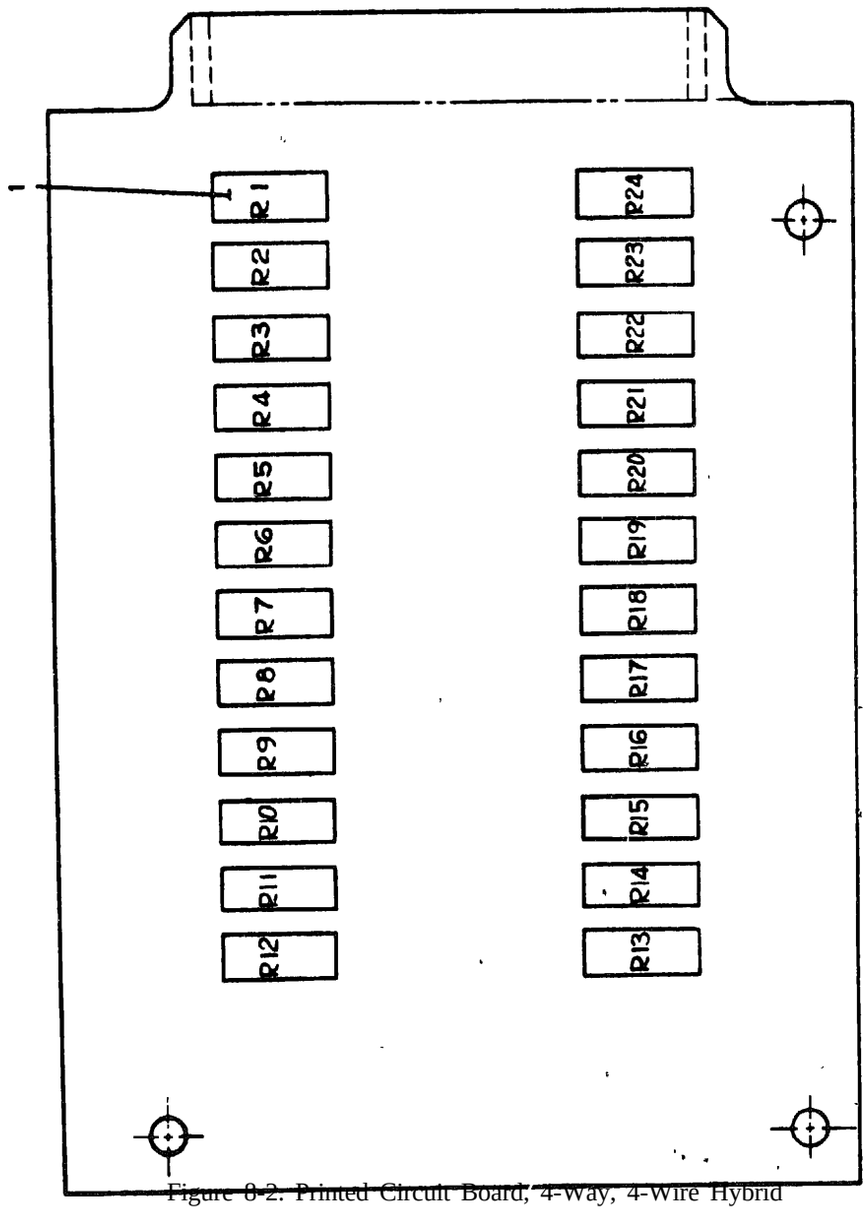

Figure 8-2. Printed Circuit Board, 4-Way, 4-Wire Hybrid

TABLE 8-2. LEGEND FOR FIGURE 8-2, (Cont)

FIG. AND INDEX NO.	REF DESIG	DESCRIPTION	QTY
8-2-	A1, A2, A3	PRINTED CIRCUIT BOARD, 4-way, 4-wire hybrid, (See fig. 8-1 for NHA)	Ref
-1	R1 thru R24	RESISTOR, Fixed, film, 732 ohms, ±1%, 1/8 w	24

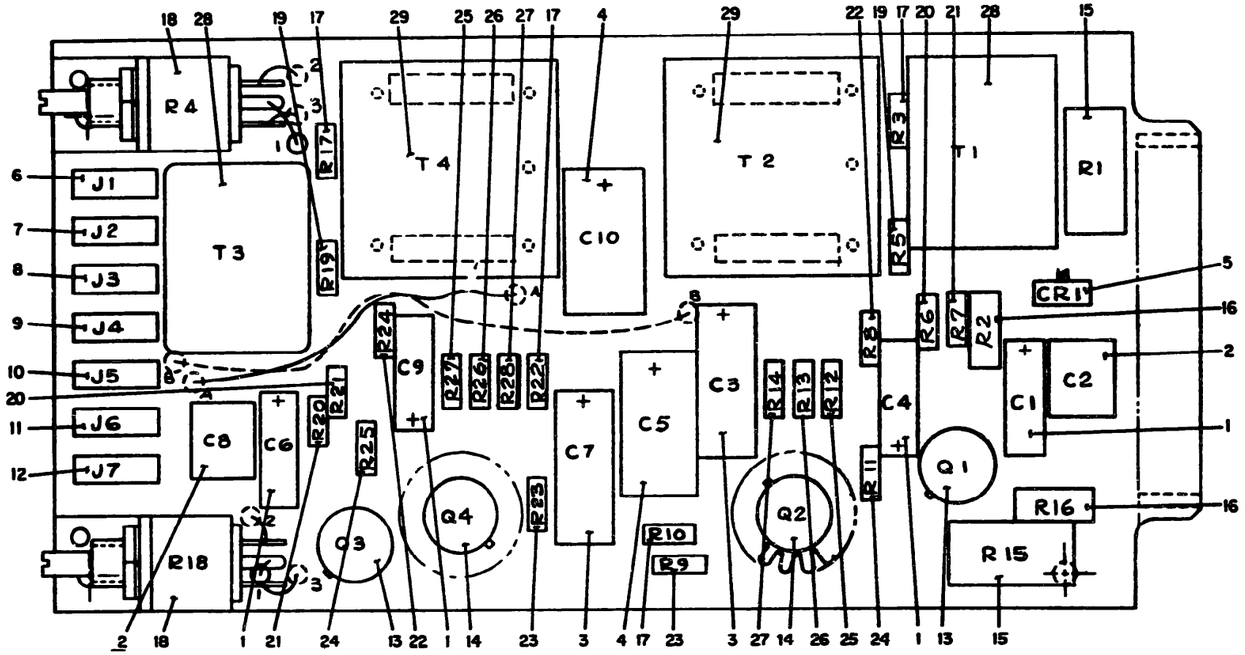

Figure 8-3. Printed Circuit Board, Voice-Frequency Amplifier

TABLE 8-3. LEGEND FOR FIGURE 8-3.

FIG. AND INDEX NO.	REF DESIG	DESCRIPTION	QTY
8-3-	AR2, AR3	PRINTED CIRCUIT BOARD, Voice-frequency amplifier, (See fig. 8-1 for NHA)	REF
-1	C1, C4, C6, C9	CAPACITOR, Fixed, elect., 10μf, ±20%, 15 vdcw	4
-2	C2, C8	CAPACITOR, Fixed, elect., 0.22μf	2
-3	C3, C7	CAPACITOR, Fixed, elect., 68 μf, ±20%, 6 vdcw	2
-4	C5, C10	CAPACITOR, Fixed, elect., 82 μf, ±20%, 50 vdcw	2
-5	CR1	SEMICONDUCTOR DEVICE, Diode	1
-6	J1	TEST POINT, Brown	1
-7	J2	TEST POINT, Red	1
-8	J3	TEST POINT, Orange	1
-9	J4	TEST POINT, Black	1
-10	J5	TEST POINT, Yellow	1
-11	J6	TEST POINT, Green	1
-12	J7	TEST POINT, Blue	1
-13	Q1, Q3	TRANSISTOR	2
-14	Q2, Q4	TRANSISTOR	2
-15	R1, R15	RESISTOR, Fixed, composition, 820 ohms, ±5%, 2 w	2

TABLE 8-3. LEGEND FOR FIGURE 8-3. (Cont)

FIG. AND INDEX NO.	REF DESIG	DESCRIPTION	QTY
8-3-16	R2, R16	RESISTOR, Fixed, composition 150 ohms, ±5%, 1/2 w	2
-17	R3, R10, R17, R22	RESISTOR, Fixed, composition 820 ohms, ±5%, 1/4 w	4
-18	R4, R18	RESISTOR, Variable, composition, 2500 ohms, ±10%	2
-19	R5, R19	RESISTOR, Fixed, composition, 5600 ohms, ±5%, 1/4 w	2
-20	R6, R21	RESISTOR, Fixed, composition, 43,000 ohms, ±5%, 1/4 w	2
-21	R7, R20	RESISTOR, Fixed, composition, 10,000 ohms, ±5%, 1/4 w	2
-22	R8, R24	RESISTOR, Fixed, composition, 2200 ohms, ±5%, 1/4 w	2
-23	R9, R23	RESISTOR, Fixed, composition 27 ohms, ±5%, 1/4 w	2
-24	R11, R25	RESISTOR, Fixed, composition, 8200 ohms, ±5%, 1/4 w	2
-25	R12, R27	RESISTOR, Fixed, composition, 13,000 ohms, ±5%, 1/4 w	2
-26	R13, R26	RESISTOR, Fixed, composition, 2000 ohms, ±5%, 1/4 w	2
-27	R14, R28	RESISTOR, Fixed, composition, 150 ohms, ±5%, 1/4 w	2

TABLE 8-3. LEGEND FOR FIGURE 8-3. (Cont)

FIG. AND INDEX NO.	REF DESIG	DESCRIPTION	QTY
8-3-28	T1, T3	TRANSFORMER, Audio frequency	2
-29	T2, T4	TRANSFORMER, Audio frequency	2

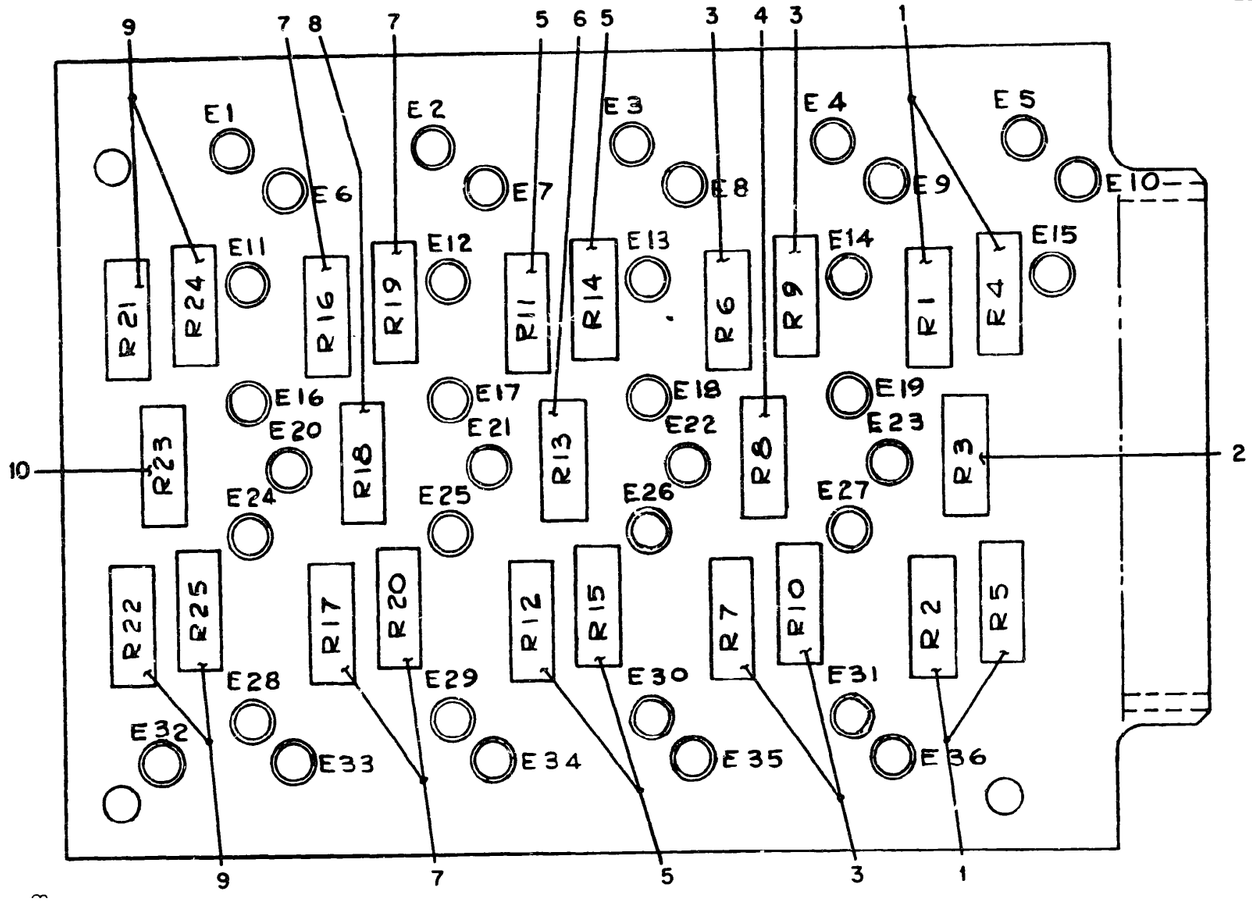

Figure 8-4. Printed Circuit Board. 5 Pad Attenuator

TABLE 8-4. LEGEND FOR FIGURE 8-4. (Cont)

FIG. AND INDEX NO.	REF DESIG	DESCRIPTION	QTY
8-4-	AT1, AT2, AT3, AT4, AT5, AT6, AT7, AT8, AT9	PRINTED CIRCUIT BOARD, 5 pad attenuator (See fig. 8-1 for NHA)	Ref
-1	R1, R2 R4, R5	RESISTOR, Fixed, film, 17.4 ohms, ±1%, 1/8 w	4
-2	R3	RESISTOR, Fixed, film, 5231 ohms, ±1%, 1/8 w	1
-3	R6, R7, R9, R10	RESISTOR, Fixed, film, 34.0 ohms, ±1%, 1/8 w	4
-4	R8	RESISTOR, Fixed, film, 2550 ohms, ±1%, 1/8 w	1
-5	R11, R12, R14, R15	RESISTOR, Fixed, film, 68.1 ohms, ±1%, 1/8 w	4
-6	R13	RESISTOR, Fixed, film, 1240 ohms, ±1%, 1/8 w	1
-7	R16, R17, R19, R20	RESISTOR, Fixed, film, 130 ohms, ±1%, 1/8 w	4
-8	R18	RESISTOR, Fixed, film, 562 ohms, ±1%, 1/8 w	1
-9	R21, R22, R24, R25	RESISTOR, Fixed, film, 215 ohms, ±1%, 1/8 w	4
-10	R23	RESISTOR, Fixed, film, 196 ohms, ±1%, 1/8 w	1

APPENDIX A

REFERENCES

DA Pam 310-4	Index of Technical Manuals, Technical Bulletins, Supply manuals (types 7, 8, and 9). Supply Bulletins, and Lubrication Orders.
DA Pam 310-7	Index of Modification Work Orders.
TB SIG 355-1	Depot Inspection Standard for Repaired Signal Equipment.
TB SIG 355-2	Depot Inspection Standard for Refinishing Repaired Signal Equipment.
'I'B SIG 355-3	Depot Inspection Standard for Moisture and fungus Resistant Treatment.
TB SIG 364	Field Instructions for Painting and Preserving Electronics Command Equipment.
TM 9-213	Painting Instructions for Field Use.
TM 11-6625-1514-15	Organizational, DS, GS, and Depot Maintenance Manual: Hewlett-Packard Vacuum Tube Voltmeter, Models 400D, 400H, 400L and H02-400D.
TM 11-6625-1537-15	Organizational, DS, GS, and Depot Maintenance Manual: Wide Range Oscillator Hewlett-Packard Model 200CD/CDR.
TM 38-750	The Army Maintenance Management System (TM)

APPENDIX B

MAINTENANCE ALLOCATION

Section I. INTRODUCTION

B-1. General

This appendix provides a summary of the maintenance operations covered in the equipment literature for Philco Express Orderwire Multidirection Unit. 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 Functions

Maintenance functions will be limited to and de fined as follows :

a. INSPECT. To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

b. TEST. To verify serviceability and to detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc. This is accomplished with external test equipment and does not include operation of the equipment and operator type tests using internal meters or indicating devices.

c. SERVICE. To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents, and air. If it is desired that elements, such as painting and lubricating, be defined separately, they may be so listed.

ct. ADJUST. To rectify to the extent necessary to bring into proper operating range.

e. *ALIGN.* To adjust two or more components or assemblies of an electrical or mechanical system so that their functions are properly synchronized. This does not include setting the frequency control knob of radio receivers or transmitters to the desired frequency.

f. CALIBRATE. To determine the corrections to be made in the readings of instruments or test equipment used in precise 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 with the certified standard.

g. INSTALL. TO set up for use in an operational environment such as an encampment, site, or vehicle.

h. REPLACE. To replace unserviceable items with serviceable like items.

i. REPAIR. To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes, but is not limited to welding, grinding, riveting, straightening, and replacement of parts other than the trial and error replacement of running spare type items such as fuses, lamps, or electron tubes.

j. *OVERHAUL.* Normally, the highest degree of maintenance performed by the Army in order to minimize time work in process is consistent with quality and economy of operation. It consists of that maintenance necessary to restore an item to completely serviceable condition as prescribed by maintenance standards in technical publications for each item of equipment. Overhaul normally does not return an item to like new, zero mileage, or zero hour condition.

k. REBUILD. The highest degree of materiel maintenance. It consists of restoring equipment as nearly as possible to new condition in accordance with original manufacturing standards. Rebuild is performed only when required by operational considerations or other paramount factors and then only at the depot maintenance category. Rebuild reduces to zero the hours of miles the equipment, or component thereof, has been in use.

i. *SYMBOLS.* The uppercase letter placed in

the appropriate column indicates the low& level at which that particular maintenance function is to he performed.

B-3. Explanation of Format

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

b. Column 2, Functional Group. Column 2 lists the noun namea of components, assemblies, sub assemblies and modules on which maintenance is authorized.

c. Column 3, Maintenance Functions. Column 3 Eats the maintenance category at which performance of the specific maintenance function is authorized. Authorization to perform a function at any category also includes authorization to perform that function at higher categories. The codes used represent the various maintenance categories as follows:

Code	Maintenance category
C ----------	Operator/crew
O ----------	Organizational maintenance
F ---------m-e	Direct support maintenance
H ----------	General support maintenance
D ---------_--	Depot maintenance

d. Column 4, Took and Equipment. Column 4 specifies, by code, those tools and teat equipment required to perform the designated function. The numbers appearing in this column refer to specific tools and test equipment which are identified in table I.

e. Column 5, Remarks. Self-explanatory.

B-4. Explanation of Format of Table I (Tool ad Test Equipment Requirements)

The columna in table I are as followa:

a. Tools and Equipment. The numbers in this column coincide with the numbera used in the tools and equipment column of the Maintenance Allocation Chart. The numbers indicate the applicable tool for the maintenance function.

b. Maintenance Category. The codes in this column indicate the maintenance category normally allocated the facility.

c. Nomenclature. This column list tooh, test and maintenance equipment required to perform the maintenance functions.

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

e. Tool Number. Not used.

SECTION II. MAINTENANCE ALLOCATION CHART

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT, ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS										TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL	REBUILD	
	PHILCO EXPRESS ORDERWIRE MULTIDIRECTION UNIT												
1	EXPRESS ORDERWIRE, 368-42525	O											Visual
			F										Voltage, resistance, continuity, level, noise, distortion
										O			Replace lamp fuse and knob
										F			1 thru 5
													1 thru 6 Replace defective piece parts and modules
1A	CIRCUIT CARD ASSEMBLY, 398-6536-7	F											Visual
			H										2 thru 4,6 Resistance, continuity
									F				5
										H			2 thru 4,6
1B	CIRCUIT CARD ASSEMBLY, 398-6545-1	F											Visual
			H										1 thru 4,6 Resistance, continuity
									F				5 Replace circuit card assembly
										H			1 thru 4,6
1C	CIRCUIT CARD ASSEMBLY, 398-6550-6	F											Visual
			H										1 thru 4,6 Resistance, continuity
									F				5
										H			1 thru 4,6
1D	CIRCUIT CARD ASSEMBLY, 398-6538-2	F											Visual
			H										1,2,3,4,6 Resistance, continuity
									F				5
										H			1,2,3,4
1E	CIRCUIT CARD ASSEMBLY, 398-4556-9	F											Visual
			H										1 thru 4,6 Resistance, continuity
									F				5
										H			1 thru 4,6
1F	CIRCUIT CARD ASSEMBLY, 398-6536-1	F											Visual
			H										1 thru 4,6 Resistance, continuity
									F				5
										H			1 thru 4,6

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS										TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL / REBUILD		
1R	CIRCUIT CARD ASSEMBLY, 368-41964	F	H						F H	H		1 thru 4 5 1 thru 4,6	Visual Resistance, continuity
1S	CIRCUIT CARD ASSEMBLY, 368-42247	F	H						F H	H		1 thru 4,6 5 1 thru 4,6	Visual Resistance, continuity
1T	VOICE FREQUENCY AMPLIFIER	F	H						F H	H		1 thru 4,6 6 1 thru 4,6	Visual Resistance, continuity
2	EXPRESS ORDERWIRE, 368-42801-2, 368-42801-4, 368-42801-5	O	F							O		1 thru 6 5	Visual Level, noise, distortion, voltage, resistance, continuity Replace lamps and fuses
2A	CIRCUIT CARD ASSEMBLY, 368-42056	F	H						F H	H		1 thru 4,6 5	Visual Resistance, continuity
2B	CIRCUIT CARD ASSEMBLY, 368-41964	F	H						F H	H		1 thru 4,6 5 1 thru 4,6	Visual Resistance, continuity

MAINTENANCE ALLOCATION CHART

GROUP NUMBER	COMPONENT ASSEMBLY NOMENCLATURE	MAINTENANCE FUNCTIONS										TOOLS AND EQUIPMENT	REMARKS
		INSPECT	TEST	SERVICE	ADJUST	ALIGN	CALIBRATE	INSTALL	REPLACE	REPAIR	OVERHAUL / REBUILD		
1G	CIRCUIT CARD ASSEMBLY, 398-6547-38585	F	H						F	H		1 thru 4,6 5 1 thru 4,6	Visual Resistance, continuity Replace circuit card assembly
1H	CIRCUIT CARD ASSEMBLY, 398-6550-5	F	H						F	H		1 thru 4,6 5 1 thru 4,6	Visual Resistance, continuity
1J	CIRCUIT CARD ASSEMBLY, 368-42057	F	H						F	H		1 thru 4,6 5 1 thru 4,6	Visual Resistance, continuity
1K	CIRCUIT CARD ASSEMBLY, 398-6538-1	F	H						F	H		1 thru 4,6 5 1 thru 4,6	Visual Resistance, continuity
1M	CIRCUIT CARD ASSEMBLY, 398-6547-17474	F	H						F	H		1 thru 4,6 5 1 thru 4,6	Visual Resistance, continuity Replace circuit card assembly
1N	CIRCUIT CARD ASSEMBLY, 398-6540-1	F	H						F	H		1 thru 4,6 5 1 thru 4,6	Visual Resistance, continuity
1P	CIRCUIT CARD ASSEMBLY, 398-6550-1	F	H						F	H		1 thru 4,6 5 1 thru 4,6	Visual Resistance, continuity
1Q	CIRCUIT CARD ASSEMBLY, 368-42056	F	H						F	H		1 thru 4,6 5 1 thru 4,6	Visual Resistance, continuity Replace circuit card assembly

TABLE I. TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOL AND TEST EQUIPMENT REQUIREMENTS

TOOLS AND EQUIPMENT	MAINTENANCE CATEGORY	NOMENCLATURE		FEDERAL STOCK NUMBER	TOOL NUMBER
		Recommended in Manual	Available on Site		
1	F	TEST OSCILLATOR, HEWLETT PACKARD 200CD	TEST OSCILLATOR, HEWLETT PACKARD 200CD		
2	F	VACUUM TUBE VOLTMETER, HEWLETT PACKARD 400L	VACUUM TUBE VOLTMETER, HEWLETT PACKARD 400L		
3	F	DISTORTION ANALYZER, HEWLETT PACKARD 330A	DISTORTION ANALYZER, HEWLETT PACKARD 330BR		
4	F	CARD EXTENDER, PHILCO 368-42411	CARD EXTENDER, PHILCO 368-42411		
5	O,F		TOOL KIT, ELECTRONIC TECHNICIAN, PHILCO T050-54B019		
6	F		MULTIMETER, SIMPSON 260		

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29-136
29-137

NG: None.
WAR: None.
For explanation of abbreviations used, see AR 310-60.

☆ U S GOVERNMENT PRINTING OFFICE 1971—431-143/532

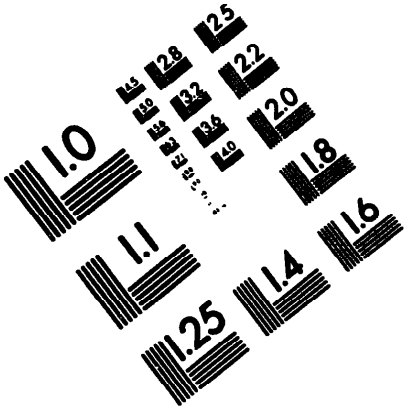
END

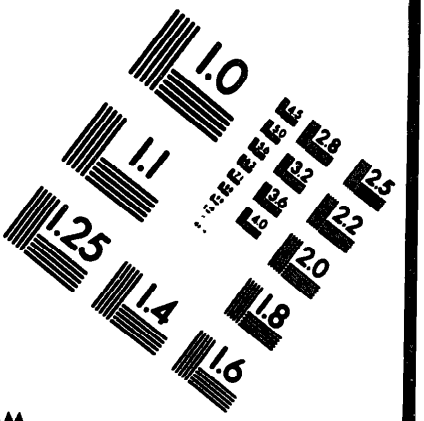
11-10-82

DATE

DEPARTMENT OF THE ARMY

MICROFORM
TEST TARGET





150 MM

10 mm (e= 81 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

15 mm (e= 1 09 mm)

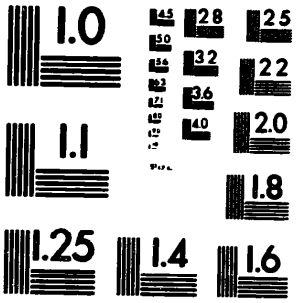
ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

2.0 mm (e= 1.37 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*



10 mm (e= 81 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

15 mm (e= 1 09 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890
abcdefghijklmnopqrstuvwxyz$¢£/%#½¼¾—=+×&@*

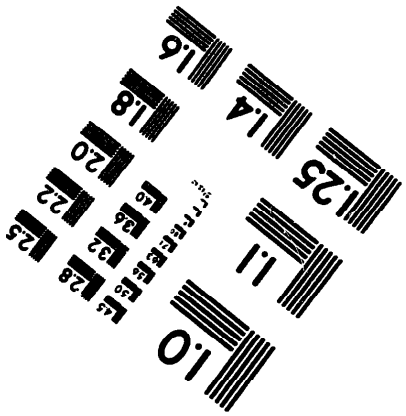
2.0 mm (e= 1 37 mm)

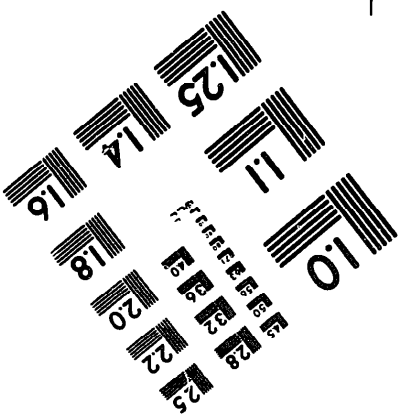
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

2.5 mm (e= 1.77 mm)

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890$¢£/%#½¼¾—=+×&@*

200 MM





250 MM